DISSERTATION

Calculation of Cross Sections Relevant for Diagnostics of Hot Fusion Plasmas

ausgeführt zum Zwecke der Erlangung des akademischen Grades einer Doktorin der technischen Wissenschaften unter der Leitung von

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To Hannah
whose backup I could always rely on
even more than on my subversion repository.

In the corner of my mind stands a jukebox
It's playin' all my favorite memories
Alabama - Jukebox In My Mind

Abstract

With the construction of the ITER device in Cadarache (France) thermonuclear fusion research is making another significant step toward the actual exploitation of fusion as a sustainable energy source. ITER is a so-called "tokamak"-reactor, where the hot deuterium-tritium plasma is confined by strong magnetic fields while being heated by energetic neutral hydrogen beams or intense electromagnetic waves to the temperatures necessary to initiate fusion processes (typically more than 100 million °C). Despite this magnetic confinement particles can still exit the plasma, e.g. through open field lines or anomalous transport, and hit the wall of the plasma vessel. Although H-mode plasmas, the best operation scheme known today, are characterized by a steep temperature gradient at the plasma edge and the temperature of the particles in the scrape-off layer (the outermost layer of a fusion plasma in a tokamak) is much lower than in the plasma center, they are nevertheless at temperatures where it is still problematic for them to be brought into direct contact with a physical wall.

It would degrade the wall and the debris from the wall would extinguish the plasma immediately. Magnetic confinement, however, is never perfect. Transport across the field lines eventually will lead to interaction between the plasma and the first wall. The intensity of this plasma-wall-interaction is largely governed by the impact energy (i.e. the local temperature) of the plasma (particles) at the material wall. Therefore, schemes are developed to cool down the plasma locally before it impacts on a physical surface.

Among these schemes radiative edge cooling is very promising. A cold, highly radiative edge plasma distributes most of its power uniformly over the first wall. Structural damage due to high local heat deposition could thus be avoided, and the impurity concentration in the plasma caused by erosion of the wall material could be significantly reduced. Controlled injection of impurity gases is a promising technique for enhancement of radiation loss power in thermonuclear fusion experiments.

For ITER the use of Argon as radiating impurity has been proposed. To understand the transport of Ar impurities in the plasma edge simulation calculations which model and experimental techniques that diagnose this transport are necessary. Both plasma – modeling and – diagnostics heavily rely on atomic collision cross sections involving Ar^{q+} ions in various charge states and plasma particles like electrons, protons and neutral hydrogen atoms.

It is the primary aim of this thesis to provide these cross sections, in particular those, which will be necessary to derive information on the density profiles of Ar^{q+} ions via charge exchange recombination spectroscopy. These cross sections will be obtained by performing state of the art atomic orbital close coupling calculations. Due to the large number of atomic states involved these calculations are challenging and require novel approaches especially in the computational implementation of the problem. Although Argon stands out because of both its complexity and its future use in ITER, several other collision systems of relevance were calculated and studied, namely Be^{4+}, C^{6+}, N^{6+}, N^{7+} and Ne^{q+} impact on ground and excited state neutral hydrogen.

The PhD thesis was performed in close collaboration with leading European fusion laboratories, e.g. the Max-Planck-Institute of Plasma Physics in Garching, Germany, and served as input for the data base on atomic collisions for fusion by the Atomic Data & Analysis (ADAS) group as well as the data base of the integrated tokamak modeling (ITM) task force of the European Fusion Development Agency (EFDA).

Kurzfassung

Mit dem Bau von ITER in Cadarache haben die Forschungsbemühungen an der thermonuklearen Fusion einen weiteren, signifikanten Schritt in Richtung einer nachhaltigen, sauberen Energiequelle gemacht. In Experimenten gleicher Bauart, sogenannten "Tokamaks" wird ein heißes Deuterium-Tritium Plasma in starken Magnetfeldern eingeschloßen. Währenddessen wird dieses Plasma mit energetischen Wasserstoffstrahlen oder intensiven elektromagnetischen Wellen auf die notwendigen Temperaturen (typischerweise liegen um die 100 Millionen °C) aufgeheizt und so der Fusionsprozess gestartet. Trotz des magnetischen Plasmaeinschlusses können Teilchen immer noch das Plasma, z.B. durch offene Feldlinien oder anormalen Transport, verlassen. Obwohl ein *H-mode* Plasma, das nach heutigem Stand der Forschung das beste Operationsmodell darstellt, einen steilen Temperaturgradienten am Plasmarand hat und dadurch die Temperatur der Teilchen in der Separatrix, dem äußersten Teil eines Tokamakplasmas, deutlich geringer ist, ist es immer noch problematisch, wenn sie in direkten Kontakt mit physischen Wänden kommen.

Dies würde die Wand zerstören und die Trümmer würden das Plasma sofort auslöschen. Trotzdem das Plasma, als quasi-neutrales Medium, durch Magnetfelder eingeschlossen werden kann und dadurch der Kontakt mit der Wand des Experiments (fast) vollständig vermieden werden kann, führt dennoch Transport durch die Feldlinien dazu, dass das Plasma irgendwann mit der Wand in Wechselwirkung tritt. Die Intensität dieser Plasma-Wand-Wechselwirkungen wird vor allem durch die Stoßgeschwindigkeit - also die lokale Temperatur - der Plasmateilchen mit dem Wandmaterial bestimmt. Deshalb wurden Methoden entwickelt, die Plasmarandschicht lokal zu kühlen, bevor sie auf die erste Wand trifft.

Als Methode ist hier vor allem *radiative plasma edge cooling* hervorzuheben. Eine kalte, stark strahlende Plasmarandschicht verteilt den grössten Teil ihrer Energie gleichmässig über die erste Wand. Strukturelle Schäden können dadurch vermieden werden und die Konzentration von Verunreinigungen, die durch Erosion des Wandmaterials ins Plasma gelangen, können signifikant reduziert werden. Die kontrollierte Injektion von Verunreinigungsgasen ist eine viel versprechende Methode die Strahlungsverluste in der Plasmarandschicht zu verstärken.

Im Speziellen für ITER wird Argon für Strahlungskühlung der Plasmarandschicht verwendet werden. Um den Transport von Argonatomen in der Plasmarandschicht untersuchen zu können, sind sowohl experimentelle Messungen und deren Auswertung als auch Simulationen notwendig. Für beides ist die Qualität der zugrunde liegenden atomare Daten essentiell.

Das Hauptaugenmerk dieser Doktorarbeit liegt auf der Berechnung von Wirkungsquerschnitten, im Besondern solcher, die für die Bestimmung von Dichteprofilen in Fusionsplasmen durch die Ladungsaustauschspektroskopie mit schweren, hochgeladenen Ionen notwendig sind. Diese Rechnungen wurden mit einem *atomic-orbital close-coupling* Programm durchgeführt. Dieser Ansatz wird besonders durch die große Anzahl von notwendigen Basiszuständen komplex und erfordert völlig neue programmiertechnische Ansätze. Obwohl Argon durch diese hohe Komplexität und durch die Verwendung bei ITER heraussticht, gibt es dennoch einige andere Stoßsysteme, die für die Kernfusionsforschung von Interesse sind. In der vorliegenden Arbeit wurden zusätzlich zu Ar^{q+} noch Be^{4+}, C^{6+}, N^{6+}, N^{7+} und $Ne^{q+} + H(n = 1, 2)$ gerechnet und analysiert.

Dieses Doktorarbeitsprojekt wurde in enger Zusammenarbeit mit Europas führenden Fusionslabors durchgeführt, im Besonderen dem Max-Planck-Institut für Plasmaphysik in Garching. Die berechneten Wirkungsquerschnitte wurden in die Datenbanken der Atomic Data & Analysis Structure (ADAS) Gruppe und der Integrated Tokamak Modeling (ITM) Taskforce der European Fusion Development Agency (EFDA) eingespeist.

Contents

Where it began
I can't begin to knowin'
But then I know it's growin' strong
Neil Diamond - Sweet Caroline

Chapter 1

Introduction

With the signing of the ITER contract in late 2006, the international cooperation of seven partners (China, EU, India, Japan, Russia, South Korea and the USA) made a very significant step toward the exploitation of controlled nuclear fusion as energy source. It comes without surprise that the scientific efforts of the international nuclear fusion community have since focussed strongly on ITER-relevant research. Simply because of its size, physics in and around ITER challenges the scientists around the world to push existing methods and knowledge further and further. This thesis deals with one of these ITER-relevant topics, more precisely with the calculation of cross sections relevant for the diagnostics of the ITER plasma.

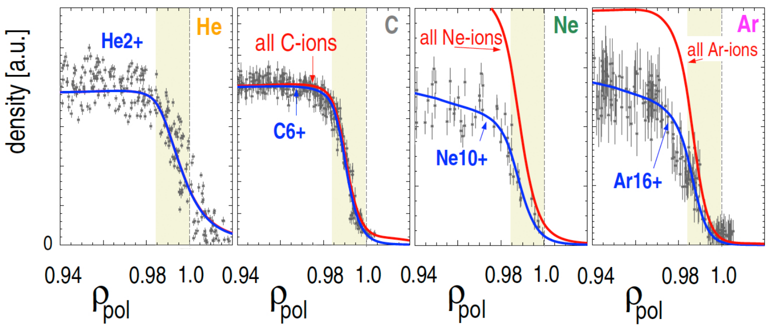

Figure 1.1: Density profiles of different impurity ions measured at the plasma edge by charge exchange recombination spectroscopy (CXRS) at ASDEX-Upgrade (AUG) as a function of the poloidal radius ρ_{pol}. The experimental results are compared to best fits of modeled data for the specific ions (blue) and the total impurity densities (red). The graphs for Ne^{10+} and Ar^{18+} clearly show that not only the fully stripped species dominates the measured radiation, but that not completely ionized atoms contribute significantly. [1, 2]

The charge exchange recombination spectroscopy (CXRS) method is routinely used to measure impurity ion densities in hot fusion plasmas inside a tokamak [3, 1]. It is described in greater detail in chapter 2. Fig. 1.1 shows density profiles of different Z impurities at ASDEX-Upgrade (AUG) [2]. It compares experimental results from CXRS with best fits of modeled data. It clearly shows that for lighter elements, e.g. He and C, the profiles can be explained taking only the fully stripped species into account. Whereas for heavier ions, like those of the noble gases Ne and Ar, the contributions of incompletely stripped ions are substantial. Obviously the analysis of CXRS data largely depends on the quality of the underlying atomic data.

Heavy, highly charged ions generally capture into high lying Rydberg states when colliding with neutral atoms [4]. The heavier and higher charged the ion is, the higher is the most populated n-level. Several theoretical methods allow in principle to include these high quantum numbers. From these methods, the approach chosen in this thesis it the atomic-orbital close-coupling (AOCC) formalism, a well-known semi-classical method to treat ion-atom collisions [5, 6]. This method in its impact parameter formulation as outlined in chapter 3 (especially section 3.2) is a very straight forward approach. But with the challenges posed by enlarging the collision systems to be treated with AOCC, a novel, modern and thus highly optimized and parallelized computational implementation became necessary. Steps taken to reach this goal are outlined in chapter 4.

Since the aim of this thesis is to provide cross sections for charge exchange (total and state-resolved) and ionization to be used in the analysis and modeling of charge exchange spectra obtained from fusion plasmas, several collision systems were treated in detail and are discussed in chapter 5. In sections 5.2 and 5.4 results for lighter collision systems of fusion relevance, for fully-stripped Be and N ions colliding with ground and exited state neutral H atoms, are shown. In section 5.3 two equally charged collision system of different elements, namely C^{6+} + $H(n = 1, 2)$ and N^{6+}+ $H(n = 1, 2)$, are compared. The results of this comparison are used to light the way toward the calculation of not fully-stripped heavier ions in collisions with hydrogen. These results, together with results for the fully-stripped ions, are presented in section 5.5 for Ne^{q+} + H(1s) and in section 5.6 for Ar^{q+} + H(1s).

The presented work has been conducted under the supervision of Prof. Dr. Friedrich Aumayr at the Institute of Applied Physics (IAP) at Vienna University of Technology (TU Wien) as well as under the supervision and collaboration with Univ.Doz. Dr. Josef Schweinzer at the Max-Planck-Institute of Plasma Physics (IPP) in Garching, Germany. During its course, this project was funded by several scholarships. Several students have contributed by means of diploma (master) or bachelor theses or project works. All students were co-supervised by Prof. Aumayr. Finally, the presented work resulted in a number of publications both in refereed journals and conference proceedings as well as several talks and posters at international conferences. All of the above shall be named in the following listings.

Scholarships received in support of this thesis project

2011	Scholarship of the Austrian Academy of Sciences through the Commission for the Coordination of Nuclear Fusion Research in Austria (KKKÖ)
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Supervised students within the scope of this thesis project

Master thesis

Markus Wallerberger — 10/2011
Effective calculations of fusion-relevant highly-charged ion collisions

Bachelor theses

Andreas Meyer — 07/2011
Implementation of the Kocbach-Liska Closed Formula in an AOCC code

Lukas Perneczky — 10/2010
Comparison of CX Cross Sections for C^{6+} *- H(1s) and* N^{6+} *- H(1s) Collisions Using the AOCC Method*

Edwin Frühwirth — 07/2010
Calculation of Effective Emission Cross Sections

Alexander Veiter — 09/2009
Calculations of Be^{4+} *- H(2s) and* N^{7+} *- H(1s,2s) Collisions Resulting in Charge Transfer*

Abhilash Valookaran — 07/2009
Enhancements of the Numerical Implementation of Wavefunctions in an Atomic-Orbital Close-Coupling Code

Matthias Willensdorfer — 12/2008
An IDL Interface for Atomic-Orbital Close-Coupling Calculations

List of Publications

Publications in refereed journal related to this thesis project

- **K. Igenbergs**, J. Schweinzer, A. Veiter, L. Perneczky, E. Frühwirth, M. Wallerberger, R.E. Olson, and F. Aumayr:
  Charge exchange and ionisation in N^{7+}, N^{6+}, C^{6+} + $H(n = 1, 2)$ collisions studied systematically by theoretical approaches
  currently in preparation

- M. Wallerberger, **K. Igenbergs**, J. Schweinzer and F. Aumayr:
  Fast computation of close-coupling exchange integrals using polynomials in a tree representation
  Computer Physics Communications (2010) Vol. 182(3), pp. 775-778
  DOI: 10.1016/j.cpc.2010.10.027

- **K. Igenbergs**, J. Schweinzer, and F. Aumayr:
  Charge exchange in Be^{4+} - $H(n = 1, 2)$ collisions studied systematically by atomic-orbital close-coupling calculations
  J. Phys. B: At. Mol. Opt. Phys. (2009), Vol. 42, 235206 (8pp)
  DOI: 10.1088/0953-4075/42/23/235206

Publications in proceedings related to this thesis project

- **K. Igenbergs**, M. Wallerberger, J. Schweinzer and F. Aumayr:
  Atomic-Orbital Close-Coupling Calculations for Collisions Involving Fusion Relevant High-q Impurity Ions and Very Large Basis Sets
  Proceedings of the 17th International Conference on Atomic Processes in Plasmas *accepted*

- **K. Igenbergs**, M. Wallerberger, J. Schweinzer and F. Aumayr:
  Atomic-Orbital Close-Coupling Calculations of Electron Capture from Hydrogen Atoms Into Highly Excited Rydberg States of Multiply Charged Ions
  Proceedings of CAARI 2010 (21^{st} International Conference on the Application of Accelerators in Research & Industry)
  AIP Conf. Proceedings (2011) Vol. 1336(1), pp. 97-100
  DOI: 10.1063/1.3586065

- **K. Igenbergs**, J. Schweinzer, and F. Aumayr:
  Atomic orbital close coupling calculations of Be^{4+} - $H(1s) \rightarrow Be^{3+}(n, l)$ - H^+ collisions
  Journal of Physics: Conference Series 194 (2009) 082022 (1 page)
  DOI: 10.1088/1742-6596/194/8/082022
  Proceedings of the XXVI International Conference on Photonic, Electronic and Atomic Collisions (ICPEAC)

- E. Wolfrum, J. Schweinzer, D. Bridi, **K. Igenbergs**, J. Kamleitner and F. Aumayr:
  A sodium (Na) beam edge diagnostic
  J. Nucl. Mat. (2009), Vol. 390-391, 1110-1113
  DOI: 10.1016/j.jnucmat.2009.01.282
  Proceedings of the 18^{th} International Conference on Plasma-Surface Interactions in Controlled Fusion Devices

Talks given by Katharina Igenbergs at conferences and workshops on selected topics

07/2011 Poster promoted talk at APiP 2011 in Belfast, UK
17th International Conference on Atomic Processes in Plasmas
Atomic-Orbital Close-Coupling Calculations of Collisions Involving High-q Impurity Ions and Very Large Basis Sets

08/2010 Invited talk at CAARI 2010 in Fort Worth, TX, USA
21st International Conference on the Application of Accelerators in Research & Industry
Atomic-Orbital Close-Coupling Calculations of Electron Capture from Hydrogen Atoms Into Highly Excited Rydberg States of Multiply Charged Ions

03/2010 Talk at ITS-LEIF Winter School in Pralognan la Vanoise, France
Charge exchange processes of highly charged ions in astrophysical plasmas

10/2009 Talk at ADAS Workshop 2009 in Schloß Ringberg, Germany
Atomic-orbital close-coupling calculations of CXRS relevant cross sections

09/2008 Talk at ADAS Workshop 2008 in Jülich, Germany
Collisions of Be^{4+} *and hydrogen*

Posters presented at conferences and workshops on research involved in this project

07/2011 **K. Igenbergs**, M. Wallerberger, J. Schweinzer, F. Aumayr
Atomic-orbital close-coupling calculations of charge exchange and ionization of H(1s) in collisions with highly charged neon and argon ions
ICPEAC 2011 (XXVII International Conference on Photonic, Electronic & Atomic Collisions) in Belfast, UK

07/2011 M. Wallerberger, **K. Igenbergs**, J. Schweinzer, F. Aumayr
Fast computation of large-scale close-coupling systems on the example of N^{7+} *- H collisions*
ICPEAC 2011 (XXVII International Conference on Photonic, Electronic & Atomic Collisions) in Belfast, UK

07/2011 **K. Igenbergs**, M. Wallerberger, J. Schweinzer, F. Aumayr
Atomic-Orbital Close-Coupling Calculations of Collisions Involving Fusion Relevant High-q Impurity Ions and Very Large Basis Sets
APiP 2011 (17th International Conference on Atomic Processes in Plasmas) in Belfast, UK

07/2010 **K. Igenbergs**, R.E. Olson, J. Schweinzer, A. Veiter, M. Wallerberger, L. Perneczky. F. Aumayr
Cross sections for neutral hydrogen beam diagnostics of hot fusion plasmas
ECAMP 2010 (10th European Conference on Atoms, Molecules & Photons) in Salamanca, Spain

05/2010 **K. Igenbergs**, M. Wallerberger, J. Schweinzer, F. Aumayr
Atomic-Orbital Close-Coupling Calculations of Fusion Relevant Charge Exchange Cross Sections
5th Annual Meeting of the EU network ITS-LEIF in Alghero, Italy

07/2009 **K. Igenbergs**, J. Schweinzer, F. Aumayr
Atomic-orbital close-coupling calculations of $Be^{4+} + H(1s) \rightarrow Be^{3+}(n\ell) + H^{+}$
ICPEAC 2009 (XXVI International Conference on Photonic, Electronic & Atomic Collisions) in Kalamazoo, USA

And it burns, burns, burns
The ring of fire, the ring of fire.
Johnny Cash - Ring of Fire

Chapter 2

Charge Exchange Plasma Diagnostics of High-q Impurities

The diagnostic application of charge exchange spectroscopy (CXS) or charge exchange recombination spectroscopy (CXRS) in fusion plasmas is used to measure ion densities, temperatures and velocities of plasma rotation, and Z_{eff}, the effective charge of the plasma [8]. CXRS in fusion plasmas makes use of optical transitions that follow electron transfer from a neutral atom into an excited state of an (impurity) ion A^{q+}. In most applications, the sources of neutral particles are energetic atom-beams (mainly H (D) [9, 10] beams, sometimes He [11, 12], Li [13, 14] or Na [15, 16]) employed either for plasma heating or for the specific purpose of active plasma diagnostics. The transitions following the charge exchange are particularly useful for determining the densities of fully and partially stripped low-Z ions (via the intensity of the emitted characteristic line radiation) and for measuring ion temperatures (via Doppler broadening of the emission lines). A transition like

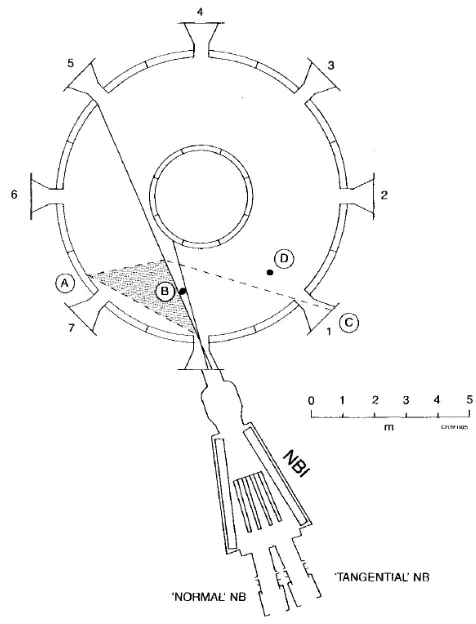


Figure 2.1: Geometrical arrangement of the heating neutral beams at JET together with the CXRS lines of sight. The shaded area is the intersection volume of the lines of sight of the spectrometers and the neutral beam. [7]

$$H^0 + A^{q+} \rightarrow H^+ + [A^{(q-1)+}(nl)]^* \tag{2.1}$$

is called charge exchange excitation, because it leaves the resulting ion $A^{+(q-1)}$ in an excited state [3]. The principal application is usually to capture the bare nuclei of impurity atoms in the plasma from the ground state of neutral donor atoms in fast neutral beams either specifically designated for spectroscopy purposes or heating beams. Subsequently the hydrogen-like impurity ion radiates as

$$A^{(q-1)+}(n\ell) \to A^{(q-1)+}(n'\ell') + h\nu \tag{2.2}$$

Composite spectral line features of the form $n \to n'$ are observed made up from unresolved $n\ell \to n'\ell'$ multiplet components. Charge exchange line features often involve high principal quantum shells and occur over wide spectral ranges including the visible range [17].

In order to calculate ion densities from CXRS data, it is first necessary to know the effective cross section for exciting individual spectral lines [3].

Reduction of observed column emissitivities to local impurity number densities is usefully viewed as two steps. Firstly, the data are reduced to an "emission measure" by use of a theoretical model of atomic reactions involving the emitting species. Then local densities are inferred from the emission measure. This step depends on a detailed model for neutral hydrogen beam attenuation. Emission measures allow comparison of densities of different species without full information on beam attenuation [7].

With the developments toward ITER, it is becoming more and more important to improve the CXRS diagnostic system also for the use with Ar. CXS lines have already been observed for Ar XVI and Ar XVIII in tokamaks like JET and DIII-D. However, discrepancies have always been encountered when trying to reconcile the charge exchange (CX) with measurements for Ar. Standard classical trajectory Monte Carlo (CTMC) calculations have for some years been a main source of fundamental state selective charge exchange cross sections and the standard CTMC data for Ar have already been used in the fusion community [18] being presently the only source of charge exchange data for Ar in Atomic Data & Analysis Structure (ADAS). New CTMC calculations have been carried out with an improved initial distribution as discussed in [19]. The discrepancies between this improved CTMC method and the standard CTMC method are very pronounced for Ar, especially in the energy range of the AUG neutral beams (60 - 90 kV), see fig.2.2, and for n-shells associated with visible line emission.

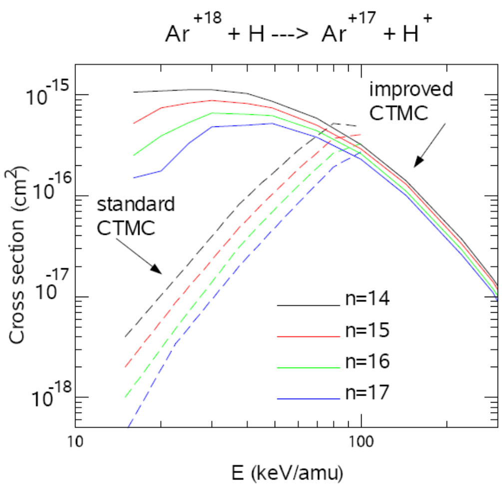


Figure 2.2: Discrepancy between improved CTMC and standard CTMC cross sections for Ar^{18+} on H(1s) for capture into $n = 14 - 17$ vs. collision energy [20]

This discrepancy is of major concern and needs to be further evaluated. The new AOCC calculations which constitutes the main part of this PhD thesis (see section 3.2) will not only provide more reliable cross sections but also include previously not calculated partial cross sections.

2.1 Intrinsic Impurities in Fusion Experiments

The so-called intrinsic impurities are elements that are present in the plasma mainly originating from sputtering of the plasma facing components (PFC). The choice of the elements the PFC are made of is highly important with respect of their main functions [21]:

- Absorb the radiated and conducted heat from the plasma and contribute to the absorption of neutronic heating;
- Minimize the plasma impurity content;
- Provide limiting surfaces that define the plasma boundary during startup and shutdown;
- Contribute to the plasma passive stabilization.

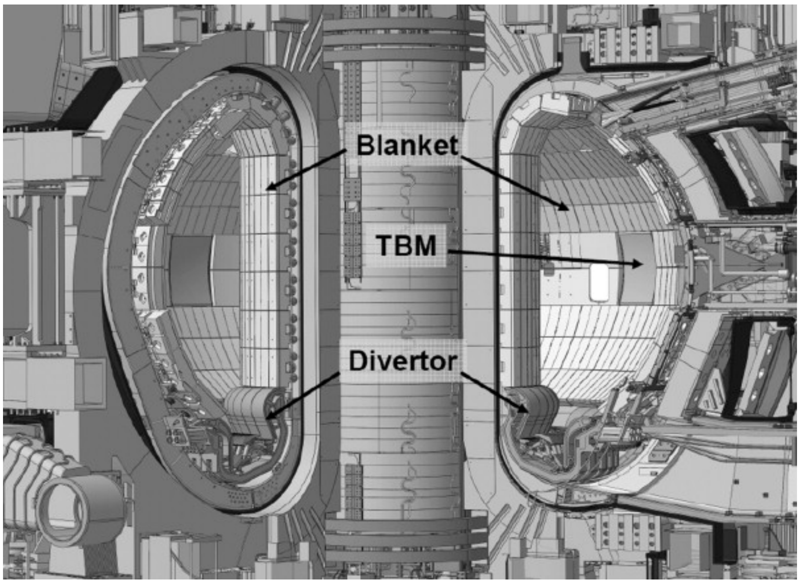


Figure 2.3: ITER plasma facing components. The divertor will be made of tungsten, whereas the blankets are made of bulk beryllium components and the test blanket modules (TBM) of steel. The TBMs are mock-ups of DEMO breeding blankets. [21]

Fig. 2.3 shows the PFCs in the planned ITER tokamak. Today's operating machines in ITER member states put a strong focus on testing materials and setups for the new machine itself, see tab. 2.1. In most tokamaks, carbon is used as a plasma facing material. This is a reasonable choice for machines not operating D-T plasmas. It was found in the D-T campaign at JET that tritium retention in the carbon wall poses a significant problem [22]. This problem can be alleviated by either using bulk beryllium beryllium-coated carbon tiles [23] or using a full tungsten machine [24].

The selection of armor materials for PFC is a compromise between multiple requirements derived from the unique features of burning plasmas [25, 26]. The wall has to withstand the intense heat load and particle flux from the core plasma over years of operation with little or no maintenance. The influx of material from the wall to the plasma needs to be controlled to avoid diluting the hydrogen isotope fuel and to avoid excessive radiation losses. In the ITER design beryllium is planned for the main chamber wall. This has low-Z and low radiation losses and is an oxygen getter, but is has a low melting temperature and limited head handling capabilities. The heat flux onto the divertor target plate is very high. Carbon and tungsten are proposed as PFC. Carbon is ideal in many ways as it does not melt and carbon radiation in the divertor plasma reduces the incident heat flux to manageable levels. There is a serious difficulty, however, as tritium codeposition with eroded carbon leads to high levels of tritium retention [27, 26]. The tritium inventory in the ITER vacuum vessel is limited for safety reasons and calculations indicated that this limit could be reached in a few weeks' operations. Continued plasma operations would not be possible until the tritium was removed. The lack of a high confidence, proven solution to quickly and effectively remove tritium led to the decision to exclude carbon from the tritium phase of operations. The divertor material will be completely tungsten during tritium operations.[26]

Two tokamaks are worth highlighting from the list in table 2.1: The JET tokamak at Culham Centre for Fusion Energy (CCFE) and the ASDEX-Upgrade (AUG) tokamak at IPP Garching. In the former, the complete first wall was just recently rebuilt using only materials that will be used in ITER and thus making JET a test-bed for developing ITER scenarios [23]. In the latter, all carbon tiles have been gradually replaced by tungsten coated tiles [24]. It is argued that the currently planned setup for the ITER divertor with carbon-fibre composites (CFC) at the strike points may result in unacceptably high tritium inventories due to the high erosion yields of Be and C [28, 29] and codeposition with tritium [30, 31, 25]. In a future power reactor Be and C are not viable solutions because of high erosion yield and high-Z components, like W, will have to be used [32, 33, 34].

2.2 Artificially Induced Impurities

Radiative Plasma Edge Cooling

The magnetically confined fusion plasma is far too hot to be brought in direct contact with a physical wall. It would degrade the wall and the debris from the wall would extinguish the plasma immediately. Therefore, schemes are developed to cool down the plasma locally before it impacts on a physical surface [36]. Among these schemes radiative edge cooling is very promising. It could solve the main difficulties related to the interaction of the plasma with the material wall. A cold, highly radiative boundary distributes most of the power uniformly over the first wall. Structural damage due to non-uniform and therefore high local heat deposition could thus be avoided, and the impurity concentration in the plasma caused by erosion of the wall material could be significantly reduced [37]. The high radiation loss is needed for mitigating the severe problem of concentrated power loading on the divertor plates. Even with optimistic assumptions about field line expansion and the design of inclined target plates, the peak load at the divertor plate would exceed 50 MW/m^2. This is far too high for stationary operation [38]. Controlled injection of impurity gases, such as Ne or Ar, is a promising technique for enhancing power loss due to radiation, either in the main chamber or in the divertor [39].

At AUG, N was very successfully used as radiating impurity [40, 41]. For ITER, the use of Ar as radiating impurity has been proposed [42]. The confinement improvement in fusion plasmas using Ar impurities for radiative cooling has already been well researched and documented [39].

Name	**Location**	**First operated in**	**Most used elements today**
TEXTOR	Forschungszentrum Jülich (FZJ) Jülich, Germany	1978	C, B
JET	**Culham Centre for Fusion Energy (CCFE)** **Culham, United Kingdom**	**1983**	**Be, W, (C)**
JT-60	Naka Fusion Institute Japan Atomic Energy Agency (JAEA) Naka, Japan	1985	C, W
Tore Supra	Commissariat à l'énergie atomique (CEA) Cadarache, France	1988	C
DIII-D	General Atomics San Diego, USA	late 1980s	C
COMPASS	Institute of Plasma Physics Academy of Sciences of the Czech Republic previously operated from 1989 to 1999 in Culham, United Kingdom	2008	C
FTU	ENEA Frascati Research Centre Italian National Agency for New Technologies Frascati, Italy	1990	Mo
ASDEX Upgrade	**Max-Planck-Institute of Plasma Physics (IPP)** **Garching, Germany**	**1991**	**W**
Alcator C-Mod	Massachusetts Institute of Technology (MIT) Cambridge, USA	1992	Mo
HL-2A	Center For Fusion Science Southwestern Institute of Physics Chengdu, China	2002	C
MAST	Culham Centre for Fusion Energy (CCFE) Culham, United Kingdom	1999	C
NSTX	Princeton University Princeton, USA	1999	C
EAST (HT-7U)	Institute of Plasma Physics Chinese Academy of Sciences Hefei, China	2006	C
KSTAR	National Fusion Research Institute Daejon, South Korea	2008	C

Table 2.1: Selection of tokamak experiments currently in operation. Most common elements used as wall, divertor or limiter materials are indicated. These materials refer to the current state of the tokamaks which is not necessarily equivalent to their original setup [35].

To understand the transport of Ar impurities in the plasma edge, simulation calculations which model and experimental techniques which diagnose this transport are necessary. Both modeling and diagnostics heavily rely on atomic collision cross sections involving Ar^{q+} ions in various charge states and plasma particles like electrons, protons and neutral hydrogen atoms. It is the primary aim of this thesis to provide these cross sections, i.e. those necessary for charge exchange diagnostics of Ar^{q+} ions.

Generally, it can be stated that the higher the Z of the seeding impurity, the higher the radiation losses. But, this needs to be balanced against the strife for a sufficiently low Z_{eff} in the plasma center.

The claim we hold
Is as good as gold.
Johnny Cash - Bonanza

Chapter 3

Theoretical Aspects of Ion-Atom Collisions Resulting in Charge Exchange

3.1 Classical Over-Barrier Model

The principles of the classical over-barrier model (COBM) were introduced by Bohr and Lindhard [43], and were further developed by Ryufuku et al. [4] and Bárány et al. [44]. Niehaus [45] and Ostrovsky [46] extended the initially static model involving the effects of the relative velocity of the target and the projectile. [47]

The COBM provides a good description of single electron charge transfer processes [48, 49, 50, 51, 52]. The COBM for electron capture by slow highly charged projectiles has been successfully used to predict total charge transfer cross sections as well as the principle quantum number n of the projectile state into which electron capture predominantly takes place. In this model capture is assumed to take place at a crossing of the diabatic potential curves at large internuclear distances R provided the charge transfer simultaneously becomes classically allowed: that is, the electron can overcome the barrier between the potential wells generated by the ionic charges of the target and the projectile. The success of this simple model stems in part from the fact that the resonant charge transfer populates preferentially states with large quantum numbers n and ℓ, yielding large and essentially "geometric" cross sections for capture into the principal shell n. In the limit of large quantum numbers and large number of open reaction channels, the shell cross section (summed over many substates) becomes independent of the quantum dynamics of individual state amplitudes. The COBM is static in the sense that the projectile velocity does not enter as a system parameter. [53]

The largest internuclear distance R_m at which the potential barrier can be crossed by the active electron depends on the projectile charge q and the binding energy I_t of the active electron in the target. [49]

$$R_m = \frac{2 \cdot \sqrt{q} + 1}{I_t} \tag{3.1}$$

In the standard formulation of the COBM it is stated that the active electron prefers the very capture channel with the largest principal quantum number n_p where the location of the potential crossing R_c still satisfies $R_c \leq R_m$. The most occupied principal shell after charge exchange is [4, 53]

$$n^* = \sqrt{2I_t \left(\frac{q-1}{2\sqrt{2}+1} + 1 \right)}. \tag{3.2}$$

n^* doesn't necessarily have an integer value. $n_p \leq n^*$ is the nearest integer that satisfies (3.2).

3.2 Atomic-Orbital Close-Coupling Calculations

In the past, the AOCC method has proven to be an extremely well-developed and reliable method for the calculation of ion-atom collisional cross sections in the intermediate and high energy ranges [54]–[56], in particular for charge exchange and excitation processes:

$$Z^{q+} + A \rightarrow Z^{(q-1)+}(n,\ell) + A^+ \tag{3.3}$$
$$Z^{q+} + A(n,\ell) \rightarrow Z^{q+} + A^*(n',\ell') \tag{3.4}$$

In the following section, a short summary of the close-coupling method using atomic orbital basis states is given.

The mass difference between core and electron is so vast that a separation of the core and electron movements is justified (Born-Oppenheimer approximation). Additionally for projectile energies above a few eV/amu, the de-Broglie wavelength of the core movement is much smaller than the region if the interaction of the two collision partners took place. Thus, while the core movement can be described by classical trajectories, the electron movement remains to be described quantum mechanically.

At this point it is useful to introduce the impact parameter $\vec{b}$ as the shortest possible distance of the collision partners where no interaction takes place, see Fig.3.1. Charge exchange occurs at relatively large internuclear separations $\vec{R}$. At sufficiently large collision energies (above a few eV/amu) and sufficiently large impact parameters an upper bound of the elastic scattering angle of the collision partners can be given. If this angle is small enough, elastic scattering effects can be neglected [57]. This together with the assumptions of linear trajectories of the cores is called the "impact parameter approximation". [6]

In the impact parameter approximation, the internuclear distance is defined as follows [5, 6]

$$\vec{R}(t) = \vec{v}t + \vec{b} \tag{3.5}$$

Thus, the close-coupling equations provide a semi-classical description of the scattering process [5, 6]. The equation of motion of the active electron in the effective potential of the projectile core $V_p(\vec{r_p})$ and the target core $V_t(\vec{r_t})$ can be written as time-dependent Schrödinger equation

$$i\frac{\partial}{\partial t}\Psi(\vec{r},t) = H_e(t)\Psi(\vec{r},t) \tag{3.6}$$

$$H_e(t) = -\frac{1}{2}\nabla_r^2 + V_p(\vec{r_p}(\vec{r},t)) + V_t(\vec{r_t}(\vec{r},t)) \tag{3.7}$$

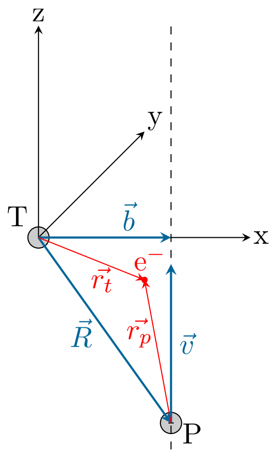


Figure 3.1: Collision frame and geometry in the impact parameter approximation: the (x,z) collision plane is defined by the projectile velocity $\vec{v}$ and the target. $\vec{b}$ is the impact parameter, $\vec{R}$ the internuclear separation vector, and $\vec{r_t}$ and $\vec{r_p}$ the position vectors of the active electron the coordinate system of the target respectively the projectile.

where the time derivative has to be calculated in an inertial system. The vector $\vec{r}$ refers to the chosen inertial system whereas the vectors $\vec{r_p}$ and $\vec{r_t}$ refer to the system of the projectile or respectively the target, see fig. 3.1. The potentials have to describe the interaction of the active electron with the nucleus and as well, if existing, with the projectile core. Especially at small distances this results in a deviation from the form of the Coulomb potential.

To solve the Schrödinger equation (3.6), a set of basis states $\chi_k(\vec{r}, t)$ is to be defined. These states do not necessarily need to be orthonormal. Thus, the complete wave function $\Psi(\vec{r}, t)$ can be expanded according to

$$\Psi(\vec{r}, t) = \sum_k a_k(t)\chi_k(\vec{r}, t) \tag{3.8}$$

In the perturbed stationary state (PSS) approximation employing atomic eigenfunctions $\chi_k(\vec{r}, t)$, the time-dependent electronic wave function decomposes into a set of atomic orbitals. The time-dependence then consists only of a phase factor [58]

$$\chi_k^{PSS}(\vec{r}, t) = \varphi_k(\vec{r}) \exp\left(-i \int^t E_k dt'\right) \tag{3.9}$$

where E_k is the time-independent energy eigenvalue of the atomic state which would describe the system if the nuclei were fixed in position [58]. The weakness of this description is that the choice does not provide an exact solution of (3.6) when the internuclear separation R is infinite, the reason being that no account has been taken of the translational motion of the separated atoms. The introduction of electron translational factors (ETF) resolves this problem [58]. The wave functions including ETF $f(\vec{R}, \vec{r})$ are commonly written as follows:

$$\chi_k^{ETF}(\vec{r}, t) = \chi_k^{PSS}(\vec{r}, t) f(\vec{R}, \vec{r}) \qquad \text{with} \qquad f(\vec{R}, \vec{r}) \xrightarrow{R\to+\infty} \exp\left(i\vec{v_c}\cdot\vec{r}\right) \tag{3.10}$$

The atomic basis states φ_k have the following properties:

$$(-\frac{1}{2}\nabla_r^2 + V_p)\varphi_k = E_k\varphi_k \qquad \varphi_k \ldots \text{projectile state} \tag{3.11}$$
$$(-\frac{1}{2}\nabla_r^2 + V_t)\varphi_i = E_i\varphi_i \qquad \varphi_i \ldots \text{target state} \tag{3.12}$$
$$\tag{3.13}$$

Inserting the expansion (3.8) & (3.10) in the Schrödinger equation (3.6) within the subspace spanned by the atomic basis states leads to

$$\sum_k \left(i\frac{\partial}{\partial t} - H(\vec{r},t) \right) |a_k(t)\chi_k(\vec{r},t)\rangle \tag{3.14}$$

Projecting an arbitrary basis state χ_j from the left side on this equation and performing the time derivative leads to

$$\sum_k i\frac{da_k(t)}{dt}\langle\chi_j|\chi_k\rangle + \sum_k \langle\chi_j| \left(i\frac{\partial}{\partial t} - H(\vec{r},t) \right) |\chi_k\rangle a_k(t) \tag{3.15}$$

Now, parts of this equation can be identified as "overlap"-matrix elements S_{ik} and the coupling matrix elements M_{ik} which are defined by

$$S_{jk} = \langle\chi_j|\chi_k\rangle \quad \text{and} \quad M_{jk} = \langle\chi_j| \left(i\frac{\partial}{\partial t} - H(\vec{r},t) \right) |\chi_k\rangle \tag{3.16}$$

Both matrices consist of one-center and two-center parts. The term "one-center" implies that only states defined on the same center of impact are used in the calculation of the respective matrix element, whereas "two-center" indicates states on opposing centers. The basis sets are diagonalized on each center separately leading to two independent orthonormal systems. After the diagonalization the one-center overlap matrix elements form the unit matrix and the two-center overlap elements fulfill

$$S_{PT} = S_{TP}^{\dagger}. \tag{3.17}$$

Put in a more descriptive way, the overlap and coupling matrices look like

$$\mathbf{S} = \left(\begin{array}{c|c} \mathbb{1} & S_{TP} \\ \hline S_{TP}^{\dagger} & \mathbb{1} \end{array} \right) \qquad \mathbf{M} = \left(\begin{array}{c|c} M_{TT} & M_{TP} \\ \hline M_{PT} & M_{PP} \end{array} \right). \tag{3.18}$$

Now (3.15) can be written in a concise manner as

$$i\ \mathbf{S}\ \frac{d}{dt}\mathbf{a} = \mathbf{M}\ \mathbf{a} \tag{3.19}$$
$$\frac{d}{dt}\mathbf{a} = \underbrace{-i\mathbf{S}^{-1}\mathbf{M}}_{\mathbf{M_{eff}}}\mathbf{a}$$

Thus, a coupled, linear set of first-order differential equations is obtained for the expansion coefficients $a_k(t)$. These equations are called the *coupled-channel equations*. The coupling of the different atomic states is a result of the effective potentials of the projectile and the target.

Using basis states that are eigenstates of the atomic Hamiltonian reduces M_{jk} from (3.16) to

$$M_{jk} =_B \langle\chi_k| - \frac{1}{2}\nabla^2 + V_A + V_B - i\frac{\partial}{\partial t}|\chi_k\rangle_A =_B \langle E_j + V_B - E_j\rangle_A =_B \langle V_B\rangle_A \tag{3.20}$$

For states that are not eigenstates of the Hamiltonian (3.7) $i\frac{\partial}{\partial t}|\chi_k\rangle = E_k|\chi\rangle$ still holds when $E_k = \langle\chi_j| - \frac{1}{2}\nabla^2 + V_A|\chi_k\rangle$. But due $H_B|\chi_k\rangle_B \neq E_k|\chi_k\rangle_B$, M_{jk} from (3.16) only reduces to

$$M_{jk} =_B \langle\chi_j|V_B|\chi_k\rangle_A - E_k\ {}_B\langle\chi_j|\chi_k\rangle_A +_B \langle\chi_j|H_B|\chi_k\rangle_A \tag{3.21}$$

The system of coupled first-order differential equations (3.20) is solved under the consideration of the following initial conditions

$$|a_i(t \to -\infty)|^2 = 1 \qquad \text{for the initial state} \tag{3.22}$$

$$|a_k(t \to -\infty)|^2 = 0 \qquad \forall\ k \neq i \tag{3.23}$$

The partial cross section for a transition $i \to k$ can be defined as follows

$$\sigma_{ik} = 2\pi \int_0^\infty |a_k(t \to \infty)|^2 b db \tag{3.24}$$

Resulting in the following definition of the total cross section

$$\sigma_{tot} = 2\pi \int (1 - |a_i(t \to \infty)|^2) b db = \sum_k \sigma_{ik} \tag{3.25}$$

The close-coupling method can be divided in three steps: first the selection and calculation of the basis states, followed by the determination of the matrix elements, and in the end the time-integration of the coupled-channel equations. [5, 6]

3.3 Choice of Basis Sets

The appropriate choice of atomic basis states reflects the physical problem that is to be treated. The basis sets, however, have commonly sought to meet the following requirements of physics and convenience.[5]

1. The basis set should include, or represent to good approximation, the initial state of the electron and some final states; in investigations of bound-state transitions, the basis should at least include or represent, at times $t = \pm\infty$, all significantly populated atomic states. [5]

2. Furthermore, the basis should include other intermediate states which, in some range of internuclear separations, may interact appreciably with the initial and final states under consideration. [5]

3. The basis states should be easily generated and/or they should allow for convenient evaluation of any matrix elements which are needed. [5]

4. Lastly, for diagnostic purposes it is of essential importance that there is line emission in the visible wavelength range which is easily accessible by spectroscopic means (e.g. fiber optics, conventional spectrometers, CCD cameras). If this is not the case for the emission

lines resulting from capture into the dominant or neighboring n-shell(s), the number of basis has to be expanded further. One must also bear in mind, that cascade effects, i.e. electrons originally captured into higher lying states that cascade down to the upper n-level of the observed transition, can play an important role.

The simplest wavefunctions are composed of Laguerre-type radial parts and spherical harmonics as angular part. They describe the initial neutral hydrogen atom as well as hydrogen-like ions after the charge-changing collision like e.g. Be^{3+} or Ar^{17+}.

$$\varphi(\vec{r}) = R_{n\ell}(r)Y_{\ell m}(\Omega) \tag{3.26}$$

$$R_{n\ell}(r) = \sqrt{(2 \cdot \frac{Z}{n})^3 \cdot \frac{(n-1)!}{2n\,[(n+\ell)!]}} \cdot e^{-r \cdot \frac{Z}{n}} \cdot (2r \cdot \frac{Z}{n})^{\ell} L^{2\ell+1}_{n-\ell-1}(2r\frac{Z}{n}) \tag{3.27}$$

where Z is the atomic number, $L^{2\ell+1}_{n-\ell-1}(2r\frac{z}{n})$ are the Laguerre polynomials. Since the spherical harmonics $Y_{\ell m}(\Omega)$ are known, the problem reduces to the determination of the radial parts $R_{n\ell}(r)$.

In addition to bound hydrogen-like states, there needs to be some way of describing the continuum. In the case of the collision systems treated in this thesis, a pseudostate approach was most convenient. Pseudostates are basis states that are not physical states like the states described before, but they can serve as a way to include the continuum, i.e. ionization, in the basis state expansion. Using a $Z > 1$ on the hydrogen center and diagonalizing the Hamiltonian matrix results in an arbitrary, user-defined number of unbound states on the H center and thus these basis states represent direct ionization. When treating lighter ions like Be^{4+}, it may also be advantageous to include pseudostates on the ion center as well. Unbound states of this sort represent capture into continuum.

Hydrogen-like wavefunctions can also describe highly excited states of the active electron in projectiles with core electrons. Electron configurations like those of the outermost shell of alkali atoms can be reduced to one-electron systems by the selection of the correct pseudopotentials. [48]

The influence of the core electrons on the wavefunctions is twofold. The core electrons shield the field of the nucleus on the one hand and on the other hand, due to Pauli's exclusion principle, is the wavefunction of the valence electron forced to be orthogonal to the core orbitals.

There are various different methods to obtain useful basis sets, e.g. the Hartree-Fock method that is based upon the central field approximation of the Hamiltonian and the variation principle [59, 49, 48]. In section 5.3, this approach was used when determining the basis functions and the pseudopotential in N^{6+} + H($n = 1, 2$) collisions.

3.4 Complexity of Atomic-Orbital Calculations of Cross Sections Involving High-q Impurities

With increasing charge state q their electronic configurations become more and more hydrogen-like. Electron capture from H^0 will mainly result in high lying (quasi-) Rydberg-states of the incident ion. Thus the number of states involved in the AOCC calculations presented in this work is larger than ever performed before. This puts a great demand not only on the computational formulation of the problem and the speed of the used algorithms, see 4.

In section 5.2, data for Be^{4+} + H($n = 1, 2$) collisions are presented that were calculated using an existing AOCC code that was mainly developed in the late 1980s and early 1990s. With today's computer powers, basis sets with up to 170 states could be calculated. But this reached the limits of this serial, old code.

Fig. 3.2 shows the number of states per n-shell and an estimate of the total number of basis states. In the Ar^{q+} case, this number of basis states needed for a convergent description of the collisional system is about one order of magnitude larger than for Be^{4+} + H collisions. Consequently, it is obvious that the problem cannot be solved simply by using larger basis sets and higher quantum numbers n and ℓ.

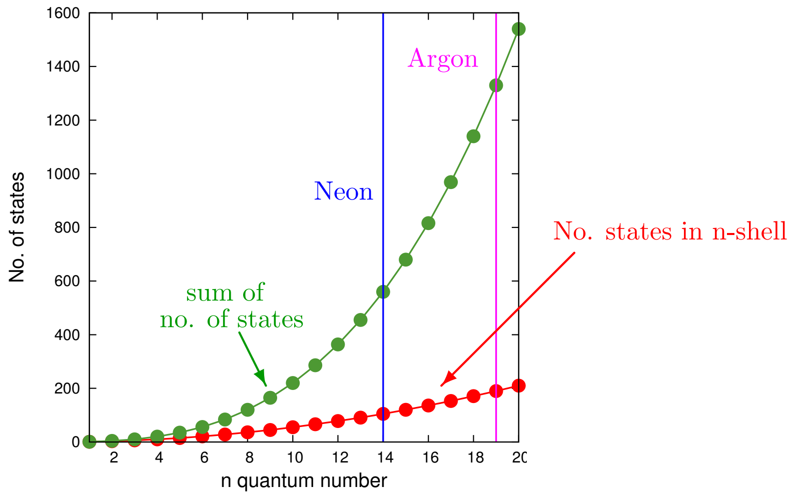


Figure 3.2: Number of basis states per n-shell and estimate of total number of basis states involved

I've always been crazy,
but it's kept me from going insane.
Waylon Jennings - I've Always Been Crazy

Chapter 4

Computational Implementation

The theoretical framework presented in section 3.2 is fairly straight forward. But when taking into account that integrals involving functions in two different coordinate systems need to be solved, the whole story gets a little more complicated. The following chapter therefore addresses the steps taken to implement a computational solution of the posed scattering problem. The problem at hand can be separated into four steps:

1. **The creation of symbolic structures** for the integrals involved in the calculation of the values of the matrix elements. Section 4.1 is dedicated to this step.
2. **The calculation of the effective matrices $\mathbf{M_{eff}}$** on the trajectory the projectile moves on during the collision. The complexity of these calculations is largely dependent on the number of basis states and the quantum numbers involved. For the collision systems targeted in this thesis, elaborate parallelization schemes became necessary which are described in section 4.2.
3. **The solution of the coupled channel equations (3.20)**, a set of coupled ordinary differential equations of first order. For this step, a solver for differential equations is needed that is best suited for these equations. The result are the probability amplitudes for each impact parameter b and each impact velocity v. This step closely links to the previous step. Also here, parallelization became necessary for large collision systems and will be commented on in section 4.2.
4. **The calculation of the actual cross sections** through integration of the probability amplitudes over the impact parameter mesh. This steps certainly takes the least efforts, the integration can be performed locally using cubic splines.

4.1 Symbolic Structures for Matrix Elements

The contents of this chapter have been published (in part) in *Computer Physics Communications* [60] and are described in much greater detail in Markus Wallerberger's diploma thesis [61] which was supervised jointly by Prof. F. Aumayr and the author at IAP at TU Wien.

To shorten our notation, vector powers are introduced by defining [62]

$$(\vec{x})^{\vec{y}} := \prod_{i=1}^{3}(x_i)^{y_i} \quad \text{and} \quad (\nabla_{\vec{x}})^{\vec{n}} := \prod_{i=1}^{3}\left(\frac{\partial}{\partial x_i}\right)^{n_i}. \tag{4.1}$$

Now, by expanding the wave function into exchange orbitals, the exchange integrals can be reduced to terms of the form

$$_A\langle\psi_1|\psi_2\rangle_B = \sum A_{n_1\ell_1 n_2\ell_2}\ {}_A\langle\alpha_1 n_1\vec{\ell_1}|\alpha_2 n_2\vec{\ell_2}\rangle_B \tag{4.2}$$

where the overlap in configuration space can be expressed by

$$_A\langle\alpha_1 n_1\vec{\ell_1}|\alpha_2 n_2\vec{\ell_2}\rangle_B = \int d^3r_A r_A^{n_1-2} r_B^{n_1-2}(\vec{r}_A)^{\vec{\ell}_1}(\vec{r}_B)^{\vec{\ell}_2}\exp(-\alpha_1 r_A - \alpha_2 r_B) \tag{4.3}$$

Similarly, for the exchange matrix elements, it is found that the potential $V(R, r_A, r_B)$ can be expanded in powers of r_A and r_B, yielding the exchange integral

$$_A\langle\alpha_1 n_1\vec{l_1}|V|\alpha_2 n_2\vec{l_2}\rangle_B = \int d^3r_A r_A^{n_1'-2} r_B^{n_1'-2}(\vec{r}_A)^{\vec{l}_1'}(\vec{r}_B)^{\vec{l}_2'}\exp(\imath\vec{a}\vec{r}_A + \imath\vec{b}\vec{r}_B - \alpha_1 r_A - \alpha_2 r_B) \tag{4.4}$$

where $\vec{a}$ and $\vec{b}$ are real vectors arising from the potential and $n', \vec{\ell}'$ are modifications to n, ℓ due to the addition of the potential. This is the most general integral that will have to be solved, also called $I(n_1, \vec{\ell}_1, n_2, \vec{\ell}_2)$.

4.1.1 Transformation to One-Dimensional Integrals

Several techniques have been proposed to solve this integral. The method of Shakeshaft [63] will be followed, where the three-dimensional integrals are transformed to a sum over one-dimensional integrals

$$\begin{aligned} I &= \int d^3r_A\, r_A^{n_1-2} r_B^{n_2-2}(\vec{r}_A)^{\vec{\ell}_1}(\vec{r}_B)^{\vec{\ell}_2}\exp(\imath\vec{a}\vec{r}_A + \imath\vec{b}\vec{r}_B - cr_A - dr_B) \\ &= 2\pi(-\imath)^{\ell_1+\ell_2}\left(\nabla_{\vec{a}}\right)^{\vec{\ell}_1}\left(\nabla_{\vec{b}}\right)^{\vec{\ell}_2}\left(-\frac{\partial}{\partial c}\right)^{n_1-1}\left(-\frac{\partial}{\partial d}\right)^{n_2-1}\int_0^1 dy\frac{\exp(\imath\vec{B}\vec{R} - AR)}{A} \end{aligned} \tag{4.5}$$

where $\vec{R} = \vec{r}_A - \vec{r}_B$ is the internuclear separation and where the quantities $A^2 := y(1-y)|\vec{a} + \vec{b}|^2 + yc^2 + (1-y)d^2$ and $\vec{B} := y\vec{a} - (1-y)\vec{b}$ are introduced. This formula is stated without its (rather labour-intensive) proof.

For a typical collision system, $\vec{a} = v\vec{e}_z$ and $\vec{b} = 0$ can be identified.

4.1.2 Simplification of One-Center Exchange Integrals

One-centre exchange integrals arise from states on one centre being affected by the potential at the other centre. The wave functions can be expanded in terms of exchange orbitals:

$$_A\langle\psi|V_B|\chi\rangle_A = \sum_p \sum_q \psi_p^* \chi_q \cdot\ _A\langle\alpha_p n_p \vec{\ell}_p|V_B|\alpha_q n_q \vec{\ell}_q\rangle_A \tag{4.6}$$

where ψ_p and χ_q are expansion coefficients of the respective wave functions. If assuming that the potential is radial-symmetrical and of the form

$$V(r) = \sum_i a_i r^{\rho_i} \exp(-f_i r) \tag{4.7}$$

the requirements of our exchange integrals can be matched:

$$_A\langle\psi|V_B|\chi\rangle_A = \sum_{p,q,i} \psi_p^* \chi_q a_i \cdot I(n_p + n_q, \vec{\ell}_p + \vec{\ell}_q, \rho_i + 2, \vec{0}) \tag{4.8}$$

as well as $c = \alpha_p + \alpha_q$, $d = f_i$ and $\vec{a} = \vec{b} = 0$. In first approximation, it can be assumed that the shielding represented by the exponential term is small and therefore set d to zero, yielding

$$A = \sqrt{y}c \quad \text{and} \quad \vec{B} = 0 \tag{4.9}$$

With these constraints, the terms of the exchange integrals $I1$ (see below) involved in calculating one-centre exchange matrix elements can be identified:

$$I \equiv I1(n, \vec{\ell}) = \sum_i a_i R^{\rho_i} R_1^{\phi_i} R_3^{\psi_i} \int_0^1 dy\, \sqrt{y}^{\sigma_i} \exp(-cR\sqrt{y}) \tag{4.10}$$

These terms are special cases of $A^{\nu\mu}_{i\alpha\rho\phi\psi}$, where the binomial expansion of $(1-y)^\mu$ is used to convert everything to powers of y. Substituting $u := cR\sqrt{y}$, a closed form of these integrals can be given:

$$I1(n, \vec{l}) = \sum_i \frac{2a_i \Gamma(\sigma_i + 2)}{c^{\sigma_i+2}} R^{\rho_i - (\sigma_i+2)} R_1^{\phi_i} R_3^{\psi_i} P(\sigma_i + 2, cR) \tag{4.11}$$

where the lower incomplete Gamma function

$$P(a, x) = \frac{1}{\Gamma(x)} \int_0^x dt\, \mathrm{e}^{-t} t^{a-1} \tag{4.12}$$

is used. Note that this approach is guaranteed to converge for $\rho_i \geq -1$, but may fail for potentials of higher order, since the integrals P may diverge.

This yields a polynomial in four variables, which is again stored in the polynomial structure. Unlike the original programme `JANAL` by Hansen and Dubois [64], the coefficients are stored in a partially evaluated form.

4.1.3 Polynomial Representation in Tree Structures

To store the symbolic form of the wave functions and the exchange integrals obtained earlier, polynomials need to be modeled. These polynomials are primarily used to perform symbolic differentiations, calculus and lots of evaluations.

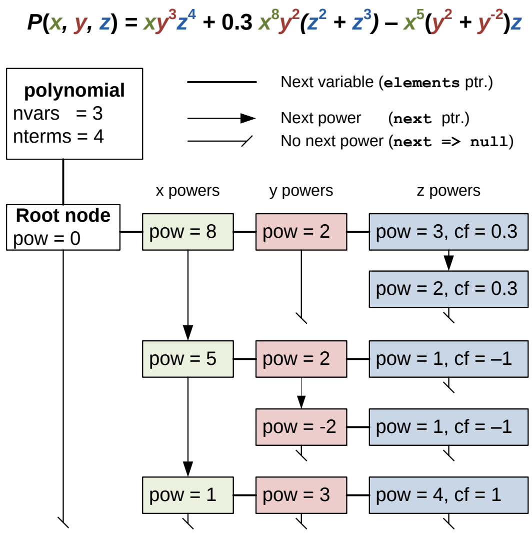


Figure 4.1: Internal representation of an instance of type `polynomial` modelling formula (4.14). The nodes, implemented in type `polyterm`, form a *LC-RS tree* structure where the right branch (`elements` pointer, lines) distinguishes different variables and the down branch (`next` pointer, arrows) points to the next power in the same variable, enforcing a descending order of powers.

Symbolic differentiation in particular is problematic because with each differentiation step, the number of terms at least triples, but at the same time lots of linearly dependent terms arise. As a result, (i) terms need to be inserted in a fast fashion and (ii) duplicates need to be detected and add up early.

Evaluation poses another problem: if a polynomial with high powers is evaluated on a term-by-term basis, the performance is massively impeached. Moreover, cancellation errors may occur and, as the number of terms increase, may even become dominant. Therefore, a more stable way to collapse a polynomial, like the Horner scheme [65]

$$\sum_{n=a}^{b} c_n x^n = (\cdots(((c_b \cdot x + c_{b-1})x + c_{b-2})x + \cdots)x + c_a x^a \tag{4.13}$$

should be used. This requires (iii) the terms to be in a *lexicographic order* [66]: this essentially means the terms need to be ordered by the power of one variable, then by the powers of the next variable, and so forth. For example $[x^3y^2z^9] < [x^3y^3z^1]$, because $[y^2] < [y^3]$. Using a descending order has the advantage of multiplying by x and not by x^{-1} in the Horner scheme. Finally, to find a fast way to use the Horner scheme, (iv) a fast way to know up to which variable the powers of two adjacent terms agree needs to be found.

To address this problem, binary tree structures have been implemented to represent the polynomials where each node of the tree represents a variable, a power thereof.

If siblings are kept sorted by power, a tree suitable for sorted insert and evaluation of the variables is constructed. However, to get a well-performing tree for sorted insert, it is essential to take care about which container to use to store the children: An array storage is inefficient when the number of elements grows too large, since many elements must be moved when inserting.

Thus, the so-called *natural correspondence* to map n-ary trees to binary trees [67] is used: for each node in the n-ary tree, an order is chosen for its children. The left branch of the binary result tree is pointed to the first child of the corresponding node in the n-ary tree, whereas the right branch points to the next sibling of this node. Because of the different semantic meanings of the branches, this data structure is also called a *left-child right-sibling (LC-RS) tree*.

Figure 4.1 shows the binary LC-RS representation of the following polynomial

$$P(x, y, z) = xy^3z^4 + 0.3 \cdot x^8y^2(z^2 + z^3) - x^5(y^2 + y^{-2})z. \tag{4.14}$$

The left branch (represented by horizontal lines) separates the levels of the tree, distinguishing different variables. The right branch (represented by vertical arrows), on the other hand, points to the next sibling of the node, which is associated with the subsequent power of the same variable.

One can easily show that the natural correspondence is a one-to-one mapping. Indeed, you can restore the polynomial (4.14) from the tree in Figure 4.1 as follows: Start from the root node (top left) and replace each node by the respective variables and powers $cf \cdot var^{pow}$. First follow the horizontal lines, replacing it with an opening bracket. Then follow the vertical lines, replacing each arrow with a '+' and each dead end ⫮ with a closing bracket.

In this representation, many common operations and calculus reduce to simple tree mutation, being considerably faster than operating on (even sorted) arrays. Moreover, using binary LC-RS trees instead of arrays considerably speeds up sorted insert, duplicate detection and evaluation at the expense of finding a specific term (which is not necessary).

A extensive library (`polynomial.f90`) of evaluation, manipulation and calculus methods was written in Fortran 90, see appendix in [61] for a comprehensive API documentation). One of the downsides of this implementation is that Fortran 90 does not provide any destruction mechanism, which leaves the task of managing the object's scope to the user.

After a symbolic structure is successfully created and no more manipulations will be necessary, the polynomials can be compressed by converting them to a sequential representation. This brings along two major advantages: On the one hand the structures are protected from unwanted changes and on the other hand the memory requirements for the structures are optimized.

Bearing this in mind, *pre-order linearisation* for the order in the array was used. This means, the node itself is stored, and then their sub-trees in some fixed order. To make this fairly abstract algorithm more concrete, Table 4.1 provides the pre-order sequential representation of the tree in Figure 4.1.

Sequence number	1	2	3	4	5	6	7	8	9	10	11	12	13
Number of children	3	1	2	0	0	2	1	0	1	0	1	1	0
Power	–	8	2	3	3	5	2	1	-2	1	1	3	4
Coefficient	–	–	–	0.3	0.3	–	–	-1.0	–	-1.0	–	–	1.0

Table 4.1: Pre-order sequential representation (with child count) of the tree in Figure 4.1.

This structure is already far more compact than the tree structure. Still, there are redundancies:

- The root node does not have a power entry.
- Since the tree has a fixed depth, all zero children entries are implied by the representation.
- Similarly, no branch node has a coefficient.

Array index	1	2	3	4	5	6	7	8	9	10	11	12
Number of children	3	1	2	2	1	1	1	1				
Power	8	2	3	3	5	2	1	-2	1	1	3	4
Coefficient	0.3	0.3	-1.0	-1.0	1.0							

Table 4.2: Improved pre-order sequential representation (with child count) of the tree in Figure 4.1.

Removing all these unnecessary entries, the memory for a branch node was reduced to 3 bytes and the memory of a leaf node to 18 bytes, yet being fully compatible to the previous structure. The resulting memory layout for the tree in fig. 4.1 is depicted in Table 4.2.

An extensive library (`lpolynomial.f90`) for evaluation and debugging of these structures was written in Fortran 90 (see Appendix in [61] for a comprehensive API documentation). Array structures are advantageous because Fortran is very good at handling large arrays as opposed to handling large pointer structures. Moreover, the risk of memory fragmentation due to frequent allocation and deallocation of small chunks of memory decreases. Finally, the scope of linear polynomials can be managed by Fortran, which minimizes the risk for memory leaks.

4.1.4 Performance Improvements of Structure Creation

To put the routines to the acid test, we used them as a basic building block for a programme computing the exchange matrices' symbolical structures introduced in the beginning of this section [60].

The basic principles of the code by Hansen [68] we closely followed, but the actual symbolic manipulations were delegated to the polynomial library. As with the previous approach – encapsulated in the subroutine `CRERS`[1] – we did not calculate the most general form of the elements, but instead partially evaluated the polynomial for values of c and d. Algorithmically, we improved the detection of terms that vanish because of the symmetries of the collision system in the impact parameter model.

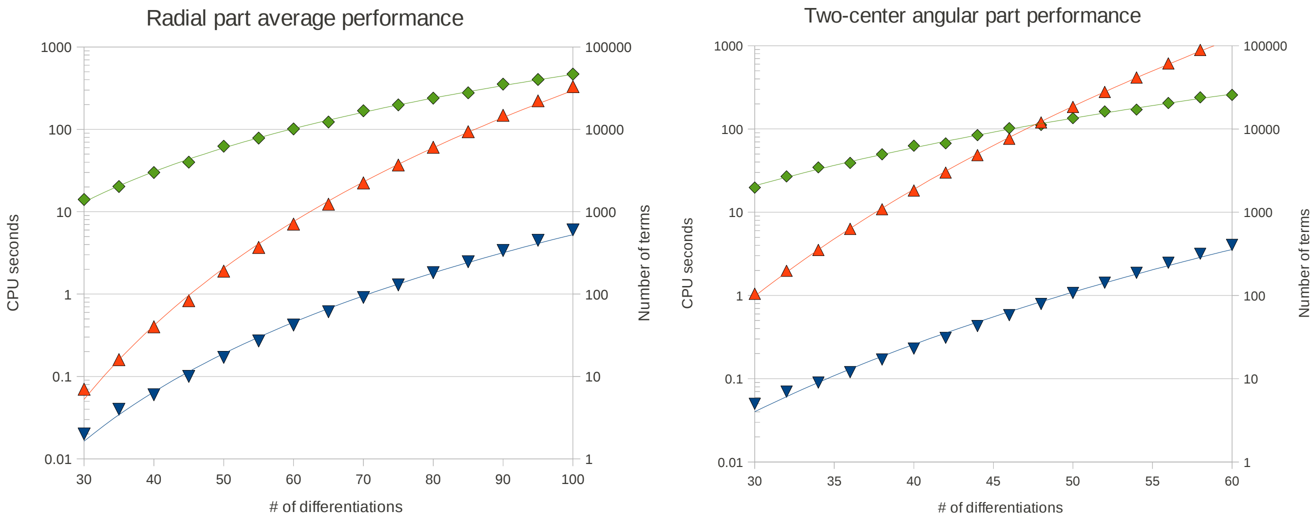
Now the runtime performance of the symbolic differentiations in both codes could be compared, illustrated by fig. 4.2: for all cases it can be clearly seen that the performance of the new tree method is a lower boundary for the running time of the old `CRERS` routine. Studying the asymptotic behaviour of the radial part, it is found that the complexity is reduced from $O(n^{7.17})$ to $O(n^{4.80})$ for the exchange integral $I(\frac{n}{2}, \vec{0}, \frac{n}{2}, \vec{0})$ with $c \neq d$. This improves running time by $O(n^{2.37})$, speeding up large integrals.

For the two-centre angular part, the exchange integral $I(1, \frac{n}{2}, 1, \frac{n}{2})$ was investigated. The complexity of the algorithm was improved from $O(n^{10.3})$ to $O(n^{6.48})$, a massive performance gain by $O(n^{3.82})$. All calculations were performed on an Intel i5 750 processor with 2 GB of RAM running Ubuntu 10.04 x64 edition. Both codes were compiled using gfortran 4.4.1 with maximum optimization levels.

4.2 Parallelization Schemes

Originally, the code used to be a serial code where first the symbolic structures for all matrix elements were created. This was followed by the calculation of the matrices along the trajectory

[1] The meaning of the subroutine's name is unknown.



(a) (b)

Figure 4.2: Performance of our tree method (∇) versus the CRERS method (△) for the creation of exchange integrals on an Intel i5 750 processor over the number n of differentiations involved: (a) radial exchange integral $I(\frac{n}{2}, 0, \frac{n}{2}, 0)$, (b) two-centre angular exchange integral $I(1, \frac{n}{2}, 1, \frac{n}{2})$ for $c \neq d$. A power regression was laid through the measurement points. The number of terms (⋄, secondary y-axis) is identical for both methods. [60]

for one pair of (b,v) after the other. These matrices were written into memory and then the coupled channel equations (3.20) were integrated. Afterwards the memory was flushed and the matrices for the next pair (b,v) were calculated. This setup obviously only works for small basis sets and small $n_v n_b$. The cross sections for Be^{4+} + $H(n = 1, 2)$ in section 5.2 were calculated using this code.[69]

Some easy, straight forward improvements helped pushing this boundary a little more toward medium sized basis sets, like the ones used in sections 5.3 and 5.4 for C^{6+}, N^{6+}, and N^{7+} + $H(n = 1, 2)$ [70]. These improvements included a rather trivial parallelization over the impact parameter mesh as outlined in fig.4.3 which could be easily and quickly implemented. On the downside, the calculation of the symbolic structures remained a single core calculations during which all the other CPUs were idle. Also the arrays containing the symbolic structures had to be copied (broadcasted and thus duplicated) to all other processors. This is an inefficient handling of available memory that only worked for medium sized systems. For larger systems the parallelization had to be much more advanced and optimized.

To emphasize the last statement, a rough estimation of memory needs for a large calculation is in place. Firstly, the symbolic structures for all matrix elements need to be calculated and stored, $n_{stat}^2 + n_{targ}n_{proj} \approx n_{stat}^2$ structures where n_{targ} and n_{proj} are the number of target (respectively projectile) states and $n_{stat} = n_{targ} + n_{proj}$ is the total number of basis states. Depending on its complexity, such a structure requires between several hundred bytes and several MB, approximating the average leads to roughly 100 KB. This leads to $10^3 \cdot 10^3 \cdot 10^2$ KB $= 10^2$ GB. Hence, it is obvious that all of the symbolic structure cannot be present on each single core at the same time. It was decided to spread them over several hundred parallel processors and use a column-wise distribution. This structure is illustrated in fig. 4.4.

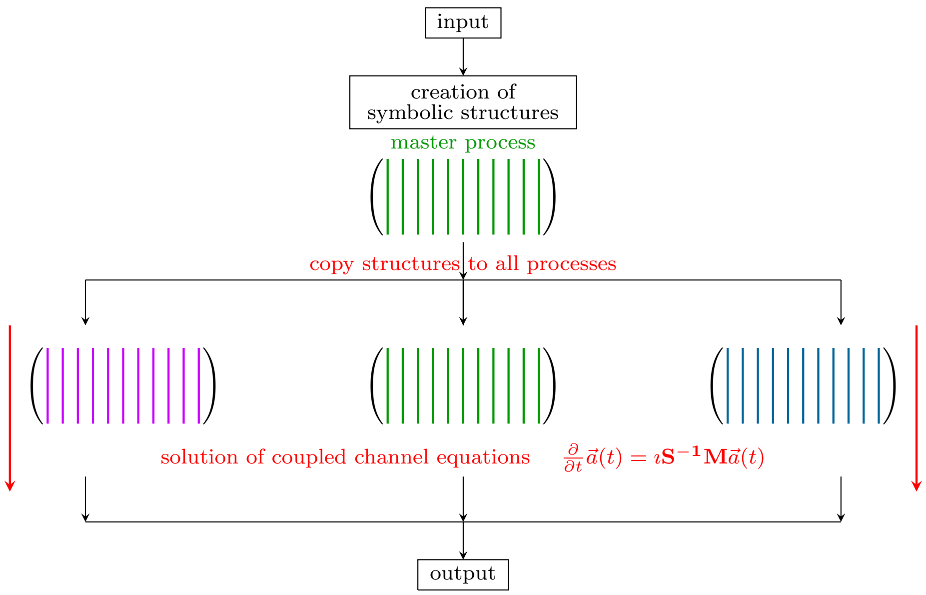


Figure 4.3: Old code structure

Secondly, the time for the calculation of a symbolic structure varies greatly with its complexity which in turn depends on the basis states involved. To reduce idle time an elaborate algorithm featuring an event dispatch loop was implemented that reduces idle times to a minimum. The main processes (rank 0) tells the secondary processes (rank ≥ 1) to calculate the symbolic structure for a specified matrix element. The secondary processes perform the calculation, write a file with the symbolic structure, report back to the distributor main rank, and receive a new assignment. This goes on until all matrix elements have been calculated. Fig.4.5 outlines this method.

Due to the way clusters maintain their job queues, it may be more beneficial to submit more jobs for shorter walltimes. Thus the code offers a possibility to calculate a range of symbolic structures that is specified in the input file.

Lastly, for large systems the calculation of an effective matrix $\mathbf{M_{eff}}$ might take quite a long time. Integrating over the trajectory on a mesh of about 400 points is very likely to exceed possible walltime limits. Also a single matrix needs approximately 16 MB. Storing the matrices in memory would thus exceed the available space easily. But according to detailed balance [71], the overlap matrix $\mathbf{S}$ and the coupling matrix $\mathbf{M}$ at $+r$ and $-r$ are linked by the following formula:

$$M_{ij}(-r) = (-1)^{\ell_i+m_i+\ell_j+m_j} M_{ij}(+r) \qquad S_{ij}(-r) = (-1)^{\ell_i+m_i+\ell_j+m_j} S_{ij}(+r). \tag{4.15}$$

Thus, the matrices at two mesh points (almost) can be calculated for the "price" of one. To exploit this formula, the matrices need to be stored in files and read in later when integrating the coupled channel equations (3.20). Additionally, the trajectory can now be split in smaller chunks and submit several job with shorter walltimes at once.

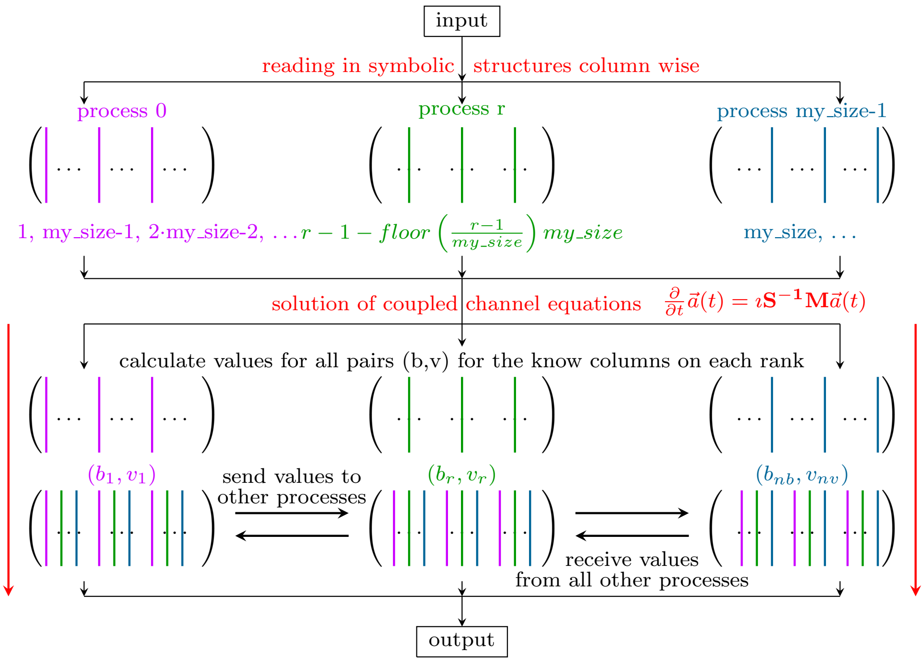


Figure 4.4: Parallelization of the calculation of the matrices along the trajectory and of the integration of the coupled channel equations (3.20). For the former, each process reads in the symbolic structures for certain, assigned columns and calculates the values of said columns for all possible pairs (b,v). For the latter, each process is assigned a pair of (b_i, v_j) for which it integrates the differential equations over the trajectory. If the total number of processes involved (`my_size`) is larger than $n_v n_b$ then the processes with rank $\geq n_v n_b$ only calculate the values of the matrix elements in their assigned columns, but do not integrate the differential equations.

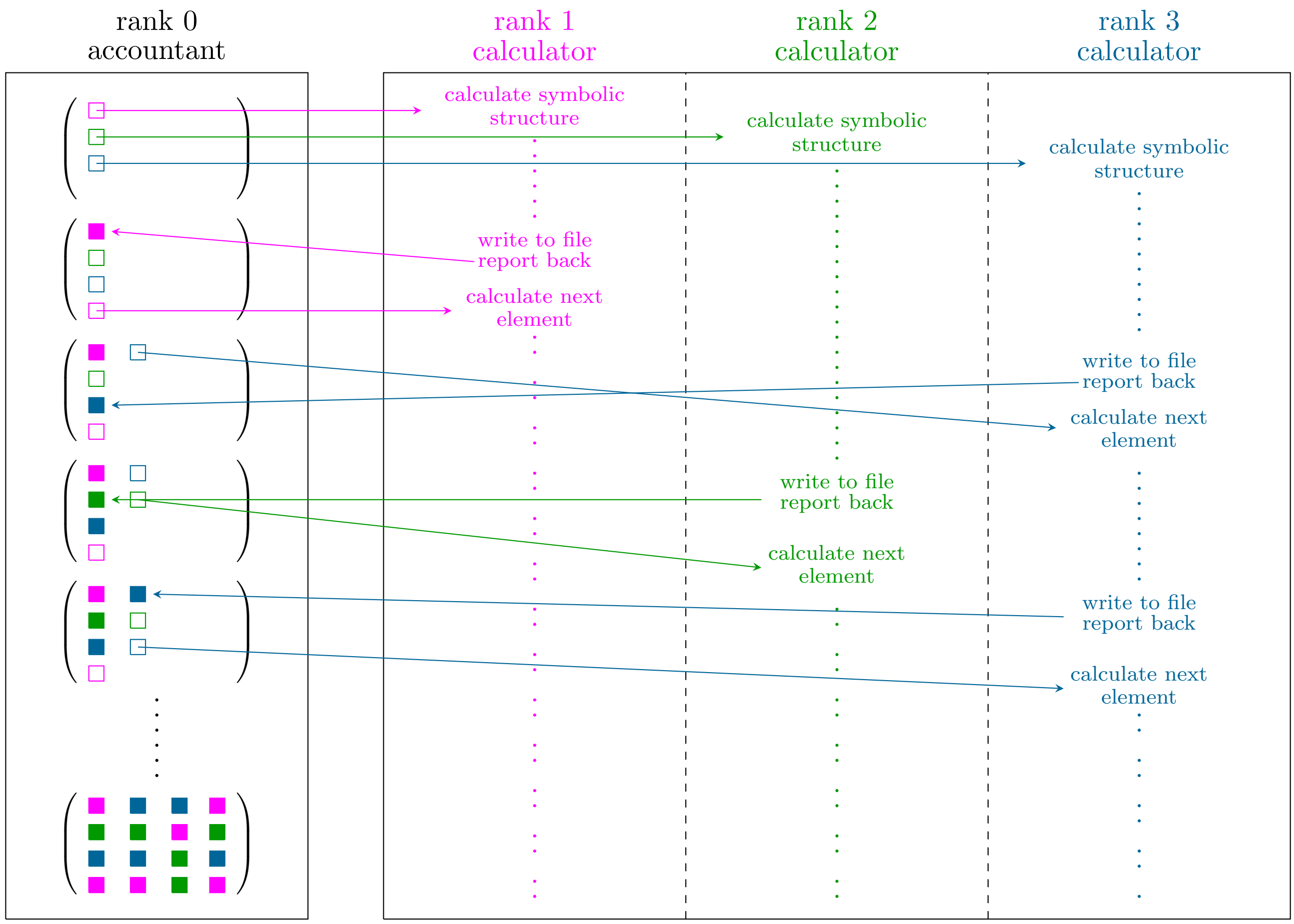


Figure 4.5: Parallelization of the creation of the symbolic structures outlined on the example of 4 parallel processes and a 4x4 matrix. The master rank (`rank 0`) serves as an accountant running through an event dispatch loop. The remaining three processes (`rank 1, 2, 3`) calculate the symbolic structures for elements they have been assigned by the master rank. This parallelization scheme minimizes idle times.

And who picks up the pieces
Every time two fools collide
Kenny Rogers & Dottie West -
Every Time Two Fools Collide

Chapter 5

Results

This chapter starts off with explaining the general procedure in treating ion-atom collisions with AOCC. This is followed by the detailed analysis of several fusion-relevant collision systems. The section of the first and lightest of these systems, Be^{4+} + H($n = 1, 2$) features a convergence study. Similar studies were also performed for the other systems, but are not shown.

The data presented in the following sections can also be found in data tables in the appendix section A.

5.1 Analysis of Total, State Selective & Emission Cross Sections

The modus operandi which was followed in the studies in this chapter yield cross sections primarily for ground state hydrogen with fully stripped impurity ions A^{q+}

$$A^{q+} + H(1s) \rightarrow A^{(q-1)+}(n\ell) + H^+ \tag{5.1}$$

as well as the first excited metastable state H(2s) which makes up a certain fraction of the neutral hydrogen beam in nuclear fusion experiments

$$A^{q+} + H(2s) \rightarrow A^{(q-1)+}(n\ell) + H^+ \tag{5.2}$$

Through collisions with plasma particles the original H(2s) population is statistically redistributed within the H($n = 2$) shell. Thus collisions of H(2p) with the impurity ion have to be taken into account as well:

$$A^{q+} + H(2p) \rightarrow A^{(q-1)+}(n\ell) + H^+ \tag{5.3}$$

The partial $2\ell(m_\ell)$ cross sections then have been added according to their statistical weight

$$\begin{aligned} \sigma(n=2) &= \tfrac{1}{4}\sigma(2s) + \tfrac{3}{4}\sigma(2p) = \\ &= \tfrac{1}{4}\sigma(2s) + \tfrac{1}{4}\left(\sigma(2p0) + \sigma(2p1) + \sigma(2p\text{-}1)\right). \end{aligned} \tag{5.4}$$

in order to get the cross section for

$$A^{q+} + H(n=2) \rightarrow A^{(q-1)+}(n\ell) + H^{+} \tag{5.5}$$

in a fusion plasma.

To achieve convergence and avoid overly large basis sets, it is favorable to get a rough idea which and how many channels would be necessary to include. The major capture channel can be estimated using the COBM [4]

$$n^{*} \leq q\left[2I_t\left(\frac{q-1}{2\sqrt{q}+1}+1\right)\right]^{-\frac{1}{2}} \tag{5.6}$$

Additionally, it is necessary - since the data are intended for CXRS - that emission lines in the visible range (and thus most suitable for fibreoptics and CCD cameras) are included. Applying the Rydberg formula yields

$$\frac{1}{\lambda} = R_H \cdot Z^2 \cdot \left(\frac{1}{n_j^2} - \frac{1}{n_i^2}\right). \tag{5.7}$$

Knowing the major capture channel and the visible transitions, the basis sets that contain both to a sufficient degree can be built. Now the descriptions of both centers need to be optimzed by adding pseudostates to implement the continuum, i.e. ionization channels. These pseudostates are not "physical states" associated with a direct interpretation like atomic orbital, but they are needed to describe the continuum [5].

After having optimized the basis sets as well as the impact parameter mesh and other numerical parameters, full calculations could be run. But, the resulting cross sections $\sigma^{CX}(n\ell)$ are not the ones that are actually observed by spectroscopic diagnostics of fusion plasma. Thus, emission cross sections for the observed lines in the $A^{(q-1)+}$ spectrum need to be calculated on the basis of the previously calculated cross sections.

The emission cross section for a transition $n_i \rightarrow n_f$ is given by

$$\sigma^{emi}_{n_i\rightarrow n_f} = \sum_{\ell_i,\ell_f} \sigma^{emi}_{n_i\ell_i\rightarrow n_f\ell_f} = \sum_{\ell_i,\ell_f}\sum_{n\geq n_i}\sum_{\ell=0}^{n-1} c_{n\ell}\sigma_{n\ell} \tag{5.8}$$

where $c_{n\ell}$ is the contribution of the $n\ell$ level to the $n_i\ell_i \rightarrow n_f\ell_f$ transition. These contributions can be calculated recursively via

$$c_{n\ell} = \sum_{n'=n_i}^{n-1}\sum_{\ell'=0}^{n'-1} b_{n\ell\rightarrow n'\ell'} c_{n'\ell'} \left[\delta_{\ell'(\ell-1)} + \delta_{\ell'(\ell+1)}\right] \tag{5.9}$$

$$c_{n_i\ell_i} = b_{n_i\ell_i\rightarrow n_f\ell_f} \tag{5.10}$$

where $b_{n\ell\rightarrow n'\ell'}$ are the branching ratios , which are defined using A_{21}, the Einstein coefficient for spontaneous emission, and the lifetime of the state τ

$$b_{n\ell\rightarrow n'\ell'} = A_{21}(n\ell\rightarrow n'\ell')\tau(n\ell) = \frac{A_{21}(n\ell\rightarrow n'\ell')}{\sum_{\ell'} A_{21}(n\ell\rightarrow n'\ell')} \tag{5.11}$$

The effective emission coefficients q are defined as the emission cross sections averaged over a velocity distribution:

$$q^{eff}_{n_i \to n_f} = \langle \sigma^{emi}_{n_i \to n_f} v \rangle \tag{5.12}$$

In first approximation, the level population can be considered to result only from primary processes, as in this case charge exchange recombination. Additionally, secondary processes like the redistribution of the populations through ℓ-mixing collisions and cascade effects have to be taken into account.

The emission cross sections for these two limiting cases can be derived, i.e. for single- and multi-collisional environments. In both cases, the cascade contributions of the various $n\ell$-levels to the emission line are calculated using (5.10). When considering a multi-collisional environment where the level populations are statistically redistributed, the redistribution must inherently include all cascade contributions to the level in question.

The first case considers a single collision environment and simply uses the $n\ell$-resolved cross sections $\sigma^{singlecoll.}_{n\ell} = \sigma^{AOCC}_{n\ell}$ as calculated by the program, the second estimates a multi-collisional environment and therefore uses a statistical redistribution of the ℓ-level population within a certain n-shell.

$$\sigma^{stat}_{n\ell} = \frac{2\ell+1}{n^2}\sigma_n = \frac{2\ell+1}{n^2}\sum_{\ell}\left(\sigma^{AOCC}_{n\ell} + \sigma^{casc}_{n\ell}\right) \tag{5.13}$$

where $\sigma^{casc}_{n\ell}$ are the cascade contributions to the $n\ell$-level by higher levels.

Since the cross sections calculated in this thesis are to be used in nuclear fusion research, the impact energies (velocities) calculated reflect the requirements given by the experimental setups. The H/D-heating beams at operating small to mid-sized tokamaks are roughly in the energy region of 100 keV but might be as high as 1 MeV in ITER.

For charge exchange processes the relative velocity of the two collisions partners is the decisive quantity. Fusion plasma temperatures do not exceed 20 keV in the center and are much lower in the plasma edge. For heavy impurity ions and H/D atoms from the heating beam the relative velocity will therefore be close to the velocity of the heating beam atoms. Thus the impurity ion can be considered almost at rest. In the frame of the heating beam though, the incident neutral H/D atoms are at rest and the ion is impacting on the atoms. This would also be the case in a laboratory experiment since ions can be accelerated and focussed much easier. But taking into consideration that all collision systems treated are essentially one-electron systems, we can simply define that the ions are the projectiles and the neutral H/D atoms are the targets. In the following energies will be given as " specific energies" in units of keV/amu.

In the AOCC method, only the electron is treated quantum mechanically. It is only influenced by the target and projectile potentials. Thus, there is no distinction made between the different H isotopes. But since the impact energies are given per atomic mass unit, the larger mass of e.g. deuterium is taken into account.

Ionization cross sections can be obtained by adding up the cross sections of all unbound (pseudo)states that are located on the H center. These states are included for the sole purpose of representing the continuum.

5.2 $\mathbf{Be^{4+}}$ + H($n = 1, 2$)

The contents of this chapter have been published in *Journal of Physics B: Atomic, Molecular & Optical Physics* [69].

Beryllium (Be) evaporation has been used at the JET tokamak for wall conditioning. After the 2010 shutdown Be-bulk and Be-coated tiles will be used in the JET main chamber for the first wall and the limiters. Tungsten(W)-bulk and W-coated tiles will be used for the divertor and other main wall/limiter regions which are subjected to heat loads too high for Be. A very similar material mix is also foreseen for the plasma facing components of ITER. Due to high erosion of Be, the influx of Be ions into future plasmas of JET and ITER will be high. Be ions in such plasmas will be abundant and therefore CXRS measurements using Be^{4+} promise a high quality determination of the plasma parameters. In particular, the precise knowledge of the Be ion concentration (or Be^{4+} density profile) is of considerable importance for transport analysis of such tokamak plasmas. The quality of such concentration measurements heavily relies on the accuracy of the underlying atomic data, namely the CX cross sections.

Beryllium itself reveals a number of remarkable features in its spectrum. The diagnostic scope is vast but requires elaborate atomic modeling for its exploitation. Fully stripped Be ions generally occur in a plasma at high temperatures. Through CX with neutral hydrogen isotopes excited $(Be^{3+})^*$ ions are formed, which then deexcite via emission of photons some of which are in the visible spectral region. Setting the viewing lines of the spectrometers detecting this radiation to the plasma centre ensures that they do originate from ions formed through CX and not simply through ionization. The high principal numbers of the active electron support this analysis. [3, 7]

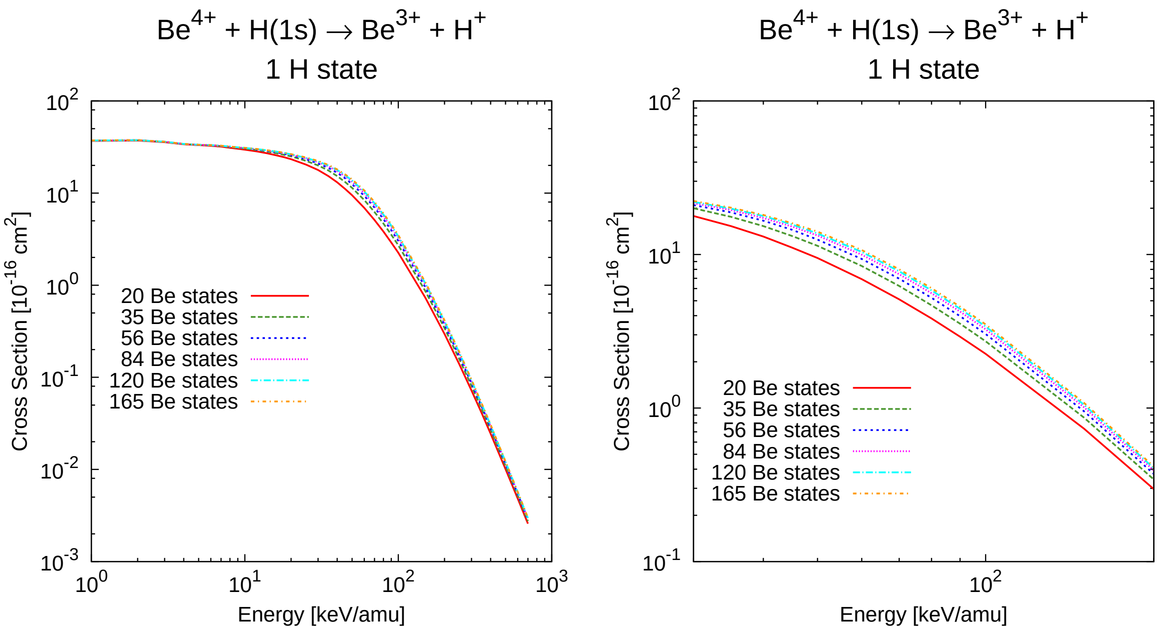
Determination of Optimzed Basis Sets for Total Cross Sections

Fig.5.1 shows a number of calculations employing only one single state on the H centre (H(1s)) and only purely hydrogen-like states on the Be centre. The maximum principal quantum numbers range from $n^{Be}_{max} = 4$, (20 states), to $n^{Be}_{max} = 9$, (165 states). It can be seen that the cross sections converge toward higher n. The difference between $n^{Be}_{max} = 8$ and $n^{Be}_{max} = 9$ is negligibly small so that the additional 45 states are not necessary for good, convergent calculations.

These configurations don't take into account that other processes than CX, i.e. as ionization or excitation, might happen when a fully stripped ion impacts on atomic hydrogen. Thus, ionization and target excitation channels need to be added to the description of the centres. The inclusion of target excitation processes is achieved by adding excited H($n\ell$)- and suitable pseudostates. First, an ideal configuration of the H centre was determined to consist of eight basis states, see Fig.5.2(a). Four pure H states ($|Z; nlm\rangle = |1.0; 100\rangle; |1.0; 200\rangle; |1.0; 210\rangle; |1.0; 211\rangle$) and four pseudostates ($|Z; nlm\rangle = |1.4; 100\rangle; |2.4; 200\rangle; |2.4; 210\rangle; |2.4; 211\rangle$).

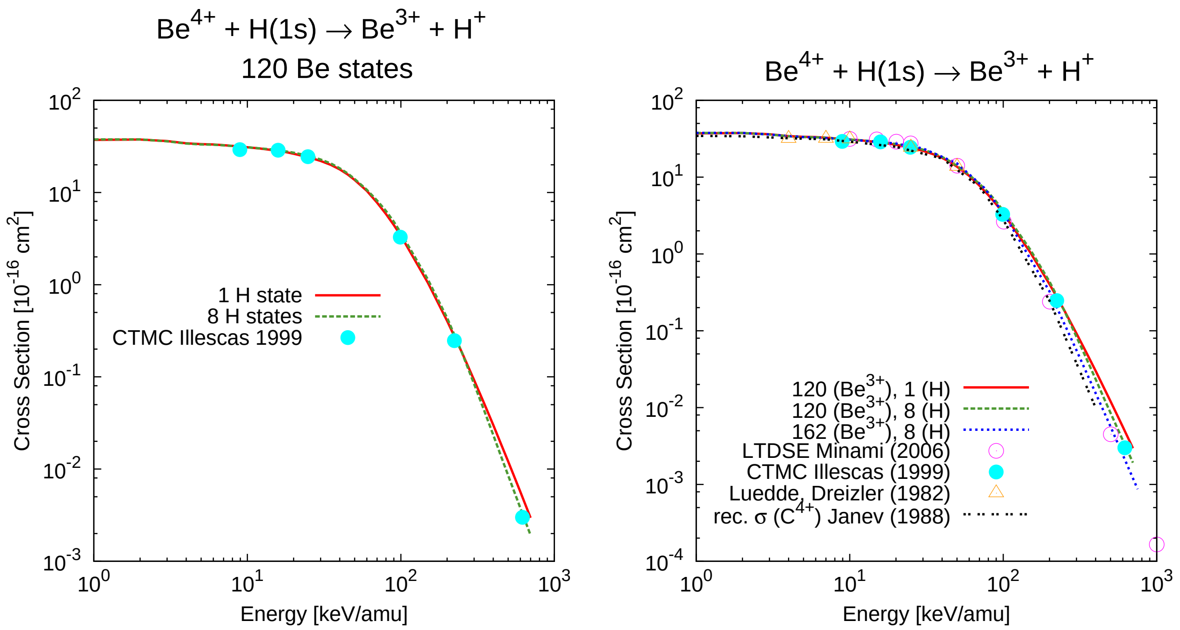
Comparing both calculations with classical trajectory Monte-Carlo (CTMC) calculations from [72] and taking into account that the CTMC description of charge exchange processes is quite accurate at high energies shows that the H centre is indeed better described using this more complex expansion.

Now, to include ionization in the description, a number of unbound or very loosely bound pseudostates were added on the Be centre. These pseudostates are not "physical states" associated with a direct interpretation like atomic orbital, but they are needed to describe the continuum [5]. In this particular case, Slater-type orbitals (STOs), namely united atom states (UA)



(a) (b)

Figure 5.1: Cross sections for charge exchange in Be^{4+} + H(1s) collisions. A comparison is made of various basis sets employing only one single target state (H(1s)) and various numbers of projectile states still omitting pseudo continuum states. (a) Shows the total cross section over the whole energy range (1 - 750 keV/amu) used in our calculations. (b) Shows an enlarged part of (a) of the energy region between 30 - 200 keV/amu.



(a) (b)

Figure 5.2: Charge exchange cross sections for Be^{4+} + H(1s) collisions as a function of the collision energy in units of keV/amu. The figures show the search for the best description of (a) the H centre. 8 basis states consisting of 4 hydrogen states and 4 pseudostates (with Z = 1.4 and Z=2.4) form a very good expansion of the wavefunction of the target atom. For comparison CTMC data from [72] are shown. (b) the Be centre. Calculations applying 120 ($n \leq 8$) and 162 ($n \leq 8$ & UA) are compared. For comparison also data from [73, 72] are shown, as well as the recommended cross section for $C^{4+} - H(1s)$ from [74]

states with $Z = 5.0$, were used. The most ideal configuration of UA states on the Be centre includes 42 states which comprise of full $n = 2$ and $n = 3$ shells, UA(4d) and UA(4f), and principal quantum numbers $5 \leq n \leq 8$ and the highest allowed values of the corresponding azimuthal quantum numbers $\ell = n - 1$.

The inclusion of these 42 UA states on the Be centre, which also include ionization channels with eigen-energies $\varepsilon > 0$, ameliorates the description of the processes on the Be centre significantly, see Fig.5.2(b). Our AOCC calculations are compared with two different theoretical approaches, the already previously mentioned CTMC approach [72] and the lattice, time-dependent Schrödinger equation (LTDSE) approach [73], as well as recommended cross sections for charge exchange between C^{4+} and H(1s) [74]. Fig.5.2(b) compares the total cross sections and it can be seen that our AOCC calculations coincide perfectly with all other approaches at low and medium energies. At energies above 100 keV/amu our calculations lie in between the CTMC and the LTDSE calculations. There is a number of other studies of this collisional system, e.g. [75]. They are not shown in fig.5.2 to keep the plot from overflowing with data points. They generally agree well with our calculations as well as the shown data from [73, 72].

For $H(n = 2)$ as donor atom, it turned out that a few energetically low lying basis states could be removed. The optimized description of the H centre consist of the same 8 basis states as above. On the Be centre, all states with principal quantum numbers $n = 1$ and $n = 2$ were removed. The optimized basis on the Be centre now comprises of 155 states. The impact parameter mesh had to be adapted as well, in particular the mesh was tightened below $b = 3.0$. The initial state was switched to either $H(2s)$, $H(2p0)$, $H(2p1)$, or $H(2p-1)$.

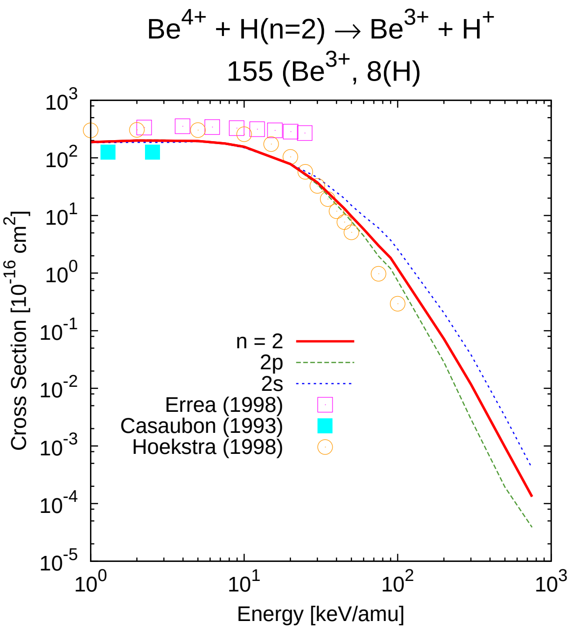
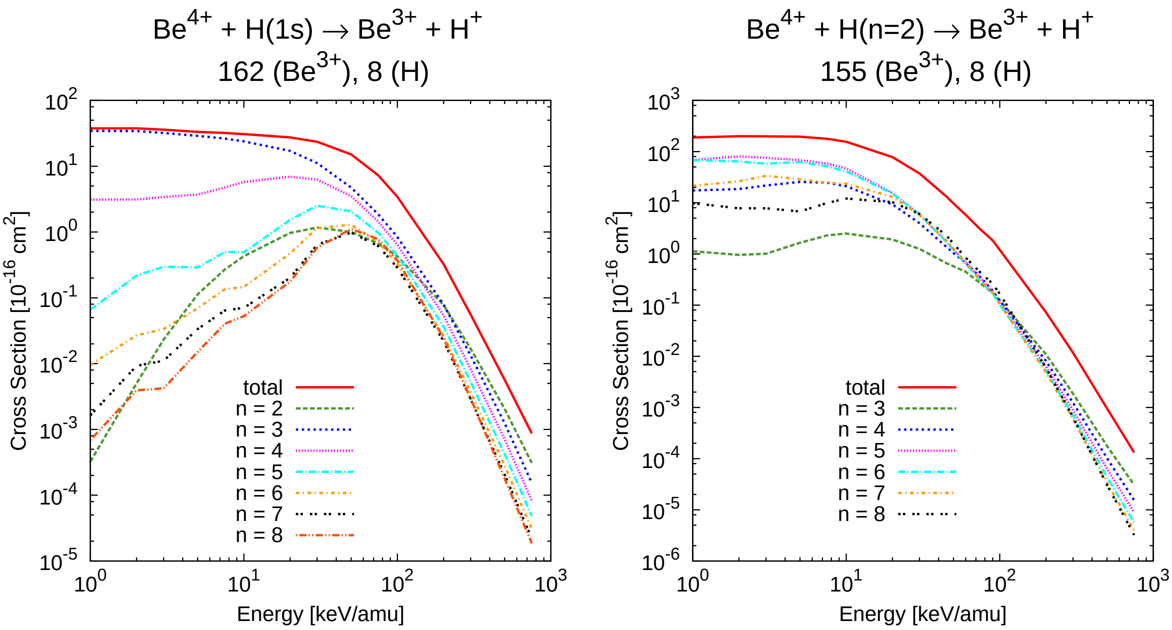


Figure 5.3: Cross sections for Be^{4+} impacting on an excited $H(n = 2)$ target in the energy range (1 - 750 keV/amu). Cross sections of the various subshells are shown as well. For comparison data for $H(n = 2)$ targets of semi-classical calculations using an expansion of wavefunctions into molecular orbitals [76], calculations using the Landau-Zener method [77], and CTMC [78] are shown.

Fig.5.3 shows our results compared to three different theoretical approaches, namely a semiclassical approach using a molecular orbital expansion of the wavefunctions [76], Landau-Zener calculations [77], and CTMC [78]. The different theoretical approaches differ sometimes quite profoundly. The complexity of all sorts of calculations involving the $n = 2$ shell of the hydrogen atom and considering the highly excited main capture channel ($Be^{3+}(n = 5)$) makes the observed deviations between the approaches not overly surprising. The molecular expansion of [76], which results in larger cross is expected to be more suitable in lower energy ranges. Our calculations roughly follow the CTMC calculations by [78]. Deviations also may result from the averaging over the initial states needed for the $H(n = 2)$ target.

State Selective Cross sections

Fig.5.4 compares the n-resolved cross sections, see eq.(3.24). At energies below 50 keV/amu capture from H(1s) into $Be^{3+}(n = 3)$ is most prominent, followed by capture into the $n = 4$ and $n = 5$ shells. Capture from $H(n = 2)$ into $Be^{3+}(n = 5)$ is most prominent, followed by capture into the $n = 6$ and $n = 7$ shells. Towards high impact energies the population of final n-shells follows more and more the well-known $1/n^3$ distribution [79].



(a) (b)

Figure 5.4: Comparison of n resolved cross sections (a) for a H(1s) target applying an expansion which uses 8 basis states on the H centre and 162 basis states on the Be centre and (b) for a $H(n = 2)$ target applying 8 basis states on the H centre and 155 basis states on the Be centre.

The wavelength of two transitions in the Be^{3+} spectrum ($6 \rightarrow 5$ and $8 \rightarrow 6$) are in the visible range and thus most convenient for CXRS from an experimental point of view, e.g. suitability for fiber optics.

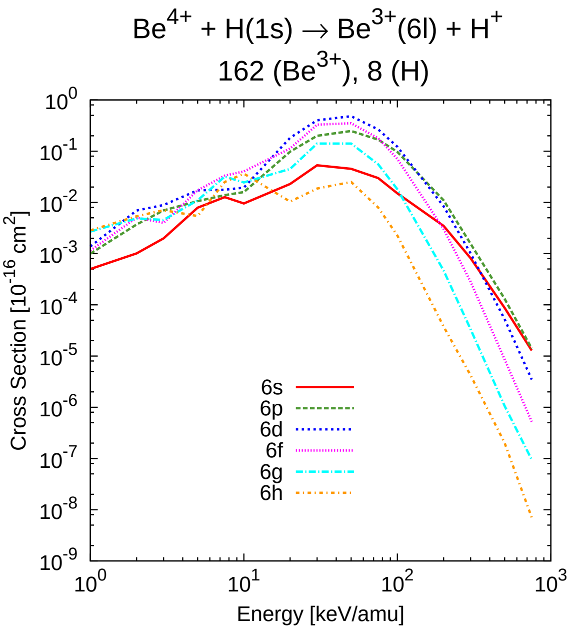
Now, we take a closer look at the state-selective cross sections $\sigma(n = 6)$ and $\sigma(n = 8)$ in terms of $n\ell$-resolved cross sections. For Be^{4+} + H(1s) collisions, the cross sections show very similar characteristics, see fig.5.5(a) and fig.5.5(b). The maximum is mostly located around $30 - 50$ keV/amu. The cross sections for capture into $\ell = 2$ (d-shell) are most prominent both for $n = 6$ and $n = 8$ around the peak between 20 keV/amu and 100 keV/amu.

For impact on H($n = 2$), see fig.5.5(c) and fig.5.5(d), the characteristics are not as prominent as for the H(1s) target. It can be seen though, that the capture cross sections are larger by up to an order of magnitude.

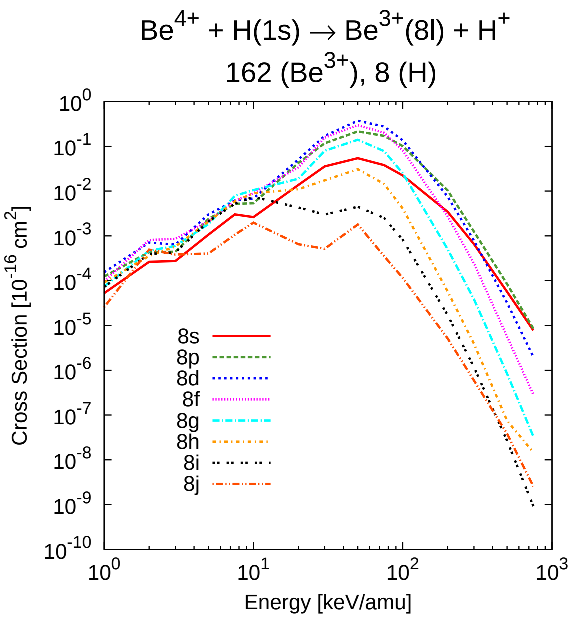
Emission Cross Sections & Effective Emission Coefficients

Fig.5.6 compares the effective emission coefficients, see section 5.1, of the various visible spectral lines for both scenarios, the single-collision environment of cold plasmas and the multi-colissional environment of hot plasmas, and also with data for the $6 \to 5$ line on the basis of a CTMC treatment of the collision [78] and with data from [80]. Figs.5.6(a) and 5.6(b) treat a H(1s) target, whereas figs.5.6(c) and 5.6(d) use H($n = 2$) as target atom. Between 20 keV/amu and 100 keV/amu, our estimation of the $6 \to 5$ line (H(1s) donor) in a single-collision environment agrees quite well with the CTMC based coefficients. For an H($n = 2$) donor the coefficients show a very good agreement between 1 keV/amu and 20 keV/amu.

In Fig. 5.7, the ratios of the emission coefficients in single- and multi-collisional environments are compared with experimental values from JET from [7] and [80]. The agreement between the experimental values and the calculations at hand is satisfactory. It is also evident that the experimental values are very close to the statistical ℓ-distribution which is to be expected since a fusion plasma is a multi-collisional environment.



(a)



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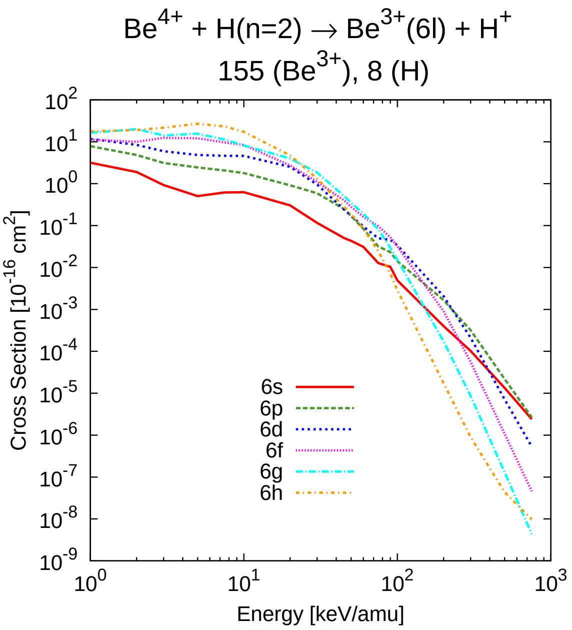
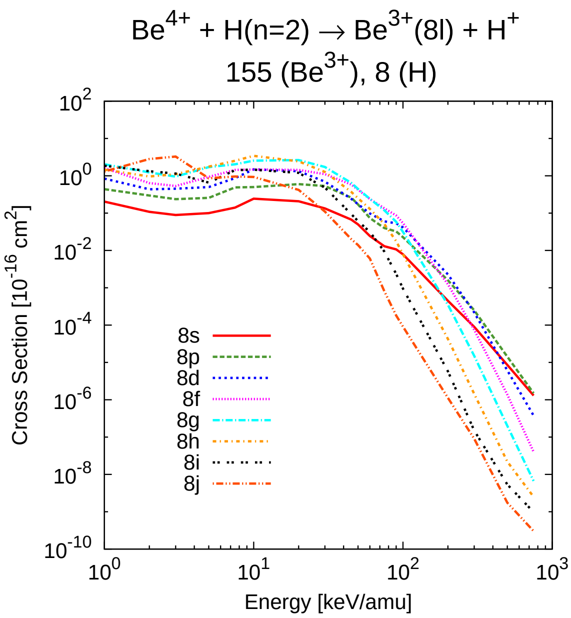


(c)



(d)

Figure 5.5: $n\ell$ resolved cross sections. (a) H(1s) target, $n = 6$ (b) H(1s) target, $n = 8$ (c) H($n = 2$) target, $n = 6$ (d) H($n = 2$) target, $n = 8$

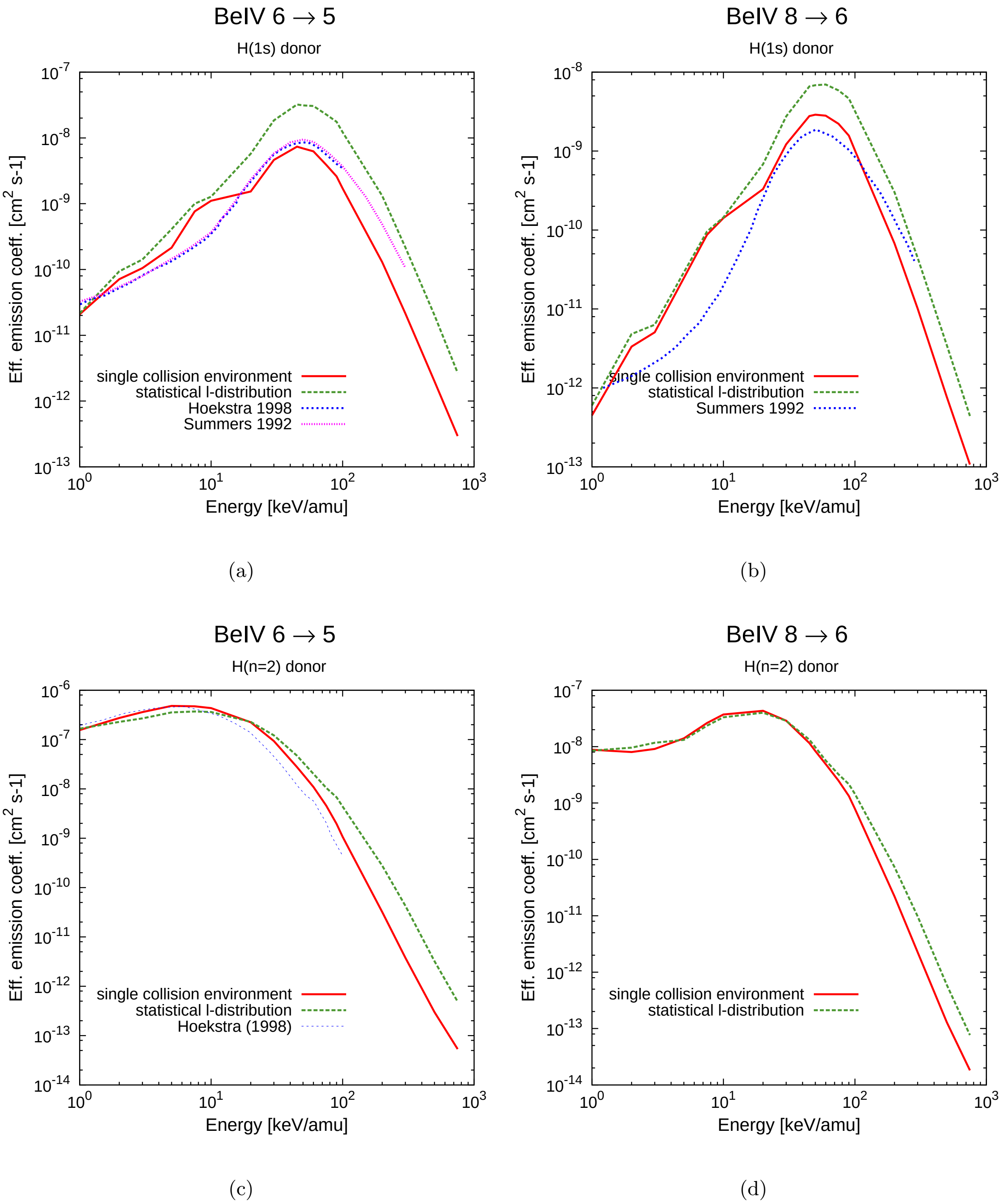


Figure 5.6: Effective emission coefficients of the two major visible lines in the Be^{3+} spectrum calculated from cross sections using the above described optimized descriptions of the collision centres. (a) The 6 → 5 transition for an H(1s) donor. (b) The 8 → 6 transition for an H(1s) donor. (c) The 6 → 5 transition for an $H(n = 2)$ donor. (d) The 8 → 6 transition for an $H(n = 2)$ donor. Our data are compared to data by [78] and [80]

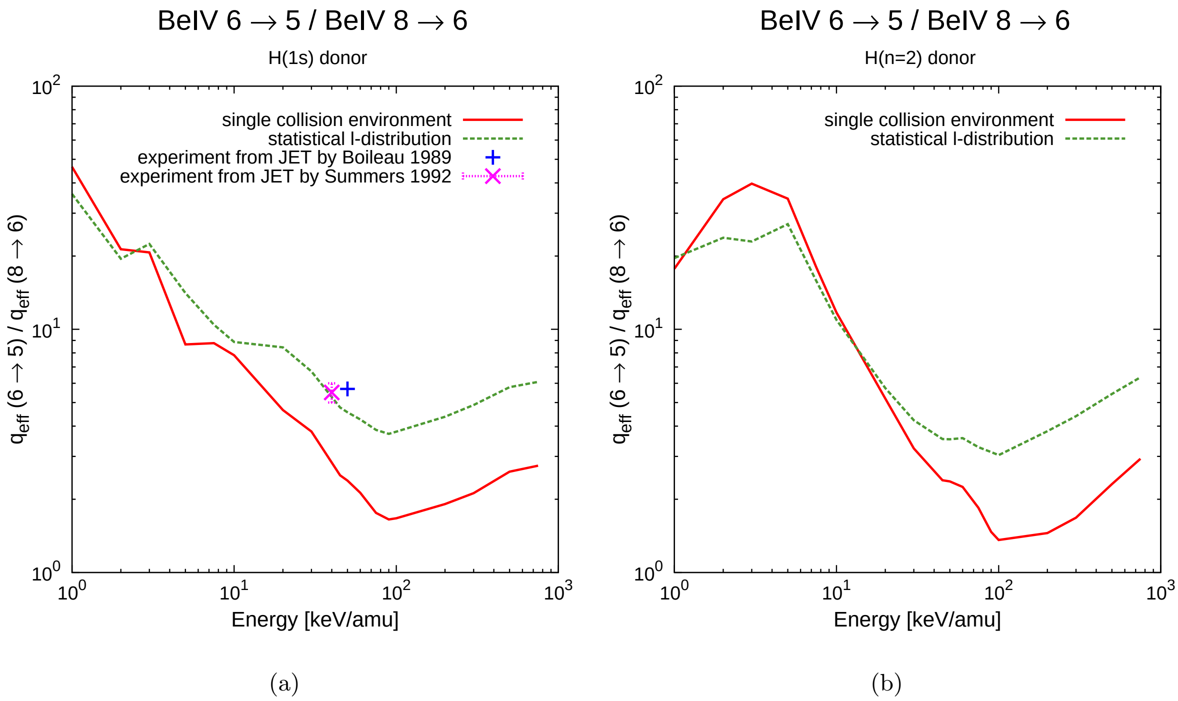


Figure 5.7: The ratio of the 6 → 5 line and the 8 → 6 line are compared for a single collision environment (red), a multi-collisional environment (green). The experimental value from JET by Boileau et al. [7] is marked with a cross and the one from Summers et al. [80] with an x (a) for an H(1s) donor atom. (b) for an H($n = 2$) donor atom.

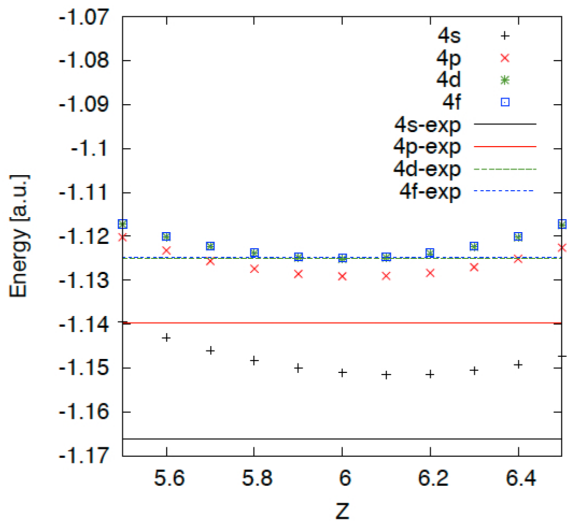


Figure 5.8: Eigenenergies of the bound states of the active electron in the frozen-core potential of N^{6+}, see (5.14) in comparison with experimental values [83].

5.3 C^{6+}+H($n = 1, 2$) and N^{6+} - H($n = 1, 2$)

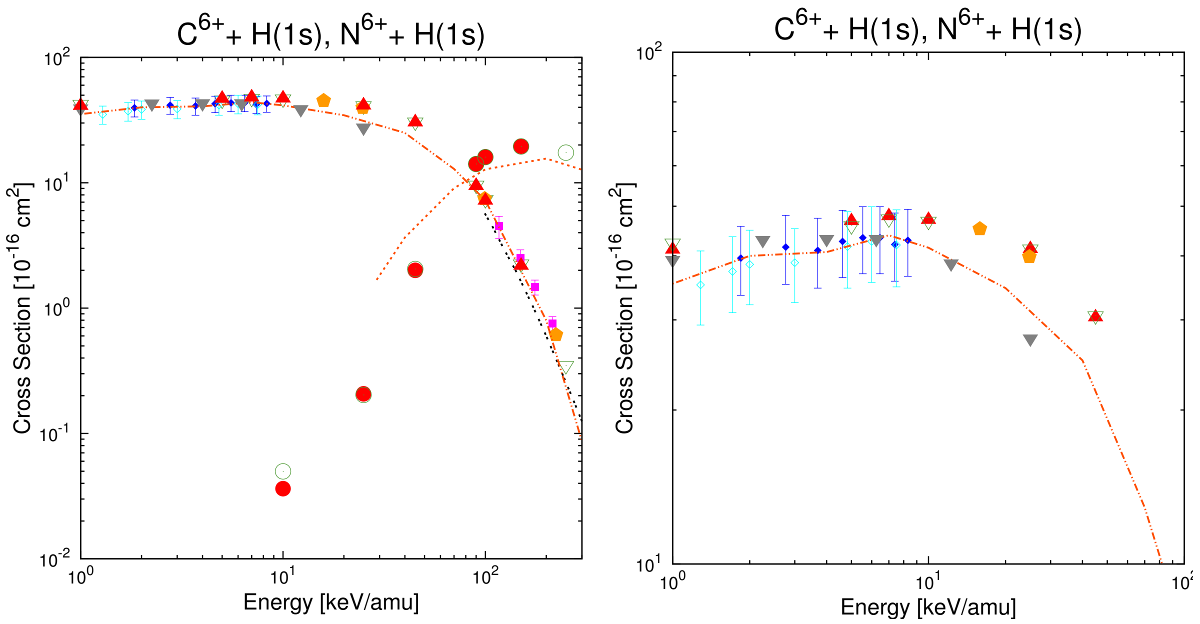
The contents of this section have been submitted for publication to *Journal of Physics B: Atomic, Molecular & Optical Physics*. This section also contains results calculated by Lukas Perneczky in the course of its bachelor thesis [81] and by Edwin Frühwirth in the course of a project work [82]. Both project were jointly supervised by Prof. F. Aumayr and the author at IAP, Vienna University Technology.

For heavier impurities, e.g., noble gas ions, the fractional abundances of ions species other than fully stripped at typical plasma temperatures are non-negligible. In single-electron transfer collisions, the AOCC method treats all passive electrons as perturbations to the potential of the active electron in the respective collision centre. This means that elaborate potentials need to be found resulting in much more complex structures of the matrix elements. It is, nevertheless, a reasonable assumption that the influence of closely bound core electrons on the active electron that captures into very high n-shells is negligible. Therefore a study of C^{6+} + H($n = 1, 2$) in comparison to N^{6+} + H($n = 1, 2$) was conducted. For H(1s) the main capture channel of the active electron is $n = 4$, which is of course much lower than in the case of Ne or Ar. One would therefore expect the difference in the cross sections as a result of the perturbed potential to be more pronounced.

To determine the appropriate pseudopotential the Hartree-Fock method in the frozen-core approximation was used [59]:

$$V^{N^{6+}}(r) = -\frac{6}{r} - \frac{e^{-14r}}{r} - 7e^{-14r} \tag{5.14}$$

Subsequently, the appropriate basis states on the N^{6+} centre had to be determined. Since basis functions with Laguerre-type radial parts were used the Z can be varied to approximate the basis functions on the N^{6+} center. Fig. 5.8 shows the eigenenergies for several possible Z in comparison with spectroscopic data from [83]. The minimum values occur at $Z = 6.1$.



(a) (b)

Figure 5.9: Comparison between C^{6+} + H(1s) (full, red symbols) and N^{6+} + H(1s) (open, green symbols). AOCC data (CX ▲ , ION ● ⨀) are compared to reference data for the former include experimental data [84] (◆ ◇) and [85] (■), CTMC data [72] (⬟), CDW data [86] (-- -- --), recommended cross sections [74] (CX -·-·-·- , ION -----) and AO+ data [54] (▼). (a) Full energy range. (b) Energy range between 1-100 keV/amu

Figs.5.9 & 5.10 show total CX and ION cross sections for both targets (ground and excited state H) and both projectiles (C^{6+}, N^{6+}). The data (for H(1s) targets) are compared to experimental data for both systems from Meyer et al. [84] and for C^{6+} + H(1s) from Goffe et al. [85], as well as AO+ data from Fritsch et al. [54] and CTMC cross sections from Illescas et al. [72]. At low energies, well below 10 keV, there is a certain difference, but when looking at fusion relevant energy regions it becomes obvious that the cross sections for the different impurity ions do not deviate at all anymore.

The same behaviour can be observed in fig.5.11 which shows n-resolved cross sections, i.e. deviations only occur at lower energies. It can be seen that the main capture channel is the $n = 4$ shell for H(1s) targets and the $n = 8$ shell for H($n = 2$) targets. In both cases large deviations only occur at those cross sections that are already very small. It can therefore be safely assumed, that are a large part of these deviations originates from numerical inaccuracies.

Thus, it can be concluded that the inclusion of a closely bound passive electron on the ion neither influences the total nor the n-resolved cross sections, especially for the main capture channel and the higher lying Rydberg states relevant for CXRS.

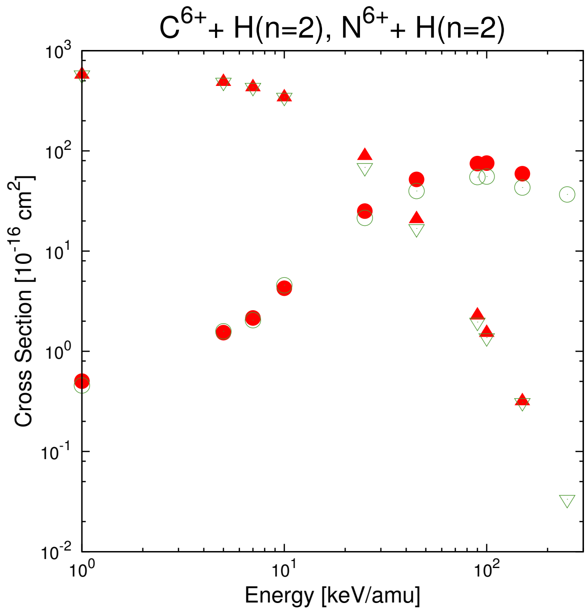
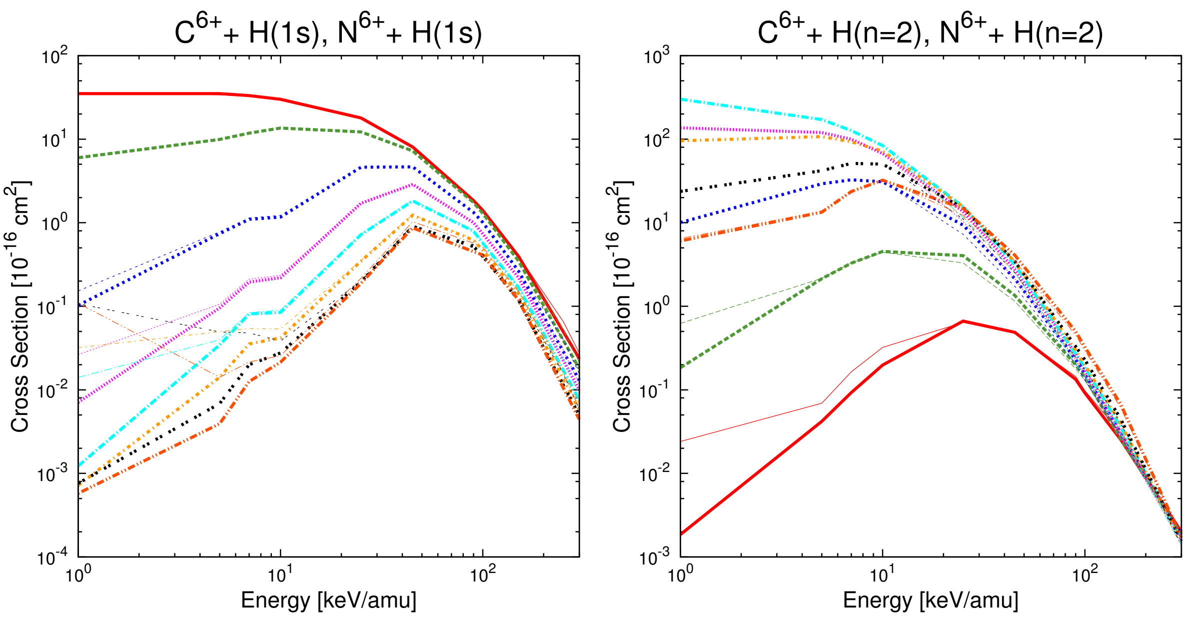


Figure 5.10: Same as fig.5.9 but for an H($n = 2$) target. C^{6+} + H($n = 2$) (full, red symbols) total CX (▲) and ION (●) cross sections are compared those for N^{6+} + H($n = 2$) (open, green symbols) for CX (▽) and ION (⨀).



(a) (b)

Figure 5.11: n-resolved cross sections from AOCC calculations for C^{6+} (thick lines) and N^{6+} (thin lines) projectiles impacting on (a) H(1s). (b) H($n = 2$). In both plots σ_n are shown in the same colors and linestyles: $n = 4$ (red, ———), $n = 5$ (green, - - - - -), $n = 6$ (blue, - - - - -), $n = 7$ (magenta, ··········), $n = 8$ (cyan, –·–·–), $n = 9$ (light orange, -·-·-·), $n = 10$ (black, -- -- --), and $n = 11$ (dark orange, –··–··–).

5.4 $\mathbf{N^{7+}}$ + $\mathbf{H}(n = 1, 2)$

The contents of this chapter have been submitted for publication in *Journal of Physics B: Atomic, Molecular & Optical Physics* alongside the results from the previous section. Also this chapter contains results calculated by Alexander Veiter in the course of its bachelor thesis supervised by Prof. F. Aumayr and the author at IAP, Vienna University Technology [87].

The work on this collision system was mainly motivated by recent experiments at AUG where nitrogen was successfully used as impurity for radiative plasma edge cooling (RPEC), see section 2.2.

For a mid-sized tokamak like AUG it turned out that nitrogen has almost optimal radiation characteristics, because it radiates predominately in the plasma edge. As a positive surprise it turned out that the introduction of N does not only protect plasma facing components, but also improves significantly the performance of discharges [40]. It is therefore now routinely used at high power discharges at AUG. In order to understand this effect better absolute N^{7+} density profiles are required. To obtain these profiles, CXRS is used, see chapter 2 [88].

In this section, no convergence discussion shall be made, the modus operandi for these kinds of studies was described in detail in section 5.2. So this section shall focus on the detailed analysis of a set of calculations with optimized description of the collision centers. This basis consists of

- N^{6+} ($2 \leq n \leq 11$) (285 basis states)
- H($1 \leq n \leq 4$) (20 basis states)
- united atom states (UA) with $2 \leq n \leq 5$ (34 states)

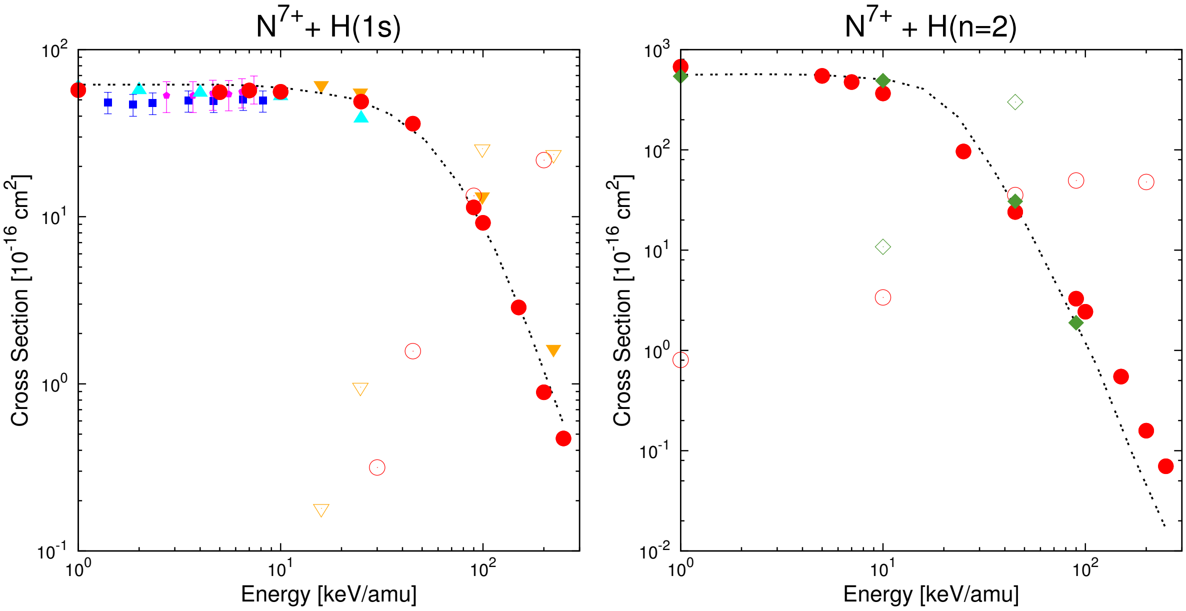
The bound H states and the pseudostates - all unbound - form a 54 state basis for the H center. This basis will be called “H54” from now on.

Total charge exchange and ionization cross sections

Fig.5.12(a) shows total CX and ionization (ION) cross sections for an H(1s) target, fig.5.12(b) for an H($n = 2$) target. The cross section in the latter case is the statistically weighted sum of the cross sections of the four different $n = 2$ symmetries [69]. The present results are compared to AO+ CX cross sections from Fritsch et al. [54] and CTMC results for both CX and ION from Illescas et al. [72]. The total CX cross sections agree well. The slight disagreement between the present AOCC and [54] at E=25 keV/amu very likely originates from computational limitations of the basis size in 1984. For ionisation, the agreement between AOCC, CTMC and [72] is generally good. Especially at high energies where ionisation plays an important antagonistic role (opposed to CX) the agreement is excellent. [70]

State selective cross sections

The n-resolved cross sections, eq.(3.24), are compared in fig.5.13 and 5.14. When capturing from H(1s), the main capture channel ($n = 5$) dominates at lower collision energies. At about 30 − 50 keV/amu capture into higher n-shells shows a maximum, before the capture cross sections decline rapidly showing an $1/n^3$ distribution [69, 79].



(a) (b)

Figure 5.12: Total cross sections for CX (full symbols) and ION (open symbols). (a) H(1s) target . Data presented in this thesis (● ○). For reference purposes, experimental CX data from [84] (■) and [89] (⬟) as well as results from various theoretical approaches are shown: AO+ CX cross sections from [54] (▲), CTMC results for CX from [72] (▼) and [70] (◆), scaled CX data (-- -- --) calculated with ADAS315 [90] and ION from [72] (▽) and [70] (◇). (b) $H(n = 2)$ target.

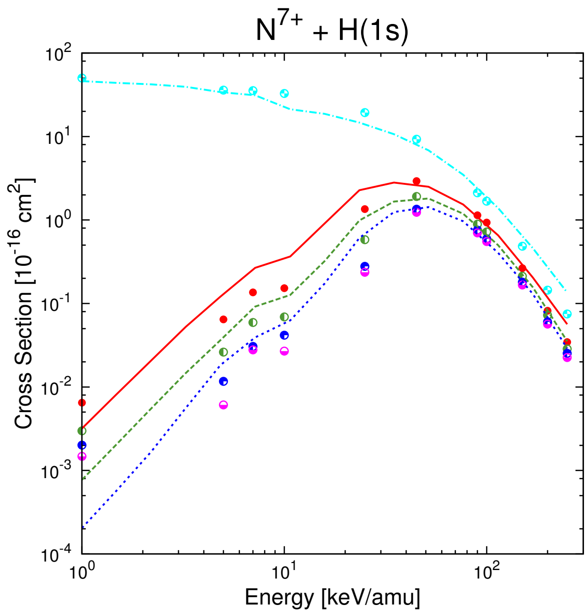


Figure 5.13: n-resolved cross sections for H(1s) target. Circle symbols are used for AOCC data and lines for ADAS315 [90] data. $\sigma(n = 5)$ (cyan, ◕ , -·-·-), $\sigma(n = 8)$ (red, ● , ——), $\sigma(n = 9)$ (green, ◐ , ------) , $\sigma(n = 10)$ (blue, ◕ , - - - -), and $\sigma(n = 11)$ (magenta, ◓ , ········).

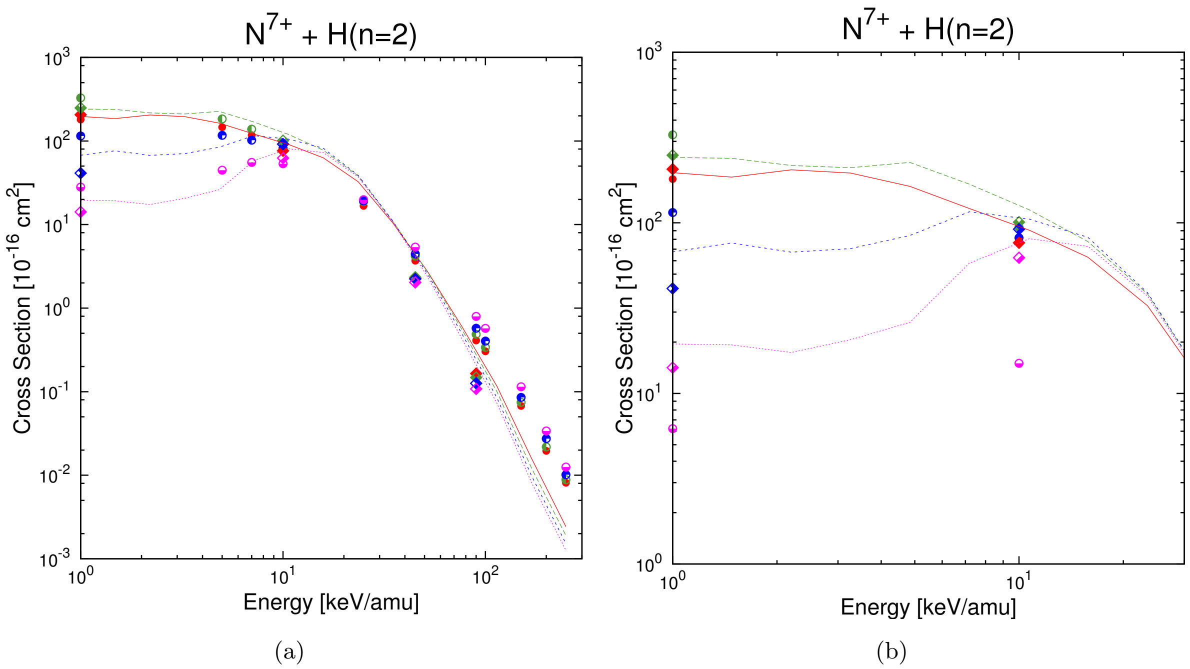
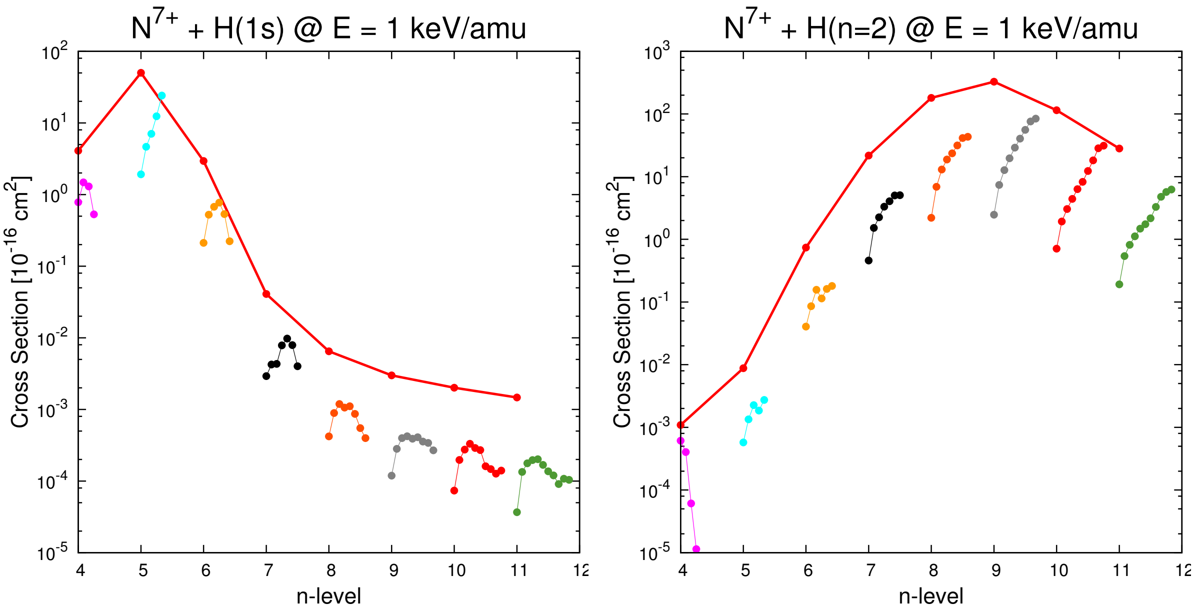


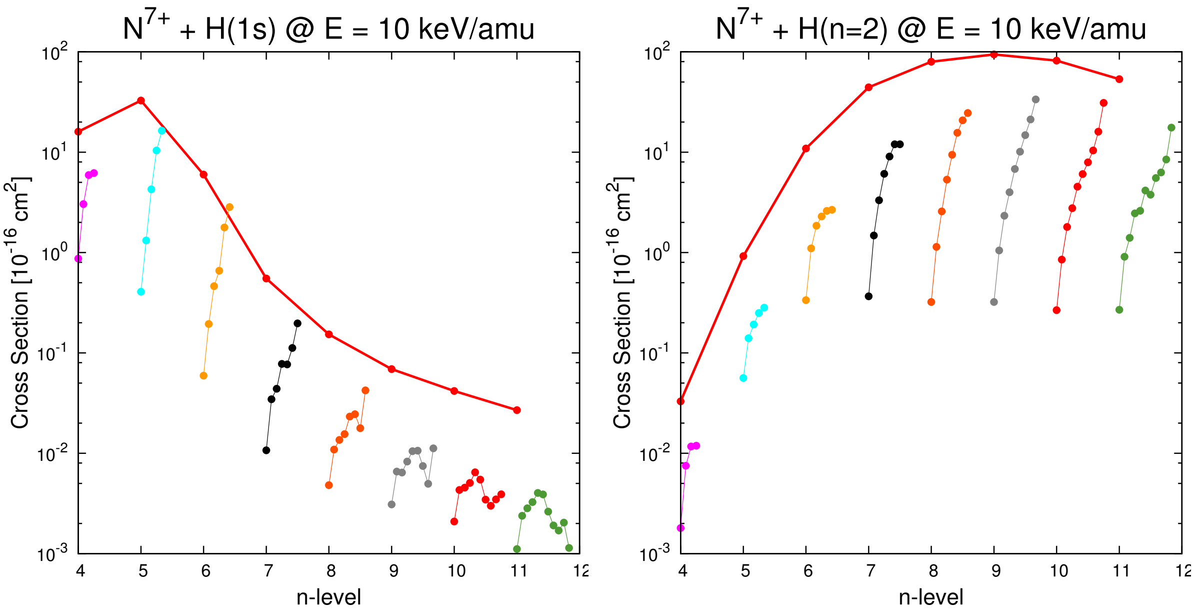
Figure 5.14: n-resolved cross sections for H($n = 2$) target. Circle symbols are used for AOCC data, triangle symbols for CTMC, and lines for ADAS315 [90] data. $\sigma(n = 8)$ (red, ● , ◆ , ——), $\sigma(n = 9)$ (green, ◐ , ◆ , -----) , $\sigma(n = 10)$ (blue, ◕ , ◆ , -----), and $\sigma(n = 11)$ (magenta, ◓ , ◆ , ...) (a) total energy range (b) 1-30 keV/amu

The wavelengths of the respective deexcitation lines, $n_i \to n_f$, can be calculated using Rydberg's formula (5.7). The wavelength of a couple of transitions ($8 \to 7$, $9 \to 8$ and $10 \to 8$) are in the visible range. Figures 5.15, 5.16 and 5.17 show $n\ell$-resolved cross sections for E = 1, 10 and 100 keV/amu. The red curves show n-resolved cross sections as a function of the principal quantum number n. For ground state hydrogen targets the main capture channel at $n = 5$ is very pronounced at E = 1 keV/amu and E = 10 keV/amu, whereas at E = 100 keV/amu the distribution is flatter, but $n = 5$ is still the largest partial cross section. For excited state targets the classical over-barrier model (COBM) yields $n = 9$ as strongest populated shell. This can be seen in figures 5.15(b) & 5.16(b). But the results for E = 100 keV/amu, fig. 5.17(b), show a different behavior. A similar trend can be observed in Be^{4+} + H($n = 2$) collisions, see fig. 5.4, where at impact energies of about 100 keV/amu the largest included n-shell shows the largest capture cross sections. Above ≈ 200 keV/amu the general trend of the n-resolved cross sections follows the $1/n^3$ rule [79]. For C^{6+} and N^{6+} impact on H($n = 2$) the $1/n^3$ rule start to be applicable at ≈ 300 keV/amu, see fig. 5.11. So for N^{7+} + H($n = 2$) the same general trend can be expected at even larger energies.



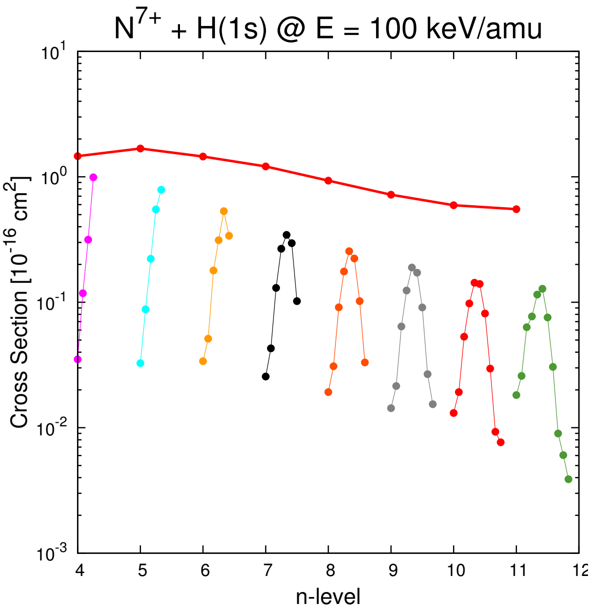
(a) (b)

Figure 5.15: $n\ell$-resolved cross sections for N^{7+} impact on (a) H(1s) and (b) H($n = 2$) collisions at E = 1 keV/amu. The red data on top show the n-resolved cross sections as a function of the principal quantum number n. The differently colored lines below the red line show the $n\ell$-resolved cross sections for the n quantum number indicated on the x-axis, each starting with $\ell = 0$ on the left and ending with $\ell = n - 1$ on the right.

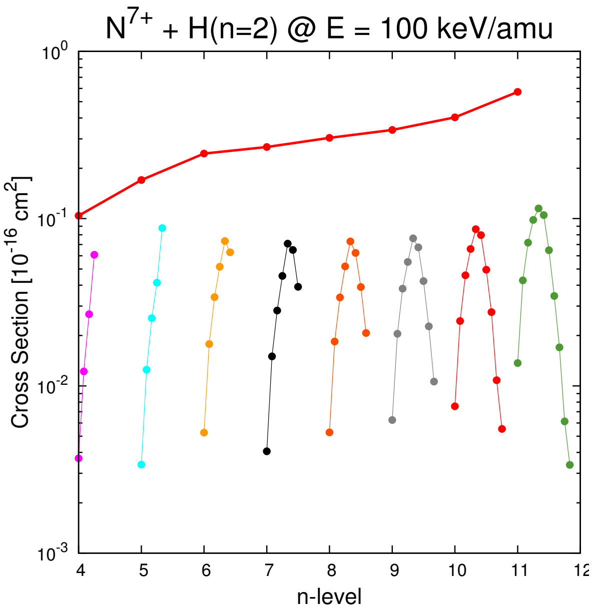


(a) (b)

Figure 5.16: The same as fig.5.15 but for E = 10 keV/amu.



(a)



(b)

Figure 5.17: The same as fig.5.15 but for E = 100 keV/amu.

5.5 $\mathbf{Ne^{q+} + H(n = 1, 2)}$

The results shown in this section have also been discussed in part in Markus Wallerberger's diploma thesis [61] which was supervised jointly by Prof. F. Aumayr and the author at IAP at TU Wien.

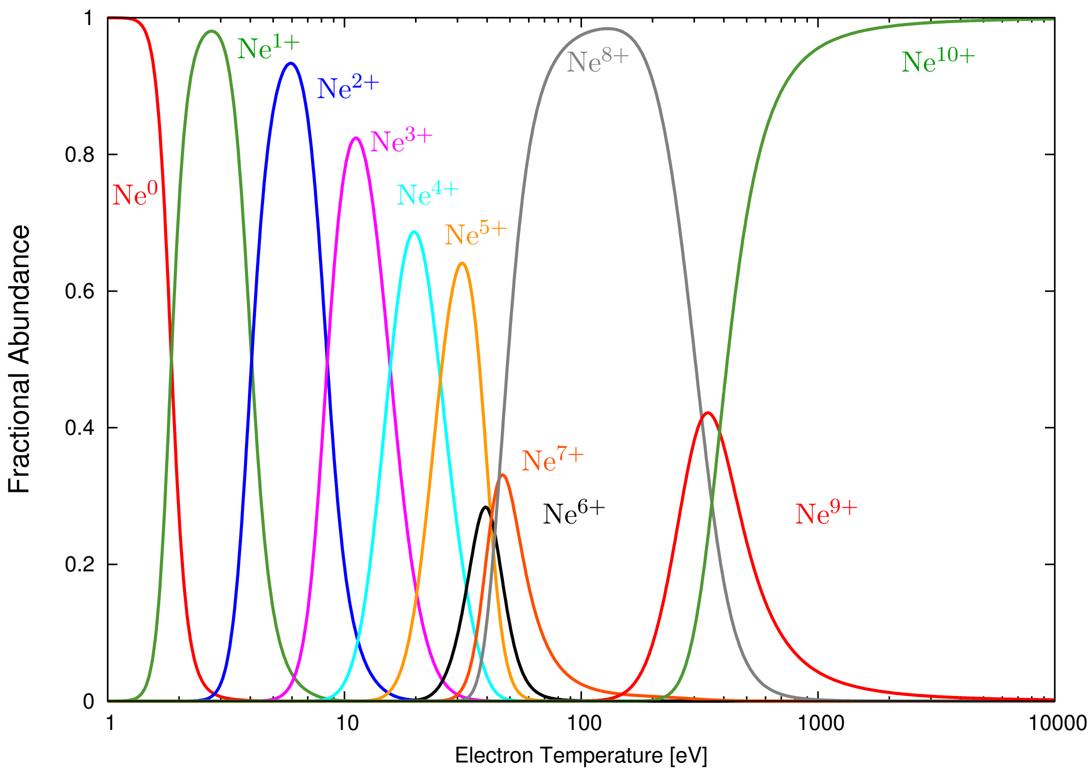


Figure 5.18: Fractional abundances of Neon ions as calculated by ADAS software [17]. Fractional abundances are defined as the ratio of the population of a certain ionization stage over the total population of the element. It can be seen that at plasma temperatures larger than 100 eV only Ne^{8+}, Ne^{9+}, and fully stripped Ne^{10+} show reasonable populations.

Fig. 5.18 shows the fractional abundances of differently charged Neon ions over electron temperature, i.e. the percentage a certain ionization stage has on the total concentration of neon in a plasma of temperature T_e. It can be easily seen that at temperatures prevailing in a hot fusion plasma (E > 100 eV) mainly fully-stripped Ne^{10+} shows significant populations, but also Ne^{9+} and Ne^{8+} can be expected to be present at fusion plasma temperatures and may thus also be used for CXRS. The cross sections in section 5.3 showed clearly that the difference between treating a not fully stripped ion (N^{6+}) and a fully-stripped ion of the same charge (C^{6+}) is negligible. Therefore, instead of calculating Ne^{9+}, F^{9+} will be treated and instead of Ne^{8+}, O^{8+} + H collisions will be looked at. The detailed analysis of calculations using optimized descriptions of the collision centers shall be discussed in the following subsections.

Following fig. 3.2 in section 3.4, the ion centers were chosen to consist of

- $Ne^{9+}(4 \leq n \leq 14)$ (550 basis states)
- $F^{8+}(4 \leq n \leq 13)$ (445 basis states)

- O^{7+}($4 \leq n \leq 12$) (354 basis states)

The two-center elements are much more expensive to calculate. Thus it is always desirable to keep the number of two-center elements as low as possible. To represent the continuum properly and to get good ionization cross sections, all pseudostates were put on the H center. It was shown previously, in sections 5.3 & 5.4, that 54 basis states (20 Laguerre states and 34 pseudostates) form a very good description of the H center. But since the number of states on the ion center rises with n^3, so does the number of basis states when using the same H center description. Subsequently, we tried to lower the number of states necessary to get convergent cross sections. Fig. 5.20 compares calculations of Ne^{10+} + H(1s) with 54 basis states on the H center and with 19 basis states on the H center. It can be clearly seen that the calculations agree very well for CX cross sections. The largest difference can be observed at large impact energies. But the ION cross sections are largely underestimated when using only 19 states on the H center, only 9 of which are unbound pseudostates. This basis expansion will henceforth be called "H19".

To resolve this problem and still be able to use the 19 state H basis, the ionization cross sections can be scaled according to

$$E_{scaled} = \frac{2 \cdot E}{\sqrt{q}} \qquad \sigma_{scaled} = \sqrt{\frac{E}{q}}\,\sigma \qquad \text{for H(1s) target} \tag{5.15}$$

$$E_{scaled} = \frac{E}{q^{4/7}} \qquad \sigma_{scaled} = \sqrt{\alpha E}\,\sigma \qquad \text{for H}(n=2)\text{ target} \tag{5.16}$$

where q is the charge of the incident ion and α is a fitting parameter. For incident F^{9+} ions, this parameter can be determined to be $\alpha_{F^{9+}} = 1.0$, and for O^{8+} ions to be $\alpha_{O^{8+}} = 4.0$. It should be mentioned though that these formulae do not come from physical contemplations. They simply provide an improvement of the calculated ION cross sections. Figures 5.19 show the accordingly scaled ionization cross sections in comparison to the unscaled Ne cross sections using the H54 basis.

The data presented in this section can also be found in the data tables in appendix section A.5. Ne^{10+} + H($n = 1, 2$) are presented in tables A.29 – A.35, F^{9+} + H($n = 1, 2$) in tables A.36 – A.42 and O^{8+} + H($n = 1, 2$) in tables A.43 – A.49.

Figures 5.22 & 5.21 show results for Ne^{10+} impact on H. The hydrogen center is expanded using the previously described H54 basis. At energies below 10 keV/amu the presented AOCC results are compared to experimental data from Meyer et al. [84], as well as two different set of CTMC calculations from Errea et al. [91] and Schmidt et al. [92]. Both of the CTMC calculations compare two different ways of describing the initial wavefunction: a hydrogenic ensemble and a microcanonical ensemble. As argued by Illescas et al. [72], the hydrogenic ensemble yields the better results, as they agree better with molecular-orbital close-coupling (MOCC) and experimental results. This is affirmed for CX by the here presented AOCC calculations. But it can also be seen in fig. 5.22(a) that for ION the here presented cross sections agree better with the microcanonical results from both CTMC sources.

In fig. 5.21 shows n-resolved cross sections for Ne^{10+} ions colliding with different targets. At lower energies (E $\leq$ 10 keV/amu) the partial cross sections into high-lying n-shells when using the H54 basis (fig. 5.21(a)) are slightly elevated. This behavior originates in an intermediate excitation from the incident ground state to higher H states and subsequent capture from these

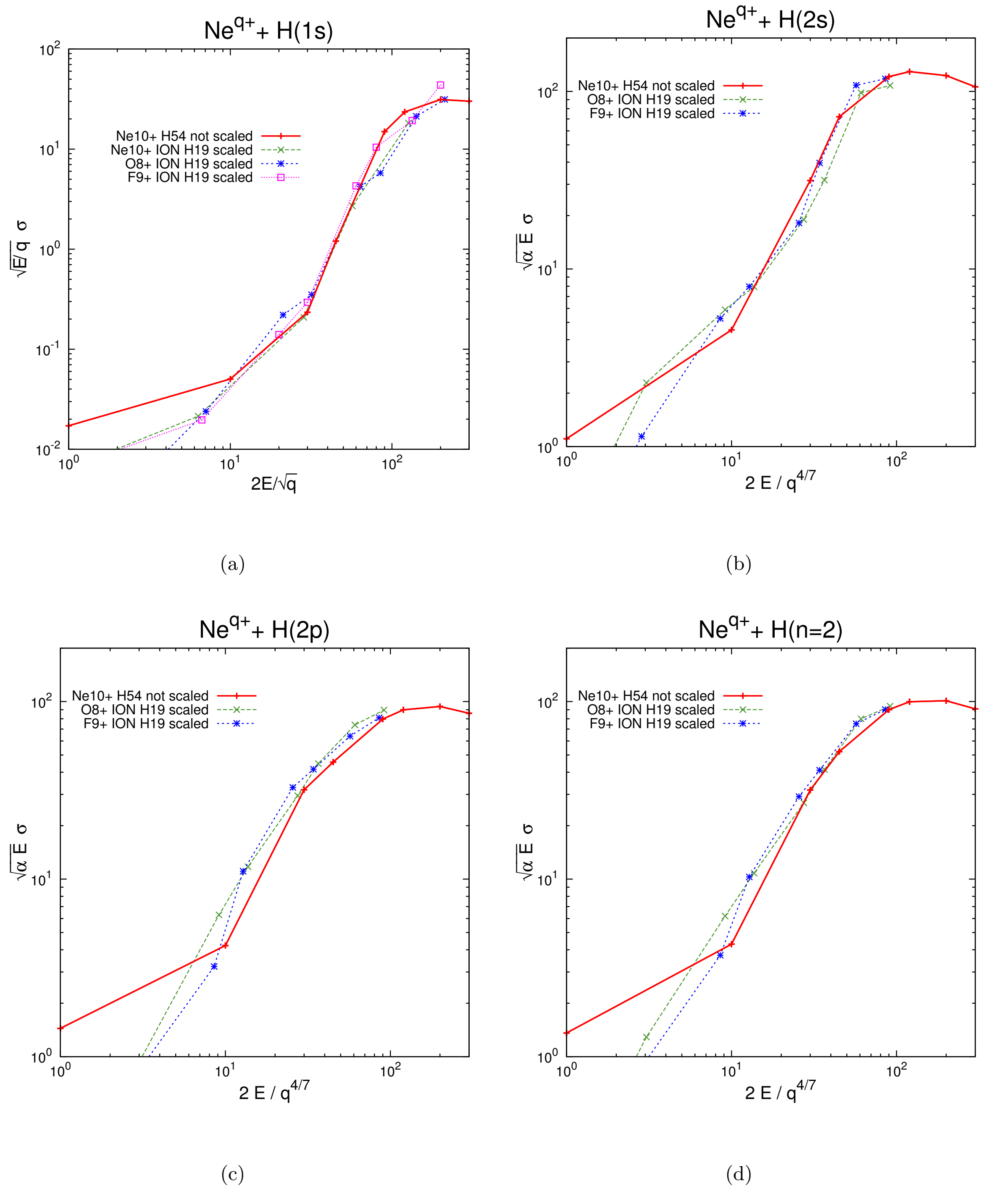


Figure 5.19: Scaling of ION cross sections for incident O^{8+} and F^{9+} ions according to (5.15) and (5.16) in comparison to unscaled ionization cross sections for Ne^{10+} projectiles and for different targets: (a) H(1s), (b) H(2s), (c) H(2p) and (d) H($n = 2$). For the last two targets the cross sections were added up according to (5.4).

states. Capture from excited state H yields a high main capture channel. In the case of Ne^{10+} + H($n = 2$) the $n = 11$ and $n = 12$ shells are populated the most as can be seen in fig. 5.21(b). This leads to an overestimation of capture into $n \geq 11$ from H(1s). This behavior can also be observed in the other ions, F^{9+} and O^{8+}, as can be seen in figures 5.25(a) & 5.25(c).

For four of the eight calculated energies n- and $n\ell$-resolved cross sections are shown in fig. 5.23. The n-resolved cross sections are plotted in red as a function of the principal quantum number n. They all show a maximum at $n = 6$ which is in agreement with COBM. This maximum becomes less pronounced the higher the impact energy is. The differently colored lines below the n-resolved cross sections are $n\ell$-resolved cross sections corresponding to the n quantum number indicated on the abscissa. The start with $\ell = 0$ on the left side and end with $\ell = n - 1$ on the right side. At low energies, e.g. fig. 5.23(a), it can be seen that especially for capture into high n-shells the high ℓ states are populated strongly. For higher and higher energies, this shifts to intermediate ℓ states and at the highest calculated energy, E = 300 keV/amu (fig. 5.23(d)), $\ell = 5$ shows the highest capture cross sections for all $n \geq 6$. $\ell = 5$ is the highest possible angular momentum quantum number for the main capture channel $n = 6$.

The figures in 5.24 show total cross sections for F^{9+} and O^{8+} impacting on ground and excited state hydrogen. They are compared with experimental results from Meyer et al. [84]. Especially in fig. 5.24(a) it can be clearly seen that the difference between Ne^{9+} impact and F^{9+} impact is negligible and thus the chosen approach to only calculate fully stripped ions is justified.

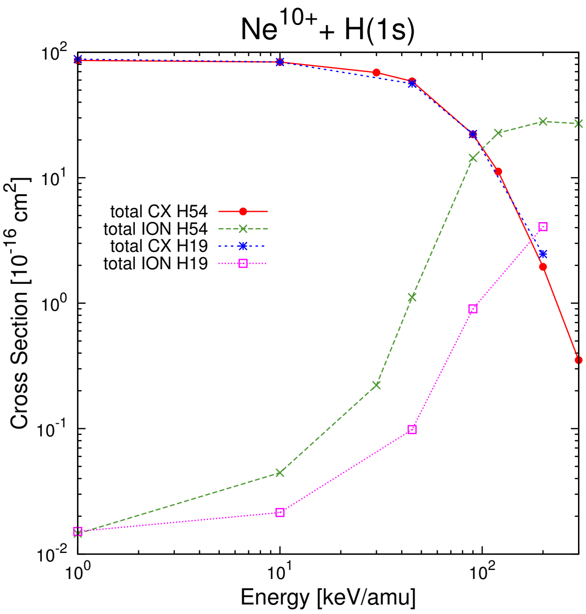
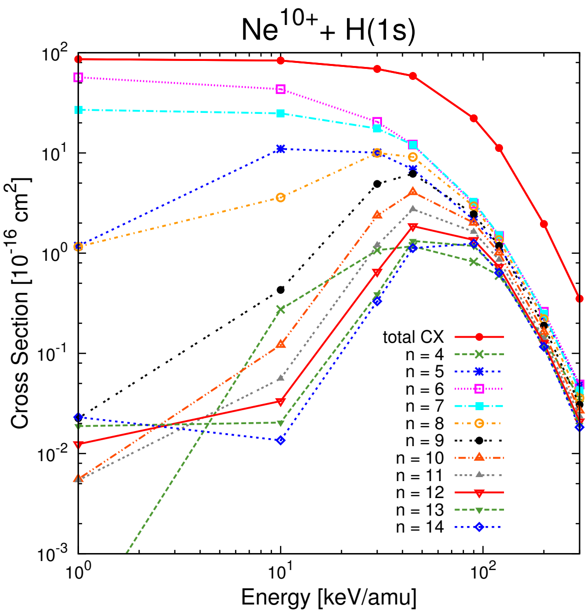
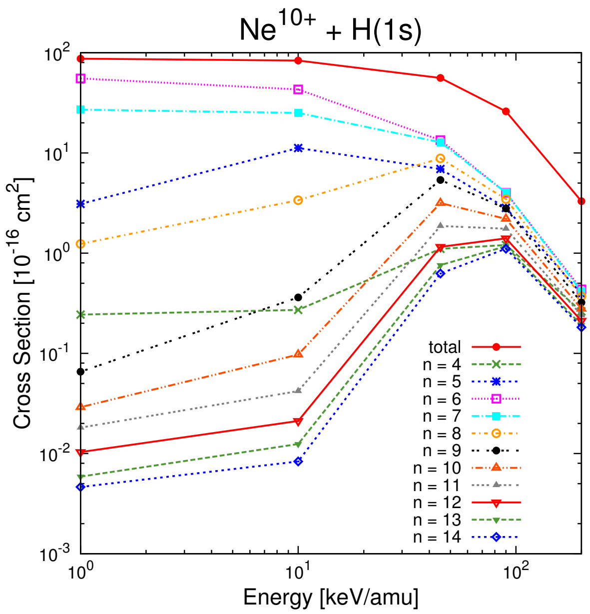


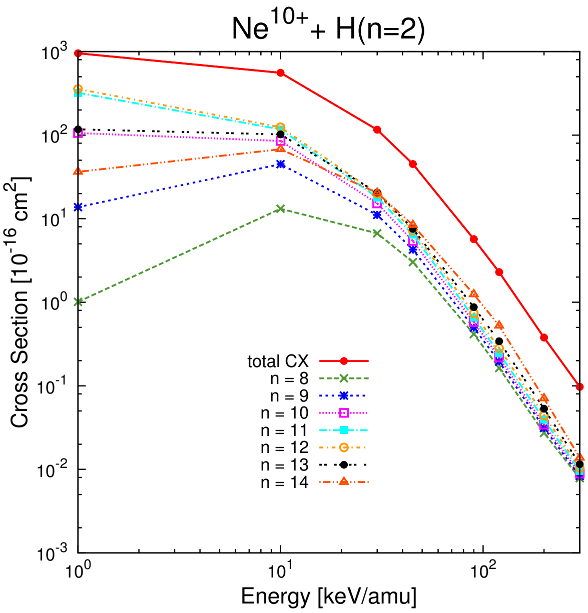
Figure 5.20: Total CX and ION cross sections for Ne^{10+} + H(1s) collisions. Two different descriptions of the H center (both including pseudostate to represent the continuum) are compared. For energies below 100 keV/amu the difference for the CX cross sections is negligible. When looking at the ION cross sections, it is obvious that the pseudostates in the H19 basis do not represent the continuum well enough.



(a)

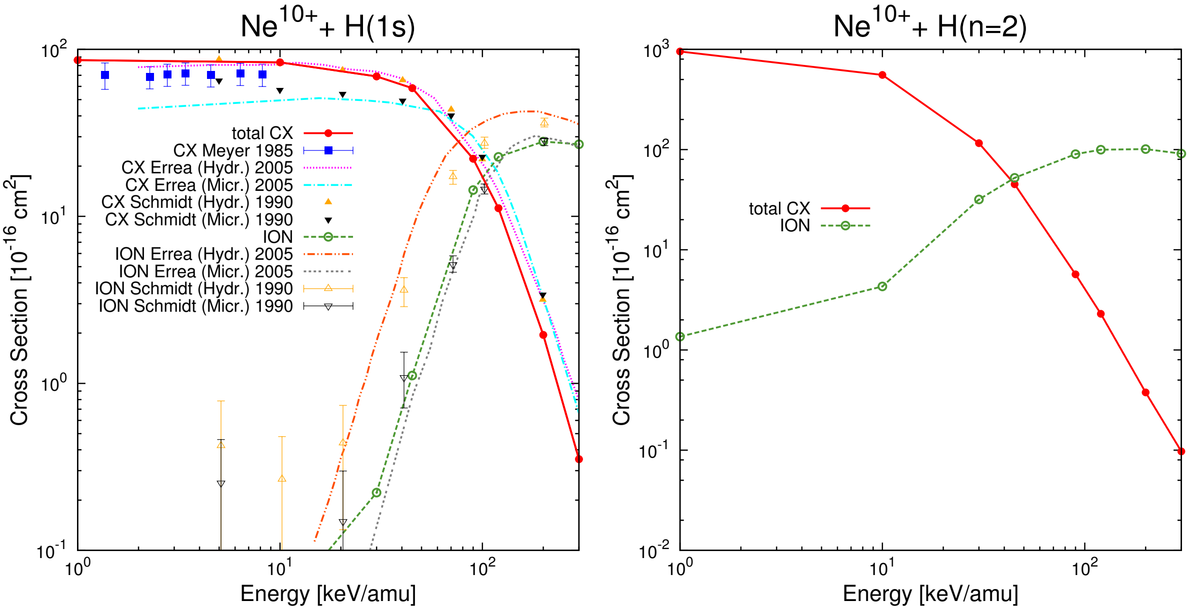


(b)



(c)

Figure 5.21: n-resolved cross sections for Ne^{10+} impact on (a) H(1s) with the H center expanded in a 54-state basis, (b) H(1s) applying only this single state and (c) H($n = 2$) added according to (5.4). For the H(1s) target, capture into high lying Rydberg states ($n \geq 11$) is slightly elevated at low impact energies (E $\leq$ 10 keV/amu). This is a result of an intermediated excitation to H($n = 2$) or higher and subsequent charge transfer from these states. This behavior cannot be observed when removing all excitation and pseudo states.



(a) (b)

Figure 5.22: Total CX (closed symbols) and ION (open symbols) cross sections for Ne^{10+} impact on (a) H(1s) and (b) H($n = 2$). The cross sections are compared to experimental results from Meyer et. al. [84] (■), CTMC calculations from Errea et al. [91] (hydrogenic: ········ (CX) –·–·–·– (ION); microcanonical: –·–·– (CX) ---- ---- (ION)) and Schmidt et al. [92] (hydrogenic: ▲ (CX) △ (ION); microcanonical: ▼ (CX) ▽ (ION)). The cross sections for the excited state target H($n = 2$) are added up according to (5.4).

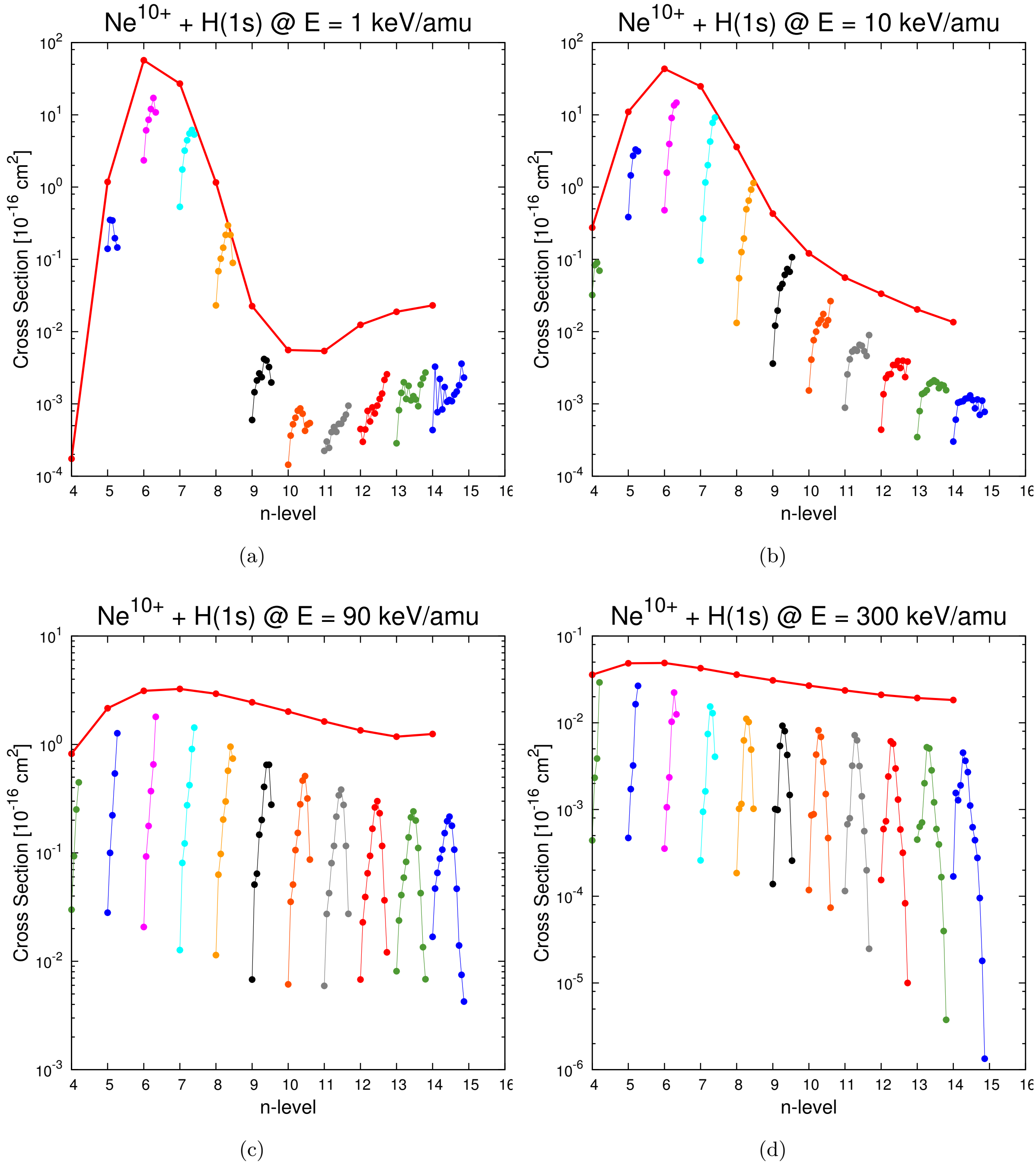


Figure 5.23: $n\ell$-resolved cross sections for Ne^{10+} + H(1s) collisions for selected impact energies. The red data on top show the n-resolved cross sections as a function of the principal quantum number n. The differently colored lines below the red line show the $n\ell$-resolved cross sections for the n quantum number indicated on the x-axis, each starting with $\ell = 0$ on the left and ending with $\ell = n - 1$ on the right.

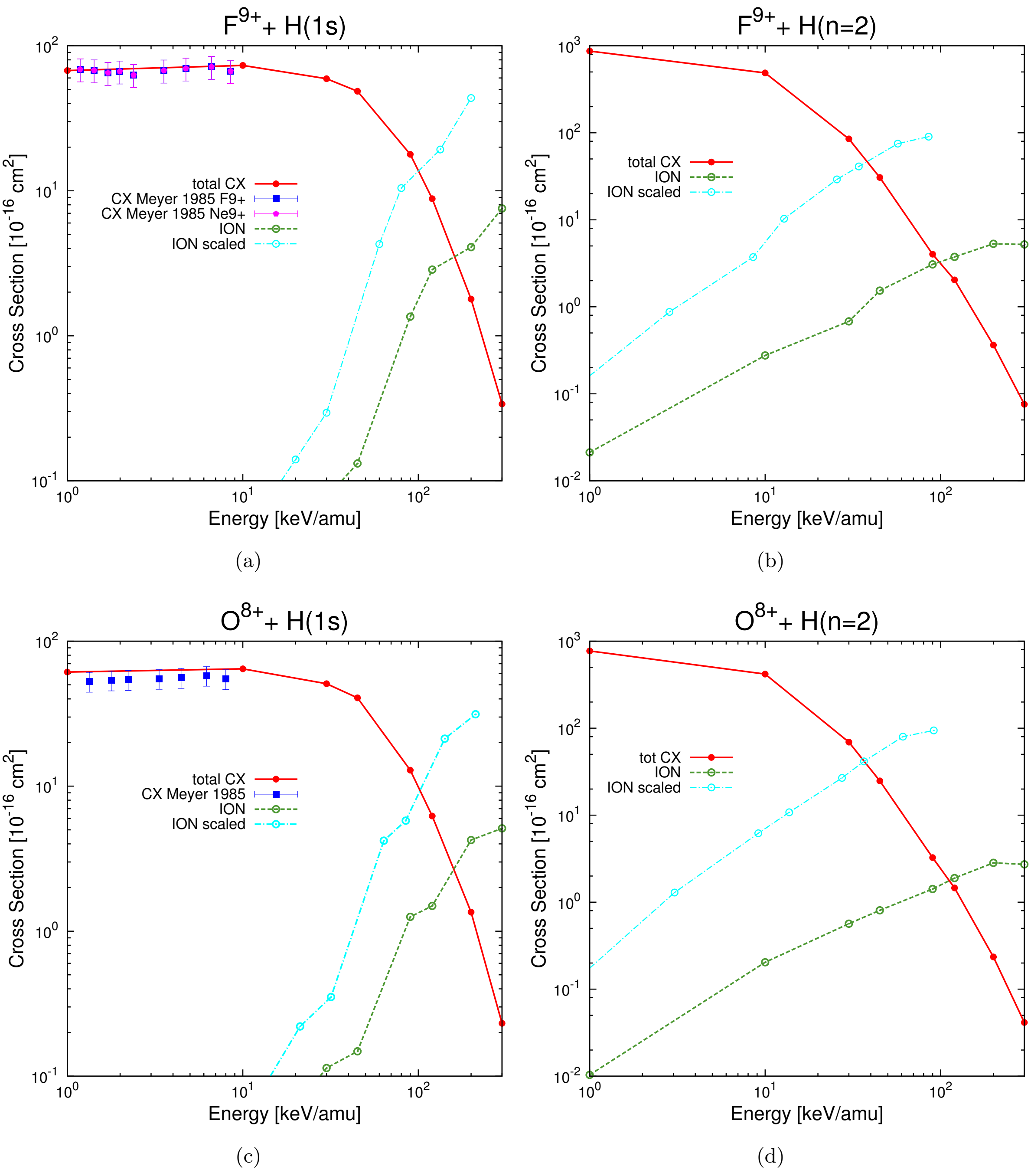


Figure 5.24: Total CX and ION cross sections for F^{9+} and O^{8+} impact on (a) H(1s) and (b) $H(n = 2)$. The cross sections for F^{9+} + H(1s) are compared to experimental results from Meyer et. al. [84] for F^{9+} projectiles (■) and for Ne^{9+} projectiles (⬟). In the case of O^{8+} + H(1s), the presented AOCC results are compared to data from Meyer et al. [84] as well (■).The cross sections for the excited state targets added up according to (5.4) and the ION cross sections are scaled according to (5.15) and (5.16).

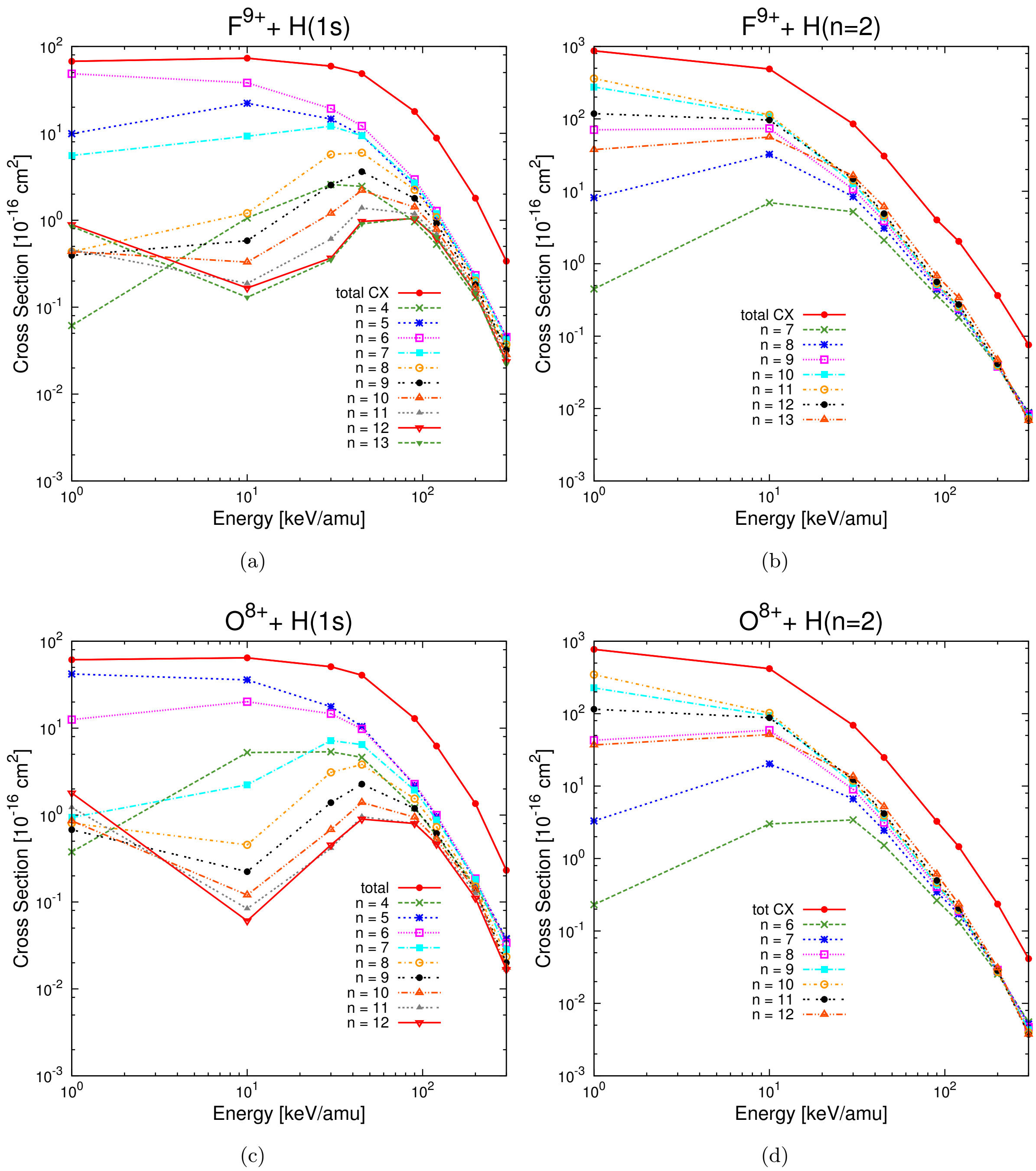


Figure 5.25: n-resolved cross sections for F^{9+} and O^{8+} impact on (a) H(1s) and (b) H($n = 2$) both using 19 basis states on the H center. The cross sections for the excited H target are added up according to (5.4). For the ground state target, a similar behavior at low energies (E $\leq$ 10 keV/amu) can be observed as for Ne^{10+} + H(1s), see fig. 5.21(a).

5.6 Ar^{q+} + H(1s)

The results shown in this section have been accepted for publications in the proceedings of the 17^{th} International Conference on Atomic Processes in Plasmas [93].

As mentioned before, plasma-surface interaction is one of the key problems in the development of the thermonuclear reactor designs and particularly, in the ITER design. To cool the outer plasma especially in the divertor region but also in the remaining vessel, argon will be seeded to reduce the heat load by means of radiative plasma edge cooling (RPEC). [94, 95].

As a first step, it is necessary to define the range of charge states q that are of interest. When neutral Ar is injected into the plasma chamber, it gets more and more ionized. The relative occurrence of certain ionization levels Ar^{q+} is strongly temperature dependent. Described in two extremes: Ar^0 will only occur in a short region very close to the first wall. Conversely only Ar^{18+} will occur in significant numbers in the plasma core where the temperature is the highest. Judging from earlier determinations of the plasma temperature, the ionization levels of interest will lie in the range of $q \in [16, 18]$, see fig. 5.26.

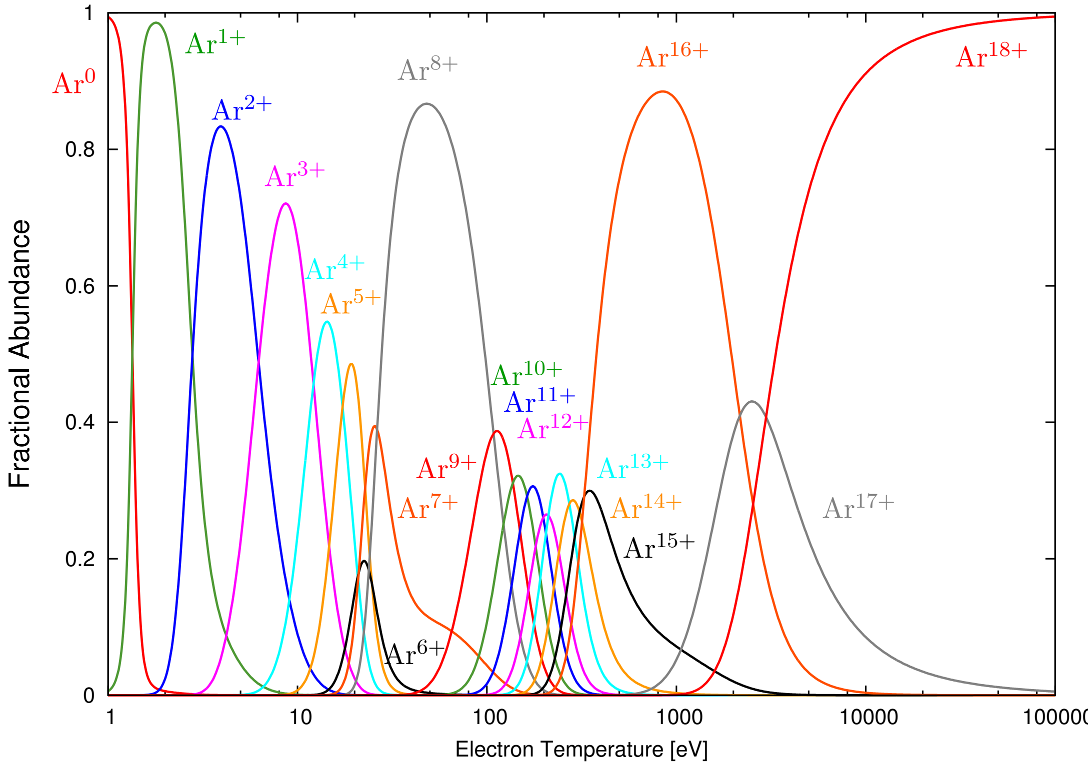


Figure 5.26: Fractional abundances of Argon ions as calculated by ADAS software [17]. Fractional abundances are defined as the ratio of the population of a certain ionization stage over the total population of the element. It can be seen that at plasma temperatures T_e larger than a few 100 eV only Ar^{16+}, Ar^{17+}, and fully stripped Ar^{18+} show reasonable populations.

Although, as discussed in section 3.4, the inclusion of basis states up to $n = 19$ or 20 would be desirable, this is currently computationally not feasible. When including states with $n \geq 16$, the values two-center elements are no longer calculated correctly, resulting in a breakdown of the differential equation solver. As a result, all the calculations in this chapter were conducted using bound states on the ion center with $7 \leq n \leq 15$. On the H center, we again applied the

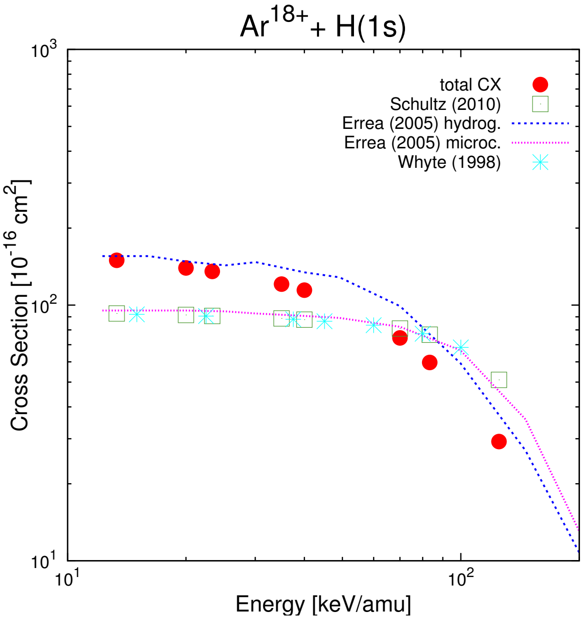


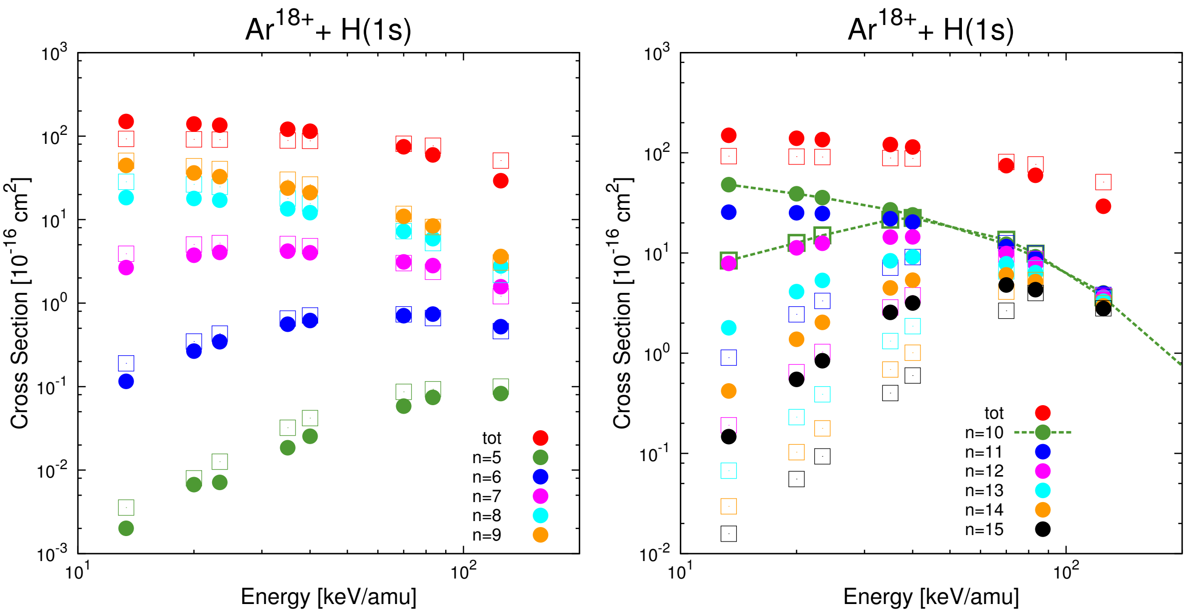
Figure 5.27: Total CX cross sections of Ar^{18+} + H(1s) collisions. AOCC data are compared to CTMC results from different sources: Schultz et al. [96] (□), Errea et al. [91] (hydrogenic: ----- , microcanonical: ········) and Whyte et al. [18] (■).

H19 basis, see the previous section 5.5. Since there is still hope to push this limitation of the maximum included n-shells further, only Ar^{18+} + H(1s) cross sections will be shown here. The data presented in this section can be found in the data table A.50 in the appendix section A.

Fig. 5.27 shows results for Ar^{18+} + H(1s) collisions resulting in CX in comparison with different CTMC calculations. It is worth noting that CTMC calculations yield different values depending on the initial distribution describing the wavefunction. This is the same behavior that motivated this work, see chapter 2 and fig. 2.2. Errea et al. [91] already stated that according to their studies, the hydrogenic distribution that they used produces more believable results than the microcanonical distribution. The other CTMC calculations use microcanonical ensembles [96, 18] and actually come from the same group at Oak Ridge National Laboratory (ORNL). Our data clearly underline the statement by Errea et al. [91].

The n-resolved cross sections shown in fig. 5.28 are compared to n resolved cross sections from Schultz et al. [96]. For capture into $Ar^{17+}(5 \leq n \leq 9)$ the calculations agree well. But for $n \geq 10$ they start to diverge at energies below 40 keV/amu. The strongest capture channels are $n = 9$ and $n = 10$. The behavior of our AOCC calculations, where only the cross sections of the less populated n-shells are dropping significantly at lower energies, is consistent with our previous calculations for lighter ions such as Be^{4+}, cf. fig. 5.4(a) [69]. Additionally, at the energies considered in this calculation, the system can be considered to be diabatic. Thus, at infinite internuclear separation, the total potential energy will be dominated by the binding energies of the electron in the respective basis states. The radius of the crossing of the diabatic potential curves of the initial H(1s) state and final $Ar^{17+}(n = 10)$ states is $R_c \approx 15$ a_0. The mere existence of this potential curve crossing indicates that the final $Ar^{17+}(n = 10)$ states should be significantly populated at lower energies.

The considerations from section 3.4 state that for convergent calculations of Ar^{18+} impact on ground state H it would be favorable to include n-shells up to $n = 19$ or 20. Unfortunately,



(a) (b)

Figure 5.28: n-resolved cross sections for Ar^{18+} + H(1s) collisions. AOCC data (●) are compared to CTMC data (⊡) from Schultz et al. [96]. (a) Total CX cross sections (red) and cross sections for capture into $Ar^{17+}(5 \leq n \leq 9)$. (b) Total CX cross sections (red) and cross sections for capture into $Ar^{17+}(10 \leq n \leq 15)$. The diverging trend is outlined at the example of capture into $Ar^{17+}(n = 10)$.

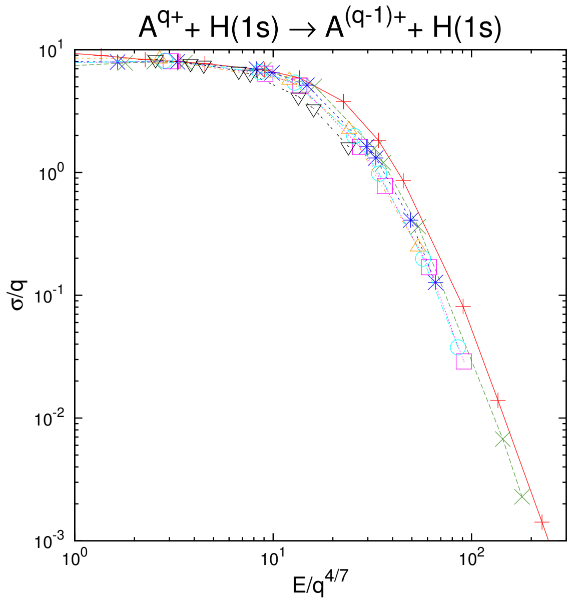


Figure 5.29: Scaled total CX cross sections for collision of H(1s) with different ions: Be^{4+} (+ ——), C^{6+} (× ------), N^{7+} (✳ -----), O^{8+} (⊙ ··········), F^{9+} (△ -·-·-·-) and Ar^{18+} (▽ -·-·-·). The impact energy and the cross sections themselves are scaled according to Cornelius et al. [97].

the limit of the code in its current development stage are at $n = 15$. It can thus be expected that the calculations analyzed here are good but not excellent in terms of convergence considerations. This is underlined by fig. 5.29. In this figure, the total CX cross sections for several projectiles in collisions with H(1s) have been scaled according to the formulae reported by Cornelius et al. [97]. It can be seen that all scaled cross sections agree reasonably well, but the scaled cross sections for an Ar^{18+} projectile start to decline at somewhat lower energies than the others. This might of course be a result of the fitting formulae, but it might also indicate that the used basis expansion in this case is not convergent enough.

The $n\ell$-resolved cross sections shown in fig. 5.30 though, show generally the same behavior as for Ne^{10+} (fig. 5.23) or N^{7+} (fig. 5.15- 5.17) projectiles. The red lines and dots represent the n-resolved cross sections for the impact energy stated on top of the graphs. The differently colored data below these red data show $n\ell$-resolved cross sections for the n-shell indicated on the abscissa, starting with $\ell = 0$ on the left and ending with $\ell = n - 1$ on the right. For lower energies the main capture channel $n = 10$ is very pronounced. The n-distribution flattens out for high energies, slowly approaching the $1/n^3$ rule [79]. Also the behavior in the ℓ-distributions within an n-shells mirror the behavior observed for the other ions. The results at E = 125 keV/amu show peaks at ℓ just above $\ell = n_{max} - 1 = 9$. It can be expected that for even higher energies $\ell = 9$ will be strongest populated where present.

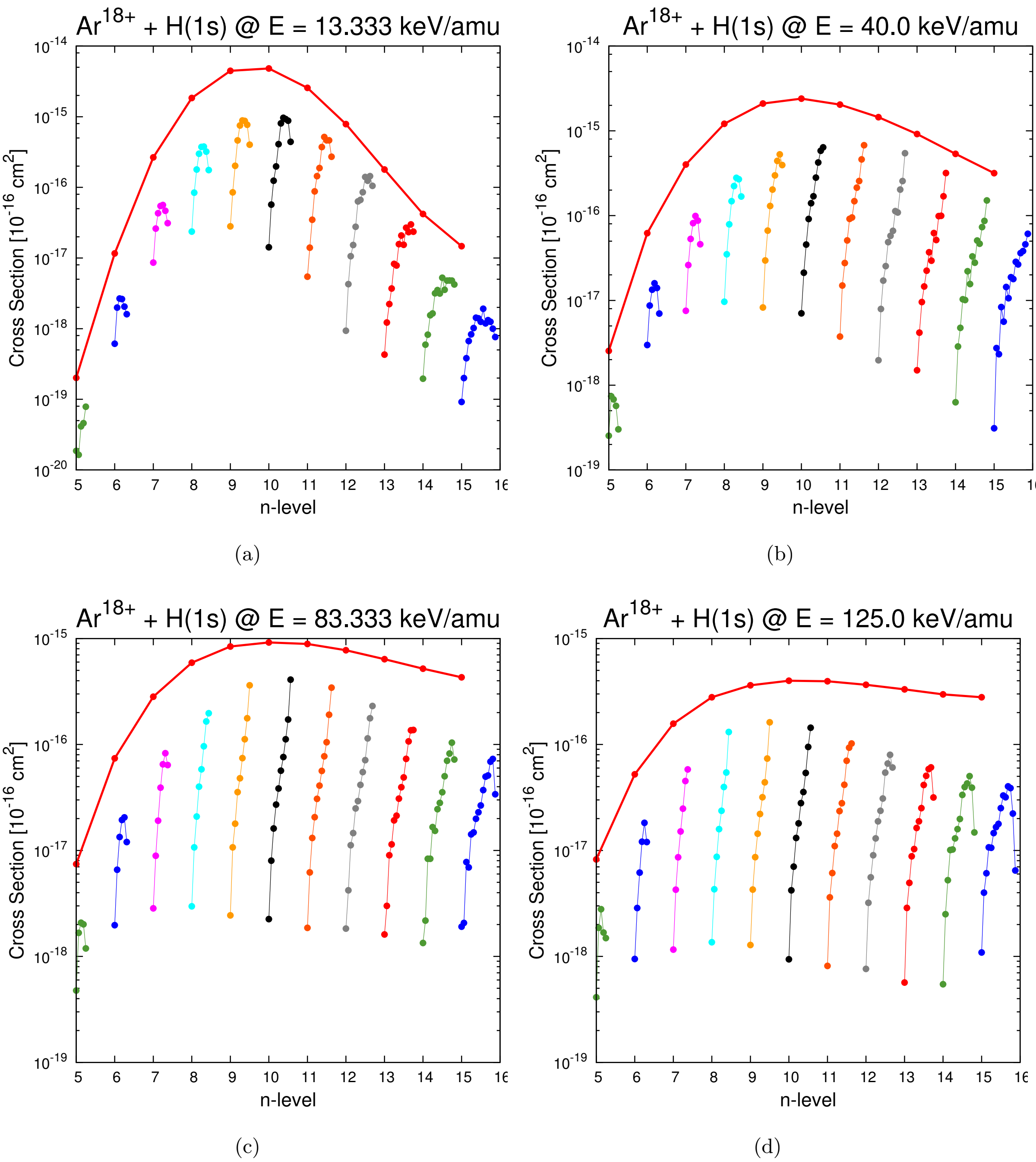


Figure 5.30: $n\ell$-resolved cross sections for Ar^{18+} + H(1s) collisions for selected impact energies. The red data on top show the n-resolved cross sections as a function of the principal quantum number n. The differently colored lines below the red line show the $n\ell$-resolved cross sections for the n quantum number indicated on the x-axis, each starting with $\ell = 0$ on the left and ending with $\ell = n - 1$ on the right.

Freedom is just another word
For nothing left to lose.
Janis Joplin - Me & Bobby McGee

Chapter 6

Summary & Outlook

Although the field of fusion-relevant ion-atom collisions in general and the atomic-orbital close-coupling (AOCC) method in particular have been researched for some decades, today's computer powers and computational methods allow treating systems previously completely out of reach.

The first chapters of this thesis described and explained the motivation for the studies undertaken as well as the theoretical and computational approaches chosen. Challenges posed by the specific problem at hand were outlined alongside solutions for different aspects.

More specifically, the necessary improvements of the computational solution were discussed in detail. The Shakeshaft method for the symbolic representation of exchange integrals, first published in the late 1970s, was put in modern code. It was shown that the new routines show an enormous speed up especially when calculating symbolic structures for exchange matrix elements involving large quantum numbers. Additionally, several concepts for parallelization were described introducing a event dispatch loop algorithm for the creation of the symbolic structures which minimizes idle times and a doubly nested parallelization for the solution of the coupled channel equations.

In the results chapter, several collision systems were analyzed. Starting from a relatively light completely stripped ion, Be^{4+}, over a comparison between two equally charged ions, C^{6+} and N^{6+}, leading finally to heavy highly charged ions like Ar^{q+}. It was shown that clearly AOCC calculations of heavy, highly charged ions in collisions with ground and excited state hydrogen are possible. Nevertheless, things get exceedingly complicated toward very high quantum numbers. Unfortunately, it was not possible to use basis sets involving $n \geq 17$. Though, it lies in principle within the code's capability to calculate basis sets exceeding 1000 basis states. It certainly remains an open topic to find ways to remove this limitation.

The program in its current development stage still offers plenty of room for improvements, but also for adaptations so that different aspects could be studied, e.g. ion-molecule collisions or ion-atom collisions at even lower impact energies than 1 keV/amu. One might also think about developing new concepts of treating atoms in strong laser field and incorporate parts of the present code the computational implementation of such systems.

Appendix A

Cross Section Data Tables

All cross sections presented in the following tables are given in units of 10^{-16} cm^2. The energies are given in units of kev/amu.

A.1 $\mathbf{Be^{4+} + H}(n = 1, 2)$

Table A.1 Be^{4+} + H(1s)

Table A.2 Be^{4+} + H(2s)

Table A.3 Be^{4+} + H(2p0)

Table A.4 Be^{4+} + H(2p1)

Table A.5 Be^{4+} + H(2p-1)

Table A.6 Be^{4+} + H(2p)

Table A.7 Be^{4+} + H($n = 2$)

Table A.1: Data for Be^{4+} + H(1s)

		impact energies [kev/amu]										
		1.0	5.0	7.5	10.0	30.0	50.0	75.	100.	200.	300.	500.
		total cross sections										
CX		3.76E+01	3.32E+01	3.20E+01	3.08E+01	2.36E+01	1.51E+01	7.29E+00	3.43E+00	3.25E-01	5.58E-02	5.68E-03
ION		2.91E-05	4.52E-03	6.75E-03	2.05E-02	1.28E-01	6.01E-01	6.53E-01	1.30E+00	3.86E+00	4.38E+00	3.40E+00
		state resolved CX cross sections										
n	ℓ											
1		1.13E-08	1.28E-08	4.70E-08	4.96E-08	2.96E-05	2.90E-04	7.53E-04	1.04E-03	3.41E-03	2.32E-03	5.95E-04
1	0	1.13E-08	1.28E-08	4.70E-08	4.96E-08	2.96E-05	2.90E-04	7.53E-04	1.04E-03	3.41E-03	2.32E-03	5.95E-04
2		3.24E-04	1.13E-01	2.69E-01	4.30E-01	1.17E+00	1.01E+00	6.68E-01	4.28E-01	7.75E-02	1.69E-02	2.05E-03
2	0	1.50E-04	4.53E-02	1.39E-01	2.07E-01	3.15E-01	2.12E-01	9.95E-02	5.03E-02	9.64E-03	3.73E-03	6.04E-04
2	1	1.74E-04	6.76E-02	1.30E-01	2.23E-01	8.53E-01	7.94E-01	5.69E-01	3.78E-01	6.79E-02	1.32E-02	1.45E-03
3		3.44E+01	2.89E+01	2.63E+01	2.39E+01	1.11E+01	4.75E+00	1.86E+00	8.39E-01	7.90E-02	1.33E-02	1.24E-03
3	0	3.19E+00	2.84E+00	2.22E+00	1.42E+00	3.76E-01	1.87E-01	6.79E-02	3.39E-02	8.10E-03	2.55E-03	3.73E-04
3	1	1.08E+01	9.77E+00	8.35E+00	6.76E+00	1.94E+00	7.90E-01	4.31E-01	2.58E-01	3.74E-02	6.58E-03	6.28E-04
3	2	2.04E+01	1.63E+01	1.57E+01	1.57E+01	8.82E+00	3.77E+00	1.36E+00	5.47E-01	3.35E-02	4.16E-03	2.36E-04
4		3.10E+00	3.70E+00	4.74E+00	5.77E+00	6.29E+00	3.51E+00	1.44E+00	6.39E-01	5.37E-02	8.26E-03	7.04E-04
4	0	4.58E-01	3.05E-01	2.18E-01	1.93E-01	1.81E-01	9.96E-02	4.69E-02	2.22E-02	5.79E-03	1.58E-03	2.14E-04
4	1	8.03E-01	9.27E-01	7.66E-01	6.45E-01	7.96E-01	5.37E-01	2.97E-01	1.78E-01	2.26E-02	3.63E-03	3.40E-04
4	2	1.13E+00	1.37E+00	1.71E+00	1.88E+00	2.38E+00	1.55E+00	6.73E-01	2.88E-01	2.00E-02	2.57E-03	1.34E-04
4	3	7.08E-01	1.10E+00	2.05E+00	3.05E+00	2.93E+00	1.32E+00	4.28E-01	1.51E-01	5.34E-03	4.84E-04	1.62E-05
5		6.61E-02	2.89E-01	4.98E-01	4.91E-01	2.51E+00	2.06E+00	9.70E-01	4.37E-01	3.63E-02	5.27E-03	4.24E-04
5	0	8.07E-03	1.67E-02	4.04E-02	3.37E-02	9.23E-02	5.94E-02	3.58E-02	1.66E-02	4.31E-03	1.10E-03	1.28E-04
5	1	5.23E-03	3.07E-02	5.64E-02	7.70E-02	3.71E-01	3.52E-01	2.09E-01	1.25E-01	1.52E-02	2.23E-03	1.98E-04
5	2	1.59E-02	8.36E-02	7.18E-02	8.91E-02	8.82E-01	8.04E-01	3.89E-01	1.72E-01	1.22E-02	1.49E-03	8.39E-05
5	3	1.96E-02	1.06E-01	1.65E-01	9.20E-02	8.45E-01	6.36E-01	2.70E-01	1.03E-01	4.14E-03	4.11E-04	1.30E-05
5	4	1.73E-02	5.21E-02	1.64E-01	1.99E-01	3.20E-01	2.09E-01	6.67E-02	2.09E-02	5.00E-04	3.84E-05	9.18E-07
6		9.58E-03	6.93E-02	1.35E-01	1.46E-01	1.14E+00	1.29E+00	7.06E-01	3.25E-01	2.64E-02	3.70E-03	2.80E-04
6	0	5.01E-04	7.89E-03	1.27E-02	9.56E-03	5.32E-02	4.53E-02	2.98E-02	1.50E-02	3.47E-03	8.13E-04	8.71E-05
6	1	1.00E-03	1.06E-02	1.39E-02	1.59E-02	2.00E-01	2.48E-01	1.68E-01	9.70E-02	1.10E-02	1.56E-03	1.31E-04
6	2	1.38E-03	1.72E-02	1.77E-02	1.95E-02	4.01E-01	4.83E-01	2.66E-01	1.22E-01	8.40E-03	1.01E-03	5.21E-05
6	3	1.15E-03	1.72E-02	3.34E-02	4.03E-02	3.30E-01	3.51E-01	1.79E-01	7.04E-02	3.02E-03	2.82E-04	8.57E-06
6	4	2.70E-03	1.10E-02	3.20E-02	2.46E-02	1.41E-01	1.41E-01	5.53E-02	1.81E-02	4.68E-04	3.34E-05	1.06E-06
6	5	2.85E-03	5.43E-03	2.50E-02	3.64E-02	1.86E-02	2.50E-02	7.91E-03	2.25E-03	3.77E-05	4.21E-06	2.01E-07
7		1.64E-03	3.34E-02	6.42E-02	7.03E-02	6.40E-01	9.80E-01	6.12E-01	2.87E-01	2.20E-02	2.90E-03	2.05E-04
7	0	1.07E-04	4.16E-03	6.79E-03	4.01E-03	3.47E-02	3.93E-02	2.85E-02	1.60E-02	3.24E-03	6.74E-04	6.51E-05
7	1	3.22E-04	6.94E-03	8.81E-03	6.45E-03	1.25E-01	2.06E-01	1.52E-01	8.83E-02	9.48E-03	1.20E-03	9.57E-05
7	2	2.22E-04	6.67E-03	8.53E-03	8.26E-03	2.21E-01	3.60E-01	2.29E-01	1.07E-01	6.51E-03	7.65E-04	3.73E-05
7	3	2.81E-04	4.65E-03	1.01E-02	1.43E-02	1.73E-01	2.49E-01	1.47E-01	5.83E-02	2.34E-03	2.30E-04	6.41E-06
7	4	3.08E-04	4.14E-03	1.46E-02	1.39E-02	7.23E-02	9.93E-02	4.60E-02	1.47E-02	4.01E-04	2.83E-05	8.04E-07
7	5	2.32E-04	3.94E-03	8.03E-03	1.28E-02	1.26E-02	2.13E-02	8.59E-03	2.39E-03	4.63E-05	2.24E-06	5.58E-08
7	6	1.65E-04	2.95E-03	7.33E-03	1.06E-02	1.43E-03	4.65E-03	1.17E-03	3.00E-04	5.37E-06	1.18E-06	9.77E-08
8		6.91E-04	1.50E-02	4.03E-02	5.26E-02	5.80E-01	1.11E+00	7.81E-01	3.70E-01	2.46E-02	2.96E-03	1.80E-04
8	0	5.27E-05	1.07E-03	3.01E-03	2.63E-03	3.55E-02	5.43E-02	3.80E-02	2.23E-02	3.44E-03	6.55E-04	5.66E-05
8	1	1.24E-04	2.38E-03	5.18E-03	5.33E-03	1.17E-01	2.15E-01	1.71E-01	1.01E-01	1.03E-02	1.24E-03	8.44E-05
8	2	1.54E-04	3.02E-03	6.15E-03	6.83E-03	1.71E-01	3.72E-01	2.76E-01	1.36E-01	7.50E-03	7.78E-04	3.20E-05
8	3	9.75E-05	2.14E-03	6.03E-03	8.95E-03	1.56E-01	2.96E-01	2.01E-01	8.09E-02	2.74E-03	2.43E-04	5.63E-06
8	4	7.36E-05	1.84E-03	7.80E-03	1.05E-02	7.92E-02	1.40E-01	7.80E-02	2.50E-02	5.03E-04	3.84E-05	8.37E-07
8	5	9.08E-05	2.08E-03	5.92E-03	8.94E-03	1.73E-02	3.07E-02	1.45E-02	4.07E-03	5.71E-05	3.90E-06	7.50E-08
8	6	7.24E-05	2.10E-03	5.18E-03	7.41E-03	3.00E-03	4.46E-03	2.51E-03	8.20E-04	1.70E-05	1.17E-06	2.67E-08
8	7	2.56E-05	4.03E-04	1.06E-03	1.98E-03	5.14E-04	1.79E-03	3.53E-04	1.15E-04	5.13E-06	5.90E-07	3.84E-08

Table A.2: Data for Be^{4+} + H(2s)

		impact energies [kev/amu]										
		1.0	5.0	7.5	10.0	30.0	50.0	75.	100.	200.	300.	500.
		total cross sections										
CX		1.84E+02	1.92E+02	1.75E+02	1.50E+02	4.57E+01	1.50E+01	6.08E+00	2.60E+00	2.04E-01	3.85E-02	3.26E-03
ION		5.29E-01	3.21E-01	1.38E+00	2.28E+00	8.04E+00	1.01E+01	6.78E+00	1.15E+01	1.83E+01	1.81E+01	1.51E+01
		state resolved CX cross sections										
n	ℓ											
3		1.04E-01	1.68E-01	2.44E-01	2.77E-01	9.41E-01	5.18E-01	4.35E-01	2.55E-01	2.90E-02	5.77E-03	5.86E-04
3	0	2.41E-02	2.20E-02	1.98E-02	2.42E-02	1.24E-01	4.73E-02	2.56E-02	1.48E-02	1.94E-03	7.69E-04	1.72E-04
3	1	5.05E-02	5.83E-02	7.39E-02	6.78E-02	3.30E-01	1.96E-01	1.05E-01	6.68E-02	1.34E-02	3.53E-03	3.50E-04
3	2	2.91E-02	8.72E-02	1.50E-01	1.85E-01	4.87E-01	2.75E-01	3.04E-01	1.73E-01	1.37E-02	1.47E-03	6.44E-05
4		1.84E+00	5.12E+00	9.06E+00	1.19E+01	6.24E+00	1.68E+00	5.87E-01	2.37E-01	1.97E-02	3.71E-03	3.39E-04
4	0	1.39E-01	3.96E-01	8.31E-01	6.89E-01	1.48E-01	3.56E-02	1.03E-02	6.87E-03	1.34E-03	5.58E-04	1.03E-04
4	1	7.84E-01	1.06E+00	2.30E+00	2.91E+00	5.83E-01	2.15E-01	4.89E-02	2.35E-02	8.04E-03	2.06E-03	1.87E-04
4	2	2.89E-01	1.30E+00	2.87E+00	4.34E+00	1.34E+00	1.81E-01	1.72E-01	1.01E-01	7.95E-03	9.49E-04	4.56E-05
4	3	6.28E-01	2.36E+00	3.06E+00	3.99E+00	4.17E+00	1.25E+00	3.56E-01	1.06E-01	2.38E-03	1.42E-04	3.76E-06
5		6.10E+01	7.70E+01	6.62E+01	4.94E+01	9.19E+00	2.00E+00	6.00E-01	2.06E-01	1.48E-02	2.59E-03	2.11E-04
5	0	1.22E+00	7.24E-01	5.39E-01	2.90E-01	1.26E-01	3.67E-02	1.43E-02	5.68E-03	9.01E-04	3.93E-04	6.42E-05
5	1	6.33E+00	3.86E+00	3.18E+00	2.35E+00	6.62E-01	1.65E-01	4.61E-02	1.54E-02	6.05E-03	1.43E-03	1.14E-04
5	2	1.28E+01	1.42E+01	8.16E+00	5.58E+00	9.99E-01	1.66E-01	1.17E-01	7.83E-02	5.79E-03	6.49E-04	2.97E-05
5	3	2.15E+01	2.96E+01	2.27E+01	1.40E+01	2.25E+00	6.33E-01	2.69E-01	7.79E-02	1.87E-03	1.07E-04	2.98E-06
5	4	1.92E+01	2.86E+01	3.16E+01	2.72E+01	5.15E+00	1.00E+00	1.54E-01	2.83E-02	2.37E-04	1.15E-05	2.14E-07
6		7.34E+01	4.31E+01	3.51E+01	2.77E+01	7.90E+00	1.93E+00	5.69E-01	1.86E-01	1.21E-02	2.04E-03	1.46E-04
6	0	2.90E+00	3.10E-01	2.18E-01	1.64E-01	1.16E-01	4.62E-02	1.52E-02	6.03E-03	7.16E-04	2.95E-04	4.40E-05
6	1	8.43E+00	1.30E+00	9.42E-01	8.43E-01	5.99E-01	1.65E-01	4.13E-02	1.84E-02	5.03E-03	1.11E-03	7.83E-05
6	2	9.16E+00	3.17E+00	2.60E+00	2.40E+00	6.28E-01	1.65E-01	8.72E-02	6.71E-02	4.69E-03	5.42E-04	2.12E-05
6	3	1.00E+01	6.86E+00	5.01E+00	4.32E+00	1.66E+00	4.96E-01	2.25E-01	6.48E-02	1.47E-03	8.29E-05	1.87E-06
6	4	2.16E+01	1.44E+01	9.68E+00	6.63E+00	2.95E+00	6.87E-01	1.63E-01	2.62E-02	2.11E-04	1.06E-05	2.30E-07
6	5	2.13E+01	1.71E+01	1.67E+01	1.33E+01	1.95E+00	3.69E-01	3.74E-02	3.87E-03	1.31E-05	1.20E-06	2.45E-08
7		2.81E+01	5.04E+01	3.27E+01	2.29E+01	6.44E+00	1.91E+00	6.00E-01	1.98E-01	1.09E-02	1.72E-03	1.14E-04
7	0	3.50E-01	2.76E-01	2.34E-01	2.65E-01	1.21E-01	5.89E-02	1.68E-02	7.31E-03	7.35E-04	2.56E-04	3.31E-05
7	1	1.04E+00	1.08E+00	1.32E+00	7.71E-01	5.24E-01	1.83E-01	4.73E-02	2.32E-02	4.58E-03	9.09E-04	6.05E-05
7	2	3.98E+00	1.83E+00	2.25E+00	2.40E+00	5.59E-01	1.81E-01	7.91E-02	6.33E-02	4.15E-03	4.72E-04	1.82E-05
7	3	4.03E+00	4.84E+00	4.67E+00	3.47E+00	1.44E+00	4.93E-01	2.29E-01	7.07E-02	1.27E-03	7.71E-05	1.77E-06
7	4	5.96E+00	8.65E+00	7.31E+00	4.86E+00	1.94E+00	5.55E-01	1.70E-01	2.87E-02	1.81E-04	8.13E-06	2.16E-07
7	5	8.57E+00	1.47E+01	9.49E+00	7.32E+00	1.24E+00	3.33E-01	4.94E-02	4.66E-03	1.16E-05	9.23E-07	4.30E-08
7	6	4.19E+00	1.90E+01	7.41E+00	3.86E+00	6.14E-01	1.05E-01	7.98E-03	5.45E-04	1.41E-06	4.39E-07	8.60E-09
8		1.63E+01	1.34E+01	1.94E+01	2.03E+01	1.10E+01	3.61E+00	1.09E+00	3.50E-01	1.26E-02	1.80E-03	1.01E-04
8	0	2.54E-01	1.72E-01	2.31E-01	3.93E-01	3.19E-01	1.31E-01	3.51E-02	1.48E-02	9.02E-04	2.73E-04	2.91E-05
8	1	6.04E-01	3.84E-01	8.32E-01	6.56E-01	1.04E+00	4.14E-01	1.06E-01	4.40E-02	4.56E-03	8.60E-04	5.16E-05
8	2	1.26E+00	9.16E-01	1.67E+00	2.90E+00	1.35E+00	4.47E-01	1.47E-01	9.01E-02	4.86E-03	5.39E-04	1.80E-05
8	3	2.53E+00	1.95E+00	2.20E+00	1.75E+00	2.42E+00	8.99E-01	3.64E-01	1.23E-01	1.87E-03	1.10E-04	2.44E-06
8	4	3.10E+00	3.25E+00	4.49E+00	5.07E+00	2.89E+00	9.66E-01	3.08E-01	6.26E-02	3.45E-04	1.40E-05	2.80E-07
8	5	2.35E+00	4.05E+00	4.83E+00	5.47E+00	2.07E+00	6.02E-01	1.11E-01	1.34E-02	3.57E-05	1.69E-06	3.36E-08
8	6	3.43E+00	1.37E+00	2.76E+00	2.03E+00	7.62E-01	1.36E-01	1.49E-02	1.70E-03	1.20E-05	2.50E-07	1.34E-08
8	7	2.74E+00	1.34E+00	2.37E+00	2.05E+00	1.00E-01	1.71E-02	1.18E-03	1.98E-04	2.74E-06	2.63E-07	4.98E-09

Table A.3: Data for Be^{4+} + H(2p0)

		impact energies [kev/amu]										
		1.0	5.0	7.5	10.0	30.0	50.0	75.	100.	200.	300.	500.
		total cross sections										
CX		1.86E+02	1.94E+02	1.80E+02	1.66E+02	4.16E+01	7.48E+00	1.50E+00	6.82E-01	3.29E-02	4.05E-03	3.18E-04
ION		3.33E-01	4.60E-01	8.30E-01	1.84E+00	5.51E+00	9.02E+00	1.10E+01	1.09E+01	7.85E+00	5.62E+00	3.27E+00
		state resolved CX cross sections										
n	ℓ											
3		1.06E-02	1.13E-01	1.77E-01	3.10E-01	6.01E-01	2.67E-01	1.77E-01	1.16E-01	6.72E-03	9.03E-04	6.50E-05
3	0	1.51E-03	1.40E-02	1.82E-02	3.82E-02	2.81E-02	2.36E-02	1.27E-02	6.15E-03	9.59E-04	2.21E-04	2.54E-05
3	1	5.17E-03	3.98E-02	5.47E-02	1.03E-01	1.78E-01	4.45E-02	3.31E-02	2.86E-02	3.45E-03	4.82E-04	3.27E-05
3	2	3.95E-03	5.94E-02	1.04E-01	1.69E-01	3.95E-01	1.99E-01	1.31E-01	8.08E-02	2.31E-03	2.00E-04	6.92E-06
4		1.42E+00	5.98E+00	7.04E+00	6.21E+00	9.66E-01	2.82E-01	1.26E-01	7.12E-02	4.97E-03	5.92E-04	3.60E-05
4	0	9.15E-02	4.75E-01	4.39E-01	2.95E-01	3.57E-02	1.71E-02	6.64E-03	3.28E-03	7.20E-04	1.52E-04	1.50E-05
4	1	6.32E-01	1.36E+00	1.29E+00	9.21E-01	1.03E-01	3.94E-02	2.11E-02	1.86E-02	2.11E-03	2.51E-04	1.49E-05
4	2	1.97E-01	1.68E+00	2.03E+00	1.74E+00	2.05E-01	9.56E-02	7.01E-02	4.18E-02	1.80E-03	1.65E-04	5.45E-06
4	3	5.01E-01	2.47E+00	3.28E+00	3.25E+00	6.22E-01	1.30E-01	2.79E-02	7.52E-03	3.39E-04	2.38E-05	6.21E-07
5		5.40E+01	4.23E+01	4.50E+01	4.05E+01	3.77E+00	5.27E-01	1.23E-01	5.56E-02	3.75E-03	4.21E-04	2.11E-05
5	0	1.22E+00	7.56E-01	4.60E-01	5.48E-01	7.53E-02	8.40E-03	4.73E-03	2.63E-03	5.26E-04	1.06E-04	9.36E-06
5	1	6.57E+00	2.12E+00	2.73E+00	1.38E+00	2.04E-01	4.21E-02	2.14E-02	1.60E-02	1.39E-03	1.50E-04	7.67E-06
5	2	1.11E+01	6.47E+00	6.93E+00	5.27E+00	4.75E-01	7.34E-02	5.17E-02	2.76E-02	1.43E-03	1.35E-04	3.52E-06
5	3	1.58E+01	1.43E+01	1.58E+01	1.33E+01	9.25E-01	2.26E-01	2.68E-02	6.06E-03	3.57E-04	2.80E-05	5.65E-07
5	4	1.93E+01	1.87E+01	1.91E+01	2.00E+01	2.09E+00	1.77E-01	1.84E-02	3.27E-03	4.93E-05	1.88E-06	2.85E-08
6		8.44E+01	1.01E+02	8.83E+01	7.00E+01	6.08E+00	7.04E-01	1.22E-01	4.89E-02	3.07E-03	3.40E-04	1.43E-05
6	0	2.66E+00	3.26E-01	5.52E-01	4.56E-01	6.27E-02	9.18E-03	3.24E-03	2.78E-03	4.16E-04	7.72E-05	6.41E-06
6	1	8.29E+00	2.67E+00	1.83E+00	1.52E+00	2.74E-01	4.53E-02	1.76E-02	1.46E-02	1.02E-03	1.03E-04	4.62E-06
6	2	1.87E+01	5.77E+00	4.86E+00	3.99E+00	5.70E-01	7.82E-02	3.85E-02	2.04E-02	1.22E-03	1.22E-04	2.64E-06
6	3	1.57E+01	1.86E+01	1.43E+01	1.10E+01	1.01E+00	2.33E-01	3.01E-02	6.01E-03	3.46E-04	3.39E-05	6.21E-07
6	4	1.63E+01	2.43E+01	1.46E+01	1.05E+01	2.48E+00	2.30E-01	2.28E-02	3.81E-03	6.13E-05	4.09E-06	4.48E-08
6	5	2.28E+01	4.93E+01	5.22E+01	4.25E+01	1.68E+00	1.08E-01	9.53E-03	1.33E-03	4.51E-06	2.53E-07	7.39E-09
7		2.73E+01	3.53E+01	2.71E+01	3.21E+01	6.84E+00	9.07E-01	1.34E-01	4.43E-02	3.00E-03	3.13E-04	1.16E-05
7	0	8.00E-01	1.91E-01	1.92E-01	2.47E-01	6.46E-02	1.65E-02	3.01E-03	2.53E-03	3.89E-04	6.29E-05	4.69E-06
7	1	2.22E+00	1.14E+00	1.13E+00	1.23E+00	4.14E-01	5.98E-02	1.44E-02	1.19E-02	9.09E-04	8.15E-05	3.31E-06
7	2	6.22E+00	1.85E+00	1.50E+00	1.88E+00	5.27E-01	8.98E-02	3.75E-02	1.61E-02	1.23E-03	1.23E-04	2.56E-06
7	3	4.45E+00	4.86E+00	5.33E+00	5.45E+00	1.24E+00	3.41E-01	4.03E-02	6.73E-03	3.88E-04	3.97E-05	9.25E-07
7	4	4.34E+00	8.04E+00	5.81E+00	4.79E+00	2.15E+00	2.45E-01	2.25E-02	4.59E-03	7.21E-05	5.60E-06	1.15E-07
7	5	5.38E+00	9.06E+00	7.64E+00	1.03E+01	1.58E+00	1.01E-01	1.31E-02	2.14E-03	7.13E-06	3.94E-07	2.25E-08
7	6	3.88E+00	1.02E+01	5.54E+00	8.21E+00	8.65E-01	5.39E-02	3.54E-03	3.18E-04	1.19E-06	4.98E-08	3.30E-09
8		1.68E+01	7.00E+00	8.62E+00	1.26E+01	9.56E+00	1.66E+00	1.98E-01	5.48E-02	3.91E-03	4.17E-04	1.24E-05
8	0	3.67E-01	8.67E-02	6.39E-02	2.02E-01	1.39E-01	4.00E-02	5.28E-03	2.65E-03	4.33E-04	6.46E-05	4.03E-06
8	1	8.09E-01	2.55E-01	6.37E-01	6.89E-01	7.35E-01	1.46E-01	1.59E-02	1.20E-02	1.04E-03	9.42E-05	3.07E-06
8	2	1.63E+00	6.22E-01	4.86E-01	1.10E+00	1.03E+00	1.54E-01	4.49E-02	1.74E-02	1.63E-03	1.75E-04	3.39E-06
8	3	3.17E+00	6.80E-01	1.81E+00	2.36E+00	1.57E+00	6.01E-01	7.03E-02	1.08E-02	6.20E-04	6.81E-05	1.63E-06
8	4	3.29E+00	1.86E+00	2.02E+00	2.04E+00	3.11E+00	5.04E-01	3.58E-02	7.74E-03	1.58E-04	1.35E-05	2.62E-07
8	5	2.15E+00	1.73E+00	1.73E+00	3.85E+00	1.99E+00	1.60E-01	1.86E-02	3.55E-03	2.30E-05	1.56E-06	3.79E-08
8	6	3.32E+00	7.02E-01	8.65E-01	1.39E+00	7.32E-01	3.47E-02	6.37E-03	6.66E-04	4.49E-06	1.83E-07	5.59E-09
8	7	2.09E+00	1.06E+00	1.01E+00	9.31E-01	2.57E-01	2.38E-02	7.55E-04	4.33E-05	9.53E-07	5.38E-08	1.31E-09

Table A.4: Data for Be^{4+} + H(2p1)

		impact energies [kev/amu]										
		1.0	5.0	7.5	10.0	30.0	50.0	75.	100.	200.	300.	500.
		total cross sections										
CX		1.97E+02	1.88E+02	1.72E+02	1.50E+02	3.25E+01	9.20E+00	3.73E+00	1.51E+00	5.17E-02	4.76E-03	2.51E-04
ION		1.41E-01	4.93E-01	6.57E-01	1.36E+00	7.24E+00	9.51E+00	1.01E+01	1.12E+01	1.14E+01	9.11E+00	6.15E+00
		state resolved CX cross sections										
n	ℓ											
3		2.25E-02	4.34E-02	1.87E-01	4.90E-01	1.49E+00	9.58E-01	3.71E-01	1.26E-01	7.81E-03	8.11E-04	5.62E-05
3	0	3.49E-03	1.07E-02	4.43E-02	1.23E-01	1.80E-01	6.79E-02	4.75E-02	1.29E-02	1.03E-03	1.29E-04	1.64E-05
3	1	8.71E-03	2.00E-02	7.83E-02	2.07E-01	6.00E-01	3.15E-01	1.08E-01	2.69E-02	1.51E-03	1.91E-04	2.27E-05
3	2	1.03E-02	1.27E-02	6.47E-02	1.60E-01	7.12E-01	5.75E-01	2.16E-01	8.58E-02	5.27E-03	4.91E-04	1.71E-05
4		1.32E+00	1.07E+01	1.55E+01	1.77E+01	5.07E+00	1.45E+00	6.10E-01	1.81E-01	7.67E-03	6.69E-04	3.39E-05
4	0	1.30E-01	1.71E+00	2.01E+00	1.76E+00	1.68E-01	4.65E-02	2.78E-02	1.16E-02	7.81E-04	8.72E-05	8.77E-06
4	1	3.09E-01	3.67E+00	5.14E+00	5.33E+00	5.03E-01	1.84E-01	1.04E-01	2.78E-02	1.03E-03	1.11E-04	1.14E-05
4	2	4.89E-01	3.66E+00	5.19E+00	6.36E+00	1.65E+00	2.65E-01	1.82E-01	6.92E-02	3.84E-03	3.36E-04	1.09E-05
4	3	3.96E-01	1.61E+00	3.14E+00	4.27E+00	2.75E+00	9.59E-01	2.96E-01	7.29E-02	2.02E-03	1.35E-04	2.81E-06
5		6.60E+01	5.46E+01	5.43E+01	4.55E+01	6.33E+00	1.54E+00	5.55E-01	1.87E-01	6.49E-03	5.09E-04	2.10E-05
5	0	5.88E+00	2.78E+00	1.79E+00	1.21E+00	1.76E-01	4.10E-02	1.43E-02	1.07E-02	5.70E-04	5.67E-05	4.94E-06
5	1	1.22E+01	7.87E+00	4.61E+00	3.66E+00	5.26E-01	1.90E-01	7.18E-02	2.62E-02	7.34E-04	7.48E-05	6.65E-06
5	2	1.76E+01	1.20E+01	1.01E+01	6.42E+00	1.21E+00	2.17E-01	1.09E-01	5.70E-02	2.81E-03	2.33E-04	6.75E-06
5	3	1.54E+01	1.74E+01	1.99E+01	1.88E+01	9.80E-01	4.14E-01	2.03E-01	6.50E-02	2.03E-03	1.29E-04	2.42E-06
5	4	1.49E+01	1.46E+01	1.79E+01	1.54E+01	3.44E+00	6.81E-01	1.57E-01	2.81E-02	3.43E-04	1.59E-05	2.20E-07
6		9.33E+01	8.79E+01	5.69E+01	3.79E+01	5.32E+00	1.31E+00	4.34E-01	1.76E-01	5.53E-03	3.95E-04	1.39E-05
6	0	5.77E+00	7.30E-01	5.78E-01	5.66E-01	1.39E-01	2.75E-02	9.07E-03	1.05E-02	4.36E-04	3.61E-05	2.99E-06
6	1	1.11E+01	3.25E+00	3.14E+00	2.75E+00	4.64E-01	1.39E-01	4.27E-02	2.38E-02	5.85E-04	5.70E-05	4.36E-06
6	2	1.16E+01	6.21E+00	3.86E+00	3.37E+00	8.88E-01	1.50E-01	6.30E-02	4.76E-02	2.29E-03	1.74E-04	4.53E-06
6	3	1.25E+01	1.46E+01	1.05E+01	9.02E+00	6.67E-01	2.79E-01	1.31E-01	5.68E-02	1.77E-03	1.07E-04	1.79E-06
6	4	2.58E+01	2.14E+01	1.45E+01	8.92E+00	1.58E+00	4.60E-01	1.43E-01	3.13E-02	4.16E-04	1.98E-05	2.41E-07
6	5	2.65E+01	4.17E+01	2.43E+01	1.33E+01	1.58E+00	2.51E-01	4.53E-02	6.01E-03	3.25E-05	1.16E-06	1.16E-08
7		2.92E+01	2.65E+01	2.90E+01	2.52E+01	4.19E+00	1.06E+00	3.62E-01	1.78E-01	5.40E-03	3.39E-04	1.02E-05
7	0	6.28E-01	3.93E-01	2.96E-01	4.19E-01	1.04E-01	3.07E-02	8.32E-03	1.07E-02	3.79E-04	2.40E-05	1.95E-06
7	1	1.80E+00	6.28E-01	1.69E+00	1.45E+00	4.13E-01	1.17E-01	3.02E-02	2.34E-02	5.68E-04	4.79E-05	3.14E-06
7	2	1.58E+00	2.43E+00	2.16E+00	2.69E+00	6.32E-01	1.04E-01	4.45E-02	4.38E-02	2.15E-03	1.49E-04	3.40E-06
7	3	2.97E+00	3.82E+00	5.73E+00	4.47E+00	5.30E-01	2.00E-01	9.86E-02	5.72E-02	1.76E-03	9.63E-05	1.43E-06
7	4	9.53E+00	4.15E+00	5.18E+00	4.76E+00	1.02E+00	3.18E-01	1.17E-01	3.37E-02	4.92E-04	2.03E-05	2.21E-07
7	5	8.72E+00	9.21E+00	7.96E+00	5.74E+00	1.08E+00	2.17E-01	5.35E-02	8.34E-03	4.56E-05	1.31E-06	1.64E-08
7	6	3.94E+00	5.89E+00	6.00E+00	5.65E+00	4.13E-01	7.25E-02	9.91E-03	9.31E-04	2.31E-06	7.85E-08	1.54E-09
8		6.00E+00	6.71E+00	1.15E+01	1.54E+01	3.73E+00	1.08E+00	4.29E-01	2.61E-01	7.40E-03	3.85E-04	8.52E-06
8	0	1.90E-01	1.43E-01	2.69E-01	3.76E-01	7.67E-02	2.91E-02	1.18E-02	1.41E-02	4.62E-04	2.21E-05	1.36E-06
8	1	3.35E-01	3.85E-01	4.88E-01	6.55E-01	3.56E-01	1.23E-01	3.75E-02	3.44E-02	7.55E-04	4.37E-05	2.41E-06
8	2	4.65E-01	4.61E-01	1.30E+00	1.96E+00	3.97E-01	9.12E-02	4.95E-02	5.75E-02	2.69E-03	1.63E-04	3.01E-06
8	3	7.55E-01	1.12E+00	1.73E+00	1.79E+00	4.70E-01	1.99E-01	1.05E-01	8.30E-02	2.48E-03	1.21E-04	1.46E-06
8	4	1.78E+00	1.73E+00	1.66E+00	3.08E+00	8.86E-01	3.03E-01	1.33E-01	5.52E-02	8.92E-04	3.25E-05	2.63E-07
8	5	1.39E+00	1.28E+00	3.56E+00	4.35E+00	1.03E+00	2.43E-01	7.48E-02	1.49E-02	1.11E-04	2.52E-06	1.66E-08
8	6	6.79E-01	5.64E-01	2.07E+00	2.43E+00	4.26E-01	7.40E-02	1.62E-02	1.45E-03	6.53E-06	1.69E-07	2.53E-09
8	7	4.08E-01	1.03E+00	4.42E-01	7.27E-01	8.46E-02	1.51E-02	1.31E-03	1.22E-04	8.06E-07	4.53E-08	7.12E-10

Table A.5: Data for Be^{4+} + H(2p-1)

		impact energies [kev/amu]										
		1.0	5.0	7.5	10.0	30.0	50.0	75.	100.	200.	300.	500.
		total cross sections										
CX		1.86E+02	2.08E+02	1.83E+02	1.59E+02	2.99E+01	7.04E+00	3.73E+00	4.02E-01	9.39E-03	9.24E-04	5.22E-05
ION		5.23E-03	4.58E-02	5.97E-02	1.00E-01	6.97E-01	2.11E+00	5.24E+00	7.28E+00	6.34E+00	4.97E+00	3.40E+00
		state resolved CX cross sections										
n	ℓ											
3		5.53E-05	1.70E-02	6.83E-02	1.54E-01	2.83E-01	2.13E-01	3.24E-01	3.72E-02	1.56E-03	1.88E-04	1.28E-05
3	1	2.47E-05	5.60E-03	2.03E-02	3.87E-02	3.01E-02	2.40E-02	1.08E-01	1.08E-02	7.54E-04	1.12E-04	9.17E-06
3	2	3.06E-05	1.14E-02	4.80E-02	1.15E-01	2.53E-01	1.89E-01	2.16E-01	2.64E-02	8.04E-04	7.61E-05	3.66E-06
4		3.92E-01	5.81E+00	8.50E+00	8.97E+00	1.99E+00	5.56E-01	5.82E-01	4.63E-02	1.40E-03	1.43E-04	7.89E-06
4	1	5.98E-02	4.52E-01	4.75E-01	3.94E-01	4.88E-02	1.72E-02	1.04E-01	8.02E-03	5.03E-04	6.71E-05	4.79E-06
4	2	2.06E-01	1.86E+00	2.27E+00	2.14E+00	3.68E-01	1.77E-01	1.82E-01	2.47E-02	7.10E-04	6.32E-05	2.71E-06
4	3	1.26E-01	3.50E+00	5.76E+00	6.44E+00	1.57E+00	3.62E-01	2.96E-01	1.36E-02	1.83E-04	1.28E-05	3.87E-07
5		6.22E+01	8.14E+01	6.76E+01	4.87E+01	3.73E+00	7.39E-01	5.41E-01	4.45E-02	1.10E-03	1.00E-04	4.93E-06
5	1	4.03E+00	9.08E-01	5.61E-01	4.02E-01	5.75E-02	1.63E-02	7.18E-02	6.65E-03	3.59E-04	4.39E-05	2.82E-06
5	2	1.32E+01	4.94E+00	2.84E+00	2.34E+00	3.15E-01	1.41E-01	1.09E-01	2.01E-02	5.40E-04	4.42E-05	1.76E-06
5	3	2.61E+01	1.69E+01	1.29E+01	8.29E+00	1.26E+00	3.51E-01	2.03E-01	1.44E-02	1.79E-04	1.11E-05	3.24E-07
5	4	1.89E+01	5.87E+01	5.13E+01	3.77E+01	2.10E+00	2.31E-01	1.57E-01	3.40E-03	2.16E-05	1.16E-06	2.51E-08
6		1.00E+02	9.88E+01	6.85E+01	5.14E+01	4.37E+00	7.95E-01	4.25E-01	4.10E-02	8.67E-04	7.19E-05	3.24E-06
6	1	6.72E+00	2.74E-01	2.42E-01	2.03E-01	5.80E-02	1.46E-02	4.27E-02	5.60E-03	2.69E-04	3.08E-05	1.82E-06
6	2	1.91E+01	2.63E+00	2.11E+00	2.10E+00	2.14E-01	1.08E-01	6.30E-02	1.69E-02	4.21E-04	3.20E-05	1.18E-06
6	3	2.80E+01	8.01E+00	5.58E+00	4.13E+00	1.09E+00	3.26E-01	1.31E-01	1.36E-02	1.51E-04	7.94E-06	2.11E-07
6	4	1.87E+01	2.33E+01	2.01E+01	1.72E+01	1.94E+00	2.70E-01	1.43E-01	4.42E-03	2.40E-05	1.09E-06	2.50E-08
6	5	2.75E+01	6.46E+01	4.05E+01	2.78E+01	1.07E+00	7.68E-02	4.53E-02	5.22E-04	1.61E-06	6.60E-08	1.14E-09
7		2.13E+01	1.81E+01	2.63E+01	2.80E+01	4.42E+00	8.60E-01	3.54E-01	4.02E-02	7.33E-04	5.52E-05	2.30E-06
7	1	3.03E-01	1.71E-01	1.22E-01	1.29E-01	6.16E-02	1.39E-02	3.02E-02	4.70E-03	2.13E-04	2.31E-05	1.28E-06
7	2	1.30E+00	6.63E-01	1.12E+00	1.32E+00	1.47E-01	8.99E-02	4.45E-02	1.52E-02	3.58E-04	2.51E-05	8.67E-07
7	3	3.64E+00	2.52E+00	2.33E+00	2.06E+00	1.02E+00	3.30E-01	9.86E-02	1.40E-02	1.36E-04	6.13E-06	1.36E-07
7	4	7.26E+00	4.16E+00	7.17E+00	8.67E+00	1.74E+00	2.95E-01	1.17E-01	5.37E-03	2.35E-05	8.14E-07	1.69E-08
7	5	6.81E+00	8.47E+00	8.96E+00	9.17E+00	1.11E+00	1.10E-01	5.35E-02	8.60E-04	1.99E-06	6.48E-08	1.43E-09
7	6	1.95E+00	2.16E+00	6.59E+00	6.63E+00	3.40E-01	2.14E-02	9.91E-03	7.14E-05	9.24E-08	2.84E-09	9.21E-11
8		1.84E+00	3.54E+00	9.42E+00	1.46E+01	5.92E+00	1.22E+00	4.17E-01	5.04E-02	7.63E-04	4.98E-05	1.83E-06
8	1	1.71E-01	5.08E-02	8.67E-02	8.84E-02	8.12E-02	1.66E-02	3.75E-02	4.11E-03	1.84E-04	1.90E-05	9.73E-07
8	2	2.95E-01	2.27E-01	4.10E-01	6.55E-01	1.73E-01	8.25E-02	4.95E-02	1.56E-02	3.66E-04	2.36E-05	7.36E-07
8	3	3.31E-01	5.52E-01	1.06E+00	1.09E+00	1.05E+00	3.96E-01	1.05E-01	1.85E-02	1.71E-04	6.35E-06	1.06E-07
8	4	3.23E-01	1.09E+00	2.26E+00	4.19E+00	2.25E+00	4.62E-01	1.33E-01	9.86E-03	3.86E-05	8.05E-07	1.04E-08
8	5	3.30E-01	1.14E+00	3.37E+00	5.00E+00	1.81E+00	2.20E-01	7.48E-02	2.13E-03	3.20E-06	4.61E-08	1.22E-09
8	6	2.37E-01	1.95E-01	1.98E+00	3.08E+00	5.10E-01	4.24E-02	1.62E-02	1.84E-04	1.50E-07	4.10E-09	1.78E-10
8	7	1.49E-01	2.88E-01	2.55E-01	4.81E-01	4.99E-02	2.76E-03	1.31E-03	9.88E-06	3.55E-08	5.50E-10	3.11E-11

Table A.6: Data for Be^{4+} + H(2p)

		impact energies [kev/amu]										
		1.0	5.0	7.5	10.0	30.0	50.0	75.	100.	200.	300.	500.
		total cross sections										
CX		1.90E+02	1.97E+02	1.78E+02	1.58E+02	3.47E+01	7.91E+00	1.97E+00	7.34E-01	2.85E-02	2.95E-03	1.93E-04
ION		6.51E-02	2.19E-01	2.73E-01	2.80E-01	1.31E+00	2.34E+00	3.11E+00	3.81E+00	3.20E+00	2.54E+00	1.74E+00
		state resolved CX cross sections										
n	ℓ											
3		1.47E+00	2.15E+00	2.98E+00	3.26E+00	1.36E+00	5.93E-01	2.07E-01	8.09E-02	4.88E-03	5.73E-04	4.07E-05
3	0	7.03E-02	6.28E-01	7.77E-01	7.67E-01	1.92E-01	8.95E-02	3.27E-02	6.59E-03	6.84E-04	1.18E-04	1.40E-05
3	1	4.66E-02	1.19E+00	1.96E+00	2.25E+00	7.83E-01	2.40E-01	5.52E-02	1.86E-02	1.66E-03	2.24E-04	1.85E-05
3	2	1.35E+00	3.27E-01	2.43E-01	2.44E-01	3.88E-01	2.63E-01	1.19E-01	5.57E-02	2.54E-03	2.31E-04	8.16E-06
4		2.25E+01	3.24E+01	2.99E+01	2.42E+01	3.25E+00	8.24E-01	2.70E-01	8.45E-02	4.24E-03	4.22E-04	2.34E-05
4	0	4.47E+00	2.38E+00	1.76E+00	1.46E+00	1.73E-01	6.82E-02	2.18E-02	5.14E-03	5.15E-04	8.03E-05	7.98E-06
4	1	9.01E+00	7.31E+00	6.44E+00	4.85E+00	6.22E-01	1.91E-01	5.04E-02	1.55E-02	1.05E-03	1.21E-04	8.77E-06
4	2	6.53E+00	2.13E+01	1.95E+01	1.53E+01	1.32E+00	1.97E-01	8.64E-02	3.70E-02	1.88E-03	1.67E-04	5.45E-06
4	3	2.54E+00	1.45E+00	2.22E+00	2.57E+00	1.14E+00	3.68E-01	1.11E-01	2.69E-02	7.97E-04	5.35E-05	1.24E-06
5		7.12E+01	6.53E+01	5.60E+01	4.58E+01	4.82E+00	9.55E-01	2.49E-01	8.11E-02	3.43E-03	3.11E-04	1.41E-05
5	0	8.73E+00	2.06E+00	1.45E+00	1.29E+00	1.55E-01	5.25E-02	1.50E-02	4.58E-03	3.76E-04	5.46E-05	4.80E-06
5	1	1.56E+01	6.00E+00	4.31E+00	3.06E+00	6.07E-01	1.86E-01	3.93E-02	1.41E-02	7.11E-04	7.50E-05	4.78E-06
5	2	1.58E+01	1.39E+01	1.24E+01	9.63E+00	1.21E+00	1.87E-01	5.66E-02	2.82E-02	1.41E-03	1.23E-04	3.42E-06
5	3	1.96E+01	3.21E+01	2.54E+01	2.00E+01	9.92E-01	2.39E-01	7.70E-02	2.37E-02	7.96E-04	5.23E-05	9.95E-07
5	4	1.15E+01	1.12E+01	1.24E+01	1.18E+01	1.86E+00	2.91E-01	6.07E-02	1.05E-02	1.38E-04	6.35E-06	1.45E-07
6		6.63E+01	6.91E+01	5.72E+01	4.52E+01	5.28E+00	9.56E-01	2.08E-01	7.52E-02	2.88E-03	2.46E-04	9.50E-06
6	0	3.24E+00	5.73E-01	7.50E-01	7.81E-01	1.16E-01	4.22E-02	1.19E-02	4.55E-03	2.92E-04	3.81E-05	3.16E-06
6	1	7.68E+00	2.81E+00	2.43E+00	2.11E+00	5.86E-01	1.71E-01	2.86E-02	1.28E-02	5.37E-04	5.34E-05	3.00E-06
6	2	1.25E+01	5.38E+00	5.30E+00	5.34E+00	1.07E+00	1.74E-01	3.75E-02	2.27E-02	1.17E-03	9.87E-05	2.39E-06
6	3	1.17E+01	1.39E+01	1.13E+01	9.73E+00	9.29E-01	2.07E-01	5.44E-02	2.09E-02	7.05E-04	4.70E-05	8.04E-07
6	4	1.47E+01	1.60E+01	1.19E+01	8.68E+00	1.47E+00	2.37E-01	5.53E-02	1.17E-02	1.59E-04	7.96E-06	9.53E-08
6	5	1.65E+01	3.04E+01	2.55E+01	1.86E+01	1.11E+00	1.25E-01	2.02E-02	2.51E-03	1.87E-05	7.95E-07	5.00E-08
7		1.93E+01	2.17E+01	2.17E+01	2.38E+01	5.61E+00	1.06E+00	1.93E-01	7.43E-02	2.81E-03	2.18E-04	7.28E-06
7	0	5.74E-01	2.70E-01	2.99E-01	4.40E-01	1.14E-01	4.32E-02	1.17E-02	4.53E-03	2.64E-04	2.92E-05	2.23E-06
7	1	1.45E+00	7.73E-01	1.29E+00	1.26E+00	6.26E-01	1.91E-01	2.61E-02	1.18E-02	4.94E-04	4.32E-05	2.15E-06
7	2	2.71E+00	1.79E+00	1.97E+00	2.92E+00	1.14E+00	2.19E-01	3.40E-02	2.00E-02	1.13E-03	9.07E-05	1.99E-06
7	3	2.58E+00	3.27E+00	4.81E+00	4.97E+00	1.19E+00	2.54E-01	4.79E-02	2.13E-02	7.16E-04	4.53E-05	7.85E-07
7	4	4.70E+00	4.13E+00	4.32E+00	4.21E+00	1.23E+00	2.02E-01	4.67E-02	1.28E-02	1.88E-04	8.63E-06	1.12E-07
7	5	4.70E+00	6.09E+00	5.20E+00	5.35E+00	8.87E-01	1.06E-01	2.22E-02	3.49E-03	1.76E-05	5.68E-07	1.30E-08
7	6	2.61E+00	5.36E+00	3.85E+00	4.62E+00	4.26E-01	4.21E-02	4.48E-03	4.16E-04	1.17E-06	4.28E-08	1.61E-09
8		7.61E+00	4.57E+00	6.71E+00	9.30E+00	4.43E+00	9.14E-01	2.09E-01	1.05E-01	3.76E-03	2.68E-04	6.99E-06
8	0	1.86E-01	7.66E-02	1.11E-01	1.93E-01	7.19E-02	2.30E-02	5.69E-03	5.58E-03	2.98E-04	2.89E-05	1.80E-06
8	1	3.81E-01	2.13E-01	3.75E-01	4.48E-01	3.64E-01	8.97E-02	1.78E-02	1.55E-02	5.98E-04	4.60E-05	1.83E-06
8	2	6.98E-01	3.61E-01	5.95E-01	1.02E+00	4.76E-01	8.17E-02	3.15E-02	2.50E-02	1.44E-03	1.13E-04	2.13E-06
8	3	1.31E+00	6.00E-01	1.18E+00	1.38E+00	6.80E-01	2.67E-01	5.84E-02	3.13E-02	1.03E-03	6.30E-05	1.03E-06
8	4	1.69E+00	1.20E+00	1.23E+00	1.71E+00	1.33E+00	2.69E-01	5.63E-02	2.10E-02	3.50E-04	1.53E-05	1.75E-07
8	5	1.18E+00	1.00E+00	1.76E+00	2.73E+00	1.01E+00	1.34E-01	3.11E-02	6.15E-03	4.47E-05	1.36E-06	1.82E-08
8	6	1.33E+00	4.22E-01	9.78E-01	1.27E+00	3.86E-01	3.62E-02	7.52E-03	7.05E-04	3.67E-06	1.17E-07	2.71E-09
8	7	8.33E-01	6.97E-01	4.84E-01	5.53E-01	1.14E-01	1.30E-02	6.88E-04	5.51E-05	5.86E-07	3.30E-08	6.74E-10

Table A.7: Data for Be^{4+} + $H(n = 2)$

						impact energies [kev/amu]						
		1.0	5.0	7.5	10.0	30.0	50.0	75.	100.	200.	300.	500.
						total cross sections						
CX		1.88E+02	1.96E+02	1.78E+02	1.56E+02	3.74E+01	9.68E+00	3.00E+00	1.20E+00	7.24E-02	1.18E-02	9.60E-04
ION		2.65E-01	4.35E-01	8.53E-01	1.51E+00	5.28E+00	7.21E+00	6.98E+00	8.38E+00	9.39E+00	8.21E+00	6.15E+00
						state resolved CX cross sections						
n	ℓ											
3		1.13E+00	1.65E+00	2.30E+00	2.51E+00	1.26E+00	5.74E-01	2.64E-01	1.24E-01	1.09E-02	1.87E-03	1.77E-04
3	0	5.88E-02	4.77E-01	5.88E-01	5.81E-01	1.75E-01	7.89E-02	3.10E-02	8.64E-03	9.98E-04	2.80E-04	5.35E-05
3	1	4.76E-02	9.05E-01	1.49E+00	1.70E+00	6.69E-01	2.29E-01	6.77E-02	3.06E-02	4.59E-03	1.05E-03	1.01E-04
3	2	1.02E+00	2.67E-01	2.20E-01	2.29E-01	4.13E-01	2.66E-01	1.65E-01	8.50E-02	5.33E-03	5.41E-04	2.22E-05
4		1.74E+01	2.56E+01	2.47E+01	2.11E+01	4.00E+00	1.04E+00	3.49E-01	1.23E-01	8.11E-03	1.24E-03	1.02E-04
4	0	3.39E+00	1.88E+00	1.53E+00	1.27E+00	1.67E-01	6.00E-02	1.90E-02	5.57E-03	7.21E-04	2.00E-04	3.17E-05
4	1	6.96E+00	5.75E+00	5.41E+00	4.36E+00	6.12E-01	1.97E-01	5.00E-02	1.75E-02	2.80E-03	6.06E-04	5.33E-05
4	2	4.97E+00	1.63E+01	1.53E+01	1.25E+01	1.32E+00	1.93E-01	1.08E-01	5.30E-02	3.40E-03	3.63E-04	1.55E-05
4	3	2.06E+00	1.68E+00	2.43E+00	2.93E+00	1.90E+00	5.88E-01	1.72E-01	4.67E-02	1.19E-03	7.57E-05	1.87E-06
5		6.88E+01	6.82E+01	5.84E+01	4.67E+01	5.93E+00	1.22E+00	3.37E-01	1.12E-01	6.29E-03	8.81E-04	6.34E-05
5	0	6.86E+00	1.72E+00	1.22E+00	1.04E+00	1.48E-01	4.85E-02	1.49E-02	4.86E-03	5.07E-04	1.39E-04	1.97E-05
5	1	1.33E+01	5.46E+00	4.03E+00	2.88E+00	6.21E-01	1.81E-01	4.10E-02	1.44E-02	2.05E-03	4.14E-04	3.21E-05
5	2	1.51E+01	1.40E+01	1.13E+01	8.62E+00	1.16E+00	1.82E-01	7.17E-02	4.07E-02	2.51E-03	2.54E-04	9.99E-06
5	3	2.01E+01	3.15E+01	2.47E+01	1.85E+01	1.31E+00	3.37E-01	1.25E-01	3.72E-02	1.06E-03	6.60E-05	1.49E-06
5	4	1.34E+01	1.55E+01	1.72E+01	1.57E+01	2.69E+00	4.68E-01	8.40E-02	1.50E-02	1.63E-04	7.64E-06	1.62E-07
6		6.81E+01	6.25E+01	5.16E+01	4.09E+01	5.93E+00	1.20E+00	2.98E-01	1.03E-01	5.19E-03	6.96E-04	4.35E-05
6	0	3.16E+00	5.07E-01	6.17E-01	6.26E-01	1.16E-01	4.32E-02	1.28E-02	4.92E-03	3.98E-04	1.02E-04	1.34E-05
6	1	7.87E+00	2.44E+00	2.06E+00	1.79E+00	5.89E-01	1.70E-01	3.18E-02	1.42E-02	1.66E-03	3.18E-04	2.18E-05
6	2	1.17E+01	4.83E+00	4.62E+00	4.61E+00	9.56E-01	1.72E-01	5.00E-02	3.38E-02	2.05E-03	2.10E-04	7.09E-06
6	3	1.13E+01	1.21E+01	9.69E+00	8.38E+00	1.11E+00	2.79E-01	9.70E-02	3.19E-02	8.97E-04	5.60E-05	1.07E-06
6	4	1.64E+01	1.56E+01	1.13E+01	8.17E+00	1.84E+00	3.50E-01	8.22E-02	1.53E-02	1.72E-04	8.62E-06	1.29E-07
6	5	1.77E+01	2.70E+01	2.33E+01	1.73E+01	1.32E+00	1.86E-01	2.45E-02	2.85E-03	1.73E-05	8.96E-07	4.36E-08
7		2.15E+01	2.89E+01	2.45E+01	2.36E+01	5.81E+00	1.27E+00	2.95E-01	1.05E-01	4.84E-03	5.95E-04	3.39E-05
7	0	5.18E-01	2.72E-01	2.83E-01	3.96E-01	1.16E-01	4.71E-02	1.30E-02	5.23E-03	3.82E-04	8.59E-05	9.95E-06
7	1	1.35E+00	8.50E-01	1.30E+00	1.14E+00	6.00E-01	1.89E-01	3.14E-02	1.47E-02	1.52E-03	2.60E-04	1.67E-05
7	2	3.03E+00	1.80E+00	2.04E+00	2.79E+00	9.92E-01	2.09E-01	4.53E-02	3.08E-02	1.88E-03	1.86E-04	6.04E-06
7	3	2.94E+00	3.67E+00	4.78E+00	4.60E+00	1.25E+00	3.14E-01	9.32E-02	3.37E-02	8.55E-04	5.33E-05	1.03E-06
7	4	5.02E+00	5.26E+00	5.07E+00	4.37E+00	1.40E+00	2.90E-01	7.75E-02	1.67E-02	1.86E-04	8.51E-06	1.38E-07
7	5	5.67E+00	8.24E+00	6.27E+00	5.84E+00	9.75E-01	1.63E-01	2.90E-02	3.79E-03	1.61E-05	6.57E-07	2.05E-08
7	6	3.00E+00	8.77E+00	4.74E+00	4.43E+00	4.73E-01	5.78E-02	5.36E-03	4.49E-04	1.23E-06	1.42E-07	3.36E-09
8		9.77E+00	6.78E+00	9.88E+00	1.21E+01	6.05E+00	1.59E+00	4.28E-01	1.66E-01	5.97E-03	6.49E-04	3.06E-05
8	0	2.03E-01	1.00E-01	1.41E-01	2.43E-01	1.34E-01	5.00E-02	1.30E-02	7.89E-03	4.49E-04	8.99E-05	8.62E-06
8	1	4.37E-01	2.56E-01	4.89E-01	5.00E-01	5.33E-01	1.71E-01	3.98E-02	2.26E-02	1.59E-03	2.49E-04	1.43E-05
8	2	8.39E-01	5.00E-01	8.64E-01	1.49E+00	6.94E-01	1.73E-01	6.04E-02	4.12E-02	2.29E-03	2.19E-04	6.10E-06
8	3	1.61E+00	9.38E-01	1.44E+00	1.48E+00	1.11E+00	4.25E-01	1.35E-01	5.42E-02	1.24E-03	7.48E-05	1.38E-06
8	4	2.04E+00	1.71E+00	2.04E+00	2.55E+00	1.72E+00	4.43E-01	1.19E-01	3.14E-02	3.49E-04	1.50E-05	2.01E-07
8	5	1.47E+00	1.76E+00	2.53E+00	3.42E+00	1.27E+00	2.51E-01	5.11E-02	7.96E-03	4.24E-05	1.44E-06	2.20E-08
8	6	1.86E+00	6.59E-01	1.42E+00	1.46E+00	4.80E-01	6.12E-02	9.37E-03	9.54E-04	5.75E-06	1.50E-07	5.38E-09
8	7	1.31E+00	8.57E-01	9.56E-01	9.27E-01	1.10E-01	1.40E-02	8.11E-04	9.08E-05	1.12E-06	9.05E-08	1.75E-09

A.2 C^{6+} + $H(n = 1, 2)$

Table A.8 C^{6+} + H(1s)

Table A.9 C^{6+} + H(2s)

Table A.10 C^{6+} + H(2p0)

Table A.11 C^{6+} + H(2p1)

Table A.12 C^{6+} + H(2p-1)

Table A.13 C^{6+} + H(2p)

Table A.14 C^{6+} + H($n = 2$)

Table A.8: Data for C^{6+} + H(1s)

		impact energies [kev/amu]										
		1.0	5.0	7.0	10.0	25.0	45.0	90.	100.	150.	250.	500.
		total cross sections										
CX		4.11E+1	4.67E+1	4.78E+1	4.70E+1	4.12E+1	3.03E+1	9.42E+0	7.20E+0	2.18E+0	2.34E-1	1.37E-2
ION		3.29E-4	8.18E-3	2.19E-2	3.63E-2	2.07E-1	2.00E+0	1.41E+1	1.61E+1	1.96E+1	1.67E+1	1.14E+1
		state resolved CX cross sections										
n	*ℓ*											
2		3.03E-06	2.19E-06	1.88E-05	1.68E-04	9.79E-03	3.33E-02	5.41E-02	5.88E-02	5.83E-02	1.04E-02	2.79E-03
2	0	1.28E-06	1.48E-06	7.04E-06	3.90E-05	4.14E-03	1.30E-02	1.90E-02	2.18E-02	1.74E-02	1.37E-03	4.22E-04
2	1	1.75E-06	7.10E-07	1.18E-05	1.29E-04	5.65E-03	2.04E-02	3.51E-02	3.70E-02	4.10E-02	9.05E-03	2.37E-03
3		4.93E-03	8.64E-01	1.37E+00	1.89E+00	3.27E+00	2.65E+00	1.08E+00	8.68E-01	3.42E-01	4.13E-02	3.38E-03
3	0	7.53E-04	2.23E-01	3.07E-01	3.53E-01	3.65E-01	1.90E-01	5.64E-02	5.14E-02	2.36E-02	7.93E-04	3.69E-04
3	1	2.36E-03	4.34E-01	6.62E-01	8.43E-01	1.19E+00	8.21E-01	1.84E-01	1.28E-01	4.57E-02	6.45E-03	1.61E-03
3	2	1.82E-03	2.07E-01	4.00E-01	6.97E-01	1.72E+00	1.64E+00	8.35E-01	6.88E-01	2.73E-01	3.40E-02	1.40E-03
4		3.50E+01	3.51E+01	3.32E+01	3.00E+01	1.80E+01	8.05E+00	1.84E+00	1.40E+00	3.97E-01	4.61E-02	2.42E-03
4	0	2.14E+00	1.68E+00	1.33E+00	8.59E-01	3.13E-01	1.41E-01	5.58E-02	4.90E-02	1.37E-02	6.89E-04	2.62E-04
4	1	6.35E+00	6.56E+00	5.01E+00	3.49E+00	1.50E+00	6.64E-01	1.23E-01	8.34E-02	4.35E-02	5.13E-03	9.69E-04
4	2	1.26E+01	1.31E+01	1.24E+01	1.01E+01	4.64E+00	1.65E+00	4.89E-01	4.17E-01	1.44E-01	2.11E-02	8.72E-04
4	3	1.39E+01	1.37E+01	1.45E+01	1.55E+01	1.15E+01	5.59E+00	1.17E+00	8.52E-01	1.96E-01	1.92E-02	3.20E-04
5		6.00E+00	9.93E+00	1.18E+01	1.36E+01	1.22E+01	7.23E+00	1.74E+00	1.29E+00	3.48E-01	3.87E-02	1.62E-03
5	0	8.31E-01	1.90E-01	1.71E-01	1.52E-01	1.45E-01	8.92E-02	5.53E-02	4.47E-02	1.02E-02	5.56E-04	1.82E-04
5	1	1.62E+00	6.09E-01	5.88E-01	6.08E-01	5.70E-01	4.09E-01	7.39E-02	6.24E-02	3.28E-02	4.71E-03	6.02E-04
5	2	1.63E+00	1.33E+00	1.31E+00	1.29E+00	1.56E+00	9.12E-01	3.93E-01	3.14E-01	1.16E-01	1.39E-02	5.33E-04
5	3	1.31E+00	3.42E+00	3.73E+00	3.71E+00	3.18E+00	2.11E+00	6.14E-01	4.62E-01	1.22E-01	1.52E-02	2.68E-04
5	4	6.00E-01	4.38E+00	6.00E+00	7.80E+00	6.77E+00	3.72E+00	6.07E-01	4.11E-01	6.69E-02	4.35E-03	3.81E-05
6		1.03E-01	7.40E-01	1.10E+00	1.17E+00	4.61E+00	4.67E+00	1.33E+00	1.01E+00	2.64E-01	2.90E-02	1.11E-03
6	0	7.19E-03	1.58E-02	3.10E-02	2.30E-02	5.38E-02	6.35E-02	3.34E-02	2.99E-02	6.67E-03	3.62E-04	1.29E-04
6	1	1.88E-02	5.25E-02	7.32E-02	6.59E-02	2.30E-01	2.26E-01	5.46E-02	4.96E-02	3.04E-02	3.25E-03	3.94E-04
6	2	1.97E-02	6.00E-02	8.27E-02	1.15E-01	5.37E-01	5.44E-01	2.35E-01	2.08E-01	6.98E-02	8.66E-03	3.42E-04
6	3	2.71E-02	1.23E-01	1.05E-01	1.68E-01	9.74E-01	1.02E+00	4.08E-01	3.08E-01	8.19E-02	1.14E-02	1.97E-04
6	4	1.79E-02	2.62E-01	3.76E-01	2.94E-01	1.35E+00	1.59E+00	4.18E-01	2.92E-01	6.04E-02	4.68E-03	4.18E-05
6	5	1.21E-02	2.27E-01	4.31E-01	5.00E-01	1.47E+00	1.22E+00	1.79E-01	1.18E-01	1.47E-02	6.47E-04	2.84E-06
7		7.08E-03	9.56E-02	1.95E-01	2.20E-01	1.71E+00	2.88E+00	1.00E+00	7.35E-01	2.21E-01	2.15E-02	7.78E-04
7	0	7.04E-04	4.52E-03	1.10E-02	8.29E-03	2.44E-02	3.53E-02	2.82E-02	1.83E-02	6.59E-03	1.95E-04	9.42E-05
7	1	1.53E-03	1.17E-02	2.42E-02	1.95E-02	9.79E-02	1.54E-01	5.16E-02	3.65E-02	2.66E-02	1.92E-03	2.70E-04
7	2	9.70E-04	1.38E-02	2.40E-02	2.38E-02	2.16E-01	2.97E-01	1.78E-01	1.28E-01	6.21E-02	5.66E-03	2.30E-04
7	3	9.14E-04	2.59E-02	3.08E-02	3.07E-02	3.52E-01	6.00E-01	2.55E-01	2.16E-01	5.82E-02	8.62E-03	1.43E-04
7	4	1.21E-03	2.09E-02	3.20E-02	4.13E-02	4.10E-01	8.15E-01	2.94E-01	2.08E-01	4.54E-02	4.11E-03	3.65E-05
7	5	1.06E-03	1.16E-02	3.67E-02	3.09E-02	4.19E-01	7.28E-01	1.56E-01	1.04E-01	1.63E-02	8.62E-04	3.92E-06
7	6	6.85E-04	7.14E-03	3.60E-02	6.51E-02	1.87E-01	2.50E-01	3.96E-02	2.45E-02	5.37E-03	1.11E-04	1.67E-07
8		1.23E-03	3.45E-02	8.10E-02	8.43E-02	7.20E-01	1.82E+00	7.91E-01	5.69E-01	1.69E-01	1.62E-02	5.67E-04
8	0	1.33E-04	1.14E-03	6.30E-03	4.44E-03	1.38E-02	2.68E-02	2.35E-02	1.63E-02	4.52E-03	1.02E-04	7.07E-05
8	1	1.65E-04	2.85E-03	1.19E-02	9.88E-03	4.49E-02	1.01E-01	3.95E-02	3.00E-02	2.00E-02	1.24E-03	1.93E-04
8	2	1.95E-04	3.59E-03	1.05E-02	1.04E-02	1.06E-01	1.98E-01	1.43E-01	1.06E-01	4.18E-02	3.94E-03	1.61E-04
8	3	1.69E-04	1.15E-02	1.44E-02	1.22E-02	1.42E-01	3.41E-01	1.97E-01	1.47E-01	4.50E-02	6.39E-03	1.07E-04
8	4	1.50E-04	8.02E-03	1.39E-02	1.13E-02	1.62E-01	4.87E-01	2.03E-01	1.50E-01	3.63E-02	3.33E-03	3.04E-05
8	5	1.54E-04	3.78E-03	1.08E-02	1.27E-02	1.51E-01	4.21E-01	1.31E-01	8.57E-02	1.37E-02	9.43E-04	4.04E-06
8	6	1.45E-04	2.26E-03	5.96E-03	6.92E-03	8.04E-02	2.02E-01	4.09E-02	2.73E-02	3.21E-03	2.09E-04	2.72E-07
8	7	1.17E-04	1.34E-03	7.16E-03	1.64E-02	2.00E-02	4.41E-02	1.42E-02	6.22E-03	3.95E-03	1.22E-05	1.75E-08
9		7.29E-04	1.44E-02	3.87E-02	4.36E-02	3.55E-01	1.24E+00	6.21E-01	4.64E-01	1.40E-01	1.26E-02	4.27E-04
9	0	5.23E-05	3.70E-04	2.89E-03	2.78E-03	7.97E-03	1.91E-02	1.90E-02	1.48E-02	4.54E-03	5.78E-05	5.43E-05
9	1	8.05E-05	7.96E-04	5.24E-03	5.73E-03	2.57E-02	7.92E-02	3.17E-02	2.67E-02	1.90E-02	9.60E-04	1.43E-04
9	2	8.50E-05	1.63E-03	4.36E-03	5.76E-03	5.59E-02	1.27E-01	1.08E-01	9.28E-02	3.52E-02	2.78E-03	1.18E-04
9	3	9.70E-05	4.55E-03	6.89E-03	5.37E-03	6.79E-02	2.50E-01	1.53E-01	1.12E-01	3.34E-02	4.72E-03	8.20E-05
9	4	8.29E-05	2.48E-03	6.36E-03	5.30E-03	7.55E-02	3.02E-01	1.53E-01	1.13E-01	2.93E-02	2.77E-03	2.52E-05
9	5	8.71E-05	1.58E-03	4.87E-03	5.31E-03	6.88E-02	2.65E-01	1.00E-01	6.98E-02	1.23E-02	1.00E-03	3.84E-06
9	6	8.34E-05	1.33E-03	3.36E-03	4.14E-03	3.63E-02	1.42E-01	3.63E-02	2.45E-02	3.07E-03	2.36E-04	3.24E-07
9	7	7.75E-05	1.17E-03	2.93E-03	4.31E-03	1.39E-02	4.41E-02	1.04E-02	6.72E-03	8.26E-04	3.05E-05	1.87E-08
9	8	8.30E-05	5.26E-04	1.82E-03	4.90E-03	3.20E-03	1.34E-02	9.49E-03	3.46E-03	2.97E-03	3.66E-06	6.44E-09
10		7.64E-04	6.85E-03	2.00E-02	2.76E-02	1.96E-01	9.03E-01	5.17E-01	3.96E-01	1.19E-01	1.01E-02	3.32E-04
10	0	3.08E-05	1.91E-04	9.28E-04	1.58E-03	4.91E-03	1.66E-02	1.62E-02	1.42E-02	3.70E-03	4.50E-05	4.22E-05
10	1	7.17E-05	4.88E-04	1.91E-03	4.01E-03	1.69E-02	6.64E-02	2.75E-02	2.92E-02	1.76E-02	8.53E-04	1.10E-04
10	2	9.72E-05	6.74E-04	1.83E-03	3.24E-03	3.14E-02	9.53E-02	8.67E-02	7.94E-02	2.85E-02	1.98E-03	8.93E-05
10	3	1.42E-04	1.49E-03	3.89E-03	3.04E-03	3.68E-02	1.71E-01	1.28E-01	8.78E-02	2.74E-02	3.56E-03	6.48E-05
10	4	8.74E-05	1.07E-03	2.97E-03	3.13E-03	4.20E-02	2.24E-01	1.23E-01	9.30E-02	2.50E-02	2.39E-03	2.13E-05
10	5	7.82E-05	8.66E-04	2.44E-03	3.27E-03	3.50E-02	1.76E-01	8.28E-02	5.81E-02	1.09E-02	9.99E-04	3.57E-06
10	6	6.93E-05	6.56E-04	2.33E-03	2.98E-03	1.81E-02	9.68E-02	3.35E-02	2.22E-02	2.86E-03	2.15E-04	3.49E-07
10	7	6.47E-05	6.34E-04	2.03E-03	2.05E-03	7.32E-03	3.54E-02	9.27E-03	7.13E-03	8.06E-04	5.65E-05	2.42E-08
10	8	5.45E-05	4.73E-04	9.82E-04	3.10E-03	2.10E-03	1.26E-02	4.47E-03	3.04E-03	4.47E-04	8.56E-06	4.99E-09
10	9	6.84E-05	3.11E-04	7.01E-04	1.22E-03	1.27E-03	9.30E-03	5.73E-03	1.81E-03	1.93E-03	3.19E-07	7.08E-09
11		5.77E-04	3.93E-03	1.26E-02	2.14E-02	1.88E-01	8.67E-01	4.51E-01	4.10E-01	1.18E-01	8.56E-03	2.70E-04
11	0	3.80E-05	2.91E-04	1.45E-03	2.51E-03	9.85E-03	3.10E-02	1.54E-02	2.01E-02	5.05E-03	5.43E-05	3.30E-05
11	1	6.27E-05	2.01E-04	6.93E-04	1.83E-03	2.02E-02	8.21E-02	2.78E-02	3.16E-02	1.75E-02	8.34E-04	8.79E-05
11	2	1.01E-04	4.23E-04	9.23E-04	2.28E-03	3.59E-02	1.21E-01	7.69E-02	9.71E-02	3.07E-02	1.45E-03	7.18E-05
11	3	8.57E-05	5.67E-04	2.15E-03	2.49E-03	3.57E-02	1.69E-01	1.04E-01	8.67E-02	2.51E-02	2.80E-03	5.26E-05
11	4	5.63E-05	7.18E-04	1.51E-03	2.56E-03	3.61E-02	1.98E-01	1.05E-01	7.96E-02	2.38E-02	2.17E-03	1.85E-05
11	5	4.30E-05	5.83E-04	1.30E-03	2.78E-03	2.72E-02	1.45E-01	6.94E-02	5.62E-02	1.14E-02	9.69E-04	3.49E-06
11	6	4.03E-05	3.29E-04	1.53E-03	2.20E-03	1.37E-02	7.59E-02	3.13E-02	2.45E-02	3.11E-03	1.91E-04	3.57E-07
11	7	2.68E-05	1.94E-04	1.32E-03	1.29E-03	6.05E-03	2.90E-02	1.05E-02	9.28E-03	6.94E-04	8.43E-05	3.22E-08
11	8	6.54E-05	1.85E-04	8.76E-04	1.78E-03	2.11E-03	8.34E-03	4.88E-03	2.50E-03	4.25E-04	1.19E-05	3.95E-09
11	9	2.68E-05	2.90E-04	5.37E-04	1.04E-03	6.64E-04	4.38E-03	3.27E-03	1.68E-03	4.24E-04	1.15E-06	5.04E-09
11	10	3.12E-05	1.52E-04	3.05E-04	6.44E-04	5.55E-04	2.71E-03	1.74E-03	4.37E-04	3.22E-04	4.26E-08	2.67E-06

Table A.9: Data for C^{6+} + H(2s)

		impact energies [kev/amu]										
		1.0	5.0	7.0	10.0	25.0	45.0	90.	100.	150.	250.	500.
		total cross sections										
CX		5.84E+02	4.77E+02	4.17E+02	3.21E+02	9.81E+01	2.46E+01	1.98E+00	1.35E+00	2.67E-01	3.07E-02	4.04E-03
ION		7.69E-01	2.15E+00	2.83E+00	6.70E+00	3.83E+01	5.93E+01	7.69E+01	7.60E+01	5.18E+01	7.45E+01	2.62E+01
		state resolved CX cross sections										
n	ℓ											
2		1.46E-04	1.66E-05	5.33E-05	1.14E-04	1.10E-04	7.57E-04	4.41E-03	3.40E-03	2.83E-03	1.55E-04	4.76E-04
2	0	6.52E-05	2.96E-06	1.17E-05	1.35E-05	3.18E-05	1.43E-04	1.38E-03	8.53E-04	1.34E-03	5.34E-05	4.70E-05
2	1	8.09E-05	1.36E-05	4.16E-05	1.01E-04	7.87E-05	6.13E-04	3.02E-03	2.55E-03	1.50E-03	1.02E-04	4.29E-04
3		9.74E-04	4.30E-04	7.75E-04	6.26E-03	5.10E-02	8.61E-02	3.82E-02	3.53E-02	1.90E-02	1.27E-03	7.30E-04
3	0	3.70E-04	1.20E-04	1.78E-04	1.12E-03	8.55E-03	5.40E-03	2.09E-03	1.03E-03	2.84E-03	1.40E-04	4.48E-05
3	1	2.18E-04	1.64E-04	2.10E-04	2.63E-03	1.70E-02	3.34E-02	1.61E-02	1.52E-02	1.46E-03	3.36E-04	3.25E-04
3	2	3.86E-04	1.46E-04	3.87E-04	2.51E-03	2.54E-02	4.73E-02	2.01E-02	1.91E-02	1.47E-02	7.96E-04	3.60E-04
4		2.38E-03	7.77E-02	1.52E-01	2.60E-01	3.64E-01	2.47E-01	1.06E-01	8.18E-02	2.70E-02	2.17E-03	6.55E-04
4	0	2.31E-04	7.16E-03	1.08E-02	1.85E-02	1.89E-02	2.28E-02	1.75E-03	1.58E-03	2.06E-03	2.34E-04	3.30E-05
4	1	8.13E-04	1.34E-02	2.57E-02	4.88E-02	4.71E-02	5.49E-02	3.05E-02	2.51E-02	2.34E-03	3.24E-04	2.14E-04
4	2	7.62E-04	2.80E-02	4.98E-02	7.81E-02	9.88E-02	7.93E-02	3.05E-02	2.17E-02	1.38E-02	7.96E-04	2.90E-04
4	3	5.76E-04	2.91E-02	6.54E-02	1.14E-01	1.99E-01	9.02E-02	4.30E-02	3.35E-02	8.86E-03	8.14E-04	1.18E-04
5		2.76E-01	2.44E+00	2.66E+00	2.71E+00	2.83E+00	1.16E+00	1.75E-01	1.25E-01	3.04E-02	3.10E-03	5.34E-04
5	0	9.50E-03	9.68E-02	9.66E-02	8.60E-02	6.00E-02	3.50E-02	2.46E-03	1.84E-03	2.26E-03	2.01E-04	2.27E-05
5	1	7.38E-02	3.18E-01	2.78E-01	2.91E-01	2.79E-01	5.02E-02	3.06E-02	2.45E-02	2.07E-03	2.55E-04	1.39E-04
5	2	3.72E-02	4.42E-01	3.95E-01	4.83E-01	6.36E-01	1.88E-01	2.58E-02	1.90E-02	1.25E-02	8.61E-04	2.20E-04
5	3	7.73E-02	6.72E-01	7.11E-01	6.63E-01	8.06E-01	4.11E-01	4.69E-02	3.89E-02	7.03E-03	9.93E-04	1.31E-04
5	4	7.80E-02	9.10E-01	1.18E+00	1.19E+00	1.05E+00	4.78E-01	6.90E-02	4.05E-02	6.49E-03	7.88E-04	2.14E-05
6		1.43E+01	2.27E+01	2.89E+01	2.98E+01	1.13E+01	2.49E+00	2.31E-01	1.48E-01	2.95E-02	3.87E-03	4.28E-04
6	0	3.97E-01	6.28E-01	6.66E-01	4.93E-01	6.93E-02	1.93E-02	3.07E-03	2.40E-03	1.66E-03	2.01E-04	1.65E-05
6	1	1.22E+00	1.95E+00	1.96E+00	1.95E+00	2.62E-01	6.00E-02	3.41E-02	2.20E-02	2.19E-03	3.06E-04	9.08E-05
6	2	2.40E+00	3.62E+00	4.25E+00	3.84E+00	6.74E-01	1.24E-01	2.00E-02	1.55E-02	9.44E-03	9.84E-04	1.67E-04
6	3	3.67E+00	4.75E+00	6.88E+00	5.97E+00	1.40E+00	3.30E-01	4.63E-02	3.50E-02	6.74E-03	1.19E-03	1.22E-04
6	4	1.76E+00	5.59E+00	8.63E+00	9.37E+00	3.81E+00	3.88E-01	4.85E-02	3.24E-02	5.22E-03	9.10E-04	2.92E-05
6	5	4.89E+00	6.14E+00	6.53E+00	8.21E+00	5.11E+00	1.57E+00	7.94E-02	4.05E-02	4.22E-03	2.78E-04	2.48E-06
7		1.24E+02	1.33E+02	1.12E+02	7.74E+01	1.75E+01	3.47E+00	2.51E-01	1.68E-01	2.83E-02	4.02E-03	3.43E-04
7	0	2.13E+00	8.53E-01	5.22E-01	2.80E-01	4.47E-02	1.78E-02	2.70E-03	2.92E-03	1.48E-03	2.06E-04	1.27E-05
7	1	6.47E+00	3.58E+00	2.24E+00	1.12E+00	2.19E-01	6.86E-02	2.58E-02	1.92E-02	1.86E-03	3.35E-04	6.16E-05
7	2	1.29E+01	8.95E+00	6.04E+00	2.99E+00	5.26E-01	1.15E-01	1.61E-02	1.46E-02	8.28E-03	1.00E-03	1.29E-04
7	3	1.77E+01	1.86E+01	1.43E+01	7.24E+00	9.88E-01	2.87E-01	3.83E-02	3.51E-02	6.01E-03	1.17E-03	1.05E-04
7	4	2.62E+01	3.17E+01	2.52E+01	1.67E+01	2.10E+00	3.44E-01	4.68E-02	3.09E-02	5.33E-03	7.87E-04	3.03E-05
7	5	4.05E+01	4.15E+01	3.60E+01	2.67E+01	3.12E+00	7.89E-01	7.29E-02	4.20E-02	3.73E-03	4.54E-04	4.09E-06
7	6	1.84E+01	2.77E+01	2.79E+01	2.24E+01	1.05E+01	1.85E+00	4.86E-02	2.29E-02	1.65E-03	7.44E-05	5.00E-07
8		3.18E+02	1.62E+02	1.18E+02	7.83E+01	1.84E+01	3.91E+00	2.47E-01	1.72E-01	2.64E-02	3.92E-03	2.78E-04
8	0	3.64E+00	3.50E-01	2.16E-01	1.51E-01	3.40E-02	2.49E-02	3.36E-03	2.86E-03	1.18E-03	1.96E-04	1.02E-05
8	1	1.03E+01	1.28E+00	9.73E-01	5.39E-01	2.16E-01	7.18E-02	1.81E-02	1.56E-02	1.85E-03	3.10E-04	4.36E-05
8	2	1.79E+01	3.08E+00	2.11E+00	1.38E+00	3.89E-01	1.43E-01	1.49E-02	1.32E-02	6.58E-03	9.49E-04	1.02E-04
8	3	2.16E+01	6.99E+00	5.13E+00	3.12E+00	8.46E-01	2.57E-01	3.07E-02	3.18E-02	5.67E-03	1.09E-03	8.84E-05
8	4	2.88E+01	1.67E+01	1.06E+01	7.07E+00	1.44E+00	2.95E-01	4.48E-02	3.19E-02	4.43E-03	7.19E-04	2.87E-05
8	5	5.53E+01	3.39E+01	2.28E+01	1.22E+01	2.07E+00	6.17E-01	6.09E-02	3.74E-02	4.32E-03	5.32E-04	4.57E-06
8	6	8.14E+01	5.33E+01	3.91E+01	2.12E+01	4.19E+00	1.37E+00	5.34E-02	3.01E-02	1.45E-03	1.17E-04	5.72E-07
8	7	9.94E+01	4.62E+01	3.72E+01	3.27E+01	9.20E+00	1.14E+00	2.06E-02	9.34E-03	9.27E-04	1.51E-05	4.36E-07
9		8.46E+01	9.40E+01	7.70E+01	5.79E+01	1.68E+01	4.13E+00	2.51E-01	1.74E-01	2.61E-02	3.85E-03	2.30E-04
9	0	1.15E+00	2.19E-01	2.34E-01	1.66E-01	5.65E-02	2.99E-02	4.33E-03	3.21E-03	1.10E-03	1.81E-04	8.42E-06
9	1	2.76E+00	7.93E-01	6.97E-01	5.24E-01	2.32E-01	7.58E-02	1.81E-02	1.40E-02	2.10E-03	2.81E-04	3.20E-05
9	2	3.72E+00	1.80E+00	1.85E+00	1.21E+00	4.45E-01	1.46E-01	1.56E-02	1.36E-02	6.34E-03	9.08E-04	8.23E-05
9	3	5.99E+00	2.93E+00	3.15E+00	2.38E+00	8.24E-01	2.34E-01	2.91E-02	2.92E-02	5.74E-03	1.06E-03	7.53E-05
9	4	9.62E+00	5.54E+00	6.25E+00	4.89E+00	1.32E+00	2.98E-01	4.25E-02	3.38E-02	4.55E-03	7.18E-04	2.64E-05
9	5	1.09E+01	1.14E+01	1.04E+01	7.54E+00	1.83E+00	5.83E-01	5.79E-02	3.50E-02	3.52E-03	5.38E-04	4.59E-06
9	6	1.68E+01	1.80E+01	1.54E+01	9.66E+00	2.88E+00	1.11E+00	5.10E-02	2.78E-02	1.55E-03	1.34E-04	5.17E-07
9	7	1.74E+01	2.42E+01	1.80E+01	1.42E+01	4.64E+00	1.18E+00	2.47E-02	1.37E-02	4.07E-04	3.55E-05	1.72E-07
9	8	1.61E+01	2.91E+01	2.09E+01	1.73E+01	4.59E+00	4.83E-01	7.53E-03	3.19E-03	7.44E-04	1.78E-06	3.12E-07
10		3.22E+01	4.59E+01	4.96E+01	4.23E+01	1.53E+01	4.06E+00	2.75E-01	1.86E-01	2.99E-02	3.95E-03	1.96E-04
10	0	1.71E-01	2.38E-01	2.54E-01	2.87E-01	8.16E-02	3.24E-02	5.37E-03	4.09E-03	1.38E-03	1.79E-04	7.99E-06
10	1	6.29E-01	5.85E-01	9.34E-01	7.27E-01	3.09E-01	9.73E-02	2.40E-02	1.69E-02	3.25E-03	2.87E-04	2.45E-05
10	2	8.39E-01	1.10E+00	1.24E+00	1.23E+00	5.81E-01	1.68E-01	1.93E-02	1.59E-02	6.89E-03	9.26E-04	6.90E-05
10	3	1.11E+00	1.87E+00	2.81E+00	2.33E+00	9.04E-01	2.66E-01	3.38E-02	3.14E-02	6.92E-03	1.09E-03	6.49E-05
10	4	1.49E+00	2.72E+00	3.61E+00	3.49E+00	1.32E+00	2.93E-01	4.58E-02	3.75E-02	5.30E-03	7.48E-04	2.41E-05
10	5	2.61E+00	4.68E+00	6.24E+00	5.44E+00	1.84E+00	4.94E-01	5.77E-02	3.50E-02	3.60E-03	5.15E-04	4.48E-06
10	6	4.70E+00	7.34E+00	6.75E+00	5.92E+00	2.36E+00	8.99E-01	4.96E-02	2.52E-02	1.51E-03	1.50E-04	5.35E-07
10	7	7.14E+00	7.53E+00	8.02E+00	7.78E+00	3.03E+00	1.02E+00	2.65E-02	1.42E-02	4.54E-04	5.27E-05	1.33E-07
10	8	7.74E+00	8.27E+00	9.10E+00	8.78E+00	3.24E+00	6.20E-01	9.52E-03	5.14E-03	1.88E-04	4.26E-06	1.50E-07
10	9	5.73E+00	1.16E+01	1.06E+01	6.36E+00	1.66E+00	1.71E-01	3.26E-03	1.13E-03	4.21E-04	3.45E-07	1.46E-07
11		9.75E+00	1.71E+01	2.84E+01	3.20E+01	1.54E+01	5.06E+00	4.06E-01	2.57E-01	4.79E-02	4.38E-03	1.72E-04
11	0	3.19E-01	2.04E-01	4.95E-01	5.21E-01	1.70E-01	1.12E-01	1.52E-02	1.03E-02	2.80E-03	1.99E-04	6.09E-06
11	1	1.42E-01	3.38E-01	8.86E-01	8.89E-01	3.58E-01	1.96E-01	3.90E-02	2.51E-02	5.18E-03	3.41E-04	1.87E-05
11	2	3.92E-01	6.66E-01	1.03E+00	1.82E+00	8.03E-01	3.43E-01	4.65E-02	3.25E-02	1.13E-02	1.03E-03	6.02E-05
11	3	5.52E-01	7.88E-01	2.21E+00	2.21E+00	1.25E+00	5.09E-01	5.90E-02	4.71E-02	1.16E-02	1.21E-03	5.86E-05
11	4	6.38E-01	1.15E+00	1.81E+00	2.66E+00	1.63E+00	5.02E-01	7.09E-02	5.22E-02	8.83E-03	8.27E-04	2.29E-05
11	5	8.55E-01	1.36E+00	3.15E+00	3.44E+00	2.21E+00	6.42E-01	7.47E-02	4.17E-02	5.06E-03	5.21E-04	4.28E-06
11	6	1.09E+00	2.20E+00	2.49E+00	3.66E+00	2.32E+00	9.14E-01	5.41E-02	2.50E-02	1.96E-03	1.80E-04	4.91E-07
11	7	1.43E+00	1.94E+00	3.54E+00	3.93E+00	2.49E+00	9.49E-01	2.94E-02	1.38E-02	7.14E-04	6.45E-05	1.03E-07
11	8	1.39E+00	2.04E+00	3.06E+00	4.69E+00	2.31E+00	6.08E-01	1.21E-02	6.19E-03	2.12E-04	7.15E-06	9.57E-08
11	9	1.61E+00	2.25E+00	4.65E+00	4.72E+00	1.35E+00	2.36E-01	4.23E-03	2.19E-03	1.39E-04	1.04E-06	1.17E-07
11	10	1.33E+00	4.17E+00	5.12E+00	3.48E+00	5.55E-01	4.96E-02	1.22E-03	3.74E-04	8.02E-05	2.24E-08	9.52E-07

Table A.10: Data for C^{6+} + H(2p0)

		impact energies [kev/amu]										
		1.0	5.0	7.0	10.0	25.0	45.0	90.	100.	150.	250.	500.
		total cross sections										
CX		5.59E+02	4.95E+02	4.39E+02	3.43E+02	9.60E+01	2.59E+01	4.04E+00	2.60E+00	5.28E-01	4.38E-02	5.03E-04
ION		3.45E-01	2.10E+00	2.87E+00	4.42E+00	2.76E+01	6.60E+01	8.72E+01	8.83E+01	6.94E+01	5.59E+01	4.24E+01
		state resolved CX cross sections										
n	*ℓ*											
2		2.24E-04	5.50E-06	1.19E-05	5.00E-05	1.79E-04	5.89E-04	3.86E-03	3.97E-03	3.44E-03	1.02E-03	2.46E-04
2	0	1.30E-04	2.97E-06	2.74E-06	9.08E-06	2.66E-05	2.23E-04	1.15E-03	1.49E-03	1.62E-03	1.33E-04	1.80E-05
2	1	9.39E-05	2.52E-06	9.17E-06	4.09E-05	1.53E-04	3.66E-04	2.71E-03	2.48E-03	1.82E-03	8.91E-04	2.28E-04
3		8.67E-04	1.79E-04	1.10E-03	3.28E-03	4.91E-02	8.00E-02	5.18E-02	4.96E-02	2.03E-02	2.92E-03	3.74E-04
3	0	3.39E-04	5.32E-05	2.12E-04	2.33E-04	3.89E-03	1.46E-02	3.67E-03	2.51E-03	9.98E-04	1.82E-04	2.25E-05
3	1	2.53E-04	6.70E-05	5.75E-04	1.16E-03	1.75E-02	2.67E-02	1.47E-02	1.42E-02	2.00E-03	5.49E-04	1.83E-04
3	2	2.74E-04	5.87E-05	3.14E-04	1.88E-03	2.77E-02	3.86E-02	3.34E-02	3.29E-02	1.73E-02	2.19E-03	1.69E-04
4		4.06E-03	7.04E-02	1.51E-01	3.04E-01	4.55E-01	4.08E-01	1.10E-01	9.11E-02	2.74E-02	3.15E-03	3.76E-04
4	0	6.61E-04	7.04E-03	1.09E-02	2.48E-02	2.42E-02	2.51E-02	3.24E-03	2.72E-03	1.62E-03	1.47E-04	1.77E-05
4	1	1.18E-03	1.22E-02	3.03E-02	5.95E-02	7.48E-02	7.70E-02	9.93E-03	7.52E-03	2.09E-03	2.98E-04	1.42E-04
4	2	1.28E-03	2.33E-02	5.09E-02	9.58E-02	9.16E-02	1.45E-01	3.17E-02	2.06E-02	1.18E-02	1.50E-03	1.67E-04
4	3	9.38E-04	2.78E-02	5.86E-02	1.23E-01	2.65E-01	1.61E-01	6.56E-02	6.02E-02	1.19E-02	1.20E-03	4.90E-05
5		3.00E-01	2.53E+00	3.65E+00	3.97E+00	1.79E+00	6.77E-01	1.29E-01	1.02E-01	2.56E-02	3.09E-03	3.53E-04
5	0	1.32E-02	9.94E-02	1.86E-01	2.15E-01	2.65E-02	1.43E-02	2.45E-03	2.17E-03	1.01E-03	1.80E-04	1.22E-05
5	1	7.57E-02	3.71E-01	5.31E-01	5.26E-01	1.07E-01	4.91E-02	1.09E-02	6.66E-03	9.53E-04	3.47E-04	1.03E-04
5	2	4.48E-02	4.96E-01	6.66E-01	6.65E-01	3.18E-01	8.62E-02	2.14E-02	1.60E-02	4.52E-03	1.18E-03	1.55E-04
5	3	8.42E-02	6.69E-01	9.65E-01	9.89E-01	5.68E-01	1.65E-01	3.02E-02	2.48E-02	1.10E-02	1.02E-03	7.22E-05
5	4	8.23E-02	8.95E-01	1.30E+00	1.58E+00	7.69E-01	3.62E-01	6.37E-02	5.21E-02	8.07E-03	3.65E-04	1.04E-05
6		9.27E+00	2.51E+01	2.27E+01	1.83E+01	4.57E+00	9.17E-01	1.30E-01	9.81E-02	2.88E-02	3.48E-03	3.17E-04
6	0	5.25E-01	5.96E-01	3.74E-01	2.11E-01	2.86E-02	9.05E-03	2.79E-03	2.19E-03	1.54E-03	2.34E-04	9.16E-06
6	1	1.54E+00	1.73E+00	1.29E+00	6.64E-01	1.03E-01	3.33E-02	5.51E-03	3.91E-03	2.09E-03	4.55E-04	7.33E-05
6	2	1.20E+00	3.09E+00	2.58E+00	1.72E+00	2.52E-01	8.22E-02	1.57E-02	9.59E-03	6.17E-03	1.14E-03	1.36E-04
6	3	2.92E+00	4.48E+00	4.05E+00	3.42E+00	5.88E-01	1.25E-01	1.23E-02	1.58E-02	7.04E-03	1.08E-03	7.99E-05
6	4	8.44E-01	6.87E+00	6.15E+00	6.04E+00	7.76E-01	2.37E-01	5.38E-02	4.24E-02	6.68E-03	4.44E-04	1.70E-05
6	5	2.23E+00	8.35E+00	8.30E+00	6.26E+00	2.82E+00	4.31E-01	4.00E-02	2.42E-02	5.27E-03	1.25E-04	1.58E-06
7		1.30E+02	9.58E+01	8.29E+01	5.79E+01	9.10E+00	1.52E+00	1.34E-01	1.06E-01	2.83E-02	3.88E-03	2.77E-04
7	0	2.90E+00	4.84E-01	4.01E-01	3.15E-01	5.24E-02	2.28E-02	3.65E-03	2.66E-03	1.27E-03	2.48E-04	7.56E-06
7	1	6.14E+00	1.78E+00	1.59E+00	1.03E+00	1.73E-01	9.68E-02	6.72E-03	5.17E-03	2.29E-03	4.76E-04	5.34E-05
7	2	1.00E+01	4.66E+00	3.60E+00	2.54E+00	4.54E-01	1.62E-01	1.39E-02	9.89E-03	4.29E-03	1.10E-03	1.17E-04
7	3	1.84E+01	1.08E+01	8.30E+00	4.75E+00	7.30E-01	2.04E-01	1.29E-02	1.30E-02	6.60E-03	1.22E-03	7.65E-05
7	4	2.60E+01	2.06E+01	1.74E+01	1.01E+01	1.29E+00	2.56E-01	3.28E-02	3.20E-02	6.57E-03	5.90E-04	1.97E-05
7	5	2.11E+01	3.03E+01	2.89E+01	1.89E+01	1.93E+00	4.20E-01	3.80E-02	2.97E-02	4.37E-03	2.05E-04	2.59E-06
7	6	4.49E+01	2.71E+01	2.27E+01	2.02E+01	4.47E+00	3.61E-01	2.58E-02	1.31E-02	2.86E-03	3.08E-05	4.56E-07
8		3.05E+02	1.98E+02	1.55E+02	1.02E+02	1.32E+01	1.96E+00	1.43E-01	1.22E-01	3.16E-02	4.27E-03	2.40E-04
8	0	3.23E+00	5.55E-01	3.82E-01	2.74E-01	8.99E-02	1.55E-02	3.35E-03	3.31E-03	1.61E-03	2.48E-04	6.66E-06
8	1	9.52E+00	1.88E+00	1.71E+00	1.36E+00	2.03E-01	8.03E-02	8.09E-03	7.61E-03	3.69E-03	4.71E-04	4.04E-05
8	2	1.56E+01	4.63E+00	4.25E+00	2.72E+00	6.09E-01	1.05E-01	1.50E-02	1.39E-02	5.18E-03	1.08E-03	9.95E-05
8	3	2.41E+01	1.05E+01	8.62E+00	5.90E+00	9.08E-01	1.38E-01	1.90E-02	1.59E-02	6.20E-03	1.41E-03	6.97E-05
8	4	4.12E+01	2.20E+01	1.64E+01	9.65E+00	1.30E+00	3.21E-01	3.41E-02	2.96E-02	6.58E-03	7.56E-04	2.02E-05
8	5	6.10E+01	4.07E+01	2.83E+01	1.73E+01	2.12E+00	5.31E-01	3.50E-02	3.01E-02	4.36E-03	2.46E-04	3.06E-06
8	6	8.30E+01	6.25E+01	4.75E+01	2.41E+01	3.33E+00	4.63E-01	1.76E-02	1.44E-02	1.56E-03	5.62E-05	3.88E-07
8	7	6.69E+01	5.54E+01	4.77E+01	4.03E+01	4.69E+00	3.09E-01	1.07E-02	7.21E-03	2.41E-03	1.01E-05	3.17E-07
9		1.03E+02	1.32E+02	1.17E+02	9.44E+01	1.51E+01	2.33E+00	1.59E-01	1.32E-01	3.43E-02	4.66E-03	2.09E-04
9	0	9.87E-01	2.69E-01	2.89E-01	2.64E-01	1.03E-01	2.07E-02	4.68E-03	3.49E-03	1.55E-03	2.54E-04	5.99E-06
9	1	2.41E+00	9.18E-01	8.47E-01	8.38E-01	2.38E-01	1.01E-01	1.13E-02	9.08E-03	4.07E-03	4.88E-04	3.15E-05
9	2	3.61E+00	2.27E+00	2.81E+00	2.38E+00	5.77E-01	1.33E-01	1.98E-02	1.54E-02	5.25E-03	1.08E-03	8.52E-05
9	3	5.42E+00	4.55E+00	4.73E+00	3.91E+00	9.42E-01	1.60E-01	2.13E-02	1.68E-02	7.00E-03	1.57E-03	6.28E-05
9	4	7.40E+00	9.09E+00	8.80E+00	6.87E+00	1.08E+00	2.91E-01	3.35E-02	3.05E-02	7.54E-03	8.90E-04	1.97E-05
9	5	9.90E+00	1.56E+01	1.36E+01	1.01E+01	1.93E+00	4.08E-01	3.53E-02	3.04E-02	4.71E-03	2.71E-04	3.18E-06
9	6	1.60E+01	2.38E+01	1.92E+01	1.35E+01	2.75E+00	5.12E-01	2.01E-02	1.58E-02	1.96E-03	8.11E-05	3.38E-07
9	7	2.68E+01	3.71E+01	2.71E+01	1.61E+01	3.75E+00	4.58E-01	8.17E-03	7.28E-03	5.34E-04	2.30E-05	1.74E-07
9	8	3.09E+01	3.78E+01	3.96E+01	4.05E+01	3.69E+00	2.43E-01	4.50E-03	2.79E-03	1.70E-03	1.81E-06	3.07E-07
10		3.35E+01	4.14E+01	5.46E+01	6.19E+01	1.58E+01	2.60E+00	1.99E-01	1.50E-01	3.96E-02	5.10E-03	1.89E-04
10	0	3.01E-01	1.68E-01	2.37E-01	3.48E-01	1.73E-01	1.71E-02	4.80E-03	3.45E-03	1.60E-03	2.74E-04	6.04E-06
10	1	1.10E+00	4.85E-01	4.67E-01	4.70E-01	2.84E-01	1.02E-01	1.84E-02	1.36E-02	6.16E-03	5.42E-04	2.64E-05
10	2	1.28E+00	8.60E-01	1.20E+00	1.63E+00	6.82E-01	1.45E-01	2.71E-02	1.79E-02	6.38E-03	1.12E-03	7.72E-05
10	3	1.64E+00	1.84E+00	2.26E+00	2.09E+00	9.70E-01	1.70E-01	3.23E-02	2.02E-02	8.36E-03	1.71E-03	5.65E-05
10	4	2.27E+00	2.68E+00	3.41E+00	3.98E+00	1.03E+00	3.15E-01	4.19E-02	3.23E-02	8.26E-03	9.97E-04	1.87E-05
10	5	3.88E+00	4.67E+00	5.35E+00	4.91E+00	1.57E+00	4.18E-01	3.94E-02	3.16E-02	4.64E-03	3.00E-04	3.20E-06
10	6	6.17E+00	6.35E+00	6.59E+00	7.06E+00	2.17E+00	4.95E-01	2.01E-02	1.86E-02	2.02E-03	1.08E-04	3.46E-07
10	7	6.92E+00	7.18E+00	8.35E+00	7.34E+00	2.99E+00	4.89E-01	8.12E-03	7.86E-03	8.07E-04	3.48E-05	1.15E-07
10	8	5.89E+00	7.58E+00	7.78E+00	1.07E+01	3.85E+00	3.07E-01	3.45E-03	2.82E-03	3.44E-04	4.85E-06	1.17E-07
10	9	4.06E+00	9.60E+00	1.90E+01	2.34E+01	2.10E+00	1.42E-01	3.17E-03	1.33E-03	1.08E-03	3.05E-07	2.16E-07
11		1.01E+01	1.22E+01	2.04E+01	3.44E+01	1.57E+01	3.21E+00	3.14E-01	2.30E-01	5.89E-02	5.82E-03	1.73E-04
11	0	4.49E-01	1.82E-01	1.39E-01	2.04E-01	2.43E-01	4.62E-02	1.27E-02	9.86E-03	3.55E-03	3.16E-04	4.85E-06
11	1	2.14E-01	2.38E-01	5.00E-01	4.60E-01	4.33E-01	1.08E-01	2.66E-02	2.11E-02	8.36E-03	6.50E-04	2.00E-05
11	2	7.37E-01	5.36E-01	6.37E-01	1.24E+00	8.40E-01	2.76E-01	4.95E-02	3.68E-02	1.10E-02	1.24E-03	7.04E-05
11	3	8.95E-01	6.76E-01	1.28E+00	1.24E+00	1.16E+00	2.85E-01	5.60E-02	4.07E-02	1.40E-02	1.92E-03	5.38E-05
11	4	9.12E-01	1.16E+00	1.28E+00	2.08E+00	1.03E+00	4.01E-01	6.28E-02	4.90E-02	1.26E-02	1.14E-03	1.83E-05
11	5	9.11E-01	1.25E+00	2.03E+00	2.32E+00	1.31E+00	4.45E-01	5.87E-02	3.81E-02	5.68E-03	3.53E-04	3.07E-06
11	6	1.11E+00	1.87E+00	2.24E+00	3.55E+00	1.64E+00	5.33E-01	3.01E-02	1.79E-02	2.01E-03	1.37E-04	3.54E-07
11	7	1.22E+00	1.65E+00	2.74E+00	3.66E+00	2.26E+00	5.15E-01	1.01E-02	9.16E-03	6.85E-04	4.56E-05	8.48E-08
11	8	1.22E+00	1.59E+00	2.70E+00	4.01E+00	3.28E+00	3.66E-01	3.05E-03	4.57E-03	5.30E-04	9.12E-06	8.18E-08
11	9	1.31E+00	1.35E+00	2.73E+00	6.53E+00	2.56E+00	1.79E-01	2.49E-03	1.71E-03	1.61E-04	9.51E-07	1.62E-07
11	10	1.08E+00	1.67E+00	4.15E+00	9.15E+00	9.87E-01	5.60E-02	1.63E-03	7.56E-04	2.60E-04	4.11E-08	1.33E-06

Table A.11: Data for C^{6+} + H(2p1)

		impact energies [kev/amu]										
		1.0	5.0	7.0	10.0	25.0	45.0	90.	100.	150.	250.	500.
		total cross sections										
CX		5.59E+02	4.95E+02	4.39E+02	3.43E+02	9.60E+01	2.59E+01	4.04E+00	2.60E+00	5.28E-01	4.38E-02	5.03E-04
ION		3.45E-01	2.10E+00	2.87E+00	4.42E+00	2.76E+01	6.60E+01	8.72E+01	8.83E+01	6.94E+01	5.59E+01	4.24E+01
		state resolved CX cross sections										
n	ℓ											
2		3.23E-05	4.03E-06	1.44E-05	1.73E-05	1.57E-05	2.57E-04	6.96E-04	1.15E-03	1.19E-03	1.21E-03	2.19E-05
2	0	8.52E-06	2.58E-07	8.70E-07	1.80E-06	6.31E-06	4.25E-05	2.64E-04	5.03E-04	4.52E-04	2.08E-04	7.06E-06
2	1	2.38E-05	3.78E-06	1.36E-05	1.55E-05	9.43E-06	2.15E-04	4.32E-04	6.46E-04	7.39E-04	1.00E-03	1.48E-05
3		8.78E-05	6.26E-05	5.76E-05	2.85E-04	2.24E-02	4.94E-02	6.33E-02	5.33E-02	1.62E-02	4.53E-03	4.43E-05
3	0	1.87E-05	1.59E-05	1.44E-05	9.53E-05	4.39E-03	1.14E-02	4.40E-03	3.09E-03	5.55E-04	2.43E-04	5.39E-06
3	1	3.66E-05	2.78E-05	2.29E-05	1.11E-04	9.56E-03	2.16E-02	2.52E-02	2.02E-02	5.64E-03	7.43E-04	1.43E-05
3	2	3.24E-05	1.89E-05	2.03E-05	7.87E-05	8.46E-03	1.65E-02	3.37E-02	3.00E-02	1.00E-02	3.55E-03	2.46E-05
4		9.05E-04	1.24E-02	4.12E-02	1.54E-01	1.53E+00	1.09E+00	2.79E-01	1.64E-01	4.29E-02	5.58E-03	5.26E-05
4	0	1.24E-04	1.56E-03	6.91E-03	2.71E-02	1.49E-01	3.77E-02	1.37E-02	7.58E-03	1.74E-03	2.03E-04	3.75E-06
4	1	2.62E-04	5.83E-03	1.75E-02	5.66E-02	4.52E-01	1.46E-01	4.38E-02	2.85E-02	8.66E-03	5.67E-04	1.54E-05
4	2	1.67E-04	3.07E-03	1.14E-02	4.33E-02	5.35E-01	3.99E-01	6.93E-02	3.82E-02	1.41E-02	2.50E-03	2.23E-05
4	3	3.53E-04	1.95E-03	5.41E-03	2.72E-02	3.94E-01	5.10E-01	1.52E-01	8.96E-02	1.84E-02	2.31E-03	1.11E-05
5		1.34E-01	2.12E+00	4.27E+00	7.66E+00	8.50E+00	2.70E+00	3.97E-01	2.78E-01	3.86E-02	5.14E-03	6.02E-05
5	0	1.44E-02	2.80E-01	4.78E-01	7.57E-01	2.14E-01	5.10E-02	1.10E-02	9.35E-03	1.59E-03	1.56E-04	2.64E-06
5	1	1.39E-02	6.28E-01	1.17E+00	1.96E+00	7.26E-01	1.82E-01	3.46E-02	3.20E-02	6.58E-03	5.42E-04	1.33E-05
5	2	4.12E-02	6.67E-01	1.31E+00	2.28E+00	1.64E+00	3.39E-01	6.79E-02	5.52E-02	1.01E-02	1.64E-03	2.27E-05
5	3	3.84E-02	4.16E-01	8.76E-01	1.63E+00	3.02E+00	7.22E-01	1.28E-01	1.02E-01	1.26E-02	1.71E-03	1.61E-05
5	4	2.65E-02	1.29E-01	4.33E-01	1.02E+00	2.91E+00	1.41E+00	1.55E-01	8.03E-02	7.69E-03	1.08E-03	5.39E-06
6		1.01E+01	3.67E+01	4.32E+01	4.42E+01	1.31E+01	3.45E+00	4.14E-01	2.71E-01	5.09E-02	4.77E-03	6.26E-05
6	0	3.97E-01	1.98E+00	1.63E+00	1.01E+00	2.43E-01	6.27E-02	1.57E-02	8.89E-03	1.80E-03	1.42E-04	1.95E-06
6	1	6.78E-01	6.17E+00	5.86E+00	3.64E+00	7.55E-01	2.04E-01	4.83E-02	3.09E-02	7.55E-03	4.88E-04	1.14E-05
6	2	1.33E+00	9.21E+00	1.03E+01	8.04E+00	1.55E+00	3.63E-01	7.77E-02	5.20E-02	1.16E-02	1.26E-03	2.19E-05
6	3	1.59E+00	9.75E+00	1.15E+01	1.25E+01	2.50E+00	6.04E-01	1.09E-01	7.82E-02	1.53E-02	1.35E-03	1.76E-05
6	4	4.03E+00	6.30E+00	7.62E+00	1.02E+01	4.16E+00	7.77E-01	1.01E-01	6.61E-02	1.08E-02	1.21E-03	8.26E-06
6	5	2.07E+00	3.33E+00	6.26E+00	8.78E+00	3.85E+00	1.44E+00	6.23E-02	3.48E-02	3.84E-03	3.14E-04	1.54E-06
7		1.50E+02	1.08E+02	9.22E+01	5.99E+01	1.46E+01	3.57E+00	5.23E-01	2.90E-01	4.73E-02	4.52E-03	6.03E-05
7	0	3.32E+00	1.68E+00	1.21E+00	7.62E-01	2.29E-01	4.69E-02	1.85E-02	1.18E-02	1.64E-03	1.37E-04	1.55E-06
7	1	1.19E+01	6.00E+00	4.31E+00	2.80E+00	7.34E-01	1.53E-01	5.49E-02	4.02E-02	6.40E-03	4.38E-04	9.85E-06
7	2	2.15E+01	1.38E+01	9.71E+00	5.84E+00	1.38E+00	2.59E-01	1.01E-01	6.17E-02	1.05E-02	1.06E-03	2.00E-05
7	3	2.14E+01	2.16E+01	1.58E+01	1.03E+01	1.90E+00	4.75E-01	1.34E-01	7.89E-02	1.43E-02	1.15E-03	1.67E-05
7	4	2.36E+01	2.25E+01	1.99E+01	1.39E+01	2.65E+00	7.42E-01	1.28E-01	5.90E-02	9.42E-03	1.18E-03	9.04E-06
7	5	2.84E+01	1.44E+01	1.35E+01	1.23E+01	3.17E+00	6.76E-01	5.95E-02	2.76E-02	1.89E-03	5.01E-04	2.54E-06
7	6	4.03E+01	2.80E+01	2.78E+01	1.39E+01	4.53E+00	1.22E+00	2.80E-02	1.04E-02	3.11E-03	5.55E-05	6.23E-07
8		2.56E+02	1.59E+02	1.09E+02	6.96E+01	1.51E+01	3.82E+00	4.77E-01	3.05E-01	6.10E-02	4.39E-03	5.59E-05
8	0	3.71E+00	9.81E-01	8.34E-01	6.44E-01	2.30E-01	7.94E-02	1.54E-02	1.12E-02	2.27E-03	1.33E-04	1.30E-06
8	1	1.07E+01	3.34E+00	2.74E+00	2.14E+00	6.53E-01	2.41E-01	4.58E-02	3.80E-02	8.03E-03	4.23E-04	8.58E-06
8	2	1.78E+01	6.42E+00	5.72E+00	4.50E+00	1.25E+00	3.58E-01	8.21E-02	5.97E-02	1.28E-02	9.39E-04	1.78E-05
8	3	2.71E+01	1.18E+01	9.57E+00	6.63E+00	1.52E+00	5.30E-01	1.06E-01	7.73E-02	1.74E-02	1.09E-03	1.51E-05
8	4	3.11E+01	1.60E+01	1.28E+01	8.54E+00	1.95E+00	5.65E-01	1.11E-01	6.80E-02	1.29E-02	1.13E-03	8.88E-06
8	5	2.96E+01	1.77E+01	1.47E+01	1.08E+01	2.66E+00	3.57E-01	6.67E-02	3.20E-02	4.03E-03	5.53E-04	2.87E-06
8	6	4.75E+01	2.22E+01	1.48E+01	1.38E+01	1.79E+00	8.64E-01	2.72E-02	1.13E-02	1.40E-03	1.09E-04	7.05E-07
8	7	8.82E+01	8.06E+01	4.80E+01	2.25E+01	5.05E+00	8.22E-01	2.32E-02	7.85E-03	2.12E-03	1.09E-05	5.86E-07
9		1.19E+02	1.21E+02	9.89E+01	6.92E+01	1.47E+01	3.81E+00	5.00E-01	3.06E-01	6.39E-02	4.35E-03	5.11E-05
9	0	1.17E+00	6.01E-01	5.08E-01	5.36E-01	2.50E-01	6.43E-02	1.83E-02	1.10E-02	2.42E-03	1.34E-04	1.15E-06
9	1	3.13E+00	1.56E+00	1.71E+00	1.64E+00	6.38E-01	2.18E-01	5.50E-02	3.65E-02	8.20E-03	4.40E-04	7.57E-06
9	2	4.58E+00	3.21E+00	3.52E+00	3.54E+00	1.23E+00	2.81E-01	9.33E-02	5.72E-02	1.34E-02	8.62E-04	1.60E-05
9	3	6.11E+00	5.40E+00	5.54E+00	4.72E+00	1.30E+00	4.89E-01	1.12E-01	7.40E-02	1.78E-02	1.10E-03	1.36E-05
9	4	7.46E+00	7.44E+00	7.16E+00	5.93E+00	1.59E+00	5.55E-01	1.09E-01	6.98E-02	1.32E-02	1.10E-03	8.42E-06
9	5	1.00E+01	9.24E+00	8.01E+00	6.47E+00	2.13E+00	3.58E-01	6.06E-02	3.42E-02	4.13E-03	5.47E-04	2.90E-06
9	6	1.78E+01	1.18E+01	1.01E+01	6.63E+00	1.68E+00	5.24E-01	2.31E-02	1.05E-02	2.22E-03	1.47E-04	5.77E-07
9	7	3.30E+01	1.97E+01	1.85E+01	1.47E+01	2.40E+00	8.57E-01	1.34E-02	6.95E-03	4.38E-04	2.52E-05	2.87E-07
9	8	3.52E+01	6.23E+01	4.39E+01	2.49E+01	3.54E+00	4.59E-01	1.55E-02	5.44E-03	2.09E-03	1.60E-06	5.56E-07
10		2.03E+01	5.18E+01	6.17E+01	5.38E+01	1.40E+01	3.52E+00	5.31E-01	3.80E-01	7.91E-02	4.46E-03	4.77E-05
10	0	2.12E-01	2.68E-01	4.13E-01	4.66E-01	2.69E-01	6.48E-02	1.62E-02	1.32E-02	3.21E-03	1.47E-04	1.09E-06
10	1	7.31E-01	1.04E+00	1.04E+00	1.28E+00	6.43E-01	2.32E-01	6.22E-02	5.19E-02	1.16E-02	4.87E-04	7.05E-06
10	2	9.41E-01	1.55E+00	1.99E+00	2.40E+00	1.19E+00	2.78E-01	9.10E-02	7.08E-02	1.65E-02	8.42E-04	1.48E-05
10	3	1.10E+00	2.53E+00	3.24E+00	3.30E+00	1.18E+00	4.56E-01	1.22E-01	9.54E-02	2.22E-02	1.15E-03	1.26E-05
10	4	1.24E+00	3.33E+00	3.60E+00	3.85E+00	1.33E+00	4.69E-01	1.19E-01	8.41E-02	1.64E-02	1.08E-03	7.98E-06
10	5	1.88E+00	3.68E+00	4.52E+00	3.88E+00	1.80E+00	2.56E-01	6.58E-02	3.75E-02	5.29E-03	5.31E-04	2.89E-06
10	6	2.76E+00	4.51E+00	4.69E+00	4.22E+00	1.63E+00	3.78E-01	2.56E-02	1.27E-02	1.86E-03	1.72E-04	6.16E-07
10	7	3.67E+00	6.01E+00	6.81E+00	6.55E+00	1.61E+00	6.66E-01	1.28E-02	7.53E-03	3.90E-04	3.69E-05	2.22E-07
10	8	4.78E+00	9.95E+00	1.22E+01	1.18E+01	2.65E+00	4.96E-01	7.24E-03	4.53E-03	2.40E-04	4.39E-06	1.98E-07
10	9	2.99E+00	1.89E+01	2.31E+01	1.60E+01	1.71E+00	2.30E-01	9.45E-03	2.53E-03	1.49E-03	2.54E-07	3.21E-07
11		3.48E+00	1.61E+01	2.99E+01	3.87E+01	1.45E+01	3.91E+00	8.58E-01	5.55E-01	1.27E-01	4.87E-03	4.66E-05
11	0	1.34E-01	3.61E-01	5.06E-01	7.13E-01	4.82E-01	1.87E-01	5.41E-02	3.14E-02	7.18E-03	1.79E-04	1.05E-06
11	1	5.92E-02	5.03E-01	7.69E-01	1.19E+00	8.99E-01	3.16E-01	9.75E-02	6.20E-02	1.70E-02	5.79E-04	5.98E-06
11	2	2.29E-01	7.64E-01	1.32E+00	2.35E+00	1.50E+00	4.28E-01	1.67E-01	1.06E-01	2.69E-02	9.04E-04	1.40E-05
11	3	2.55E-01	1.20E+00	2.13E+00	2.90E+00	1.57E+00	5.11E-01	1.94E-01	1.34E-01	3.39E-02	1.28E-03	1.23E-05
11	4	2.54E-01	1.40E+00	2.08E+00	2.76E+00	1.40E+00	4.97E-01	1.78E-01	1.18E-01	2.60E-02	1.13E-03	7.98E-06
11	5	2.42E-01	1.36E+00	2.40E+00	2.43E+00	1.61E+00	2.93E-01	9.87E-02	5.92E-02	1.05E-02	5.46E-04	2.96E-06
11	6	4.18E-01	1.44E+00	1.98E+00	2.77E+00	1.55E+00	3.01E-01	3.76E-02	2.26E-02	4.01E-03	1.92E-04	6.58E-07
11	7	6.11E-01	1.47E+00	2.97E+00	2.92E+00	1.40E+00	5.72E-01	1.62E-02	1.15E-02	6.75E-04	4.53E-05	1.69E-07
11	8	5.62E-01	1.99E+00	3.51E+00	5.22E+00	1.83E+00	5.10E-01	6.14E-03	5.54E-03	4.00E-04	7.65E-06	1.25E-07
11	9	5.20E-01	2.22E+00	5.86E+00	8.01E+00	1.62E+00	2.16E-01	4.81E-03	2.73E-03	2.38E-04	7.69E-07	2.29E-07
11	10	1.97E-01	3.44E+00	6.34E+00	7.40E+00	6.02E-01	7.93E-02	3.36E-03	9.81E-04	3.19E-04	3.31E-08	1.12E-06

Table A.12: Data for C^{6+} + H(2p-1)

		impact energies [kev/amu]										
		1.0	5.0	7.0	10.0	25.0	45.0	90.	100.	150.	250.	500.
		total cross sections										
CX		5.67E+02	4.65E+02	4.11E+02	3.27E+02	8.49E+01	1.91E+01	1.68E+00	1.06E+00	1.71E-01	8.45E-03	1.77E-04
ION		7.17E-02	1.64E-01	5.91E-01	1.62E+00	1.35E+01	4.74E+01	7.96E+01	7.89E+01	6.35E+01	5.31E+01	2.72E+01
		state resolved CX cross sections										
n	ℓ											
2		5.28E-08	4.51E-10	1.06E-09	2.81E-09	7.67E-07	5.73E-05	5.70E-05	2.98E-05	1.62E-04	1.16E-05	2.59E-06
2	1	5.28E-08	4.51E-10	1.06E-09	2.81E-09	7.67E-07	5.73E-05	5.70E-05	2.98E-05	1.62E-04	1.16E-05	2.59E-06
3		8.48E-07	9.05E-07	9.50E-06	8.46E-05	5.09E-03	6.71E-03	6.83E-03	5.96E-03	2.04E-03	8.02E-05	1.13E-05
3	1	1.47E-07	4.22E-07	3.87E-06	2.89E-05	9.59E-04	1.45E-03	1.03E-03	7.21E-04	3.38E-04	3.22E-05	2.37E-06
3	2	7.01E-07	4.82E-07	5.63E-06	5.56E-05	4.13E-03	5.26E-03	5.80E-03	5.24E-03	1.70E-03	4.79E-05	8.89E-06
4		5.06E-05	7.18E-03	2.65E-02	7.50E-02	3.04E-01	2.02E-01	3.91E-02	3.03E-02	4.91E-03	3.41E-04	2.12E-05
4	1	1.00E-05	9.94E-04	3.18E-03	7.89E-03	1.28E-02	7.23E-03	3.13E-03	2.10E-03	8.61E-04	4.19E-05	1.67E-06
4	2	1.89E-05	3.19E-03	1.08E-02	2.83E-02	9.35E-02	4.41E-02	7.83E-03	7.69E-03	2.68E-03	4.62E-05	1.06E-05
4	3	2.17E-05	3.00E-03	1.25E-02	3.88E-02	1.97E-01	1.51E-01	2.82E-02	2.05E-02	1.37E-03	2.53E-04	8.89E-06
5		2.53E-02	1.46E+00	2.56E+00	3.80E+00	2.99E+00	8.51E-01	9.40E-02	5.77E-02	9.39E-03	6.97E-04	2.58E-05
5	1	2.81E-03	5.57E-02	8.37E-02	9.01E-02	3.10E-02	1.55E-02	6.25E-03	4.35E-03	1.15E-03	4.38E-05	1.03E-06
5	2	6.89E-03	2.58E-01	4.07E-01	5.00E-01	2.11E-01	7.69E-02	1.85E-02	1.55E-02	3.38E-03	5.90E-05	9.42E-06
5	3	8.77E-03	5.38E-01	9.26E-01	1.33E+00	6.74E-01	1.31E-01	4.79E-02	2.83E-02	2.69E-03	3.56E-04	1.22E-05
5	4	6.83E-03	6.08E-01	1.14E+00	1.88E+00	2.08E+00	6.28E-01	2.14E-02	9.50E-03	2.17E-03	2.38E-04	3.06E-06
6		6.52E+00	3.26E+01	3.55E+01	3.12E+01	8.44E+00	1.69E+00	1.46E-01	9.36E-02	1.44E-02	9.75E-04	2.56E-05
6	1	2.74E-01	3.05E-01	2.36E-01	1.40E-01	5.29E-02	2.30E-02	7.53E-03	5.41E-03	1.37E-03	4.39E-05	6.40E-07
6	2	7.96E-01	1.73E+00	1.49E+00	9.26E-01	3.02E-01	1.02E-01	2.27E-02	1.89E-02	4.09E-03	6.91E-05	7.70E-06
6	3	1.41E+00	5.36E+00	5.20E+00	3.56E+00	8.56E-01	1.51E-01	5.51E-02	3.61E-02	4.20E-03	4.00E-04	1.22E-05
6	4	2.46E+00	1.10E+01	1.19E+01	9.93E+00	1.89E+00	6.84E-01	4.37E-02	2.48E-02	3.84E-03	3.86E-04	4.62E-06
6	5	1.58E+00	1.42E+01	1.67E+01	1.67E+01	5.33E+00	7.31E-01	1.75E-02	8.30E-03	9.26E-04	7.57E-05	4.83E-07
7		1.42E+02	1.44E+02	1.12E+02	7.40E+01	1.32E+01	2.39E+00	1.76E-01	1.19E-01	2.02E-02	1.14E-03	2.32E-05
7	1	2.23E+00	3.06E-01	2.17E-01	1.49E-01	6.16E-02	3.07E-02	8.48E-03	6.01E-03	1.46E-03	4.33E-05	4.12E-07
7	2	8.00E+00	1.96E+00	1.35E+00	9.02E-01	3.39E-01	1.22E-01	2.61E-02	2.12E-02	4.52E-03	7.50E-05	6.17E-06
7	3	1.64E+01	7.33E+00	5.03E+00	3.26E+00	8.76E-01	1.86E-01	5.90E-02	4.16E-02	5.61E-03	4.11E-04	1.08E-05
7	4	2.65E+01	2.10E+01	1.43E+01	8.74E+00	1.82E+00	7.19E-01	5.49E-02	3.51E-02	5.94E-03	4.60E-04	4.96E-06
7	5	3.99E+01	4.59E+01	3.42E+01	1.86E+01	4.09E+00	8.52E-01	2.19E-02	1.21E-02	2.33E-03	1.41E-04	8.13E-07
7	6	4.90E+01	6.75E+01	5.72E+01	4.23E+01	6.05E+00	4.82E-01	6.04E-03	3.11E-03	2.85E-04	1.27E-05	5.07E-08
8		3.26E+02	1.68E+02	1.25E+02	8.45E+01	1.56E+01	2.86E+00	2.15E-01	1.38E-01	2.41E-02	1.23E-03	2.04E-05
8	1	2.05E+00	1.77E-01	1.39E-01	1.24E-01	5.80E-02	3.62E-02	9.89E-03	6.65E-03	1.47E-03	4.29E-05	2.76E-07
8	2	8.25E+00	1.05E+00	8.80E-01	6.93E-01	3.00E-01	1.40E-01	3.19E-02	2.33E-02	4.66E-03	7.95E-05	4.94E-06
8	3	1.91E+01	3.78E+00	3.16E+00	2.37E+00	8.29E-01	2.18E-01	6.81E-02	4.45E-02	6.40E-03	4.06E-04	9.33E-06
8	4	3.77E+01	1.07E+01	8.13E+00	5.98E+00	1.48E+00	7.09E-01	6.65E-02	4.09E-02	7.23E-03	4.89E-04	4.77E-06
8	5	6.18E+01	2.44E+01	1.81E+01	1.10E+01	3.42E+00	8.96E-01	2.73E-02	1.64E-02	3.47E-03	1.84E-04	9.67E-07
8	6	8.02E+01	4.80E+01	3.17E+01	2.03E+01	5.00E+00	6.26E-01	8.86E-03	6.06E-03	7.01E-04	2.72E-05	8.54E-08
8	7	1.17E+02	7.96E+01	6.28E+01	4.41E+01	4.53E+00	2.39E-01	2.41E-03	4.31E-04	1.55E-04	1.52E-06	1.14E-08
9		8.22E+01	8.31E+01	8.03E+01	6.62E+01	1.56E+01	3.28E+00	2.64E-01	1.60E-01	2.76E-02	1.28E-03	1.77E-05
9	1	3.80E-01	7.25E-02	7.86E-02	8.72E-02	5.43E-02	4.08E-02	1.09E-02	7.29E-03	1.49E-03	4.25E-05	1.92E-07
9	2	1.50E+00	4.82E-01	4.73E-01	4.62E-01	2.48E-01	1.65E-01	3.62E-02	2.55E-02	4.80E-03	8.30E-05	4.00E-06
9	3	3.40E+00	1.54E+00	1.61E+00	1.49E+00	7.47E-01	2.62E-01	7.66E-02	4.81E-02	7.15E-03	3.94E-04	7.97E-06
9	4	6.72E+00	4.05E+00	4.00E+00	3.59E+00	1.20E+00	7.48E-01	8.22E-02	4.81E-02	8.45E-03	4.99E-04	4.39E-06
9	5	1.22E+01	8.25E+00	7.99E+00	6.10E+00	2.57E+00	9.25E-01	3.99E-02	2.25E-02	4.45E-03	2.13E-04	1.01E-06
9	6	1.87E+01	1.40E+01	1.21E+01	1.04E+01	4.07E+00	6.73E-01	1.10E-02	6.99E-03	1.04E-03	4.03E-05	1.10E-07
9	7	1.94E+01	2.14E+01	1.81E+01	1.45E+01	4.33E+00	3.70E-01	5.46E-03	1.73E-03	1.76E-04	3.84E-06	1.01E-08
9	8	1.99E+01	3.33E+01	3.60E+01	2.96E+01	2.37E+00	9.75E-02	2.08E-03	3.07E-04	6.01E-05	1.73E-07	6.70E-09
10		8.74E+00	2.84E+01	3.93E+01	4.28E+01	1.50E+01	3.61E+00	3.21E-01	1.96E-01	3.13E-02	1.31E-03	1.54E-05
10	1	6.04E-02	4.00E-02	3.90E-02	6.26E-02	4.86E-02	4.24E-02	1.18E-02	8.10E-03	1.52E-03	4.28E-05	1.39E-07
10	2	1.92E-01	1.96E-01	2.64E-01	2.81E-01	2.18E-01	1.85E-01	4.03E-02	2.86E-02	4.98E-03	8.77E-05	3.29E-06
10	3	3.74E-01	6.64E-01	7.04E-01	9.38E-01	6.53E-01	2.95E-01	8.39E-02	5.46E-02	7.84E-03	3.85E-04	6.85E-06
10	4	5.85E-01	1.42E+00	1.93E+00	2.02E+00	1.05E+00	7.53E-01	9.88E-02	5.96E-02	9.59E-03	5.03E-04	4.00E-06
10	5	8.61E-01	2.86E+00	3.12E+00	3.27E+00	1.98E+00	9.75E-01	5.61E-02	3.16E-02	5.50E-03	2.34E-04	1.00E-06
10	6	1.41E+00	4.03E+00	4.95E+00	5.56E+00	3.31E+00	7.23E-01	1.72E-02	9.34E-03	1.51E-03	5.14E-05	1.25E-07
10	7	2.14E+00	5.37E+00	6.27E+00	5.96E+00	3.91E+00	4.30E-01	6.72E-03	3.27E-03	2.82E-04	6.39E-06	1.10E-08
10	8	2.05E+00	5.18E+00	7.63E+00	1.09E+01	2.84E+00	1.74E-01	4.09E-03	7.72E-04	4.03E-05	5.06E-07	4.10E-09
10	9	1.07E+00	8.65E+00	1.44E+01	1.38E+01	9.84E-01	3.29E-02	1.50E-03	2.71E-04	2.64E-05	1.83E-08	3.93E-09
11		9.01E-01	8.00E+00	1.58E+01	2.42E+01	1.37E+01	4.16E+00	4.16E-01	2.60E-01	3.70E-02	1.38E-03	1.37E-05
11	1	9.65E-03	2.14E-02	2.33E-02	4.93E-02	4.97E-02	4.42E-02	1.29E-02	8.71E-03	1.48E-03	4.39E-05	9.80E-08
11	2	2.95E-02	8.80E-02	1.56E-01	1.89E-01	2.11E-01	2.22E-01	4.96E-02	3.44E-02	5.45E-03	9.50E-05	2.77E-06
11	3	4.94E-02	2.76E-01	3.34E-01	6.09E-01	5.99E-01	3.70E-01	1.02E-01	6.73E-02	9.14E-03	3.87E-04	6.03E-06
11	4	7.60E-02	5.17E-01	9.51E-01	1.20E+00	9.91E-01	7.90E-01	1.27E-01	7.94E-02	1.14E-02	5.21E-04	3.70E-06
11	5	9.82E-02	9.40E-01	1.28E+00	1.81E+00	1.59E+00	1.07E+00	8.08E-02	4.75E-02	6.95E-03	2.59E-04	9.85E-07
11	6	1.15E-01	1.17E+00	2.11E+00	3.04E+00	2.57E+00	8.42E-01	2.81E-02	1.55E-02	2.09E-03	6.25E-05	1.34E-07
11	7	1.22E-01	1.46E+00	2.36E+00	2.83E+00	3.30E+00	5.11E-01	7.82E-03	4.59E-03	4.11E-04	9.04E-06	1.19E-08
11	8	1.33E-01	1.20E+00	2.29E+00	4.14E+00	2.76E+00	2.34E-01	4.10E-03	1.94E-03	6.22E-05	9.14E-07	3.20E-09
11	9	1.63E-01	1.19E+00	3.25E+00	6.12E+00	1.34E+00	6.45E-02	2.92E-03	9.00E-04	1.07E-05	5.70E-08	3.25E-09
11	10	1.06E-01	1.13E+00	3.08E+00	4.18E+00	3.07E-01	1.22E-02	9.06E-04	1.11E-04	1.46E-05	2.71E-09	1.65E-09

Table A.13: Data for C^{6+} + H(2p)

		impact energies [kev/amu]										
		1.0	5.0	7.0	10.0	25.0	45.0	90.	100.	150.	250.	500.
		total cross sections										
CX		5.72E+02	4.89E+02	4.36E+02	3.48E+02	8.56E+01	1.96E+01	2.36E+00	1.58E+00	3.33E-01	2.99E-02	1.14E-03
ION		4.15E-01	1.33E+00	1.92E+00	3.44E+00	2.07E+01	4.94E+01	7.40E+01	7.52E+01	6.16E+01	3.39E+01	3.36E+01
		state resolved CX cross sections										
n	ℓ											
2		8.53E-05	3.18E-06	8.78E-06	2.24E-05	6.53E-05	3.01E-04	1.54E-03	1.72E-03	1.60E-03	7.48E-04	9.01E-05
2	0	4.60E-05	1.08E-06	1.20E-06	3.63E-06	1.10E-05	8.86E-05	4.72E-04	6.64E-04	6.91E-04	1.14E-04	8.36E-06
2	1	3.92E-05	2.10E-06	7.58E-06	1.88E-05	5.43E-05	2.13E-04	1.07E-03	1.05E-03	9.06E-04	6.35E-04	8.17E-05
3		3.19E-04	8.08E-05	3.89E-04	1.22E-03	2.55E-02	4.54E-02	4.06E-02	3.63E-02	1.28E-02	2.51E-03	1.43E-04
3	0	1.19E-04	2.30E-05	7.55E-05	1.10E-04	2.76E-03	8.66E-03	2.69E-03	1.87E-03	5.17E-04	1.42E-04	9.28E-06
3	1	9.67E-05	3.17E-05	2.01E-04	4.34E-04	9.35E-03	1.66E-02	1.37E-02	1.17E-02	2.66E-03	4.41E-04	6.65E-05
3	2	1.02E-04	2.60E-05	1.13E-04	6.72E-04	1.34E-02	2.01E-02	2.43E-02	2.27E-02	9.67E-03	1.93E-03	6.75E-05
4		1.67E-03	3.00E-02	7.28E-02	1.78E-01	7.63E-01	5.68E-01	1.43E-01	9.50E-02	2.51E-02	3.02E-03	1.50E-04
4	0	2.62E-04	2.87E-03	5.92E-03	1.73E-02	5.77E-02	2.09E-02	5.66E-03	3.43E-03	1.12E-03	1.16E-04	7.14E-06
4	1	4.83E-04	6.35E-03	1.70E-02	4.13E-02	1.80E-01	7.69E-02	1.89E-02	1.27E-02	3.87E-03	3.02E-04	5.29E-05
4	2	4.89E-04	9.87E-03	2.44E-02	5.58E-02	2.40E-01	1.96E-01	3.63E-02	2.21E-02	9.53E-03	1.35E-03	6.67E-05
4	3	4.38E-04	1.09E-02	2.55E-02	6.32E-02	2.85E-01	2.74E-01	8.19E-02	5.68E-02	1.06E-02	1.25E-03	2.30E-05
5		1.53E-01	2.04E+00	3.49E+00	5.14E+00	4.43E+00	1.41E+00	2.07E-01	1.46E-01	2.45E-02	2.97E-03	1.46E-04
5	0	9.20E-03	1.27E-01	2.21E-01	3.24E-01	8.02E-02	2.18E-02	4.50E-03	3.84E-03	8.67E-04	1.12E-04	4.93E-06
5	1	3.08E-02	3.52E-01	5.96E-01	8.59E-01	2.88E-01	8.22E-02	1.72E-02	1.43E-02	2.89E-03	3.11E-04	3.91E-05
5	2	3.10E-02	4.74E-01	7.94E-01	1.15E+00	7.24E-01	1.67E-01	3.60E-02	2.89E-02	6.00E-03	9.60E-04	6.23E-05
5	3	4.38E-02	5.41E-01	9.22E-01	1.31E+00	1.42E+00	3.39E-01	6.87E-02	5.15E-02	8.79E-03	1.03E-03	3.35E-05
5	4	3.85E-02	5.44E-01	9.58E-01	1.49E+00	1.92E+00	8.00E-01	8.02E-02	4.73E-02	5.97E-03	5.62E-04	6.28E-06
6		8.63E+00	3.15E+01	3.38E+01	3.13E+01	8.69E+00	2.02E+00	2.30E-01	1.54E-01	3.14E-02	3.07E-03	1.35E-04
6	0	3.07E-01	8.59E-01	6.69E-01	4.08E-01	9.05E-02	2.39E-02	6.17E-03	3.69E-03	1.12E-03	1.25E-04	3.70E-06
6	1	8.32E-01	2.74E+00	2.46E+00	1.48E+00	3.04E-01	8.68E-02	2.05E-02	1.34E-02	3.67E-03	3.29E-04	2.84E-05
6	2	1.11E+00	4.67E+00	4.80E+00	3.56E+00	7.00E-01	1.82E-01	3.87E-02	2.69E-02	7.27E-03	8.24E-04	5.53E-05
6	3	1.98E+00	6.53E+00	6.92E+00	6.50E+00	1.31E+00	2.93E-01	5.88E-02	4.34E-02	8.85E-03	9.44E-04	3.65E-05
6	4	2.44E+00	8.05E+00	8.57E+00	8.74E+00	2.28E+00	5.66E-01	6.61E-02	4.44E-02	7.12E-03	6.81E-04	9.97E-06
6	5	1.96E+00	8.64E+00	1.04E+01	1.06E+01	4.00E+00	8.68E-01	3.99E-02	2.24E-02	3.34E-03	1.72E-04	1.20E-06
7		1.41E+02	1.16E+02	9.58E+01	6.39E+01	1.23E+01	2.49E+00	2.78E-01	1.71E-01	3.19E-02	3.18E-03	1.20E-04
7	0	2.07E+00	7.21E-01	5.37E-01	3.59E-01	9.39E-02	2.32E-02	7.38E-03	4.83E-03	9.72E-04	1.29E-04	3.04E-06
7	1	6.75E+00	2.69E+00	2.04E+00	1.33E+00	3.23E-01	9.34E-02	2.34E-02	1.71E-02	3.38E-03	3.19E-04	2.12E-05
7	2	1.32E+01	6.79E+00	4.88E+00	3.10E+00	7.25E-01	1.81E-01	4.69E-02	3.09E-02	6.45E-03	7.47E-04	4.77E-05
7	3	1.87E+01	1.32E+01	9.72E+00	6.12E+00	1.17E+00	2.88E-01	6.86E-02	4.45E-02	8.84E-03	9.28E-04	3.47E-05
7	4	2.54E+01	2.14E+01	1.72E+01	1.09E+01	1.92E+00	5.72E-01	7.17E-02	4.20E-02	7.31E-03	7.42E-04	1.13E-05
7	5	2.98E+01	3.02E+01	2.55E+01	1.66E+01	3.06E+00	6.49E-01	3.98E-02	2.31E-02	2.87E-03	2.82E-04	1.98E-06
7	6	4.47E+01	4.09E+01	3.59E+01	2.54E+01	5.02E+00	6.86E-01	2.00E-02	8.89E-03	2.09E-03	3.30E-05	3.76E-07
8		2.96E+02	1.75E+02	1.30E+02	8.52E+01	1.47E+01	2.88E+00	2.78E-01	1.89E-01	3.89E-02	3.30E-03	1.06E-04
8	0	2.31E+00	5.12E-01	4.05E-01	3.06E-01	1.07E-01	3.16E-02	6.26E-03	4.85E-03	1.29E-03	1.27E-04	2.65E-06
8	1	7.42E+00	1.80E+00	1.53E+00	1.21E+00	3.05E-01	1.19E-01	2.13E-02	1.74E-02	4.40E-03	3.13E-04	1.64E-05
8	2	1.39E+01	4.03E+00	3.62E+00	2.64E+00	7.21E-01	2.01E-01	4.30E-02	3.23E-02	7.55E-03	6.98E-04	4.08E-05
8	3	2.34E+01	8.72E+00	7.12E+00	4.97E+00	1.08E+00	2.95E-01	6.43E-02	4.59E-02	9.98E-03	9.66E-04	3.14E-05
8	4	3.67E+01	1.62E+01	1.25E+01	8.05E+00	1.57E+00	5.32E-01	7.04E-02	4.61E-02	8.92E-03	7.93E-04	1.13E-05
8	5	5.08E+01	2.76E+01	2.04E+01	1.30E+01	2.73E+00	5.95E-01	4.30E-02	2.61E-02	3.95E-03	3.28E-04	2.30E-06
8	6	7.02E+01	4.42E+01	3.13E+01	1.94E+01	3.37E+00	6.51E-01	1.79E-02	1.06E-02	1.22E-03	6.41E-05	3.93E-07
8	7	9.08E+01	7.19E+01	5.28E+01	3.56E+01	4.75E+00	4.57E-01	1.21E-02	5.16E-03	1.56E-03	7.52E-06	3.05E-07
9		1.01E+02	1.12E+02	9.87E+01	7.66E+01	1.51E+01	3.14E+00	3.08E-01	1.99E-01	4.19E-02	3.43E-03	9.26E-05
9	0	7.19E-01	2.90E-01	2.66E-01	2.66E-01	1.18E-01	2.83E-02	7.66E-03	4.83E-03	1.32E-03	1.29E-04	2.38E-06
9	1	1.97E+00	8.51E-01	8.80E-01	8.55E-01	3.10E-01	1.20E-01	2.57E-02	1.76E-02	4.58E-03	3.24E-04	1.31E-05
9	2	3.23E+00	1.99E+00	2.27E+00	2.13E+00	6.85E-01	1.93E-01	4.98E-02	3.27E-02	7.80E-03	6.75E-04	3.50E-05
9	3	4.98E+00	3.83E+00	3.96E+00	3.38E+00	9.95E-01	3.04E-01	7.00E-02	4.63E-02	1.06E-02	1.02E-03	2.81E-05
9	4	7.19E+00	6.86E+00	6.65E+00	5.46E+00	1.29E+00	5.31E-01	7.48E-02	4.95E-02	9.74E-03	8.29E-04	1.08E-05
9	5	1.07E+01	1.10E+01	9.87E+00	7.55E+00	2.21E+00	5.64E-01	4.52E-02	2.90E-02	4.43E-03	3.44E-04	2.36E-06
9	6	1.75E+01	1.65E+01	1.38E+01	1.02E+01	2.83E+00	5.70E-01	1.81E-02	1.11E-02	1.74E-03	8.95E-05	3.42E-07
9	7	2.64E+01	2.61E+01	2.12E+01	1.51E+01	3.49E+00	5.62E-01	9.00E-03	5.32E-03	3.83E-04	1.73E-05	1.57E-07
9	8	2.87E+01	4.45E+01	3.98E+01	3.17E+01	3.20E+00	2.67E-01	7.35E-03	2.85E-03	1.28E-03	1.19E-06	2.90E-07
10		2.09E+01	4.05E+01	5.19E+01	5.28E+01	1.49E+01	3.24E+00	3.50E-01	2.42E-01	5.00E-02	3.62E-03	8.40E-05
10	0	1.71E-01	1.45E-01	2.17E-01	2.71E-01	1.47E-01	2.73E-02	7.01E-03	5.54E-03	1.60E-03	1.40E-04	2.38E-06
10	1	6.32E-01	5.23E-01	5.16E-01	6.03E-01	3.25E-01	1.26E-01	3.08E-02	2.45E-02	6.44E-03	3.57E-04	1.12E-05
10	2	8.05E-01	8.69E-01	1.15E+00	1.44E+00	6.97E-01	2.03E-01	5.28E-02	3.91E-02	9.28E-03	6.84E-04	3.18E-05
10	3	1.04E+00	1.68E+00	2.07E+00	2.11E+00	9.35E-01	3.07E-01	7.95E-02	5.67E-02	1.28E-02	1.08E-03	2.53E-05
10	4	1.37E+00	2.48E+00	2.98E+00	3.29E+00	1.14E+00	5.12E-01	8.64E-02	5.86E-02	1.14E-02	8.61E-04	1.02E-05
10	5	2.21E+00	3.74E+00	4.33E+00	4.02E+00	1.78E+00	5.49E-01	5.38E-02	3.36E-02	5.15E-03	3.55E-04	2.37E-06
10	6	3.45E+00	4.96E+00	5.41E+00	5.61E+00	2.37E+00	5.32E-01	2.10E-02	1.36E-02	1.80E-03	1.10E-04	3.62E-07
10	7	4.25E+00	6.18E+00	7.14E+00	6.62E+00	2.84E+00	5.28E-01	9.21E-03	6.22E-03	4.93E-04	2.60E-05	1.16E-07
10	8	4.24E+00	7.57E+00	9.21E+00	1.11E+01	3.11E+00	3.25E-01	4.93E-03	2.71E-03	2.08E-04	3.25E-06	1.06E-07
10	9	2.71E+00	1.24E+01	1.88E+01	1.78E+01	1.60E+00	1.35E-01	4.70E-03	1.38E-03	8.67E-04	1.93E-07	1.80E-07
11		4.81E+00	1.21E+01	2.20E+01	3.24E+01	1.46E+01	3.76E+00	5.29E-01	3.48E-01	7.44E-02	4.02E-03	7.76E-05
11	0	1.94E-01	1.81E-01	2.15E-01	3.06E-01	2.41E-01	7.79E-02	2.23E-02	1.38E-02	3.58E-03	1.65E-04	1.97E-06
11	1	9.44E-02	2.54E-01	4.31E-01	5.67E-01	4.61E-01	1.56E-01	4.57E-02	3.06E-02	8.96E-03	4.24E-04	8.71E-06
11	2	3.32E-01	4.63E-01	7.04E-01	1.26E+00	8.50E-01	3.09E-01	8.87E-02	5.92E-02	1.45E-02	7.47E-04	2.91E-05
11	3	4.00E-01	7.17E-01	1.25E+00	1.58E+00	1.11E+00	3.89E-01	1.17E-01	8.06E-02	1.90E-02	1.20E-03	2.40E-05
11	4	4.14E-01	1.03E+00	1.44E+00	2.01E+00	1.14E+00	5.63E-01	1.23E-01	8.23E-02	1.66E-02	9.33E-04	1.00E-05
11	5	4.17E-01	1.18E+00	1.90E+00	2.19E+00	1.50E+00	6.03E-01	7.94E-02	4.83E-02	7.73E-03	3.86E-04	2.34E-06
11	6	5.47E-01	1.49E+00	2.11E+00	3.12E+00	1.92E+00	5.59E-01	3.19E-02	1.87E-02	2.70E-03	1.30E-04	3.82E-07
11	7	6.52E-01	1.52E+00	2.69E+00	3.13E+00	2.32E+00	5.33E-01	1.13E-02	8.43E-03	5.90E-04	3.33E-05	8.86E-08
11	8	6.36E-01	1.59E+00	2.83E+00	4.46E+00	2.62E+00	3.70E-01	4.43E-03	4.02E-03	3.31E-04	5.89E-06	7.02E-08
11	9	6.63E-01	1.59E+00	3.95E+00	6.89E+00	1.84E+00	1.53E-01	3.41E-03	1.78E-03	1.37E-04	5.93E-07	1.31E-07
11	10	4.63E-01	2.08E+00	4.52E+00	6.91E+00	6.32E-01	4.92E-02	1.97E-03	6.16E-04	1.98E-04	2.57E-08	8.14E-07

Table A.14: Data for C^{6+} + H($n=2$)

		impact energies [kev/amu]										
		1.0	5.0	7.0	10.0	25.0	45.0	90.	100.	150.	250.	500.
		total cross sections										
CX		5.75E+02	4.86E+02	4.31E+02	3.41E+02	8.87E+01	2.08E+01	2.27E+00	1.52E+00	3.16E-01	3.01E-02	1.87E-03
ION		4.77E-01	1.38E+00	1.85E+00	3.50E+00	2.13E+01	3.89E+01	5.37E+01	5.45E+01	4.11E+01	4.41E+01	2.30E+01
		state resolved CX cross sections										
n	ℓ											
2		1.00E-04	6.54E-06	1.99E-05	4.54E-05	7.66E-05	4.15E-04	2.26E-03	2.14E-03	1.91E-03	6.00E-04	1.87E-04
2	0	5.08E-05	1.55E-06	3.84E-06	6.10E-06	1.62E-05	1.02E-04	7.00E-04	7.11E-04	8.52E-04	9.86E-05	1.80E-05
2	1	4.97E-05	4.99E-06	1.61E-05	3.93E-05	6.04E-05	3.13E-04	1.56E-03	1.43E-03	1.05E-03	5.01E-04	1.69E-04
3		4.82E-04	1.68E-04	4.86E-04	2.48E-03	3.19E-02	5.56E-02	4.00E-02	3.60E-02	1.44E-02	2.20E-03	2.90E-04
3	0	1.82E-04	4.73E-05	1.01E-04	3.63E-04	4.21E-03	7.85E-03	2.54E-03	1.66E-03	1.10E-03	1.41E-04	1.82E-05
3	1	1.27E-04	6.48E-05	2.03E-04	9.82E-04	1.13E-02	2.08E-02	1.42E-02	1.26E-02	2.36E-03	4.15E-04	1.31E-04
3	2	1.73E-04	5.61E-05	1.81E-04	1.13E-03	1.64E-02	2.69E-02	2.32E-02	2.18E-02	1.09E-02	1.64E-03	1.41E-04
4		1.85E-03	4.19E-02	9.25E-02	1.98E-01	6.63E-01	4.88E-01	1.33E-01	9.17E-02	2.56E-02	2.81E-03	2.76E-04
4	0	2.54E-04	3.94E-03	7.13E-03	1.76E-02	4.80E-02	2.14E-02	4.68E-03	2.97E-03	1.35E-03	1.46E-04	1.36E-05
4	1	5.66E-04	8.12E-03	1.92E-02	4.32E-02	1.47E-01	7.14E-02	2.18E-02	1.58E-02	3.49E-03	3.08E-04	9.33E-05
4	2	5.57E-04	1.44E-02	3.07E-02	6.14E-02	2.05E-01	1.67E-01	3.48E-02	2.20E-02	1.06E-02	1.21E-03	1.22E-04
4	3	4.72E-04	1.55E-02	3.55E-02	7.59E-02	2.64E-01	2.28E-01	7.22E-02	5.10E-02	1.01E-02	1.14E-03	4.68E-05
5		1.84E-01	2.14E+00	3.28E+00	4.53E+00	4.03E+00	1.35E+00	1.99E-01	1.41E-01	2.60E-02	3.00E-03	2.43E-04
5	0	9.27E-03	1.19E-01	1.90E-01	2.65E-01	7.52E-02	2.51E-02	3.99E-03	3.34E-03	1.21E-03	1.34E-04	9.38E-06
5	1	4.15E-02	3.43E-01	5.16E-01	7.17E-01	2.86E-01	7.42E-02	2.06E-02	1.69E-02	2.69E-03	2.97E-04	6.41E-05
5	2	3.25E-02	4.66E-01	6.94E-01	9.83E-01	7.02E-01	1.72E-01	3.34E-02	2.64E-02	7.62E-03	9.35E-04	1.02E-04
5	3	5.22E-02	5.74E-01	8.70E-01	1.15E+00	1.27E+00	3.57E-01	6.33E-02	4.84E-02	8.35E-03	1.02E-03	5.80E-05
5	4	4.84E-02	6.35E-01	1.01E+00	1.42E+00	1.70E+00	7.19E-01	7.74E-02	4.56E-02	6.10E-03	6.19E-04	1.01E-05
6		1.01E+01	2.93E+01	3.26E+01	3.09E+01	9.35E+00	2.14E+00	2.30E-01	1.53E-01	3.09E-02	3.27E-03	2.08E-04
6	0	3.30E-01	8.01E-01	6.68E-01	4.29E-01	8.52E-02	2.28E-02	5.40E-03	3.37E-03	1.25E-03	1.44E-04	6.90E-06
6	1	9.28E-01	2.54E+00	2.34E+00	1.60E+00	2.93E-01	8.01E-02	2.39E-02	1.56E-02	3.30E-03	3.23E-04	4.40E-05
6	2	1.43E+00	4.41E+00	4.66E+00	3.63E+00	6.94E-01	1.68E-01	3.40E-02	2.40E-02	7.81E-03	8.64E-04	8.33E-05
6	3	2.40E+00	6.09E+00	6.91E+00	6.37E+00	1.34E+00	3.03E-01	5.57E-02	4.13E-02	8.32E-03	1.01E-03	5.78E-05
6	4	2.27E+00	7.43E+00	8.59E+00	8.89E+00	2.66E+00	5.22E-01	6.17E-02	4.15E-02	6.65E-03	7.38E-04	1.48E-05
6	5	2.69E+00	8.01E+00	9.44E+00	9.98E+00	4.28E+00	1.04E+00	4.98E-02	2.70E-02	3.57E-03	1.98E-04	1.52E-06
7		1.37E+02	1.20E+02	9.99E+01	6.73E+01	1.36E+01	2.74E+00	2.71E-01	1.71E-01	3.10E-02	3.39E-03	1.76E-04
7	0	2.09E+00	7.54E-01	5.33E-01	3.39E-01	8.16E-02	2.18E-02	6.21E-03	4.35E-03	1.10E-03	1.48E-04	5.45E-06
7	1	6.68E+00	2.92E+00	2.09E+00	1.27E+00	2.97E-01	8.72E-02	2.40E-02	1.76E-02	3.00E-03	3.23E-04	3.13E-05
7	2	1.31E+01	7.33E+00	5.17E+00	3.07E+00	6.75E-01	1.65E-01	3.92E-02	2.69E-02	6.91E-03	8.10E-04	6.81E-05
7	3	1.85E+01	1.46E+01	1.09E+01	6.40E+00	1.12E+00	2.88E-01	6.10E-02	4.22E-02	8.13E-03	9.88E-04	5.21E-05
7	4	2.56E+01	2.39E+01	1.92E+01	1.24E+01	1.97E+00	5.15E-01	6.55E-02	3.92E-02	6.82E-03	7.53E-04	1.60E-05
7	5	3.25E+01	3.30E+01	2.82E+01	1.91E+01	3.08E+00	6.84E-01	4.81E-02	2.79E-02	3.08E-03	3.25E-04	2.51E-06
7	6	3.82E+01	3.76E+01	3.39E+01	2.47E+01	6.40E+00	9.78E-01	2.71E-02	1.24E-02	1.98E-03	4.33E-05	4.07E-07
8		3.01E+02	1.72E+02	1.27E+02	8.35E+01	1.56E+01	3.14E+00	2.70E-01	1.84E-01	3.58E-02	3.45E-03	1.49E-04
8	0	2.64E+00	4.71E-01	3.58E-01	2.67E-01	8.86E-02	2.99E-02	5.54E-03	4.35E-03	1.27E-03	1.44E-04	4.53E-06
8	1	8.14E+00	1.67E+00	1.39E+00	1.04E+00	2.83E-01	1.07E-01	2.05E-02	1.70E-02	3.76E-03	3.12E-04	2.32E-05
8	2	1.49E+01	3.79E+00	3.24E+00	2.33E+00	6.38E-01	1.87E-01	3.60E-02	2.75E-02	7.31E-03	7.61E-04	5.61E-05
8	3	2.29E+01	8.29E+00	6.62E+00	4.50E+00	1.02E+00	2.85E-01	5.59E-02	4.24E-02	8.90E-03	9.97E-04	4.57E-05
8	4	3.47E+01	1.64E+01	1.20E+01	7.81E+00	1.54E+00	4.73E-01	6.40E-02	4.26E-02	7.80E-03	7.74E-04	1.57E-05
8	5	5.19E+01	2.92E+01	2.10E+01	1.28E+01	2.57E+00	6.00E-01	4.75E-02	2.90E-02	4.05E-03	3.79E-04	2.87E-06
8	6	7.30E+01	4.65E+01	3.32E+01	1.99E+01	3.58E+00	8.31E-01	2.68E-02	1.55E-02	1.28E-03	7.73E-05	4.38E-07
8	7	9.29E+01	6.55E+01	4.89E+01	3.49E+01	5.87E+00	6.26E-01	1.42E-02	6.21E-03	1.40E-03	9.41E-06	3.37E-07
9		9.72E+01	1.07E+02	9.33E+01	7.19E+01	1.56E+01	3.39E+00	2.93E-01	1.93E-01	3.80E-02	3.54E-03	1.27E-04
9	0	8.28E-01	2.72E-01	2.58E-01	2.41E-01	1.02E-01	2.87E-02	6.83E-03	4.43E-03	1.27E-03	1.42E-04	3.89E-06
9	1	2.17E+00	8.36E-01	8.34E-01	7.72E-01	2.91E-01	1.09E-01	2.38E-02	1.67E-02	3.96E-03	3.13E-04	1.78E-05
9	2	3.35E+00	1.94E+00	2.16E+00	1.90E+00	6.25E-01	1.81E-01	4.12E-02	2.79E-02	7.44E-03	7.33E-04	4.69E-05
9	3	5.23E+00	3.60E+00	3.76E+00	3.13E+00	9.52E-01	2.86E-01	5.98E-02	4.20E-02	9.42E-03	1.03E-03	3.99E-05
9	4	7.80E+00	6.53E+00	6.55E+00	5.32E+00	1.30E+00	4.73E-01	6.67E-02	4.56E-02	8.44E-03	8.01E-04	1.47E-05
9	5	1.08E+01	1.11E+01	1.00E+01	7.55E+00	2.12E+00	5.69E-01	4.84E-02	3.05E-02	4.20E-03	3.92E-04	2.92E-06
9	6	1.74E+01	1.69E+01	1.42E+01	1.00E+01	2.85E+00	7.04E-01	2.63E-02	1.53E-02	1.69E-03	1.01E-04	3.86E-07
9	7	2.41E+01	2.56E+01	2.04E+01	1.49E+01	3.78E+00	7.16E-01	1.29E-02	7.41E-03	3.89E-04	2.19E-05	1.61E-07
9	8	2.56E+01	4.07E+01	3.51E+01	2.81E+01	3.55E+00	3.21E-01	7.39E-03	2.93E-03	1.15E-03	1.34E-06	2.96E-07
10		2.37E+01	4.19E+01	5.13E+01	5.02E+01	1.50E+01	3.45E+00	3.31E-01	2.28E-01	4.50E-02	3.70E-03	1.12E-04
10	0	1.71E-01	1.68E-01	2.26E-01	2.75E-01	1.31E-01	2.86E-02	6.60E-03	5.18E-03	1.55E-03	1.50E-04	3.78E-06
10	1	6.31E-01	5.38E-01	6.21E-01	6.34E-01	3.21E-01	1.18E-01	2.91E-02	2.26E-02	5.64E-03	3.40E-04	1.45E-05
10	2	8.13E-01	9.27E-01	1.17E+00	1.39E+00	6.68E-01	1.94E-01	4.44E-02	3.33E-02	8.68E-03	7.45E-04	4.11E-05
10	3	1.05E+00	1.73E+00	2.25E+00	2.17E+00	9.27E-01	2.97E-01	6.81E-02	5.04E-02	1.13E-02	1.09E-03	3.52E-05
10	4	1.40E+00	2.54E+00	3.14E+00	3.34E+00	1.19E+00	4.57E-01	7.63E-02	5.33E-02	9.88E-03	8.33E-04	1.37E-05
10	5	2.31E+00	3.97E+00	4.81E+00	4.38E+00	1.80E+00	5.35E-01	5.47E-02	3.40E-02	4.76E-03	3.95E-04	2.89E-06
10	6	3.76E+00	5.56E+00	5.75E+00	5.69E+00	2.37E+00	6.24E-01	2.81E-02	1.65E-02	1.73E-03	1.20E-04	4.06E-07
10	7	4.97E+00	6.52E+00	7.36E+00	6.90E+00	2.88E+00	6.52E-01	1.35E-02	8.21E-03	4.83E-04	3.27E-05	1.20E-07
10	8	5.12E+00	7.75E+00	9.18E+00	1.05E+01	3.14E+00	3.99E-01	6.08E-03	3.32E-03	2.03E-04	3.50E-06	1.17E-07
10	9	3.46E+00	1.22E+01	1.68E+01	1.49E+01	1.61E+00	1.44E-01	4.34E-03	1.31E-03	7.55E-04	2.31E-07	1.72E-07
11		6.05E+00	1.34E+01	2.36E+01	3.23E+01	1.48E+01	4.09E+00	4.98E-01	3.25E-01	6.78E-02	4.11E-03	1.01E-04
11	0	2.25E-01	1.87E-01	2.85E-01	3.59E-01	2.24E-01	8.64E-02	2.05E-02	1.29E-02	3.38E-03	1.73E-04	3.00E-06
11	1	1.06E-01	2.75E-01	5.45E-01	6.48E-01	4.35E-01	1.66E-01	4.40E-02	2.92E-02	8.01E-03	4.03E-04	1.12E-05
11	2	3.47E-01	5.13E-01	7.85E-01	1.40E+00	8.38E-01	3.17E-01	7.82E-02	5.25E-02	1.37E-02	8.17E-04	3.69E-05
11	3	4.38E-01	7.34E-01	1.49E+00	1.74E+00	1.14E+00	4.19E-01	1.03E-01	7.22E-02	1.72E-02	1.20E-03	3.27E-05
11	4	4.70E-01	1.06E+00	1.53E+00	2.17E+00	1.26E+00	5.48E-01	1.10E-01	7.47E-02	1.47E-02	9.07E-04	1.32E-05
11	5	5.27E-01	1.23E+00	2.21E+00	2.50E+00	1.68E+00	6.13E-01	7.82E-02	4.66E-02	7.06E-03	4.20E-04	2.82E-06
11	6	6.84E-01	1.67E+00	2.21E+00	3.26E+00	2.02E+00	6.48E-01	3.75E-02	2.02E-02	2.52E-03	1.43E-04	4.09E-07
11	7	8.46E-01	1.63E+00	2.90E+00	3.33E+00	2.36E+00	6.37E-01	1.59E-02	9.78E-03	6.21E-04	4.11E-05	9.23E-08
11	8	8.25E-01	1.71E+00	2.89E+00	4.51E+00	2.54E+00	4.29E-01	6.35E-03	4.56E-03	3.01E-04	6.21E-06	7.65E-08
11	9	9.00E-01	1.75E+00	4.12E+00	6.35E+00	1.72E+00	1.74E-01	3.62E-03	1.88E-03	1.37E-04	7.04E-07	1.28E-07
11	10	6.80E-01	2.60E+00	4.67E+00	6.05E+00	6.13E-01	4.93E-02	1.78E-03	5.56E-04	1.69E-04	2.48E-08	8.49E-07

A.3 N^{6+} + H$(n = 1, 2)$

Table A.15 N^{6+} + H(1s)

Table A.16 N^{6+} + H(2s)

Table A.17 N^{6+} + H(2p0)

Table A.18 N^{6+} + H(2p1)

Table A.19 N^{6+} + H(2p-1)

Table A.20 N^{6+} + H(2p)

Table A.21 N^{6+} + H$(n = 2)$

Table A.15: Data for N^{6+} + H(1s)

		impact energies [kev/amu]										
		1.0	5.0	7.0	10.0	25.0	45.0	90.	100.	150.	250.	500.
		total cross sections										
CX		4.24E+1	4.58E+1	4.73E+1	4.68E+1	4.13E+1	3.06E+1	9.60E+0	7.37E+0	2.26E+0	3.49E-1	1.40E-2
ION		6.37E-2	1.09E-1	8.18E-2	4.98E-2	2.03E-1	2.05E+0	1.41E+1	1.60E+1	1.95E+1	1.74E+1	1.14E+1
		state resolved CX cross sections										
n	ℓ											
2		6.00E-7	3.11E-6	1.61E-5	2.06E-4	8.00E-3	2.81E-2	5.06E-2	5.15E-2	5.84E-2	2.30E-2	2.79E-3
2	0	5.06E-7	7.89E-7	8.67E-7	4.04E-6	2.28E-3	9.39E-3	1.53E-2	1.58E-2	1.91E-2	1.73E-3	4.02E-4
2	1	9.33E-8	2.33E-6	1.53E-5	2.02E-4	5.71E-3	1.87E-2	3.53E-2	3.57E-2	3.93E-2	2.12E-2	2.39E-3
3		7.85E-3	8.69E-1	1.20E+0	1.61E+0	3.12E+0	2.64E+0	1.05E+0	8.66E-1	3.45E-1	6.53E-2	3.36E-3
3	0	6.22E-5	8.31E-2	2.25E-1	3.07E-1	3.53E-1	1.89E-1	3.28E-2	3.78E-2	2.86E-2	2.50E-3	3.12E-4
3	1	2.15E-3	5.06E-1	5.44E-1	6.45E-1	1.09E+0	8.17E-1	1.92E-1	1.38E-1	4.21E-2	2.00E-2	1.63E-3
3	2	5.64E-3	2.80E-1	4.31E-1	6.61E-1	1.68E+0	1.63E+0	8.29E-1	6.90E-1	2.74E-1	4.28E-2	1.41E-3
4		3.60E+1	3.39E+1	3.25E+1	2.97E+1	1.80E+1	8.01E+0	1.84E+0	1.40E+0	4.01E-1	6.55E-2	2.41E-3
4	0	7.20E+0	3.30E+0	2.21E+0	1.21E+0	2.83E-1	1.05E-1	4.37E-2	4.12E-2	1.91E-2	2.16E-3	2.14E-4
4	1	5.44E+0	5.38E+0	4.41E+0	3.28E+0	1.50E+0	6.29E-1	1.42E-1	9.54E-2	4.17E-2	1.70E-2	9.87E-4
4	2	1.08E+1	1.21E+1	1.19E+1	1.00E+1	4.62E+0	1.70E+0	4.86E-1	4.11E-1	1.45E-1	2.74E-2	8.88E-4
4	3	1.25E+1	1.32E+1	1.40E+1	1.52E+1	1.16E+1	5.58E+0	1.17E+0	8.53E-1	1.95E-1	1.90E-2	3.24E-4
5		5.94E+0	1.00E+1	1.20E+1	1.38E+1	1.23E+1	7.24E+0	1.75E+0	1.30E+0	3.50E-1	5.26E-2	1.63E-3
5	0	9.98E-1	3.30E-1	2.46E-1	1.78E-1	1.29E-1	8.13E-2	4.52E-2	4.44E-2	1.32E-2	1.63E-3	1.46E-4
5	1	1.58E+0	5.19E-1	5.68E-1	6.04E-1	5.64E-1	3.96E-1	8.22E-2	5.89E-2	2.95E-2	1.25E-2	6.20E-4
5	2	1.58E+0	1.31E+0	1.30E+0	1.28E+0	1.57E+0	9.37E-1	3.85E-1	3.23E-1	1.16E-1	1.89E-2	5.53E-4
5	3	1.21E+0	3.46E+0	3.82E+0	3.75E+0	3.23E+0	2.10E+0	6.29E-1	4.65E-1	1.25E-1	1.55E-2	2.74E-4
5	4	5.72E-1	4.40E+0	6.06E+0	7.96E+0	6.77E+0	3.72E+0	6.04E-1	4.11E-1	6.65E-2	4.04E-3	3.88E-5
6		1.53E-1	7.79E-1	1.14E+0	1.23E+0	4.64E+0	4.69E+0	1.33E+0	1.01E+0	2.69E-1	3.98E-2	1.13E-3
6	0	4.40E-2	2.16E-2	4.25E-2	2.84E-2	4.83E-2	6.33E-2	2.70E-2	2.81E-2	8.49E-3	1.11E-3	1.03E-4
6	1	2.16E-2	5.06E-2	6.14E-2	6.77E-2	2.40E-1	2.17E-1	5.87E-2	4.77E-2	3.09E-2	8.85E-3	4.12E-4
6	2	2.16E-2	6.90E-2	8.42E-2	1.17E-1	5.32E-1	5.68E-1	2.28E-1	2.11E-1	7.11E-2	1.30E-2	3.62E-4
6	3	3.30E-2	1.21E-1	1.07E-1	1.68E-1	9.98E-1	1.02E+0	4.13E-1	3.16E-1	8.12E-2	1.19E-2	2.05E-4
6	4	1.93E-2	2.68E-1	3.87E-1	3.12E-1	1.35E+0	1.60E+0	4.24E-1	2.92E-1	6.16E-2	4.36E-3	4.32E-5
6	5	1.31E-2	2.48E-1	4.59E-1	5.32E-1	1.47E+0	1.22E+0	1.77E-1	1.18E-1	1.53E-2	6.11E-4	2.91E-6
7		2.64E-2	1.06E-1	2.11E-1	2.35E-1	1.73E+0	2.89E+0	1.02E+0	7.43E-1	2.24E-1	2.99E-2	8.09E-4
7	0	3.55E-3	1.07E-2	1.67E-2	1.09E-2	2.19E-2	3.67E-2	2.65E-2	1.65E-2	7.38E-3	7.25E-4	7.53E-5
7	1	9.23E-3	1.30E-2	2.37E-2	2.07E-2	1.04E-1	1.42E-1	5.18E-2	3.92E-2	2.32E-2	6.31E-3	2.89E-4
7	2	7.92E-3	1.50E-2	2.40E-2	2.42E-2	2.13E-1	3.16E-1	1.92E-1	1.27E-1	6.32E-2	8.91E-3	2.50E-4
7	3	2.45E-3	2.33E-2	3.29E-2	3.17E-2	3.64E-1	5.77E-1	2.58E-1	2.18E-1	6.11E-2	9.02E-3	1.53E-4
7	4	1.28E-3	2.37E-2	3.41E-2	4.50E-2	4.14E-1	8.39E-1	2.95E-1	2.12E-1	4.57E-2	4.01E-3	3.84E-5
7	5	1.23E-3	1.24E-2	3.92E-2	3.29E-2	4.21E-1	7.22E-1	1.59E-1	1.05E-1	1.70E-2	8.62E-4	4.08E-6
7	6	7.75E-4	7.93E-3	4.03E-2	6.94E-2	1.88E-1	2.52E-1	4.05E-2	2.50E-2	6.43E-3	7.93E-5	1.66E-7
8		1.41E-2	3.98E-2	8.38E-2	9.01E-2	7.31E-1	1.85E+0	8.05E-1	5.80E-1	1.74E-1	2.29E-2	6.05E-4
8	0	6.07E-4	2.98E-3	7.03E-3	6.04E-3	1.20E-2	3.02E-2	1.99E-2	1.52E-2	5.21E-3	4.99E-4	5.65E-5
8	1	3.48E-3	3.67E-3	1.11E-2	9.76E-3	4.76E-2	9.05E-2	4.07E-2	3.05E-2	2.16E-2	4.73E-3	2.12E-4
8	2	4.83E-3	4.13E-3	1.09E-2	9.89E-3	1.04E-1	2.22E-1	1.43E-1	1.07E-1	4.14E-2	6.19E-3	1.82E-4
8	3	2.83E-3	1.06E-2	1.62E-2	1.35E-2	1.50E-1	3.36E-1	2.06E-1	1.52E-1	4.46E-2	6.86E-3	1.17E-4
8	4	1.12E-3	9.76E-3	1.37E-2	1.20E-2	1.61E-1	4.90E-1	2.05E-1	1.51E-1	3.84E-2	3.52E-3	3.30E-5
8	5	4.23E-4	4.16E-3	1.12E-2	1.32E-2	1.54E-1	4.34E-1	1.30E-1	8.83E-2	1.39E-2	9.50E-4	4.36E-6
8	6	3.56E-4	2.48E-3	6.70E-3	7.66E-3	8.09E-2	2.00E-1	4.23E-2	2.86E-2	3.29E-3	1.47E-4	2.88E-7
8	7	4.38E-4	2.03E-3	6.96E-3	1.81E-2	2.10E-2	4.23E-2	1.66E-2	7.49E-3	5.17E-3	1.02E-5	9.32E-9
9		2.69E-2	4.53E-2	5.61E-2	5.53E-2	3.62E-1	1.27E+0	6.39E-1	4.78E-1	1.57E-1	1.82E-2	4.73E-4
9	0	2.07E-3	2.36E-3	3.86E-3	2.84E-3	8.06E-3	1.79E-2	1.58E-2	1.36E-2	5.23E-3	3.71E-4	4.38E-5
9	1	1.79E-3	1.91E-3	5.36E-3	5.60E-3	2.45E-2	8.18E-2	3.47E-2	2.47E-2	1.82E-2	3.76E-3	1.63E-4
9	2	1.04E-2	7.17E-3	6.54E-3	6.98E-3	6.03E-2	1.28E-1	1.07E-1	9.35E-2	4.10E-2	4.45E-3	1.39E-4
9	3	8.06E-3	1.08E-2	1.16E-2	8.51E-3	6.89E-2	2.53E-1	1.61E-1	1.20E-1	3.73E-2	5.32E-3	9.37E-5
9	4	1.98E-3	8.66E-3	1.02E-2	8.34E-3	7.65E-2	3.17E-1	1.59E-1	1.15E-1	3.11E-2	3.11E-3	2.84E-5
9	5	4.35E-4	5.50E-3	6.95E-3	7.20E-3	6.95E-2	2.67E-1	1.02E-1	7.26E-2	1.43E-2	9.92E-4	4.28E-6
9	6	8.76E-4	4.18E-3	4.31E-3	5.68E-3	3.78E-2	1.45E-1	3.77E-2	2.67E-2	4.20E-3	2.02E-4	3.57E-7
9	7	4.22E-4	3.04E-3	4.04E-3	4.69E-3	1.38E-2	4.78E-2	1.04E-2	7.16E-3	9.50E-4	2.56E-5	1.75E-8
9	8	8.17E-4	1.72E-3	3.23E-3	5.44E-3	2.81E-3	1.25E-2	1.17E-2	4.52E-3	4.61E-3	1.49E-6	1.01E-9
10		1.07E-1	4.92E-2	4.79E-2	3.85E-2	2.01E-1	9.35E-1	5.46E-1	4.23E-1	1.32E-1	1.55E-2	3.90E-4
10	0	3.22E-3	4.53E-4	1.53E-3	1.55E-3	5.11E-3	1.66E-2	1.26E-2	1.32E-2	3.73E-3	2.56E-4	3.48E-5
10	1	6.93E-3	6.16E-3	3.47E-3	3.88E-3	1.56E-2	6.15E-2	2.98E-2	2.69E-2	1.71E-2	3.32E-3	1.34E-4
10	2	1.87E-2	6.24E-3	7.02E-3	4.39E-3	3.45E-2	1.02E-1	8.23E-2	8.42E-2	3.00E-2	3.43E-3	1.12E-4
10	3	9.83E-3	7.29E-3	1.06E-2	5.20E-3	3.72E-2	1.70E-1	1.41E-1	9.68E-2	2.99E-2	4.28E-3	7.92E-5
10	4	1.70E-2	6.81E-3	8.89E-3	5.86E-3	4.20E-2	2.34E-1	1.35E-1	9.97E-2	2.86E-2	2.85E-3	2.55E-5
10	5	1.77E-2	5.72E-3	6.05E-3	5.57E-3	3.55E-2	1.89E-1	8.83E-2	6.35E-2	1.25E-2	1.04E-3	4.20E-6
10	6	1.46E-2	5.19E-3	3.89E-3	4.81E-3	1.93E-2	1.01E-1	3.67E-2	2.51E-2	3.64E-3	2.59E-4	3.99E-7
10	7	9.94E-3	5.39E-3	2.70E-3	2.69E-3	7.98E-3	3.65E-2	9.79E-3	7.36E-3	2.04E-3	4.50E-5	2.45E-8
10	8	6.79E-3	3.21E-3	1.93E-3	3.19E-3	2.56E-3	1.45E-2	4.91E-3	3.84E-3	5.85E-4	4.61E-6	1.45E-9
10	9	2.69E-3	2.75E-3	1.79E-3	1.36E-3	8.61E-4	1.01E-2	6.89E-3	2.38E-3	4.09E-3	2.56E-7	4.96E-9
11		1.09E-1	1.42E-2	2.15E-2	2.56E-2	2.16E-1	1.03E+0	5.69E-1	5.09E-1	1.51E-1	1.60E-2	3.83E-4
11	0	4.21E-3	1.57E-3	2.47E-3	3.19E-3	9.95E-3	3.48E-2	1.37E-2	1.89E-2	5.22E-3	3.37E-4	3.04E-5
11	1	2.89E-3	7.43E-4	1.60E-3	1.85E-3	2.00E-2	8.39E-2	3.70E-2	3.43E-2	1.81E-2	3.47E-3	1.28E-4
11	2	1.51E-2	7.09E-4	2.49E-3	2.67E-3	4.61E-2	1.59E-1	9.17E-2	1.20E-1	3.97E-2	3.31E-3	1.10E-4
11	3	3.23E-2	7.66E-4	3.58E-3	3.15E-3	3.75E-2	1.79E-1	1.30E-1	1.17E-1	3.34E-2	4.04E-3	7.86E-5
11	4	2.77E-2	1.05E-3	3.26E-3	3.73E-3	4.24E-2	2.39E-1	1.38E-1	1.00E-1	3.07E-2	3.07E-3	2.70E-5
11	5	8.38E-3	1.25E-3	1.83E-3	3.05E-3	3.15E-2	1.87E-1	9.26E-2	6.91E-2	1.55E-2	1.30E-3	5.06E-6
11	6	3.80E-3	1.29E-3	1.38E-3	2.29E-3	1.69E-2	9.47E-2	4.05E-2	3.10E-2	4.45E-3	3.73E-4	4.82E-7
11	7	2.89E-3	1.25E-3	1.29E-3	1.51E-3	7.44E-3	3.49E-2	1.36E-2	1.17E-2	1.12E-3	8.16E-5	3.37E-8
11	8	3.26E-3	2.03E-3	1.24E-3	1.59E-3	2.68E-3	9.83E-3	6.15E-3	3.50E-3	1.12E-3	1.15E-5	1.86E-9
11	9	5.24E-3	8.72E-4	6.22E-4	1.35E-3	7.98E-4	4.33E-3	4.03E-3	2.31E-3	4.84E-4	9.17E-7	2.78E-9
11	10	2.93E-3	2.61E-3	1.78E-3	1.25E-3	5.54E-4	2.70E-3	2.56E-3	7.10E-4	9.88E-4	1.62E-6	3.00E-6

Table A.16: Data for N^{6+} + H(2s)

	impact energies [kev/amu]										
	1.0	5.0	7.0	10.0	25.0	45.0	90.	100.	150.	250.	500.
	total cross sections										
CX											
ION											
	state resolved CX cross sections										
n ℓ											
2	1.59E-04	3.20E-03	5.70E-03	1.05E-02	2.96E-02	7.78E-02	4.57E-02	5.12E-02	2.28E-02	2.49E-03	4.90E-04
2 0	2.22E-05	7.74E-04	1.40E-03	3.44E-03	1.59E-02	7.00E-02	4.28E-02	4.79E-02	1.98E-02	7.70E-04	7.28E-05
2 1	1.37E-04	2.42E-03	4.30E-03	7.08E-03	1.37E-02	7.83E-03	2.94E-03	3.32E-03	2.91E-03	1.72E-03	4.17E-04
3	2.04E-01	2.78E-01	1.02E+00	3.64E-01	3.03E-01	2.67E-01	5.11E-02	7.96E-02	2.91E-02	8.49E-03	7.09E-04
3 0	1.62E-02	1.98E-01	8.90E-01	2.38E-01	2.25E-01	1.56E-01	1.35E-02	3.86E-02	1.07E-02	2.30E-03	5.09E-05
3 1	1.13E-01	5.66E-02	1.03E-01	9.45E-02	5.10E-02	5.01E-02	1.58E-02	2.00E-02	2.03E-03	1.35E-03	3.04E-04
3 2	7.46E-02	2.31E-02	2.23E-02	3.19E-02	2.68E-02	6.06E-02	2.17E-02	2.09E-02	1.64E-02	4.85E-03	3.54E-04
4	5.71E-02	1.41E-01	3.40E-01	5.56E-01	4.20E-01	3.20E-01	1.23E-01	9.81E-02	3.54E-02	7.44E-03	6.25E-04
4 0	1.65E-02	2.90E-02	1.06E-01	2.41E-01	1.08E-01	1.02E-01	1.87E-02	1.33E-02	1.03E-02	1.25E-03	3.14E-05
4 1	1.55E-02	4.40E-02	1.00E-01	1.19E-01	6.14E-02	5.71E-02	3.05E-02	2.77E-02	2.21E-03	1.09E-03	1.99E-04
4 2	1.31E-02	3.47E-02	6.62E-02	8.31E-02	8.94E-02	6.29E-02	2.92E-02	2.11E-02	1.30E-02	3.07E-03	2.82E-04
4 3	1.20E-02	3.31E-02	6.79E-02	1.13E-01	1.62E-01	9.79E-02	4.44E-02	3.61E-02	9.86E-03	2.05E-03	1.12E-04
5	1.52E+00	2.40E+00	2.73E+00	2.68E+00	3.03E+00	1.18E+00	1.82E-01	1.33E-01	3.56E-02	5.91E-03	5.02E-04
5 0	2.12E-01	1.10E-01	1.25E-01	8.42E-02	8.74E-02	4.03E-02	1.02E-02	7.04E-03	6.17E-03	5.66E-04	1.92E-05
5 1	2.79E-01	3.23E-01	3.08E-01	2.82E-01	3.22E-01	6.55E-02	2.65E-02	2.46E-02	2.25E-03	8.77E-04	1.31E-04
5 2	4.55E-01	4.24E-01	4.22E-01	4.44E-01	6.82E-01	1.94E-01	2.74E-02	1.82E-02	1.25E-02	2.14E-03	2.11E-04
5 3	3.43E-01	6.44E-01	7.34E-01	6.69E-01	8.63E-01	4.18E-01	4.71E-02	4.09E-02	8.10E-03	1.47E-03	1.22E-04
5 4	2.32E-01	8.95E-01	1.14E+00	1.20E+00	1.08E+00	4.63E-01	7.04E-02	4.22E-02	6.59E-03	8.60E-04	1.94E-05
6	1.37E+01	2.29E+01	2.97E+01	3.05E+01	1.13E+01	2.53E+00	2.39E-01	1.55E-01	3.23E-02	4.99E-03	3.99E-04
6 0	7.06E-01	5.16E-01	6.37E-01	6.51E-01	1.21E-01	2.90E-02	8.01E-03	6.41E-03	3.02E-03	2.87E-04	1.26E-05
6 1	1.06E+00	1.93E+00	1.92E+00	2.01E+00	2.61E-01	6.42E-02	3.33E-02	2.36E-02	2.25E-03	7.14E-04	8.67E-05
6 2	2.24E+00	3.85E+00	4.47E+00	3.83E+00	7.27E-01	1.30E-01	2.29E-02	1.44E-02	9.51E-03	1.68E-03	1.60E-04
6 3	3.39E+00	4.92E+00	6.99E+00	6.15E+00	1.40E+00	3.25E-01	4.70E-02	3.73E-02	7.57E-03	1.08E-03	1.12E-04
6 4	1.69E+00	5.75E+00	8.88E+00	9.55E+00	3.81E+00	4.00E-01	4.89E-02	3.31E-02	5.73E-03	9.57E-04	2.64E-05
6 5	4.64E+00	5.97E+00	6.84E+00	8.28E+00	5.01E+00	1.58E+00	7.90E-02	4.06E-02	4.25E-03	2.84E-04	2.06E-06
7	1.25E+02	1.32E+02	1.10E+02	7.64E+01	1.70E+01	3.43E+00	2.56E-01	1.76E-01	3.06E-02	4.38E-03	3.21E-04
7 0	3.88E+00	9.74E-01	5.70E-01	3.14E-01	6.41E-02	2.49E-02	5.86E-03	5.32E-03	2.21E-03	1.61E-04	9.10E-06
7 1	6.26E+00	3.45E+00	2.15E+00	1.11E+00	1.94E-01	6.98E-02	2.57E-02	2.17E-02	1.91E-03	5.99E-04	5.98E-05
7 2	1.24E+01	8.69E+00	5.90E+00	2.86E+00	4.84E-01	1.19E-01	1.73E-02	1.44E-02	8.85E-03	1.34E-03	1.24E-04
7 3	1.67E+01	1.85E+01	1.39E+01	7.18E+00	9.46E-01	2.98E-01	3.81E-02	3.82E-02	6.29E-03	8.91E-04	9.73E-05
7 4	2.67E+01	3.15E+01	2.47E+01	1.68E+01	1.91E+00	3.44E-01	4.87E-02	3.15E-02	5.54E-03	8.82E-04	2.78E-05
7 5	3.70E+01	4.10E+01	3.55E+01	2.62E+01	3.08E+00	7.27E-01	7.19E-02	4.18E-02	3.89E-03	4.39E-04	3.52E-06
7 6	2.15E+01	2.76E+01	2.76E+01	2.19E+01	1.03E+01	1.85E+00	4.89E-02	2.32E-02	1.86E-03	5.95E-05	1.75E-07
8	3.22E+02	1.59E+02	1.15E+02	7.61E+01	1.73E+01	3.95E+00	2.47E-01	1.76E-01	2.71E-02	4.00E-03	2.65E-04
8 0	7.40E+00	3.99E-01	2.12E-01	1.32E-01	4.34E-02	3.12E-02	4.82E-03	4.50E-03	1.36E-03	1.02E-04	7.03E-06
8 1	9.43E+00	1.26E+00	8.99E-01	6.00E-01	1.56E-01	6.98E-02	1.91E-02	1.77E-02	2.05E-03	5.36E-04	4.32E-05
8 2	1.78E+01	2.96E+00	1.98E+00	1.34E+00	3.42E-01	1.38E-01	1.55E-02	1.35E-02	6.84E-03	1.11E-03	9.88E-05
8 3	2.12E+01	6.85E+00	4.76E+00	3.01E+00	8.15E-01	2.64E-01	3.12E-02	3.42E-02	5.87E-03	8.39E-04	8.40E-05
8 4	3.13E+01	1.65E+01	1.05E+01	7.13E+00	1.32E+00	3.12E-01	4.55E-02	3.15E-02	4.03E-03	8.05E-04	2.72E-05
8 5	5.82E+01	3.33E+01	2.26E+01	1.23E+01	1.95E+00	5.93E-01	5.81E-02	3.55E-02	4.06E-03	4.80E-04	4.25E-06
8 6	8.14E+01	5.24E+01	3.81E+01	2.04E+01	3.90E+00	1.37E+00	5.13E-02	2.90E-02	1.55E-03	1.18E-04	3.28E-07
8 7	9.55E+01	4.55E+01	3.61E+01	3.12E+01	8.73E+00	1.17E+00	2.12E-02	9.67E-03	1.31E-03	1.08E-05	3.97E-08
9	7.95E+01	9.71E+01	7.87E+01	5.76E+01	1.61E+01	3.89E+00	2.48E-01	1.73E-01	2.89E-02	3.80E-03	2.25E-04
9 0	1.77E+00	2.60E-01	2.12E-01	1.34E-01	4.37E-02	2.95E-02	5.13E-03	4.57E-03	1.41E-03	7.38E-05	5.73E-06
9 1	2.28E+00	7.93E-01	6.58E-01	5.50E-01	1.68E-01	5.57E-02	1.86E-02	1.56E-02	2.18E-03	5.20E-04	3.27E-05
9 2	3.16E+00	1.92E+00	1.80E+00	1.24E+00	3.54E-01	1.42E-01	1.55E-02	1.29E-02	7.47E-03	9.43E-04	8.19E-05
9 3	5.09E+00	3.14E+00	3.22E+00	2.40E+00	7.71E-01	2.12E-01	2.97E-02	3.04E-02	6.14E-03	8.45E-04	7.39E-05
9 4	8.34E+00	6.02E+00	6.23E+00	4.93E+00	1.21E+00	2.52E-01	4.18E-02	3.22E-02	4.80E-03	7.60E-04	2.61E-05
9 5	1.09E+01	1.20E+01	1.08E+01	7.85E+00	1.75E+00	5.24E-01	5.41E-02	3.32E-02	3.81E-03	4.76E-04	4.59E-06
9 6	1.59E+01	1.88E+01	1.63E+01	9.54E+00	2.83E+00	1.03E+00	4.97E-02	2.74E-02	1.54E-03	1.55E-04	4.34E-07
9 7	1.77E+01	2.45E+01	1.79E+01	1.39E+01	4.45E+00	1.16E+00	2.47E-02	1.37E-02	3.99E-04	2.53E-05	3.52E-08
9 8	1.44E+01	2.96E+01	2.17E+01	1.70E+01	4.53E+00	4.88E-01	8.49E-03	3.46E-03	1.15E-03	1.85E-06	2.57E-08
10	3.30E+01	4.83E+01	5.17E+01	4.44E+01	1.41E+01	3.85E+00	2.74E-01	1.88E-01	3.17E-02	3.94E-03	2.03E-04
10 0	2.47E-01	2.35E-01	2.87E-01	3.07E-01	6.32E-02	2.98E-02	5.58E-03	5.16E-03	1.54E-03	7.06E-05	5.36E-06
10 1	5.17E-01	6.59E-01	9.51E-01	7.64E-01	2.13E-01	8.58E-02	2.45E-02	1.86E-02	3.04E-03	5.77E-04	2.66E-05
10 2	7.60E-01	1.11E+00	1.33E+00	1.47E+00	5.15E-01	1.65E-01	1.86E-02	1.46E-02	7.11E-03	8.85E-04	7.26E-05
10 3	1.06E+00	1.96E+00	2.91E+00	2.39E+00	8.30E-01	2.50E-01	3.31E-02	3.22E-02	7.11E-03	9.18E-04	6.76E-05
10 4	1.33E+00	2.90E+00	3.93E+00	3.90E+00	1.25E+00	2.70E-01	4.35E-02	3.59E-02	4.73E-03	7.87E-04	2.54E-05
10 5	2.14E+00	4.89E+00	6.37E+00	5.68E+00	1.73E+00	4.55E-01	5.49E-02	3.41E-02	4.09E-03	4.81E-04	4.83E-06
10 6	4.54E+00	7.52E+00	7.74E+00	6.26E+00	2.25E+00	8.15E-01	5.08E-02	2.56E-02	2.09E-03	1.80E-04	5.27E-07
10 7	7.19E+00	7.55E+00	7.61E+00	7.96E+00	2.79E+00	9.82E-01	2.81E-02	1.47E-02	8.72E-04	3.98E-05	4.44E-08
10 8	8.73E+00	8.71E+00	9.04E+00	8.74E+00	2.94E+00	6.17E-01	1.05E-02	5.73E-03	2.55E-04	5.23E-06	1.09E-08
10 9	6.48E+00	1.28E+01	1.15E+01	6.89E+00	1.56E+00	1.83E-01	4.11E-03	1.24E-03	8.77E-04	3.49E-07	1.35E-08
11	1.04E+01	1.76E+01	2.82E+01	3.39E+01	1.63E+01	5.61E+00	4.53E-01	3.06E-01	4.95E-02	5.11E-03	2.15E-04
11 0	2.97E-01	1.99E-01	3.01E-01	6.30E-01	1.86E-01	1.18E-01	1.60E-02	1.37E-02	2.68E-03	1.00E-04	4.39E-06
11 1	1.64E-01	3.11E-01	7.10E-01	7.10E-01	3.64E-01	2.21E-01	4.17E-02	3.12E-02	4.83E-03	7.42E-04	2.43E-05
11 2	3.40E-01	6.84E-01	9.41E-01	1.79E+00	9.53E-01	3.97E-01	5.32E-02	3.81E-02	1.24E-02	1.09E-03	7.65E-05
11 3	4.93E-01	7.43E-01	1.94E+00	2.08E+00	1.19E+00	5.33E-01	5.90E-02	5.28E-02	1.12E-02	1.21E-03	7.37E-05
11 4	5.91E-01	1.43E+00	1.85E+00	3.14E+00	1.77E+00	5.77E-01	7.90E-02	6.19E-02	8.41E-03	1.04E-03	2.91E-05
11 5	7.15E-01	1.28E+00	2.84E+00	3.29E+00	2.31E+00	6.93E-01	8.32E-02	5.04E-02	5.86E-03	6.21E-04	6.06E-06
11 6	9.47E-01	2.43E+00	2.84E+00	4.00E+00	2.55E+00	9.65E-01	6.20E-02	2.96E-02	2.39E-03	2.30E-04	6.06E-07
11 7	1.27E+00	1.81E+00	3.04E+00	3.97E+00	2.59E+00	1.05E+00	3.59E-02	1.72E-02	7.84E-04	6.00E-05	5.93E-08
11 8	1.68E+00	2.21E+00	3.03E+00	4.47E+00	2.36E+00	7.10E-01	1.58E-02	7.68E-03	5.22E-04	1.04E-05	1.04E-08
11 9	2.25E+00	2.11E+00	4.80E+00	5.51E+00	1.43E+00	2.83E-01	5.65E-03	2.70E-03	1.80E-04	1.00E-06	1.05E-08
11 10	1.68E+00	4.35E+00	5.91E+00	4.27E+00	5.97E-01	5.85E-02	1.94E-03	4.55E-04	2.32E-04	1.87E-06	4.33E-07

Table A.17: Data for N^{6+} + H(2p0)

	impact energies [kev/amu]										
	1.0	5.0	7.0	10.0	25.0	45.0	90.	100.	150.	250.	500.
	total cross sections										
CX											
ION											
	state resolved CX cross sections										
n ℓ											
2	1.85E-04	2.50E-04	2.80E-04	3.09E-03	1.64E-02	7.11E-02	7.09E-02	7.76E-02	2.20E-02	2.23E-03	2.69E-04
2 0	3.24E-05	8.43E-05	7.58E-05	1.06E-03	8.42E-03	6.41E-02	6.62E-02	7.43E-02	1.83E-02	8.95E-04	5.13E-05
2 1	1.52E-04	1.66E-04	2.04E-04	2.03E-03	7.95E-03	7.02E-03	4.71E-03	3.23E-03	3.64E-03	1.33E-03	2.18E-04
3	2.52E-01	2.82E-02	5.24E-02	1.16E-01	2.42E-01	2.97E-01	8.33E-02	1.30E-01	3.65E-02	6.55E-03	3.75E-04
3 0	2.37E-02	1.70E-02	4.31E-02	7.14E-02	1.47E-01	2.07E-01	2.54E-02	7.12E-02	1.38E-02	2.62E-03	4.07E-05
3 1	1.11E-01	7.07E-03	7.19E-03	3.00E-02	5.76E-02	4.83E-02	1.96E-02	2.36E-02	3.73E-03	7.68E-04	1.67E-04
3 2	1.17E-01	4.12E-03	2.12E-03	1.49E-02	3.73E-02	4.14E-02	3.84E-02	3.50E-02	1.89E-02	3.17E-03	1.67E-04
4	3.51E-02	7.27E-02	1.57E-01	3.82E-01	5.48E-01	5.10E-01	1.45E-01	1.15E-01	4.01E-02	5.11E-03	3.57E-04
4 0	7.36E-03	5.41E-03	1.43E-02	8.92E-02	5.35E-02	1.09E-01	4.10E-02	2.63E-02	1.43E-02	1.35E-03	2.27E-05
4 1	8.37E-03	1.64E-02	3.41E-02	6.21E-02	1.12E-01	1.12E-01	9.98E-03	8.21E-03	2.58E-03	5.26E-04	1.25E-04
4 2	8.87E-03	2.36E-02	5.33E-02	9.91E-02	1.02E-01	1.32E-01	2.84E-02	1.98E-02	1.05E-02	1.76E-03	1.63E-04
4 3	1.04E-02	2.74E-02	5.57E-02	1.31E-01	2.80E-01	1.57E-01	6.59E-02	6.12E-02	1.27E-02	1.47E-03	4.60E-05
5	6.83E-01	2.52E+00	3.67E+00	4.11E+00	1.72E+00	7.13E-01	1.49E-01	1.11E-01	3.24E-02	3.92E-03	3.21E-04
5 0	9.90E-02	6.56E-02	1.78E-01	1.94E-01	4.47E-02	2.91E-02	1.68E-02	1.05E-02	5.90E-03	5.88E-04	1.22E-05
5 1	8.14E-02	3.85E-01	5.42E-01	5.61E-01	1.08E-01	5.91E-02	1.42E-02	7.60E-03	1.82E-03	5.01E-04	9.18E-05
5 2	1.35E-01	5.25E-01	6.74E-01	7.13E-01	2.69E-01	9.40E-02	2.28E-02	1.56E-02	4.53E-03	1.28E-03	1.45E-04
5 3	1.83E-01	6.76E-01	9.60E-01	1.02E+00	5.38E-01	1.69E-01	3.16E-02	2.73E-02	1.15E-02	1.20E-03	6.32E-05
5 4	1.85E-01	8.73E-01	1.32E+00	1.62E+00	7.62E-01	3.62E-01	6.40E-02	5.02E-02	8.69E-03	3.47E-04	8.86E-06
6	9.45E+00	2.45E+01	2.20E+01	1.82E+01	4.57E+00	9.62E-01	1.47E-01	1.04E-01	3.20E-02	3.80E-03	2.82E-04
6 0	6.58E-01	6.34E-01	4.27E-01	2.53E-01	5.22E-02	1.47E-02	8.82E-03	5.48E-03	2.92E-03	2.99E-04	7.41E-06
6 1	1.34E+00	1.56E+00	1.15E+00	5.86E-01	1.36E-01	3.52E-02	9.14E-03	5.58E-03	2.84E-03	5.70E-04	6.54E-05
6 2	1.31E+00	2.90E+00	2.42E+00	1.64E+00	2.40E-01	8.86E-02	1.89E-02	9.72E-03	6.68E-03	1.21E-03	1.25E-04
6 3	2.79E+00	4.29E+00	3.92E+00	3.48E+00	5.90E-01	1.13E-01	1.33E-02	1.68E-02	8.00E-03	1.15E-03	6.88E-05
6 4	8.73E-01	6.71E+00	5.94E+00	6.07E+00	8.16E-01	2.63E-01	5.59E-02	4.36E-02	6.34E-03	4.69E-04	1.42E-05
6 5	2.48E+00	8.42E+00	8.11E+00	6.15E+00	2.73E+00	4.48E-01	4.10E-02	2.26E-02	5.26E-03	9.59E-05	1.11E-06
7	1.24E+02	9.66E+01	8.55E+01	5.99E+01	9.63E+00	1.62E+00	1.42E-01	1.06E-01	2.95E-02	4.04E-03	2.46E-04
7 0	4.59E+00	5.99E-01	3.69E-01	3.63E-01	6.18E-02	3.03E-02	7.10E-03	4.15E-03	1.40E-03	1.83E-04	5.36E-06
7 1	5.45E+00	1.82E+00	1.65E+00	9.95E-01	2.01E-01	7.68E-02	9.26E-03	6.97E-03	3.15E-03	6.19E-04	4.78E-05
7 2	9.82E+00	4.81E+00	3.88E+00	2.78E+00	4.37E-01	1.74E-01	1.47E-02	9.46E-03	5.21E-03	1.17E-03	1.07E-04
7 3	1.77E+01	1.12E+01	8.93E+00	4.87E+00	8.48E-01	2.05E-01	1.41E-02	1.35E-02	6.89E-03	1.25E-03	6.68E-05
7 4	2.34E+01	2.11E+01	1.81E+01	1.10E+01	1.34E+00	3.15E-01	3.22E-02	3.05E-02	6.27E-03	6.14E-04	1.69E-05
7 5	2.28E+01	3.06E+01	2.99E+01	1.94E+01	2.11E+00	4.35E-01	3.60E-02	2.81E-02	4.00E-03	1.72E-04	2.05E-06
7 6	4.05E+01	2.66E+01	2.28E+01	2.04E+01	4.63E+00	3.86E-01	2.84E-02	1.32E-02	2.54E-03	3.24E-05	1.19E-07
8	3.04E+02	2.01E+02	1.58E+02	1.04E+02	1.39E+01	2.20E+00	1.37E-01	1.19E-01	3.41E-02	4.38E-03	2.16E-04
8 0	6.60E+00	4.57E-01	3.37E-01	3.17E-01	6.94E-02	2.46E-02	5.17E-03	3.92E-03	1.11E-03	1.36E-04	4.42E-06
8 1	9.03E+00	2.01E+00	1.87E+00	1.59E+00	2.34E-01	1.00E-01	8.17E-03	9.69E-03	4.56E-03	6.53E-04	3.63E-05
8 2	1.51E+01	4.78E+00	4.33E+00	2.81E+00	4.69E-01	1.37E-01	1.30E-02	1.37E-02	6.86E-03	1.15E-03	9.18E-05
8 3	2.45E+01	1.08E+01	8.71E+00	6.13E+00	1.03E+00	1.86E-01	1.77E-02	1.73E-02	7.16E-03	1.37E-03	6.24E-05
8 4	4.18E+01	2.27E+01	1.71E+01	1.02E+01	1.28E+00	3.33E-01	3.23E-02	2.70E-02	6.29E-03	7.57E-04	1.80E-05
8 5	5.91E+01	4.21E+01	2.93E+01	1.75E+01	2.27E+00	5.64E-01	3.16E-02	2.70E-02	4.23E-03	2.37E-04	2.63E-06
8 6	8.05E+01	6.34E+01	4.87E+01	2.53E+01	3.44E+00	5.08E-01	1.65E-02	1.33E-02	1.65E-03	6.76E-05	2.01E-07
8 7	6.77E+01	5.44E+01	4.77E+01	4.00E+01	5.06E+00	3.47E-01	1.24E-02	7.06E-03	2.28E-03	9.13E-06	2.54E-08
9	1.05E+02	1.30E+02	1.16E+02	9.61E+01	1.60E+01	2.58E+00	1.48E-01	1.25E-01	3.42E-02	4.74E-03	1.93E-04
9 0	1.71E+00	2.68E-01	2.32E-01	2.12E-01	9.03E-02	2.75E-02	5.65E-03	3.80E-03	8.69E-04	1.22E-04	3.91E-06
9 1	2.22E+00	9.29E-01	9.61E-01	1.10E+00	2.47E-01	1.02E-01	1.12E-02	1.04E-02	4.54E-03	6.85E-04	2.89E-05
9 2	3.43E+00	2.15E+00	2.59E+00	2.10E+00	4.75E-01	1.56E-01	1.77E-02	1.50E-02	5.88E-03	1.15E-03	8.07E-05
9 3	5.66E+00	4.51E+00	4.79E+00	4.39E+00	9.86E-01	1.92E-01	1.90E-02	1.73E-02	6.93E-03	1.48E-03	5.82E-05
9 4	7.72E+00	8.83E+00	8.58E+00	6.78E+00	1.14E+00	3.49E-01	2.95E-02	2.67E-02	6.77E-03	8.86E-04	1.84E-05
9 5	1.04E+01	1.56E+01	1.37E+01	1.04E+01	1.81E+00	4.79E-01	3.14E-02	2.69E-02	4.39E-03	3.00E-04	2.98E-06
9 6	1.55E+01	2.42E+01	1.91E+01	1.38E+01	2.96E+00	5.39E-01	1.92E-02	1.49E-02	2.14E-03	9.84E-05	2.67E-07
9 7	2.62E+01	3.67E+01	2.71E+01	1.62E+01	4.04E+00	4.78E-01	8.55E-03	7.66E-03	6.83E-04	2.25E-05	2.31E-08
9 8	3.20E+01	3.66E+01	3.92E+01	4.11E+01	4.28E+00	2.58E-01	6.25E-03	2.75E-03	1.95E-03	1.98E-06	1.79E-08
10	3.26E+01	4.02E+01	5.31E+01	6.21E+01	1.61E+01	2.81E+00	1.83E-01	1.42E-01	4.44E-02	5.44E-03	1.85E-04
10 0	3.76E-01	1.44E-01	2.42E-01	3.79E-01	1.22E-01	2.16E-02	5.49E-03	4.03E-03	1.12E-03	1.36E-04	3.89E-06
10 1	8.33E-01	4.99E-01	4.45E-01	4.50E-01	2.68E-01	9.58E-02	1.61E-02	1.44E-02	7.12E-03	8.02E-04	2.55E-05
10 2	1.18E+00	7.35E-01	1.25E+00	1.60E+00	4.28E-01	1.48E-01	2.31E-02	1.68E-02	8.01E-03	1.24E-03	7.72E-05
10 3	1.39E+00	1.73E+00	2.16E+00	2.18E+00	9.75E-01	1.68E-01	2.89E-02	1.92E-02	9.66E-03	1.66E-03	5.57E-05
10 4	1.96E+00	2.56E+00	3.64E+00	3.99E+00	9.64E-01	3.21E-01	3.74E-02	2.71E-02	8.63E-03	1.05E-03	1.87E-05
10 5	3.09E+00	4.41E+00	5.32E+00	4.99E+00	1.49E+00	4.75E-01	3.58E-02	2.85E-02	4.68E-03	3.72E-04	3.28E-06
10 6	5.91E+00	6.36E+00	6.74E+00	6.85E+00	2.27E+00	5.32E-01	1.92E-02	1.92E-02	1.94E-03	1.29E-04	3.29E-07
10 7	7.22E+00	6.85E+00	8.12E+00	7.66E+00	3.14E+00	5.48E-01	8.67E-03	8.57E-03	9.92E-04	3.84E-05	2.40E-08
10 8	6.06E+00	7.49E+00	7.75E+00	1.01E+01	4.06E+00	3.57E-01	3.94E-03	3.12E-03	5.00E-04	5.85E-06	6.79E-09
10 9	4.55E+00	9.39E+00	1.74E+01	2.39E+01	2.37E+00	1.40E-01	4.47E-03	1.45E-03	1.75E-03	4.46E-07	1.49E-08
11	9.78E+00	1.24E+01	1.97E+01	3.46E+01	1.71E+01	3.80E+00	3.37E-01	2.54E-01	6.52E-02	7.50E-03	2.04E-04
11 0	4.55E-01	1.55E-01	2.03E-01	3.94E-01	1.96E-01	3.46E-02	1.41E-02	1.23E-02	2.80E-03	1.89E-04	3.40E-06
11 1	1.70E-01	2.13E-01	3.17E-01	2.81E-01	4.62E-01	8.94E-02	2.73E-02	2.32E-02	9.03E-03	1.00E-03	2.31E-05
11 2	4.03E-01	4.66E-01	5.36E-01	1.06E+00	8.61E-01	2.88E-01	5.39E-02	4.09E-02	1.26E-02	1.71E-03	8.60E-05
11 3	5.02E-01	6.51E-01	9.75E-01	1.28E+00	1.19E+00	2.71E-01	5.49E-02	4.04E-02	1.37E-02	2.23E-03	6.43E-05
11 4	5.77E-01	1.11E+00	1.35E+00	2.17E+00	1.13E+00	4.38E-01	6.58E-02	5.18E-02	1.38E-02	1.51E-03	2.25E-05
11 5	7.86E-01	1.23E+00	1.78E+00	2.29E+00	1.23E+00	5.98E-01	6.49E-02	4.47E-02	8.26E-03	5.94E-04	4.12E-06
11 6	1.03E+00	1.90E+00	2.27E+00	3.27E+00	1.72E+00	6.44E-01	3.39E-02	2.12E-02	2.83E-03	1.84E-04	4.05E-07
11 7	1.16E+00	1.75E+00	2.43E+00	3.95E+00	2.48E+00	6.42E-01	1.30E-02	1.03E-02	8.30E-04	6.22E-05	3.45E-08
11 8	1.65E+00	1.59E+00	2.87E+00	3.72E+00	3.55E+00	4.79E-01	3.77E-03	5.83E-03	5.79E-04	1.22E-05	7.85E-09
11 9	1.59E+00	1.46E+00	2.64E+00	6.31E+00	3.04E+00	2.51E-01	3.21E-03	2.12E-03	2.48E-04	1.35E-06	1.03E-08
11 10	1.44E+00	1.83E+00	4.34E+00	9.83E+00	1.21E+00	6.56E-02	2.15E-03	9.33E-04	5.47E-04	4.06E-06	4.84E-07

Table A.18: Data for N^{6+} + H(2p1)

	impact energies [kev/amu]										
	1.0	5.0	7.0	10.0	25.0	45.0	90.	100.	150.	250.	500.
	total cross sections										
CX											
ION											
	state resolved CX cross sections										
n ℓ											
2	7.15E-06	2.10E-03	3.81E-03	3.85E-03	5.42E-03	1.15E-02	1.12E-02	8.44E-03	2.50E-03	4.36E-04	2.06E-05
2 0	9.85E-07	4.21E-04	9.31E-04	1.14E-03	2.44E-03	1.05E-02	1.04E-02	7.77E-03	1.70E-03	1.34E-04	6.40E-06
2 1	6.17E-06	1.68E-03	2.88E-03	2.71E-03	2.98E-03	1.04E-03	8.12E-04	6.74E-04	8.01E-04	3.02E-04	1.42E-05
3	8.35E-03	1.61E-01	6.31E-01	1.15E-01	9.91E-02	1.10E-01	6.20E-02	6.53E-02	1.90E-02	1.79E-03	4.39E-05
3 0	5.41E-04	1.28E-01	5.64E-01	8.38E-02	7.39E-02	5.93E-02	5.95E-03	1.88E-02	2.88E-03	3.09E-04	5.86E-06
3 1	5.61E-03	2.77E-02	5.98E-02	2.64E-02	1.70E-02	3.45E-02	2.32E-02	1.85E-02	6.34E-03	4.59E-04	1.34E-05
3 2	2.20E-03	5.74E-03	7.54E-03	4.82E-03	8.19E-03	1.64E-02	3.28E-02	2.81E-02	9.82E-03	1.02E-03	2.47E-05
4	4.04E-03	5.58E-02	1.32E-01	2.73E-01	1.59E+00	1.09E+00	3.09E-01	1.77E-01	4.65E-02	2.88E-03	4.99E-05
4 0	1.40E-03	1.97E-02	5.09E-02	1.16E-01	1.57E-01	5.63E-02	3.83E-02	2.01E-02	4.71E-03	2.30E-04	3.73E-06
4 1	1.13E-03	2.74E-02	5.35E-02	9.25E-02	5.01E-01	1.36E-01	4.64E-02	3.07E-02	9.82E-03	5.46E-04	1.43E-05
4 2	8.70E-04	6.25E-03	2.13E-02	4.09E-02	5.44E-01	3.90E-01	6.73E-02	3.58E-02	1.39E-02	1.07E-03	2.15E-05
4 3	6.32E-04	2.43E-03	6.59E-03	2.38E-02	3.85E-01	5.04E-01	1.57E-01	9.01E-02	1.81E-02	1.03E-03	1.03E-05
5	2.65E-01	2.23E+00	4.27E+00	7.25E+00	8.44E+00	2.70E+00	3.82E-01	2.74E-01	4.05E-02	3.88E-03	5.42E-05
5 0	2.86E-02	2.59E-01	4.18E-01	7.83E-01	1.81E-01	4.79E-02	1.86E-02	1.23E-02	2.22E-03	2.18E-04	2.30E-06
5 1	5.13E-02	7.31E-01	1.22E+00	1.78E+00	6.91E-01	1.72E-01	3.32E-02	3.09E-02	8.04E-03	5.64E-04	1.22E-05
5 2	9.60E-02	7.11E-01	1.33E+00	2.15E+00	1.69E+00	3.36E-01	5.43E-02	4.87E-02	1.08E-02	1.17E-03	2.10E-05
5 3	5.68E-02	4.14E-01	8.78E-01	1.54E+00	3.02E+00	7.24E-01	1.14E-01	9.72E-02	1.21E-02	1.20E-03	1.42E-05
5 4	3.19E-02	1.17E-01	4.24E-01	9.95E-01	2.86E+00	1.42E+00	1.62E-01	8.44E-02	7.31E-03	7.33E-04	4.59E-06
6	1.03E+01	3.63E+01	4.24E+01	4.39E+01	1.32E+01	3.43E+00	4.27E-01	2.63E-01	4.99E-02	4.25E-03	5.47E-05
6 0	5.47E-01	2.21E+00	2.07E+00	1.09E+00	2.63E-01	5.34E-02	1.74E-02	7.91E-03	1.35E-03	2.00E-04	1.52E-06
6 1	6.40E-01	5.80E+00	5.50E+00	3.68E+00	7.06E-01	2.08E-01	5.49E-02	3.23E-02	8.14E-03	5.24E-04	1.01E-05
6 2	1.42E+00	9.16E+00	9.92E+00	7.92E+00	1.55E+00	3.53E-01	8.11E-02	5.10E-02	1.19E-02	1.13E-03	1.97E-05
6 3	1.58E+00	9.73E+00	1.13E+01	1.25E+01	2.52E+00	5.99E-01	1.11E-01	7.43E-02	1.44E-02	1.19E-03	1.53E-05
6 4	4.12E+00	6.21E+00	7.44E+00	1.00E+01	4.17E+00	7.29E-01	9.69E-02	6.14E-02	1.01E-02	9.47E-04	6.98E-06
6 5	2.02E+00	3.21E+00	6.13E+00	8.69E+00	3.98E+00	1.49E+00	6.54E-02	3.64E-02	3.97E-03	2.60E-04	1.11E-06
7	1.52E+02	1.07E+02	9.19E+01	6.01E+01	1.47E+01	3.47E+00	5.30E-01	3.01E-01	4.62E-02	4.18E-03	5.27E-05
7 0	7.35E+00	2.16E+00	1.32E+00	7.10E-01	2.61E-01	5.18E-02	1.55E-02	9.68E-03	9.43E-04	1.69E-04	1.13E-06
7 1	1.13E+01	5.98E+00	4.39E+00	2.95E+00	6.92E-01	1.56E-01	5.34E-02	4.40E-02	7.12E-03	4.58E-04	8.57E-06
7 2	2.01E+01	1.36E+01	9.40E+00	5.89E+00	1.35E+00	2.80E-01	1.00E-01	6.79E-02	1.12E-02	1.03E-03	1.81E-05
7 3	2.03E+01	2.11E+01	1.58E+01	1.04E+01	1.85E+00	4.33E-01	1.32E-01	8.10E-02	1.35E-02	1.13E-03	1.48E-05
7 4	2.38E+01	2.19E+01	1.98E+01	1.38E+01	2.58E+00	6.24E-01	1.28E-01	5.78E-02	8.56E-03	9.42E-04	7.86E-06
7 5	2.90E+01	1.39E+01	1.34E+01	1.23E+01	3.33E+00	6.98E-01	6.65E-02	2.89E-02	1.82E-03	3.85E-04	1.97E-06
7 6	3.97E+01	2.79E+01	2.79E+01	1.41E+01	4.59E+00	1.22E+00	3.35E-02	1.16E-02	3.11E-03	5.58E-05	1.85E-07
8	2.56E+02	1.60E+02	1.10E+02	6.98E+01	1.50E+01	3.95E+00	4.46E-01	2.99E-01	5.96E-02	4.04E-03	4.95E-05
8 0	7.57E+00	1.10E+00	8.17E-01	5.70E-01	2.38E-01	6.79E-02	1.12E-02	7.86E-03	1.25E-03	1.42E-04	9.37E-07
8 1	9.28E+00	3.23E+00	2.92E+00	2.26E+00	6.90E-01	2.63E-01	4.40E-02	3.84E-02	8.25E-03	4.05E-04	7.45E-06
8 2	1.67E+01	6.48E+00	5.81E+00	4.58E+00	1.19E+00	3.53E-01	7.88E-02	6.14E-02	1.27E-02	9.72E-04	1.65E-05
8 3	2.77E+01	1.17E+01	9.49E+00	6.72E+00	1.54E+00	5.86E-01	9.47E-02	7.23E-02	1.61E-02	1.09E-03	1.38E-05
8 4	3.05E+01	1.61E+01	1.29E+01	8.71E+00	1.87E+00	6.00E-01	9.50E-02	6.32E-02	1.22E-02	8.96E-04	8.01E-06
8 5	2.88E+01	1.80E+01	1.47E+01	1.07E+01	2.62E+00	3.53E-01	6.34E-02	3.30E-02	4.51E-03	4.25E-04	2.46E-06
8 6	4.77E+01	2.26E+01	1.52E+01	1.38E+01	1.85E+00	8.60E-01	3.05E-02	1.34E-02	2.09E-03	1.01E-04	3.47E-07
8 7	8.77E+01	8.11E+01	4.84E+01	2.24E+01	5.00E+00	8.62E-01	2.81E-02	9.26E-03	2.43E-03	9.49E-06	5.12E-08
9	1.18E+02	1.22E+02	1.00E+02	7.01E+01	1.50E+01	3.63E+00	4.83E-01	2.89E-01	6.12E-02	3.97E-03	4.69E-05
9 0	1.93E+00	5.78E-01	4.65E-01	4.72E-01	2.41E-01	5.51E-02	1.48E-02	7.22E-03	1.57E-03	1.24E-04	8.35E-07
9 1	2.76E+00	1.53E+00	1.79E+00	1.71E+00	6.16E-01	1.99E-01	5.48E-02	3.52E-02	8.62E-03	3.69E-04	6.70E-06
9 2	4.26E+00	3.35E+00	3.58E+00	3.48E+00	1.17E+00	2.59E-01	9.38E-02	5.63E-02	1.36E-02	9.46E-04	1.52E-05
9 3	6.15E+00	5.57E+00	5.59E+00	4.81E+00	1.28E+00	4.24E-01	1.05E-01	6.57E-02	1.67E-02	1.07E-03	1.29E-05
9 4	7.42E+00	7.38E+00	7.44E+00	6.11E+00	1.52E+00	5.05E-01	9.77E-02	6.41E-02	1.18E-02	8.63E-04	7.93E-06
9 5	9.95E+00	9.71E+00	7.88E+00	6.56E+00	2.24E+00	3.67E-01	5.84E-02	3.51E-02	3.35E-03	4.38E-04	2.72E-06
9 6	1.67E+01	1.18E+01	1.01E+01	6.79E+00	1.73E+00	5.30E-01	2.36E-02	1.15E-02	2.09E-03	1.30E-04	4.55E-07
9 7	3.32E+01	2.02E+01	1.86E+01	1.53E+01	2.40E+00	8.11E-01	1.47E-02	7.30E-03	8.04E-04	2.16E-05	5.48E-08
9 8	3.61E+01	6.21E+01	4.45E+01	2.49E+01	3.78E+00	4.83E-01	2.01E-02	6.62E-03	2.75E-03	1.50E-06	4.06E-08
10	2.08E+01	5.24E+01	6.13E+01	5.49E+01	1.39E+01	3.41E+00	5.19E-01	3.67E-01	8.54E-02	4.24E-03	4.67E-05
10 0	2.83E-01	3.13E-01	4.65E-01	4.61E-01	2.45E-01	5.58E-02	1.32E-02	8.99E-03	2.21E-03	1.28E-04	8.14E-07
10 1	6.28E-01	9.36E-01	1.05E+00	1.30E+00	6.20E-01	2.15E-01	6.28E-02	4.99E-02	1.23E-02	3.91E-04	6.60E-06
10 2	8.63E-01	1.53E+00	2.30E+00	2.57E+00	1.12E+00	2.50E-01	9.23E-02	7.06E-02	1.72E-02	1.01E-03	1.50E-05
10 3	1.07E+00	2.53E+00	3.21E+00	3.34E+00	1.16E+00	4.21E-01	1.14E-01	8.77E-02	2.25E-02	1.15E-03	1.27E-05
10 4	1.22E+00	3.35E+00	4.10E+00	4.07E+00	1.27E+00	4.53E-01	1.09E-01	8.08E-02	1.77E-02	9.01E-04	8.03E-06
10 5	1.93E+00	3.77E+00	4.49E+00	3.93E+00	1.77E+00	2.61E-01	6.56E-02	3.88E-02	7.05E-03	4.65E-04	2.92E-06
10 6	2.64E+00	4.52E+00	4.76E+00	4.29E+00	1.67E+00	3.57E-01	2.67E-02	1.28E-02	2.97E-03	1.56E-04	5.60E-07
10 7	3.86E+00	5.84E+00	6.82E+00	6.92E+00	1.60E+00	6.51E-01	1.37E-02	8.30E-03	6.10E-04	3.44E-05	7.08E-08
10 8	5.00E+00	1.01E+01	1.17E+01	1.17E+01	2.67E+00	4.92E-01	9.19E-03	5.41E-03	4.14E-04	4.19E-06	1.41E-08
10 9	3.29E+00	1.96E+01	2.25E+01	1.64E+01	1.78E+00	2.52E-01	1.32E-02	3.32E-03	2.41E-03	2.88E-07	2.68E-08
11	4.59E+00	1.67E+01	3.07E+01	3.92E+01	1.56E+01	4.59E+00	1.02E+00	6.21E-01	1.30E-01	5.61E-03	5.45E-05
11 0	1.52E-01	3.24E-01	5.09E-01	6.91E-01	5.02E-01	2.25E-01	5.59E-02	2.73E-02	5.18E-03	1.37E-04	8.44E-07
11 1	7.57E-02	5.14E-01	7.02E-01	9.78E-01	9.09E-01	4.00E-01	1.20E-01	7.16E-02	1.79E-02	4.69E-04	6.67E-06
11 2	1.48E-01	7.55E-01	1.24E+00	2.30E+00	1.71E+00	5.28E-01	2.10E-01	1.26E-01	2.84E-02	1.37E-03	1.75E-05
11 3	2.26E-01	1.11E+00	2.03E+00	2.76E+00	1.55E+00	5.87E-01	2.13E-01	1.39E-01	3.30E-02	1.52E-03	1.48E-05
11 4	2.70E-01	1.50E+00	2.08E+00	2.93E+00	1.48E+00	5.83E-01	2.09E-01	1.36E-01	2.66E-02	1.18E-03	9.48E-06
11 5	3.08E-01	1.30E+00	2.29E+00	2.34E+00	1.70E+00	3.64E-01	1.24E-01	7.21E-02	1.14E-02	6.41E-04	3.86E-06
11 6	5.20E-01	1.62E+00	2.10E+00	2.85E+00	1.74E+00	3.32E-01	4.69E-02	2.49E-02	4.39E-03	2.18E-04	7.39E-07
11 7	7.66E-01	1.52E+00	2.94E+00	3.22E+00	1.47E+00	6.04E-01	2.08E-02	1.18E-02	1.15E-03	5.64E-05	9.03E-08
11 8	8.96E-01	2.22E+00	3.58E+00	5.04E+00	1.97E+00	5.88E-01	7.11E-03	6.04E-03	7.66E-04	9.20E-06	1.32E-08
11 9	8.70E-01	2.23E+00	6.09E+00	8.11E+00	1.86E+00	7.67E-01	6.91E-03	4.12E-03	5.03E-04	8.19E-07	1.80E-08
11 10	3.60E-01	3.63E+00	7.11E+00	8.03E+00	7.45E-01	1.08E-01	4.73E-03	1.33E-03	8.37E-04	9.42E-07	5.40E-07

Table A.19: Data for N^{6+} + H(2p-1)

	impact energies [kev/amu]										
	1.0	5.0	7.0	10.0	25.0	45.0	90.	100.	150.	250.	500.
					total cross sections						
CX											
ION											
					state resolved CX cross sections						
n ℓ											
2	1.45E-09	2.47E-10	2.65E-10	4.09E-10	1.38E-06	1.06E-04	4.18E-05	3.14E-05	1.58E-04	9.67E-05	3.36E-06
2 1	1.45E-09	2.47E-10	2.65E-10	4.09E-10	1.38E-06	1.06E-04	4.18E-05	3.14E-05	1.58E-04	9.67E-05	3.36E-06
3	3.06E-09	7.30E-07	8.23E-06	8.19E-05	5.60E-03	9.45E-03	5.59E-03	5.31E-03	2.72E-03	2.43E-04	1.16E-05
3 1	9.24E-10	2.16E-07	2.81E-06	2.52E-05	1.44E-03	2.79E-03	8.02E-04	6.56E-04	4.97E-04	1.10E-04	3.15E-06
3 2	2.14E-09	5.14E-07	5.42E-06	5.68E-05	4.16E-03	6.66E-03	4.79E-03	4.66E-03	2.22E-03	1.32E-04	8.41E-06
4	2.58E-06	7.10E-03	2.60E-02	7.35E-02	3.19E-01	1.91E-01	3.56E-02	2.76E-02	5.05E-03	4.28E-04	1.86E-05
4 1	3.02E-07	8.89E-04	3.02E-03	7.44E-03	1.51E-02	1.12E-02	3.01E-03	2.18E-03	9.79E-04	1.01E-04	2.32E-06
4 2	1.22E-06	3.22E-03	1.08E-02	2.76E-02	9.57E-02	3.99E-02	7.11E-03	7.25E-03	2.63E-03	8.54E-05	9.02E-06
4 3	1.06E-06	2.99E-03	1.23E-02	3.84E-02	2.08E-01	1.40E-01	2.55E-02	1.82E-02	1.45E-03	2.42E-04	7.23E-06
5	2.46E-02	1.46E+00	2.53E+00	3.73E+00	2.97E+00	8.37E-01	8.92E-02	5.48E-02	9.10E-03	7.41E-04	2.10E-05
5 1	2.43E-03	5.35E-02	7.88E-02	8.94E-02	2.70E-02	1.74E-02	5.96E-03	4.28E-03	1.19E-03	8.07E-05	1.46E-06
5 2	6.30E-03	2.62E-01	4.06E-01	5.01E-01	2.38E-01	7.01E-02	1.70E-02	1.45E-02	3.25E-03	8.28E-05	7.84E-06
5 3	8.62E-03	5.41E-01	9.19E-01	1.32E+00	6.59E-01	1.25E-01	4.47E-02	2.63E-02	2.79E-03	3.36E-04	9.31E-06
5 4	7.23E-03	6.08E-01	1.13E+00	1.83E+00	2.04E+00	6.25E-01	2.16E-02	9.68E-03	1.88E-03	2.41E-04	2.38E-06
6	6.47E+00	3.26E+01	3.54E+01	3.09E+01	8.43E+00	1.66E+00	1.41E-01	9.03E-02	1.36E-02	9.65E-04	2.05E-05
6 1	3.02E-01	3.01E-01	2.34E-01	1.42E-01	4.15E-02	2.38E-02	7.02E-03	5.15E-03	1.33E-03	6.91E-05	8.97E-07
6 2	7.67E-01	1.75E+00	1.52E+00	9.37E-01	3.31E-01	8.98E-02	2.07E-02	1.77E-02	3.91E-03	8.35E-05	6.39E-06
6 3	1.44E+00	5.41E+00	5.26E+00	3.60E+00	8.15E-01	1.49E-01	5.20E-02	3.48E-02	4.20E-03	3.75E-04	9.29E-06
6 4	2.40E+00	1.10E+01	1.20E+01	9.93E+00	1.88E+00	6.52E-01	4.36E-02	2.47E-02	3.36E-03	3.68E-04	3.54E-06
6 5	1.56E+00	1.41E+01	1.64E+01	1.63E+01	5.36E+00	7.44E-01	1.73E-02	7.83E-03	8.41E-04	6.94E-05	3.76E-07
7	1.42E+02	1.44E+02	1.12E+02	7.39E+01	1.33E+01	2.32E+00	1.68E-01	1.13E-01	1.82E-02	1.09E-03	1.89E-05
7 1	2.41E+00	3.03E-01	2.17E-01	1.44E-01	4.93E-02	3.00E-02	7.88E-03	5.60E-03	1.33E-03	6.22E-05	5.63E-07
7 2	7.84E+00	2.02E+00	1.43E+00	9.35E-01	3.57E-01	1.10E-01	2.43E-02	1.98E-02	4.20E-03	8.14E-05	5.13E-06
7 3	1.64E+01	7.55E+00	5.13E+00	3.24E+00	8.19E-01	1.81E-01	5.69E-02	4.01E-02	5.30E-03	3.82E-04	8.53E-06
7 4	2.69E+01	2.14E+01	1.48E+01	8.83E+00	1.82E+00	6.86E-01	5.28E-02	3.33E-02	5.00E-03	4.25E-04	3.93E-06
7 5	4.06E+01	4.62E+01	3.47E+01	1.87E+01	4.08E+00	8.31E-01	2.02E-02	1.09E-02	2.06E-03	1.29E-04	6.63E-07
7 6	4.74E+01	6.65E+01	5.62E+01	4.20E+01	6.14E+00	4.81E-01	6.28E-03	3.31E-03	2.64E-04	1.11E-05	4.13E-08
8	3.27E+02	1.68E+02	1.26E+02	8.46E+01	1.54E+01	2.81E+00	1.99E-01	1.26E-01	2.13E-02	1.18E-03	1.71E-05
8 1	2.15E+00	1.81E-01	1.38E-01	1.11E-01	5.20E-02	3.63E-02	8.94E-03	6.01E-03	1.33E-03	5.84E-05	3.70E-07
8 2	8.08E+00	1.08E+00	8.97E-01	7.27E-01	2.86E-01	1.29E-01	2.91E-02	2.14E-02	4.31E-03	8.17E-05	4.15E-06
8 3	1.92E+01	3.91E+00	3.25E+00	2.31E+00	8.00E-01	2.21E-01	6.45E-02	4.17E-02	5.92E-03	3.82E-04	7.63E-06
8 4	3.81E+01	1.10E+01	8.23E+00	6.05E+00	1.42E+00	6.85E-01	6.12E-02	3.67E-02	6.03E-03	4.59E-04	3.97E-06
8 5	6.22E+01	2.50E+01	1.84E+01	1.10E+01	3.30E+00	8.64E-01	2.40E-02	1.42E-02	3.01E-03	1.71E-04	8.42E-07
8 6	8.31E+01	4.87E+01	3.19E+01	2.02E+01	4.99E+00	6.25E-01	8.52E-03	5.75E-03	6.35E-04	2.45E-05	8.69E-08
8 7	1.14E+02	7.81E+01	6.30E+01	4.41E+01	4.54E+00	2.48E-01	2.45E-03	4.97E-04	1.24E-04	1.52E-06	5.76E-09
9	8.23E+01	8.36E+01	8.05E+01	6.59E+01	1.59E+01	3.14E+00	2.44E-01	1.47E-01	2.48E-02	1.25E-03	1.55E-05
9 1	3.73E-01	7.40E-02	7.86E-02	8.12E-02	5.11E-02	3.93E-02	9.78E-03	6.56E-03	1.32E-03	5.72E-05	2.57E-07
9 2	1.41E+00	4.93E-01	4.54E-01	4.80E-01	2.32E-01	1.50E-01	3.28E-02	2.34E-02	4.45E-03	8.52E-05	3.44E-06
9 3	3.26E+00	1.54E+00	1.69E+00	1.49E+00	7.24E-01	2.52E-01	7.21E-02	4.51E-02	6.61E-03	3.82E-04	6.83E-06
9 4	6.47E+00	4.17E+00	3.92E+00	3.69E+00	1.19E+00	7.05E-01	7.57E-02	4.34E-02	7.20E-03	4.85E-04	3.88E-06
9 5	1.15E+01	8.33E+00	8.14E+00	6.14E+00	2.47E+00	8.83E-01	3.58E-02	1.99E-02	4.02E-03	2.03E-04	9.47E-07
9 6	1.85E+01	1.42E+01	1.18E+01	1.04E+01	4.16E+00	6.48E-01	1.03E-02	6.38E-03	9.88E-04	3.78E-05	1.27E-07
9 7	2.03E+01	2.16E+01	1.81E+01	1.45E+01	4.55E+00	3.63E-01	5.47E-03	1.96E-03	1.51E-04	3.78E-06	1.21E-08
9 8	2.04E+01	3.32E+01	3.63E+01	2.91E+01	2.54E+00	9.90E-02	2.02E-03	2.96E-04	4.68E-05	2.39E-07	1.70E-09
10	9.05E+00	2.88E+01	3.90E+01	4.45E+01	1.50E+01	3.49E+00	3.02E-01	1.85E-01	2.94E-02	1.38E-03	1.46E-05
10 1	5.54E-02	3.86E-02	3.96E-02	5.86E-02	4.89E-02	4.00E-02	1.07E-02	7.40E-03	1.40E-03	5.97E-05	1.91E-07
10 2	1.72E-01	2.11E-01	2.69E-01	2.94E-01	1.98E-01	1.69E-01	3.66E-02	2.66E-02	4.81E-03	9.57E-05	2.99E-06
10 3	3.40E-01	6.53E-01	7.87E-01	9.12E-01	6.51E-01	2.78E-01	7.94E-02	5.22E-02	7.52E-03	4.01E-04	6.34E-06
10 4	5.63E-01	1.47E+00	1.95E+00	2.13E+00	1.05E+00	6.98E-01	9.32E-02	5.60E-02	8.58E-03	5.27E-04	3.84E-06
10 5	8.22E-01	2.87E+00	3.44E+00	3.21E+00	1.88E+00	9.42E-01	5.30E-02	2.96E-02	5.24E-03	2.40E-04	1.03E-06
10 6	1.29E+00	4.09E+00	4.88E+00	5.76E+00	3.29E+00	7.14E-01	1.71E-02	9.08E-03	1.54E-03	5.21E-05	1.63E-07
10 7	2.05E+00	5.31E+00	6.49E+00	6.23E+00	3.95E+00	4.30E-01	6.63E-03	3.44E-03	2.93E-04	6.73E-06	2.01E-08
10 8	2.49E+00	5.25E+00	7.34E+00	1.10E+01	2.93E+00	1.83E-01	4.02E-03	8.24E-04	3.36E-05	7.62E-07	2.42E-09
10 9	1.28E+00	8.86E+00	1.38E+01	1.49E+01	1.04E+00	3.46E-02	1.53E-03	2.88E-04	2.36E-05	2.43E-08	8.11E-10
11	1.11E+00	8.09E+00	1.53E+01	2.44E+01	1.51E+01	4.71E+00	4.67E-01	2.95E-01	4.19E-02	1.78E-03	1.59E-05
11 1	1.00E-02	1.88E-02	1.94E-02	4.07E-02	5.66E-02	5.00E-02	1.41E-02	9.59E-03	1.64E-03	7.01E-05	1.64E-07
11 2	2.52E-02	7.87E-02	1.43E-01	1.96E-01	2.23E-01	2.34E-01	5.29E-02	3.75E-02	6.27E-03	1.27E-04	3.02E-06
11 3	4.32E-02	2.51E-01	3.24E-01	5.42E-01	6.30E-01	4.03E-01	1.12E-01	7.57E-02	1.04E-02	4.97E-04	6.81E-06
11 4	7.09E-02	4.68E-01	8.61E-01	1.26E+00	1.14E+00	8.29E-01	1.42E-01	8.95E-02	1.23E-02	6.68E-04	4.36E-06
11 5	8.92E-02	8.68E-01	1.31E+00	1.65E+00	1.59E+00	1.19E+00	9.26E-02	5.45E-02	8.00E-03	3.24E-04	1.26E-06
11 6	1.07E-01	1.09E+00	1.85E+00	3.03E+00	2.70E+00	9.92E-01	3.42E-02	1.88E-02	2.56E-03	7.82E-05	2.20E-07
11 7	1.35E-01	1.36E+00	2.37E+00	2.92E+00	3.62E+00	6.16E-01	9.37E-03	5.33E-03	5.16E-04	1.20E-05	3.19E-08
11 8	1.94E-01	1.23E+00	2.07E+00	3.77E+00	3.16E+00	2.93E-01	4.68E-03	2.51E-03	7.96E-05	1.70E-06	4.48E-09
11 9	2.53E-01	1.22E+00	2.98E+00	6.21E+00	1.63E+00	8.66E-02	3.14E-03	1.01E-03	7.31E-06	1.02E-07	9.51E-10
11 10	1.79E-01	1.50E+00	3.33E+00	4.74E+00	3.92E-01	1.47E-02	1.02E-03	1.50E-04	1.78E-05	6.81E-09	3.80E-10

Table A.20: Data for N^{6+} + H(2p)

	impact energies [kev/amu]										
	1.0	5.0	7.0	10.0	25.0	45.0	90.	100.	150.	250.	500.
	total cross sections										
CX											
ION											
	state resolved CX cross sections										
n *ℓ*											
2	6.39E-05	7.83E-04	1.36E-03	2.31E-03	7.26E-03	2.76E-02	2.74E-02	2.87E-02	8.21E-03	9.21E-04	9.77E-05
2 0	1.11E-05	1.68E-04	3.36E-04	7.32E-04	3.62E-03	2.48E-02	2.55E-02	2.74E-02	6.68E-03	3.43E-04	1.92E-05
2 1	5.28E-05	6.15E-04	1.03E-03	1.58E-03	3.64E-03	2.72E-03	1.85E-03	1.31E-03	1.53E-03	5.78E-04	7.85E-05
3	8.67E-02	6.32E-02	2.28E-01	7.71E-02	1.16E-01	1.39E-01	5.03E-02	6.68E-02	1.94E-02	2.86E-03	1.43E-04
3 0	8.08E-03	4.83E-02	2.02E-01	5.17E-02	7.37E-02	8.88E-02	1.04E-02	3.00E-02	5.58E-03	9.75E-04	1.55E-05
3 1	3.89E-02	1.16E-02	2.23E-02	1.88E-02	2.54E-02	2.85E-02	1.46E-02	1.43E-02	3.52E-03	4.46E-04	6.12E-05
3 2	3.97E-02	3.29E-03	3.22E-03	6.58E-03	1.65E-02	2.15E-02	2.53E-02	2.26E-02	1.03E-02	1.44E-03	6.68E-05
4	1.30E-02	4.52E-02	1.05E-01	2.43E-01	8.18E-01	5.96E-01	1.63E-01	1.07E-01	3.05E-02	2.81E-03	1.42E-04
4 0	2.92E-03	8.38E-03	2.17E-02	6.85E-02	7.00E-02	5.52E-02	2.64E-02	1.55E-02	6.35E-03	5.27E-04	8.82E-06
4 1	3.17E-03	1.49E-02	3.02E-02	5.41E-02	2.10E-01	8.66E-02	1.98E-02	1.37E-02	4.46E-03	3.91E-04	4.74E-05
4 2	3.25E-03	1.10E-02	2.85E-02	5.59E-02	2.47E-01	1.87E-01	3.43E-02	2.09E-02	9.01E-03	9.72E-04	6.45E-05
4 3	3.69E-03	1.09E-02	2.48E-02	6.45E-02	2.91E-01	2.67E-01	8.28E-02	5.65E-02	1.07E-02	9.15E-04	2.12E-05
5	3.24E-01	2.07E+00	3.49E+00	5.03E+00	4.37E+00	1.42E+00	2.07E-01	1.46E-01	2.73E-02	2.85E-03	1.32E-04
5 0	4.25E-02	1.08E-01	1.99E-01	3.26E-01	7.54E-02	2.57E-02	1.18E-02	7.61E-03	2.70E-03	2.69E-04	4.83E-06
5 1	4.50E-02	3.90E-01	6.12E-01	8.10E-01	2.75E-01	8.29E-02	1.78E-02	1.42E-02	3.68E-03	3.82E-04	3.52E-05
5 2	7.91E-02	5.00E-01	8.04E-01	1.12E+00	7.31E-01	1.67E-01	3.14E-02	2.63E-02	6.20E-03	8.45E-04	5.80E-05
5 3	8.28E-02	5.44E-01	9.19E-01	1.29E+00	1.41E+00	3.39E-01	6.34E-02	5.03E-02	8.80E-03	9.11E-04	2.89E-05
5 4	7.47E-02	5.32E-01	9.58E-01	1.48E+00	1.89E+00	8.02E-01	8.24E-02	4.81E-02	5.96E-03	4.40E-04	5.28E-06
6	8.75E+00	3.11E+01	3.32E+01	3.10E+01	8.73E+00	2.02E+00	2.38E-01	1.52E-01	3.19E-02	3.01E-03	1.19E-04
6 0	4.02E-01	9.47E-01	8.33E-01	4.47E-01	1.05E-01	2.27E-02	8.74E-03	4.46E-03	1.42E-03	1.66E-04	2.97E-06
6 1	7.62E-01	2.55E+00	2.29E+00	1.47E+00	2.94E-01	8.90E-02	2.37E-02	1.43E-02	4.10E-03	3.88E-04	2.54E-05
6 2	1.16E+00	4.61E+00	4.62E+00	3.50E+00	7.08E-01	1.77E-01	4.02E-02	2.61E-02	7.50E-03	8.07E-04	5.03E-05
6 3	1.93E+00	6.48E+00	6.84E+00	6.53E+00	1.31E+00	2.87E-01	5.88E-02	4.20E-02	8.88E-03	9.08E-04	3.11E-05
6 4	2.47E+00	7.97E+00	8.46E+00	8.68E+00	2.29E+00	5.48E-01	6.55E-02	4.32E-02	6.59E-03	5.95E-04	8.25E-06
6 5	2.02E+00	8.60E+00	1.02E+01	1.04E+01	4.03E+00	8.94E-01	4.12E-02	2.22E-02	3.36E-03	1.42E-04	8.67E-07
7	1.39E+02	1.16E+02	9.66E+01	6.47E+01	1.25E+01	2.47E+00	2.80E-01	1.73E-01	3.13E-02	3.10E-03	1.06E-04
7 0	3.98E+00	9.19E-01	5.62E-01	3.58E-01	1.07E-01	2.74E-02	7.52E-03	4.61E-03	7.81E-04	1.17E-04	2.16E-06
7 1	6.39E+00	2.70E+00	2.09E+00	1.36E+00	3.14E-01	8.76E-02	2.35E-02	1.88E-02	3.87E-03	3.80E-04	1.90E-05
7 2	1.26E+01	6.82E+00	4.91E+00	3.20E+00	7.15E-01	1.88E-01	4.63E-02	3.24E-02	6.86E-03	7.63E-04	4.33E-05
7 3	1.81E+01	1.33E+01	9.94E+00	6.16E+00	1.17E+00	2.73E-01	6.78E-02	4.49E-02	8.57E-03	9.19E-04	3.00E-05
7 4	2.47E+01	2.14E+01	1.76E+01	1.12E+01	1.91E+00	5.42E-01	7.11E-02	4.05E-02	6.61E-03	6.60E-04	9.57E-06
7 5	3.08E+01	3.02E+01	2.60E+01	1.68E+01	3.17E+00	6.55E-01	4.09E-02	2.26E-02	2.63E-03	2.29E-04	1.56E-06
7 6	4.26E+01	4.03E+01	3.56E+01	2.55E+01	5.12E+00	6.97E-01	2.27E-02	9.39E-03	1.97E-03	3.31E-05	1.15E-07
8	2.96E+02	1.76E+02	1.31E+02	8.61E+01	1.47E+01	2.98E+00	2.60E-01	1.81E-01	3.84E-02	3.20E-03	9.41E-05
8 0	4.72E+00	5.17E-01	3.85E-01	2.96E-01	1.02E-01	3.08E-02	5.47E-03	3.92E-03	7.89E-04	9.28E-05	1.78E-06
8 1	6.82E+00	1.81E+00	1.64E+00	1.32E+00	3.25E-01	1.33E-01	2.04E-02	1.80E-02	4.71E-03	3.72E-04	1.47E-05
8 2	1.33E+01	4.12E+00	3.68E+00	2.71E+00	6.48E-01	2.06E-01	4.03E-02	3.21E-02	7.97E-03	7.35E-04	3.75E-05
8 3	2.38E+01	8.81E+00	7.15E+00	5.05E+00	1.12E+00	3.31E-01	5.90E-02	4.38E-02	9.74E-03	9.48E-04	2.79E-05
8 4	3.68E+01	1.66E+01	1.27E+01	8.34E+00	1.52E+00	5.39E-01	6.28E-02	4.23E-02	8.17E-03	7.04E-04	1.00E-05
8 5	5.00E+01	2.84E+01	2.08E+01	1.31E+01	2.73E+00	5.94E-01	3.97E-02	2.47E-02	3.92E-03	2.78E-04	1.98E-06
8 6	7.04E+01	4.49E+01	3.19E+01	1.98E+01	3.43E+00	6.64E-01	1.85E-02	1.08E-02	1.46E-03	6.43E-05	2.12E-07
8 7	8.97E+01	7.12E+01	5.30E+01	3.55E+01	4.87E+00	4.86E-01	1.43E-02	5.60E-03	1.61E-03	6.71E-06	2.75E-08
9	1.02E+02	1.12E+02	9.89E+01	7.74E+01	1.56E+01	3.12E+00	2.92E-01	1.87E-01	4.01E-02	3.32E-03	8.53E-05
9 0	1.21E+00	2.82E-01	2.32E-01	2.28E-01	1.10E-01	2.75E-02	6.82E-03	3.67E-03	8.14E-04	8.21E-05	1.58E-06
9 1	1.78E+00	8.44E-01	9.43E-01	9.64E-01	3.05E-01	1.13E-01	2.52E-02	1.74E-02	4.83E-03	3.71E-04	1.20E-05
9 2	3.03E+00	2.00E+00	2.21E+00	2.02E+00	6.25E-01	1.88E-01	4.81E-02	3.16E-02	7.96E-03	7.27E-04	3.31E-05
9 3	5.02E+00	3.87E+00	4.03E+00	3.56E+00	9.95E-01	2.89E-01	6.53E-02	4.27E-02	1.01E-02	9.78E-04	2.60E-05
9 4	7.20E+00	6.79E+00	6.65E+00	5.53E+00	1.28E+00	5.20E-01	6.76E-02	4.47E-02	8.60E-03	7.44E-04	1.01E-05
9 5	1.06E+01	1.12E+01	9.90E+00	7.71E+00	2.17E+00	5.77E-01	4.19E-02	2.73E-02	3.92E-03	3.14E-04	2.22E-06
9 6	1.69E+01	1.67E+01	1.37E+01	1.03E+01	2.95E+00	5.72E-01	1.77E-02	1.09E-02	1.74E-03	8.87E-05	2.83E-07
9 7	2.66E+01	2.62E+01	2.13E+01	1.53E+01	3.66E+00	5.51E-01	9.56E-03	5.64E-03	5.46E-04	1.60E-05	3.00E-08
9 8	2.95E+01	4.40E+01	4.00E+01	3.17E+01	3.54E+00	2.80E-01	9.47E-03	3.22E-03	1.58E-03	1.24E-06	2.01E-08
10	2.08E+01	4.05E+01	5.11E+01	5.38E+01	1.50E+01	3.23E+00	3.35E-01	2.31E-01	5.31E-02	3.69E-03	8.20E-05
10 0	2.20E-01	1.52E-01	2.36E-01	2.80E-01	1.22E-01	2.58E-02	6.25E-03	4.34E-03	1.11E-03	8.81E-05	1.57E-06
10 1	5.05E-01	4.91E-01	5.12E-01	6.02E-01	3.12E-01	1.17E-01	2.99E-02	2.39E-02	6.95E-03	4.18E-04	1.08E-05
10 2	7.39E-01	8.24E-01	1.27E+00	1.49E+00	5.82E-01	1.89E-01	5.07E-02	3.80E-02	1.00E-02	7.81E-04	3.17E-05
10 3	9.31E-01	1.64E+00	2.05E+00	2.14E+00	9.29E-01	2.89E-01	7.41E-02	5.30E-02	1.32E-02	1.07E-03	2.49E-05
10 4	1.25E+00	2.46E+00	3.23E+00	3.40E+00	1.09E+00	4.90E-01	7.98E-02	5.46E-02	1.16E-02	8.27E-04	1.02E-05
10 5	1.95E+00	3.69E+00	4.41E+00	4.04E+00	1.71E+00	5.59E-01	5.15E-02	3.23E-02	5.66E-03	3.59E-04	2.41E-06
10 6	3.28E+00	4.99E+00	5.46E+00	5.63E+00	2.41E+00	5.34E-01	2.10E-02	1.37E-02	2.15E-03	1.12E-04	3.51E-07
10 7	4.38E+00	6.00E+00	7.14E+00	6.94E+00	2.90E+00	5.43E-01	9.66E-03	6.77E-03	6.32E-04	2.65E-05	3.83E-08
10 8	4.52E+00	7.60E+00	8.92E+00	1.09E+01	3.22E+00	3.44E-01	5.72E-03	3.12E-03	3.16E-04	3.60E-06	7.79E-09
10 9	3.04E+00	1.26E+01	1.79E+01	1.84E+01	1.73E+00	1.42E-01	6.40E-03	1.69E-03	1.40E-03	2.53E-07	1.42E-08
11	5.16E+00	1.24E+01	2.19E+01	3.27E+01	1.60E+01	4.36E+00	6.07E-01	3.90E-01	7.90E-02	4.96E-03	9.16E-05
11 0	2.02E-01	1.60E-01	2.37E-01	3.61E-01	2.33E-01	8.65E-02	2.33E-02	1.32E-02	2.66E-03	1.08E-04	1.42E-06
11 1	8.53E-02	2.48E-01	3.46E-01	4.33E-01	4.76E-01	1.80E-01	5.39E-02	3.48E-02	9.53E-03	5.14E-04	9.98E-06
11 2	1.92E-01	4.33E-01	6.41E-01	1.18E+00	9.33E-01	3.50E-01	1.05E-01	6.81E-02	1.57E-02	1.07E-03	3.55E-05
11 3	2.57E-01	6.72E-01	1.11E+00	1.53E+00	1.12E+00	4.20E-01	1.27E-01	8.52E-02	1.90E-02	1.42E-03	2.86E-05
11 4	3.06E-01	1.03E+00	1.43E+00	2.12E+00	1.25E+00	6.17E-01	1.39E-01	9.24E-02	1.76E-02	1.12E-03	1.21E-05
11 5	3.94E-01	1.13E+00	1.80E+00	2.09E+00	1.51E+00	7.17E-01	9.38E-02	5.71E-02	9.21E-03	5.20E-04	3.08E-06
11 6	5.54E-01	1.54E+00	2.07E+00	3.05E+00	2.05E+00	6.56E-01	3.83E-02	2.17E-02	3.26E-03	1.60E-04	4.55E-07
11 7	6.88E-01	1.55E+00	2.58E+00	3.36E+00	2.52E+00	6.21E-01	1.44E-02	9.16E-03	8.31E-04	4.36E-05	5.22E-08
11 8	9.14E-01	1.68E+00	2.84E+00	4.17E+00	2.89E+00	4.53E-01	5.19E-03	4.79E-03	4.75E-04	7.69E-06	8.52E-09
11 9	9.05E-01	1.64E+00	3.90E+00	6.88E+00	2.18E+00	2.02E-01	4.42E-03	2.42E-03	2.53E-04	7.58E-07	9.77E-09
11 10	6.61E-01	2.32E+00	4.93E+00	7.53E+00	7.82E-01	6.29E-02	2.63E-03	8.04E-04	4.67E-04	1.67E-06	3.41E-07

Table A.21: Data for N^{6+} + H($n = 2$)

	impact energies [kev/amu]										
	1.0	5.0	7.0	10.0	25.0	45.0	90.	100.	150.	250.	500.
	total cross sections										
CX											
ION											
	state resolved CX cross sections										
n ℓ											
2	8.78E-05	1.39E-03	2.45E-03	4.36E-03	1.28E-02	4.01E-02	3.20E-02	3.43E-02	1.18E-02	1.31E-03	1.96E-04
2 0	1.39E-05	3.20E-04	6.02E-04	1.41E-03	6.69E-03	3.61E-02	2.98E-02	3.25E-02	9.97E-03	4.50E-04	3.26E-05
2 1	7.39E-05	1.07E-03	1.85E-03	2.95E-03	6.15E-03	4.00E-03	2.13E-03	1.81E-03	1.88E-03	8.63E-04	1.63E-04
3	1.16E-01	1.17E-01	4.25E-01	1.49E-01	1.62E-01	1.71E-01	5.05E-02	7.00E-02	2.18E-02	4.27E-03	2.85E-04
3 0	1.01E-02	8.57E-02	3.74E-01	9.83E-02	1.12E-01	1.06E-01	1.12E-02	3.22E-02	6.85E-03	1.31E-03	2.43E-05
3 1	5.74E-02	2.28E-02	4.25E-02	3.77E-02	3.18E-02	3.39E-02	1.49E-02	1.57E-02	3.15E-03	6.71E-04	1.22E-04
3 2	4.84E-02	8.24E-03	8.00E-03	1.29E-02	1.91E-02	3.13E-02	2.44E-02	2.21E-02	1.18E-02	2.29E-03	1.39E-04
4	2.41E-02	6.91E-02	1.64E-01	3.21E-01	7.18E-01	5.27E-01	1.53E-01	1.04E-01	3.18E-02	3.97E-03	2.63E-04
4 0	6.32E-03	1.35E-02	4.27E-02	1.12E-01	7.94E-02	6.70E-02	2.45E-02	1.49E-02	7.34E-03	7.08E-04	1.45E-05
4 1	6.26E-03	2.22E-02	4.78E-02	7.02E-02	1.72E-01	7.92E-02	2.25E-02	1.72E-02	3.90E-03	5.65E-04	8.52E-05
4 2	5.71E-03	1.69E-02	3.79E-02	6.27E-02	2.08E-01	1.56E-01	3.30E-02	2.10E-02	1.00E-02	1.50E-03	1.19E-04
4 3	5.76E-03	1.65E-02	3.56E-02	7.66E-02	2.59E-01	2.25E-01	7.32E-02	5.14E-02	1.05E-02	1.20E-03	4.40E-05
5	6.23E-01	2.15E+00	3.30E+00	4.44E+00	4.04E+00	1.36E+00	2.01E-01	1.43E-01	2.94E-02	3.61E-03	2.25E-04
5 0	8.48E-02	1.09E-01	1.80E-01	2.65E-01	7.84E-02	2.93E-02	1.14E-02	7.47E-03	3.57E-03	3.43E-04	8.42E-06
5 1	1.03E-01	3.73E-01	5.36E-01	6.78E-01	2.87E-01	7.86E-02	1.99E-02	1.69E-02	3.32E-03	5.06E-04	5.90E-05
5 2	1.73E-01	4.81E-01	7.08E-01	9.51E-01	7.19E-01	1.73E-01	3.04E-02	2.43E-02	7.77E-03	1.17E-03	9.63E-05
5 3	1.48E-01	5.69E-01	8.73E-01	1.14E+00	1.27E+00	3.59E-01	5.93E-02	4.79E-02	8.63E-03	1.05E-03	5.21E-05
5 4	1.14E-01	6.23E-01	1.00E+00	1.41E+00	1.68E+00	7.18E-01	7.94E-02	4.66E-02	6.12E-03	5.45E-04	8.82E-06
6	9.99E+00	2.91E+01	3.24E+01	3.09E+01	9.38E+00	2.15E+00	2.38E-01	1.53E-01	3.20E-02	3.50E-03	1.89E-04
6 0	4.78E-01	8.39E-01	7.84E-01	4.98E-01	1.09E-01	2.43E-02	8.56E-03	4.95E-03	1.82E-03	1.96E-04	5.38E-06
6 1	8.37E-01	2.40E+00	2.20E+00	1.60E+00	2.86E-01	8.28E-02	2.61E-02	1.66E-02	3.64E-03	4.69E-04	4.08E-05
6 2	1.43E+00	4.42E+00	4.58E+00	3.58E+00	7.13E-01	1.65E-01	3.59E-02	2.32E-02	8.00E-03	1.02E-03	7.76E-05
6 3	2.30E+00	6.09E+00	6.88E+00	6.43E+00	1.33E+00	2.97E-01	5.59E-02	4.08E-02	8.55E-03	9.50E-04	5.13E-05
6 4	2.27E+00	7.41E+00	8.56E+00	8.90E+00	2.67E+00	5.11E-01	6.14E-02	4.07E-02	6.37E-03	6.85E-04	1.28E-05
6 5	2.67E+00	7.94E+00	9.36E+00	9.85E+00	4.27E+00	1.07E+00	5.07E-02	2.68E-02	3.58E-03	1.77E-04	1.17E-06
7	1.35E+02	1.20E+02	1.00E+02	6.76E+01	1.36E+01	2.71E+00	2.74E-01	1.74E-01	3.11E-02	3.42E-03	1.60E-04
7 0	3.96E+00	9.33E-01	5.64E-01	3.47E-01	9.66E-02	2.67E-02	7.10E-03	4.79E-03	1.14E-03	1.28E-04	3.90E-06
7 1	6.36E+00	2.89E+00	2.10E+00	1.30E+00	2.84E-01	8.31E-02	2.41E-02	1.95E-02	3.38E-03	4.34E-04	2.92E-05
7 2	1.26E+01	7.29E+00	5.15E+00	3.12E+00	6.57E-01	1.71E-01	3.91E-02	2.79E-02	7.36E-03	9.08E-04	6.34E-05
7 3	1.78E+01	1.46E+01	1.09E+01	6.41E+00	1.12E+00	2.80E-01	6.04E-02	4.32E-02	8.00E-03	9.12E-04	4.69E-05
7 4	2.52E+01	2.40E+01	1.93E+01	1.26E+01	1.91E+00	4.92E-01	6.55E-02	3.83E-02	6.34E-03	7.16E-04	1.41E-05
7 5	3.24E+01	3.29E+01	2.83E+01	1.92E+01	3.15E+00	6.73E-01	4.87E-02	2.74E-02	2.94E-03	2.81E-04	2.05E-06
7 6	3.73E+01	3.71E+01	3.36E+01	2.46E+01	6.42E+00	9.86E-01	2.93E-02	1.29E-02	1.94E-03	3.97E-05	1.30E-07
8	3.02E+02	1.72E+02	1.27E+02	8.36E+01	1.54E+01	3.22E+00	2.57E-01	1.80E-01	3.55E-02	3.40E-03	1.37E-04
8 0	5.39E+00	4.88E-01	3.42E-01	2.55E-01	8.76E-02	3.09E-02	5.31E-03	4.07E-03	9.31E-04	9.51E-05	3.10E-06
8 1	7.47E+00	1.67E+00	1.46E+00	1.14E+00	2.83E-01	1.17E-01	2.01E-02	1.79E-02	4.04E-03	4.13E-04	2.18E-05
8 2	1.44E+01	3.83E+00	3.25E+00	2.36E+00	5.71E-01	1.89E-01	3.41E-02	2.75E-02	7.69E-03	8.27E-04	5.28E-05
8 3	2.32E+01	8.32E+00	6.55E+00	4.54E+00	1.05E+00	3.14E-01	5.20E-02	4.14E-02	8.77E-03	9.21E-04	4.20E-05
8 4	3.55E+01	1.66E+01	1.22E+01	8.04E+00	1.47E+00	4.83E-01	5.85E-02	3.96E-02	7.14E-03	7.29E-04	1.43E-05
8 5	5.21E+01	2.96E+01	2.12E+01	1.29E+01	2.54E+00	5.94E-01	4.43E-02	2.74E-02	3.95E-03	3.28E-04	2.55E-06
8 6	7.32E+01	4.67E+01	3.35E+01	1.99E+01	3.54E+00	8.41E-01	2.67E-02	1.54E-02	1.48E-03	7.76E-05	2.41E-07
8 7	9.11E+01	6.48E+01	4.88E+01	3.44E+01	5.83E+00	6.56E-01	1.61E-02	6.62E-03	1.54E-03	7.73E-06	3.05E-08
9	9.62E+01	1.08E+02	9.39E+01	7.24E+01	1.58E+01	3.31E+00	2.81E-01	1.84E-01	3.73E-02	3.44E-03	1.20E-04
9 0	1.35E+00	2.77E-01	2.27E-01	2.05E-01	9.37E-02	2.80E-02	6.40E-03	3.90E-03	9.62E-04	8.00E-05	2.62E-06
9 1	1.91E+00	8.32E-01	8.72E-01	8.61E-01	2.71E-01	9.87E-02	2.36E-02	1.69E-02	4.17E-03	4.08E-04	1.71E-05
9 2	3.06E+00	1.98E+00	2.11E+00	1.82E+00	5.57E-01	1.76E-01	4.00E-02	2.69E-02	7.84E-03	7.81E-04	4.53E-05
9 3	5.04E+00	3.69E+00	3.82E+00	3.27E+00	9.39E-01	2.70E-01	5.64E-02	3.96E-02	9.08E-03	9.45E-04	3.80E-05
9 4	7.49E+00	6.60E+00	6.54E+00	5.38E+00	1.27E+00	4.53E-01	6.12E-02	4.16E-02	7.65E-03	7.48E-04	1.41E-05
9 5	1.07E+01	1.14E+01	1.01E+01	7.75E+00	2.07E+00	5.63E-01	4.49E-02	2.88E-02	3.89E-03	3.54E-04	2.81E-06
9 6	1.66E+01	1.72E+01	1.43E+01	1.01E+01	2.92E+00	6.87E-01	2.57E-02	1.50E-02	1.69E-03	1.05E-04	3.21E-07
9 7	2.43E+01	2.58E+01	2.04E+01	1.50E+01	3.86E+00	7.02E-01	1.34E-02	7.64E-03	5.09E-04	1.83E-05	3.13E-08
9 8	2.58E+01	4.04E+01	3.54E+01	2.81E+01	3.78E+00	3.32E-01	9.22E-03	3.28E-03	1.47E-03	1.39E-06	2.15E-08
10	2.38E+01	4.24E+01	5.13E+01	5.15E+01	1.48E+01	3.39E+00	3.20E-01	2.21E-01	4.77E-02	3.75E-03	1.12E-04
10 0	2.26E-01	1.73E-01	2.48E-01	2.87E-01	1.08E-01	2.68E-02	6.08E-03	4.54E-03	1.22E-03	8.37E-05	2.51E-06
10 1	5.08E-01	5.33E-01	6.22E-01	6.43E-01	2.87E-01	1.09E-01	2.85E-02	2.26E-02	5.97E-03	4.58E-04	1.47E-05
10 2	7.45E-01	8.95E-01	1.29E+00	1.48E+00	5.65E-01	1.83E-01	4.27E-02	3.21E-02	9.28E-03	8.07E-04	4.19E-05
10 3	9.62E-01	1.72E+00	2.27E+00	2.21E+00	9.04E-01	2.79E-01	6.39E-02	4.78E-02	1.17E-02	1.03E-03	3.56E-05
10 4	1.27E+00	2.57E+00	3.40E+00	3.52E+00	1.13E+00	4.35E-01	7.07E-02	4.99E-02	9.91E-03	8.17E-04	1.40E-05
10 5	1.99E+00	3.98E+00	4.90E+00	4.45E+00	1.72E+00	5.33E-01	5.23E-02	3.27E-02	5.26E-03	3.89E-04	3.02E-06
10 6	3.59E+00	5.62E+00	6.03E+00	5.79E+00	2.37E+00	6.05E-01	2.85E-02	1.67E-02	2.14E-03	1.29E-04	3.95E-07
10 7	5.08E+00	6.39E+00	7.26E+00	7.19E+00	2.87E+00	6.53E-01	1.43E-02	8.76E-03	6.92E-04	2.99E-05	3.98E-08
10 8	5.57E+00	7.88E+00	8.95E+00	1.04E+01	3.15E+00	4.12E-01	6.91E-03	3.77E-03	3.01E-04	4.00E-06	8.58E-09
10 9	3.90E+00	1.27E+01	1.63E+01	1.55E+01	1.69E+00	1.52E-01	5.82E-03	1.58E-03	1.27E-03	2.77E-07	1.40E-08
11	6.48E+00	1.37E+01	2.35E+01	3.30E+01	1.60E+01	4.68E+00	5.69E-01	3.69E-01	7.16E-02	5.00E-03	1.22E-04
11 0	2.26E-01	1.70E-01	2.53E-01	4.28E-01	2.21E-01	9.43E-02	2.15E-02	1.33E-02	2.66E-03	1.06E-04	2.16E-06
11 1	1.05E-01	2.64E-01	4.37E-01	5.02E-01	4.48E-01	1.90E-01	5.08E-02	3.39E-02	8.35E-03	5.71E-04	1.36E-05
11 2	2.29E-01	4.96E-01	7.16E-01	1.33E+00	9.38E-01	3.61E-01	9.24E-02	6.06E-02	1.49E-02	1.07E-03	4.57E-05
11 3	3.16E-01	6.90E-01	1.32E+00	1.67E+00	1.14E+00	4.48E-01	1.10E-01	7.71E-02	1.71E-02	1.37E-03	3.99E-05
11 4	3.77E-01	1.13E+00	1.54E+00	2.37E+00	1.38E+00	6.07E-01	1.24E-01	8.48E-02	1.53E-02	1.10E-03	1.64E-05
11 5	4.75E-01	1.17E+00	2.06E+00	2.39E+00	1.71E+00	7.11E-01	9.11E-02	5.54E-02	8.37E-03	5.45E-04	3.82E-06
11 6	6.52E-01	1.76E+00	2.26E+00	3.29E+00	2.18E+00	7.34E-01	4.42E-02	2.37E-02	3.04E-03	1.78E-04	4.93E-07
11 7	8.34E-01	1.61E+00	2.69E+00	3.52E+00	2.54E+00	7.29E-01	1.98E-02	1.12E-02	8.19E-04	4.77E-05	5.40E-08
11 8	1.11E+00	1.81E+00	2.89E+00	4.25E+00	2.76E+00	5.17E-01	7.84E-03	5.51E-03	4.87E-04	8.37E-06	9.00E-09
11 9	1.24E+00	1.76E+00	4.13E+00	6.54E+00	1.99E+00	2.22E-01	4.73E-03	2.49E-03	2.34E-04	8.19E-07	9.96E-09
11 10	9.15E-01	2.83E+00	5.17E+00	6.71E+00	7.36E-01	6.18E-02	2.46E-03	7.17E-04	4.08E-04	1.72E-06	3.64E-07

A.4 N^{7+} + $H(n = 1, 2)$

Table A.22 N^{7+} + H(1s)

Table A.23 N^{7+} + H(2s)

Table A.24 N^{7+} + H(2p0)

Table A.25 N^{7+} + H(2p1)

Table A.26 N^{7+} + H(2p-1)

Table A.27 N^{7+} + H(2p)

Table A.28 N^{7+} + H($n = 2$)

Table A.22: Data for N^{7+} + H(1s)

	impact energies [kev/amu]											
	1.0	5.0	7.0	10.0	25.0	45.0	90.0	100.0	150.0	200.0	250.0	500.0
	total cross sections											
CX	5.73E+1	5.56E+1	5.70E+1	5.58E+1	4.88E+1	3.61E+1	1.14E+1	9.19E+0	2.86E+0	8.90E-1	4.71E-1	2.72E-2
ION	1.90E-3	9.25E-3	2.50E-2	3.55E-2	1.56E-1	1.57E+0	1.33E+1	1-58E+1	2.16E+1	2.18E+1	2.11E+1	1.47E+1
	state resolved CX cross sections											
n ℓ												
2	3.28E-09	5.55E-09	1.76E-07	3.08E-06	8.40E-04	2.02E-03	6.08E-03	1.62E-02	2.32E-02	9.11E-03	1.65E-02	3.30E-03
2 0	1.35E-09	3.16E-09	9.34E-08	4.12E-07	3.61E-04	8.51E-04	2.41E-03	5.21E-03	9.42E-03	2.99E-03	2.91E-03	3.62E-04
2 1	1.93E-09	2.39E-09	8.27E-08	2.67E-06	4.79E-04	1.16E-03	3.67E-03	1.10E-02	1.38E-02	6.11E-03	1.36E-02	2.94E-03
3	2.55E-05	5.94E-02	1.40E-01	2.43E-01	8.70E-01	9.44E-01	5.86E-01	5.79E-01	2.80E-01	9.53E-02	7.58E-02	5.99E-03
3 0	3.03E-06	1.26E-02	3.54E-02	6.19E-02	1.36E-01	1.03E-01	2.19E-02	2.33E-02	1.93E-02	5.30E-03	3.28E-03	3.20E-04
3 1	1.66E-05	2.77E-02	6.10E-02	1.02E-01	3.56E-01	3.64E-01	1.83E-01	1.55E-01	3.47E-02	1.21E-02	1.85E-02	2.63E-03
3 2	5.89E-06	1.91E-02	4.35E-02	7.94E-02	3.77E-01	4.76E-01	3.81E-01	4.01E-01	2.26E-01	7.79E-02	5.40E-02	3.04E-03
4	4.09E+00	1.51E+01	1.56E+01	1.60E+01	1.31E+01	6.78E+00	1.78E+00	1.46E+00	4.92E-01	1.48E-01	9.01E-02	4.53E-03
4 0	7.81E-01	1.23E+00	9.76E-01	8.71E-01	3.68E-01	1.30E-01	2.27E-02	3.51E-02	2.29E-02	3.54E-03	1.87E-03	2.37E-04
4 1	1.48E+00	4.41E+00	3.55E+00	3.04E+00	1.67E+00	5.46E-01	1.58E-01	1.18E-01	2.57E-02	8.23E-03	1.38E-02	1.45E-03
4 2	1.30E+00	5.71E+00	6.11E+00	5.91E+00	4.24E+00	1.82E+00	3.30E-01	3.15E-01	1.57E-01	3.82E-02	3.51E-02	1.70E-03
4 3	5.29E-01	3.77E+00	4.96E+00	6.20E+00	6.88E+00	4.28E+00	1.27E+00	9.91E-01	2.86E-01	9.83E-02	3.94E-02	1.14E-03
5	5.02E+01	3.59E+01	3.54E+01	3.27E+01	1.94E+01	9.28E+00	2.12E+00	1.68E+00	4.85E-01	1.44E-01	7.50E-02	3.69E-03
5 0	1.92E+00	6.98E-01	6.15E-01	4.07E-01	1.87E-01	9.19E-02	2.30E-02	3.27E-02	1.78E-02	3.33E-03	9.97E-04	2.44E-04
5 1	4.64E+00	2.48E+00	2.03E+00	1.32E+00	7.59E-01	3.77E-01	1.10E-01	8.78E-02	2.28E-02	6.10E-03	9.80E-03	1.24E-03
5 2	7.06E+00	5.42E+00	4.59E+00	4.27E+00	2.26E+00	9.82E-01	2.13E-01	2.22E-01	1.05E-01	3.28E-02	2.22E-02	1.03E-03
5 3	1.24E+01	1.19E+01	1.17E+01	1.04E+01	5.06E+00	2.15E+00	6.65E-01	5.50E-01	1.76E-01	6.11E-02	2.85E-02	8.63E-04
5 4	2.41E+01	1.54E+01	1.65E+01	1.64E+01	1.11E+01	5.67E+00	1.10E+00	7.88E-01	1.63E-01	4.09E-02	1.35E-02	3.09E-04
6	2.94E+00	4.14E+00	5.02E+00	5.99E+00	9.50E+00	7.08E+00	1.88E+00	1.45E+00	4.20E-01	1.20E-01	5.81E-02	2.68E-03
6 0	2.12E-01	4.36E-02	4.72E-02	5.93E-02	7.61E-02	5.04E-02	2.89E-02	3.39E-02	1.33E-02	2.35E-03	9.37E-04	1.44E-04
6 1	5.24E-01	1.72E-01	1.42E-01	1.94E-01	3.02E-01	2.52E-01	8.09E-02	5.12E-02	1.41E-02	5.71E-03	7.32E-03	7.69E-04
6 2	6.76E-01	3.09E-01	3.25E-01	4.62E-01	7.94E-01	5.53E-01	1.83E-01	1.79E-01	8.11E-02	2.08E-02	1.70E-02	7.67E-04
6 3	7.74E-01	4.70E-01	5.72E-01	6.59E-01	1.54E+00	1.10E+00	4.09E-01	3.12E-01	1.25E-01	4.44E-02	1.80E-02	6.30E-04
6 4	5.35E-01	1.41E+00	1.43E+00	1.78E+00	2.40E+00	2.00E+00	6.65E-01	5.32E-01	1.30E-01	3.75E-02	1.15E-02	2.34E-04
6 5	2.23E-01	1.74E+00	2.51E+00	2.84E+00	4.38E+00	3.13E+00	5.11E-01	3.39E-01	5.63E-02	9.41E-03	3.39E-03	1.35E-04
7	4.10E-02	3.00E-01	5.38E-01	5.52E-01	3.52E+00	4.55E+00	1.51E+00	1.21E+00	3.41E-01	1.02E-01	4.46E-02	1.96E-03
7 0	2.92E-03	4.87E-03	1.38E-02	1.07E-02	2.97E-02	3.62E-02	1.91E-02	2.56E-02	1.06E-02	2.44E-03	7.09E-04	1.41E-04
7 1	4.24E-03	1.52E-02	3.82E-02	3.45E-02	1.27E-01	1.37E-01	5.37E-02	4.29E-02	1.07E-02	5.16E-03	5.27E-03	5.52E-04
7 2	4.32E-03	2.78E-02	5.36E-02	4.40E-02	2.82E-01	3.49E-01	1.10E-01	1.30E-01	6.73E-02	1.98E-02	1.26E-02	4.44E-04
7 3	7.85E-03	4.18E-02	6.48E-02	7.78E-02	5.52E-01	5.63E-01	2.99E-01	2.67E-01	8.97E-02	3.25E-02	1.36E-02	5.01E-04
7 4	9.78E-03	5.27E-02	6.30E-02	7.68E-02	6.90E-01	1.00E+00	4.59E-01	3.44E-01	9.36E-02	2.80E-02	8.62E-03	1.75E-04
7 5	7.91E-03	7.02E-02	1.28E-01	1.12E-01	9.09E-01	1.47E+00	4.13E-01	2.96E-01	5.50E-02	1.15E-02	3.10E-03	5.58E-05
7 6	4.01E-03	8.75E-02	1.77E-01	1.97E-01	9.32E-01	9.98E-01	1.58E-01	1.02E-01	1.37E-02	2.63E-03	7.60E-04	9.67E-05
8	6.48E-03	6.44E-02	1.36E-01	1.53E-01	1.35E+00	2.92E+00	1.14E+00	9.32E-01	2.65E-01	8.19E-02	3.45E-02	1.74E-03
8 0	4.21E-04	1.17E-03	5.06E-03	4.81E-03	1.41E-02	2.52E-02	1.62E-02	1.92E-02	8.46E-03	1.70E-03	5.13E-04	1.16E-04
8 1	8.90E-04	3.86E-03	1.33E-02	1.09E-02	5.76E-02	9.00E-02	3.28E-02	3.09E-02	1.04E-02	4.39E-03	4.27E-03	5.00E-04
8 2	1.19E-03	6.80E-03	1.55E-02	1.36E-02	1.21E-01	2.17E-01	8.27E-02	9.12E-02	4.83E-02	1.27E-02	8.22E-03	3.87E-04
8 3	1.06E-03	1.16E-02	2.22E-02	1.55E-02	2.19E-01	3.32E-01	1.98E-01	1.76E-01	5.88E-02	2.51E-02	1.01E-02	3.72E-04
8 4	1.11E-03	1.90E-02	2.32E-02	2.32E-02	2.39E-01	5.54E-01	3.09E-01	2.55E-01	7.19E-02	2.42E-02	7.62E-03	1.96E-04
8 5	8.67E-04	1.21E-02	2.06E-02	2.45E-02	2.81E-01	8.08E-01	3.05E-01	2.23E-01	4.71E-02	9.69E-03	2.62E-03	3.55E-05
8 6	5.49E-04	6.92E-03	1.59E-02	1.78E-02	2.88E-01	6.67E-01	1.53E-01	1.02E-01	1.76E-02	2.48E-03	8.04E-04	4.26E-05
8 7	3.98E-04	2.92E-03	1.98E-02	4.23E-02	1.30E-01	2.28E-01	4.16E-02	3.31E-02	2.28E-03	1.59E-03	3.26E-04	8.90E-05
9	2.99E-03	2.62E-02	5.93E-02	6.90E-02	5.80E-01	1.91E+00	8.92E-01	7.19E-01	2.12E-01	7.23E-02	2.86E-02	1.28E-03
9 0	1.19E-04	6.06E-04	1.86E-03	3.09E-03	7.74E-03	1.81E-02	1.68E-02	1.43E-02	7.24E-03	1.86E-03	6.11E-04	7.61E-05
9 1	2.82E-04	1.58E-03	5.01E-03	6.57E-03	2.67E-02	7.25E-02	2.58E-02	2.15E-02	8.87E-03	4.10E-03	4.04E-03	3.12E-04
9 2	3.98E-04	2.09E-03	4.98E-03	6.43E-03	6.07E-02	1.41E-01	6.98E-02	6.41E-02	3.64E-02	1.28E-02	6.39E-03	2.74E-04
9 3	4.23E-04	3.67E-03	1.08E-02	8.26E-03	9.29E-02	2.25E-01	1.35E-01	1.24E-01	4.25E-02	2.02E-02	6.92E-03	2.88E-04
9 4	3.91E-04	7.05E-03	1.15E-02	1.05E-02	9.89E-02	3.41E-01	2.19E-01	1.89E-01	5.59E-02	1.90E-02	6.54E-03	1.35E-04
9 5	4.10E-04	4.96E-03	9.68E-03	1.06E-02	1.09E-01	4.66E-01	2.36E-01	1.72E-01	4.03E-02	9.58E-03	2.70E-03	5.86E-05
9 6	3.56E-04	3.86E-03	5.82E-03	7.46E-03	1.10E-01	4.12E-01	1.33E-01	9.10E-02	1.56E-02	2.71E-03	6.39E-04	5.83E-06
9 7	3.41E-04	1.36E-03	4.89E-03	4.96E-03	5.95E-02	1.95E-01	4.25E-02	2.67E-02	4.76E-03	6.48E-04	4.88E-04	4.93E-05
9 8	2.69E-04	1.01E-03	4.75E-03	1.12E-02	1.52E-02	4.15E-02	1.31E-02	1.54E-02	7.83E-04	1.42E-03	2.40E-04	7.89E-05
10	2.01E-03	1.17E-02	3.06E-02	4.17E-02	2.78E-01	1.35E+00	7.57E-01	5.94E-01	1.80E-01	6.03E-02	2.53E-02	1.06E-03
10 0	7.36E-05	2.67E-04	1.12E-03	2.09E-03	4.99E-03	1.79E-02	1.64E-02	1.31E-02	6.75E-03	1.32E-03	7.33E-04	7.67E-05
10 1	1.97E-04	6.32E-04	2.26E-03	4.31E-03	1.48E-02	5.33E-02	3.03E-02	1.92E-02	7.62E-03	3.36E-03	3.67E-03	2.71E-04
10 2	2.75E-04	8.25E-04	2.01E-03	4.54E-03	3.39E-02	1.19E-01	6.06E-02	5.31E-02	3.16E-02	8.21E-03	5.95E-03	1.96E-04
10 3	3.31E-04	1.67E-03	5.16E-03	5.07E-03	4.65E-02	1.39E-01	1.18E-01	9.77E-02	3.55E-02	1.59E-02	5.50E-03	2.37E-04
10 4	2.90E-04	2.39E-03	5.03E-03	6.47E-03	4.53E-02	2.53E-01	1.58E-01	1.43E-01	4.28E-02	1.76E-02	5.15E-03	1.11E-04
10 5	2.71E-04	1.81E-03	4.68E-03	5.46E-03	5.04E-02	2.85E-01	1.87E-01	1.40E-01	3.36E-02	8.49E-03	2.55E-03	2.68E-05
10 6	1.61E-04	1.90E-03	3.96E-03	3.45E-03	4.77E-02	2.63E-01	1.21E-01	8.14E-02	1.49E-02	2.71E-03	6.96E-04	2.05E-05
10 7	1.47E-04	8.79E-04	2.80E-03	3.00E-03	2.42E-02	1.57E-01	4.68E-02	2.96E-02	6.29E-03	9.30E-04	3.73E-04	1.26E-06
10 8	1.27E-04	7.11E-04	1.76E-03	3.47E-03	8.39E-03	4.88E-02	1.60E-02	9.27E-03	8.72E-04	3.07E-04	4.70E-04	5.08E-05
10 9	1.40E-04	5.97E-04	1.81E-03	3.90E-03	2.12E-03	9.44E-03	4.10E-03	7.66E-03	4.69E-04	1.39E-03	1.76E-04	6.49E-05
11	1.47E-03	6.09E-03	2.78E-02	2.69E-02	2.36E-01	1.24E+00	7.01E-01	5.52E-01	1.66E-01	5.67E-02	2.25E-02	9.56E-04
11 0	3.68E-05	1.03E-04	4.07E-03	1.11E-03	6.56E-03	2.63E-02	1.67E-02	1.82E-02	6.98E-03	1.44E-03	6.89E-04	6.84E-05
11 1	1.34E-04	3.21E-04	2.27E-03	2.38E-03	1.91E-02	8.02E-02	4.21E-02	2.59E-02	9.15E-03	3.25E-03	3.15E-03	2.49E-04
11 2	1.77E-04	4.86E-04	3.56E-03	2.83E-03	3.36E-02	1.38E-01	5.60E-02	6.33E-02	3.03E-02	8.78E-03	5.04E-03	1.77E-04
11 3	1.96E-04	9.40E-04	6.27E-03	3.26E-03	4.29E-02	1.62E-01	1.12E-01	7.70E-02	3.05E-02	1.41E-02	5.09E-03	1.99E-04
11 4	2.02E-04	8.35E-04	2.55E-03	4.02E-03	3.91E-02	2.23E-01	1.33E-01	1.15E-01	3.76E-02	1.49E-02	4.32E-03	1.13E-04
11 5	1.68E-04	7.75E-04	2.69E-03	3.89E-03	3.85E-02	2.28E-01	1.53E-01	1.28E-01	2.99E-02	8.43E-03	2.14E-03	2.39E-05
11 6	1.37E-04	1.18E-03	2.27E-03	2.62E-03	3.21E-02	1.99E-01	1.11E-01	7.56E-02	1.37E-02	2.76E-03	7.92E-04	1.09E-05
11 7	1.20E-04	4.74E-04	1.66E-03	1.91E-03	1.56E-02	1.12E-01	5.08E-02	3.05E-02	5.59E-03	8.48E-04	2.36E-04	1.19E-05
11 8	9.10E-05	3.43E-04	1.07E-03	1.70E-03	6.17E-03	4.45E-02	1.42E-02	8.98E-03	1.59E-03	4.78E-04	4.54E-04	3.02E-06
11 9	1.08E-04	3.33E-04	5.40E-04	2.04E-03	2.43E-03	1.77E-02	9.95E-03	6.05E-03	9.35E-04	2.97E-04	4.43E-04	4.95E-05
11 10	1.04E-04	2.98E-04	8.88E-04	1.14E-03	4.41E-04	5.14E-03	1.44E-03	3.88E-03	1.31E-04	1.30E-03	1.29E-04	4.98E-05

Table A.23: Data for N^{7+} + H(2s)

	impact energies [kev/amu]											
	1.0	5.0	7.0	10.0	25.0	45.0	90.0	100.0	150.0	200.0	250.0	500.0
	total cross sections											
CX	6.57E+02	5.58E+02	4.81E+02	3.67E+02	1.10E+02	3.29E+01	6.08E+00	4.45E+00	8.31E-01	2.57E-01	8.98E-02	2.67E-03
ION	6.57E-01	2.45E+00	3.18E+00	4.43E+00	2.16E+01	5.66E+01	7.82E+01	7.81E+01	6.51E+01	7.49E+01	5.94E+01	4.45E+01
	state resolved CX cross sections											
n ℓ												
2	2.46E-06	1.28E-05	3.88E-06	2.00E-06	1.01E-05	1.14E-05	3.66E-05	1.72E-04	7.14E-04	2.30E-04	3.50E-04	3.28E-05
2 0	1.74E-06	1.01E-05	1.93E-06	2.51E-07	2.30E-06	1.79E-06	6.23E-06	3.32E-05	2.83E-04	9.58E-05	9.70E-05	1.21E-05
2 1	7.19E-07	2.68E-06	1.95E-06	1.75E-06	7.79E-06	9.57E-06	3.03E-05	1.39E-04	4.31E-04	1.35E-04	2.53E-04	2.07E-05
3	3.47E-06	6.50E-05	3.27E-04	4.07E-06	4.73E-03	9.42E-03	3.27E-02	3.20E-02	1.77E-02	4.29E-03	2.98E-03	1.03E-04
3 0	1.09E-06	3.90E-05	1.71E-04	7.36E-07	5.76E-04	2.24E-03	5.34E-03	3.73E-03	9.47E-04	1.74E-04	1.80E-04	1.29E-05
3 1	5.99E-07	2.42E-05	1.42E-04	1.72E-06	2.54E-03	4.12E-03	1.48E-02	1.36E-02	6.39E-03	1.55E-03	1.01E-03	3.53E-05
3 2	1.78E-06	1.74E-06	1.33E-05	1.61E-06	1.61E-03	3.06E-03	1.26E-02	1.46E-02	1.04E-02	2.56E-03	1.80E-03	5.43E-05
4	2.02E-04	1.81E-03	3.29E-03	1.30E-02	3.55E-01	5.20E-01	2.62E-01	2.19E-01	4.37E-02	1.35E-02	6.40E-03	1.95E-04
4 0	1.16E-04	2.99E-04	4.07E-04	1.54E-03	5.76E-02	3.16E-02	8.10E-03	8.78E-03	1.49E-03	7.13E-04	5.40E-04	1.18E-05
4 1	7.43E-05	8.54E-04	1.73E-03	5.19E-03	1.18E-01	1.25E-01	2.23E-02	2.32E-02	6.70E-03	2.86E-03	1.43E-03	4.10E-05
4 2	1.05E-05	4.61E-04	8.88E-04	4.37E-03	1.11E-01	2.01E-01	7.62E-02	5.79E-02	1.03E-02	3.91E-03	2.08E-03	8.09E-05
4 3	1.33E-06	1.95E-04	2.67E-04	1.89E-03	6.77E-02	1.62E-01	1.55E-01	1.29E-01	2.52E-02	6.05E-03	2.34E-03	6.15E-05
5	3.13E-03	1.11E-01	3.76E-01	9.81E-01	5.01E+00	2.29E+00	4.38E-01	3.24E-01	8.15E-02	1.54E-02	8.75E-03	2.87E-04
5 0	2.57E-04	1.59E-02	5.03E-02	1.15E-01	1.68E-01	3.86E-02	1.26E-02	8.51E-03	2.98E-03	7.34E-04	5.76E-04	9.88E-06
5 1	7.77E-04	3.31E-02	1.17E-01	2.79E-01	6.51E-01	1.53E-01	3.15E-02	2.27E-02	1.12E-02	2.46E-03	1.42E-03	3.44E-05
5 2	1.01E-03	3.89E-02	1.17E-01	2.89E-01	1.36E+00	3.18E-01	6.86E-02	4.76E-02	1.85E-02	3.47E-03	2.14E-03	9.56E-05
5 3	5.89E-04	1.64E-02	6.42E-02	1.91E-01	1.60E+00	7.23E-01	9.41E-02	7.66E-02	2.97E-02	5.42E-03	2.52E-03	8.96E-05
5 4	5.00E-04	6.86E-03	2.76E-02	1.07E-01	1.23E+00	1.05E+00	2.32E-01	1.69E-01	1.91E-02	3.36E-03	2.10E-03	5.76E-05
6	6.35E-01	6.82E+00	1.15E+01	1.83E+01	1.28E+01	3.64E+00	6.36E-01	4.98E-01	9.78E-02	2.21E-02	8.64E-03	3.40E-04
6 0	2.81E-02	6.04E-01	8.69E-01	9.26E-01	1.77E-01	4.51E-02	1.08E-02	1.50E-02	3.60E-03	8.51E-04	4.52E-04	1.02E-05
6 1	7.71E-02	1.55E+00	2.32E+00	3.07E+00	6.78E-01	1.87E-01	3.50E-02	4.09E-02	1.27E-02	2.95E-03	1.11E-03	3.04E-05
6 2	1.09E-01	1.83E+00	3.04E+00	4.78E+00	1.38E+00	2.99E-01	7.96E-02	8.41E-02	1.98E-02	4.28E-03	1.92E-03	9.58E-05
6 3	1.70E-01	1.63E+00	2.69E+00	4.53E+00	2.59E+00	5.13E-01	1.34E-01	1.21E-01	2.73E-02	7.14E-03	2.41E-03	9.43E-05
6 4	1.51E-01	8.61E-01	1.63E+00	2.96E+00	4.12E+00	9.94E-01	2.33E-01	1.60E-01	2.38E-02	5.41E-03	2.06E-03	8.26E-05
6 5	9.99E-02	3.49E-01	9.61E-01	1.98E+00	3.82E+00	1.60E+00	1.44E-01	7.68E-02	1.06E-02	1.47E-03	6.93E-04	2.63E-05
7	2.16E+01	5.93E+01	6.50E+01	5.68E+01	1.66E+01	4.37E+00	6.78E-01	5.03E-01	9.49E-02	2.40E-02	9.71E-03	3.53E-04
7 0	7.42E-01	2.16E+00	1.39E+00	8.58E-01	1.96E-01	5.52E-02	1.80E-02	1.20E-02	3.14E-03	9.16E-04	4.53E-04	9.50E-06
7 1	1.54E+00	7.00E+00	5.36E+00	3.27E+00	7.10E-01	2.30E-01	4.77E-02	3.15E-02	1.11E-02	3.11E-03	1.12E-03	2.97E-05
7 2	1.73E+00	1.16E+01	1.12E+01	6.92E+00	1.28E+00	3.26E-01	9.18E-02	6.42E-02	1.73E-02	4.72E-03	2.14E-03	9.78E-05
7 3	2.54E+00	1.40E+01	1.54E+01	1.15E+01	2.09E+00	4.90E-01	1.27E-01	9.57E-02	2.39E-02	7.51E-03	2.77E-03	9.52E-05
7 4	3.21E+00	1.18E+01	1.36E+01	1.40E+01	3.01E+00	7.37E-01	1.60E-01	1.40E-01	2.44E-02	5.32E-03	2.22E-03	7.87E-05
7 5	8.57E+00	6.90E+00	8.59E+00	9.79E+00	4.92E+00	8.42E-01	1.44E-01	1.13E-01	1.26E-02	1.50E-03	8.61E-04	3.18E-05
7 6	3.23E+00	5.84E+00	9.46E+00	1.04E+01	4.39E+00	1.69E+00	8.99E-02	4.70E-02	2.41E-03	9.77E-04	1.44E-04	1.00E-05
8	1.98E+02	1.30E+02	1.03E+02	6.84E+01	1.84E+01	4.84E+00	7.47E-01	5.51E-01	1.01E-01	3.29E-02	1.18E-02	3.62E-04
8 0	3.34E+00	1.41E+00	1.15E+00	7.31E-01	2.02E-01	6.86E-02	2.08E-02	1.50E-02	3.07E-03	1.16E-03	4.88E-04	1.02E-05
8 1	1.16E+01	5.07E+00	3.54E+00	2.43E+00	8.13E-01	2.33E-01	5.48E-02	4.04E-02	1.14E-02	3.93E-03	1.24E-03	2.65E-05
8 2	2.38E+01	1.14E+01	8.27E+00	5.25E+00	1.23E+00	3.46E-01	9.57E-02	7.90E-02	1.85E-02	5.88E-03	2.37E-03	9.43E-05
8 3	2.80E+01	1.85E+01	1.41E+01	8.72E+00	1.95E+00	4.71E-01	1.35E-01	1.14E-01	2.65E-02	9.48E-03	3.27E-03	9.75E-05
8 4	2.39E+01	2.32E+01	1.71E+01	1.28E+01	2.43E+00	6.65E-01	1.67E-01	1.39E-01	2.72E-02	7.72E-03	2.69E-03	8.51E-05
8 5	2.34E+01	1.74E+01	1.54E+01	1.34E+01	2.72E+00	7.63E-01	1.43E-01	9.39E-02	1.14E-02	3.20E-03	1.30E-03	3.53E-05
8 6	3.99E+01	1.45E+01	1.15E+01	9.05E+00	4.13E+00	6.28E-01	8.32E-02	4.07E-02	2.45E-03	1.06E-03	3.31E-04	7.89E-06
8 7	4.42E+01	3.86E+01	3.18E+01	1.60E+01	4.91E+00	1.67E+00	4.70E-02	2.94E-02	8.12E-04	4.29E-04	1.01E-04	5.71E-06
9	2.77E+02	1.75E+02	1.25E+02	8.28E+01	1.88E+01	5.39E+00	8.80E-01	5.82E-01	1.09E-01	3.62E-02	1.24E-02	3.41E-04
9 0	3.42E+00	7.49E-01	7.10E-01	7.47E-01	1.84E-01	8.83E-02	2.83E-02	1.80E-02	3.29E-03	1.36E-03	4.66E-04	9.86E-06
9 1	1.01E+01	2.67E+00	2.56E+00	2.08E+00	8.16E-01	2.78E-01	7.98E-02	4.89E-02	1.21E-02	4.41E-03	1.22E-03	2.46E-05
9 2	1.57E+01	5.66E+00	4.85E+00	4.46E+00	1.03E+00	4.46E-01	1.26E-01	8.48E-02	2.02E-02	6.56E-03	2.34E-03	8.45E-05
9 3	2.50E+01	1.07E+01	8.89E+00	6.62E+00	1.74E+00	5.37E-01	1.76E-01	1.16E-01	2.84E-02	1.01E-02	3.33E-03	8.62E-05
9 4	3.38E+01	1.47E+01	1.12E+01	8.59E+00	1.87E+00	7.39E-01	1.86E-01	1.32E-01	2.83E-02	7.92E-03	2.71E-03	7.77E-05
9 5	3.01E+01	1.55E+01	1.38E+01	9.49E+00	1.98E+00	6.96E-01	1.37E-01	9.65E-02	1.18E-02	3.27E-03	1.50E-03	4.08E-05
9 6	2.77E+01	1.37E+01	1.35E+01	1.22E+01	3.23E+00	4.55E-01	7.47E-02	4.47E-02	3.21E-03	1.48E-03	5.17E-04	9.20E-06
9 7	5.45E+01	2.89E+01	1.64E+01	1.15E+01	2.56E+00	1.00E+00	4.97E-02	2.35E-02	8.00E-04	4.55E-04	2.11E-04	3.82E-06
9 8	7.68E+01	8.24E+01	5.34E+01	2.71E+01	5.43E+00	1.15E+00	2.31E-02	1.72E-02	6.18E-04	6.24E-04	7.46E-05	4.86E-06
10	1.35E+02	1.29E+02	1.07E+02	7.94E+01	1.86E+01	5.20E+00	1.00E+00	6.84E-01	1.19E-01	4.85E-02	1.29E-02	3.28E-04
10 0	9.68E-01	4.84E-01	6.50E-01	4.64E-01	2.48E-01	1.11E-01	3.24E-02	2.29E-02	3.96E-03	1.91E-03	5.04E-04	1.00E-05
10 1	2.60E+00	1.71E+00	1.54E+00	1.71E+00	8.84E-01	2.80E-01	9.92E-02	6.45E-02	1.37E-02	6.06E-03	1.29E-03	2.53E-05
10 2	4.12E+00	2.71E+00	3.37E+00	2.88E+00	1.17E+00	4.58E-01	1.41E-01	1.04E-01	2.24E-02	8.71E-03	2.51E-03	8.19E-05
10 3	5.39E+00	5.15E+00	5.08E+00	4.53E+00	1.67E+00	4.15E-01	1.98E-01	1.42E-01	3.01E-02	1.30E-02	3.48E-03	8.29E-05
10 4	6.03E+00	7.20E+00	6.27E+00	5.59E+00	1.72E+00	5.39E-01	2.01E-01	1.49E-01	2.89E-02	1.08E-02	2.70E-03	7.10E-05
10 5	7.85E+00	7.69E+00	7.71E+00	5.94E+00	1.57E+00	6.17E-01	1.55E-01	1.05E-01	1.34E-02	5.15E-03	1.45E-03	3.71E-05
10 6	1.12E+01	8.95E+00	7.54E+00	6.88E+00	2.43E+00	4.66E-01	8.27E-02	4.81E-02	4.61E-03	1.84E-03	5.21E-04	1.03E-05
10 7	1.59E+01	1.29E+01	1.08E+01	6.80E+00	2.63E+00	6.25E-01	5.60E-02	2.67E-02	1.01E-03	3.17E-04	2.13E-04	1.83E-06
10 8	3.77E+01	2.58E+01	1.65E+01	1.48E+01	2.31E+00	1.11E+00	3.14E-02	1.18E-02	8.25E-04	8.68E-05	1.36E-04	3.40E-06
10 9	4.29E+01	5.64E+01	4.72E+01	2.97E+01	3.92E+00	5.79E-01	7.97E-03	9.59E-03	2.98E-04	6.37E-04	4.85E-05	4.09E-06
11	2.49E+01	5.75E+01	6.92E+01	6.01E+01	1.99E+01	6.66E+00	1.40E+00	1.05E+00	1.66E-01	5.96E-02	1.60E-02	3.32E-04
11 0	2.42E-01	2.38E-01	3.92E-01	4.47E-01	4.47E-01	2.16E-01	5.53E-02	4.16E-02	6.52E-03	2.46E-03	6.91E-04	1.10E-05
11 1	5.78E-01	8.09E-01	1.17E+00	1.92E+00	1.28E+00	5.15E-01	1.69E-01	1.20E-01	2.05E-02	7.54E-03	1.72E-03	2.58E-05
11 2	7.08E-01	1.51E+00	2.27E+00	2.33E+00	1.90E+00	8.59E-01	2.26E-01	1.77E-01	3.21E-02	1.06E-02	3.20E-03	8.24E-05
11 3	7.87E-01	2.32E+00	3.28E+00	4.26E+00	2.13E+00	7.48E-01	2.94E-01	2.28E-01	4.06E-02	1.52E-02	4.29E-03	8.40E-05
11 4	9.57E-01	3.55E+00	4.33E+00	3.47E+00	2.22E+00	8.55E-01	2.67E-01	2.19E-01	3.77E-02	1.27E-02	3.32E-03	7.24E-05
11 5	1.39E+00	3.85E+00	4.25E+00	4.68E+00	1.71E+00	6.79E-01	1.82E-01	1.49E-01	1.90E-02	6.55E-03	1.74E-03	3.80E-05
11 6	2.12E+00	4.07E+00	4.78E+00	3.34E+00	1.94E+00	4.15E-01	9.22E-02	5.95E-02	5.79E-03	2.82E-03	5.62E-04	9.79E-06
11 7	3.05E+00	5.00E+00	4.75E+00	4.71E+00	2.31E+00	4.52E-01	5.99E-02	2.92E-02	1.67E-03	8.83E-04	1.64E-04	1.87E-06
11 8	3.64E+00	6.11E+00	7.71E+00	5.02E+00	1.85E+00	8.79E-01	3.10E-02	1.47E-02	1.22E-03	2.37E-04	1.20E-04	6.16E-07
11 9	5.00E+00	1.01E+01	9.40E+00	1.03E+01	2.26E+00	7.92E-01	1.95E-02	9.15E-03	6.43E-04	1.11E-04	1.11E-04	3.23E-06
11 10	6.39E+00	1.99E+01	2.69E+01	1.95E+01	1.84E+00	2.51E-01	2.58E-03	4.54E-03	9.68E-05	5.56E-04	3.52E-05	3.15E-06

Table A.24: Data for N^{7+} + H(2p0)

	impact energies [kev/amu]											
	1.0	5.0	7.0	10.0	25.0	45.0	90.0	100.0	150.0	200.0	250.0	500.0
	total cross sections											
CX	6.88E+02	5.68E+02	5.06E+02	4.01E+02	7.84E+01	1.37E+01	1.87E+00	1.52E+00	5.09E-01	1.69E-01	8.49E-02	7.49E-03
ION	1.38E+00	2.30E+00	2.73E+00	3.72E+00	1.75E+01	3.39E+01	4.57E+01	4.51E+01	4.45E+01	5.22E+01	4.38E+01	3.34E+01
	state resolved CX cross sections											
n ℓ												
2	3.51E-05	9.84E-06	2.89E-06	4.05E-06	3.34E-05	4.65E-05	2.01E-04	8.84E-04	1.50E-03	6.29E-04	1.87E-03	7.14E-04
2 0	2.82E-05	8.65E-06	1.41E-06	3.18E-07	6.32E-06	1.33E-05	3.90E-05	2.25E-04	5.60E-04	2.54E-04	6.07E-04	4.38E-05
2 1	6.87E-06	1.19E-06	1.48E-06	3.73E-06	2.71E-05	3.31E-05	1.62E-04	6.58E-04	9.41E-04	3.74E-04	1.27E-03	6.70E-04
3	2.71E-05	5.52E-05	2.89E-04	3.37E-04	2.53E-02	1.77E-02	2.62E-02	3.19E-02	1.91E-02	7.42E-03	6.56E-03	6.31E-04
3 0	1.90E-05	2.92E-05	1.31E-04	5.19E-05	2.97E-03	1.08E-03	1.69E-03	1.39E-03	1.29E-03	2.97E-04	3.53E-04	2.90E-05
3 1	5.42E-06	2.11E-05	1.18E-04	1.40E-04	1.06E-02	7.08E-03	8.54E-03	9.81E-03	3.99E-03	1.19E-03	8.61E-04	2.29E-04
3 2	2.63E-06	4.94E-06	3.99E-05	1.46E-04	1.17E-02	9.56E-03	1.60E-02	2.07E-02	1.39E-02	5.93E-03	5.35E-03	3.73E-04
4	3.03E-03	6.87E-03	2.05E-02	5.13E-02	2.54E-01	2.24E-01	1.09E-01	1.01E-01	3.61E-02	1.21E-02	8.33E-03	7.48E-04
4 0	1.71E-03	7.43E-04	1.15E-03	2.68E-03	2.32E-02	1.91E-02	1.74E-03	1.59E-03	1.18E-03	3.22E-04	2.55E-04	4.84E-05
4 1	1.12E-03	1.82E-03	4.24E-03	1.16E-02	3.42E-02	5.37E-02	9.33E-03	1.14E-02	2.80E-03	8.88E-04	5.40E-04	2.02E-04
4 2	1.63E-04	2.45E-03	7.03E-03	1.96E-02	7.79E-02	4.41E-02	3.29E-02	2.90E-02	7.19E-03	2.59E-03	2.72E-03	3.49E-04
4 3	3.15E-05	1.86E-03	8.10E-03	1.74E-02	1.18E-01	1.07E-01	6.50E-02	5.88E-02	2.49E-02	8.26E-03	4.82E-03	1.49E-04
5	1.82E-02	3.84E-01	7.45E-01	1.21E+00	1.11E+00	5.92E-01	1.78E-01	1.45E-01	4.55E-02	1.41E-02	7.99E-03	8.79E-04
5 0	1.46E-03	2.13E-02	3.71E-02	6.72E-02	5.04E-02	1.34E-02	9.82E-04	8.34E-04	6.65E-04	3.55E-04	2.51E-04	3.94E-05
5 1	2.93E-03	5.58E-02	9.89E-02	1.56E-01	1.30E-01	3.84E-02	6.94E-03	8.44E-03	2.42E-03	4.88E-04	3.38E-04	1.33E-04
5 2	4.75E-03	8.08E-02	1.52E-01	2.17E-01	1.97E-01	8.98E-02	1.93E-02	2.11E-02	5.37E-03	1.48E-03	1.80E-03	3.60E-04
5 3	3.60E-03	1.12E-01	2.25E-01	3.26E-01	2.28E-01	2.20E-01	2.67E-02	1.74E-02	1.21E-02	5.82E-03	3.28E-03	2.47E-04
5 4	5.45E-03	1.15E-01	2.32E-01	4.45E-01	5.02E-01	2.30E-01	1.24E-01	9.73E-02	2.50E-02	5.98E-03	2.32E-03	1.01E-04
6	1.29E+00	6.75E+00	8.37E+00	7.92E+00	2.68E+00	9.35E-01	1.77E-01	1.53E-01	4.94E-02	1.59E-02	8.14E-03	8.05E-04
6 0	6.81E-02	2.25E-01	2.76E-01	2.39E-01	2.91E-02	1.36E-02	1.08E-03	1.51E-03	9.85E-04	4.96E-04	3.28E-04	3.32E-05
6 1	1.57E-01	6.71E-01	7.35E-01	7.10E-01	8.26E-02	4.07E-02	6.77E-03	1.01E-02	1.86E-03	8.55E-04	4.51E-04	8.38E-05
6 2	2.78E-01	1.08E+00	1.07E+00	1.01E+00	1.90E-01	7.33E-02	1.26E-02	1.27E-02	5.14E-03	1.96E-03	1.59E-03	2.79E-04
6 3	1.44E-01	1.29E+00	1.42E+00	1.28E+00	3.82E-01	1.67E-01	1.81E-02	1.51E-02	8.64E-03	4.07E-03	2.49E-03	2.62E-04
6 4	2.83E-01	1.68E+00	2.29E+00	1.98E+00	7.90E-01	1.88E-01	3.65E-02	3.52E-02	1.94E-02	5.42E-03	2.43E-03	8.88E-05
6 5	3.64E-01	1.81E+00	2.59E+00	2.71E+00	1.21E+00	4.53E-01	1.02E-01	7.82E-02	1.34E-02	3.12E-03	8.58E-04	5.82E-05
7	2.22E+01	3.73E+01	3.44E+01	2.79E+01	6.23E+00	1.47E+00	1.69E-01	1.52E-01	5.47E-02	1.74E-02	8.25E-03	8.48E-04
7 0	6.62E-01	5.76E-01	3.46E-01	1.99E-01	5.35E-02	9.79E-03	8.81E-04	1.56E-03	1.45E-03	5.70E-04	3.26E-04	3.69E-05
7 1	2.46E+00	1.74E+00	1.21E+00	6.86E-01	1.27E-01	2.89E-02	5.31E-03	7.53E-03	2.66E-03	1.24E-03	5.70E-04	8.63E-05
7 2	2.80E+00	3.00E+00	2.62E+00	1.56E+00	2.89E-01	6.79E-02	9.70E-03	1.19E-02	6.13E-03	1.77E-03	1.30E-03	2.76E-04
7 3	3.21E+00	4.34E+00	4.77E+00	3.63E+00	5.60E-01	1.66E-01	1.46E-02	1.41E-02	7.64E-03	3.47E-03	2.16E-03	2.81E-04
7 4	4.73E+00	6.44E+00	7.00E+00	5.94E+00	7.73E-01	2.23E-01	2.66E-02	2.88E-02	1.60E-02	5.31E-03	2.48E-03	1.02E-04
7 5	2.29E+00	1.03E+01	8.98E+00	8.94E+00	1.28E+00	4.93E-01	6.72E-02	5.28E-02	1.62E-02	3.88E-03	1.19E-03	2.43E-05
7 6	6.06E+00	1.09E+01	9.43E+00	6.98E+00	3.15E+00	4.86E-01	4.42E-02	3.49E-02	4.64E-03	1.19E-03	2.23E-04	4.11E-05
8	1.66E+02	1.30E+02	1.11E+02	7.80E+01	1.16E+01	1.96E+00	1.86E-01	1.61E-01	6.05E-02	2.00E-02	8.60E-03	7.88E-04
8 0	2.84E+00	5.38E-01	5.24E-01	3.24E-01	6.39E-02	2.25E-02	1.94E-03	2.68E-03	1.78E-03	6.49E-04	3.47E-04	3.10E-05
8 1	7.59E+00	2.01E+00	1.78E+00	1.24E+00	2.22E-01	3.07E-02	8.77E-03	1.03E-02	3.64E-03	1.80E-03	7.19E-04	5.31E-05
8 2	1.01E+01	4.93E+00	3.85E+00	2.32E+00	3.77E-01	1.14E-01	1.32E-02	1.39E-02	7.05E-03	2.33E-03	1.24E-03	2.37E-04
8 3	1.68E+01	1.03E+01	7.79E+00	5.54E+00	7.37E-01	1.21E-01	1.88E-02	1.82E-02	7.57E-03	3.77E-03	2.04E-03	2.71E-04
8 4	2.46E+01	2.01E+01	1.63E+01	8.74E+00	1.13E+00	1.62E-01	2.53E-02	2.44E-02	1.54E-02	5.32E-03	2.44E-03	1.14E-04
8 5	2.96E+01	3.18E+01	2.69E+01	1.60E+01	1.63E+00	3.15E-01	5.57E-02	4.43E-02	1.66E-02	3.86E-03	1.38E-03	2.66E-05
8 6	3.84E+01	3.58E+01	3.41E+01	2.46E+01	2.61E+00	6.26E-01	4.62E-02	3.40E-02	6.87E-03	1.42E-03	3.64E-04	1.59E-05
8 7	3.65E+01	2.43E+01	2.03E+01	1.94E+01	4.80E+00	5.71E-01	1.62E-02	1.27E-02	1.62E-03	8.04E-04	6.57E-05	3.88E-05
9	3.24E+02	2.15E+02	1.71E+02	1.18E+02	1.62E+01	2.39E+00	2.36E-01	1.95E-01	6.62E-02	2.17E-02	9.62E-03	7.20E-04
9 0	3.42E+00	4.61E-01	5.03E-01	3.93E-01	6.48E-02	3.00E-02	4.26E-03	2.59E-03	1.72E-03	6.38E-04	4.14E-04	3.10E-05
9 1	9.85E+00	1.56E+00	1.61E+00	1.35E+00	3.27E-01	3.35E-02	1.52E-02	1.09E-02	3.94E-03	2.02E-03	1.00E-03	4.90E-05
9 2	1.56E+01	3.71E+00	3.90E+00	3.04E+00	4.45E-01	1.38E-01	1.81E-02	1.74E-02	7.02E-03	2.25E-03	1.41E-03	2.01E-04
9 3	2.20E+01	9.05E+00	6.85E+00	5.03E+00	8.61E-01	1.28E-01	2.60E-02	2.45E-02	8.11E-03	3.86E-03	2.35E-03	2.48E-04
9 4	2.97E+01	1.73E+01	1.36E+01	9.21E+00	1.19E+00	1.85E-01	2.77E-02	3.35E-02	1.60E-02	5.71E-03	2.43E-03	1.04E-04
9 5	4.13E+01	3.28E+01	2.30E+01	1.37E+01	1.64E+00	3.23E-01	5.74E-02	4.85E-02	1.75E-02	4.38E-03	1.40E-03	2.95E-05
9 6	5.57E+01	5.15E+01	3.55E+01	2.09E+01	2.00E+00	5.16E-01	5.74E-02	3.58E-02	8.67E-03	1.78E-03	4.40E-04	5.03E-06
9 7	7.61E+01	5.87E+01	4.94E+01	2.98E+01	4.17E+00	5.24E-01	2.40E-02	1.54E-02	2.61E-03	3.96E-04	1.34E-04	1.79E-05
9 8	7.05E+01	3.95E+01	3.64E+01	3.49E+01	5.55E+00	5.11E-01	6.48E-03	6.01E-03	6.07E-04	6.50E-04	4.32E-05	3.39E-05
10	1.35E+02	1.37E+02	1.24E+02	1.04E+02	1.92E+01	2.89E+00	3.14E-01	2.44E-01	7.69E-02	2.67E-02	1.15E-02	6.97E-04
10 0	9.79E-01	2.83E-01	3.76E-01	3.22E-01	1.04E-01	4.35E-02	6.90E-03	2.58E-03	1.77E-03	8.63E-04	4.85E-04	3.15E-05
10 1	2.72E+00	1.15E+00	1.07E+00	8.36E-01	3.99E-01	4.80E-02	2.41E-02	1.12E-02	4.67E-03	3.00E-03	1.36E-03	4.97E-05
10 2	3.88E+00	1.74E+00	2.42E+00	2.34E+00	6.15E-01	1.91E-01	3.03E-02	2.00E-02	8.12E-03	3.40E-03	1.68E-03	1.91E-04
10 3	6.27E+00	4.43E+00	4.46E+00	2.98E+00	8.59E-01	1.62E-01	4.04E-02	2.97E-02	1.01E-02	5.06E-03	2.92E-03	2.37E-04
10 4	9.13E+00	7.59E+00	6.62E+00	5.86E+00	1.28E+00	2.29E-01	4.17E-02	3.95E-02	1.79E-02	6.58E-03	2.82E-03	1.06E-04
10 5	1.00E+01	1.22E+01	1.19E+01	7.25E+00	1.52E+00	2.76E-01	5.74E-02	5.97E-02	1.94E-02	4.46E-03	1.48E-03	2.32E-05
10 6	1.37E+01	2.00E+01	1.52E+01	1.04E+01	1.75E+00	4.74E-01	6.40E-02	4.77E-02	1.02E-02	1.91E-03	4.41E-04	9.73E-06
10 7	2.21E+01	2.86E+01	2.01E+01	1.37E+01	3.16E+00	5.57E-01	3.16E-02	2.22E-02	3.41E-03	6.20E-04	1.44E-04	1.80E-06
10 8	2.84E+01	3.55E+01	3.11E+01	1.97E+01	4.70E+00	5.81E-01	1.33E-02	8.09E-03	1.10E-03	2.17E-04	1.01E-04	1.90E-05
10 9	3.78E+01	2.58E+01	3.07E+01	4.07E+01	4.83E+00	3.32E-01	4.50E-03	3.02E-03	1.79E-04	6.23E-04	3.33E-05	2.78E-05
11	3.84E+01	4.18E+01	5.59E+01	6.36E+01	2.10E+01	3.25E+00	4.73E-01	3.40E-01	9.85E-02	3.33E-02	1.40E-02	6.65E-04
11 0	2.90E-01	1.85E-01	1.85E-01	3.21E-01	2.16E-01	3.96E-02	1.24E-02	5.52E-03	2.22E-03	1.06E-03	5.64E-04	3.07E-05
11 1	8.67E-01	4.13E-01	9.42E-01	7.35E-01	5.37E-01	6.41E-02	4.10E-02	2.11E-02	6.62E-03	3.83E-03	1.76E-03	4.29E-05
11 2	1.48E+00	1.03E+00	9.96E-01	1.52E+00	1.01E+00	1.65E-01	5.41E-02	3.12E-02	1.10E-02	4.32E-03	2.00E-03	1.77E-04
11 3	2.20E+00	1.29E+00	2.33E+00	2.32E+00	1.05E+00	2.07E-01	6.67E-02	4.42E-02	1.37E-02	6.24E-03	3.53E-03	2.32E-04
11 4	2.79E+00	2.48E+00	2.54E+00	2.80E+00	1.49E+00	2.41E-01	6.91E-02	4.54E-02	2.13E-02	8.30E-03	3.55E-03	1.06E-04
11 5	2.92E+00	3.39E+00	4.22E+00	4.46E+00	1.56E+00	2.98E-01	7.80E-02	6.77E-02	2.36E-02	5.78E-03	1.80E-03	2.26E-05
11 6	3.02E+00	4.89E+00	5.41E+00	4.91E+00	1.61E+00	4.51E-01	7.86E-02	6.52E-02	1.37E-02	2.29E-03	4.83E-04	5.49E-06
11 7	4.71E+00	6.39E+00	6.16E+00	6.31E+00	2.21E+00	5.07E-01	4.59E-02	3.37E-02	4.78E-03	5.43E-04	1.27E-04	6.10E-06
11 8	6.86E+00	6.14E+00	7.34E+00	8.45E+00	3.52E+00	5.92E-01	1.66E-02	1.79E-02	1.10E-03	2.55E-04	1.18E-04	1.51E-06
11 9	6.30E+00	7.76E+00	9.68E+00	7.87E+00	4.92E+00	5.15E-01	7.24E-03	5.74E-03	4.08E-04	9.00E-05	9.08E-05	1.95E-05
11 10	6.95E+00	7.85E+00	1.61E+01	2.39E+01	2.88E+00	1.66E-01	3.33E-03	2.80E-03	9.07E-05	6.02E-04	2.51E-05	2.15E-05

Table A.25: Data for N^{7+} + H(2p1)

	impact energies [kev/amu]											
	1.0	5.0	7.0	10.0	25.0	45.0	90.0	100.0	150.0	200.0	250.0	500.0
	total cross sections											
CX	6.82E+02	5.35E+02	4.55E+02	3.40E+02	1.05E+02	2.65E+01	2.43E+00	1.74E+00	4.48E-01	1.12E-01	6.39E-02	9.38E-03
ION	1.24E+00	1.82E+00	3.39E+00	5.86E+00	3.63E+01	5.32E+01	7.66E+01	7.36E+01	5.30E+01	7.04E+01	4.29E+01	2.92E+01
	state resolved CX cross sections											
n ℓ												
2	1.33E-05	4.21E-05	1.35E-05	1.18E-05	2.92E-05	5.29E-05	6.02E-04	1.27E-03	9.06E-04	6.10E-04	1.78E-03	8.73E-04
2 0	1.09E-05	3.24E-05	4.07E-06	4.53E-07	6.42E-06	1.50E-05	2.49E-04	5.68E-04	1.56E-04	2.91E-04	6.14E-04	5.97E-05
2 1	2.41E-06	9.75E-06	9.45E-06	1.13E-05	2.28E-05	3.79E-05	3.53E-04	6.98E-04	7.49E-04	3.18E-04	1.16E-03	8.14E-04
3	1.12E-05	2.04E-04	7.58E-04	2.46E-04	9.50E-03	4.88E-02	1.21E-02	1.91E-02	1.49E-02	5.89E-03	5.36E-03	1.13E-03
3 0	6.16E-06	1.23E-04	3.96E-04	3.94E-05	6.22E-04	1.04E-02	1.93E-03	2.52E-03	7.14E-04	6.37E-04	6.36E-04	2.99E-05
3 1	2.66E-06	7.44E-05	3.15E-04	7.76E-05	4.26E-03	2.19E-02	2.30E-03	4.46E-03	4.92E-03	4.05E-04	7.12E-04	4.29E-04
3 2	2.37E-06	7.08E-06	4.63E-05	1.29E-04	4.62E-03	1.65E-02	7.89E-03	1.21E-02	9.25E-03	4.84E-03	4.01E-03	6.74E-04
4	1.12E-03	9.84E-03	2.22E-02	6.30E-02	2.38E-01	1.63E-01	5.91E-02	6.79E-02	2.88E-02	8.66E-03	6.15E-03	1.13E-03
4 0	6.24E-04	1.35E-03	1.22E-03	2.97E-03	1.64E-02	7.87E-03	5.60E-03	4.39E-03	6.12E-04	4.43E-04	5.03E-04	4.26E-05
4 1	4.13E-04	3.48E-03	6.55E-03	1.27E-02	4.21E-02	2.57E-02	7.38E-03	1.12E-02	6.13E-03	7.29E-04	4.58E-04	2.49E-04
4 2	7.03E-05	2.70E-03	7.94E-03	2.11E-02	6.77E-02	2.78E-02	1.29E-02	1.64E-02	8.59E-03	4.74E-03	4.14E-03	4.43E-04
4 3	1.28E-05	2.31E-03	6.45E-03	2.63E-02	1.12E-01	1.01E-01	3.32E-02	3.60E-02	1.34E-02	2.75E-03	1.05E-03	3.99E-04
5	1.36E-02	4.58E-01	7.59E-01	9.90E-01	9.84E-01	4.94E-01	1.49E-01	1.28E-01	3.94E-02	1.04E-02	5.08E-03	1.22E-03
5 0	5.76E-04	2.38E-02	3.70E-02	4.35E-02	5.83E-02	1.10E-02	6.09E-03	4.19E-03	5.70E-04	4.80E-04	3.04E-04	4.02E-05
5 1	1.62E-03	6.20E-02	9.81E-02	1.05E-01	1.34E-01	6.98E-02	9.75E-03	1.40E-02	6.83E-03	7.15E-04	3.79E-04	1.96E-04
5 2	3.24E-03	9.79E-02	1.52E-01	1.68E-01	1.55E-01	1.25E-01	2.39E-02	2.23E-02	7.78E-03	4.43E-03	2.87E-03	3.67E-04
5 3	3.16E-03	1.34E-01	2.20E-01	2.92E-01	2.62E-01	1.32E-01	5.11E-02	4.21E-02	1.65E-02	3.00E-03	8.76E-04	4.38E-04
5 4	4.97E-03	1.41E-01	2.52E-01	3.81E-01	3.74E-01	1.56E-01	5.85E-02	4.53E-02	7.64E-03	1.76E-03	6.54E-04	1.76E-04
6	8.48E-01	5.78E+00	6.42E+00	7.69E+00	6.09E+00	1.96E+00	2.47E-01	1.90E-01	4.02E-02	1.10E-02	5.61E-03	1.03E-03
6 0	6.62E-02	1.50E-01	1.81E-01	1.79E-01	9.08E-02	2.90E-02	5.80E-03	4.48E-03	7.74E-04	3.20E-04	2.86E-04	2.83E-05
6 1	1.02E-01	4.45E-01	4.97E-01	5.16E-01	3.09E-01	6.96E-02	9.53E-03	1.41E-02	4.65E-03	7.17E-04	4.91E-04	1.11E-04
6 2	2.15E-01	7.38E-01	7.33E-01	1.04E+00	6.23E-01	1.61E-01	2.78E-02	2.42E-02	6.78E-03	3.40E-03	2.47E-03	2.62E-04
6 3	9.82E-02	9.63E-01	1.11E+00	1.61E+00	1.42E+00	2.22E-01	3.77E-02	3.73E-02	1.27E-02	3.05E-03	9.52E-04	3.69E-04
6 4	1.53E-01	1.58E+00	1.64E+00	2.08E+00	1.65E+00	6.82E-01	5.86E-02	4.36E-02	9.29E-03	1.82E-03	9.49E-04	1.77E-04
6 5	2.14E-01	1.90E+00	2.26E+00	2.27E+00	2.00E+00	7.97E-01	1.07E-01	6.67E-02	6.00E-03	1.71E-03	4.60E-04	7.78E-05
7	2.70E+01	4.33E+01	5.03E+01	4.60E+01	1.48E+01	3.49E+00	3.03E-01	2.16E-01	4.42E-02	1.13E-02	6.28E-03	9.74E-04
7 0	4.32E-01	7.39E-01	7.56E-01	4.06E-01	8.44E-02	2.94E-02	4.31E-03	2.62E-03	9.82E-04	3.77E-04	2.36E-04	3.55E-05
7 1	1.81E+00	2.55E+00	2.33E+00	1.85E+00	2.29E-01	5.88E-02	1.18E-02	1.33E-02	3.40E-03	7.18E-04	5.27E-04	1.07E-04
7 2	3.41E+00	4.78E+00	4.35E+00	4.11E+00	5.70E-01	1.66E-01	1.93E-02	1.58E-02	7.08E-03	3.20E-03	2.06E-03	2.27E-04
7 3	5.40E+00	7.48E+00	8.07E+00	6.65E+00	1.10E+00	2.14E-01	3.44E-02	2.73E-02	1.25E-02	2.89E-03	1.17E-03	3.59E-04
7 4	4.67E+00	9.86E+00	1.20E+01	9.28E+00	1.94E+00	4.30E-01	4.91E-02	4.16E-02	9.49E-03	1.85E-03	1.11E-03	1.58E-04
7 5	4.02E+00	1.02E+01	1.39E+01	1.34E+01	4.59E+00	6.49E-01	7.12E-02	5.22E-02	7.13E-03	1.48E-03	9.21E-04	3.93E-05
7 6	7.24E+00	7.65E+00	8.80E+00	1.02E+01	6.27E+00	1.95E+00	1.13E-01	6.35E-02	3.67E-03	8.08E-04	2.51E-04	4.77E-05
8	1.65E+02	1.54E+02	1.24E+02	8.56E+01	2.04E+01	4.35E+00	3.44E-01	2.41E-01	5.23E-02	1.18E-02	5.96E-03	8.87E-04
8 0	2.68E+00	6.67E-01	3.37E-01	2.34E-01	6.69E-02	2.75E-02	3.92E-03	3.37E-03	9.16E-04	3.16E-04	1.70E-04	2.62E-05
8 1	6.97E+00	2.72E+00	1.60E+00	7.83E-01	1.64E-01	4.62E-02	9.95E-03	1.44E-02	3.94E-03	8.49E-04	5.80E-04	8.05E-05
8 2	1.21E+01	6.83E+00	4.12E+00	2.08E+00	4.39E-01	1.45E-01	2.07E-02	1.64E-02	6.50E-03	2.74E-03	1.59E-03	1.80E-04
8 3	1.71E+01	1.45E+01	9.61E+00	4.78E+00	7.57E-01	1.84E-01	2.76E-02	2.31E-02	1.37E-02	2.94E-03	1.17E-03	3.16E-04
8 4	2.27E+01	2.45E+01	1.98E+01	1.02E+01	1.42E+00	3.42E-01	4.61E-02	3.96E-02	1.12E-02	1.98E-03	1.02E-03	1.85E-04
8 5	3.54E+01	3.66E+01	2.98E+01	2.04E+01	2.41E+00	4.48E-01	6.07E-02	4.75E-02	8.85E-03	1.81E-03	8.56E-04	3.90E-05
8 6	3.18E+01	4.20E+01	3.52E+01	2.73E+01	3.95E+00	8.96E-01	1.09E-01	6.19E-02	5.63E-03	7.03E-04	4.27E-04	1.89E-05
8 7	3.62E+01	2.63E+01	2.40E+01	1.99E+01	1.12E+01	2.26E+00	6.68E-02	3.43E-02	1.63E-03	4.45E-04	1.44E-04	4.22E-05
9	3.55E+02	1.72E+02	1.25E+02	8.32E+01	2.13E+01	4.74E+00	3.63E-01	2.54E-01	5.79E-02	1.36E-02	6.60E-03	7.53E-04
9 0	3.02E+00	3.07E-01	2.66E-01	1.49E-01	5.77E-02	2.34E-02	3.08E-03	4.36E-03	1.06E-03	4.46E-04	2.12E-04	2.47E-05
9 1	8.57E+00	1.20E+00	8.78E-01	6.92E-01	1.61E-01	4.35E-02	1.03E-02	1.28E-02	4.22E-03	1.06E-03	8.01E-04	5.87E-05
9 2	1.46E+01	2.34E+00	1.83E+00	1.29E+00	3.75E-01	1.41E-01	1.83E-02	1.91E-02	6.89E-03	3.12E-03	1.66E-03	1.45E-04
9 3	2.01E+01	5.03E+00	3.54E+00	2.65E+00	6.94E-01	1.84E-01	3.07E-02	2.01E-02	1.42E-02	3.31E-03	1.43E-03	2.58E-04
9 4	2.89E+01	1.11E+01	7.49E+00	5.30E+00	1.11E+00	3.54E-01	4.20E-02	3.71E-02	1.30E-02	2.60E-03	1.22E-03	1.49E-04
9 5	4.78E+01	2.31E+01	1.51E+01	9.04E+00	1.81E+00	4.02E-01	5.71E-02	4.40E-02	7.94E-03	1.71E-03	6.64E-04	5.25E-05
9 6	7.22E+01	4.02E+01	2.54E+01	1.36E+01	2.53E+00	6.99E-01	8.97E-02	5.76E-02	5.87E-03	7.41E-04	3.06E-04	7.21E-06
9 7	7.67E+01	4.95E+01	3.78E+01	2.18E+01	4.34E+00	1.45E+00	8.31E-02	4.37E-02	4.11E-03	1.97E-04	2.12E-04	2.14E-05
9 8	8.33E+01	3.94E+01	3.26E+01	2.86E+01	1.03E+01	1.45E+00	2.91E-02	1.53E-02	6.98E-04	3.66E-04	9.01E-05	3.72E-05
10	9.49E+01	1.10E+02	9.15E+01	6.95E+01	2.05E+01	5.07E+00	4.07E-01	2.72E-01	6.94E-02	1.67E-02	9.00E-03	7.13E-04
10 0	8.91E-01	3.17E-01	2.80E-01	2.80E-01	7.46E-02	2.31E-02	3.21E-03	4.72E-03	1.75E-03	5.28E-04	3.29E-04	2.70E-05
10 1	2.18E+00	1.10E+00	9.82E-01	7.88E-01	2.30E-01	5.78E-02	1.25E-02	1.20E-02	5.08E-03	1.45E-03	1.12E-03	6.15E-05
10 2	3.30E+00	1.65E+00	1.84E+00	1.69E+00	4.32E-01	1.55E-01	1.91E-02	2.20E-02	9.12E-03	3.36E-03	2.10E-03	1.37E-04
10 3	3.96E+00	3.18E+00	3.06E+00	2.42E+00	7.95E-01	2.19E-01	3.45E-02	2.18E-02	1.56E-02	3.99E-03	2.03E-03	2.46E-04
10 4	6.25E+00	5.04E+00	5.14E+00	4.55E+00	1.13E+00	3.86E-01	4.92E-02	3.45E-02	1.59E-02	3.33E-03	1.87E-03	1.38E-04
10 5	8.19E+00	1.02E+01	9.72E+00	6.08E+00	1.86E+00	4.06E-01	6.36E-02	4.64E-02	8.82E-03	2.30E-03	9.29E-04	3.55E-05
10 6	1.30E+01	1.66E+01	1.28E+01	8.43E+00	2.46E+00	6.56E-01	8.68E-02	5.50E-02	6.77E-03	9.72E-04	2.46E-04	1.38E-05
10 7	1.67E+01	2.26E+01	1.72E+01	1.04E+01	3.39E+00	1.16E+00	8.36E-02	4.73E-02	4.31E-03	3.61E-04	1.43E-04	1.50E-06
10 8	2.13E+01	2.23E+01	1.79E+01	1.57E+01	4.66E+00	1.34E+00	4.30E-02	2.08E-02	1.47E-03	1.03E-04	1.71E-04	2.24E-05
10 9	1.91E+01	2.69E+01	2.26E+01	1.92E+01	5.44E+00	6.64E-01	1.12E-02	7.28E-03	4.67E-04	2.88E-04	6.48E-05	3.06E-05
11	3.89E+01	4.94E+01	5.66E+01	4.71E+01	2.09E+01	6.22E+00	5.49E-01	3.47E-01	9.97E-02	2.19E-02	1.21E-02	6.70E-04
11 0	2.32E-01	2.43E-01	3.31E-01	3.07E-01	1.48E-01	4.25E-02	6.32E-03	7.56E-03	3.09E-03	8.04E-04	4.39E-04	2.44E-05
11 1	6.66E-01	6.61E-01	1.01E+00	9.26E-01	4.49E-01	1.23E-01	2.44E-02	1.78E-02	8.35E-03	2.25E-03	1.44E-03	5.51E-05
11 2	9.43E-01	1.19E+00	1.64E+00	1.57E+00	7.19E-01	2.57E-01	3.56E-02	3.26E-02	1.38E-02	4.42E-03	2.50E-03	1.20E-04
11 3	1.26E+00	1.59E+00	2.37E+00	2.46E+00	1.21E+00	3.60E-01	5.96E-02	3.52E-02	2.07E-02	5.24E-03	2.65E-03	2.29E-04
11 4	1.76E+00	2.27E+00	3.06E+00	3.08E+00	1.50E+00	5.62E-01	7.58E-02	4.54E-02	2.30E-02	4.63E-03	2.59E-03	1.43E-04
11 5	2.09E+00	4.11E+00	4.88E+00	4.47E+00	2.08E+00	6.06E-01	8.37E-02	5.72E-02	1.42E-02	2.69E-03	1.47E-03	3.63E-05
11 6	2.59E+00	5.05E+00	5.91E+00	4.12E+00	2.62E+00	7.60E-01	9.84E-02	5.99E-02	8.76E-03	1.01E-03	4.38E-04	7.96E-06
11 7	4.23E+00	7.27E+00	6.33E+00	5.77E+00	2.92E+00	1.17E+00	8.91E-02	4.97E-02	4.26E-03	3.12E-04	1.24E-04	6.28E-06
11 8	6.75E+00	6.05E+00	6.74E+00	6.13E+00	3.51E+00	1.25E+00	5.35E-02	2.83E-02	2.63E-03	2.37E-04	1.82E-04	1.34E-06
11 9	8.93E+00	6.94E+00	8.36E+00	7.90E+00	3.72E+00	8.42E-01	1.80E-02	8.99E-03	7.74E-04	7.17E-05	1.72E-04	2.24E-05
11 10	9.49E+00	1.41E+01	1.59E+01	1.04E+01	2.07E+00	2.45E-01	4.34E-03	4.07E-03	2.10E-04	2.71E-04	5.03E-05	2.36E-05

Table A.26: Data for N^{7+} + H(2p-1)

	impact energies [kev/amu]											
	1.0	5.0	7.0	10.0	25.0	45.0	90.0	100.0	150.0	200.0	250.0	500.0
	total cross sections											
CX	6.69E+02	5.27E+02	4.55E+02	3.53E+02	9.12E+01	2.28E+01	2.75E+00	2.00E+00	4.02E-01	9.46E-02	4.12E-02	9.36E-04
ION	1.04E-01	3.08E-01	8.17E-01	1.79E+00	9.76E+00	2.84E+01	6.50E+01	6.74E+01	6.17E+01	5.99E+01	4.98E+01	3.12E+01
	state resolved CX cross sections											
n ℓ												
2	3.01E-10	4.34E-09	8.67E-10	1.42E-10	1.31E-07	4.21E-07	7.23E-06	8.04E-05	3.62E-05	1.89E-05	1.11E-04	3.21E-06
2 1	3.01E-10	4.34E-09	8.67E-10	1.42E-10	1.31E-07	4.21E-07	7.23E-06	8.04E-05	3.62E-05	1.89E-05	1.11E-04	3.21E-06
3	1.23E-09	1.12E-07	6.87E-07	1.26E-06	3.22E-04	1.52E-03	1.39E-03	1.99E-03	1.79E-03	3.57E-04	4.25E-04	2.41E-05
3 1	7.75E-10	9.37E-08	5.09E-07	5.34E-07	1.32E-04	3.76E-04	6.15E-04	7.98E-04	2.96E-04	1.07E-04	1.63E-04	2.76E-06
3 2	4.51E-10	1.81E-08	1.78E-07	7.26E-07	1.89E-04	1.15E-03	7.78E-04	1.20E-03	1.49E-03	2.50E-04	2.62E-04	2.14E-05
4	3.75E-07	1.59E-04	9.23E-04	4.42E-03	7.04E-02	6.94E-02	2.95E-02	2.60E-02	9.87E-03	1.74E-03	1.08E-03	7.30E-05
4 1	1.50E-07	2.58E-05	1.37E-04	5.55E-04	5.52E-03	2.81E-03	2.46E-03	2.85E-03	1.04E-03	2.86E-04	2.10E-04	1.81E-06
4 2	1.39E-07	7.28E-05	4.09E-04	1.82E-03	2.32E-02	2.41E-02	4.62E-03	3.96E-03	3.44E-03	5.58E-04	2.56E-04	2.89E-05
4 3	8.56E-08	6.00E-05	3.77E-04	2.05E-03	4.17E-02	4.25E-02	2.24E-02	1.92E-02	5.39E-03	8.95E-04	6.16E-04	4.23E-05
5	1.72E-04	9.09E-02	2.39E-01	5.00E-01	1.31E+00	5.93E-01	9.69E-02	8.46E-02	1.93E-02	4.78E-03	2.25E-03	1.17E-04
5 1	1.93E-05	5.02E-03	1.15E-02	2.16E-02	1.62E-02	6.49E-03	4.23E-03	4.85E-03	1.70E-03	4.20E-04	2.38E-04	1.18E-06
5 2	4.50E-05	1.99E-02	4.83E-02	9.45E-02	1.15E-01	4.45E-02	1.08E-02	1.04E-02	5.05E-03	9.54E-04	3.17E-04	2.78E-05
5 3	5.30E-05	3.54E-02	9.11E-02	1.90E-01	4.14E-01	1.01E-01	2.55E-02	2.94E-02	6.77E-03	1.59E-03	9.22E-04	6.48E-05
5 4	5.43E-05	3.05E-02	8.78E-02	1.94E-01	7.69E-01	4.42E-01	5.63E-02	3.99E-02	5.75E-03	1.82E-03	7.68E-04	2.34E-05
6	1.81E-01	5.03E+00	7.57E+00	9.55E+00	6.02E+00	1.59E+00	1.74E-01	1.38E-01	3.41E-02	8.31E-03	3.80E-03	1.36E-04
6 1	6.62E-03	8.87E-02	1.15E-01	9.48E-02	3.01E-02	9.12E-03	6.67E-03	6.17E-03	2.06E-03	5.11E-04	2.67E-04	9.84E-07
6 2	2.46E-02	4.37E-01	5.86E-01	5.73E-01	1.85E-01	7.42E-02	1.78E-02	1.45E-02	6.57E-03	1.31E-03	4.34E-04	2.30E-05
6 3	4.38E-02	1.08E+00	1.56E+00	1.73E+00	6.08E-01	1.39E-01	3.45E-02	3.27E-02	1.05E-02	2.31E-03	1.25E-03	6.64E-05
6 4	6.27E-02	1.73E+00	2.66E+00	3.40E+00	1.32E+00	3.53E-01	7.45E-02	5.49E-02	1.17E-02	3.17E-03	1.47E-03	3.88E-05
6 5	4.32E-02	1.69E+00	2.64E+00	3.75E+00	3.88E+00	1.02E+00	4.05E-02	2.97E-02	3.23E-03	1.01E-03	3.81E-04	6.79E-06
7	1.60E+01	5.67E+01	5.69E+01	4.65E+01	1.24E+01	2.69E+00	2.76E-01	2.00E-01	4.58E-02	1.14E-02	5.24E-03	1.35E-04
7 1	2.91E-01	2.63E-01	1.83E-01	1.22E-01	4.05E-02	1.19E-02	8.80E-03	7.88E-03	2.29E-03	5.41E-04	2.77E-04	8.57E-07
7 2	1.08E+00	1.54E+00	1.18E+00	6.93E-01	2.17E-01	9.27E-02	2.60E-02	2.12E-02	7.58E-03	1.52E-03	5.20E-04	1.92E-05
7 3	2.13E+00	5.11E+00	4.28E+00	2.53E+00	7.06E-01	1.77E-01	4.85E-02	4.45E-02	1.26E-02	2.80E-03	1.45E-03	6.08E-05
7 4	3.58E+00	1.18E+01	1.09E+01	7.00E+00	1.43E+00	3.45E-01	1.02E-01	7.31E-02	1.51E-02	4.23E-03	2.01E-03	4.15E-05
7 5	5.20E+00	1.89E+01	1.96E+01	1.58E+01	3.07E+00	1.02E+00	7.28E-02	4.26E-02	6.55E-03	2.06E-03	8.61E-04	1.06E-05
7 6	3.69E+00	1.92E+01	2.08E+01	2.04E+01	6.95E+00	1.04E+00	1.85E-02	1.12E-02	1.64E-03	2.70E-04	1.22E-04	1.47E-06
8	1.93E+02	1.72E+02	1.30E+02	8.71E+01	1.66E+01	3.62E+00	3.65E-01	2.65E-01	5.56E-02	1.38E-02	6.22E-03	1.27E-04
8 1	1.40E+00	2.33E-01	1.56E-01	1.09E-01	4.02E-02	1.52E-02	1.02E-02	8.55E-03	2.34E-03	5.51E-04	2.73E-04	8.11E-07
8 2	5.91E+00	1.33E+00	9.98E-01	6.55E-01	2.23E-01	1.11E-01	3.30E-02	2.56E-02	7.92E-03	1.64E-03	5.63E-04	1.58E-05
8 3	1.33E+01	4.85E+00	3.54E+00	2.28E+00	6.35E-01	2.01E-01	5.95E-02	5.18E-02	1.35E-02	3.09E-03	1.52E-03	5.46E-05
8 4	2.33E+01	1.40E+01	9.55E+00	5.89E+00	1.37E+00	3.65E-01	1.18E-01	8.95E-02	1.81E-02	4.90E-03	2.30E-03	4.14E-05
8 5	3.74E+01	3.24E+01	2.14E+01	1.27E+01	2.40E+00	9.84E-01	9.88E-02	6.34E-02	1.04E-02	2.91E-03	1.23E-03	1.20E-05
8 6	5.52E+01	5.68E+01	4.17E+01	2.24E+01	4.68E+00	1.19E+00	3.67E-02	1.95E-02	2.98E-03	6.43E-04	2.99E-04	1.71E-06
8 7	5.65E+01	6.22E+01	5.28E+01	4.30E+01	7.26E+00	7.59E-01	8.77E-03	6.34E-03	3.19E-04	6.27E-05	3.84E-05	3.75E-07
9	3.54E+02	1.72E+02	1.34E+02	9.28E+01	1.89E+01	4.22E+00	4.67E-01	3.26E-01	6.52E-02	1.58E-02	6.76E-03	1.16E-04
9 1	1.07E+00	1.13E-01	1.12E-01	8.14E-02	3.40E-02	1.83E-02	1.11E-02	9.37E-03	2.39E-03	5.54E-04	2.69E-04	7.84E-07
9 2	4.76E+00	7.91E-01	5.78E-01	5.26E-01	2.13E-01	1.26E-01	4.00E-02	3.10E-02	8.38E-03	1.74E-03	5.91E-04	1.31E-05
9 3	1.17E+01	2.49E+00	2.22E+00	1.67E+00	5.23E-01	2.26E-01	7.15E-02	5.98E-02	1.46E-02	3.30E-03	1.53E-03	4.76E-05
9 4	2.37E+01	7.09E+00	5.66E+00	4.08E+00	1.18E+00	3.90E-01	1.41E-01	1.02E-01	2.09E-02	5.43E-03	2.41E-03	3.94E-05
9 5	4.26E+01	1.65E+01	1.17E+01	8.25E+00	2.06E+00	9.34E-01	1.29E-01	8.04E-02	1.36E-02	3.62E-03	1.44E-03	1.32E-05
9 6	6.78E+01	3.12E+01	2.23E+01	1.24E+01	3.23E+00	1.16E+00	5.61E-02	3.13E-02	4.25E-03	1.00E-03	4.23E-04	2.01E-06
9 7	9.62E+01	5.15E+01	3.49E+01	2.18E+01	5.60E+00	9.49E-01	1.55E-02	8.27E-03	9.42E-04	1.33E-04	8.56E-05	2.45E-07
9 8	1.06E+02	6.28E+01	5.62E+01	4.39E+01	6.03E+00	4.18E-01	2.80E-03	3.78E-03	6.55E-05	1.51E-05	1.23E-05	2.12E-07
10	9.50E+01	9.06E+01	8.65E+01	7.37E+01	1.84E+01	4.65E+00	5.76E-01	4.12E-01	7.64E-02	1.78E-02	7.28E-03	1.06E-04
10 1	2.09E-01	7.37E-02	5.53E-02	6.43E-02	2.86E-02	2.01E-02	1.17E-02	1.00E-02	2.58E-03	5.74E-04	2.73E-04	7.69E-07
10 2	8.59E-01	3.64E-01	4.21E-01	2.96E-01	2.09E-01	1.29E-01	4.66E-02	3.69E-02	9.30E-03	1.87E-03	6.38E-04	1.12E-05
10 3	2.00E+00	1.36E+00	1.07E+00	1.14E+00	4.42E-01	2.56E-01	8.12E-02	6.99E-02	1.63E-02	3.54E-03	1.59E-03	4.20E-05
10 4	3.93E+00	2.90E+00	3.26E+00	2.11E+00	9.90E-01	3.98E-01	1.57E-01	1.22E-01	2.37E-02	5.91E-03	2.54E-03	3.63E-05
10 5	7.00E+00	6.59E+00	5.29E+00	4.96E+00	1.81E+00	9.17E-01	1.62E-01	1.07E-01	1.67E-02	4.27E-03	1.60E-03	1.32E-05
10 6	1.15E+01	1.07E+01	1.02E+01	5.98E+00	2.15E+00	1.14E+00	8.26E-02	4.71E-02	6.02E-03	1.39E-03	5.02E-04	2.41E-06
10 7	1.79E+01	1.62E+01	1.23E+01	1.09E+01	3.96E+00	9.98E-01	2.82E-02	1.43E-02	1.48E-03	2.40E-04	1.06E-04	2.08E-07
10 8	2.61E+01	2.40E+01	2.00E+01	1.38E+01	5.37E+00	6.18E-01	5.66E-03	2.65E-03	2.22E-04	2.36E-05	2.43E-05	1.38E-07
10 9	2.54E+01	2.84E+01	3.40E+01	3.45E+01	3.45E+00	1.83E-01	1.29E-03	2.23E-03	3.40E-05	5.06E-06	4.99E-06	1.51E-07
11	1.01E+01	3.05E+01	4.03E+01	4.31E+01	1.75E+01	5.38E+00	7.65E-01	5.47E-01	9.41E-02	2.05E-02	8.01E-03	9.86E-05
11 1	4.87E-02	3.44E-02	2.66E-02	5.24E-02	3.39E-02	2.57E-02	1.34E-02	1.15E-02	2.92E-03	6.13E-04	2.82E-04	7.63E-07
11 2	1.47E-01	1.23E-01	2.28E-01	1.86E-01	1.82E-01	1.43E-01	5.91E-02	4.63E-02	1.08E-02	2.06E-03	6.95E-04	9.70E-06
11 3	2.41E-01	5.31E-01	4.58E-01	8.11E-01	4.97E-01	3.18E-01	1.04E-01	8.53E-02	1.91E-02	3.91E-03	1.69E-03	3.78E-05
11 4	4.02E-01	9.39E-01	1.51E+00	1.07E+00	7.52E-01	4.64E-01	1.94E-01	1.49E-01	2.84E-02	6.63E-03	2.76E-03	3.42E-05
11 5	5.68E-01	2.08E+00	2.00E+00	2.98E+00	1.78E+00	9.16E-01	2.15E-01	1.45E-01	2.16E-02	5.09E-03	1.83E-03	1.31E-05
11 6	9.49E-01	3.05E+00	4.11E+00	2.73E+00	1.73E+00	1.21E+00	1.22E-01	7.42E-02	8.60E-03	1.83E-03	6.03E-04	2.55E-06
11 7	1.18E+00	4.10E+00	3.97E+00	5.33E+00	2.62E+00	1.12E+00	4.46E-02	2.52E-02	2.11E-03	3.61E-04	1.17E-04	2.78E-07
11 8	1.82E+00	5.07E+00	6.63E+00	5.53E+00	4.43E+00	7.72E-01	1.11E-02	7.06E-03	5.29E-04	4.84E-05	2.47E-05	4.43E-08
11 9	2.61E+00	5.37E+00	5.91E+00	7.68E+00	3.96E+00	3.48E-01	1.70E-03	6.59E-04	6.34E-05	3.71E-06	1.15E-05	1.20E-07
11 10	2.15E+00	9.21E+00	1.54E+01	1.68E+01	1.54E+00	7.15E-02	1.15E-03	2.09E-03	1.39E-05	3.70E-06	2.89E-06	1.01E-07

Table A.27: Data for N^{7+} + H(2p)

	impact energies [kev/amu]											
	1.0	5.0	7.0	10.0	25.0	45.0	90.0	100.0	150.0	200.0	250.0	500.0
	total cross sections											
CX	6.79E+02	5.43E+02	4.72E+02	3.65E+02	9.16E+01	2.10E+01	2.35E+00	1.75E+00	4.53E-01	1.25E-01	6.33E-02	5.94E-03
ION	8.52E-01	1.18E+00	1.83E+00	3.02E+00	1.76E+01	2.84E+01	3.99E+01	3.87E+01	3.13E+01	3.87E+01	2.65E+01	1.91E+01
	state resolved CX cross sections											
n ℓ												
2	1.61E-05	1.73E-05	5.47E-06	5.29E-06	2.09E-05	3.33E-05	2.70E-04	7.44E-04	8.14E-04	4.19E-04	1.25E-03	5.30E-04
2 0	1.30E-05	1.37E-05	1.83E-06	2.57E-07	4.25E-06	9.44E-06	9.60E-05	2.64E-04	2.39E-04	1.82E-04	4.07E-04	3.45E-05
2 1	3.09E-06	3.65E-06	3.64E-06	5.03E-06	1.67E-05	2.38E-05	1.74E-04	4.79E-04	5.75E-04	2.37E-04	8.47E-04	4.96E-04
3	1.28E-05	8.66E-05	3.49E-04	1.95E-04	1.17E-02	2.27E-02	1.32E-02	1.77E-02	1.19E-02	4.55E-03	4.12E-03	5.96E-04
3 0	8.39E-06	5.07E-05	1.76E-04	3.04E-05	1.20E-03	3.83E-03	1.21E-03	1.30E-03	6.67E-04	3.11E-04	3.30E-04	1.96E-05
3 1	2.69E-06	3.18E-05	1.45E-04	7.26E-05	4.98E-03	9.79E-03	3.82E-03	5.02E-03	3.07E-03	5.66E-04	5.79E-04	2.20E-04
3 2	1.67E-06	4.01E-06	2.88E-05	9.16E-05	5.52E-03	9.06E-03	8.21E-03	1.13E-02	8.20E-03	3.68E-03	3.21E-03	3.56E-04
4	1.38E-03	5.62E-03	1.45E-02	3.96E-02	1.87E-01	1.52E-01	6.59E-02	6.49E-02	2.49E-02	7.48E-03	5.19E-03	6.52E-04
4 0	7.79E-04	6.98E-04	7.91E-04	1.88E-03	1.32E-02	9.00E-03	2.45E-03	1.99E-03	5.97E-04	2.55E-04	2.53E-04	3.04E-05
4 1	5.12E-04	1.78E-03	3.64E-03	8.27E-03	2.73E-02	2.74E-02	6.39E-03	8.47E-03	3.32E-03	6.35E-04	4.03E-04	1.51E-04
4 2	7.79E-05	1.74E-03	5.12E-03	1.42E-02	5.62E-02	3.20E-02	1.68E-02	1.65E-02	6.41E-03	2.63E-03	2.37E-03	2.74E-04
4 3	1.48E-05	1.41E-03	4.98E-03	1.52E-02	9.07E-02	8.37E-02	4.02E-02	3.80E-02	1.46E-02	3.97E-03	2.16E-03	1.97E-04
5	1.06E-02	3.11E-01	5.81E-01	9.00E-01	1.14E+00	5.60E-01	1.41E-01	1.19E-01	3.47E-02	9.76E-03	5.11E-03	7.38E-04
5 0	6.79E-04	1.50E-02	2.47E-02	3.69E-02	3.62E-02	8.11E-03	2.36E-03	1.68E-03	4.12E-04	2.78E-04	1.85E-04	2.65E-05
5 1	1.52E-03	4.10E-02	6.95E-02	9.42E-02	9.34E-02	3.82E-02	6.97E-03	9.10E-03	3.65E-03	5.41E-04	3.18E-04	1.10E-04
5 2	2.68E-03	6.62E-02	1.18E-01	1.60E-01	1.56E-01	8.64E-02	1.80E-02	1.80E-02	6.07E-03	2.29E-03	1.66E-03	2.51E-04
5 3	2.27E-03	9.35E-02	1.79E-01	2.70E-01	3.01E-01	1.51E-01	3.45E-02	2.96E-02	1.18E-02	3.47E-03	1.69E-03	2.50E-04
5 4	3.49E-03	9.54E-02	1.90E-01	3.40E-01	5.48E-01	2.76E-01	7.95E-02	6.08E-02	1.28E-02	3.18E-03	1.25E-03	1.00E-04
6	7.74E-01	5.85E+00	7.45E+00	8.39E+00	4.93E+00	1.50E+00	1.99E-01	1.60E-01	4.13E-02	1.18E-02	5.85E-03	6.55E-04
6 0	4.48E-02	1.25E-01	1.52E-01	1.40E-01	3.99E-02	1.42E-02	2.29E-03	2.00E-03	5.86E-04	2.72E-04	2.05E-04	2.05E-05
6 1	8.85E-02	4.02E-01	4.49E-01	4.40E-01	1.41E-01	3.98E-02	7.65E-03	1.01E-02	2.86E-03	6.94E-04	4.03E-04	6.53E-05
6 2	1.72E-01	7.51E-01	7.96E-01	8.74E-01	3.33E-01	1.03E-01	1.94E-02	1.71E-02	6.16E-03	2.23E-03	1.50E-03	1.88E-04
6 3	9.54E-02	1.11E+00	1.36E+00	1.54E+00	8.05E-01	1.76E-01	3.01E-02	2.84E-02	1.06E-02	3.14E-03	1.56E-03	2.33E-04
6 4	1.66E-01	1.66E+00	2.19E+00	2.49E+00	1.25E+00	4.08E-01	5.65E-02	4.45E-02	1.35E-02	3.47E-03	1.62E-03	1.02E-04
6 5	2.07E-01	1.80E+00	2.50E+00	2.91E+00	2.36E+00	7.56E-01	8.33E-02	5.82E-02	7.54E-03	1.95E-03	5.66E-04	4.76E-05
7	2.17E+01	4.58E+01	4.72E+01	4.01E+01	1.11E+01	2.55E+00	2.49E-01	1.89E-01	4.82E-02	1.34E-02	6.59E-03	6.52E-04
7 0	3.65E-01	4.38E-01	3.67E-01	2.02E-01	4.59E-02	1.31E-02	1.73E-03	1.39E-03	8.09E-04	3.16E-04	1.87E-04	2.41E-05
7 1	1.52E+00	1.52E+00	1.24E+00	8.85E-01	1.32E-01	3.32E-02	8.65E-03	9.56E-03	2.79E-03	8.34E-04	4.58E-04	6.48E-05
7 2	2.43E+00	3.11E+00	2.72E+00	2.12E+00	3.59E-01	1.09E-01	1.83E-02	1.63E-02	6.93E-03	2.16E-03	1.29E-03	1.74E-04
7 3	3.58E+00	5.64E+00	5.71E+00	4.27E+00	7.88E-01	1.86E-01	3.25E-02	2.86E-02	1.09E-02	3.05E-03	1.60E-03	2.34E-04
7 4	4.33E+00	9.35E+00	9.97E+00	7.41E+00	1.38E+00	3.33E-01	5.92E-02	4.78E-02	1.35E-02	3.80E-03	1.87E-03	1.01E-04
7 5	3.84E+00	1.32E+01	1.42E+01	1.27E+01	2.98E+00	7.22E-01	7.04E-02	4.92E-02	9.96E-03	2.48E-03	9.92E-04	2.47E-05
7 6	5.66E+00	1.26E+01	1.30E+01	1.25E+01	5.46E+00	1.16E+00	5.85E-02	3.65E-02	3.32E-03	7.55E-04	1.99E-04	3.01E-05
8	1.75E+02	1.52E+02	1.22E+02	8.36E+01	1.62E+01	3.31E+00	2.99E-01	2.22E-01	5.62E-02	1.52E-02	6.93E-03	6.00E-04
8 0	1.84E+00	4.02E-01	2.87E-01	1.86E-01	4.36E-02	1.67E-02	1.95E-03	2.01E-03	8.99E-04	3.22E-04	1.73E-04	1.91E-05
8 1	5.32E+00	1.66E+00	1.18E+00	7.12E-01	1.42E-01	3.07E-02	9.65E-03	1.11E-02	3.31E-03	1.07E-03	5.24E-04	4.48E-05
8 2	9.35E+00	4.36E+00	2.99E+00	1.68E+00	3.46E-01	1.23E-01	2.23E-02	1.87E-02	7.16E-03	2.24E-03	1.13E-03	1.44E-04
8 3	1.57E+01	9.88E+00	6.98E+00	4.20E+00	7.10E-01	1.69E-01	3.53E-02	3.11E-02	1.16E-02	3.27E-03	1.58E-03	2.14E-04
8 4	2.35E+01	1.95E+01	1.52E+01	8.28E+00	1.30E+00	2.90E-01	6.33E-02	5.12E-02	1.49E-02	4.07E-03	1.92E-03	1.13E-04
8 5	3.42E+01	3.36E+01	2.60E+01	1.63E+01	2.15E+00	5.83E-01	7.17E-02	5.17E-02	1.20E-02	2.86E-03	1.16E-03	2.58E-05
8 6	4.18E+01	4.49E+01	3.70E+01	2.47E+01	3.75E+00	9.03E-01	6.39E-02	3.85E-02	5.16E-03	9.22E-04	3.63E-04	1.22E-05
8 7	4.30E+01	3.76E+01	3.24E+01	2.74E+01	7.76E+00	1.20E+00	3.06E-02	1.78E-02	1.19E-03	4.37E-04	8.28E-05	2.71E-05
9	3.45E+02	1.86E+02	1.43E+02	9.81E+01	1.88E+01	3.78E+00	3.56E-01	2.58E-01	6.31E-02	1.70E-02	7.66E-03	5.30E-04
9 0	2.15E+00	2.56E-01	2.56E-01	1.81E-01	4.08E-02	1.78E-02	2.45E-03	2.32E-03	9.27E-04	3.61E-04	2.09E-04	1.86E-05
9 1	6.50E+00	9.57E-01	8.65E-01	7.09E-01	1.74E-01	3.18E-02	1.22E-02	1.10E-02	3.52E-03	1.21E-03	6.90E-04	3.62E-05
9 2	1.17E+01	2.28E+00	2.10E+00	1.62E+00	3.44E-01	1.35E-01	2.55E-02	2.25E-02	7.43E-03	2.37E-03	1.22E-03	1.20E-04
9 3	1.79E+01	5.53E+00	4.20E+00	3.12E+00	6.93E-01	1.79E-01	4.27E-02	3.48E-02	1.23E-02	3.49E-03	1.77E-03	1.85E-04
9 4	2.74E+01	1.18E+01	8.93E+00	6.20E+00	1.16E+00	3.10E-01	7.01E-02	5.76E-02	1.66E-02	4.58E-03	2.02E-03	9.73E-05
9 5	4.39E+01	2.41E+01	1.66E+01	1.03E+01	1.83E+00	5.53E-01	8.12E-02	5.76E-02	1.30E-02	3.24E-03	1.17E-03	3.17E-05
9 6	6.52E+01	4.09E+01	2.77E+01	1.57E+01	2.59E+00	7.91E-01	6.77E-02	4.16E-02	6.26E-03	1.18E-03	3.90E-04	4.75E-06
9 7	8.30E+01	5.32E+01	4.07E+01	2.45E+01	4.70E+00	9.73E-01	4.09E-02	2.25E-02	2.55E-03	2.42E-04	1.44E-04	1.31E-05
9 8	8.68E+01	4.72E+01	4.17E+01	3.58E+01	7.28E+00	7.92E-01	1.28E-02	8.35E-03	4.57E-04	3.44E-04	4.85E-05	2.38E-05
10	1.08E+02	1.13E+02	1.01E+02	8.24E+01	1.94E+01	4.21E+00	4.32E-01	3.09E-01	7.42E-02	2.04E-02	9.25E-03	5.05E-04
10 0	6.24E-01	2.00E-01	2.18E-01	2.01E-01	5.94E-02	2.22E-02	3.37E-03	2.43E-03	1.17E-03	4.64E-04	2.71E-04	1.95E-05
10 1	1.71E+00	7.75E-01	7.04E-01	5.63E-01	2.19E-01	4.20E-02	1.61E-02	1.11E-02	4.11E-03	1.68E-03	9.21E-04	3.73E-05
10 2	2.68E+00	1.25E+00	1.56E+00	1.44E+00	4.19E-01	1.58E-01	3.20E-02	2.63E-02	8.85E-03	2.88E-03	1.47E-03	1.13E-04
10 3	4.08E+00	2.99E+00	2.87E+00	2.18E+00	6.98E-01	2.12E-01	5.20E-02	4.05E-02	1.40E-02	4.19E-03	2.18E-03	1.75E-04
10 4	6.44E+00	5.18E+00	5.01E+00	4.17E+00	1.13E+00	3.38E-01	8.27E-02	6.54E-02	1.92E-02	5.27E-03	2.41E-03	9.33E-05
10 5	8.40E+00	9.66E+00	8.98E+00	6.10E+00	1.73E+00	5.33E-01	9.42E-02	7.10E-02	1.50E-02	3.68E-03	1.34E-03	2.40E-05
10 6	1.28E+01	1.58E+01	1.27E+01	8.27E+00	2.12E+00	7.55E-01	7.78E-02	4.99E-02	7.67E-03	1.43E-03	3.96E-04	8.64E-06
10 7	1.89E+01	2.25E+01	1.65E+01	1.17E+01	3.50E+00	9.05E-01	4.78E-02	2.79E-02	3.07E-03	4.07E-04	1.31E-04	1.17E-06
10 8	2.52E+01	2.72E+01	2.30E+01	1.64E+01	4.91E+00	8.47E-01	2.07E-02	1.05E-02	9.29E-04	1.15E-04	9.86E-05	1.38E-05
10 9	2.74E+01	2.70E+01	2.91E+01	3.15E+01	4.57E+00	3.93E-01	5.65E-03	4.18E-03	2.27E-04	3.05E-04	3.43E-05	1.95E-05
11	2.92E+01	4.06E+01	5.09E+01	5.13E+01	1.98E+01	4.95E+00	5.96E-01	4.11E-01	9.74E-02	2.53E-02	1.14E-02	4.78E-04
11 0	1.74E-01	1.43E-01	1.72E-01	2.09E-01	1.21E-01	2.74E-02	6.24E-03	4.36E-03	1.77E-03	6.20E-04	3.34E-04	1.83E-05
11 1	5.27E-01	3.69E-01	6.58E-01	5.71E-01	3.40E-01	7.08E-02	2.63E-02	1.68E-02	5.96E-03	2.23E-03	1.16E-03	3.29E-05
11 2	8.57E-01	7.81E-01	9.56E-01	1.09E+00	6.38E-01	1.89E-01	4.96E-02	3.67E-02	1.19E-02	3.60E-03	1.73E-03	1.02E-04
11 3	1.23E+00	1.14E+00	1.72E+00	1.86E+00	9.18E-01	2.95E-01	7.67E-02	5.49E-02	1.78E-02	5.13E-03	2.63E-03	1.66E-04
11 4	1.65E+00	1.89E+00	2.37E+00	2.32E+00	1.25E+00	4.22E-01	1.13E-01	8.00E-02	2.42E-02	6.52E-03	2.97E-03	9.46E-05
11 5	1.86E+00	3.19E+00	3.70E+00	3.97E+00	1.81E+00	6.07E-01	1.26E-01	9.01E-02	1.98E-02	4.52E-03	1.70E-03	2.40E-05
11 6	2.19E+00	4.33E+00	5.14E+00	3.92E+00	1.99E+00	8.06E-01	9.96E-02	6.64E-02	1.03E-02	1.71E-03	5.08E-04	5.33E-06
11 7	3.37E+00	5.92E+00	5.49E+00	5.80E+00	2.58E+00	9.32E-01	5.99E-02	3.62E-02	3.72E-03	4.05E-04	1.23E-04	4.22E-06
11 8	5.14E+00	5.75E+00	6.90E+00	6.70E+00	3.82E+00	8.73E-01	2.71E-02	1.77E-02	1.42E-03	1.80E-04	1.08E-04	9.62E-07
11 9	5.95E+00	6.69E+00	7.98E+00	7.81E+00	4.20E+00	5.69E-01	8.98E-03	5.13E-03	4.15E-04	5.51E-05	9.13E-05	1.40E-05
11 10	6.20E+00	1.04E+01	1.58E+01	1.70E+01	2.16E+00	1.61E-01	2.94E-03	2.98E-03	1.05E-04	2.92E-04	2.61E-05	1.51E-05

Table A.28: Data for N^{7+} + H($n = 2$)

	impact energies [kev/amu]											
	1.0	5.0	7.0	10.0	25.0	45.0	90.0	100.0	150.0	200.0	250.0	500.0
	total cross sections											
CX	6.74E+2	5.47E+2	4.74E+2	3.65E+2	9.63E+1	2.40E+1	3.28E+0	2.43E+0	5.47E-1	1.58E-1	6.99E-2	5.12E-3
ION	8.03E-1	1.49E+0	2.17E+0	3.37E+0	1.86E+01	3.54E+1	4.95E+1	4.85E+1	3.97E+1	4.78E+1	3.47E+1	2.54E+1
	state resolved CX cross sections											
n ℓ												
2	1.27E-05	1.62E-05	5.08E-06	4.46E-06	1.82E-05	2.78E-05	2.12E-04	6.01E-04	7.89E-04	3.72E-04	1.03E-03	4.06E-04
2 0	1.02E-05	1.28E-05	1.86E-06	2.56E-07	3.76E-06	7.52E-06	7.36E-05	2.07E-04	2.50E-04	1.60E-04	3.29E-04	2.89E-05
2 1	2.50E-06	3.41E-06	3.22E-06	4.21E-06	1.44E-05	2.03E-05	1.38E-04	3.94E-04	5.39E-04	2.12E-04	6.98E-04	3.77E-04
3	1.04E-05	8.12E-05	3.44E-04	1.47E-04	9.96E-03	1.94E-02	1.81E-02	2.12E-02	1.34E-02	4.49E-03	3.83E-03	4.72E-04
3 0	6.57E-06	4.78E-05	1.75E-04	2.30E-05	1.04E-03	3.44E-03	2.24E-03	1.91E-03	7.37E-04	2.77E-04	2.92E-04	1.80E-05
3 1	2.17E-06	2.99E-05	1.44E-04	5.49E-05	4.37E-03	8.37E-03	6.56E-03	7.18E-03	3.90E-03	8.13E-04	6.86E-04	1.74E-04
3 2	1.70E-06	3.45E-06	2.49E-05	6.91E-05	4.54E-03	7.56E-03	9.30E-03	1.22E-02	8.74E-03	3.40E-03	2.86E-03	2.81E-04
4	1.09E-03	4.67E-03	1.17E-02	3.29E-02	2.29E-01	2.44E-01	1.15E-01	1.04E-01	2.96E-02	9.00E-03	5.49E-03	5.37E-04
4 0	6.13E-04	5.98E-04	6.95E-04	1.80E-03	2.43E-02	1.46E-02	3.86E-03	3.69E-03	8.20E-04	3.70E-04	3.24E-04	2.57E-05
4 1	4.03E-04	1.55E-03	3.16E-03	7.50E-03	5.00E-02	5.17E-02	1.04E-02	1.22E-02	4.17E-03	1.19E-03	6.60E-04	1.23E-04
4 2	6.11E-05	1.42E-03	4.07E-03	1.17E-02	7.00E-02	7.43E-02	3.16E-02	2.68E-02	7.37E-03	2.95E-03	2.30E-03	2.25E-04
4 3	1.14E-05	1.11E-03	3.80E-03	1.19E-02	8.49E-02	1.03E-01	6.89E-02	6.08E-02	1.72E-02	4.49E-03	2.21E-03	1.63E-04
5	8.77E-03	2.61E-01	5.30E-01	9.21E-01	2.10E+00	9.91E-01	2.16E-01	1.70E-01	4.64E-02	1.12E-02	6.02E-03	6.25E-04
5 0	5.74E-04	1.52E-02	3.11E-02	5.63E-02	6.92E-02	1.57E-02	4.92E-03	3.38E-03	1.05E-03	3.92E-04	2.83E-04	2.24E-05
5 1	1.34E-03	3.90E-02	8.13E-02	1.40E-01	2.33E-01	6.69E-02	1.31E-02	1.25E-02	5.53E-03	1.02E-03	5.93E-04	9.11E-05
5 2	2.26E-03	5.94E-02	1.17E-01	1.92E-01	4.57E-01	1.44E-01	3.07E-02	2.54E-02	9.17E-03	2.59E-03	1.78E-03	2.12E-04
5 3	1.85E-03	7.42E-02	1.50E-01	2.50E-01	6.27E-01	2.94E-01	4.94E-02	4.14E-02	1.63E-02	3.96E-03	1.90E-03	2.10E-04
5 4	2.74E-03	7.33E-02	1.50E-01	2.82E-01	7.18E-01	4.70E-01	1.17E-01	8.77E-02	1.43E-02	3.23E-03	1.46E-03	8.94E-05
6	7.39E-01	6.09E+00	8.47E+00	1.09E+01	6.89E+00	2.03E+00	3.08E-01	2.45E-01	5.54E-02	1.43E-02	6.55E-03	5.76E-04
6 0	4.06E-02	2.44E-01	3.32E-01	3.36E-01	7.42E-02	2.19E-02	4.42E-03	5.25E-03	1.34E-03	4.17E-04	2.67E-04	1.79E-05
6 1	8.56E-02	6.89E-01	9.17E-01	1.10E+00	2.75E-01	7.66E-02	1.45E-02	1.78E-02	5.31E-03	1.26E-03	5.81E-04	5.66E-05
6 2	1.57E-01	1.02E+00	1.36E+00	1.85E+00	5.96E-01	1.52E-01	3.45E-02	3.39E-02	9.57E-03	2.74E-03	1.60E-03	1.65E-04
6 3	1.14E-01	1.24E+00	1.70E+00	2.29E+00	1.25E+00	2.60E-01	5.59E-02	5.15E-02	1.48E-02	4.14E-03	1.78E-03	1.98E-04
6 4	1.62E-01	1.46E+00	2.05E+00	2.60E+00	1.97E+00	5.54E-01	1.01E-01	7.34E-02	1.61E-02	3.96E-03	1.73E-03	9.68E-05
6 5	1.80E-01	1.44E+00	2.11E+00	2.67E+00	2.73E+00	9.68E-01	9.84E-02	6.29E-02	8.31E-03	1.83E-03	5.98E-04	4.23E-05
7	2.17E+01	4.92E+01	5.16E+01	4.43E+01	1.25E+01	3.01E+00	3.57E-01	2.68E-01	5.99E-02	1.61E-02	7.37E-03	5.77E-04
7 0	4.59E-01	8.68E-01	6.23E-01	3.66E-01	8.33E-02	2.36E-02	5.80E-03	4.06E-03	1.39E-03	4.66E-04	2.54E-04	2.05E-05
7 1	1.52E+00	2.89E+00	2.27E+00	1.48E+00	2.76E-01	8.23E-02	1.84E-02	1.50E-02	4.86E-03	1.40E-03	6.23E-04	5.60E-05
7 2	2.25E+00	5.24E+00	4.83E+00	3.32E+00	5.90E-01	1.63E-01	3.67E-02	2.82E-02	9.53E-03	2.80E-03	1.50E-03	1.55E-04
7 3	3.32E+00	7.72E+00	8.13E+00	6.09E+00	1.11E+00	2.62E-01	5.61E-02	4.54E-02	1.41E-02	4.17E-03	1.89E-03	1.99E-04
7 4	4.05E+00	9.98E+00	1.09E+01	9.05E+00	1.79E+00	4.34E-01	8.45E-02	7.08E-02	1.63E-02	4.18E-03	1.96E-03	9.51E-05
7 5	5.02E+00	1.16E+01	1.28E+01	1.20E+01	3.46E+00	7.52E-01	8.87E-02	6.50E-02	1.06E-02	2.23E-03	9.59E-04	2.65E-05
7 6	5.06E+00	1.09E+01	1.21E+01	1.20E+01	5.19E+00	1.29E+00	6.64E-02	3.91E-02	3.09E-03	8.10E-04	1.85E-04	2.51E-05
8	1.81E+02	1.46E+02	1.17E+02	7.98E+01	1.67E+01	3.69E+00	4.11E-01	3.04E-01	6.74E-02	1.96E-02	8.14E-03	5.41E-04
8 0	2.21E+00	6.54E-01	5.03E-01	3.22E-01	8.32E-02	2.97E-02	6.65E-03	5.27E-03	1.44E-03	5.31E-04	2.51E-04	1.68E-05
8 1	6.89E+00	2.51E+00	1.77E+00	1.14E+00	3.10E-01	8.14E-02	2.09E-02	1.84E-02	5.33E-03	1.78E-03	7.02E-04	4.02E-05
8 2	1.30E+01	6.13E+00	4.31E+00	2.57E+00	5.67E-01	1.79E-01	4.07E-02	3.38E-02	9.99E-03	3.15E-03	1.44E-03	1.32E-04
8 3	1.88E+01	1.20E+01	8.76E+00	5.33E+00	1.02E+00	2.44E-01	6.03E-02	5.18E-02	1.53E-02	4.82E-03	2.00E-03	1.85E-04
8 4	2.36E+01	2.04E+01	1.57E+01	9.42E+00	1.59E+00	3.83E-01	8.91E-02	7.30E-02	1.80E-02	4.98E-03	2.11E-03	1.06E-04
8 5	3.15E+01	2.95E+01	2.34E+01	1.56E+01	2.29E+00	6.28E-01	8.95E-02	6.23E-02	1.18E-02	2.95E-03	1.19E-03	2.82E-05
8 6	4.14E+01	3.73E+01	3.06E+01	2.08E+01	3.84E+00	8.34E-01	6.87E-02	3.90E-02	4.48E-03	9.56E-04	3.55E-04	1.11E-05
8 7	4.33E+01	3.79E+01	3.22E+01	2.46E+01	7.04E+00	1.31E+00	3.47E-02	2.07E-02	1.10E-03	4.35E-04	8.74E-05	2.18E-05
9	3.28E+02	1.84E+02	1.39E+02	9.43E+01	1.88E+01	4.19E+00	4.87E-01	3.39E-01	7.45E-02	2.18E-02	8.84E-03	4.83E-04
9 0	2.47E+00	3.79E-01	3.70E-01	3.22E-01	7.66E-02	3.54E-02	8.92E-03	6.25E-03	1.52E-03	6.10E-04	2.73E-04	1.64E-05
9 1	7.39E+00	1.38E+00	1.29E+00	1.05E+00	3.35E-01	9.34E-02	2.91E-02	2.05E-02	5.66E-03	2.01E-03	8.22E-04	3.33E-05
9 2	1.27E+01	3.12E+00	2.79E+00	2.33E+00	5.15E-01	2.13E-01	5.06E-02	3.81E-02	1.06E-02	3.42E-03	1.50E-03	1.11E-04
9 3	1.97E+01	6.82E+00	5.38E+00	3.99E+00	9.54E-01	2.69E-01	7.60E-02	5.51E-02	1.63E-02	5.14E-03	2.16E-03	1.60E-04
9 4	2.90E+01	1.25E+01	9.50E+00	6.80E+00	1.34E+00	4.17E-01	9.90E-02	7.62E-02	1.95E-02	5.42E-03	2.19E-03	9.24E-05
9 5	4.05E+01	2.20E+01	1.59E+01	1.01E+01	1.87E+00	5.89E-01	9.51E-02	6.73E-02	1.27E-02	3.25E-03	1.25E-03	3.40E-05
9 6	5.58E+01	3.41E+01	2.41E+01	1.48E+01	2.75E+00	7.07E-01	6.95E-02	4.23E-02	5.50E-03	1.25E-03	4.21E-04	5.86E-06
9 7	7.59E+01	4.72E+01	3.46E+01	2.12E+01	4.17E+00	9.81E-01	4.31E-02	2.27E-02	2.11E-03	2.95E-04	1.61E-04	1.08E-05
9 8	8.43E+01	5.60E+01	4.46E+01	3.36E+01	6.82E+00	8.82E-01	1.54E-02	1.06E-02	4.97E-04	4.14E-04	5.51E-05	1.90E-05
10	1.15E+02	1.17E+02	1.02E+02	8.17E+01	1.92E+01	4.45E+00	5.75E-01	4.03E-01	8.55E-02	2.74E-02	1.02E-02	4.61E-04
10 0	7.10E-01	2.71E-01	3.26E-01	2.67E-01	1.07E-01	4.45E-02	1.06E-02	7.55E-03	1.87E-03	8.26E-04	3.29E-04	1.71E-05
10 1	1.93E+00	1.01E+00	9.12E-01	8.50E-01	3.85E-01	1.01E-01	3.69E-02	2.44E-02	6.51E-03	2.77E-03	1.01E-03	3.43E-05
10 2	3.04E+00	1.62E+00	2.01E+00	1.80E+00	6.06E-01	2.33E-01	5.91E-02	4.59E-02	1.22E-02	4.34E-03	1.73E-03	1.05E-04
10 3	4.41E+00	3.53E+00	3.42E+00	2.77E+00	9.41E-01	2.63E-01	8.86E-02	6.58E-02	1.80E-02	6.40E-03	2.50E-03	1.52E-04
10 4	6.33E+00	5.69E+00	5.32E+00	4.53E+00	1.28E+00	3.88E-01	1.12E-01	8.64E-02	2.16E-02	6.65E-03	2.48E-03	8.77E-05
10 5	8.27E+00	9.16E+00	8.67E+00	6.06E+00	1.69E+00	5.54E-01	1.09E-01	7.96E-02	1.46E-02	4.05E-03	1.36E-03	2.73E-05
10 6	1.23E+01	1.41E+01	1.14E+01	7.92E+00	2.20E+00	6.83E-01	7.90E-02	4.95E-02	6.90E-03	1.53E-03	4.27E-04	9.05E-06
10 7	1.82E+01	2.01E+01	1.51E+01	1.04E+01	3.29E+00	8.35E-01	4.98E-02	2.76E-02	2.55E-03	3.85E-04	1.51E-04	1.33E-06
10 8	2.84E+01	2.69E+01	2.14E+01	1.60E+01	4.26E+00	9.13E-01	2.33E-02	1.08E-02	9.03E-04	1.08E-04	1.08E-04	1.12E-05
10 9	3.13E+01	3.44E+01	3.36E+01	3.10E+01	4.41E+00	4.39E-01	6.23E-03	5.53E-03	2.45E-04	3.88E-04	3.79E-05	1.57E-05
11	2.81E+01	4.48E+01	5.55E+01	5.35E+01	1.98E+01	5.38E+00	7.96E-01	5.72E-01	1.15E-01	3.39E-02	1.25E-02	4.42E-04
11 0	1.91E-01	1.66E-01	2.27E-01	2.69E-01	2.03E-01	7.45E-02	1.85E-02	1.37E-02	2.96E-03	1.08E-03	4.24E-04	1.65E-05
11 1	5.40E-01	4.79E-01	7.86E-01	9.07E-01	5.75E-01	1.82E-01	6.19E-02	4.27E-02	9.61E-03	3.56E-03	1.30E-03	3.11E-05
11 2	8.19E-01	9.64E-01	1.28E+00	1.40E+00	9.52E-01	3.56E-01	9.38E-02	7.18E-02	1.69E-02	5.35E-03	2.10E-03	9.73E-05
11 3	1.12E+00	1.43E+00	2.11E+00	2.46E+00	1.22E+00	4.08E-01	1.31E-01	9.82E-02	2.35E-02	7.64E-03	3.04E-03	1.46E-04
11 4	1.48E+00	2.31E+00	2.86E+00	2.61E+00	1.49E+00	5.30E-01	1.51E-01	1.15E-01	2.76E-02	8.06E-03	3.05E-03	8.91E-05
11 5	1.74E+00	3.35E+00	3.84E+00	4.15E+00	1.78E+00	6.25E-01	1.40E-01	1.05E-01	1.96E-02	5.03E-03	1.71E-03	2.75E-05
11 6	2.17E+00	4.27E+00	5.05E+00	3.77E+00	1.97E+00	7.08E-01	9.78E-02	6.47E-02	9.20E-03	1.99E-03	5.21E-04	6.45E-06
11 7	3.29E+00	5.69E+00	5.30E+00	5.53E+00	2.52E+00	8.12E-01	5.99E-02	3.45E-02	3.21E-03	5.25E-04	1.33E-04	3.63E-06
11 8	4.77E+00	5.84E+00	7.10E+00	6.28E+00	3.33E+00	8.74E-01	2.81E-02	1.70E-02	1.37E-03	1.95E-04	1.11E-04	8.76E-07
11 9	5.71E+00	7.54E+00	8.34E+00	8.45E+00	3.72E+00	6.24E-01	1.16E-02	6.13E-03	4.72E-04	6.92E-05	9.61E-05	1.13E-05
11 10	6.25E+00	1.28E+01	1.86E+01	1.76E+01	2.08E+00	1.83E-01	2.85E-03	3.37E-03	1.03E-04	3.58E-04	2.84E-05	1.21E-05

A.5 $\mathbf{Ne^{q+} + H}(n = 1, 2)$

Table A.29 Ne^{10+} + H(1s)

Table A.30 Ne^{10+} + H(2s)

Table A.31 Ne^{10+} + H(2p0)

Table A.32 Ne^{10+} + H(2p1)

Table A.33 Ne^{10+} + H(2p-1)

Table A.34 Ne^{10+} + H(2p)

Table A.35 Ne^{10+} + H($n = 2$)

Table A.36 F^{9+} + H(1s) *

Table A.37 F^{9+} + H(2s) †

Table A.38 F^{9+} + H(2p0) †

Table A.39 F^{9+} + H(2p1) †

Table A.40 F^{9+} + H(2p-1) †

Table A.41 F^{9+} + H(2p) †

Table A.42 F^{9+} + H($n = 2$) †

Table A.43 O^{8+} + H(1s) *

Table A.44 O^{8+} + H(2s) †

Table A.45 O^{8+} + H(2p0) †

Table A.46 O^{8+} + H(2p1) †

Table A.47 O^{8+} + H(2p-1) †

Table A.48 O^{8+} + H(2p) †

Table A.49 O^{8+} + H($n = 2$) †

* Ionization cross sections need to be scaled according to (5.15). † Ionization cross sections need to be scaled according to (5.16).

Table A.29: Data for Ne^{10+} + H(1s)

	impact energies [kev/amu]							
	1.0	10.0	30.0	45.0	90.0	120.0	200.0	300.0
	total cross sections							
CX	8.62E+01	8.36E+01	6.90E+01	5.86E+01	2.22E+01	1.12E+01	1.95E+00	3.51E-01
ION	1.72E-02	5.04E-02	2.34E-01	1.21E+00	1.49E+01	2.35E+01	3.13E+01	3.01E+01
	state resolved CX cross sections							
n ℓ								
4	1.74E-04	2.75E-01	1.07E+00	1.17E+00	8.21E-01	5.97E-01	1.39E-01	3.58E-02
4 0	3.52E-05	3.21E-02	9.20E-02	7.77E-02	2.99E-02	1.37E-02	2.43E-03	4.41E-04
4 1	6.18E-05	8.31E-02	2.68E-01	2.51E-01	9.33E-02	5.70E-02	9.06E-03	2.32E-03
4 2	4.38E-05	8.98E-02	3.80E-01	4.25E-01	2.51E-01	1.39E-01	2.43E-02	3.87E-03
4 3	3.30E-05	6.97E-02	3.32E-01	4.18E-01	4.47E-01	3.87E-01	1.03E-01	2.92E-02
5	1.18E+00	1.10E+01	1.01E+01	6.85E+00	2.16E+00	1.16E+00	2.31E-01	4.85E-02
5 0	1.40E-01	3.85E-01	2.06E-01	9.99E-02	2.81E-02	1.35E-02	3.04E-03	4.71E-04
5 1	3.51E-01	1.45E+00	8.34E-01	4.49E-01	1.00E-01	5.22E-02	7.09E-03	1.72E-03
5 2	3.45E-01	2.71E+00	2.03E+00	1.12E+00	2.22E-01	1.06E-01	1.96E-02	3.22E-03
5 3	1.97E-01	3.31E+00	3.45E+00	2.32E+00	5.40E-01	2.57E-01	4.93E-02	1.64E-02
5 4	1.46E-01	3.13E+00	3.54E+00	2.87E+00	1.27E+00	7.32E-01	1.52E-01	2.67E-02
6	5.68E+01	4.33E+01	2.04E+01	1.21E+01	3.12E+00	1.49E+00	2.60E-01	4.89E-02
6 0	2.34E+00	4.79E-01	1.36E-01	8.25E-02	2.07E-02	8.83E-03	3.09E-03	3.54E-04
6 1	6.10E+00	1.58E+00	5.69E-01	3.25E-01	9.25E-02	4.61E-02	5.51E-03	1.06E-03
6 2	8.53E+00	3.94E+00	1.53E+00	8.09E-01	1.77E-01	7.62E-02	1.69E-02	2.35E-03
6 3	1.20E+01	9.04E+00	3.40E+00	1.65E+00	3.71E-01	1.72E-01	3.34E-02	1.03E-02
6 4	1.71E+01	1.35E+01	6.33E+00	3.19E+00	6.54E-01	3.71E-01	9.91E-02	2.23E-02
6 5	1.08E+01	1.47E+01	8.46E+00	6.08E+00	1.80E+00	8.11E-01	1.02E-01	1.25E-02
7	2.70E+01	2.48E+01	1.75E+01	1.20E+01	3.25E+00	1.51E+00	2.47E-01	4.26E-02
7 0	5.33E-01	9.60E-02	8.13E-02	5.96E-02	1.27E-02	6.52E-03	2.52E-03	2.59E-04
7 1	1.75E+00	3.67E-01	2.96E-01	2.08E-01	8.08E-02	3.52E-02	4.34E-03	9.43E-04
7 2	3.19E+00	1.16E+00	7.41E-01	5.43E-01	1.22E-01	5.54E-02	1.27E-02	1.62E-03
7 3	4.45E+00	2.01E+00	1.59E+00	9.66E-01	2.75E-01	1.32E-01	2.57E-02	7.42E-03
7 4	5.51E+00	4.26E+00	2.53E+00	1.56E+00	4.21E-01	2.39E-01	7.06E-02	1.54E-02
7 5	6.17E+00	7.76E+00	3.97E+00	2.47E+00	9.08E-01	5.17E-01	8.88E-02	1.29E-02
7 6	5.34E+00	9.18E+00	8.32E+00	6.24E+00	1.43E+00	5.23E-01	4.26E-02	4.06E-03
8	1.16E+00	3.59E+00	1.00E+01	9.11E+00	2.94E+00	1.36E+00	2.20E-01	3.59E-02
8 0	2.31E-02	1.32E-02	3.55E-02	3.76E-02	1.14E-02	5.85E-03	2.32E-03	1.85E-04
8 1	6.86E-02	5.47E-02	1.51E-01	1.35E-01	6.30E-02	2.33E-02	3.13E-03	1.02E-03
8 2	1.02E-01	1.26E-01	3.41E-01	3.31E-01	9.78E-02	4.69E-02	1.10E-02	1.17E-03
8 3	1.45E-01	1.94E-01	6.91E-01	5.75E-01	2.03E-01	8.69E-02	1.80E-02	6.26E-03
8 4	2.18E-01	4.94E-01	1.07E+00	8.66E-01	2.98E-01	1.76E-01	5.27E-02	1.11E-02
8 5	2.95E-01	6.49E-01	1.31E+00	1.22E+00	5.72E-01	3.39E-01	7.20E-02	1.02E-02
8 6	2.18E-01	9.22E-01	2.18E+00	2.18E+00	9.54E-01	4.51E-01	4.76E-02	4.91E-03
8 7	8.95E-02	1.14E+00	4.23E+00	3.77E+00	7.42E-01	2.28E-01	1.32E-02	1.02E-03
9	2.25E-02	4.29E-01	4.91E+00	6.20E+00	2.45E+00	1.19E+00	1.89E-01	3.08E-02
9 0	5.98E-04	3.61E-03	1.77E-02	2.22E-02	6.79E-03	4.68E-03	1.78E-03	1.38E-04
9 1	1.45E-03	1.21E-02	6.77E-02	8.77E-02	5.10E-02	2.19E-02	2.62E-03	1.01E-03
9 2	2.11E-03	1.95E-02	1.75E-01	1.99E-01	6.42E-02	3.38E-02	8.58E-03	9.88E-04
9 3	2.64E-03	4.00E-02	2.97E-01	3.42E-01	1.47E-01	7.67E-02	1.47E-02	5.40E-03
9 4	2.34E-03	4.55E-02	4.88E-01	5.01E-01	2.01E-01	1.19E-01	4.06E-02	9.24E-03
9 5	4.18E-03	6.10E-02	5.30E-01	6.74E-01	4.06E-01	2.71E-01	5.61E-02	8.02E-03
9 6	3.99E-03	7.34E-02	8.20E-01	1.09E+00	6.49E-01	3.40E-01	4.32E-02	4.26E-03
9 7	3.24E-03	6.73E-02	1.09E+00	1.73E+00	6.50E-01	2.41E-01	1.79E-02	1.47E-03
9 8	1.98E-03	1.07E-01	1.42E+00	1.56E+00	2.78E-01	7.81E-02	3.77E-03	2.57E-04
10	5.56E-03	1.21E-01	2.37E+00	4.06E+00	2.01E+00	1.01E+00	1.64E-01	2.68E-02
10 0	1.44E-04	1.53E-03	1.04E-02	1.47E-02	6.13E-03	4.09E-03	1.77E-03	1.18E-04
10 1	3.65E-04	4.10E-03	3.21E-02	5.81E-02	3.54E-02	1.68E-02	2.01E-03	8.57E-04
10 2	5.22E-04	7.62E-03	8.97E-02	1.29E-01	5.10E-02	2.72E-02	8.06E-03	8.83E-04
10 3	6.43E-04	1.00E-02	1.45E-01	2.12E-01	1.06E-01	5.82E-02	1.10E-02	4.29E-03
10 4	8.05E-04	1.30E-02	2.24E-01	3.11E-01	1.53E-01	9.49E-02	3.31E-02	8.19E-03
10 5	8.66E-04	1.45E-02	2.48E-01	3.93E-01	2.81E-01	1.97E-01	4.65E-02	6.87E-03
10 6	7.31E-04	1.75E-02	3.54E-01	6.06E-01	4.64E-01	2.74E-01	3.64E-02	3.54E-03
10 7	4.24E-04	1.23E-02	4.12E-01	9.17E-01	5.11E-01	2.21E-01	1.84E-02	1.52E-03
10 8	5.18E-04	1.44E-02	5.11E-01	9.51E-01	3.17E-01	9.35E-02	4.96E-03	4.69E-04
10 9	5.42E-04	2.64E-02	3.43E-01	4.72E-01	8.67E-02	2.46E-02	1.31E-03	7.38E-05
11	5.40E-03	5.59E-02	1.20E+00	2.75E+00	1.63E+00	8.58E-01	1.41E-01	2.36E-02
11 0	2.24E-04	8.86E-04	6.16E-03	1.10E-02	5.93E-03	3.42E-03	1.41E-03	1.15E-04
11 1	3.01E-04	2.56E-03	1.90E-02	3.96E-02	2.73E-02	1.40E-02	1.69E-03	6.77E-04
11 2	2.46E-04	4.14E-03	4.70E-02	9.22E-02	4.25E-02	2.08E-02	6.55E-03	7.92E-04
11 3	4.08E-04	5.31E-03	8.22E-02	1.37E-01	8.04E-02	4.53E-02	9.43E-03	3.20E-03
11 4	4.78E-04	5.67E-03	1.08E-01	2.09E-01	1.16E-01	7.46E-02	2.65E-02	7.18E-03
11 5	4.10E-04	5.44E-03	1.35E-01	2.51E-01	2.16E-01	1.60E-01	3.78E-02	6.28E-03
11 6	5.29E-04	6.57E-03	1.68E-01	3.68E-01	3.40E-01	2.14E-01	3.17E-02	3.17E-03
11 7	5.31E-04	6.37E-03	1.87E-01	5.44E-01	3.83E-01	1.89E-01	1.74E-02	1.42E-03
11 8	6.17E-04	5.35E-03	2.14E-01	5.82E-01	2.77E-01	9.72E-02	6.09E-03	5.62E-04
11 9	7.10E-04	4.61E-03	1.67E-01	3.93E-01	1.16E-01	2.94E-02	1.30E-03	1.99E-04
11 10	9.44E-04	8.96E-03	6.59E-02	1.20E-01	2.74E-02	9.49E-03	7.77E-04	2.48E-05

Table continues on next page.

Data for Ne^{10+} + H(1s) (cont.)

	impact energies [kev/amu]							
	1.0	10.0	30.0	45.0	90.0	120.0	200.0	300.0
	state resolved CX cross sections							
n ℓ								
12	1.24E-02	3.34E-02	6.53E-01	1.86E+00	1.35E+00	7.30E-01	1.27E-01	2.10E-02
12 0	4.49E-04	4.39E-04	3.90E-03	9.16E-03	6.79E-03	3.41E-03	1.69E-03	1.54E-04
12 1	2.99E-04	1.36E-03	1.40E-02	2.84E-02	2.29E-02	1.05E-02	1.54E-03	5.96E-04
12 2	4.43E-04	2.28E-03	2.69E-02	6.89E-02	3.92E-02	1.74E-02	6.69E-03	7.33E-04
12 3	8.00E-04	2.54E-03	5.19E-02	9.11E-02	6.48E-02	3.30E-02	7.77E-03	2.40E-03
12 4	5.71E-04	2.59E-03	5.88E-02	1.46E-01	9.38E-02	6.09E-02	2.34E-02	6.10E-03
12 5	8.96E-04	3.46E-03	8.15E-02	1.66E-01	1.67E-01	1.20E-01	3.39E-02	5.73E-03
12 6	7.38E-04	3.47E-03	8.68E-02	2.42E-01	2.63E-01	1.76E-01	2.71E-02	2.97E-03
12 7	9.48E-04	3.93E-03	9.57E-02	3.34E-01	3.00E-01	1.65E-01	1.57E-02	1.30E-03
12 8	1.17E-03	3.14E-03	1.01E-01	3.63E-01	2.32E-01	9.38E-02	6.10E-03	5.88E-04
12 9	1.39E-03	3.96E-03	7.88E-02	2.67E-01	1.16E-01	3.54E-02	1.77E-03	3.17E-04
12 10	2.15E-03	2.35E-03	4.19E-02	1.19E-01	3.65E-02	8.80E-03	4.18E-04	8.29E-05
12 11	2.57E-03	3.85E-03	1.19E-02	2.67E-02	1.21E-02	5.50E-03	6.92E-04	1.00E-05
13	1.88E-02	2.03E-02	3.88E-01	1.32E+00	1.18E+00	6.58E-01	1.16E-01	1.93E-02
13 0	2.85E-04	3.47E-04	2.60E-03	6.87E-03	8.10E-03	5.15E-03	2.63E-03	4.49E-04
13 1	8.19E-04	7.93E-04	1.06E-02	2.36E-02	2.38E-02	1.11E-02	1.39E-03	6.33E-04
13 2	1.42E-03	1.37E-03	1.78E-02	5.28E-02	4.08E-02	1.81E-02	5.72E-03	7.07E-04
13 3	1.99E-03	1.43E-03	3.49E-02	7.15E-02	5.91E-02	3.24E-02	7.29E-03	2.01E-03
13 4	1.17E-03	1.55E-03	3.73E-02	1.06E-01	8.27E-02	5.34E-02	1.94E-02	5.22E-03
13 5	1.78E-03	1.90E-03	5.24E-02	1.27E-01	1.39E-01	1.07E-01	2.95E-02	5.06E-03
13 6	1.12E-03	2.00E-03	5.20E-02	1.65E-01	2.13E-01	1.45E-01	2.55E-02	2.83E-03
13 7	1.28E-03	2.12E-03	5.41E-02	2.26E-01	2.41E-01	1.37E-01	1.47E-02	1.21E-03
13 8	1.15E-03	2.01E-03	5.33E-02	2.32E-01	1.99E-01	9.05E-02	6.23E-03	5.96E-04
13 9	9.29E-04	1.65E-03	3.96E-02	1.80E-01	1.11E-01	3.90E-02	1.83E-03	3.96E-04
13 10	1.85E-03	1.84E-03	2.26E-02	9.47E-02	4.25E-02	1.15E-02	5.91E-04	1.66E-04
13 11	2.26E-03	1.79E-03	8.21E-03	3.16E-02	1.35E-02	4.03E-03	2.07E-04	3.97E-05
13 12	2.71E-03	1.55E-03	3.05E-03	7.15E-03	6.83E-03	3.68E-03	7.05E-04	3.76E-06
14	2.31E-02	1.35E-02	3.31E-01	1.12E+00	1.25E+00	6.37E-01	1.16E-01	1.83E-02
14 0	4.35E-04	3.01E-04	4.62E-03	1.07E-02	1.68E-02	1.01E-02	3.14E-03	1.69E-04
14 1	3.27E-03	6.06E-04	1.52E-02	3.03E-02	4.69E-02	1.72E-02	2.43E-03	1.55E-03
14 2	7.67E-04	1.04E-03	2.31E-02	5.66E-02	6.54E-02	1.28E-02	6.97E-03	1.28E-03
14 3	2.21E-03	1.07E-03	3.55E-02	7.98E-02	8.85E-02	2.95E-02	9.97E-03	1.90E-03
14 4	8.39E-04	1.09E-03	3.98E-02	1.08E-01	1.07E-01	4.62E-02	1.99E-02	4.52E-03
14 5	1.71E-03	1.18E-03	4.73E-02	1.19E-01	1.51E-01	8.96E-02	2.65E-02	3.64E-03
14 6	1.08E-03	1.20E-03	4.36E-02	1.41E-01	1.96E-01	1.45E-01	2.44E-02	2.70E-03
14 7	1.13E-03	1.31E-03	4.03E-02	1.65E-01	2.16E-01	1.32E-01	1.35E-02	1.11E-03
14 8	1.09E-03	1.13E-03	3.40E-02	1.67E-01	1.78E-01	8.46E-02	5.90E-03	6.25E-04
14 9	1.34E-03	8.68E-04	2.42E-02	1.28E-01	1.07E-01	4.17E-02	1.96E-03	4.43E-04
14 10	1.48E-03	1.15E-03	1.38E-02	7.33E-02	4.67E-02	1.57E-02	5.81E-04	2.77E-04
14 11	1.81E-03	7.04E-04	6.19E-03	3.12E-02	1.40E-02	5.29E-03	2.63E-04	9.52E-05
14 12	3.60E-03	1.11E-03	2.23E-03	8.91E-03	7.50E-03	3.95E-03	1.29E-04	1.80E-05
14 13	2.31E-03	7.76E-04	1.34E-03	3.40E-03	4.25E-03	2.42E-03	6.80E-04	1.34E-06

Table A.30: Data for Ne^{10+} + H(2s)

	impact energies [kev/amu]							
	1.0	10.0	30.0	45.0	90.0	120.0	200.0	300.0
	total cross sections							
CX	9.60E+02	5.48E+02	1.40E+02	6.14E+01	7.31E+00	3.16E+00	4.41E-01	1.27E-01
ION	1.11E+00	4.54E+00	3.15E+01	7.20E+01	1.21E+02	1.29E+02	1.23E+02	1.06E+02
	state resolved CX cross sections							
n ℓ								
4	3.88E-03	2.82E-03	8.25E-03	3.32E-02	8.80E-02	7.49E-02	3.55E-02	6.49E-03
4 0	7.16E-04	1.46E-04	2.03E-04	2.53E-03	3.16E-03	5.10E-03	5.23E-04	2.01E-04
4 1	1.04E-03	7.77E-04	7.77E-04	5.74E-03	1.44E-02	1.82E-02	2.25E-03	1.23E-03
4 2	9.03E-04	9.29E-04	2.16E-03	7.95E-03	2.83E-02	2.09E-02	1.06E-02	1.33E-03
4 3	1.22E-03	9.69E-04	5.11E-03	1.70E-02	4.21E-02	3.08E-02	2.22E-02	3.73E-03
5	1.79E-02	1.73E-03	1.17E-01	3.20E-01	1.78E-01	8.86E-02	1.75E-02	5.50E-03
5 0	3.94E-03	1.67E-04	1.61E-02	1.36E-02	1.42E-03	1.02E-03	4.36E-04	2.21E-04
5 1	6.57E-03	2.93E-04	3.39E-02	5.58E-02	9.81E-03	5.27E-03	1.18E-03	1.00E-03
5 2	4.40E-03	4.47E-04	3.29E-02	1.03E-01	2.82E-02	1.00E-02	4.00E-03	1.04E-03
5 3	1.79E-03	4.59E-04	2.27E-02	9.89E-02	5.62E-02	2.31E-02	4.64E-03	2.09E-03
5 4	1.19E-03	3.67E-04	1.18E-02	4.79E-02	8.24E-02	4.92E-02	7.28E-03	1.14E-03
6	6.16E-02	7.67E-02	1.81E+00	1.62E+00	3.32E-01	1.40E-01	1.58E-02	6.89E-03
6 0	1.49E-02	6.79E-03	5.69E-02	1.89E-02	1.56E-03	1.28E-03	3.78E-04	2.38E-04
6 1	1.94E-02	1.77E-02	1.93E-01	9.41E-02	7.14E-03	5.95E-03	9.11E-04	1.02E-03
6 2	1.41E-02	2.07E-02	4.01E-01	2.17E-01	1.91E-02	1.21E-02	2.64E-03	1.02E-03
6 3	5.83E-03	1.62E-02	5.20E-01	3.67E-01	3.44E-02	2.04E-02	2.69E-03	2.01E-03
6 4	4.01E-03	9.74E-03	4.28E-01	4.81E-01	8.58E-02	2.84E-02	5.51E-03	9.83E-04
6 5	3.41E-03	5.57E-03	2.08E-01	4.39E-01	1.84E-01	7.18E-02	3.68E-03	1.62E-03
7	9.20E-02	2.05E+00	6.40E+00	3.39E+00	4.79E-01	1.77E-01	2.04E-02	8.15E-03
7 0	5.60E-03	1.31E-01	7.75E-02	3.20E-02	3.55E-03	1.85E-03	4.52E-04	2.25E-04
7 1	1.88E-02	3.59E-01	2.71E-01	1.28E-01	1.02E-02	7.42E-03	1.19E-03	9.01E-04
7 2	2.08E-02	4.79E-01	5.94E-01	2.41E-01	2.10E-02	1.33E-02	2.93E-03	8.87E-04
7 3	1.78E-02	4.48E-01	1.03E+00	3.72E-01	3.53E-02	2.19E-02	2.92E-03	1.86E-03
7 4	1.53E-02	3.14E-01	1.56E+00	6.50E-01	6.22E-02	2.71E-02	5.82E-03	1.20E-03
7 5	7.13E-03	1.95E-01	1.61E+00	1.01E+00	9.28E-02	4.42E-02	4.35E-03	1.78E-03
7 6	6.56E-03	1.26E-01	1.25E+00	9.61E-01	2.54E-01	6.10E-02	2.74E-03	1.30E-03
8	6.45E-01	2.00E+01	1.11E+01	4.89E+00	6.06E-01	2.09E-01	2.43E-02	8.68E-03
8 0	7.87E-03	6.26E-01	9.20E-02	4.58E-02	5.18E-03	2.08E-03	5.28E-04	1.90E-04
8 1	3.09E-02	2.11E+00	3.32E-01	1.36E-01	9.92E-03	8.92E-03	1.50E-03	7.50E-04
8 2	7.05E-02	3.55E+00	6.00E-01	2.58E-01	2.67E-02	1.37E-02	3.10E-03	7.97E-04
8 3	1.06E-01	4.27E+00	1.04E+00	3.91E-01	3.48E-02	1.92E-02	3.26E-03	1.78E-03
8 4	8.33E-02	3.87E+00	1.60E+00	5.58E-01	5.46E-02	2.61E-02	5.92E-03	1.46E-03
8 5	1.63E-01	2.69E+00	2.32E+00	8.21E-01	9.93E-02	4.48E-02	4.46E-03	1.64E-03
8 6	9.20E-02	1.67E+00	2.92E+00	1.24E+00	1.34E-01	5.56E-02	3.77E-03	1.59E-03
8 7	9.10E-02	1.19E+00	2.23E+00	1.44E+00	2.42E-01	3.82E-02	1.80E-03	4.67E-04
9	1.33E+01	6.13E+01	1.51E+01	6.08E+00	6.94E-01	2.62E-01	3.02E-02	9.35E-03
9 0	2.84E-01	6.55E-01	1.07E-01	4.99E-02	5.84E-03	4.08E-03	7.93E-04	1.71E-04
9 1	6.98E-01	2.28E+00	3.70E-01	1.14E-01	1.68E-02	1.49E-02	2.16E-03	7.30E-04
9 2	7.81E-01	4.60E+00	6.13E-01	2.65E-01	3.14E-02	2.19E-02	3.98E-03	8.44E-04
9 3	8.88E-01	8.06E+00	1.08E+00	3.31E-01	3.49E-02	2.90E-02	4.27E-03	1.92E-03
9 4	1.25E+00	1.17E+01	1.37E+00	4.88E-01	5.50E-02	3.57E-02	6.84E-03	1.79E-03
9 5	1.51E+00	1.26E+01	1.92E+00	6.97E-01	7.90E-02	4.34E-02	5.16E-03	1.65E-03
9 6	2.86E+00	9.52E+00	2.84E+00	7.87E-01	1.26E-01	4.22E-02	3.64E-03	1.47E-03
9 7	3.79E+00	6.52E+00	3.84E+00	1.26E+00	1.65E-01	4.71E-02	2.14E-03	6.50E-04
9 8	1.24E+00	5.42E+00	2.97E+00	2.09E+00	1.81E-01	2.42E-02	1.26E-03	1.16E-04
10	1.06E+02	8.29E+01	1.85E+01	7.25E+00	7.71E-01	2.98E-01	3.42E-02	1.09E-02
10 0	1.17E+00	5.40E-01	1.01E-01	5.07E-02	6.47E-03	4.58E-03	1.01E-03	1.62E-04
10 1	3.91E+00	1.90E+00	4.00E-01	1.11E-01	1.87E-02	1.54E-02	2.68E-03	7.97E-04
10 2	7.70E+00	4.06E+00	6.02E-01	2.71E-01	3.32E-02	2.38E-02	4.68E-03	9.26E-04
10 3	1.03E+01	7.00E+00	1.07E+00	3.19E-01	3.71E-02	3.11E-02	4.96E-03	2.17E-03
10 4	8.18E+00	1.10E+01	1.23E+00	5.15E-01	5.38E-02	4.23E-02	7.32E-03	2.26E-03
10 5	8.23E+00	1.36E+01	1.69E+00	6.10E-01	8.18E-02	5.19E-02	5.59E-03	2.03E-03
10 6	1.09E+01	1.37E+01	2.09E+00	6.73E-01	1.22E-01	4.62E-02	4.04E-03	1.56E-03
10 7	1.65E+01	1.03E+01	2.49E+00	1.03E+00	1.26E-01	3.84E-02	2.12E-03	7.09E-04
10 8	2.77E+01	8.04E+00	4.56E+00	1.08E+00	1.73E-01	2.90E-02	7.30E-04	1.95E-04
10 9	1.18E+01	1.28E+01	4.27E+00	2.58E+00	1.19E-01	1.49E-02	1.10E-03	4.77E-05
11	3.52E+02	1.02E+02	2.09E+01	8.36E+00	8.42E-01	3.34E-01	4.36E-02	1.32E-02
11 0	2.56E+00	4.06E-01	1.07E-01	6.23E-02	9.64E-03	6.79E-03	1.41E-03	1.56E-04
11 1	7.65E+00	1.45E+00	4.19E-01	1.27E-01	2.42E-02	2.09E-02	3.72E-03	8.96E-04
11 2	1.30E+01	3.07E+00	5.99E-01	3.16E-01	4.53E-02	3.26E-02	6.31E-03	1.02E-03
11 3	2.13E+01	5.21E+00	1.07E+00	3.11E-01	4.53E-02	3.79E-02	6.82E-03	2.45E-03
11 4	3.54E+01	7.88E+00	1.17E+00	5.32E-01	6.11E-02	4.61E-02	9.32E-03	2.86E-03
11 5	4.29E+01	9.77E+00	1.54E+00	5.44E-01	8.00E-02	4.72E-02	7.07E-03	2.64E-03
11 6	4.07E+01	1.27E+01	1.90E+00	6.00E-01	1.12E-01	4.74E-02	4.56E-03	1.93E-03
11 7	3.40E+01	1.43E+01	1.92E+00	9.43E-01	1.12E-01	3.81E-02	2.11E-03	8.31E-04
11 8	3.21E+01	1.07E+01	3.10E+00	1.12E+00	1.44E-01	3.03E-02	9.16E-04	2.63E-04
11 9	5.88E+01	9.97E+00	3.71E+00	1.18E+00	1.42E-01	1.71E-02	3.58E-04	1.27E-04
11 10	6.34E+01	2.61E+01	5.33E+00	2.63E+00	6.63E-02	9.59E-03	9.53E-04	2.26E-05

Table continues on next page.

Data for Ne^{10+} + H(2s) (cont.)

	impact energies [kev/amu]							
	1.0	10.0	30.0	45.0	90.0	120.0	200.0	300.0
	state resolved CX cross sections							
n ℓ								
12	3.13E+02	1.12E+02	2.21E+01	9.18E+00	9.00E-01	3.86E-01	5.22E-02	1.59E-02
12 0	1.63E+00	3.52E-01	1.19E-01	8.09E-02	1.09E-02	7.76E-03	1.66E-03	1.62E-04
12 1	5.54E+00	1.18E+00	4.61E-01	1.20E-01	2.46E-02	2.24E-02	4.40E-03	1.01E-03
12 2	8.86E+00	2.25E+00	6.39E-01	3.75E-01	4.90E-02	3.71E-02	7.52E-03	1.17E-03
12 3	1.21E+01	3.90E+00	1.02E+00	3.13E-01	5.11E-02	4.42E-02	8.12E-03	2.74E-03
12 4	1.55E+01	5.80E+00	1.18E+00	6.05E-01	6.85E-02	5.66E-02	1.09E-02	3.47E-03
12 5	2.32E+01	6.63E+00	1.35E+00	5.71E-01	8.97E-02	5.82E-02	8.66E-03	3.24E-03
12 6	3.27E+01	8.51E+00	1.73E+00	6.44E-01	1.17E-01	5.67E-02	5.69E-03	2.36E-03
12 7	3.74E+01	9.45E+00	1.73E+00	8.76E-01	9.78E-02	3.67E-02	2.58E-03	1.07E-03
12 8	3.50E+01	1.04E+01	2.35E+00	1.12E+00	1.14E-01	2.91E-02	9.19E-04	3.73E-04
12 9	3.37E+01	1.25E+01	3.60E+00	8.90E-01	1.46E-01	2.03E-02	5.20E-04	2.11E-04
12 10	4.87E+01	1.03E+01	2.62E+00	1.59E+00	9.97E-02	9.63E-03	4.44E-04	7.56E-05
12 11	5.86E+01	4.06E+01	5.34E+00	1.99E+00	3.19E-02	7.40E-03	8.25E-04	9.54E-06
13	1.37E+02	9.67E+01	2.16E+01	9.51E+00	1.01E+00	4.33E-01	6.89E-02	1.88E-02
13 0	5.19E-01	2.93E-01	1.42E-01	9.11E-02	1.37E-02	1.09E-02	2.20E-03	1.43E-04
13 1	2.05E+00	9.19E-01	5.19E-01	1.62E-01	2.99E-02	3.14E-02	6.58E-03	1.15E-03
13 2	3.29E+00	1.69E+00	7.45E-01	4.14E-01	5.74E-02	4.86E-02	1.10E-02	1.58E-03
13 3	3.33E+00	2.91E+00	1.05E+00	3.70E-01	6.64E-02	5.13E-02	1.12E-02	3.10E-03
13 4	3.19E+00	4.31E+00	1.24E+00	5.73E-01	7.98E-02	5.74E-02	1.40E-02	3.85E-03
13 5	3.71E+00	4.66E+00	1.25E+00	5.47E-01	1.02E-01	5.39E-02	1.11E-02	3.73E-03
13 6	4.78E+00	5.93E+00	1.57E+00	5.95E-01	1.28E-01	5.57E-02	6.83E-03	2.84E-03
13 7	7.61E+00	6.04E+00	1.52E+00	8.07E-01	1.12E-01	4.21E-02	2.89E-03	1.39E-03
13 8	1.02E+01	6.80E+00	1.79E+00	1.28E+00	9.23E-02	3.48E-02	9.44E-04	5.32E-04
13 9	1.42E+01	7.18E+00	2.95E+00	8.55E-01	1.33E-01	2.43E-02	3.78E-04	2.91E-04
13 10	1.98E+01	9.22E+00	2.70E+00	9.99E-01	1.17E-01	1.08E-02	5.05E-04	1.50E-04
13 11	2.62E+01	1.14E+01	2.30E+00	1.65E+00	6.02E-02	5.73E-03	4.01E-04	3.72E-05
13 12	3.83E+01	3.54E+01	3.85E+00	1.17E+00	1.50E-02	5.78E-03	8.47E-04	3.52E-06
14	3.77E+01	7.16E+01	2.20E+01	1.08E+01	1.41E+00	7.61E-01	9.83E-02	2.32E-02
14 0	2.17E-01	2.31E-01	2.83E-01	1.32E-01	3.51E-02	3.39E-02	3.85E-03	3.22E-04
14 1	1.72E+00	8.26E-01	7.13E-01	3.26E-01	6.23E-02	7.61E-02	9.96E-03	1.67E-03
14 2	8.31E-01	1.21E+00	1.17E+00	5.54E-01	1.11E-01	1.04E-01	1.68E-02	2.43E-03
14 3	2.78E+00	2.15E+00	1.49E+00	6.54E-01	1.33E-01	1.12E-01	1.54E-02	3.62E-03
14 4	9.88E-01	2.67E+00	1.69E+00	7.55E-01	1.41E-01	1.22E-01	1.79E-02	4.42E-03
14 5	1.54E+00	3.49E+00	1.53E+00	8.10E-01	1.59E-01	1.01E-01	1.61E-02	4.04E-03
14 6	1.17E+00	3.69E+00	1.67E+00	7.67E-01	1.58E-01	7.16E-02	1.05E-02	3.42E-03
14 7	1.11E+00	4.30E+00	1.67E+00	8.38E-01	1.39E-01	4.06E-02	4.45E-03	1.82E-03
14 8	1.61E+00	4.00E+00	1.40E+00	1.17E+00	1.02E-01	3.29E-02	1.19E-03	7.27E-04
14 9	2.12E+00	4.67E+00	2.18E+00	9.89E-01	1.23E-01	3.07E-02	4.63E-04	3.73E-04
14 10	2.65E+00	4.34E+00	2.44E+00	8.74E-01	1.33E-01	1.96E-02	3.90E-04	2.47E-04
14 11	4.29E+00	6.68E+00	1.87E+00	1.16E+00	7.71E-02	6.91E-03	3.50E-04	8.61E-05
14 12	5.40E+00	8.40E+00	1.90E+00	1.21E+00	3.28E-02	4.87E-03	2.19E-04	1.61E-05
14 13	1.13E+01	2.50E+01	1.96E+00	5.56E-01	8.32E-03	4.12E-03	8.61E-04	1.23E-06

Table A.31: Data for Ne^{10+} + H(2p0)

	impact energies [kev/amu]							
	1.0	10.0	30.0	45.0	90.0	120.0	200.0	300.0
	total cross sections							
CX	9.30E+02	5.73E+02	8.34E+01	2.54E+01	4.83E+00	2.59E+00	5.11E-01	1.13E-01
ION	1.86E+00	5.72E+00	3.35E+01	5.00E+01	5.93E+01	6.86E+01	7.69E+01	7.40E+01
	state resolved CX cross sections							
n ℓ								
4	1.20E-02	1.44E-03	2.12E-02	2.08E-02	4.38E-02	2.21E-02	2.13E-02	1.45E-02
4 0	1.13E-03	5.62E-05	1.86E-03	1.33E-03	1.38E-03	8.43E-04	1.95E-04	7.51E-05
4 1	3.59E-03	3.50E-04	5.55E-03	3.09E-03	2.97E-03	3.45E-03	1.18E-03	4.15E-04
4 2	3.63E-03	4.05E-04	6.45E-03	6.70E-03	1.49E-02	7.22E-03	4.71E-03	1.86E-03
4 3	3.69E-03	6.31E-04	7.30E-03	9.69E-03	2.46E-02	1.06E-02	1.53E-02	1.22E-02
5	1.12E-01	1.48E-02	1.25E-01	1.78E-01	1.37E-01	7.93E-02	2.50E-02	1.09E-02
5 0	1.39E-02	3.34E-04	4.10E-03	7.79E-03	3.13E-03	1.70E-03	2.69E-04	1.00E-04
5 1	3.32E-02	1.38E-03	1.10E-02	1.76E-02	8.11E-03	6.93E-03	2.38E-03	4.02E-04
5 2	2.86E-02	3.06E-03	2.58E-02	3.34E-02	3.19E-02	9.20E-03	3.01E-03	1.01E-03
5 3	1.59E-02	4.88E-03	4.00E-02	6.88E-02	4.20E-02	3.01E-02	6.02E-03	3.88E-03
5 4	2.00E-02	5.13E-03	4.45E-02	5.08E-02	5.23E-02	3.14E-02	1.34E-02	5.46E-03
6	4.59E-01	2.66E-01	5.78E-01	7.75E-01	2.62E-01	1.57E-01	3.57E-02	1.02E-02
6 0	3.04E-02	1.05E-02	2.72E-02	1.27E-02	4.55E-03	1.57E-03	2.70E-04	6.11E-05
6 1	1.03E-01	2.92E-02	5.42E-02	4.45E-02	8.80E-03	7.23E-03	2.30E-03	3.29E-04
6 2	1.20E-01	4.65E-02	8.02E-02	1.11E-01	2.76E-02	1.03E-02	2.54E-03	5.41E-04
6 3	8.58E-02	6.12E-02	8.82E-02	1.64E-01	3.35E-02	2.79E-02	6.32E-03	2.04E-03
6 4	6.78E-02	6.76E-02	1.46E-01	1.54E-01	9.47E-02	2.81E-02	7.20E-03	4.46E-03
6 5	5.22E-02	5.15E-02	1.82E-01	2.89E-01	9.31E-02	8.20E-02	1.71E-02	2.74E-03
7	6.92E-01	2.58E+00	2.12E+00	1.56E+00	3.83E-01	2.12E-01	4.24E-02	1.01E-02
7 0	2.79E-02	7.71E-02	2.27E-02	1.33E-02	4.51E-03	2.34E-03	2.17E-04	5.54E-05
7 1	8.92E-02	2.10E-01	7.34E-02	3.80E-02	1.31E-02	8.60E-03	1.82E-03	3.76E-04
7 2	1.30E-01	2.73E-01	1.99E-01	9.03E-02	3.27E-02	1.23E-02	2.28E-03	4.52E-04
7 3	1.21E-01	3.37E-01	3.50E-01	1.83E-01	3.32E-02	2.30E-02	6.22E-03	1.68E-03
7 4	1.52E-01	4.94E-01	4.49E-01	2.88E-01	8.88E-02	3.23E-02	5.98E-03	3.29E-03
7 5	1.15E-01	6.30E-01	4.44E-01	4.51E-01	5.15E-02	2.64E-02	1.50E-02	3.02E-03
7 6	5.71E-02	5.56E-01	5.77E-01	4.99E-01	1.59E-01	1.07E-01	1.09E-02	1.23E-03
8	1.34E+00	1.21E+01	4.04E+00	2.05E+00	3.83E-01	2.30E-01	4.56E-02	9.81E-03
8 0	3.84E-02	2.32E-01	2.31E-02	1.17E-02	3.26E-03	2.31E-03	1.15E-04	4.69E-05
8 1	9.54E-02	6.79E-01	5.69E-02	3.25E-02	8.73E-03	8.47E-03	1.32E-03	3.21E-04
8 2	1.44E-01	1.01E+00	1.23E-01	5.94E-02	2.07E-02	1.29E-02	1.72E-03	3.94E-04
8 3	2.43E-01	1.12E+00	2.13E-01	1.20E-01	2.47E-02	2.14E-02	5.25E-03	1.41E-03
8 4	2.51E-01	1.36E+00	4.39E-01	1.70E-01	5.11E-02	3.08E-02	5.42E-03	2.60E-03
8 5	1.52E-01	2.15E+00	7.58E-01	2.95E-01	4.47E-02	1.96E-02	1.38E-02	2.81E-03
8 6	1.85E-01	3.00E+00	1.12E+00	5.62E-01	6.99E-02	5.65E-02	1.33E-02	1.81E-03
8 7	2.33E-01	2.53E+00	1.30E+00	8.03E-01	1.60E-01	7.85E-02	4.64E-03	4.18E-04
9	1.89E+01	3.11E+01	5.97E+00	2.24E+00	3.95E-01	2.39E-01	4.89E-02	9.34E-03
9 0	1.54E-01	1.70E-01	3.10E-02	9.46E-03	2.30E-03	1.98E-03	1.18E-04	2.76E-05
9 1	5.79E-01	6.14E-01	6.36E-02	2.79E-02	7.50E-03	6.75E-03	1.39E-03	2.14E-04
9 2	1.35E+00	1.41E+00	1.40E-01	5.55E-02	1.66E-02	1.07E-02	1.53E-03	3.19E-04
9 3	1.78E+00	2.58E+00	1.81E-01	8.94E-02	2.51E-02	1.72E-02	5.04E-03	1.17E-03
9 4	2.94E+00	3.93E+00	3.62E-01	1.34E-01	4.97E-02	2.95E-02	4.96E-03	2.24E-03
9 5	2.84E+00	4.78E+00	4.72E-01	1.97E-01	4.38E-02	1.76E-02	1.21E-02	2.69E-03
9 6	2.16E+00	5.22E+00	7.32E-01	2.95E-01	4.34E-02	4.98E-02	1.46E-02	1.86E-03
9 7	2.89E+00	6.22E+00	1.35E+00	4.69E-01	1.04E-01	6.78E-02	7.11E-03	6.97E-04
9 8	4.26E+00	6.12E+00	2.65E+00	9.58E-01	1.03E-01	3.73E-02	2.10E-03	1.30E-04
10	1.01E+02	6.72E+01	8.41E+00	2.65E+00	4.18E-01	2.36E-01	5.00E-02	8.93E-03
10 0	6.83E-01	1.68E-01	3.63E-02	1.53E-02	1.97E-03	1.97E-03	1.34E-04	1.94E-05
10 1	2.78E+00	5.38E-01	9.03E-02	3.38E-02	8.03E-03	6.00E-03	1.21E-03	1.73E-04
10 2	5.43E+00	1.15E+00	1.81E-01	8.28E-02	1.63E-02	1.05E-02	1.49E-03	2.76E-04
10 3	1.03E+01	2.37E+00	2.46E-01	1.10E-01	2.58E-02	1.56E-02	4.48E-03	9.88E-04
10 4	1.32E+01	4.32E+00	4.39E-01	1.72E-01	4.67E-02	2.48E-02	4.73E-03	1.92E-03
10 5	1.29E+01	8.32E+00	5.42E-01	2.34E-01	4.13E-02	1.49E-02	1.09E-02	2.53E-03
10 6	1.48E+01	1.31E+01	7.91E-01	2.79E-01	3.98E-02	3.22E-02	1.48E-02	1.82E-03
10 7	1.26E+01	1.47E+01	1.14E+00	3.50E-01	8.49E-02	6.13E-02	8.33E-03	8.98E-04
10 8	9.30E+00	1.31E+01	1.30E+00	6.39E-01	9.93E-02	5.17E-02	2.69E-03	2.60E-04
10 9	1.88E+01	9.48E+00	3.64E+00	7.32E-01	5.41E-02	1.74E-02	1.26E-03	4.15E-05
11	3.00E+02	1.14E+02	1.12E+01	3.24E+00	4.65E-01	2.50E-01	5.31E-02	8.73E-03
11 0	1.41E+00	2.15E-01	3.23E-02	1.98E-02	2.15E-03	2.39E-03	1.90E-04	2.00E-05
11 1	5.03E+00	9.80E-01	1.20E-01	3.61E-02	1.09E-02	7.41E-03	1.48E-03	1.83E-04
11 2	1.09E+01	1.60E+00	1.80E-01	1.04E-01	1.82E-02	1.24E-02	1.63E-03	2.47E-04
11 3	1.60E+01	3.43E+00	3.11E-01	1.15E-01	3.14E-02	1.91E-02	4.66E-03	8.48E-04
11 4	1.95E+01	5.43E+00	4.57E-01	2.03E-01	4.80E-02	2.66E-02	4.86E-03	1.63E-03
11 5	2.12E+01	8.49E+00	6.59E-01	2.49E-01	4.75E-02	1.85E-02	9.75E-03	2.34E-03
11 6	3.07E+01	1.39E+01	8.42E-01	3.40E-01	4.21E-02	2.87E-02	1.51E-02	1.88E-03
11 7	3.58E+01	1.57E+01	1.26E+00	3.59E-01	7.80E-02	5.33E-02	1.00E-02	1.06E-03
11 8	4.15E+01	2.17E+01	1.36E+00	6.01E-01	9.27E-02	4.78E-02	3.78E-03	3.61E-04
11 9	5.70E+01	2.56E+01	2.43E+00	6.39E-01	6.36E-02	2.30E-02	9.42E-04	1.24E-04
11 10	6.09E+01	1.71E+01	3.52E+00	5.76E-01	3.02E-02	1.13E-02	7.66E-04	1.82E-05

Table continues on next page.

Data for Ne^{10+} + H(2p0) (cont.)

n ℓ	1.0	10.0	30.0	45.0	90.0	120.0	200.0	300.0
	impact energies [kev/amu]							
	state resolved CX cross sections							
12	3.41E+02	1.42E+02	1.45E+01	3.75E+00	5.48E-01	2.65E-01	5.47E-02	8.93E-03
12 0	1.04E+00	2.78E-01	3.57E-02	2.93E-02	3.42E-03	2.81E-03	1.75E-04	2.99E-05
12 1	3.52E+00	9.91E-01	1.59E-01	4.81E-02	1.53E-02	8.08E-03	1.27E-03	2.26E-04
12 2	5.56E+00	2.04E+00	2.32E-01	1.34E-01	2.55E-02	1.41E-02	1.71E-03	2.78E-04
12 3	7.92E+00	3.38E+00	4.03E-01	1.27E-01	4.08E-02	2.00E-02	4.36E-03	8.07E-04
12 4	1.07E+01	5.95E+00	5.61E-01	2.25E-01	5.59E-02	2.68E-02	5.18E-03	1.50E-03
12 5	1.47E+01	7.03E+00	7.49E-01	2.33E-01	5.97E-02	2.10E-02	9.10E-03	2.20E-03
12 6	2.22E+01	1.23E+01	9.16E-01	3.19E-01	5.15E-02	2.80E-02	1.47E-02	1.96E-03
12 7	3.61E+01	1.26E+01	1.32E+00	3.18E-01	7.99E-02	5.03E-02	1.08E-02	1.16E-03
12 8	5.25E+01	1.81E+01	1.32E+00	6.15E-01	9.21E-02	5.00E-02	4.70E-03	4.58E-04
12 9	6.39E+01	2.54E+01	2.32E+00	6.20E-01	6.88E-02	2.79E-02	1.70E-03	2.35E-04
12 10	5.78E+01	2.98E+01	2.90E+00	5.88E-01	3.56E-02	9.16E-03	4.52E-04	6.39E-05
12 11	6.51E+01	2.43E+01	3.60E+00	4.98E-01	1.91E-02	7.10E-03	6.31E-04	8.11E-06
13	1.20E+02	1.24E+02	1.74E+01	4.15E+00	7.00E-01	3.46E-01	6.09E-02	9.70E-03
13 0	5.96E-01	3.43E-01	6.14E-02	3.04E-02	6.67E-03	4.86E-03	3.43E-04	8.32E-05
13 1	1.39E+00	7.00E-01	1.57E-01	5.25E-02	2.49E-02	1.35E-02	1.72E-03	3.13E-04
13 2	2.01E+00	2.01E+00	3.31E-01	1.26E-01	3.84E-02	2.47E-02	2.32E-03	4.13E-04
13 3	2.04E+00	2.36E+00	4.00E-01	1.40E-01	6.44E-02	3.21E-02	5.28E-03	8.99E-04
13 4	2.44E+00	4.69E+00	7.25E-01	1.90E-01	7.63E-02	3.98E-02	6.11E-03	1.52E-03
13 5	2.90E+00	5.14E+00	7.85E-01	2.35E-01	8.11E-02	3.36E-02	8.90E-03	2.14E-03
13 6	3.70E+00	7.64E+00	1.05E+00	2.99E-01	6.62E-02	3.69E-02	1.52E-02	2.00E-03
13 7	4.16E+00	8.50E+00	1.43E+00	3.31E-01	8.71E-02	5.49E-02	1.21E-02	1.23E-03
13 8	5.53E+00	9.83E+00	1.28E+00	5.90E-01	9.97E-02	5.03E-02	5.61E-03	5.85E-04
13 9	9.76E+00	1.40E+01	2.22E+00	5.59E-01	7.77E-02	3.19E-02	1.71E-03	3.44E-04
13 10	1.89E+01	1.59E+01	2.38E+00	5.95E-01	4.37E-02	1.39E-02	7.51E-04	1.37E-04
13 11	2.44E+01	2.76E+01	3.21E+00	6.30E-01	2.33E-02	5.52E-03	1.88E-04	3.44E-05
13 12	4.25E+01	2.49E+01	3.34E+00	3.76E-01	1.04E-02	4.44E-03	6.44E-04	3.05E-06
14	4.59E+01	7.93E+01	1.91E+01	4.75E+00	1.09E+00	5.49E-01	7.36E-02	1.17E-02
14 0	8.17E-01	2.85E-01	1.59E-01	4.54E-02	1.26E-02	1.02E-02	5.26E-04	2.60E-04
14 1	2.65E+00	6.79E-01	2.28E-01	9.71E-02	5.40E-02	2.53E-02	2.16E-03	6.35E-04
14 2	1.36E+00	1.35E+00	5.16E-01	1.52E-01	8.14E-02	4.23E-02	4.04E-03	7.76E-04
14 3	4.32E+00	2.03E+00	4.99E-01	2.10E-01	1.09E-01	5.27E-02	6.96E-03	1.09E-03
14 4	1.16E+00	2.41E+00	9.54E-01	2.41E-01	1.28E-01	6.34E-02	8.04E-03	1.75E-03
14 5	2.32E+00	3.58E+00	9.28E-01	2.73E-01	1.38E-01	6.33E-02	9.86E-03	2.17E-03
14 6	1.44E+00	3.36E+00	9.83E-01	3.40E-01	1.18E-01	5.84E-02	1.64E-02	2.09E-03
14 7	2.17E+00	5.10E+00	1.61E+00	2.81E-01	1.24E-01	8.10E-02	1.42E-02	1.46E-03
14 8	2.25E+00	4.52E+00	1.14E+00	5.34E-01	1.33E-01	7.43E-02	7.10E-03	7.10E-04
14 9	2.90E+00	7.16E+00	2.06E+00	5.89E-01	9.56E-02	4.19E-02	2.48E-03	4.68E-04
14 10	3.94E+00	6.89E+00	2.06E+00	4.63E-01	5.20E-02	1.98E-02	7.52E-04	2.37E-04
14 11	6.19E+00	9.79E+00	2.19E+00	7.12E-01	2.65E-02	7.82E-03	3.23E-04	8.59E-05
14 12	7.32E+00	1.16E+01	3.47E+00	5.78E-01	1.66E-02	5.59E-03	7.70E-05	1.47E-05
14 13	7.07E+00	2.05E+01	2.31E+00	2.31E-01	5.23E-03	3.21E-03	6.16E-04	1.17E-06

Table A.32: Data for Ne^{10+} + H(2p1)

	impact energies [kev/amu]							
	1.0	10.0	30.0	45.0	90.0	120.0	200.0	300.0
	total cross sections							
CX	9.33E+02	5.55E+02	1.33E+02	5.21E+01	6.64E+00	2.07E+00	2.90E-01	7.48E-02
ION	1.88E+00	4.96E+00	4.34E+01	5.43E+01	9.68E+01	1.08E+02	1.10E+02	1.00E+02
	state resolved CX cross sections							
n ℓ								
4	1.52E-02	2.58E-03	2.90E-02	4.75E-02	3.12E-02	2.31E-02	7.61E-03	4.14E-03
4 0	1.92E-03	1.03E-04	7.86E-04	3.00E-03	1.36E-03	4.19E-04	3.37E-04	8.68E-05
4 1	4.21E-03	6.42E-04	4.18E-03	9.47E-03	5.05E-03	1.91E-03	1.43E-03	6.22E-04
4 2	4.43E-03	8.24E-04	8.75E-03	1.20E-02	8.49E-03	9.57E-03	1.61E-03	5.07E-04
4 3	4.59E-03	1.01E-03	1.53E-02	2.30E-02	1.63E-02	1.12E-02	4.23E-03	2.92E-03
5	1.34E-01	1.20E-02	1.24E-01	1.93E-01	8.94E-02	4.85E-02	1.05E-02	4.89E-03
5 0	2.25E-02	3.27E-04	4.47E-03	4.74E-03	1.15E-03	2.78E-04	6.05E-04	1.09E-04
5 1	4.52E-02	1.64E-03	1.53E-02	2.00E-02	6.28E-03	3.40E-03	1.23E-03	8.95E-04
5 2	2.95E-02	3.12E-03	1.95E-02	3.51E-02	9.74E-03	6.16E-03	1.50E-03	7.51E-04
5 3	1.72E-02	3.67E-03	3.90E-02	4.81E-02	2.23E-02	5.58E-03	5.43E-03	2.20E-03
5 4	1.94E-02	3.30E-03	4.53E-02	8.46E-02	5.00E-02	3.31E-02	1.77E-03	9.35E-04
6	5.06E-01	2.81E-01	6.13E-01	4.01E-01	1.92E-01	8.24E-02	1.56E-02	5.43E-03
6 0	4.53E-02	1.00E-02	1.87E-02	1.34E-02	1.47E-03	6.77E-04	6.63E-04	8.40E-05
6 1	1.15E-01	2.86E-02	6.02E-02	3.42E-02	6.86E-03	5.32E-03	1.23E-03	6.94E-04
6 2	1.44E-01	4.44E-02	9.76E-02	5.54E-02	1.57E-02	6.87E-03	2.27E-03	6.37E-04
6 3	8.00E-02	5.90E-02	1.12E-01	6.88E-02	4.17E-02	1.17E-02	4.19E-03	2.06E-03
6 4	6.58E-02	7.07E-02	1.16E-01	9.27E-02	4.00E-02	3.03E-02	5.36E-03	7.67E-04
6 5	5.56E-02	6.80E-02	2.08E-01	1.37E-01	8.68E-02	2.75E-02	1.88E-03	1.19E-03
7	7.42E-01	2.45E+00	1.88E+00	1.15E+00	3.29E-01	1.18E-01	1.93E-02	6.05E-03
7 0	3.40E-02	6.98E-02	3.83E-02	1.57E-02	2.84E-03	6.36E-04	8.10E-04	6.29E-05
7 1	7.59E-02	1.80E-01	1.15E-01	5.05E-02	9.48E-03	4.18E-03	1.42E-03	5.38E-04
7 2	1.40E-01	2.51E-01	2.25E-01	8.85E-02	2.13E-02	7.80E-03	2.79E-03	6.29E-04
7 3	1.31E-01	3.22E-01	2.88E-01	1.84E-01	4.33E-02	1.19E-02	3.91E-03	1.95E-03
7 4	1.69E-01	4.75E-01	2.66E-01	2.55E-01	3.99E-02	2.48E-02	6.18E-03	8.92E-04
7 5	1.30E-01	6.14E-01	3.68E-01	2.58E-01	1.25E-01	4.08E-02	1.87E-03	1.26E-03
7 6	6.22E-02	5.34E-01	5.79E-01	3.01E-01	8.67E-02	2.80E-02	2.34E-03	7.19E-04
8	1.87E+00	9.37E+00	5.73E+00	2.78E+00	4.70E-01	1.59E-01	2.20E-02	6.85E-03
8 0	4.14E-02	1.28E-01	6.58E-02	2.52E-02	3.05E-03	9.00E-04	6.38E-04	6.60E-05
8 1	2.18E-01	3.50E-01	1.70E-01	6.59E-02	8.46E-03	4.65E-03	1.17E-03	4.87E-04
8 2	1.53E-01	6.24E-01	4.13E-01	1.29E-01	2.44E-02	8.95E-03	2.54E-03	6.59E-04
8 3	3.69E-01	9.20E-01	5.44E-01	1.98E-01	3.80E-02	1.38E-02	4.14E-03	1.86E-03
8 4	2.51E-01	1.32E+00	8.46E-01	3.20E-01	4.67E-02	2.54E-02	6.47E-03	9.71E-04
8 5	2.29E-01	1.79E+00	1.19E+00	5.30E-01	1.09E-01	4.24E-02	3.05E-03	1.39E-03
8 6	3.26E-01	2.10E+00	1.11E+00	7.40E-01	1.01E-01	2.38E-02	2.45E-03	1.19E-03
8 7	2.82E-01	2.13E+00	1.39E+00	7.70E-01	1.40E-01	3.88E-02	1.53E-03	2.24E-04
9	1.45E+01	4.21E+01	1.27E+01	4.91E+00	6.08E-01	1.85E-01	2.37E-02	7.48E-03
9 0	1.85E-01	4.08E-01	6.65E-02	3.07E-02	2.68E-03	1.16E-03	5.71E-04	6.65E-05
9 1	6.62E-01	1.26E+00	1.94E-01	6.83E-02	1.09E-02	3.12E-03	1.09E-03	4.59E-04
9 2	1.34E+00	2.36E+00	4.60E-01	1.49E-01	2.67E-02	1.01E-02	2.36E-03	6.13E-04
9 3	1.63E+00	3.06E+00	5.69E-01	2.17E-01	4.13E-02	1.28E-02	4.15E-03	1.72E-03
9 4	1.86E+00	4.03E+00	1.03E+00	3.59E-01	5.42E-02	2.67E-02	6.31E-03	1.02E-03
9 5	2.52E+00	6.72E+00	1.39E+00	4.58E-01	1.00E-01	3.39E-02	3.92E-03	1.54E-03
9 6	1.86E+00	1.01E+01	2.06E+00	6.06E-01	1.03E-01	2.85E-02	2.45E-03	1.54E-03
9 7	1.86E+00	9.12E+00	3.17E+00	1.18E+00	8.52E-02	3.19E-02	2.02E-03	4.85E-04
9 8	2.57E+00	5.04E+00	3.73E+00	1.84E+00	1.84E-01	3.67E-02	8.71E-04	4.72E-05
10	1.18E+02	9.67E+01	1.91E+01	6.72E+00	7.38E-01	2.08E-01	2.65E-02	7.79E-03
10 0	1.38E+00	3.22E-01	6.24E-02	3.21E-02	4.00E-03	1.52E-03	4.70E-04	6.59E-05
10 1	3.44E+00	1.12E+00	1.75E-01	7.28E-02	1.45E-02	2.53E-03	1.09E-03	4.39E-04
10 2	4.46E+00	2.56E+00	4.02E-01	1.43E-01	3.02E-02	1.15E-02	2.41E-03	5.56E-04
10 3	5.81E+00	4.96E+00	5.40E-01	2.33E-01	4.91E-02	1.14E-02	4.45E-03	1.56E-03
10 4	9.52E+00	8.02E+00	8.35E-01	2.91E-01	5.33E-02	2.81E-02	6.51E-03	1.02E-03
10 5	1.48E+01	1.26E+01	1.10E+00	4.49E-01	9.47E-02	3.24E-02	4.61E-03	1.54E-03
10 6	1.47E+01	1.65E+01	1.50E+00	5.63E-01	9.70E-02	3.00E-02	3.13E-03	1.71E-03
10 7	1.66E+01	1.91E+01	2.53E+00	8.22E-01	8.49E-02	2.74E-02	2.33E-03	7.48E-04
10 8	2.19E+01	1.99E+01	4.16E+00	1.21E+00	1.48E-01	3.93E-02	1.03E-03	1.42E-04
10 9	2.51E+01	1.16E+01	7.77E+00	2.91E+00	1.62E-01	2.41E-02	4.72E-04	1.01E-05
11	2.63E+02	1.31E+02	2.24E+01	8.04E+00	8.26E-01	2.29E-01	2.95E-02	7.70E-03
11 0	1.40E+00	2.16E-01	4.95E-02	2.68E-02	4.65E-03	1.65E-03	4.57E-04	6.52E-05
11 1	3.71E+00	7.76E-01	1.39E-01	7.66E-02	1.54E-02	2.97E-03	1.16E-03	4.16E-04
11 2	6.05E+00	1.46E+00	2.91E-01	1.24E-01	2.86E-02	1.15E-02	2.50E-03	5.19E-04
11 3	7.77E+00	3.06E+00	4.31E-01	2.20E-01	5.08E-02	1.05E-02	4.53E-03	1.40E-03
11 4	1.27E+01	4.85E+00	5.82E-01	2.60E-01	5.13E-02	2.61E-02	6.85E-03	9.65E-04
11 5	2.11E+01	8.12E+00	8.88E-01	4.04E-01	9.80E-02	3.25E-02	5.37E-03	1.39E-03
11 6	3.30E+01	1.28E+01	1.11E+00	5.31E-01	1.01E-01	3.28E-02	4.04E-03	1.71E-03
11 7	4.69E+01	1.90E+01	1.98E+00	6.14E-01	9.31E-02	2.99E-02	2.50E-03	9.55E-04
11 8	5.32E+01	2.89E+01	2.39E+00	1.11E+00	1.13E-01	3.60E-02	1.35E-03	2.49E-04
11 9	3.57E+01	3.19E+01	4.56E+00	1.46E+00	1.73E-01	3.28E-02	4.50E-04	3.77E-05
11 10	4.19E+01	1.99E+01	9.96E+00	3.22E+00	9.86E-02	1.21E-02	3.28E-04	3.96E-06

Table continues on next page.

Data for Ne^{10+} + H(2p1) (cont.)

	impact energies [kev/amu]							
	1.0	10.0	30.0	45.0	90.0	120.0	200.0	300.0
	state resolved CX cross sections							
n ℓ								
12	3.73E+02	1.22E+02	2.41E+01	8.87E+00	8.90E-01	2.65E-01	3.46E-02	7.53E-03
12 0	8.21E-01	1.66E-01	5.39E-02	2.60E-02	4.83E-03	2.29E-03	5.23E-04	7.08E-05
12 1	2.75E+00	5.50E-01	1.51E-01	8.18E-02	2.04E-02	3.59E-03	1.43E-03	3.93E-04
12 2	5.15E+00	1.00E+00	2.73E-01	1.20E-01	2.92E-02	1.41E-02	3.00E-03	5.20E-04
12 3	8.43E+00	1.75E+00	4.28E-01	2.44E-01	5.37E-02	1.29E-02	5.04E-03	1.28E-03
12 4	1.19E+01	3.14E+00	5.19E-01	2.65E-01	5.22E-02	3.09E-02	7.37E-03	9.16E-04
12 5	1.62E+01	4.68E+00	8.13E-01	4.19E-01	8.84E-02	3.93E-02	6.06E-03	1.25E-03
12 6	2.13E+01	7.18E+00	9.42E-01	5.39E-01	9.23E-02	3.46E-02	5.01E-03	1.63E-03
12 7	3.44E+01	9.71E+00	1.73E+00	5.59E-01	9.48E-02	3.18E-02	3.51E-03	1.04E-03
12 8	5.06E+01	1.37E+01	2.02E+00	9.15E-01	1.12E-01	3.58E-02	1.61E-03	3.25E-04
12 9	6.30E+01	1.99E+01	3.10E+00	1.22E+00	1.66E-01	3.56E-02	5.97E-04	8.13E-05
12 10	6.99E+01	3.09E+01	4.58E+00	1.99E+00	1.30E-01	1.85E-02	1.84E-04	1.46E-05
12 11	8.85E+01	2.92E+01	9.53E+00	2.49E+00	4.70E-02	5.71E-03	2.86E-04	1.51E-06
13	1.12E+02	9.15E+01	2.38E+01	9.16E+00	1.03E+00	3.22E-01	4.16E-02	7.74E-03
13 0	8.59E-01	1.70E-01	6.82E-02	1.78E-02	8.58E-03	2.19E-03	1.05E-03	1.21E-04
13 1	1.66E+00	5.30E-01	2.09E-01	7.22E-02	2.86E-02	5.08E-03	1.93E-03	3.70E-04
13 2	2.28E+00	1.04E+00	3.46E-01	1.02E-01	3.84E-02	1.53E-02	3.67E-03	5.84E-04
13 3	2.97E+00	1.49E+00	5.11E-01	2.12E-01	6.96E-02	1.68E-02	6.04E-03	1.33E-03
13 4	3.44E+00	2.48E+00	5.69E-01	2.61E-01	6.66E-02	3.31E-02	8.20E-03	9.34E-04
13 5	3.47E+00	3.75E+00	8.70E-01	4.00E-01	1.01E-01	4.79E-02	7.02E-03	1.22E-03
13 6	4.56E+00	4.72E+00	9.31E-01	5.57E-01	9.82E-02	4.44E-02	6.12E-03	1.60E-03
13 7	6.25E+00	6.13E+00	1.64E+00	5.88E-01	9.98E-02	4.24E-02	4.02E-03	1.04E-03
13 8	1.01E+01	6.89E+00	1.86E+00	8.40E-01	1.18E-01	4.11E-02	2.00E-03	3.78E-04
13 9	1.53E+01	9.56E+00	2.44E+00	1.12E+00	1.51E-01	3.79E-02	8.21E-04	1.25E-04
13 10	1.70E+01	1.33E+01	3.33E+00	1.39E+00	1.52E-01	2.42E-02	3.18E-04	3.10E-05
13 11	1.93E+01	1.99E+01	4.35E+00	2.15E+00	7.91E-02	8.35E-03	1.20E-04	6.58E-06
13 12	2.49E+01	2.15E+01	6.68E+00	1.45E+00	1.94E-02	2.89E-03	2.57E-04	5.57E-07
14	4.91E+01	5.91E+01	2.20E+01	9.83E+00	1.43E+00	4.27E-01	5.89E-02	9.21E-03
14 0	3.09E-01	2.21E-01	1.43E-01	2.42E-02	1.64E-02	6.47E-03	1.95E-03	3.33E-04
14 1	3.12E+00	4.93E-01	3.32E-01	8.63E-02	4.86E-02	1.10E-02	3.86E-03	4.94E-04
14 2	9.83E-01	8.40E-01	4.47E-01	1.20E-01	6.90E-02	2.87E-02	5.16E-03	7.76E-04
14 3	5.32E+00	1.48E+00	7.75E-01	2.52E-01	1.08E-01	2.90E-02	7.65E-03	1.38E-03
14 4	1.22E+00	1.52E+00	7.48E-01	3.25E-01	1.19E-01	4.52E-02	1.19E-02	1.28E-03
14 5	2.48E+00	3.03E+00	1.00E+00	4.98E-01	1.49E-01	5.57E-02	9.16E-03	1.56E-03
14 6	1.71E+00	2.50E+00	1.03E+00	6.84E-01	1.54E-01	4.68E-02	8.34E-03	1.65E-03
14 7	2.12E+00	3.94E+00	1.57E+00	7.24E-01	1.39E-01	5.49E-02	6.55E-03	1.09E-03
14 8	2.14E+00	3.60E+00	1.75E+00	8.67E-01	1.47E-01	5.25E-02	2.71E-03	4.05E-04
14 9	2.58E+00	5.16E+00	2.03E+00	1.13E+00	1.68E-01	4.45E-02	9.06E-04	1.69E-04
14 10	3.40E+00	5.75E+00	2.54E+00	1.18E+00	1.59E-01	3.27E-02	2.85E-04	5.12E-05
14 11	5.15E+00	6.96E+00	2.55E+00	1.62E+00	9.98E-02	1.34E-02	1.69E-04	1.71E-05
14 12	8.16E+00	1.03E+01	3.76E+00	1.66E+00	4.24E-02	4.71E-03	9.55E-05	2.57E-06
14 13	1.04E+01	1.33E+01	3.32E+00	6.59E-01	1.04E-02	1.74E-03	2.48E-04	2.14E-07

Table A.33: Data for Ne^{10+} + H(2p-1)

	impact energies [kev/amu]							
	1.0	10.0	30.0	45.0	90.0	120.0	200.0	300.0
	total cross sections							
CX	9.88E+02	5.51E+02	1.08E+02	4.13E+01	3.99E+00	1.36E+00	2.67E-01	7.41E-02
ION	5.87E-01	2.00E+00	1.86E+01	3.25E+01	8.29E+01	9.30E+01	9.43E+01	8.35E+01
	state resolved CX cross sections							
n ℓ								
4	3.98E-03	1.77E-03	6.42E-03	1.91E-02	1.90E-02	2.00E-02	1.48E-02	3.41E-03
4 1	2.32E-04	3.38E-05	2.23E-04	8.87E-04	8.00E-04	6.05E-04	2.25E-04	3.82E-05
4 2	9.73E-04	7.90E-04	2.05E-03	4.52E-03	5.42E-03	3.41E-03	1.46E-03	5.73E-04
4 3	2.77E-03	9.45E-04	4.15E-03	1.37E-02	1.28E-02	1.60E-02	1.31E-02	2.79E-03
5	1.62E-04	6.28E-04	2.42E-02	5.25E-02	2.26E-02	9.10E-03	5.94E-03	2.53E-03
5 1	1.22E-05	3.60E-05	9.86E-04	1.66E-03	5.45E-04	1.90E-04	1.18E-04	2.09E-05
5 2	4.22E-05	1.81E-04	5.03E-03	5.68E-03	3.57E-03	1.81E-03	6.89E-04	3.26E-04
5 3	4.77E-05	2.34E-04	9.28E-03	1.82E-02	5.30E-03	1.81E-03	3.08E-03	9.21E-04
5 4	6.03E-05	1.77E-04	8.95E-03	2.70E-02	1.32E-02	5.29E-03	2.06E-03	1.26E-03
6	1.66E-04	4.83E-02	4.06E-01	3.33E-01	6.12E-02	1.76E-02	7.58E-03	3.43E-03
6 1	1.35E-05	1.47E-03	3.47E-03	2.97E-03	6.10E-04	2.15E-04	1.56E-04	3.20E-05
6 2	2.65E-05	6.23E-03	1.97E-02	1.42E-02	4.31E-03	1.49E-03	7.60E-04	3.13E-04
6 3	3.48E-05	1.31E-02	6.81E-02	4.86E-02	7.82E-03	1.76E-03	2.03E-03	4.72E-04
6 4	3.65E-05	1.63E-02	1.50E-01	9.22E-02	1.56E-02	5.32E-03	1.55E-03	1.29E-03
6 5	5.43E-05	1.12E-02	1.65E-01	1.76E-01	3.28E-02	8.80E-03	3.09E-03	1.31E-03
7	2.61E-03	1.20E+00	2.13E+00	1.11E+00	1.20E-01	3.15E-02	1.25E-02	4.72E-03
7 1	5.67E-05	1.51E-02	7.26E-03	5.95E-03	8.49E-04	2.19E-04	2.06E-04	4.45E-05
7 2	1.61E-04	7.22E-02	3.85E-02	2.03E-02	6.60E-03	1.54E-03	1.00E-03	3.39E-04
7 3	5.48E-04	1.84E-01	1.28E-01	7.70E-02	9.55E-03	2.09E-03	2.29E-03	4.03E-04
7 4	6.34E-04	3.16E-01	3.07E-01	1.40E-01	1.66E-02	5.84E-03	1.90E-03	1.31E-03
7 5	5.73E-04	3.69E-01	6.22E-01	2.63E-01	3.01E-02	1.01E-02	4.32E-03	1.95E-03
7 6	6.37E-04	2.47E-01	1.03E+00	6.01E-01	5.66E-02	1.17E-02	2.79E-03	6.75E-04
8	1.85E-01	1.12E+01	5.84E+00	2.37E+00	2.04E-01	5.54E-02	1.75E-02	6.03E-03
8 1	1.21E-03	4.63E-02	1.14E-02	8.39E-03	1.13E-03	4.22E-04	2.31E-04	5.33E-05
8 2	4.80E-03	2.63E-01	5.82E-02	2.92E-02	8.42E-03	2.51E-03	1.10E-03	3.73E-04
8 3	1.35E-02	8.05E-01	1.89E-01	1.09E-01	1.35E-02	3.65E-03	2.42E-03	4.34E-04
8 4	2.38E-02	1.77E+00	4.21E-01	1.86E-01	2.18E-02	7.72E-03	2.33E-03	1.37E-03
8 5	4.45E-02	2.88E+00	8.34E-01	3.31E-01	3.69E-02	1.12E-02	4.87E-03	2.37E-03
8 6	5.59E-02	3.29E+00	1.35E+00	5.15E-01	6.12E-02	1.96E-02	5.05E-03	1.24E-03
8 7	4.09E-02	2.15E+00	2.98E+00	1.19E+00	6.14E-02	1.04E-02	1.52E-03	1.92E-04
9	8.14E+00	4.53E+01	1.06E+01	3.79E+00	2.90E-01	9.23E-02	2.22E-02	7.13E-03
9 1	3.02E-02	6.01E-02	1.29E-02	9.19E-03	1.18E-03	6.87E-04	2.68E-04	5.65E-05
9 2	1.52E-01	3.45E-01	7.09E-02	3.02E-02	7.98E-03	3.70E-03	1.24E-03	3.94E-04
9 3	3.87E-01	1.12E+00	2.14E-01	1.27E-01	1.44E-02	6.21E-03	2.70E-03	4.73E-04
9 4	6.86E-01	2.99E+00	4.98E-01	1.96E-01	2.27E-02	1.18E-02	2.82E-03	1.40E-03
9 5	1.10E+00	6.51E+00	8.92E-01	3.60E-01	4.15E-02	1.58E-02	5.51E-03	2.66E-03
9 6	1.73E+00	1.10E+01	1.43E+00	5.43E-01	6.82E-02	2.55E-02	6.25E-03	1.69E-03
9 7	2.38E+00	1.35E+01	2.43E+00	9.50E-01	8.64E-02	2.14E-02	2.73E-03	4.14E-04
9 8	1.67E+00	9.83E+00	5.04E+00	1.58E+00	4.74E-02	7.19E-03	6.74E-04	4.03E-05
10	9.86E+01	9.32E+01	1.48E+01	5.00E+00	3.85E-01	1.32E-01	2.66E-02	8.03E-03
10 1	2.13E-01	6.50E-02	1.38E-02	9.72E-03	1.36E-03	8.64E-04	2.84E-04	5.66E-05
10 2	9.86E-01	3.49E-01	7.10E-02	3.07E-02	8.12E-03	4.40E-03	1.30E-03	4.05E-04
10 3	2.62E+00	1.17E+00	2.26E-01	1.37E-01	1.65E-02	8.22E-03	2.93E-03	5.09E-04
10 4	5.05E+00	2.98E+00	5.01E-01	1.80E-01	2.67E-02	1.49E-02	3.27E-03	1.39E-03
10 5	8.18E+00	6.30E+00	8.81E-01	3.82E-01	4.56E-02	2.08E-02	6.16E-03	2.86E-03
10 6	1.25E+01	1.07E+01	1.40E+00	5.09E-01	7.51E-02	3.14E-02	7.57E-03	2.06E-03
10 7	1.95E+01	1.80E+01	2.03E+00	8.61E-01	1.02E-01	3.13E-02	3.84E-03	6.34E-04
10 8	2.67E+01	2.74E+01	3.54E+00	1.38E+00	7.71E-02	1.51E-02	9.40E-04	1.04E-04
10 9	2.27E+01	2.62E+01	6.14E+00	1.51E+00	3.25E-02	4.60E-03	3.30E-04	1.01E-05
11	3.68E+02	1.22E+02	1.73E+01	6.11E+00	4.85E-01	1.68E-01	3.09E-02	8.74E-03
11 1	3.64E-01	5.06E-02	1.36E-02	8.88E-03	1.63E-03	1.06E-03	3.08E-04	5.62E-05
11 2	1.84E+00	3.21E-01	7.11E-02	3.23E-02	8.61E-03	5.15E-03	1.40E-03	4.12E-04
11 3	5.08E+00	9.93E-01	2.18E-01	1.30E-01	1.90E-02	1.02E-02	3.21E-03	5.43E-04
11 4	1.05E+01	2.46E+00	4.68E-01	1.78E-01	3.22E-02	1.78E-02	3.69E-03	1.36E-03
11 5	1.89E+01	5.19E+00	7.96E-01	3.66E-01	5.17E-02	2.42E-02	6.72E-03	2.95E-03
11 6	3.08E+01	8.49E+00	1.23E+00	5.34E-01	8.53E-02	3.61E-02	8.52E-03	2.35E-03
11 7	4.60E+01	1.39E+01	1.78E+00	7.47E-01	1.15E-01	3.85E-02	5.01E-03	8.47E-04
11 8	6.89E+01	2.02E+01	2.64E+00	1.32E+00	1.00E-01	2.24E-02	1.51E-03	1.80E-04
11 9	9.59E+01	2.95E+01	4.23E+00	1.60E+00	5.12E-02	9.18E-03	2.83E-04	3.03E-05
11 10	8.95E+01	4.11E+01	5.90E+00	1.19E+00	2.04E-02	2.92E-03	2.11E-04	3.34E-06

Table continues on next page.

Data for Ne^{10+} + H(2p-1) (cont.)

	impact energies [kev/amu]							
	1.0	10.0	30.0	45.0	90.0	120.0	200.0	300.0
	state resolved CX cross sections							
n ℓ								
12	4.01E+02	1.21E+02	1.91E+01	6.85E+00	6.07E-01	2.10E-01	3.57E-02	9.30E-03
12 1	2.03E-01	4.33E-02	1.32E-02	8.54E-03	2.07E-03	1.33E-03	3.31E-04	5.62E-05
12 2	1.07E+00	2.24E-01	6.83E-02	3.23E-02	1.05E-02	6.31E-03	1.51E-03	4.20E-04
12 3	3.01E+00	7.60E-01	2.06E-01	1.22E-01	2.30E-02	1.32E-02	3.57E-03	5.80E-04
12 4	6.70E+00	1.76E+00	4.07E-01	1.75E-01	4.06E-02	2.23E-02	4.24E-03	1.33E-03
12 5	1.31E+01	3.69E+00	7.44E-01	3.41E-01	5.91E-02	2.95E-02	7.45E-03	2.98E-03
12 6	2.28E+01	5.84E+00	1.02E+00	5.35E-01	9.57E-02	4.20E-02	9.68E-03	2.57E-03
12 7	3.64E+01	8.93E+00	1.65E+00	6.75E-01	1.34E-01	4.61E-02	6.09E-03	1.04E-03
12 8	5.25E+01	1.17E+01	2.06E+00	1.18E+00	1.24E-01	2.89E-02	2.09E-03	2.58E-04
12 9	7.14E+01	1.71E+01	3.20E+00	1.59E+00	7.61E-02	1.26E-02	5.01E-04	5.59E-05
12 10	9.84E+01	2.86E+01	4.93E+00	1.46E+00	3.03E-02	5.65E-03	9.14E-05	1.15E-05
12 11	9.55E+01	4.25E+01	4.79E+00	7.40E-01	1.15E-02	2.00E-03	1.61E-04	1.12E-06
13	9.89E+01	9.54E+01	1.94E+01	7.43E+00	7.56E-01	2.65E-01	4.17E-02	9.92E-03
13 1	7.45E-02	3.79E-02	1.33E-02	9.00E-03	2.60E-03	1.63E-03	3.88E-04	6.06E-05
13 2	3.00E-01	1.26E-01	7.28E-02	3.46E-02	1.28E-02	7.55E-03	1.72E-03	4.38E-04
13 3	7.17E-01	5.69E-01	2.06E-01	1.24E-01	2.85E-02	1.64E-02	4.10E-03	6.35E-04
13 4	1.42E+00	1.04E+00	3.73E-01	1.90E-01	5.20E-02	2.81E-02	4.95E-03	1.33E-03
13 5	2.28E+00	2.40E+00	7.45E-01	3.36E-01	7.30E-02	3.73E-02	8.33E-03	3.02E-03
13 6	3.79E+00	3.52E+00	8.46E-01	5.49E-01	1.11E-01	5.09E-02	1.09E-02	2.77E-03
13 7	5.27E+00	5.39E+00	1.51E+00	6.40E-01	1.53E-01	5.70E-02	7.40E-03	1.23E-03
13 8	7.26E+00	6.67E+00	1.70E+00	1.03E+00	1.47E-01	3.80E-02	2.79E-03	3.36E-04
13 9	9.62E+00	9.39E+00	2.25E+00	1.49E+00	1.01E-01	1.64E-02	7.00E-04	8.34E-05
13 10	1.40E+01	1.21E+01	3.87E+00	1.56E+00	5.17E-02	6.47E-03	1.85E-04	2.32E-05
13 11	2.56E+01	1.85E+01	4.80E+00	1.06E+00	1.64E-02	3.85E-03	3.42E-05	4.30E-06
13 12	2.86E+01	3.57E+01	3.02E+00	3.88E-01	7.03E-03	1.49E-03	1.40E-04	3.63E-07
14	1.29E+01	6.08E+01	1.85E+01	8.20E+00	1.04E+00	3.59E-01	5.18E-02	1.09E-02
â 1	1.40E-01	2.25E-02	2.00E-02	1.13E-02	3.57E-03	2.29E-03	4.42E-04	6.33E-05
14								
14 2	7.78E-02	8.45E-02	7.28E-02	4.73E-02	1.95E-02	9.85E-03	2.16E-03	4.78E-04
14 3	1.91E-01	3.28E-01	2.45E-01	1.24E-01	4.21E-02	2.12E-02	5.02E-03	7.44E-04
14 4	2.65E-01	5.70E-01	3.28E-01	2.52E-01	7.78E-02	3.71E-02	6.23E-03	1.39E-03
14 5	3.72E-01	1.35E+00	7.91E-01	3.52E-01	1.05E-01	4.96E-02	1.02E-02	3.17E-03
14 6	4.26E-01	1.79E+00	7.68E-01	6.14E-01	1.48E-01	6.66E-02	1.33E-02	3.04E-03
14 7	5.99E-01	2.94E+00	1.28E+00	7.25E-01	2.02E-01	7.65E-02	9.30E-03	1.44E-03
14 8	7.69E-01	3.42E+00	1.66E+00	9.35E-01	1.91E-01	5.51E-02	3.76E-03	4.19E-04
14 9	8.77E-01	4.97E+00	1.56E+00	1.41E+00	1.35E-01	2.49E-02	1.03E-03	1.12E-04
14 10	1.17E+00	5.36E+00	2.72E+00	1.61E+00	7.35E-02	8.22E-03	2.25E-04	3.68E-05
14 11	1.73E+00	8.41E+00	3.98E+00	1.28E+00	3.03E-02	3.69E-03	6.88E-05	9.87E-06
14 12	2.63E+00	8.26E+00	3.57E+00	6.39E-01	7.70E-03	3.10E-03	1.68E-05	1.61E-06
14 13	3.70E+00	2.33E+01	1.51E+00	1.90E-01	5.27E-03	1.23E-03	1.21E-04	1.15E-07

Table A.34: Data for Ne^{10+} + H(2p)

	impact energies [kev/amu]							
	1.0	10.0	30.0	45.0	90.0	120.0	200.0	300.0
	total cross sections							
CX	9.50E+02	5.59E+02	1.08E+02	3.96E+01	5.15E+00	2.01E+00	3.56E-01	8.73E-02
ION	1.44E+00	4.22E+00	3.19E+01	4.56E+01	7.97E+01	8.99E+01	9.38E+01	8.59E+01
	state resolved CX cross sections							
n ℓ								
4	1.04E-02	1.93E-03	1.89E-02	2.91E-02	3.13E-02	2.17E-02	1.46E-02	7.36E-03
4 0	1.02E-03	5.32E-05	8.83E-04	1.44E-03	9.11E-04	4.20E-04	1.77E-04	5.40E-05
4 1	2.68E-03	3.42E-04	3.32E-03	4.48E-03	2.94E-03	1.99E-03	9.43E-04	3.58E-04
4 2	3.01E-03	6.73E-04	5.75E-03	7.73E-03	9.59E-03	6.73E-03	2.60E-03	9.80E-04
4 3	3.69E-03	8.64E-04	8.92E-03	1.55E-02	1.79E-02	1.26E-02	1.09E-02	5.97E-03
5	8.18E-02	9.15E-03	9.11E-02	1.41E-01	8.31E-02	4.56E-02	1.38E-02	6.09E-03
5 0	1.21E-02	2.20E-04	2.86E-03	4.18E-03	1.43E-03	6.58E-04	2.91E-04	6.99E-05
5 1	2.61E-02	1.02E-03	9.11E-03	1.31E-02	4.98E-03	3.51E-03	1.25E-03	4.39E-04
5 2	1.94E-02	2.12E-03	1.68E-02	2.47E-02	1.51E-02	5.72E-03	1.73E-03	6.96E-04
5 3	1.11E-02	2.93E-03	2.94E-02	4.50E-02	2.32E-02	1.25E-02	4.84E-03	2.33E-03
5 4	1.31E-02	2.87E-03	3.29E-02	5.41E-02	3.85E-02	2.32E-02	5.73E-03	2.55E-03
6	3.22E-01	1.98E-01	5.32E-01	5.03E-01	1.72E-01	8.57E-02	1.96E-02	6.34E-03
6 0	2.52E-02	6.85E-03	1.53E-02	8.72E-03	2.01E-03	7.48E-04	3.11E-04	4.84E-05
6 1	7.26E-02	1.98E-02	3.93E-02	2.72E-02	5.42E-03	4.26E-03	1.23E-03	3.52E-04
6 2	8.82E-02	3.24E-02	6.59E-02	6.00E-02	1.59E-02	6.22E-03	1.86E-03	4.97E-04
6 3	5.53E-02	4.44E-02	8.94E-02	9.38E-02	2.77E-02	1.38E-02	4.18E-03	1.53E-03
6 4	4.45E-02	5.15E-02	1.38E-01	1.13E-01	5.01E-02	2.12E-02	4.70E-03	2.17E-03
6 5	3.60E-02	4.35E-02	1.85E-01	2.01E-01	7.09E-02	3.94E-02	7.34E-03	1.75E-03
7	4.79E-01	2.08E+00	2.04E+00	1.27E+00	2.77E-01	1.20E-01	2.47E-02	6.96E-03
7 0	2.06E-02	4.90E-02	2.03E-02	9.67E-03	2.45E-03	9.93E-04	3.42E-04	3.94E-05
7 1	5.51E-02	1.35E-01	6.53E-02	3.15E-02	7.80E-03	4.33E-03	1.15E-03	3.20E-04
7 2	9.00E-02	1.99E-01	1.54E-01	6.64E-02	2.02E-02	7.21E-03	2.02E-03	4.73E-04
7 3	8.42E-02	2.81E-01	2.56E-01	1.48E-01	2.87E-02	1.23E-02	4.14E-03	1.34E-03
7 4	1.07E-01	4.28E-01	3.41E-01	2.28E-01	4.84E-02	2.10E-02	4.68E-03	1.83E-03
7 5	8.18E-02	5.38E-01	4.78E-01	3.24E-01	6.90E-02	2.57E-02	7.07E-03	2.08E-03
7 6	4.00E-02	4.46E-01	7.28E-01	4.67E-01	1.01E-01	4.88E-02	5.34E-03	8.76E-04
8	1.13E+00	1.09E+01	5.20E+00	2.40E+00	3.52E-01	1.48E-01	2.84E-02	7.56E-03
8 0	2.66E-02	1.20E-01	2.96E-02	1.23E-02	2.11E-03	1.07E-03	2.51E-04	3.76E-05
8 1	1.05E-01	3.59E-01	7.95E-02	3.56E-02	6.11E-03	4.51E-03	9.09E-04	2.87E-04
8 2	1.00E-01	6.34E-01	1.98E-01	7.24E-02	1.78E-02	8.11E-03	1.79E-03	4.75E-04
8 3	2.08E-01	9.49E-01	3.15E-01	1.42E-01	2.54E-02	1.30E-02	3.94E-03	1.23E-03
8 4	1.75E-01	1.48E+00	5.68E-01	2.25E-01	3.98E-02	2.13E-02	4.74E-03	1.65E-03
8 5	1.42E-01	2.28E+00	9.27E-01	3.86E-01	6.34E-02	2.44E-02	7.24E-03	2.19E-03
8 6	1.89E-01	2.80E+00	1.19E+00	6.06E-01	7.73E-02	3.33E-02	6.94E-03	1.41E-03
8 7	1.85E-01	2.27E+00	1.89E+00	9.21E-01	1.20E-01	4.25E-02	2.56E-03	2.78E-04
9	1.39E+01	3.95E+01	9.74E+00	3.65E+00	4.31E-01	1.72E-01	3.16E-02	7.99E-03
9 0	1.13E-01	1.93E-01	3.25E-02	1.34E-02	1.66E-03	1.05E-03	2.30E-04	3.14E-05
9 1	4.24E-01	6.45E-01	9.00E-02	3.51E-02	6.52E-03	3.52E-03	9.15E-04	2.43E-04
9 2	9.49E-01	1.37E+00	2.24E-01	7.83E-02	1.71E-02	8.18E-03	1.71E-03	4.42E-04
9 3	1.26E+00	2.25E+00	3.22E-01	1.44E-01	2.69E-02	1.21E-02	3.96E-03	1.12E-03
9 4	1.83E+00	3.65E+00	6.31E-01	2.30E-01	4.22E-02	2.27E-02	4.70E-03	1.55E-03
9 5	2.15E+00	6.01E+00	9.19E-01	3.38E-01	6.18E-02	2.24E-02	7.16E-03	2.30E-03
9 6	1.92E+00	8.77E+00	1.40E+00	4.81E-01	7.16E-02	3.46E-02	7.76E-03	1.70E-03
9 7	2.38E+00	9.60E+00	2.32E+00	8.68E-01	9.17E-02	4.04E-02	3.95E-03	5.32E-04
9 8	2.83E+00	7.00E+00	3.80E+00	1.46E+00	1.12E-01	2.71E-02	1.22E-03	7.25E-05
10	1.06E+02	8.57E+01	1.41E+01	4.79E+00	5.13E-01	1.92E-01	3.44E-02	8.25E-03
10 0	6.89E-01	1.63E-01	3.29E-02	1.58E-02	1.99E-03	1.16E-03	2.01E-04	2.85E-05
10 1	2.14E+00	5.74E-01	9.32E-02	3.88E-02	7.97E-03	3.13E-03	8.62E-04	2.23E-04
10 2	3.63E+00	1.35E+00	2.18E-01	8.55E-02	1.82E-02	8.82E-03	1.73E-03	4.12E-04
10 3	6.24E+00	2.83E+00	3.38E-01	1.60E-01	3.05E-02	1.17E-02	3.95E-03	1.02E-03
10 4	9.25E+00	5.11E+00	5.92E-01	2.14E-01	4.23E-02	2.26E-02	4.83E-03	1.45E-03
10 5	1.20E+01	9.07E+00	8.40E-01	3.55E-01	6.05E-02	2.27E-02	7.23E-03	2.31E-03
10 6	1.40E+01	1.35E+01	1.23E+00	4.50E-01	7.06E-02	3.12E-02	8.50E-03	1.86E-03
10 7	1.62E+01	1.73E+01	1.90E+00	6.77E-01	9.04E-02	4.00E-02	4.83E-03	7.60E-04
10 8	1.93E+01	2.01E+01	3.00E+00	1.07E+00	1.08E-01	3.54E-02	1.55E-03	1.69E-04
10 9	2.22E+01	1.58E+01	5.85E+00	1.72E+00	8.27E-02	1.54E-02	6.86E-04	2.06E-05
11	3.10E+02	1.22E+02	1.70E+01	5.80E+00	5.92E-01	2.16E-01	3.78E-02	8.39E-03
11 0	9.35E-01	1.44E-01	2.73E-02	1.56E-02	2.26E-03	1.35E-03	2.15E-04	2.84E-05
11 1	3.03E+00	6.02E-01	9.07E-02	4.05E-02	9.31E-03	3.82E-03	9.83E-04	2.18E-04
11 2	6.27E+00	1.12E+00	1.81E-01	8.67E-02	1.85E-02	9.67E-03	1.84E-03	3.93E-04
11 3	9.62E+00	2.49E+00	3.20E-01	1.55E-01	3.37E-02	1.33E-02	4.13E-03	9.29E-04
11 4	1.42E+01	4.25E+00	5.02E-01	2.14E-01	4.38E-02	2.35E-02	5.13E-03	1.32E-03
11 5	2.04E+01	7.27E+00	7.81E-01	3.40E-01	6.57E-02	2.51E-02	7.28E-03	2.23E-03
11 6	3.15E+01	1.17E+01	1.06E+00	4.68E-01	7.60E-02	3.26E-02	9.21E-03	1.98E-03
11 7	4.29E+01	1.62E+01	1.67E+00	5.73E-01	9.53E-02	4.06E-02	5.83E-03	9.55E-04
11 8	5.46E+01	2.36E+01	2.13E+00	1.01E+00	1.02E-01	3.54E-02	2.21E-03	2.64E-04
11 9	6.29E+01	2.90E+01	3.74E+00	1.23E+00	9.58E-02	2.17E-02	5.58E-04	6.41E-05
11 10	6.41E+01	2.60E+01	6.46E+00	1.66E+00	4.97E-02	8.77E-03	4.35E-04	8.52E-06

Table continues on next page.

Data for Ne^{10+} + H(2p) (cont.)

	impact energies [kev/amu]							
	1.0	10.0	30.0	45.0	90.0	120.0	200.0	300.0
	state resolved CX cross sections							
n ℓ								
12	3.72E+02	1.29E+02	1.93E+01	6.49E+00	6.82E-01	2.47E-01	4.17E-02	8.58E-03
12 0	6.20E-01	1.48E-01	2.98E-02	1.84E-02	2.75E-03	1.70E-03	2.33E-04	3.36E-05
12 1	2.16E+00	5.28E-01	1.08E-01	4.61E-02	1.26E-02	4.33E-03	1.01E-03	2.25E-04
12 2	3.93E+00	1.09E+00	1.91E-01	9.55E-02	2.17E-02	1.15E-02	2.07E-03	4.06E-04
12 3	6.45E+00	1.96E+00	3.46E-01	1.64E-01	3.91E-02	1.53E-02	4.32E-03	8.90E-04
12 4	9.80E+00	3.62E+00	4.96E-01	2.22E-01	4.96E-02	2.67E-02	5.60E-03	1.25E-03
12 5	1.46E+01	5.14E+00	7.69E-01	3.31E-01	6.91E-02	2.99E-02	7.54E-03	2.14E-03
12 6	2.21E+01	8.44E+00	9.60E-01	4.65E-01	7.98E-02	3.49E-02	9.79E-03	2.05E-03
12 7	3.56E+01	1.04E+01	1.57E+00	5.17E-01	1.03E-01	4.28E-02	6.80E-03	1.08E-03
12 8	5.19E+01	1.45E+01	1.80E+00	9.02E-01	1.09E-01	3.82E-02	2.80E-03	3.47E-04
12 9	6.61E+01	2.08E+01	2.87E+00	1.14E+00	1.04E-01	2.54E-02	9.32E-04	1.24E-04
12 10	7.54E+01	2.98E+01	4.13E+00	1.35E+00	6.51E-02	1.11E-02	2.43E-04	3.00E-05
12 11	8.30E+01	3.20E+01	5.98E+00	1.24E+00	2.59E-02	4.94E-03	3.59E-04	3.58E-06
13	1.11E+02	1.04E+02	2.02E+01	6.91E+00	8.29E-01	3.11E-01	4.80E-02	9.12E-03
13 0	4.85E-01	1.71E-01	4.32E-02	1.61E-02	5.08E-03	2.35E-03	4.66E-04	6.82E-05
13 1	1.04E+00	4.23E-01	1.27E-01	4.46E-02	1.87E-02	6.75E-03	1.35E-03	2.48E-04
13 2	1.53E+00	1.06E+00	2.50E-01	8.76E-02	2.99E-02	1.59E-02	2.57E-03	4.79E-04
13 3	1.91E+00	1.47E+00	3.72E-01	1.59E-01	5.41E-02	2.18E-02	5.14E-03	9.53E-04
13 4	2.43E+00	2.74E+00	5.56E-01	2.14E-01	6.49E-02	3.37E-02	6.42E-03	1.26E-03
13 5	2.88E+00	3.76E+00	8.00E-01	3.23E-01	8.51E-02	3.96E-02	8.08E-03	2.13E-03
13 6	4.02E+00	5.29E+00	9.42E-01	4.68E-01	9.19E-02	4.41E-02	1.07E-02	2.12E-03
13 7	5.23E+00	6.68E+00	1.52E+00	5.20E-01	1.13E-01	5.14E-02	7.85E-03	1.17E-03
13 8	7.63E+00	7.80E+00	1.61E+00	8.21E-01	1.22E-01	4.31E-02	3.46E-03	4.33E-04
13 9	1.16E+01	1.10E+01	2.30E+00	1.06E+00	1.10E-01	2.88E-02	1.08E-03	1.84E-04
13 10	1.67E+01	1.38E+01	3.19E+00	1.18E+00	8.24E-02	1.49E-02	4.18E-04	6.36E-05
13 11	2.31E+01	2.20E+01	4.12E+00	1.28E+00	3.96E-02	5.90E-03	1.14E-04	1.51E-05
13 12	3.20E+01	2.74E+01	4.35E+00	7.36E-01	1.23E-02	2.94E-03	3.47E-04	1.32E-06
14	3.60E+01	6.64E+01	1.99E+01	7.59E+00	1.19E+00	4.45E-01	6.14E-02	1.06E-02
14 0	3.75E-01	1.69E-01	1.01E-01	2.32E-02	9.66E-03	5.56E-03	8.25E-04	1.98E-04
14 1	1.97E+00	3.98E-01	1.93E-01	6.49E-02	3.54E-02	1.28E-02	2.15E-03	3.98E-04
14 2	8.06E-01	7.58E-01	3.45E-01	1.06E-01	5.66E-02	2.70E-02	3.79E-03	6.76E-04
14 3	3.28E+00	1.28E+00	5.06E-01	1.96E-01	8.65E-02	3.43E-02	6.54E-03	1.07E-03
14 4	8.83E-01	1.50E+00	6.77E-01	2.73E-01	1.08E-01	4.86E-02	8.71E-03	1.47E-03
14 5	1.72E+00	2.65E+00	9.08E-01	3.74E-01	1.31E-01	5.62E-02	9.73E-03	2.30E-03
14 6	1.19E+00	2.55E+00	9.28E-01	5.46E-01	1.40E-01	5.73E-02	1.27E-02	2.26E-03
14 7	1.63E+00	3.99E+00	1.49E+00	5.77E-01	1.55E-01	7.08E-02	1.00E-02	1.33E-03
14 8	1.72E+00	3.85E+00	1.52E+00	7.79E-01	1.57E-01	6.06E-02	4.52E-03	5.12E-04
14 9	2.12E+00	5.76E+00	1.88E+00	1.04E+00	1.33E-01	3.71E-02	1.47E-03	2.49E-04
14 10	2.84E+00	6.00E+00	2.44E+00	1.09E+00	9.49E-02	2.02E-02	4.21E-04	1.08E-04
14 11	4.36E+00	8.39E+00	2.91E+00	1.21E+00	5.22E-02	8.30E-03	1.87E-04	3.77E-05
14 12	6.04E+00	1.00E+01	3.60E+00	9.57E-01	2.22E-02	4.47E-03	6.31E-05	6.30E-06
14 13	7.05E+00	1.91E+01	2.38E+00	3.60E-01	6.96E-03	2.06E-03	3.28E-04	5.01E-07

Table A.35: Data for Ne^{10+} + H($n = 2$)

	impact energies [kev/amu]							
	1.0	10.0	30.0	45.0	90.0	120.0	200.0	300.0
	total cross sections							
CX	9.53E+02	5.57E+02	1.16E+02	4.50E+01	5.69E+00	2.29E+00	3.77E-01	9.72E-02
ION	1.36E+00	4.30E+00	3.18E+01	5.22E+01	9.00E+01	9.98E+01	1.01E+02	9.10E+01
	state resolved CX cross sections							
n ℓ								
4	8.76E-03	2.15E-03	1.62E-02	3.01E-02	4.55E-02	3.50E-02	1.98E-02	7.14E-03
4 0	9.40E-04	7.62E-05	7.13E-04	1.72E-03	1.47E-03	1.59E-03	2.64E-04	9.07E-05
4 1	2.27E-03	4.51E-04	2.68E-03	4.80E-03	5.80E-03	6.03E-03	1.27E-03	5.76E-04
4 2	2.48E-03	7.37E-04	4.85E-03	7.79E-03	1.43E-02	1.03E-02	4.60E-03	1.07E-03
4 3	3.07E-03	8.90E-04	7.97E-03	1.58E-02	2.39E-02	1.71E-02	1.37E-02	5.41E-03
5	6.59E-02	7.30E-03	9.77E-02	1.86E-01	1.07E-01	5.64E-02	1.48E-02	5.94E-03
5 0	1.01E-02	2.07E-04	6.17E-03	6.53E-03	1.43E-03	7.48E-04	3.28E-04	1.08E-04
5 1	2.13E-02	8.37E-04	1.53E-02	2.38E-02	6.19E-03	3.95E-03	1.23E-03	5.80E-04
5 2	1.56E-02	1.70E-03	2.08E-02	4.44E-02	1.84E-02	6.80E-03	2.30E-03	7.82E-04
5 3	8.74E-03	2.31E-03	2.77E-02	5.85E-02	3.15E-02	1.52E-02	4.79E-03	2.27E-03
5 4	1.02E-02	2.24E-03	2.77E-02	5.26E-02	4.95E-02	2.97E-02	6.11E-03	2.20E-03
6	2.57E-01	1.68E-01	8.51E-01	7.82E-01	2.12E-01	9.92E-02	1.87E-02	6.48E-03
6 0	2.26E-02	6.83E-03	2.57E-02	1.13E-02	1.90E-03	8.80E-04	3.28E-04	9.59E-05
6 1	5.93E-02	1.92E-02	7.77E-02	4.40E-02	5.85E-03	4.68E-03	1.15E-03	5.18E-04
6 2	6.96E-02	2.95E-02	1.49E-01	9.93E-02	1.67E-02	7.68E-03	2.05E-03	6.28E-04
6 3	4.29E-02	3.74E-02	1.97E-01	1.62E-01	2.94E-02	1.54E-02	3.81E-03	1.65E-03
6 4	3.44E-02	4.11E-02	2.10E-01	2.05E-01	5.90E-02	2.30E-02	4.90E-03	1.88E-03
6 5	2.78E-02	3.40E-02	1.91E-01	2.60E-01	9.92E-02	4.75E-02	6.43E-03	1.71E-03
7	3.82E-01	2.07E+00	3.13E+00	1.80E+00	3.28E-01	1.34E-01	2.37E-02	7.26E-03
7 0	1.69E-02	6.95E-02	3.46E-02	1.53E-02	2.72E-03	1.21E-03	3.70E-04	8.58E-05
7 1	4.60E-02	1.91E-01	1.17E-01	5.56E-02	8.40E-03	5.11E-03	1.16E-03	4.65E-04
7 2	7.27E-02	2.69E-01	2.64E-01	1.10E-01	2.04E-02	8.73E-03	2.25E-03	5.77E-04
7 3	6.76E-02	3.23E-01	4.50E-01	2.04E-01	3.03E-02	1.47E-02	3.83E-03	1.47E-03
7 4	8.41E-02	4.00E-01	6.46E-01	3.33E-01	5.19E-02	2.25E-02	4.97E-03	1.67E-03
7 5	6.31E-02	4.52E-01	7.62E-01	4.96E-01	7.50E-02	3.04E-02	6.39E-03	2.00E-03
7 6	3.16E-02	3.66E-01	8.58E-01	5.90E-01	1.39E-01	5.19E-02	4.68E-03	9.83E-04
8	1.01E+00	1.32E+01	6.69E+00	3.02E+00	4.16E-01	1.63E-01	2.74E-02	7.84E-03
8 0	2.19E-02	2.47E-01	4.52E-02	2.07E-02	2.87E-03	1.32E-03	3.20E-04	7.57E-05
8 1	8.64E-02	7.96E-01	1.43E-01	6.06E-02	7.06E-03	5.61E-03	1.06E-03	4.03E-04
8 2	9.30E-02	1.36E+00	2.99E-01	1.19E-01	2.00E-02	9.50E-03	2.12E-03	5.56E-04
8 3	1.83E-01	1.78E+00	4.97E-01	2.04E-01	2.77E-02	1.45E-02	3.77E-03	1.37E-03
8 4	1.52E-01	2.08E+00	8.27E-01	3.08E-01	4.35E-02	2.25E-02	5.04E-03	1.60E-03
8 5	1.47E-01	2.38E+00	1.27E+00	4.94E-01	7.24E-02	2.95E-02	6.55E-03	2.05E-03
8 6	1.65E-01	2.52E+00	1.63E+00	7.65E-01	9.15E-02	3.89E-02	6.15E-03	1.46E-03
8 7	1.62E-01	2.00E+00	1.98E+00	1.05E+00	1.51E-01	4.15E-02	2.37E-03	3.25E-04
9	1.37E+01	4.49E+01	1.11E+01	4.26E+00	4.97E-01	1.95E-01	3.13E-02	8.33E-03
9 0	1.56E-01	3.08E-01	5.10E-02	2.25E-02	2.71E-03	1.80E-03	3.70E-04	6.64E-05
9 1	4.92E-01	1.05E+00	1.60E-01	5.47E-02	9.09E-03	6.37E-03	1.22E-03	3.65E-04
9 2	9.07E-01	2.18E+00	3.21E-01	1.25E-01	2.07E-02	1.16E-02	2.28E-03	5.43E-04
9 3	1.17E+00	3.70E+00	5.12E-01	1.91E-01	2.89E-02	1.63E-02	4.04E-03	1.32E-03
9 4	1.68E+00	5.66E+00	8.16E-01	2.94E-01	4.54E-02	2.59E-02	5.23E-03	1.61E-03
9 5	1.99E+00	7.65E+00	1.17E+00	4.28E-01	6.61E-02	2.77E-02	6.66E-03	2.14E-03
9 6	2.15E+00	8.95E+00	1.76E+00	5.58E-01	8.51E-02	3.65E-02	6.73E-03	1.64E-03
9 7	2.73E+00	8.83E+00	2.70E+00	9.66E-01	1.10E-01	4.20E-02	3.50E-03	5.62E-04
9 8	2.43E+00	6.60E+00	3.60E+00	1.62E+00	1.29E-01	2.63E-02	1.23E-03	8.34E-05
10	1.06E+02	8.50E+01	1.52E+01	5.40E+00	5.78E-01	2.19E-01	3.44E-02	8.90E-03
10 0	8.09E-01	2.57E-01	5.00E-02	2.45E-02	3.11E-03	2.02E-03	4.03E-04	6.18E-05
10 1	2.58E+00	9.05E-01	1.70E-01	5.69E-02	1.07E-02	6.21E-03	1.32E-03	3.66E-04
10 2	4.64E+00	2.03E+00	3.14E-01	1.32E-01	2.19E-02	1.26E-02	2.47E-03	5.41E-04
10 3	7.26E+00	3.88E+00	5.20E-01	2.00E-01	3.21E-02	1.66E-02	4.20E-03	1.31E-03
10 4	8.98E+00	6.57E+00	7.52E-01	2.89E-01	4.52E-02	2.75E-02	5.46E-03	1.65E-03
10 5	1.10E+01	1.02E+01	1.05E+00	4.19E-01	6.58E-02	3.00E-02	6.82E-03	2.24E-03
10 6	1.32E+01	1.35E+01	1.45E+00	5.06E-01	8.34E-02	3.50E-02	7.38E-03	1.79E-03
10 7	1.63E+01	1.55E+01	2.05E+00	7.67E-01	9.94E-02	3.96E-02	4.16E-03	7.47E-04
10 8	2.14E+01	1.71E+01	3.39E+00	1.07E+00	1.24E-01	3.38E-02	1.35E-03	1.75E-04
10 9	1.96E+01	1.50E+01	5.46E+00	1.93E+00	9.18E-02	1.52E-02	7.91E-04	2.73E-05
11	3.21E+02	1.17E+02	1.79E+01	6.44E+00	6.55E-01	2.45E-01	3.93E-02	9.59E-03
11 0	1.34E+00	2.09E-01	4.72E-02	2.72E-02	4.11E-03	2.71E-03	5.14E-04	6.04E-05
11 1	4.19E+00	8.13E-01	1.73E-01	6.20E-02	1.30E-02	8.09E-03	1.67E-03	3.88E-04
11 2	7.95E+00	1.61E+00	2.85E-01	1.44E-01	2.52E-02	1.54E-02	2.96E-03	5.50E-04
11 3	1.26E+01	3.17E+00	5.08E-01	1.94E-01	3.66E-02	1.94E-02	4.80E-03	1.31E-03
11 4	1.95E+01	5.16E+00	6.69E-01	2.93E-01	4.81E-02	2.91E-02	6.18E-03	1.70E-03
11 5	2.60E+01	7.89E+00	9.72E-01	3.91E-01	6.93E-02	3.06E-02	7.23E-03	2.33E-03
11 6	3.38E+01	1.20E+01	1.27E+00	5.01E-01	8.49E-02	3.63E-02	8.05E-03	1.97E-03
11 7	4.07E+01	1.57E+01	1.74E+00	6.66E-01	9.95E-02	3.99E-02	4.90E-03	9.24E-04
11 8	4.89E+01	2.04E+01	2.37E+00	1.04E+00	1.12E-01	3.41E-02	1.89E-03	2.63E-04
11 9	6.18E+01	2.42E+01	3.73E+00	1.22E+00	1.07E-01	2.05E-02	5.08E-04	7.97E-05
11 10	6.39E+01	2.61E+01	6.18E+00	1.90E+00	5.39E-02	8.97E-03	5.65E-04	1.20E-05

Table continues on next page.

Data for Ne^{10+} + H(n = 2) (cont.)

n ℓ	1.0	10.0	30.0	45.0	90.0	120.0	200.0	300.0
	impact energies [kev/amu]							
	state resolved CX cross sections							
12	3.57E+02	1.24E+02	2.00E+01	7.16E+00	7.36E-01	2.82E-01	4.43E-02	1.04E-02
12 0	8.73E-01	1.99E-01	5.22E-02	3.41E-02	4.80E-03	3.21E-03	5.89E-04	6.57E-05
12 1	3.00E+00	6.90E-01	1.96E-01	6.45E-02	1.56E-02	8.86E-03	1.86E-03	4.22E-04
12 2	5.16E+00	1.38E+00	3.03E-01	1.65E-01	2.85E-02	1.79E-02	3.44E-03	5.97E-04
12 3	7.86E+00	2.45E+00	5.15E-01	2.02E-01	4.21E-02	2.26E-02	5.27E-03	1.35E-03
12 4	1.12E+01	4.16E+00	6.66E-01	3.18E-01	5.43E-02	3.42E-02	6.92E-03	1.80E-03
12 5	1.68E+01	5.51E+00	9.14E-01	3.91E-01	7.43E-02	3.70E-02	7.82E-03	2.42E-03
12 6	2.48E+01	8.46E+00	1.15E+00	5.09E-01	8.92E-02	4.03E-02	8.76E-03	2.13E-03
12 7	3.61E+01	1.02E+01	1.61E+00	6.07E-01	1.02E-01	4.13E-02	5.74E-03	1.08E-03
12 8	4.77E+01	1.35E+01	1.94E+00	9.57E-01	1.11E-01	3.59E-02	2.33E-03	3.54E-04
12 9	5.80E+01	1.87E+01	3.06E+00	1.08E+00	1.14E-01	2.41E-02	8.29E-04	1.46E-04
12 10	6.87E+01	2.49E+01	3.75E+00	1.41E+00	7.38E-02	1.07E-02	2.93E-04	4.14E-05
12 11	7.69E+01	3.42E+01	5.82E+00	1.43E+00	2.74E-02	5.55E-03	4.76E-04	5.07E-06
13	1.17E+02	1.02E+02	2.05E+01	7.56E+00	8.73E-01	3.42E-01	5.33E-02	1.15E-02
13 0	4.93E-01	2.01E-01	6.79E-02	3.48E-02	7.24E-03	4.49E-03	8.99E-04	8.68E-05
13 1	1.29E+00	5.47E-01	2.25E-01	7.39E-02	2.15E-02	1.29E-02	2.66E-03	4.74E-04
13 2	1.97E+00	1.22E+00	3.74E-01	1.69E-01	3.68E-02	2.40E-02	4.69E-03	7.53E-04
13 3	2.26E+00	1.83E+00	5.42E-01	2.11E-01	5.72E-02	2.92E-02	6.65E-03	1.49E-03
13 4	2.62E+00	3.13E+00	7.26E-01	3.03E-01	6.86E-02	3.96E-02	8.32E-03	1.91E-03
13 5	3.09E+00	3.98E+00	9.14E-01	3.79E-01	8.93E-02	4.32E-02	8.84E-03	2.53E-03
13 6	4.21E+00	5.45E+00	1.10E+00	5.00E-01	1.01E-01	4.70E-02	9.76E-03	2.30E-03
13 7	5.82E+00	6.52E+00	1.52E+00	5.91E-01	1.13E-01	4.91E-02	6.61E-03	1.22E-03
13 8	8.28E+00	7.55E+00	1.66E+00	9.35E-01	1.14E-01	4.11E-02	2.83E-03	4.58E-04
13 9	1.22E+01	1.00E+01	2.46E+00	1.01E+00	1.16E-01	2.76E-02	9.02E-04	2.11E-04
13 10	1.75E+01	1.26E+01	3.07E+00	1.14E+00	9.10E-02	1.38E-02	4.40E-04	8.53E-05
13 11	2.39E+01	1.94E+01	3.67E+00	1.38E+00	4.47E-02	5.86E-03	1.86E-04	2.06E-05
13 12	3.36E+01	2.94E+01	4.22E+00	8.44E-01	1.30E-02	3.65E-03	4.72E-04	1.87E-06
14	3.64E+01	6.77E+01	2.04E+01	8.39E+00	1.24E+00	5.24E-01	7.07E-02	1.38E-02
14 0	3.36E-01	1.84E-01	1.46E-01	5.05E-02	1.60E-02	1.26E-02	1.58E-03	2.29E-04
14 1	1.91E+00	5.05E-01	3.23E-01	1.30E-01	4.21E-02	2.86E-02	4.10E-03	7.15E-04
14 2	8.12E-01	8.70E-01	5.52E-01	2.18E-01	7.01E-02	4.63E-02	7.03E-03	1.12E-03
14 3	3.15E+00	1.50E+00	7.53E-01	3.10E-01	9.82E-02	5.38E-02	8.75E-03	1.71E-03
14 4	9.09E-01	1.79E+00	9.31E-01	3.93E-01	1.16E-01	6.69E-02	1.10E-02	2.21E-03
14 5	1.68E+00	2.86E+00	1.06E+00	4.83E-01	1.38E-01	6.75E-02	1.13E-02	2.74E-03
14 6	1.19E+00	2.83E+00	1.11E+00	6.01E-01	1.45E-01	6.09E-02	1.21E-02	2.55E-03
14 7	1.50E+00	4.07E+00	1.53E+00	6.42E-01	1.51E-01	6.32E-02	8.64E-03	1.45E-03
14 8	1.69E+00	3.89E+00	1.49E+00	8.77E-01	1.44E-01	5.37E-02	3.69E-03	5.65E-04
14 9	2.12E+00	5.49E+00	1.96E+00	1.03E+00	1.30E-01	3.55E-02	1.22E-03	2.80E-04
14 10	2.79E+00	5.59E+00	2.44E+00	1.03E+00	1.04E-01	2.01E-02	4.13E-04	1.43E-04
14 11	4.34E+00	7.96E+00	2.65E+00	1.20E+00	5.84E-02	7.95E-03	2.28E-04	4.98E-05
14 12	5.88E+00	9.64E+00	3.17E+00	1.02E+00	2.49E-02	4.57E-03	1.02E-04	8.74E-06
14 13	8.10E+00	2.05E+01	2.28E+00	4.09E-01	7.30E-03	2.57E-03	4.61E-04	6.84E-07

Table A.36: Data for F^{9+} + H(1s)

	impact energies [kev/amu] 1.0	10.0	30.0	45.0	90.0	120.0	200.0	300.
	total cross sections							
CX	6.75E+01	7.32E+01	5.93E+01	4.86E+01	1.78E+01	8.83E+00	1.79E+00	3.39E-01
ION	1.56E-02	1.86E-02	7.68E-02	1.32E-01	1.36E+00	2.86E+00	4.09E+00	7.56E+00
	state resolved CX cross sections							
n ℓ								
4	6.15E-02	1.06E+00	2.57E+00	2.46E+00	9.65E-01	5.29E-01	1.29E-01	3.64E-02
4 0	7.20E-03	9.98E-02	1.58E-01	1.29E-01	2.18E-02	9.92E-03	3.42E-03	1.54E-03
4 1	1.41E-02	2.51E-01	6.00E-01	4.60E-01	1.12E-01	4.90E-02	5.34E-03	1.01E-03
4 2	2.48E-02	3.76E-01	9.35E-01	8.28E-01	2.87E-01	1.25E-01	4.14E-02	1.47E-02
4 3	1.54E-02	3.35E-01	8.77E-01	1.04E+00	5.44E-01	3.45E-01	7.92E-02	1.91E-02
5	9.92E+00	2.22E+01	1.46E+01	9.47E+00	2.48E+00	1.09E+00	2.18E-01	4.56E-02
5 0	8.89E-01	5.72E-01	2.16E-01	9.90E-02	2.14E-02	7.28E-03	2.15E-03	1.64E-03
5 1	2.63E+00	2.28E+00	8.83E-01	4.94E-01	9.85E-02	5.55E-02	8.07E-03	1.19E-03
5 2	2.60E+00	4.52E+00	2.54E+00	1.16E+00	2.84E-01	8.64E-02	2.78E-02	1.13E-02
5 3	2.41E+00	7.06E+00	4.89E+00	2.97E+00	4.93E-01	2.36E-01	4.52E-02	1.29E-02
5 4	1.40E+00	7.78E+00	6.10E+00	4.76E+00	1.58E+00	7.03E-01	1.35E-01	1.86E-02
6	4.85E+01	3.81E+01	1.92E+01	1.22E+01	2.96E+00	1.28E+00	2.34E-01	4.54E-02
6 0	1.53E+00	2.16E-01	1.21E-01	6.34E-02	2.28E-02	8.57E-03	1.42E-03	1.49E-03
6 1	4.54E+00	1.21E+00	5.03E-01	3.45E-01	7.64E-02	6.83E-02	9.26E-03	1.23E-03
6 2	7.72E+00	2.86E+00	1.27E+00	7.41E-01	2.18E-01	7.76E-02	1.78E-02	8.80E-03
6 3	9.22E+00	6.32E+00	2.67E+00	1.54E+00	3.22E-01	1.84E-01	3.71E-02	1.08E-02
6 4	9.12E+00	1.13E+01	5.20E+00	2.55E+00	7.66E-01	3.45E-01	9.11E-02	1.42E-02
6 5	1.64E+01	1.61E+01	9.48E+00	6.93E+00	1.55E+00	5.99E-01	7.71E-02	8.89E-03
7	5.56E+00	9.26E+00	1.21E+01	9.42E+00	2.69E+00	1.19E+00	2.20E-01	4.21E-02
7 0	2.09E-01	5.51E-02	4.72E-02	4.60E-02	1.62E-02	6.29E-03	1.20E-03	1.19E-03
7 1	5.48E-01	2.02E-01	2.50E-01	1.84E-01	6.04E-02	4.87E-02	8.94E-03	1.43E-03
7 2	8.65E-01	3.59E-01	5.50E-01	4.58E-01	1.54E-01	5.50E-02	1.28E-02	7.00E-03
7 3	1.15E+00	8.10E-01	1.11E+00	7.94E-01	1.99E-01	1.43E-01	3.17E-02	9.13E-03
7 4	1.25E+00	1.68E+00	1.76E+00	1.23E+00	5.42E-01	2.32E-01	6.82E-02	1.14E-02
7 5	1.21E+00	2.37E+00	2.52E+00	2.27E+00	8.70E-01	4.14E-01	7.00E-02	9.67E-03
7 6	3.29E-01	3.78E+00	5.87E+00	4.44E+00	8.54E-01	2.96E-01	2.75E-02	2.28E-03
8	4.36E-01	1.20E+00	5.72E+00	5.98E+00	2.24E+00	1.08E+00	2.01E-01	3.72E-02
8 0	9.83E-03	2.46E-02	2.39E-02	3.30E-02	1.26E-02	9.17E-03	1.32E-03	1.02E-03
8 1	2.59E-02	6.80E-02	1.04E-01	9.37E-02	4.41E-02	5.53E-02	8.19E-03	1.70E-03
8 2	4.29E-02	9.81E-02	2.46E-01	2.81E-01	1.20E-01	5.37E-02	1.11E-02	5.64E-03
8 3	5.91E-02	1.50E-01	4.60E-01	4.07E-01	1.52E-01	1.25E-01	2.63E-02	7.47E-03
8 4	8.14E-02	1.37E-01	6.49E-01	6.48E-01	3.93E-01	1.56E-01	5.68E-02	9.48E-03
8 5	7.45E-02	2.47E-01	8.55E-01	1.07E+00	5.26E-01	2.91E-01	5.74E-02	8.16E-03
8 6	7.65E-02	2.22E-01	1.45E+00	1.68E+00	6.56E-01	2.86E-01	3.24E-02	3.09E-03
8 7	6.58E-02	2.58E-01	1.94E+00	1.77E+00	3.39E-01	1.07E-01	7.79E-03	6.18E-04
9	3.93E-01	5.82E-01	2.54E+00	3.63E+00	1.79E+00	9.17E-01	1.82E-01	3.20E-02
9 0	8.29E-03	1.46E-02	1.57E-02	2.44E-02	1.17E-02	5.67E-03	1.50E-03	8.12E-04
9 1	1.69E-02	3.94E-02	4.21E-02	4.95E-02	4.73E-02	4.09E-02	7.60E-03	1.45E-03
9 2	2.59E-02	5.15E-02	1.18E-01	1.78E-01	9.27E-02	3.89E-02	1.05E-02	4.30E-03
9 3	4.28E-02	5.70E-02	2.03E-01	2.19E-01	1.29E-01	1.01E-01	2.15E-02	6.23E-03
9 4	4.57E-02	7.02E-02	2.61E-01	3.58E-01	2.60E-01	1.28E-01	4.84E-02	8.12E-03
9 5	5.44E-02	8.26E-02	3.44E-01	5.65E-01	3.62E-01	2.05E-01	4.89E-02	6.81E-03
9 6	7.79E-02	8.58E-02	5.07E-01	7.99E-01	4.38E-01	2.31E-01	3.01E-02	3.23E-03
9 7	7.98E-02	8.28E-02	5.78E-01	8.86E-01	3.36E-01	1.29E-01	1.16E-02	8.99E-04
9 8	4.13E-02	9.82E-02	4.73E-01	5.48E-01	1.14E-01	3.79E-02	1.98E-03	1.91E-04
10	4.37E-01	3.30E-01	1.20E+00	2.21E+00	1.42E+00	7.82E-01	1.66E-01	2.84E-02
10 0	8.57E-03	7.66E-03	9.20E-03	1.63E-02	1.05E-02	7.67E-03	1.59E-03	6.36E-04
10 1	1.50E-02	1.99E-02	2.40E-02	3.00E-02	4.21E-02	4.05E-02	7.37E-03	1.29E-03
10 2	1.96E-02	2.57E-02	5.77E-02	1.12E-01	7.19E-02	3.91E-02	1.00E-02	3.54E-03
10 3	4.18E-02	2.56E-02	1.06E-01	1.30E-01	9.59E-02	8.33E-02	1.83E-02	5.66E-03
10 4	5.68E-02	3.34E-02	1.12E-01	2.09E-01	1.96E-01	9.65E-02	4.09E-02	7.06E-03
10 5	5.00E-02	4.23E-02	1.63E-01	3.17E-01	2.57E-01	1.51E-01	4.32E-02	5.79E-03
10 6	5.66E-02	4.90E-02	2.06E-01	4.21E-01	3.04E-01	1.81E-01	2.77E-02	3.02E-03
10 7	5.14E-02	4.41E-02	2.12E-01	4.51E-01	2.82E-01	1.20E-01	1.27E-02	9.40E-04
10 8	4.62E-02	3.82E-02	2.10E-01	3.82E-01	1.25E-01	4.27E-02	3.86E-03	3.65E-04
10 9	9.09E-02	4.37E-02	1.03E-01	1.37E-01	3.46E-02	2.12E-02	5.40E-04	6.22E-05
11	4.57E-01	1.87E-01	6.07E-01	1.39E+00	1.18E+00	6.85E-01	1.52E-01	2.57E-02
11 0	1.11E-02	2.85E-03	4.25E-03	1.12E-02	8.34E-03	5.90E-03	1.60E-03	5.66E-04
11 1	2.50E-02	7.44E-03	1.52E-02	1.81E-02	3.29E-02	3.30E-02	7.39E-03	1.40E-03
11 2	3.71E-02	1.03E-02	2.56E-02	7.42E-02	5.97E-02	3.40E-02	9.56E-03	3.20E-03
11 3	5.61E-02	1.24E-02	6.20E-02	8.07E-02	7.82E-02	7.29E-02	1.65E-02	5.17E-03
11 4	6.29E-02	1.96E-02	5.07E-02	1.31E-01	1.71E-01	8.75E-02	3.44E-02	6.04E-03
11 5	5.22E-02	2.68E-02	8.84E-02	1.91E-01	1.86E-01	1.18E-01	3.78E-02	5.04E-03
11 6	4.36E-02	3.06E-02	9.50E-02	2.40E-01	2.36E-01	1.48E-01	2.57E-02	2.75E-03
11 7	3.45E-02	2.50E-02	9.11E-02	2.44E-01	2.31E-01	1.10E-01	1.26E-02	9.53E-04
11 8	2.69E-02	2.21E-02	9.26E-02	2.34E-01	1.24E-01	4.67E-02	5.01E-03	4.00E-04
11 9	4.54E-02	1.62E-02	5.73E-02	1.32E-01	4.57E-02	1.23E-02	1.37E-03	1.45E-04
11 10	6.24E-02	1.40E-02	2.53E-02	2.92E-02	9.82E-03	1.68E-02	1.71E-04	2.18E-05

Table continues on next page.

Data for F^{9+} + H(1s) (cont.)

				impact energies [kev/amu]				
	1.0	10.0	30.0	45.0	90.0	120.0	200.0	300.
				state resolved CX cross sections				
n ℓ								
12	8.90E-01	1.66E-01	3.67E-01	9.68E-01	1.05E+00	6.23E-01	1.43E-01	2.36E-02
12 0	9.28E-03	2.55E-03	3.32E-03	8.31E-03	1.07E-02	8.63E-03	1.61E-03	5.50E-04
12 1	2.93E-02	7.70E-03	1.15E-02	1.35E-02	4.16E-02	3.62E-02	7.66E-03	1.54E-03
12 2	5.49E-02	1.12E-02	1.82E-02	5.27E-02	6.30E-02	3.83E-02	9.33E-03	2.91E-03
12 3	7.74E-02	1.57E-02	3.86E-02	5.71E-02	8.68E-02	6.68E-02	1.58E-02	4.61E-03
12 4	7.95E-02	1.94E-02	3.28E-02	9.13E-02	1.46E-01	7.33E-02	3.01E-02	5.27E-03
12 5	7.74E-02	2.22E-02	5.20E-02	1.30E-01	1.47E-01	9.47E-02	3.32E-02	4.60E-03
12 6	9.31E-02	2.16E-02	5.38E-02	1.54E-01	1.79E-01	1.24E-01	2.44E-02	2.56E-03
12 7	1.05E-01	1.65E-02	4.58E-02	1.48E-01	1.79E-01	9.80E-02	1.25E-02	9.39E-04
12 8	8.52E-02	1.54E-02	4.90E-02	1.57E-01	1.20E-01	4.74E-02	5.66E-03	3.40E-04
12 9	8.91E-02	1.16E-02	3.36E-02	1.10E-01	5.14E-02	1.69E-02	2.24E-03	1.99E-04
12 10	8.83E-02	1.40E-02	1.61E-02	3.91E-02	1.76E-02	4.62E-03	5.59E-04	5.97E-05
12 11	1.01E-01	8.24E-03	1.22E-02	6.85E-03	3.67E-03	1.42E-02	5.96E-05	6.08E-06
13	8.52E-01	1.30E-01	3.50E-01	9.11E-01	1.06E+00	6.45E-01	1.45E-01	2.21E-02
13 0	1.37E-02	1.98E-03	3.96E-03	1.04E-02	1.40E-02	8.86E-03	1.60E-03	4.26E-04
13 1	4.59E-02	6.08E-03	1.49E-02	2.05E-02	5.74E-02	4.08E-02	8.52E-03	1.43E-03
13 2	6.87E-02	9.91E-03	2.11E-02	5.33E-02	8.31E-02	4.87E-02	1.05E-02	2.65E-03
13 3	8.25E-02	1.40E-02	3.91E-02	6.65E-02	1.00E-01	7.68E-02	1.64E-02	3.96E-03
13 4	8.91E-02	1.59E-02	3.82E-02	9.44E-02	1.49E-01	8.48E-02	2.89E-02	5.10E-03
13 5	9.21E-02	1.76E-02	5.06E-02	1.26E-01	1.39E-01	8.71E-02	3.06E-02	4.60E-03
13 6	9.24E-02	1.49E-02	4.96E-02	1.40E-01	1.57E-01	1.12E-01	2.42E-02	2.45E-03
13 7	9.22E-02	1.11E-02	4.05E-02	1.20E-01	1.67E-01	9.58E-02	1.30E-02	8.78E-04
13 8	6.98E-02	1.07E-02	3.69E-02	1.25E-01	1.17E-01	4.91E-02	6.34E-03	2.89E-04
13 9	5.56E-02	8.58E-03	2.64E-02	9.76E-02	4.69E-02	1.75E-02	3.18E-03	2.15E-04
13 10	4.53E-02	9.42E-03	1.52E-02	4.39E-02	1.91E-02	8.20E-03	1.19E-03	8.71E-05
13 11	4.20E-02	6.82E-03	6.77E-03	1.21E-02	6.95E-03	3.92E-03	2.50E-04	1.89E-05
13 12	6.22E-02	3.00E-03	7.12E-03	1.97E-03	3.07E-03	1.13E-02	2.15E-05	1.50E-06

Table A.37: Data for F^{9+} + H(2s)

	impact energies [kev/amu]							
	1.0	10.0	30.0	45.0	90.0	120.0	200.0	300.
	total cross sections							
CX	8.59E+02	4.89E+02	1.16E+02	4.69E+01	7.07E+00	3.46E+00	6.18E-01	1.52E-01
ION	1.84E-02	3.61E-01	9.61E-01	1.19E+00	1.91E+00	3.61E+00	7.67E+00	6.80E+00
	state resolved CX cross sections							
n ℓ								
4	2.78E-02	1.35E-02	2.45E-01	9.22E-02	1.04E-01	6.25E-02	3.68E-02	8.66E-03
4 0	2.88E-03	9.96E-04	2.44E-02	7.55E-03	5.54E-03	2.30E-03	1.29E-03	3.58E-04
4 1	1.11E-02	3.46E-03	4.28E-02	2.06E-02	2.09E-02	1.11E-02	3.98E-03	1.02E-03
4 2	6.44E-03	5.00E-03	9.31E-02	2.50E-02	3.66E-02	2.07E-02	1.11E-02	2.68E-03
4 3	7.37E-03	4.02E-03	8.52E-02	3.90E-02	4.04E-02	2.84E-02	2.04E-02	4.59E-03
5	3.87E-02	4.01E-02	6.60E-01	5.80E-01	2.53E-01	1.61E-01	6.52E-02	1.42E-02
5 0	3.89E-03	1.50E-03	4.93E-02	3.70E-02	5.45E-03	2.47E-03	1.53E-03	4.83E-04
5 1	9.68E-03	5.73E-03	1.19E-01	1.16E-01	1.31E-02	1.21E-02	4.90E-03	1.27E-03
5 2	1.03E-02	1.07E-02	1.52E-01	1.58E-01	3.40E-02	1.54E-02	1.30E-02	4.01E-03
5 3	7.24E-03	1.09E-02	1.80E-01	1.47E-01	8.63E-02	4.11E-02	1.63E-02	4.11E-03
5 4	7.59E-03	1.12E-02	1.59E-01	1.22E-01	1.14E-01	8.95E-02	2.95E-02	4.30E-03
6	9.79E-02	6.09E-01	4.18E+00	2.40E+00	4.92E-01	2.45E-01	7.99E-02	1.64E-02
6 0	6.36E-03	5.75E-02	1.47E-01	3.21E-02	7.68E-03	2.93E-03	1.39E-03	5.50E-04
6 1	1.27E-02	1.42E-01	4.14E-01	1.08E-01	1.43E-02	1.58E-02	4.53E-03	1.34E-03
6 2	1.35E-02	1.53E-01	8.77E-01	2.27E-01	4.49E-02	1.81E-02	1.09E-02	3.80E-03
6 3	1.59E-02	1.12E-01	1.20E+00	5.91E-01	7.45E-02	4.36E-02	1.52E-02	3.31E-03
6 4	1.85E-02	8.23E-02	9.85E-01	8.50E-01	9.83E-02	4.26E-02	2.31E-02	4.42E-03
6 5	3.09E-02	6.17E-02	5.59E-01	5.92E-01	2.52E-01	1.22E-01	2.48E-02	3.02E-03
7	3.89E-01	9.71E+00	1.09E+01	4.18E+00	6.76E-01	3.13E-01	7.95E-02	1.73E-02
7 0	1.20E-02	5.53E-01	1.19E-01	4.08E-02	1.15E-02	3.93E-03	1.15E-03	4.34E-04
7 1	3.87E-02	1.54E+00	4.15E-01	1.26E-01	2.30E-02	1.72E-02	3.65E-03	9.90E-04
7 2	5.68E-02	2.21E+00	8.99E-01	2.03E-01	6.10E-02	2.22E-02	8.60E-03	3.16E-03
7 3	8.77E-02	2.23E+00	1.47E+00	4.42E-01	7.71E-02	4.80E-02	1.31E-02	3.25E-03
7 4	7.78E-02	1.62E+00	2.54E+00	5.52E-01	1.13E-01	4.72E-02	1.70E-02	4.50E-03
7 5	5.44E-02	1.02E+00	3.15E+00	1.14E+00	1.50E-01	9.89E-02	2.49E-02	3.90E-03
7 6	6.18E-02	5.37E-01	2.28E+00	1.68E+00	2.41E-01	7.52E-02	1.11E-02	1.04E-03
8	7.34E+00	5.04E+01	1.47E+01	5.35E+00	7.61E-01	3.65E-01	7.12E-02	1.77E-02
8 0	6.68E-02	7.09E-01	1.13E-01	4.91E-02	1.26E-02	5.40E-03	9.91E-04	4.36E-04
8 1	2.33E-01	2.69E+00	3.76E-01	1.49E-01	2.31E-02	2.24E-02	2.90E-03	1.05E-03
8 2	4.58E-01	6.03E+00	7.14E-01	2.34E-01	6.09E-02	2.93E-02	6.99E-03	3.12E-03
8 3	8.79E-01	1.00E+01	1.03E+00	4.46E-01	6.28E-02	5.36E-02	1.08E-02	3.43E-03
8 4	1.23E+00	1.14E+01	1.62E+00	5.06E-01	1.07E-01	5.46E-02	1.26E-02	4.04E-03
8 5	1.84E+00	8.98E+00	2.50E+00	7.67E-01	1.43E-01	7.85E-02	1.98E-02	3.71E-03
8 6	1.68E+00	5.86E+00	4.29E+00	1.12E+00	2.00E-01	8.33E-02	1.38E-02	1.67E-03
8 7	9.58E-01	4.64E+00	4.10E+00	2.07E+00	1.52E-01	3.79E-02	3.27E-03	2.77E-04
9	6.79E+01	7.76E+01	1.55E+01	5.96E+00	8.19E-01	4.03E-01	6.26E-02	1.70E-02
9 0	1.14E+00	8.67E-01	1.05E-01	4.98E-02	1.41E-02	5.88E-03	9.46E-04	4.58E-04
9 1	4.37E+00	2.79E+00	3.28E-01	1.43E-01	2.26E-02	2.29E-02	2.57E-03	1.12E-03
9 2	6.46E+00	5.70E+00	5.84E-01	2.39E-01	6.68E-02	3.22E-02	6.13E-03	2.92E-03
9 3	5.88E+00	8.94E+00	8.84E-01	4.04E-01	6.56E-02	5.38E-02	9.23E-03	3.10E-03
9 4	5.04E+00	1.18E+01	1.17E+00	5.02E-01	1.20E-01	6.46E-02	1.00E-02	3.36E-03
9 5	7.44E+00	1.43E+01	1.67E+00	5.87E-01	1.37E-01	7.76E-02	1.57E-02	3.46E-03
9 6	1.14E+01	1.23E+01	1.94E+00	9.62E-01	1.55E-01	8.53E-02	1.24E-02	2.01E-03
9 7	1.91E+01	8.88E+00	4.14E+00	1.06E+00	1.44E-01	4.22E-02	4.75E-03	4.90E-04
9 8	7.16E+00	1.19E+01	4.73E+00	2.01E+00	9.27E-02	1.82E-02	8.45E-04	7.01E-05
10	3.12E+02	8.90E+01	1.62E+01	6.16E+00	8.44E-01	4.08E-01	5.69E-02	1.57E-02
10 0	2.78E+00	6.31E-01	8.86E-02	5.00E-02	1.63E-02	6.49E-03	9.53E-04	4.19E-04
10 1	8.52E+00	2.01E+00	3.53E-01	1.26E-01	2.74E-02	2.35E-02	2.59E-03	9.86E-04
10 2	1.72E+01	4.00E+00	4.81E-01	2.41E-01	7.53E-02	3.43E-02	5.69E-03	2.50E-03
10 3	3.20E+01	7.08E+00	8.74E-01	3.37E-01	7.19E-02	5.07E-02	8.54E-03	2.70E-03
10 4	4.06E+01	9.95E+00	8.89E-01	4.88E-01	1.19E-01	6.30E-02	8.72E-03	2.96E-03
10 5	3.74E+01	1.24E+01	1.48E+00	4.52E-01	1.20E-01	6.65E-02	1.34E-02	3.31E-03
10 6	3.08E+01	1.31E+01	1.28E+00	8.31E-01	1.35E-01	8.24E-02	1.05E-02	2.09E-03
10 7	2.74E+01	9.68E+00	2.52E+00	8.88E-01	1.40E-01	4.79E-02	4.72E-03	5.84E-04
10 8	5.67E+01	7.58E+00	2.84E+00	9.83E-01	8.94E-02	2.38E-02	1.50E-03	1.54E-04
10 9	5.86E+01	2.26E+01	5.43E+00	1.77E+00	4.97E-02	8.87E-03	2.35E-04	2.06E-05
11	3.05E+02	1.02E+02	1.66E+01	6.28E+00	8.77E-01	4.29E-01	5.38E-02	1.49E-02
11 0	2.45E+00	4.04E-01	8.30E-02	6.11E-02	1.84E-02	7.85E-03	9.93E-04	3.82E-04
11 1	7.26E+00	1.50E+00	3.97E-01	1.29E-01	3.11E-02	2.53E-02	2.81E-03	8.80E-04
11 2	1.17E+01	2.88E+00	4.35E-01	2.90E-01	8.05E-02	3.99E-02	5.47E-03	2.24E-03
11 3	1.59E+01	4.71E+00	9.43E-01	3.16E-01	7.71E-02	5.29E-02	8.40E-03	2.57E-03
11 4	2.34E+01	6.92E+00	7.82E-01	5.26E-01	1.12E-01	6.97E-02	8.06E-03	2.81E-03
11 5	3.11E+01	7.42E+00	1.45E+00	3.99E-01	1.23E-01	6.61E-02	1.23E-02	3.13E-03
11 6	3.59E+01	8.56E+00	1.20E+00	7.02E-01	1.35E-01	7.82E-02	9.36E-03	2.02E-03
11 7	3.34E+01	1.02E+01	1.70E+00	8.14E-01	1.29E-01	4.78E-02	4.11E-03	6.33E-04
11 8	3.26E+01	1.14E+01	2.67E+00	6.74E-01	8.67E-02	2.43E-02	1.69E-03	2.05E-04
11 9	5.03E+01	9.88E+00	2.12E+00	1.17E+00	6.32E-02	1.21E-02	5.34E-04	4.99E-05
11 10	6.10E+01	3.85E+01	4.84E+00	1.20E+00	2.10E-02	4.92E-03	6.87E-05	6.36E-06

Table continues on next page.

Data for F^{9+} + H(2s) (cont.)

	impact energies [kev/amu]							
	1.0	10.0	30.0	45.0	90.0	120.0	200.0	300.
	state resolved CX cross sections							
n ℓ								
12	1.34E+02	9.65E+01	1.70E+01	6.70E+00	9.67E-01	4.67E-01	5.35E-02	1.47E-02
12 0	7.13E-01	3.36E-01	1.10E-01	8.70E-02	2.24E-02	1.04E-02	1.08E-03	3.93E-04
12 1	1.91E+00	9.32E-01	4.93E-01	1.63E-01	4.06E-02	3.04E-02	3.16E-03	9.08E-04
12 2	2.83E+00	2.23E+00	5.33E-01	4.00E-01	9.55E-02	4.91E-02	5.40E-03	2.19E-03
12 3	3.32E+00	2.81E+00	1.13E+00	3.59E-01	9.63E-02	5.85E-02	8.61E-03	2.63E-03
12 4	3.70E+00	4.72E+00	8.77E-01	6.32E-01	1.25E-01	7.64E-02	7.91E-03	2.72E-03
12 5	4.46E+00	4.65E+00	1.55E+00	4.37E-01	1.43E-01	6.64E-02	1.20E-02	2.92E-03
12 6	5.89E+00	5.62E+00	1.29E+00	6.36E-01	1.30E-01	7.75E-02	9.15E-03	1.94E-03
12 7	7.88E+00	5.55E+00	1.44E+00	7.87E-01	1.19E-01	5.20E-02	3.63E-03	6.84E-04
12 8	1.16E+01	6.39E+00	2.26E+00	5.95E-01	9.00E-02	2.50E-02	1.56E-03	2.18E-04
12 9	2.03E+01	9.65E+00	2.06E+00	8.22E-01	6.25E-02	1.34E-02	7.66E-04	7.06E-05
12 10	2.80E+01	1.31E+01	2.13E+00	1.13E+00	3.56E-02	5.04E-03	2.04E-04	1.87E-05
12 11	4.30E+01	4.06E+01	3.08E+00	6.45E-01	7.50E-03	2.97E-03	2.03E-05	1.72E-06
13	3.24E+01	6.33E+01	2.00E+01	9.19E+00	1.28E+00	6.03E-01	5.81E-02	1.51E-02
13 0	1.83E-01	2.76E-01	2.31E-01	1.84E-01	3.62E-02	1.58E-02	1.09E-03	3.81E-04
13 1	6.54E-01	6.06E-01	8.50E-01	3.67E-01	7.17E-02	4.42E-02	3.93E-03	9.97E-04
13 2	8.81E-01	1.60E+00	1.02E+00	7.99E-01	1.41E-01	7.19E-02	6.12E-03	2.41E-03
13 3	9.38E-01	1.91E+00	1.80E+00	7.11E-01	1.57E-01	7.96E-02	9.48E-03	2.76E-03
13 4	1.01E+00	2.95E+00	1.55E+00	1.08E+00	1.71E-01	1.05E-01	8.68E-03	2.64E-03
13 5	1.07E+00	3.12E+00	2.13E+00	8.29E-01	1.91E-01	8.72E-02	1.27E-02	2.90E-03
13 6	1.11E+00	3.47E+00	1.95E+00	8.38E-01	1.55E-01	8.82E-02	9.80E-03	1.95E-03
13 7	1.50E+00	3.01E+00	1.64E+00	9.70E-01	1.36E-01	5.92E-02	3.55E-03	7.31E-04
13 8	2.37E+00	3.60E+00	2.08E+00	6.79E-01	1.00E-01	2.62E-02	1.40E-03	2.09E-04
13 9	3.21E+00	3.47E+00	2.07E+00	7.05E-01	6.22E-02	1.46E-02	9.18E-04	7.93E-05
13 10	4.61E+00	5.86E+00	1.66E+00	9.37E-01	4.25E-02	7.18E-03	3.82E-04	3.05E-05
13 11	5.20E+00	8.70E+00	1.66E+00	8.07E-01	1.56E-02	2.15E-03	7.92E-05	5.56E-06
13 12	9.66E+00	2.47E+01	1.40E+00	2.86E-01	2.83E-03	1.78E-03	6.33E-06	3.93E-07

Table A.38: Data for F^{9+} + H(2p0)

	impact energies [kev/amu]							
	1.0	10.0	30.0	45.0	90.0	120.0	200.0	300.
	total cross sections							
CX	8.64E+02	5.16E+02	6.21E+01	1.88E+01	2.09E+00	1.29E+00	2.60E-01	2.78E-02
ION	3.39E-02	2.63E-01	6.03E-01	1.37E+00	2.54E+00	3.44E+00	5.07E+00	4.42E+00
	state resolved CX cross sections							
n ℓ								
4	2.10E-02	4.21E-02	1.06E-01	1.12E-01	5.33E-02	3.95E-02	7.60E-03	3.35E-03
4 0	1.72E-03	2.66E-03	3.79E-03	6.25E-03	1.63E-03	1.95E-03	5.50E-05	1.28E-04
4 1	5.77E-03	9.83E-03	1.46E-02	1.82E-02	7.24E-03	7.98E-03	2.37E-04	1.56E-04
4 2	7.13E-03	1.42E-02	2.81E-02	3.39E-02	2.05E-02	1.27E-02	1.81E-03	1.08E-03
4 3	6.36E-03	1.54E-02	5.94E-02	5.41E-02	2.40E-02	1.69E-02	5.50E-03	1.98E-03
5	4.26E-02	1.11E-01	3.27E-01	1.98E-01	6.16E-02	4.98E-02	8.44E-03	3.06E-03
5 0	3.32E-03	3.25E-03	2.89E-02	7.94E-03	2.29E-03	1.19E-03	1.54E-04	8.75E-05
5 1	8.66E-03	1.48E-02	5.15E-02	2.73E-02	7.36E-03	6.66E-03	7.12E-04	1.13E-04
5 2	1.07E-02	3.57E-02	6.44E-02	3.55E-02	1.24E-02	1.07E-02	1.43E-03	6.75E-04
5 3	1.01E-02	2.69E-02	8.50E-02	5.07E-02	1.34E-02	1.61E-02	2.09E-03	7.45E-04
5 4	9.76E-03	3.00E-02	9.74E-02	7.68E-02	2.62E-02	1.51E-02	4.06E-03	1.44E-03
6	9.28E-02	9.25E-01	1.10E+00	3.38E-01	1.21E-01	6.82E-02	1.17E-02	2.99E-03
6 0	6.50E-03	3.96E-02	2.35E-02	6.56E-03	2.09E-03	1.33E-03	3.63E-04	6.35E-05
6 1	1.21E-02	1.09E-01	5.16E-02	2.43E-02	6.46E-03	7.12E-03	1.37E-03	1.09E-04
6 2	1.10E-02	1.42E-01	1.48E-01	3.24E-02	1.23E-02	1.16E-02	1.90E-03	4.95E-04
6 3	2.06E-02	1.90E-01	2.60E-01	4.75E-02	2.12E-02	1.40E-02	2.72E-03	4.67E-04
6 4	1.59E-02	2.17E-01	2.72E-01	6.99E-02	3.47E-02	1.99E-02	2.39E-03	1.07E-03
6 5	2.66E-02	2.26E-01	3.41E-01	1.58E-01	4.39E-02	1.42E-02	3.00E-03	7.77E-04
7	6.30E-01	7.17E+00	1.38E+00	5.80E-01	1.71E-01	8.07E-02	1.58E-02	2.99E-03
7 0	2.03E-02	2.37E-01	1.65E-02	5.82E-03	2.07E-03	7.27E-04	5.15E-04	6.32E-05
7 1	4.83E-02	6.79E-01	4.61E-02	1.95E-02	8.16E-03	3.82E-03	1.82E-03	1.43E-04
7 2	8.05E-02	8.65E-01	9.04E-02	3.40E-02	1.23E-02	8.45E-03	2.38E-03	4.39E-04
7 3	9.71E-02	9.63E-01	1.51E-01	4.82E-02	1.88E-02	1.14E-02	3.36E-03	4.17E-04
7 4	8.61E-02	1.29E+00	2.36E-01	8.99E-02	2.51E-02	2.08E-02	2.77E-03	7.52E-04
7 5	1.56E-01	1.70E+00	2.83E-01	1.22E-01	4.61E-02	1.84E-02	2.55E-03	8.47E-04
7 6	1.42E-01	1.44E+00	5.59E-01	2.61E-01	5.85E-02	1.71E-02	2.35E-03	3.28E-04
8	1.14E+01	1.99E+01	2.67E+00	1.10E+00	2.06E-01	1.29E-01	1.98E-02	2.85E-03
8 0	2.36E-01	2.22E-01	1.77E-02	6.55E-03	2.14E-03	2.02E-03	6.34E-04	6.54E-05
8 1	5.64E-01	7.34E-01	5.28E-02	2.32E-02	6.69E-03	8.23E-03	2.18E-03	1.40E-04
8 2	9.97E-01	1.40E+00	1.07E-01	3.86E-02	1.22E-02	1.38E-02	2.83E-03	3.86E-04
8 3	2.01E+00	2.04E+00	1.24E-01	6.64E-02	1.82E-02	1.66E-02	3.92E-03	3.56E-04
8 4	2.27E+00	2.46E+00	2.82E-01	9.10E-02	2.33E-02	2.48E-02	3.36E-03	5.60E-04
8 5	1.22E+00	3.17E+00	3.19E-01	1.66E-01	4.11E-02	2.58E-02	2.87E-03	8.00E-04
8 6	2.18E+00	4.75E+00	7.40E-01	2.13E-01	5.63E-02	2.31E-02	2.89E-03	4.52E-04
8 7	1.94E+00	5.17E+00	1.02E+00	4.98E-01	4.57E-02	1.50E-02	1.09E-03	8.71E-05
9	7.10E+01	5.21E+01	5.40E+00	1.97E+00	2.33E-01	1.44E-01	2.48E-02	2.70E-03
9 0	1.53E+00	3.35E-01	2.60E-02	9.62E-03	2.17E-03	1.57E-03	7.82E-04	5.98E-05
9 1	3.75E+00	9.81E-01	8.47E-02	3.55E-02	4.97E-03	5.83E-03	2.61E-03	1.31E-04
9 2	6.44E+00	1.74E+00	1.54E-01	4.78E-02	1.11E-02	1.15E-02	3.42E-03	3.36E-04
9 3	8.54E+00	2.89E+00	2.13E-01	9.92E-02	1.55E-02	1.48E-02	4.67E-03	3.30E-04
9 4	8.36E+00	6.52E+00	4.13E-01	1.10E-01	2.38E-02	2.30E-02	4.10E-03	4.71E-04
9 5	1.05E+01	1.01E+01	4.09E-01	2.69E-01	3.55E-02	2.82E-02	3.55E-03	7.23E-04
9 6	7.40E+00	1.16E+01	9.57E-01	2.05E-01	6.63E-02	2.22E-02	3.44E-03	4.84E-04
9 7	8.43E+00	1.05E+01	7.15E-01	5.92E-01	5.25E-02	2.34E-02	1.81E-03	1.50E-04
9 8	1.60E+01	7.48E+00	2.43E+00	6.03E-01	2.08E-02	1.32E-02	3.81E-04	1.95E-05
10	2.48E+02	1.14E+02	9.38E+00	2.81E+00	2.63E-01	1.54E-01	3.09E-02	2.57E-03
10 0	1.76E+00	3.74E-01	3.36E-02	1.43E-02	3.70E-03	2.17E-03	9.50E-04	5.51E-05
10 1	6.01E+00	1.03E+00	1.38E-01	4.86E-02	7.28E-03	7.19E-03	3.10E-03	1.33E-04
10 2	1.03E+01	2.38E+00	2.00E-01	6.90E-02	1.63E-02	1.35E-02	4.12E-03	3.04E-04
10 3	1.26E+01	3.97E+00	3.97E-01	1.30E-01	1.64E-02	1.67E-02	5.60E-03	3.27E-04
10 4	1.63E+01	7.81E+00	5.51E-01	1.35E-01	2.88E-02	2.42E-02	5.06E-03	4.12E-04
10 5	2.72E+01	1.20E+01	6.59E-01	3.24E-01	3.23E-02	2.74E-02	4.36E-03	6.36E-04
10 6	3.22E+01	1.52E+01	1.24E+00	2.20E-01	5.95E-02	2.16E-02	4.18E-03	4.78E-04
10 7	4.28E+01	2.59E+01	8.89E-01	5.37E-01	5.91E-02	1.81E-02	2.51E-03	1.85E-04
10 8	5.58E+01	2.86E+01	1.95E+00	8.31E-01	3.23E-02	1.07E-02	8.48E-04	3.91E-05
10 9	4.31E+01	1.67E+01	3.32E+00	5.03E-01	7.18E-03	1.24E-02	1.31E-04	3.84E-06
11	3.48E+02	1.36E+02	1.25E+01	3.35E+00	2.79E-01	1.65E-01	3.75E-02	2.46E-03
11 0	1.72E+00	2.91E-01	3.92E-02	1.98E-02	3.88E-03	2.04E-03	1.13E-03	5.37E-05
11 1	4.83E+00	9.80E-01	1.76E-01	5.55E-02	7.28E-03	6.28E-03	3.62E-03	1.36E-04
11 2	7.67E+00	2.09E+00	2.26E-01	9.63E-02	1.59E-02	1.27E-02	4.89E-03	2.88E-04
11 3	1.16E+01	3.75E+00	5.03E-01	1.49E-01	1.75E-02	1.66E-02	6.62E-03	3.24E-04
11 4	1.68E+01	6.15E+00	5.94E-01	1.67E-01	2.70E-02	2.53E-02	6.13E-03	3.68E-04
11 5	2.47E+01	9.82E+00	7.69E-01	3.49E-01	3.28E-02	3.08E-02	5.15E-03	5.65E-04
11 6	3.52E+01	1.20E+01	1.35E+00	2.45E-01	4.79E-02	2.68E-02	4.94E-03	4.61E-04
11 7	4.71E+01	1.89E+01	1.01E+00	4.50E-01	7.02E-02	2.13E-02	3.22E-03	2.01E-04
11 8	6.15E+01	2.31E+01	1.72E+00	7.99E-01	4.11E-02	1.01E-02	1.37E-03	5.08E-05
11 9	6.32E+01	3.25E+01	2.90E+00	6.72E-01	1.25E-02	3.76E-03	3.74E-04	8.50E-06
11 10	7.37E+01	2.69E+01	3.23E+00	3.42E-01	3.10E-03	9.46E-03	4.39E-05	7.78E-07

Table continues on next page.

Data for F^{9+} + H(2p0) (cont.)

	impact energies [kev/amu]							
	1.0	10.0	30.0	45.0	90.0	120.0	200.0	300.
	state resolved CX cross sections							
n ℓ								
12	1.32E+02	1.20E+02	1.40E+01	3.68E+00	3.10E-01	1.96E-01	4.55E-02	2.40E-03
12 0	5.53E-01	2.47E-01	4.64E-02	2.88E-02	4.92E-03	3.54E-03	1.34E-03	5.28E-05
12 1	1.69E+00	8.36E-01	2.39E-01	6.48E-02	9.88E-03	1.03E-02	4.26E-03	1.40E-04
12 2	2.44E+00	1.64E+00	2.57E-01	1.35E-01	2.05E-02	1.83E-02	5.85E-03	2.85E-04
12 3	3.53E+00	2.78E+00	6.00E-01	1.76E-01	2.30E-02	2.17E-02	7.81E-03	3.24E-04
12 4	3.90E+00	4.30E+00	5.85E-01	2.06E-01	3.09E-02	2.95E-02	7.42E-03	3.45E-04
12 5	4.96E+00	6.20E+00	7.91E-01	3.75E-01	3.57E-02	3.14E-02	6.12E-03	5.20E-04
12 6	6.55E+00	7.68E+00	1.19E+00	2.64E-01	4.35E-02	2.91E-02	5.82E-03	4.47E-04
12 7	6.45E+00	1.02E+01	1.00E+00	3.86E-01	7.16E-02	2.29E-02	4.01E-03	2.12E-04
12 8	1.08E+01	1.17E+01	1.32E+00	6.97E-01	4.34E-02	1.38E-02	1.95E-03	5.75E-05
12 9	1.92E+01	1.66E+01	2.42E+00	6.54E-01	1.96E-02	7.27E-03	7.00E-04	1.23E-05
12 10	2.67E+01	2.86E+01	2.98E+00	4.92E-01	5.73E-03	3.16E-03	1.53E-04	2.16E-06
12 11	4.53E+01	2.97E+01	2.62E+00	2.02E-01	1.76E-03	5.37E-03	1.45E-05	1.98E-07
13	5.26E+01	6.52E+01	1.52E+01	4.62E+00	3.93E-01	2.67E-01	5.85E-02	2.43E-03
13 0	2.79E-01	2.58E-01	1.03E-01	6.85E-02	7.33E-03	5.44E-03	1.68E-03	6.46E-05
13 1	8.04E-01	5.19E-01	4.58E-01	1.68E-01	1.67E-02	1.50E-02	5.21E-03	1.42E-04
13 2	1.51E+00	1.42E+00	4.84E-01	2.89E-01	3.16E-02	2.60E-02	7.45E-03	2.76E-04
13 3	1.76E+00	1.58E+00	8.88E-01	3.53E-01	3.69E-02	3.15E-02	9.89E-03	3.48E-04
13 4	2.71E+00	2.59E+00	7.88E-01	3.53E-01	4.14E-02	4.11E-02	9.65E-03	3.47E-04
13 5	3.48E+00	3.15E+00	9.08E-01	5.09E-01	4.87E-02	4.40E-02	7.94E-03	4.97E-04
13 6	4.45E+00	3.51E+00	1.07E+00	3.59E-01	4.73E-02	3.84E-02	7.36E-03	4.52E-04
13 7	4.51E+00	4.55E+00	9.33E-01	3.85E-01	7.30E-02	2.98E-02	5.15E-03	2.24E-04
13 8	5.04E+00	4.58E+00	9.95E-01	6.28E-01	5.44E-02	1.46E-02	2.65E-03	6.22E-05
13 9	6.17E+00	6.46E+00	1.64E+00	5.67E-01	2.35E-02	6.40E-03	1.09E-03	1.50E-05
13 10	6.30E+00	7.09E+00	2.42E+00	4.97E-01	7.69E-03	7.64E-03	3.26E-04	3.56E-06
13 11	7.87E+00	1.08E+01	2.82E+00	3.39E-01	2.78E-03	4.14E-03	5.95E-05	5.65E-07
13 12	7.75E+00	1.87E+01	1.70E+00	1.04E-01	1.30E-03	3.02E-03	5.03E-06	4.11E-08

Table A.39: Data for F^{9+} + H(2p1)

n ℓ	1.0	10.0	30.0	45.0	90.0	120.0	200.0	300.
	impact energies [kev/amu]							
	total cross sections							
CX	8.72E+02	4.72E+02	8.20E+01	3.22E+01	4.68E+00	2.48E+00	4.00E-01	6.54E-02
ION	3.07E-02	3.18E-01	6.27E-01	1.04E+00	5.85E+00	5.67E+00	5.24E+00	5.62E+00
	state resolved CX cross sections							
4	3.26E-02	2.79E-02	1.19E-01	1.70E-01	8.94E-02	6.55E-02	1.49E-02	6.07E-03
4 0	4.52E-03	2.64E-03	3.53E-03	1.50E-02	1.68E-03	2.02E-03	1.98E-04	6.74E-05
4 1	1.21E-02	6.11E-03	1.20E-02	3.73E-02	9.89E-03	2.90E-03	1.13E-03	2.88E-04
4 2	1.08E-02	9.27E-03	2.66E-02	5.95E-02	3.60E-02	1.79E-02	1.77E-03	7.76E-04
4 3	5.23E-03	9.88E-03	7.69E-02	5.78E-02	4.18E-02	4.27E-02	1.18E-02	4.93E-03
5	5.16E-02	9.71E-02	6.23E-01	3.48E-01	1.19E-01	1.02E-01	2.27E-02	7.00E-03
5 0	6.67E-03	2.61E-03	3.40E-02	1.27E-02	3.88E-03	2.46E-03	2.49E-04	1.01E-04
5 1	1.43E-02	1.22E-02	8.87E-02	3.59E-02	1.07E-02	4.18E-03	1.23E-03	3.36E-04
5 2	1.18E-02	2.35E-02	1.07E-01	6.32E-02	2.22E-02	1.69E-02	1.69E-03	7.63E-04
5 3	1.05E-02	2.52E-02	1.38E-01	9.13E-02	2.31E-02	2.00E-02	8.61E-03	3.39E-03
5 4	8.32E-03	3.36E-02	2.56E-01	1.45E-01	5.92E-02	5.80E-02	1.09E-02	2.41E-03
6	1.10E-01	1.33E+00	2.02E+00	1.02E+00	2.55E-01	1.70E-01	3.17E-02	7.73E-03
6 0	9.12E-03	6.05E-02	5.16E-02	1.79E-02	5.16E-03	3.31E-03	1.98E-04	9.61E-05
6 1	1.48E-02	1.49E-01	1.20E-01	6.06E-02	1.39E-02	6.86E-03	1.55E-03	2.31E-04
6 2	1.24E-02	2.07E-01	2.40E-01	1.19E-01	2.61E-02	1.64E-02	1.48E-03	5.72E-04
6 3	2.20E-02	2.78E-01	3.79E-01	1.65E-01	3.34E-02	1.54E-02	7.31E-03	2.62E-03
6 4	2.44E-02	3.54E-01	4.96E-01	2.86E-01	7.58E-02	4.88E-02	9.48E-03	2.84E-03
6 5	2.69E-02	2.84E-01	7.31E-01	3.69E-01	1.00E-01	7.88E-02	1.17E-02	1.37E-03
7	6.30E-01	6.85E+00	5.70E+00	2.48E+00	4.28E-01	2.39E-01	3.81E-02	7.88E-03
7 0	1.98E-02	1.70E-01	5.50E-02	1.53E-02	6.74E-03	2.69E-03	2.22E-04	5.53E-05
7 1	3.99E-02	4.02E-01	2.06E-01	6.88E-02	1.48E-02	9.19E-03	1.76E-03	2.39E-04
7 2	7.62E-02	5.74E-01	4.63E-01	1.14E-01	3.13E-02	1.43E-02	1.60E-03	4.38E-04
7 3	7.55E-02	7.11E-01	7.02E-01	2.31E-01	4.38E-02	2.08E-02	6.25E-03	2.07E-03
7 4	9.22E-02	1.19E+00	8.51E-01	4.60E-01	5.09E-02	3.55E-02	9.18E-03	2.72E-03
7 5	1.53E-01	1.82E+00	1.43E+00	5.99E-01	9.16E-02	5.54E-02	1.11E-02	1.76E-03
7 6	1.73E-01	1.99E+00	1.99E+00	9.87E-01	1.89E-01	1.02E-01	7.93E-03	5.95E-04
8	9.64E+00	2.97E+01	9.90E+00	3.83E+00	5.66E-01	2.94E-01	4.23E-02	7.41E-03
8 0	1.35E-01	4.13E-01	5.78E-02	1.41E-02	4.65E-03	3.93E-03	3.16E-04	4.26E-05
8 1	6.65E-01	1.22E+00	1.49E-01	7.13E-02	2.05E-02	8.56E-03	1.77E-03	2.13E-04
8 2	1.40E+00	1.63E+00	3.63E-01	1.09E-01	2.30E-02	1.93E-02	2.02E-03	3.51E-04
8 3	1.27E+00	2.79E+00	5.10E-01	2.21E-01	5.92E-02	1.55E-02	5.16E-03	1.46E-03
8 4	1.61E+00	4.75E+00	8.93E-01	3.52E-01	3.52E-02	4.07E-02	9.46E-03	2.32E-03
8 5	1.22E+00	6.99E+00	1.90E+00	4.86E-01	1.02E-01	3.58E-02	1.07E-02	1.97E-03
8 6	1.37E+00	7.00E+00	2.10E+00	9.59E-01	1.00E-01	8.34E-02	9.43E-03	8.63E-04
8 7	1.98E+00	4.89E+00	3.93E+00	1.62E+00	2.20E-01	8.72E-02	3.49E-03	1.84E-04
9	7.96E+01	8.03E+01	1.17E+01	4.65E+00	6.20E-01	3.08E-01	4.51E-02	6.81E-03
9 0	9.78E-01	3.89E-01	6.24E-02	1.50E-02	4.44E-03	3.63E-03	4.31E-04	3.69E-05
9 1	2.29E+00	1.42E+00	1.11E-01	6.85E-02	1.56E-02	6.81E-03	1.66E-03	1.37E-04
9 2	3.99E+00	2.75E+00	3.08E-01	9.41E-02	2.19E-02	1.71E-02	2.50E-03	2.96E-04
9 3	8.05E+00	5.27E+00	3.90E-01	1.92E-01	4.66E-02	1.40E-02	4.19E-03	9.92E-04
9 4	1.17E+01	9.59E+00	6.64E-01	2.62E-01	2.98E-02	3.14E-02	9.48E-03	2.07E-03
9 5	1.21E+01	1.24E+01	9.51E-01	4.61E-01	7.32E-02	3.84E-02	1.09E-02	1.98E-03
9 6	1.22E+01	1.67E+01	1.40E+00	5.58E-01	9.94E-02	5.37E-02	9.60E-03	9.33E-04
9 7	1.29E+01	2.03E+01	2.88E+00	1.09E+00	1.61E-01	9.10E-02	5.20E-03	3.15E-04
9 8	1.55E+01	1.14E+01	4.95E+00	1.91E+00	1.68E-01	5.16E-02	1.10E-03	5.03E-05
10	2.27E+02	1.10E+02	1.21E+01	4.85E+00	6.37E-01	3.07E-01	4.75E-02	6.24E-03
10 0	1.57E+00	1.98E-01	4.74E-02	1.70E-02	3.72E-03	3.83E-03	5.29E-04	3.03E-05
10 1	4.83E+00	7.46E-01	9.02E-02	6.66E-02	1.43E-02	7.56E-03	1.52E-03	1.03E-04
10 2	7.82E+00	1.79E+00	2.11E-01	8.68E-02	1.91E-02	1.74E-02	2.91E-03	2.68E-04
10 3	1.17E+01	2.74E+00	2.80E-01	1.68E-01	4.38E-02	1.40E-02	3.58E-03	7.30E-04
10 4	1.78E+01	5.27E+00	4.33E-01	1.92E-01	2.71E-02	2.71E-02	9.06E-03	1.82E-03
10 5	2.62E+01	8.54E+00	5.94E-01	3.68E-01	6.79E-02	3.32E-02	1.15E-02	1.81E-03
10 6	3.73E+01	1.53E+01	8.59E-01	3.83E-01	9.69E-02	4.18E-02	9.91E-03	9.71E-04
10 7	4.18E+01	2.69E+01	1.35E+00	8.16E-01	1.02E-01	7.52E-02	6.09E-03	4.01E-04
10 8	3.15E+01	3.17E+01	2.23E+00	9.73E-01	1.70E-01	6.22E-02	2.10E-03	8.65E-05
10 9	4.67E+01	1.72E+01	6.02E+00	1.78E+00	9.20E-02	2.49E-02	2.81E-04	1.29E-05
11	3.90E+02	1.05E+02	1.22E+01	4.68E+00	6.42E-01	3.10E-01	4.92E-02	5.72E-03
11 0	1.20E+00	1.64E-01	5.34E-02	2.04E-02	2.40E-03	3.63E-03	6.00E-04	2.54E-05
11 1	4.18E+00	4.98E-01	1.38E-01	7.15E-02	1.51E-02	7.74E-03	1.43E-03	9.87E-05
11 2	8.23E+00	9.96E-01	2.36E-01	9.45E-02	1.46E-02	1.62E-02	3.17E-03	2.44E-04
11 3	1.28E+01	2.01E+00	2.86E-01	1.67E-01	4.55E-02	1.60E-02	3.38E-03	5.68E-04
11 4	1.78E+01	2.82E+00	3.86E-01	1.66E-01	2.72E-02	2.35E-02	8.25E-03	1.53E-03
11 5	2.30E+01	5.38E+00	4.67E-01	2.97E-01	6.39E-02	3.36E-02	1.17E-02	1.64E-03
11 6	3.96E+01	8.27E+00	5.36E-01	3.13E-01	8.68E-02	3.84E-02	1.04E-02	1.03E-03
11 7	6.06E+01	1.19E+01	9.87E-01	5.54E-01	8.25E-02	6.44E-02	6.68E-03	4.42E-04
11 8	6.85E+01	1.79E+01	1.18E+00	6.94E-01	1.47E-01	6.52E-02	2.89E-03	1.05E-04
11 9	7.23E+01	2.79E+01	1.94E+00	1.05E+00	1.17E-01	3.05E-02	6.78E-04	2.96E-05
11 10	8.13E+01	2.68E+01	5.93E+00	1.25E+00	3.92E-02	1.12E-02	6.50E-05	3.26E-06

Table continues on next page.

Data for F^{9+} + H(2p1) (cont.)

n ℓ	1.0	10.0	30.0	45.0	90.0	120.0	200.0	300.
	impact energies [kev/amu]							
	state resolved CX cross sections							
12	1.09E+02	8.60E+01	1.26E+01	4.63E+00	6.33E-01	3.17E-01	5.17E-02	5.34E-03
12 0	9.77E-01	1.98E-01	7.14E-02	2.67E-02	2.30E-03	4.42E-03	6.62E-04	2.22E-05
12 1	1.96E+00	6.63E-01	2.01E-01	9.63E-02	1.30E-02	9.32E-03	1.49E-03	9.14E-05
12 2	3.82E+00	1.14E+00	3.14E-01	1.22E-01	1.46E-02	1.93E-02	3.45E-03	2.30E-04
12 3	4.78E+00	1.92E+00	3.75E-01	2.05E-01	4.01E-02	1.60E-02	3.58E-03	4.45E-04
12 4	5.12E+00	3.17E+00	4.51E-01	1.89E-01	2.74E-02	2.59E-02	7.48E-03	1.29E-03
12 5	6.06E+00	4.33E+00	5.36E-01	2.86E-01	5.26E-02	2.71E-02	1.17E-02	1.56E-03
12 6	6.75E+00	6.61E+00	4.74E-01	3.04E-01	7.69E-02	3.18E-02	1.11E-02	1.08E-03
12 7	9.06E+00	7.67E+00	8.56E-01	4.22E-01	8.48E-02	5.87E-02	7.33E-03	4.49E-04
12 8	1.21E+01	9.93E+00	9.24E-01	5.18E-01	1.24E-01	6.62E-02	3.57E-03	1.21E-04
12 9	1.45E+01	1.29E+01	1.03E+00	6.70E-01	1.21E-01	3.97E-02	1.12E-03	4.02E-05
12 10	1.99E+01	1.67E+01	2.97E+00	1.09E+00	6.31E-02	1.35E-02	1.99E-04	8.36E-06
12 11	2.37E+01	2.08E+01	4.43E+00	7.03E-01	1.30E-02	4.96E-03	1.51E-05	7.34E-07
13	5.64E+01	5.30E+01	1.50E+01	5.57E+00	6.91E-01	3.65E-01	5.70E-02	5.19E-03
13 0	2.55E-01	2.82E-01	1.58E-01	5.76E-02	2.18E-03	6.16E-03	8.81E-04	4.37E-05
13 1	1.11E+00	4.98E-01	4.44E-01	2.02E-01	1.34E-02	1.15E-02	1.75E-03	8.91E-05
13 2	1.89E+00	1.41E+00	6.71E-01	2.65E-01	1.57E-02	2.62E-02	3.68E-03	2.10E-04
13 3	2.20E+00	1.28E+00	7.99E-01	3.87E-01	4.24E-02	2.34E-02	4.36E-03	3.30E-04
13 4	2.99E+00	2.71E+00	7.98E-01	3.83E-01	3.71E-02	3.21E-02	7.31E-03	1.16E-03
13 5	3.50E+00	2.88E+00	9.01E-01	4.12E-01	5.78E-02	3.90E-02	1.20E-02	1.57E-03
13 6	3.83E+00	3.95E+00	6.87E-01	4.52E-01	9.14E-02	3.10E-02	1.24E-02	1.13E-03
13 7	4.44E+00	4.65E+00	8.83E-01	4.42E-01	8.77E-02	5.30E-02	8.32E-03	4.58E-04
13 8	5.32E+00	4.87E+00	1.05E+00	4.79E-01	1.09E-01	6.67E-02	4.26E-03	1.39E-04
13 9	6.42E+00	5.97E+00	8.41E-01	4.74E-01	1.24E-01	4.51E-02	1.61E-03	4.31E-05
13 10	6.89E+00	6.15E+00	1.78E+00	8.20E-01	7.98E-02	2.08E-02	4.02E-04	1.19E-05
13 11	8.77E+00	7.52E+00	3.53E+00	8.68E-01	2.66E-02	7.53E-03	5.86E-05	2.31E-06
13 12	8.81E+00	1.08E+01	2.47E+00	3.24E-01	3.91E-03	2.55E-03	3.88E-06	1.65E-07

Table A.40: Data for F^{9+} + H(2p-1)

	impact energies [kev/amu]							
	1.0	10.0	30.0	45.0	90.0	120.0	200.0	300.
	total cross sections							
CX	8.84E+02	4.74E+02	7.99E+01	2.49E+01	2.25E+00	9.15E-01	1.76E-01	5.80E-02
ION	1.91E-03	1.64E-01	5.33E-01	2.54E+00	1.99E+00	2.27E+00	3.23E+00	3.99E+00
	state resolved CX cross sections							
n ℓ								
4	1.25E-02	3.89E-03	2.19E-01	1.34E-01	3.72E-02	2.14E-02	1.03E-02	4.17E-03
4 1	1.78E-03	6.48E-05	1.01E-02	2.24E-03	6.01E-04	3.99E-04	2.78E-04	1.18E-04
4 2	4.16E-03	6.67E-04	1.75E-02	1.30E-02	5.61E-03	3.07E-03	1.52E-03	7.77E-04
4 3	6.55E-03	3.16E-03	1.91E-01	1.18E-01	3.10E-02	1.79E-02	8.55E-03	3.27E-03
5	1.45E-03	5.40E-03	1.39E-01	1.56E-01	5.81E-02	3.81E-02	1.67E-02	5.64E-03
5 1	8.99E-05	3.02E-04	5.56E-03	3.40E-03	8.55E-04	4.34E-04	2.27E-04	1.18E-04
5 2	3.47E-04	8.62E-04	1.53E-02	1.65E-02	5.88E-03	2.51E-03	1.06E-03	5.45E-04
5 3	4.74E-04	2.01E-03	5.10E-02	5.66E-02	1.55E-02	7.25E-03	5.61E-03	2.61E-03
5 4	5.40E-04	2.23E-03	6.73E-02	7.93E-02	3.59E-02	2.79E-02	9.76E-03	2.37E-03
6	6.64E-03	2.37E-01	7.81E-01	4.99E-01	1.22E-01	6.83E-02	2.12E-02	6.80E-03
6 1	2.00E-04	6.50E-03	7.00E-03	4.48E-03	8.08E-04	6.20E-04	2.03E-04	1.08E-04
6 2	9.63E-04	2.88E-02	4.20E-02	2.14E-02	5.40E-03	3.79E-03	8.94E-04	4.29E-04
6 3	1.68E-03	6.11E-02	1.39E-01	5.65E-02	1.33E-02	7.18E-03	3.81E-03	2.12E-03
6 4	2.09E-03	8.05E-02	2.70E-01	1.75E-01	3.79E-02	2.60E-02	9.77E-03	3.05E-03
6 5	1.71E-03	5.98E-02	3.23E-01	2.42E-01	6.45E-02	3.07E-02	6.50E-03	1.10E-03
7	1.42E-01	4.13E+00	2.91E+00	1.20E+00	1.84E-01	9.53E-02	2.24E-02	7.16E-03
7 1	2.87E-03	4.37E-02	1.03E-02	4.93E-03	1.04E-03	5.59E-04	1.72E-04	9.85E-05
7 2	9.01E-03	2.19E-01	5.64E-02	2.69E-02	5.26E-03	3.40E-03	7.44E-04	3.72E-04
7 3	2.33E-02	5.97E-01	1.58E-01	6.85E-02	1.34E-02	6.26E-03	2.68E-03	1.74E-03
7 4	2.59E-02	1.09E+00	3.48E-01	2.03E-01	2.79E-02	2.23E-02	8.21E-03	2.96E-03
7 5	2.82E-02	1.32E+00	9.04E-01	1.85E-01	5.87E-02	3.81E-02	8.10E-03	1.66E-03
7 6	5.24E-02	8.62E-01	1.44E+00	7.16E-01	7.79E-02	2.47E-02	2.48E-03	3.31E-04
8	4.27E+00	2.97E+01	6.45E+00	2.10E+00	2.42E-01	1.10E-01	2.15E-02	6.91E-03
8 1	2.43E-02	7.96E-02	1.35E-02	5.51E-03	9.93E-04	5.99E-04	1.49E-04	8.47E-05
8 2	1.18E-01	4.78E-01	6.84E-02	2.86E-02	4.34E-03	3.20E-03	6.33E-04	3.13E-04
8 3	2.38E-01	1.59E+00	1.93E-01	7.42E-02	1.39E-02	5.87E-03	2.01E-03	1.38E-03
8 4	4.91E-01	4.04E+00	4.15E-01	1.94E-01	2.48E-02	1.79E-02	6.59E-03	2.64E-03
8 5	1.04E+00	7.40E+00	8.59E-01	2.21E-01	5.91E-02	3.38E-02	7.66E-03	1.86E-03
8 6	1.56E+00	9.42E+00	1.01E+00	5.02E-01	8.36E-02	3.28E-02	3.76E-03	5.62E-04
8 7	7.93E-01	6.68E+00	3.89E+00	1.08E+00	5.55E-02	1.57E-02	6.75E-04	6.19E-05
9	6.34E+01	8.48E+01	1.01E+01	3.00E+00	2.82E-01	1.17E-01	1.97E-02	6.45E-03
9 1	2.50E-01	8.14E-02	1.54E-02	6.51E-03	1.05E-03	5.37E-04	1.34E-04	7.16E-05
9 2	1.22E+00	4.97E-01	7.76E-02	2.94E-02	4.11E-03	3.13E-03	5.69E-04	2.62E-04
9 3	2.94E+00	1.68E+00	2.20E-01	7.88E-02	1.40E-02	5.73E-03	1.63E-03	1.11E-03
9 4	5.11E+00	4.23E+00	4.52E-01	1.80E-01	2.23E-02	1.64E-02	5.33E-03	2.32E-03
9 5	8.15E+00	9.14E+00	8.57E-01	2.53E-01	4.79E-02	3.17E-02	6.65E-03	1.86E-03
9 6	1.31E+01	1.72E+01	1.08E+00	4.08E-01	8.92E-02	3.24E-02	4.04E-03	6.85E-04
9 7	1.97E+01	2.71E+01	2.20E+00	1.05E+00	7.64E-02	1.95E-02	1.22E-03	1.32E-04
9 8	1.29E+01	2.50E+01	5.18E+00	9.92E-01	2.75E-02	8.05E-03	1.58E-04	1.07E-05
10	3.14E+02	1.21E+02	1.34E+01	3.76E+00	3.06E-01	1.18E-01	1.81E-02	5.91E-03
10 1	6.04E-01	6.34E-02	1.69E-02	7.68E-03	1.05E-03	4.82E-04	1.23E-04	6.13E-05
10 2	2.90E+00	3.51E-01	8.69E-02	3.13E-02	3.32E-03	2.62E-03	5.28E-04	2.23E-04
10 3	7.52E+00	1.31E+00	2.35E-01	8.69E-02	1.40E-02	5.23E-03	1.40E-03	9.13E-04
10 4	1.43E+01	3.04E+00	4.73E-01	1.77E-01	2.00E-02	1.29E-02	4.47E-03	2.00E-03
10 5	2.46E+01	6.74E+00	8.43E-01	2.69E-01	4.30E-02	2.79E-02	5.76E-03	1.75E-03
10 6	3.88E+01	1.17E+01	1.14E+00	3.64E-01	8.74E-02	3.37E-02	3.88E-03	7.49E-04
10 7	6.08E+01	1.85E+01	1.77E+00	9.26E-01	8.16E-02	2.26E-02	1.53E-03	1.84E-04
10 8	8.98E+01	3.12E+01	3.98E+00	1.21E+00	4.38E-02	8.78E-03	3.56E-04	2.28E-05
10 9	7.44E+01	4.78E+01	4.85E+00	6.83E-01	1.17E-02	4.08E-03	3.74E-05	2.29E-06
11	3.96E+02	1.10E+02	1.51E+01	4.26E+00	3.23E-01	1.17E-01	1.65E-02	5.39E-03
11 1	3.43E-01	5.08E-02	1.73E-02	8.62E-03	1.06E-03	4.51E-04	1.13E-04	5.34E-05
11 2	1.74E+00	2.35E-01	9.39E-02	3.34E-02	3.21E-03	2.52E-03	4.97E-04	1.95E-04
11 3	4.86E+00	8.96E-01	2.34E-01	9.53E-02	1.38E-02	5.11E-03	1.22E-03	7.57E-04
11 4	1.07E+01	2.12E+00	4.81E-01	1.80E-01	2.05E-02	1.16E-02	3.84E-03	1.72E-03
11 5	2.01E+01	4.22E+00	8.07E-01	2.78E-01	3.57E-02	2.40E-02	5.05E-03	1.63E-03
11 6	3.32E+01	7.41E+00	1.09E+00	3.55E-01	8.12E-02	3.10E-02	3.56E-03	7.76E-04
11 7	4.95E+01	1.00E+01	1.59E+00	7.71E-01	9.01E-02	2.42E-02	1.63E-03	2.16E-04
11 8	7.05E+01	1.62E+01	2.93E+00	1.20E+00	5.29E-02	1.19E-02	5.21E-04	3.33E-05
11 9	1.05E+02	2.43E+01	4.33E+00	9.62E-01	1.98E-02	3.27E-03	1.05E-04	5.66E-06
11 10	1.00E+02	4.43E+01	3.56E+00	3.82E-01	4.63E-03	2.69E-03	9.79E-06	3.91E-07

Table continues on next page.

Data for F^{9+} + H(2p-1) (cont.)

	impact energies [kev/amu]							
	1.0	10.0	30.0	45.0	90.0	120.0	200.0	300.
	state resolved CX cross sections							
n ℓ								
12	9.70E+01	8.21E+01	1.55E+01	4.65E+00	3.34E-01	1.14E-01	1.54E-02	4.96E-03
12 1	7.99E-02	3.13E-02	1.67E-02	9.01E-03	1.10E-03	4.13E-04	1.04E-04	4.75E-05
12 2	3.80E-01	1.78E-01	9.83E-02	3.43E-02	3.14E-03	2.17E-03	4.73E-04	1.75E-04
12 3	9.39E-01	5.16E-01	2.22E-01	9.98E-02	1.32E-02	4.89E-03	1.09E-03	6.41E-04
12 4	1.90E+00	1.36E+00	4.67E-01	1.84E-01	2.15E-02	9.80E-03	3.39E-03	1.51E-03
12 5	3.13E+00	2.27E+00	7.70E-01	2.85E-01	2.95E-02	2.14E-02	4.56E-03	1.52E-03
12 6	4.67E+00	4.40E+00	9.60E-01	3.72E-01	7.67E-02	3.02E-02	3.29E-03	7.79E-04
12 7	6.73E+00	5.10E+00	1.50E+00	6.39E-01	9.34E-02	2.45E-02	1.63E-03	2.37E-04
12 8	9.55E+00	8.80E+00	2.12E+00	1.08E+00	5.99E-02	1.29E-02	6.33E-04	4.28E-05
12 9	1.44E+01	9.45E+00	3.28E+00	1.11E+00	2.55E-02	4.95E-03	1.85E-04	8.26E-06
12 10	2.52E+01	1.83E+01	3.89E+00	6.51E-01	8.80E-03	1.09E-03	3.36E-05	1.11E-06
12 11	3.00E+01	3.16E+01	2.21E+00	1.87E-01	1.64E-03	2.13E-03	2.74E-06	9.01E-08
13	8.79E+00	4.23E+01	1.52E+01	5.10E+00	3.59E-01	1.14E-01	1.47E-02	4.65E-03
13 1	3.07E-02	1.58E-02	1.87E-02	9.64E-03	1.18E-03	4.18E-04	9.62E-05	4.19E-05
13 2	1.16E-01	1.16E-01	9.85E-02	3.76E-02	3.45E-03	2.14E-03	4.53E-04	1.58E-04
13 3	2.33E-01	2.61E-01	2.47E-01	1.06E-01	1.33E-02	4.97E-03	9.93E-04	5.51E-04
13 4	3.01E-01	7.23E-01	4.19E-01	2.04E-01	2.47E-02	9.39E-03	3.06E-03	1.36E-03
13 5	3.93E-01	1.12E+00	8.33E-01	2.93E-01	2.77E-02	1.86E-02	4.26E-03	1.44E-03
13 6	4.54E-01	2.11E+00	8.01E-01	4.27E-01	7.22E-02	2.84E-02	3.12E-03	7.81E-04
13 7	5.63E-01	2.32E+00	1.43E+00	5.60E-01	9.83E-02	2.60E-02	1.62E-03	2.55E-04
13 8	7.27E-01	4.08E+00	1.71E+00	9.26E-01	7.07E-02	1.48E-02	7.15E-04	5.16E-05
13 9	8.06E-01	3.50E+00	2.12E+00	1.18E+00	3.17E-02	5.58E-03	2.70E-04	9.79E-06
13 10	1.21E+00	6.85E+00	3.34E+00	8.87E-01	1.14E-02	1.98E-03	7.25E-05	1.86E-06
13 11	1.79E+00	5.49E+00	3.04E+00	3.93E-01	3.48E-03	4.21E-04	1.17E-05	2.80E-07
13 12	2.17E+00	1.57E+01	1.15E+00	8.14E-02	5.68E-04	1.67E-03	8.10E-07	1.67E-08

Table A.41: Data for F^{9+} + H(2p)

	impact energies [kev/amu] 1.0	10.0	30.0	45.0	90.0	120.0	200.0	300.
	total cross sections							
CX	8.73E+02	4.87E+02	7.47E+01	2.53E+01	3.01E+00	1.56E+00	2.79E-01	5.04E-02
ION	2.22E-02	2.48E-01	5.87E-01	1.65E+00	3.46E+00	3.80E+00	4.51E+00	4.68E+00
	state resolved CX cross sections							
n ℓ								
4	2.20E-02	2.46E-02	1.48E-01	1.39E-01	6.00E-02	4.21E-02	1.09E-02	4.53E-03
4 0	2.08E-03	1.76E-03	2.44E-03	7.08E-03	1.10E-03	1.32E-03	8.42E-05	6.50E-05
4 1	6.55E-03	5.33E-03	1.22E-02	1.92E-02	5.91E-03	3.76E-03	5.49E-04	1.88E-04
4 2	7.36E-03	8.06E-03	2.41E-02	3.55E-02	2.07E-02	1.12E-02	1.70E-03	8.79E-04
4 3	6.05E-03	9.46E-03	1.09E-01	7.68E-02	3.23E-02	2.58E-02	8.61E-03	3.40E-03
5	3.19E-02	7.11E-02	3.63E-01	2.34E-01	7.96E-02	6.32E-02	1.59E-02	5.23E-03
5 0	3.33E-03	1.95E-03	2.10E-02	6.87E-03	2.06E-03	1.22E-03	1.34E-04	6.29E-05
5 1	7.70E-03	9.11E-03	4.86E-02	2.22E-02	6.31E-03	3.76E-03	7.23E-04	1.89E-04
5 2	7.60E-03	2.00E-02	6.22E-02	3.84E-02	1.35E-02	1.00E-02	1.39E-03	6.61E-04
5 3	7.04E-03	1.80E-02	9.12E-02	6.62E-02	1.73E-02	1.45E-02	5.44E-03	2.25E-03
5 4	6.21E-03	2.19E-02	1.40E-01	1.00E-01	4.05E-02	3.37E-02	8.23E-03	2.07E-03
6	6.97E-02	8.31E-01	1.30E+00	6.18E-01	1.66E-01	1.02E-01	2.15E-02	5.84E-03
6 0	5.21E-03	3.34E-02	2.50E-02	8.15E-03	2.42E-03	1.55E-03	1.87E-04	5.32E-05
6 1	9.03E-03	8.80E-02	5.95E-02	2.98E-02	7.05E-03	4.87E-03	1.04E-03	1.50E-04
6 2	8.13E-03	1.26E-01	1.43E-01	5.77E-02	1.46E-02	1.06E-02	1.43E-03	4.99E-04
6 3	1.48E-02	1.76E-01	2.60E-01	8.98E-02	2.26E-02	1.22E-02	4.61E-03	1.73E-03
6 4	1.42E-02	2.17E-01	3.46E-01	1.77E-01	4.95E-02	3.16E-02	7.21E-03	2.32E-03
6 5	1.84E-02	1.90E-01	4.65E-01	2.56E-01	6.96E-02	4.13E-02	7.06E-03	1.08E-03
7	4.67E-01	6.05E+00	3.33E+00	1.42E+00	2.61E-01	1.38E-01	2.54E-02	6.01E-03
7 0	1.34E-02	1.36E-01	2.38E-02	7.04E-03	2.94E-03	1.14E-03	2.46E-04	3.95E-05
7 1	3.03E-02	3.75E-01	8.76E-02	3.11E-02	8.00E-03	4.52E-03	1.25E-03	1.60E-04
7 2	5.53E-02	5.52E-01	2.03E-01	5.84E-02	1.63E-02	8.71E-03	1.58E-03	4.16E-04
7 3	6.53E-02	7.57E-01	3.37E-01	1.16E-01	2.53E-02	1.28E-02	4.10E-03	1.41E-03
7 4	6.80E-02	1.19E+00	4.78E-01	2.51E-01	3.46E-02	2.62E-02	6.72E-03	2.14E-03
7 5	1.12E-01	1.61E+00	8.73E-01	3.02E-01	6.55E-02	3.73E-02	7.26E-03	1.42E-03
7 6	1.23E-01	1.43E+00	1.33E+00	6.54E-01	1.08E-01	4.78E-02	4.26E-03	4.18E-04
8	8.44E+00	2.64E+01	6.34E+00	2.35E+00	3.38E-01	1.78E-01	2.79E-02	5.72E-03
8 0	1.23E-01	2.12E-01	2.51E-02	6.89E-03	2.26E-03	1.98E-03	3.17E-04	3.60E-05
8 1	4.17E-01	6.79E-01	7.19E-02	3.33E-02	9.40E-03	5.80E-03	1.37E-03	1.46E-04
8 2	8.37E-01	1.17E+00	1.79E-01	5.87E-02	1.32E-02	1.21E-02	1.83E-03	3.50E-04
8 3	1.17E+00	2.14E+00	2.76E-01	1.20E-01	3.04E-02	1.26E-02	3.70E-03	1.07E-03
8 4	1.46E+00	3.75E+00	5.30E-01	2.13E-01	2.78E-02	2.78E-02	6.47E-03	1.84E-03
8 5	1.16E+00	5.85E+00	1.02E+00	2.91E-01	6.75E-02	3.18E-02	7.07E-03	1.54E-03
8 6	1.70E+00	7.05E+00	1.28E+00	5.58E-01	8.00E-02	4.64E-02	5.36E-03	6.26E-04
8 7	1.57E+00	5.58E+00	2.95E+00	1.07E+00	1.07E-01	3.93E-02	1.75E-03	1.11E-04
9	7.13E+01	7.24E+01	9.06E+00	3.20E+00	3.78E-01	1.90E-01	2.99E-02	5.32E-03
9 0	8.37E-01	2.41E-01	2.95E-02	8.22E-03	2.20E-03	1.73E-03	4.05E-04	3.22E-05
9 1	2.10E+00	8.26E-01	7.03E-02	3.68E-02	7.22E-03	4.39E-03	1.47E-03	1.13E-04
9 2	3.88E+00	1.66E+00	1.80E-01	5.71E-02	1.24E-02	1.06E-02	2.16E-03	2.98E-04
9 3	6.51E+00	3.28E+00	2.74E-01	1.23E-01	2.54E-02	1.15E-02	3.50E-03	8.12E-04
9 4	8.39E+00	6.78E+00	5.10E-01	1.84E-01	2.53E-02	2.36E-02	6.30E-03	1.62E-03
9 5	1.02E+01	1.06E+01	7.39E-01	3.28E-01	5.22E-02	3.28E-02	7.03E-03	1.52E-03
9 6	1.09E+01	1.51E+01	1.15E+00	3.90E-01	8.49E-02	3.61E-02	5.69E-03	7.00E-04
9 7	1.37E+01	1.93E+01	1.93E+00	9.10E-01	9.67E-02	4.46E-02	2.74E-03	1.99E-04
9 8	1.48E+01	1.46E+01	4.19E+00	1.17E+00	7.20E-02	2.43E-02	5.46E-04	2.68E-05
10	2.63E+02	1.15E+02	1.16E+01	3.81E+00	4.02E-01	1.93E-01	3.21E-02	4.91E-03
10 0	1.11E+00	1.91E-01	2.70E-02	1.04E-02	2.48E-03	2.00E-03	4.93E-04	2.85E-05
10 1	3.81E+00	6.14E-01	8.18E-02	4.10E-02	7.53E-03	5.08E-03	1.58E-03	9.91E-05
10 2	7.00E+00	1.51E+00	1.66E-01	6.24E-02	1.29E-02	1.12E-02	2.52E-03	2.65E-04
10 3	1.06E+01	2.67E+00	3.04E-01	1.28E-01	2.47E-02	1.20E-02	3.52E-03	6.56E-04
10 4	1.61E+01	5.37E+00	4.86E-01	1.68E-01	2.53E-02	2.14E-02	6.20E-03	1.41E-03
10 5	2.60E+01	9.10E+00	6.99E-01	3.20E-01	4.77E-02	2.95E-02	7.19E-03	1.40E-03
10 6	3.61E+01	1.41E+01	1.08E+00	3.23E-01	8.13E-02	3.23E-02	5.99E-03	7.33E-04
10 7	4.84E+01	2.38E+01	1.34E+00	7.60E-01	8.10E-02	3.86E-02	3.38E-03	2.57E-04
10 8	5.90E+01	3.05E+01	2.72E+00	1.01E+00	8.19E-02	2.73E-02	1.10E-03	4.95E-05
10 9	5.47E+01	2.72E+01	4.73E+00	9.89E-01	3.70E-02	1.38E-02	1.50E-04	6.34E-06
11	3.78E+02	1.17E+02	1.33E+01	4.10E+00	4.15E-01	1.97E-01	3.44E-02	4.52E-03
11 0	9.73E-01	1.51E-01	3.09E-02	1.34E-02	2.10E-03	1.89E-03	5.77E-04	2.64E-05
11 1	3.12E+00	5.10E-01	1.10E-01	4.52E-02	7.83E-03	4.83E-03	1.72E-03	9.61E-05
11 2	5.88E+00	1.11E+00	1.85E-01	7.47E-02	1.12E-02	1.05E-02	2.85E-03	2.42E-04
11 3	9.74E+00	2.22E+00	3.41E-01	1.37E-01	2.56E-02	1.26E-02	3.74E-03	5.50E-04
11 4	1.51E+01	3.70E+00	4.87E-01	1.71E-01	2.49E-02	2.01E-02	6.07E-03	1.21E-03
11 5	2.26E+01	6.47E+00	6.81E-01	3.08E-01	4.41E-02	2.95E-02	7.31E-03	1.28E-03
11 6	3.60E+01	9.22E+00	9.94E-01	3.04E-01	7.20E-02	3.21E-02	6.29E-03	7.55E-04
11 7	5.24E+01	1.36E+01	1.20E+00	5.92E-01	8.09E-02	3.67E-02	3.84E-03	2.86E-04
11 8	6.68E+01	1.91E+01	1.94E+00	8.96E-01	8.04E-02	2.91E-02	1.59E-03	6.31E-05
11 9	8.02E+01	2.82E+01	3.06E+00	8.96E-01	4.99E-02	1.25E-02	3.86E-04	1.46E-05
11 10	8.50E+01	3.27E+01	4.24E+00	6.59E-01	1.57E-02	7.78E-03	3.96E-05	1.48E-06

Table continues on next page.

Data for F^{9+} + H(2p) (cont.)

	impact energies [kev/amu]							
	1.0	10.0	30.0	45.0	90.0	120.0	200.0	300.
	state resolved CX cross sections							
n ℓ								
12	1.13E+02	9.62E+01	1.41E+01	4.32E+00	4.26E-01	2.09E-01	3.75E-02	4.23E-03
12 0	5.10E-01	1.48E-01	3.93E-02	1.85E-02	2.41E-03	2.65E-03	6.68E-04	2.50E-05
12 1	1.24E+00	5.10E-01	1.52E-01	5.67E-02	8.01E-03	6.68E-03	1.95E-03	9.28E-05
12 2	2.21E+00	9.83E-01	2.23E-01	9.71E-02	1.27E-02	1.33E-02	3.26E-03	2.30E-04
12 3	3.08E+00	1.74E+00	3.99E-01	1.60E-01	2.55E-02	1.42E-02	4.16E-03	4.70E-04
12 4	3.64E+00	2.94E+00	5.01E-01	1.93E-01	2.66E-02	2.17E-02	6.10E-03	1.05E-03
12 5	4.72E+00	4.27E+00	6.99E-01	3.15E-01	3.92E-02	2.66E-02	7.47E-03	1.20E-03
12 6	5.99E+00	6.23E+00	8.74E-01	3.13E-01	6.57E-02	3.04E-02	6.72E-03	7.67E-04
12 7	7.41E+00	7.65E+00	1.12E+00	4.82E-01	8.33E-02	3.54E-02	4.33E-03	2.99E-04
12 8	1.08E+01	1.01E+01	1.46E+00	7.67E-01	7.59E-02	3.09E-02	2.05E-03	7.38E-05
12 9	1.60E+01	1.30E+01	2.25E+00	8.11E-01	5.52E-02	1.73E-02	6.69E-04	2.03E-05
12 10	2.39E+01	2.12E+01	3.28E+00	7.43E-01	2.59E-02	5.90E-03	1.29E-04	3.88E-06
12 11	3.30E+01	2.74E+01	3.08E+00	3.64E-01	5.46E-03	4.15E-03	1.08E-05	3.41E-07
13	3.93E+01	5.35E+01	1.51E+01	5.10E+00	4.81E-01	2.49E-01	4.34E-02	4.09E-03
13 0	1.78E-01	1.80E-01	8.72E-02	4.21E-02	3.17E-03	3.87E-03	8.53E-04	3.61E-05
13 1	6.49E-01	3.44E-01	3.07E-01	1.27E-01	1.04E-02	8.96E-03	2.35E-03	9.12E-05
13 2	1.17E+00	9.82E-01	4.18E-01	1.97E-01	1.69E-02	1.81E-02	3.86E-03	2.15E-04
13 3	1.40E+00	1.04E+00	6.45E-01	2.82E-01	3.09E-02	2.00E-02	5.08E-03	4.09E-04
13 4	2.00E+00	2.01E+00	6.69E-01	3.13E-01	3.44E-02	2.75E-02	6.68E-03	9.56E-04
13 5	2.46E+00	2.38E+00	8.81E-01	4.05E-01	4.48E-02	3.38E-02	8.07E-03	1.17E-03
13 6	2.91E+00	3.19E+00	8.53E-01	4.13E-01	7.03E-02	3.26E-02	7.62E-03	7.89E-04
13 7	3.17E+00	3.84E+00	1.08E+00	4.62E-01	8.63E-02	3.63E-02	5.03E-03	3.12E-04
13 8	3.69E+00	4.51E+00	1.25E+00	6.78E-01	7.80E-02	3.20E-02	2.54E-03	8.41E-05
13 9	4.47E+00	5.31E+00	1.53E+00	7.39E-01	5.96E-02	1.90E-02	9.90E-04	2.26E-05
13 10	4.80E+00	6.70E+00	2.52E+00	7.34E-01	3.30E-02	1.01E-02	2.67E-04	5.79E-06
13 11	6.14E+00	7.92E+00	3.13E+00	5.33E-01	1.09E-02	4.03E-03	4.33E-05	1.05E-06
13 12	6.25E+00	1.51E+01	1.77E+00	1.70E-01	1.92E-03	2.41E-03	3.24E-06	7.43E-08

Table A.42: Data for F^{9+} + H($n = 2$)

	impact energies [kev/amu]							
	1.0	10.0	30.0	45.0	90.0	120.0	200.0	300.
	total cross sections							
CX	8.70E+02	4.88E+02	8.50E+01	3.07E+01	4.02E+00	2.04E+00	3.64E-01	7.57E-02
ION	2.12E-02	2.76E-01	6.81E-01	1.53E+00	3.07E+00	3.75E+00	5.30E+00	5.21E+00
	state resolved CX cross sections							
n ℓ								
4	2.35E-02	2.18E-02	1.72E-01	1.27E-01	7.09E-02	4.72E-02	1.74E-02	5.56E-03
4 0	2.28E-03	1.57E-03	7.92E-03	7.20E-03	2.21E-03	1.57E-03	3.87E-04	1.38E-04
4 1	7.69E-03	4.87E-03	1.99E-02	1.96E-02	9.67E-03	5.60E-03	1.41E-03	3.96E-04
4 2	7.13E-03	7.30E-03	4.13E-02	3.28E-02	2.47E-02	1.36E-02	4.05E-03	1.33E-03
4 3	6.38E-03	8.10E-03	1.03E-01	6.73E-02	3.43E-02	2.65E-02	1.16E-02	3.69E-03
5	3.36E-02	6.33E-02	4.37E-01	3.20E-01	1.23E-01	8.75E-02	2.83E-02	7.47E-03
5 0	3.47E-03	1.84E-03	2.81E-02	1.44E-02	2.90E-03	1.53E-03	4.82E-04	1.68E-04
5 1	8.20E-03	8.27E-03	6.62E-02	4.56E-02	8.02E-03	5.85E-03	1.77E-03	4.59E-04
5 2	8.26E-03	1.77E-02	8.48E-02	6.83E-02	1.86E-02	1.14E-02	4.28E-03	1.50E-03
5 3	7.09E-03	1.63E-02	1.14E-01	8.63E-02	3.45E-02	2.11E-02	8.16E-03	2.71E-03
5 4	6.55E-03	1.93E-02	1.45E-01	1.06E-01	5.88E-02	4.76E-02	1.36E-02	2.63E-03
6	7.67E-02	7.76E-01	2.02E+00	1.06E+00	2.47E-01	1.38E-01	3.61E-02	8.49E-03
6 0	5.49E-03	3.94E-02	5.54E-02	1.41E-02	3.73E-03	1.89E-03	4.87E-04	1.77E-04
6 1	9.96E-03	1.02E-01	1.48E-01	4.94E-02	8.86E-03	7.61E-03	1.91E-03	4.47E-04
6 2	9.47E-03	1.33E-01	3.27E-01	1.00E-01	2.22E-02	1.25E-02	3.79E-03	1.32E-03
6 3	1.50E-02	1.60E-01	4.95E-01	2.15E-01	3.56E-02	2.00E-02	7.25E-03	2.13E-03
6 4	1.52E-02	1.84E-01	5.06E-01	3.45E-01	6.17E-02	3.43E-02	1.12E-02	2.84E-03
6 5	2.15E-02	1.58E-01	4.88E-01	3.40E-01	1.15E-01	6.14E-02	1.15E-02	1.57E-03
7	4.48E-01	6.97E+00	5.22E+00	2.11E+00	3.65E-01	1.82E-01	3.89E-02	8.82E-03
7 0	1.30E-02	2.40E-01	4.77E-02	1.55E-02	5.08E-03	1.84E-03	4.71E-04	1.38E-04
7 1	3.24E-02	6.67E-01	1.69E-01	5.48E-02	1.17E-02	7.69E-03	1.85E-03	3.68E-04
7 2	5.56E-02	9.66E-01	3.77E-01	9.45E-02	2.75E-02	1.21E-02	3.33E-03	1.10E-03
7 3	7.09E-02	1.12E+00	6.21E-01	1.97E-01	3.83E-02	2.16E-02	6.36E-03	1.87E-03
7 4	7.05E-02	1.30E+00	9.93E-01	3.26E-01	5.42E-02	3.14E-02	9.29E-03	2.73E-03
7 5	9.79E-02	1.46E+00	1.44E+00	5.12E-01	8.66E-02	5.27E-02	1.17E-02	2.04E-03
7 6	1.07E-01	1.21E+00	1.57E+00	9.11E-01	1.42E-01	5.46E-02	5.96E-03	5.73E-04
8	8.17E+00	3.24E+01	8.44E+00	3.10E+00	4.44E-01	2.25E-01	3.87E-02	8.72E-03
8 0	1.09E-01	3.36E-01	4.72E-02	1.75E-02	4.86E-03	2.84E-03	4.85E-04	1.36E-04
8 1	3.71E-01	1.18E+00	1.48E-01	6.24E-02	1.28E-02	9.96E-03	1.75E-03	3.71E-04
8 2	7.42E-01	2.38E+00	3.13E-01	1.03E-01	2.51E-02	1.64E-02	3.12E-03	1.04E-03
8 3	1.10E+00	4.11E+00	4.65E-01	2.02E-01	3.85E-02	2.29E-02	5.47E-03	1.66E-03
8 4	1.40E+00	5.67E+00	8.03E-01	2.86E-01	4.76E-02	3.45E-02	8.00E-03	2.39E-03
8 5	1.33E+00	6.63E+00	1.39E+00	4.10E-01	8.64E-02	4.35E-02	1.03E-02	2.09E-03
8 6	1.70E+00	6.76E+00	2.03E+00	6.98E-01	1.10E-01	5.57E-02	7.48E-03	8.87E-04
8 7	1.42E+00	5.34E+00	3.23E+00	1.32E+00	1.18E-01	3.90E-02	2.13E-03	1.53E-04
9	7.05E+01	7.37E+01	1.07E+01	3.89E+00	4.88E-01	2.43E-01	3.80E-02	8.24E-03
9 0	9.11E-01	3.98E-01	4.84E-02	1.86E-02	5.19E-03	2.77E-03	5.40E-04	1.39E-04
9 1	2.67E+00	1.32E+00	1.35E-01	6.34E-02	1.11E-02	9.01E-03	1.75E-03	3.64E-04
9 2	4.53E+00	2.67E+00	2.81E-01	1.03E-01	2.60E-02	1.60E-02	3.15E-03	9.53E-04
9 3	6.35E+00	4.69E+00	4.27E-01	1.93E-01	3.54E-02	2.21E-02	4.93E-03	1.38E-03
9 4	7.55E+00	8.05E+00	6.74E-01	2.64E-01	4.91E-02	3.38E-02	7.24E-03	2.05E-03
9 5	9.54E+00	1.15E+01	9.72E-01	3.93E-01	7.34E-02	4.40E-02	9.19E-03	2.01E-03
9 6	1.10E+01	1.44E+01	1.34E+00	5.33E-01	1.02E-01	4.84E-02	7.37E-03	1.03E-03
9 7	1.50E+01	1.67E+01	2.48E+00	9.48E-01	1.09E-01	4.40E-02	3.25E-03	2.72E-04
9 8	1.29E+01	1.39E+01	4.32E+00	1.38E+00	7.72E-02	2.28E-02	6.21E-04	3.77E-05
10	2.75E+02	1.09E+02	1.28E+01	4.40E+00	5.12E-01	2.47E-01	3.83E-02	7.61E-03
10 0	1.53E+00	3.01E-01	4.24E-02	2.03E-02	5.94E-03	3.12E-03	6.08E-04	1.26E-04
10 1	4.99E+00	9.64E-01	1.49E-01	6.21E-02	1.25E-02	9.69E-03	1.83E-03	3.21E-04
10 2	9.57E+00	2.13E+00	2.45E-01	1.07E-01	2.85E-02	1.69E-02	3.31E-03	8.23E-04
10 3	1.59E+01	3.78E+00	4.47E-01	1.80E-01	3.65E-02	2.17E-02	4.78E-03	1.17E-03
10 4	2.23E+01	6.52E+00	5.87E-01	2.48E-01	4.88E-02	3.18E-02	6.83E-03	1.80E-03
10 5	2.89E+01	9.93E+00	8.94E-01	3.53E-01	6.58E-02	3.87E-02	8.75E-03	1.88E-03
10 6	3.48E+01	1.38E+01	1.13E+00	4.50E-01	9.47E-02	4.49E-02	7.13E-03	1.07E-03
10 7	4.32E+01	2.03E+01	1.63E+00	7.92E-01	9.57E-02	4.10E-02	3.71E-03	3.38E-04
10 8	5.84E+01	2.48E+01	2.75E+00	1.00E+00	8.38E-02	2.64E-02	1.20E-03	7.56E-05
10 9	5.57E+01	2.61E+01	4.91E+00	1.18E+00	4.01E-02	1.26E-02	1.71E-04	9.90E-06
11	3.60E+02	1.13E+02	1.41E+01	4.64E+00	5.30E-01	2.55E-01	3.93E-02	7.12E-03
11 0	1.34E+00	2.15E-01	4.39E-02	2.53E-02	6.17E-03	3.38E-03	6.81E-04	1.15E-04
11 1	4.15E+00	7.57E-01	1.82E-01	6.62E-02	1.37E-02	9.93E-03	1.99E-03	2.92E-04
11 2	7.33E+00	1.55E+00	2.48E-01	1.29E-01	2.85E-02	1.78E-02	3.51E-03	7.41E-04
11 3	1.13E+01	2.84E+00	4.91E-01	1.82E-01	3.85E-02	2.26E-02	4.90E-03	1.06E-03
11 4	1.72E+01	4.50E+00	5.61E-01	2.60E-01	4.68E-02	3.25E-02	6.57E-03	1.61E-03
11 5	2.47E+01	6.71E+00	8.72E-01	3.31E-01	6.38E-02	3.86E-02	8.56E-03	1.74E-03
11 6	3.60E+01	9.06E+00	1.05E+00	4.04E-01	8.78E-02	4.36E-02	7.06E-03	1.07E-03
11 7	4.77E+01	1.28E+01	1.32E+00	6.47E-01	9.29E-02	3.94E-02	3.91E-03	3.73E-04
11 8	5.83E+01	1.71E+01	2.12E+00	8.41E-01	8.20E-02	2.79E-02	1.62E-03	9.87E-05
11 9	7.28E+01	2.36E+01	2.82E+00	9.65E-01	5.32E-02	1.24E-02	4.23E-04	2.34E-05
11 10	7.90E+01	3.41E+01	4.39E+00	7.94E-01	1.70E-02	7.07E-03	4.69E-05	2.70E-06

Table continues on next page.

Data for F^{9+} + H($n = 2$) (cont.)

	impact energies [kev/amu]							
	1.0	10.0	30.0	45.0	90.0	120.0	200.0	300.
	state resolved CX cross sections							
n ℓ								
12	1.18E+02	9.63E+01	1.48E+01	4.91E+00	5.61E-01	2.74E-01	4.15E-02	6.85E-03
12 0	5.61E-01	1.95E-01	5.69E-02	3.56E-02	7.40E-03	4.59E-03	7.71E-04	1.17E-04
12 1	1.41E+00	6.15E-01	2.38E-01	8.32E-02	1.62E-02	1.26E-02	2.25E-03	2.96E-04
12 2	2.37E+00	1.30E+00	3.00E-01	1.73E-01	3.34E-02	2.22E-02	3.79E-03	7.20E-04
12 3	3.14E+00	2.01E+00	5.82E-01	2.10E-01	4.32E-02	2.53E-02	5.27E-03	1.01E-03
12 4	3.65E+00	3.39E+00	5.95E-01	3.03E-01	5.13E-02	3.54E-02	6.55E-03	1.47E-03
12 5	4.65E+00	4.36E+00	9.12E-01	3.46E-01	6.51E-02	3.66E-02	8.59E-03	1.63E-03
12 6	5.96E+00	6.08E+00	9.79E-01	3.94E-01	8.19E-02	4.21E-02	7.33E-03	1.06E-03
12 7	7.53E+00	7.13E+00	1.20E+00	5.59E-01	9.22E-02	3.96E-02	4.15E-03	3.95E-04
12 8	1.10E+01	9.21E+00	1.66E+00	7.24E-01	7.94E-02	2.94E-02	1.93E-03	1.10E-04
12 9	1.71E+01	1.21E+01	2.20E+00	8.14E-01	5.70E-02	1.63E-02	6.93E-04	3.29E-05
12 10	2.49E+01	1.92E+01	2.99E+00	8.41E-01	2.83E-02	5.69E-03	1.47E-04	7.58E-06
12 11	3.55E+01	3.07E+01	3.08E+00	4.34E-01	5.97E-03	3.86E-03	1.32E-05	6.84E-07
13	3.76E+01	5.59E+01	1.64E+01	6.12E+00	6.81E-01	3.37E-01	4.71E-02	6.84E-03
13 0	1.79E-01	2.04E-01	1.23E-01	7.75E-02	1.14E-02	6.86E-03	9.13E-04	1.22E-04
13 1	6.51E-01	4.10E-01	4.43E-01	1.87E-01	2.57E-02	1.78E-02	2.75E-03	3.18E-04
13 2	1.10E+00	1.14E+00	5.68E-01	3.48E-01	4.78E-02	3.16E-02	4.43E-03	7.62E-04
13 3	1.28E+00	1.26E+00	9.34E-01	3.89E-01	6.24E-02	3.49E-02	6.18E-03	9.97E-04
13 4	1.75E+00	2.24E+00	8.89E-01	5.05E-01	6.84E-02	4.69E-02	7.17E-03	1.38E-03
13 5	2.11E+00	2.57E+00	1.19E+00	5.11E-01	8.14E-02	4.72E-02	9.21E-03	1.60E-03
13 6	2.46E+00	3.26E+00	1.13E+00	5.19E-01	9.15E-02	4.65E-02	8.16E-03	1.08E-03
13 7	2.75E+00	3.63E+00	1.22E+00	5.89E-01	9.87E-02	4.20E-02	4.66E-03	4.17E-04
13 8	3.36E+00	4.28E+00	1.46E+00	6.78E-01	8.36E-02	3.06E-02	2.26E-03	1.15E-04
13 9	4.15E+00	4.85E+00	1.67E+00	7.31E-01	6.03E-02	1.79E-02	9.72E-04	3.68E-05
13 10	4.75E+00	6.49E+00	2.30E+00	7.85E-01	3.53E-02	9.40E-03	2.96E-04	1.20E-05
13 11	5.91E+00	8.12E+00	2.76E+00	6.02E-01	1.21E-02	3.56E-03	5.23E-05	2.18E-06
13 12	7.10E+00	1.75E+01	1.68E+00	1.99E-01	2.15E-03	2.26E-03	4.01E-06	1.54E-07

Table A.43: Data for O^{8+} + H(1s)

	impact energies [kev/amu]							
	1.0	10.0	30.0	45.0	90.0	120.0	200.0	300.
	total cross sections							
CX	6.12E+01	6.45E+01	5.09E+01	4.07E+01	1.29E+01	6.22E+00	1.35E+00	2.31E-01
ION	1.64E-03	2.14E-02	1.14E-01	1.48E-01	1.26E+00	1.49E+00	4.25E+00	5.12E+00
	state resolved CX cross sections							
n *ℓ*								
4	3.77E-01	5.24E+00	5.34E+00	4.62E+00	1.21E+00	5.80E-01	1.51E-01	3.71E-02
4 0	4.99E-02	3.72E-01	2.44E-01	1.35E-01	2.43E-02	7.18E-03	2.82E-03	1.29E-03
4 1	1.63E-01	1.23E+00	9.85E-01	6.19E-01	1.12E-01	4.78E-02	7.29E-03	1.46E-03
4 2	9.38E-02	1.97E+00	1.99E+00	1.50E+00	2.83E-01	1.15E-01	3.17E-02	1.21E-02
4 3	7.04E-02	1.67E+00	2.12E+00	2.36E+00	7.94E-01	4.10E-01	1.09E-01	2.22E-02
5	4.20E+01	3.59E+01	1.77E+01	1.04E+01	2.20E+00	9.63E-01	1.71E-01	3.78E-02
5 0	2.14E+00	5.82E-01	1.47E-01	8.97E-02	1.60E-02	9.50E-03	2.41E-03	1.02E-03
5 1	5.27E+00	2.56E+00	8.08E-01	4.63E-01	1.34E-01	5.29E-02	6.13E-03	1.50E-03
5 2	6.70E+00	6.18E+00	2.35E+00	1.08E+00	1.88E-01	8.04E-02	2.20E-02	9.20E-03
5 3	1.42E+01	1.18E+01	5.18E+00	2.55E+00	4.67E-01	2.49E-01	5.20E-02	1.54E-02
5 4	1.38E+01	1.48E+01	9.18E+00	6.25E+00	1.39E+00	5.71E-01	8.86E-02	1.07E-02
6	1.25E+01	2.01E+01	1.46E+01	9.82E+00	2.28E+00	1.00E+00	1.86E-01	3.38E-02
6 0	5.89E-01	1.36E-01	1.35E-01	5.87E-02	1.35E-02	7.59E-03	4.40E-03	7.35E-04
6 1	1.52E+00	4.88E-01	3.08E-01	2.72E-01	1.11E-01	5.08E-02	7.98E-03	1.35E-03
6 2	2.48E+00	1.14E+00	1.14E+00	6.73E-01	1.45E-01	5.63E-02	2.62E-02	6.77E-03
6 3	2.75E+00	3.02E+00	2.00E+00	1.20E+00	3.43E-01	1.93E-01	3.42E-02	1.12E-02
6 4	2.96E+00	5.74E+00	3.35E+00	2.20E+00	7.08E-01	3.51E-01	7.25E-02	1.04E-02
6 5	2.24E+00	9.63E+00	7.72E+00	5.41E+00	9.55E-01	3.41E-01	4.05E-02	3.35E-03
7	9.36E-01	2.23E+00	7.20E+00	6.46E+00	1.93E+00	8.83E-01	1.82E-01	2.83E-02
7 0	2.35E-02	2.32E-02	5.11E-02	3.65E-02	1.22E-02	8.39E-03	3.87E-03	5.16E-04
7 1	6.90E-02	6.60E-02	1.71E-01	1.49E-01	7.90E-02	4.58E-02	8.01E-03	1.06E-03
7 2	1.30E-01	1.51E-01	4.01E-01	3.83E-01	1.08E-01	4.75E-02	2.40E-02	4.97E-03
7 3	1.92E-01	2.56E-01	8.57E-01	6.06E-01	2.58E-01	1.43E-01	3.11E-02	7.89E-03
7 4	1.50E-01	3.72E-01	1.04E+00	1.07E+00	4.51E-01	2.34E-01	5.66E-02	8.83E-03
7 5	2.46E-01	5.65E-01	1.82E+00	1.93E+00	6.33E-01	2.76E-01	4.37E-02	4.30E-03
7 6	1.26E-01	7.98E-01	2.85E+00	2.28E+00	3.87E-01	1.28E-01	1.44E-02	6.90E-04
8	8.06E-01	4.55E-01	3.10E+00	3.81E+00	1.54E+00	7.28E-01	1.51E-01	2.34E-02
8 0	1.42E-02	9.00E-03	2.04E-02	2.28E-02	1.02E-02	8.01E-03	2.34E-03	3.94E-04
8 1	4.76E-02	2.53E-02	9.15E-02	8.81E-02	5.87E-02	3.18E-02	4.75E-03	7.95E-04
8 2	9.39E-02	4.50E-02	1.65E-01	2.16E-01	8.51E-02	3.70E-02	1.62E-02	3.83E-03
8 3	1.25E-01	5.68E-02	3.61E-01	3.28E-01	1.85E-01	1.06E-01	2.17E-02	5.57E-03
8 4	1.19E-01	8.72E-02	3.86E-01	5.56E-01	3.09E-01	1.69E-01	4.44E-02	7.20E-03
8 5	1.21E-01	6.50E-02	6.28E-01	9.04E-01	4.33E-01	2.01E-01	3.75E-02	4.40E-03
8 6	1.49E-01	7.04E-02	7.87E-01	1.02E+00	3.48E-01	1.39E-01	1.75E-02	1.12E-03
8 7	1.36E-01	9.62E-02	6.66E-01	6.73E-01	1.16E-01	3.64E-02	6.51E-03	1.14E-04
9	6.79E-01	2.23E-01	1.39E+00	2.27E+00	1.19E+00	6.14E-01	1.37E-01	2.00E-02
9 0	2.12E-02	4.63E-03	7.77E-03	1.62E-02	8.92E-03	7.22E-03	3.07E-03	3.52E-04
9 1	4.68E-02	1.27E-02	5.31E-02	4.85E-02	4.42E-02	3.22E-02	4.85E-03	6.22E-04
9 2	5.26E-02	2.04E-02	7.02E-02	1.33E-01	6.53E-02	3.23E-02	1.64E-02	3.18E-03
9 3	5.78E-02	2.81E-02	1.65E-01	1.84E-01	1.25E-01	9.40E-02	1.61E-02	4.08E-03
9 4	5.86E-02	3.47E-02	1.58E-01	3.18E-01	2.12E-01	1.21E-01	3.50E-02	5.86E-03
9 5	7.49E-02	3.84E-02	2.73E-01	4.72E-01	3.05E-01	1.52E-01	3.27E-02	4.25E-03
9 6	1.05E-01	3.26E-02	2.72E-01	5.02E-01	2.71E-01	1.20E-01	1.59E-02	1.39E-03
9 7	1.20E-01	2.44E-02	2.52E-01	4.26E-01	1.33E-01	4.53E-02	8.55E-03	2.47E-04
9 8	1.42E-01	2.70E-02	1.37E-01	1.70E-01	2.67E-02	1.02E-02	4.73E-03	1.62E-05
10	8.61E-01	1.20E-01	6.80E-01	1.40E+00	9.46E-01	5.23E-01	1.39E-01	1.77E-02
10 0	2.47E-02	2.39E-03	6.05E-03	1.32E-02	7.57E-03	8.13E-03	3.74E-03	3.61E-04
10 1	6.27E-02	8.29E-03	2.23E-02	2.86E-02	3.14E-02	3.08E-02	6.63E-03	5.58E-04
10 2	7.50E-02	1.02E-02	4.74E-02	9.14E-02	4.96E-02	3.25E-02	1.80E-02	2.85E-03
10 3	6.56E-02	1.69E-02	6.92E-02	1.12E-01	8.55E-02	7.80E-02	1.80E-02	3.18E-03
10 4	6.73E-02	1.58E-02	8.65E-02	1.96E-01	1.53E-01	9.20E-02	2.94E-02	4.81E-03
10 5	1.09E-01	1.83E-02	1.26E-01	2.70E-01	2.31E-01	1.17E-01	2.98E-02	3.99E-03
10 6	1.39E-01	1.72E-02	1.09E-01	2.60E-01	2.15E-01	9.89E-02	1.48E-02	1.57E-03
10 7	1.04E-01	1.46E-02	1.04E-01	2.43E-01	1.25E-01	4.87E-02	7.12E-03	3.82E-04
10 8	6.62E-02	9.02E-03	8.05E-02	1.44E-01	4.14E-02	1.29E-02	7.15E-03	4.51E-05
10 9	1.47E-01	7.48E-03	2.86E-02	3.99E-02	5.58E-03	4.24E-03	3.97E-03	2.36E-06
11	1.22E+00	8.40E-02	4.15E-01	9.58E-01	7.99E-01	4.67E-01	1.26E-01	1.66E-02
11 0	2.22E-02	1.89E-03	4.71E-03	9.48E-03	7.20E-03	9.33E-03	2.71E-03	4.02E-04
11 1	6.37E-02	7.12E-03	1.33E-02	2.16E-02	2.56E-02	3.30E-02	5.58E-03	5.89E-04
11 2	9.69E-02	7.73E-03	3.36E-02	6.34E-02	4.35E-02	3.43E-02	1.37E-02	2.73E-03
11 3	1.11E-01	1.06E-02	3.69E-02	7.86E-02	6.92E-02	7.00E-02	1.63E-02	2.70E-03
11 4	9.99E-02	7.60E-03	5.74E-02	1.29E-01	1.21E-01	7.64E-02	2.53E-02	4.06E-03
11 5	1.04E-01	9.11E-03	7.64E-02	1.78E-01	1.83E-01	9.32E-02	2.63E-02	3.76E-03
11 6	1.51E-01	1.06E-02	5.81E-02	1.55E-01	1.76E-01	8.42E-02	1.45E-02	1.73E-03
11 7	1.71E-01	9.77E-03	5.48E-02	1.53E-01	1.14E-01	4.64E-02	5.77E-03	5.17E-04
11 8	1.33E-01	8.18E-03	4.43E-02	1.12E-01	4.82E-02	1.43E-02	5.23E-03	8.48E-05
11 9	1.05E-01	6.48E-03	2.50E-02	4.37E-02	1.06E-02	3.24E-03	6.98E-03	8.40E-06
11 10	1.65E-01	4.88E-03	1.01E-02	1.37E-02	1.14E-03	2.63E-03	3.19E-03	3.37E-07

Table continues on next page.

Data for O^{8+} + H(1s) (cont.)

	impact energies [kev/amu]							
	1.0	10.0	30.0	45.0	90.0	120.0	200.0	300.
	state resolved CX cross sections							
n ℓ								
12	1.79E+00	6.07E-02	4.53E-01	8.98E-01	8.00E-01	4.63E-01	1.11E-01	1.67E-02
12 0	3.88E-02	1.62E-03	8.27E-03	1.17E-02	1.06E-02	1.06E-02	2.47E-03	4.78E-04
12 1	9.87E-02	5.60E-03	1.73E-02	2.97E-02	3.14E-02	3.64E-02	4.99E-03	7.12E-04
12 2	1.38E-01	6.77E-03	4.75E-02	6.90E-02	5.42E-02	3.85E-02	1.16E-02	2.82E-03
12 3	1.79E-01	8.11E-03	4.43E-02	8.66E-02	7.88E-02	7.16E-02	1.21E-02	2.57E-03
12 4	2.18E-01	5.91E-03	7.10E-02	1.23E-01	1.14E-01	7.42E-02	2.13E-02	3.65E-03
12 5	2.35E-01	6.18E-03	7.38E-02	1.61E-01	1.63E-01	8.46E-02	2.25E-02	3.72E-03
12 6	2.22E-01	6.15E-03	5.90E-02	1.29E-01	1.63E-01	7.88E-02	1.32E-02	1.95E-03
12 7	1.81E-01	6.13E-03	4.90E-02	1.23E-01	1.14E-01	4.64E-02	5.23E-03	6.58E-04
12 8	1.25E-01	5.79E-03	4.08E-02	9.90E-02	5.30E-02	1.54E-02	2.63E-03	1.32E-04
12 9	9.00E-02	3.57E-03	2.63E-02	4.44E-02	1.48E-02	4.04E-03	5.38E-03	1.78E-05
12 10	1.21E-01	3.02E-03	1.13E-02	1.35E-02	2.77E-03	1.01E-03	6.86E-03	1.40E-06
12 11	1.47E-01	1.88E-03	4.30E-03	7.03E-03	2.14E-04	1.48E-03	2.64E-03	5.81E-08

Table A.44: Data for O^{8+} + H(2s)

	impact energies [kev/amu]							
	1.0	10.0	30.0	45.0	90.0	120.0	200.0	300.
	total cross sections							
CX	7.55E+02	4.21E+02	9.55E+01	3.91E+01	5.96E+00	2.74E+00	4.06E-01	5.94E-02
ION	1.64E-02	3.62E-01	5.39E-01	5.92E-01	1.00E+00	1.45E+00	3.48E+00	3.12E+00
	state resolved CX cross sections							
n ℓ								
4	7.40E-02	2.21E-02	6.79E-01	1.81E-01	1.27E-01	8.18E-02	2.04E-02	4.61E-03
4 0	7.97E-03	1.57E-03	4.42E-02	1.99E-02	3.07E-03	1.48E-03	9.97E-04	2.11E-04
4 1	2.18E-02	3.83E-03	1.05E-01	4.63E-02	2.06E-02	9.14E-03	2.54E-03	1.03E-03
4 2	2.35E-02	7.06E-03	2.52E-01	5.57E-02	4.74E-02	3.00E-02	7.11E-03	1.79E-03
4 3	2.07E-02	9.65E-03	2.77E-01	5.94E-02	5.62E-02	4.12E-02	9.73E-03	1.58E-03
5	8.42E-02	1.72E-01	1.56E+00	1.43E+00	3.33E-01	1.57E-01	3.95E-02	5.83E-03
5 0	8.65E-03	1.46E-02	9.69E-02	4.37E-02	5.44E-03	2.61E-03	1.29E-03	2.07E-04
5 1	1.60E-02	3.51E-02	3.05E-01	1.85E-01	2.89E-02	1.20E-02	2.47E-03	8.26E-04
5 2	1.75E-02	4.04E-02	3.99E-01	4.02E-01	4.14E-02	2.47E-02	8.91E-03	1.67E-03
5 3	2.88E-02	3.86E-02	3.93E-01	4.70E-01	9.23E-02	2.92E-02	9.32E-03	1.60E-03
5 4	1.33E-02	4.35E-02	3.68E-01	3.28E-01	1.65E-01	8.81E-02	1.75E-02	1.53E-03
6	3.63E-01	3.62E+00	7.47E+00	3.47E+00	5.41E-01	2.45E-01	4.51E-02	6.78E-03
6 0	1.81E-02	2.79E-01	1.33E-01	5.21E-02	7.25E-03	3.65E-03	1.16E-03	2.01E-04
6 1	5.38E-02	7.51E-01	4.35E-01	1.72E-01	3.98E-02	1.54E-02	1.90E-03	7.11E-04
6 2	6.36E-02	9.45E-01	9.77E-01	3.13E-01	4.96E-02	2.61E-02	7.62E-03	1.59E-03
6 3	7.69E-02	7.74E-01	1.98E+00	5.27E-01	9.32E-02	4.37E-02	7.43E-03	1.53E-03
6 4	6.80E-02	5.33E-01	2.38E+00	1.12E+00	9.76E-02	6.20E-02	1.50E-02	1.91E-03
6 5	8.30E-02	3.35E-01	1.57E+00	1.29E+00	2.53E-01	9.45E-02	1.20E-02	8.33E-04
7	2.84E+00	3.30E+01	1.25E+01	4.69E+00	6.50E-01	3.12E-01	4.61E-02	7.16E-03
7 0	4.48E-02	8.69E-01	1.26E-01	5.04E-02	8.91E-03	4.07E-03	1.35E-03	1.96E-04
7 1	1.84E-01	3.16E+00	3.59E-01	1.62E-01	4.17E-02	1.95E-02	2.26E-03	6.21E-04
7 2	3.97E-01	6.23E+00	7.37E-01	2.93E-01	4.99E-02	2.88E-02	7.88E-03	1.51E-03
7 3	5.03E-01	8.08E+00	1.34E+00	4.70E-01	9.20E-02	5.49E-02	6.81E-03	1.44E-03
7 4	7.51E-01	6.90E+00	2.20E+00	6.87E-01	1.06E-01	5.87E-02	1.22E-02	1.92E-03
7 5	6.33E-01	4.55E+00	3.93E+00	1.06E+00	1.80E-01	9.18E-02	1.17E-02	1.25E-03
7 6	3.28E-01	3.21E+00	3.85E+00	1.97E+00	1.72E-01	5.41E-02	3.80E-03	2.24E-04
8	4.04E+01	7.03E+01	1.38E+01	5.08E+00	7.27E-01	3.42E-01	5.06E-02	7.22E-03
8 0	8.25E-01	9.73E-01	1.19E-01	4.97E-02	8.69E-03	5.99E-03	1.54E-03	1.97E-04
8 1	2.88E+00	3.28E+00	3.78E-01	1.51E-01	4.13E-02	2.48E-02	2.76E-03	5.59E-04
8 2	3.45E+00	6.34E+00	6.83E-01	2.64E-01	5.25E-02	3.35E-02	8.53E-03	1.44E-03
8 3	2.93E+00	9.88E+00	1.00E+00	4.35E-01	9.41E-02	5.73E-02	7.97E-03	1.36E-03
8 4	4.41E+00	1.40E+01	1.50E+00	4.86E-01	1.27E-01	5.04E-02	1.23E-02	1.81E-03
8 5	6.39E+00	1.45E+01	1.67E+00	8.44E-01	1.54E-01	8.13E-02	1.24E-02	1.41E-03
8 6	1.46E+01	9.94E+00	3.79E+00	9.45E-01	1.64E-01	6.78E-02	4.20E-03	4.04E-04
8 7	4.88E+00	1.15E+01	4.68E+00	1.91E+00	8.50E-02	2.10E-02	9.17E-04	3.92E-05
9	2.55E+02	7.83E+01	1.40E+01	5.38E+00	7.64E-01	3.51E-01	5.06E-02	7.10E-03
9 0	3.12E+00	6.84E-01	1.15E-01	5.47E-02	9.68E-03	5.42E-03	1.35E-03	2.00E-04
9 1	1.01E+01	2.32E+00	3.25E-01	1.66E-01	4.48E-02	2.35E-02	2.53E-03	5.22E-04
9 2	2.17E+01	4.91E+00	6.42E-01	2.66E-01	6.02E-02	2.88E-02	7.44E-03	1.38E-03
9 3	3.39E+01	8.48E+00	7.76E-01	4.63E-01	9.76E-02	5.35E-02	7.61E-03	1.29E-03
9 4	3.31E+01	1.16E+01	1.28E+00	3.97E-01	1.33E-01	5.23E-02	1.10E-02	1.66E-03
9 5	2.85E+01	1.35E+01	1.16E+00	7.44E-01	1.29E-01	8.19E-02	1.32E-02	1.44E-03
9 6	2.37E+01	1.12E+01	2.25E+00	7.69E-01	1.54E-01	6.92E-02	5.72E-03	5.23E-04
9 7	5.04E+01	7.50E+00	2.41E+00	9.10E-01	9.84E-02	2.86E-02	1.17E-03	8.44E-05
9 8	5.09E+01	1.81E+01	5.07E+00	1.61E+00	3.67E-02	7.47E-03	5.07E-04	5.52E-06
10	2.93E+02	8.98E+01	1.42E+01	5.43E+00	8.03E-01	3.68E-01	4.71E-02	6.90E-03
10 0	2.80E+00	4.76E-01	1.44E-01	5.22E-02	1.20E-02	6.08E-03	1.31E-03	2.04E-04
10 1	8.40E+00	1.70E+00	3.27E-01	2.00E-01	4.87E-02	2.65E-02	2.55E-03	5.01E-04
10 2	1.34E+01	3.19E+00	7.36E-01	2.55E-01	7.04E-02	3.19E-02	6.83E-03	1.31E-03
10 3	1.98E+01	5.89E+00	7.16E-01	4.88E-01	9.88E-02	5.85E-02	6.82E-03	1.23E-03
10 4	2.96E+01	7.04E+00	1.29E+00	3.76E-01	1.34E-01	5.72E-02	9.04E-03	1.52E-03
10 5	3.46E+01	8.15E+00	9.62E-01	6.52E-01	1.22E-01	7.42E-02	1.15E-02	1.41E-03
10 6	3.17E+01	9.27E+00	1.65E+00	7.11E-01	1.49E-01	6.51E-02	6.36E-03	5.89E-04
10 7	2.75E+01	1.21E+01	2.21E+00	6.15E-01	1.02E-01	3.44E-02	1.61E-03	1.21E-04
10 8	5.55E+01	8.71E+00	1.79E+00	1.05E+00	5.11E-02	1.11E-02	6.44E-04	1.36E-05
10 9	6.96E+01	3.33E+01	4.36E+00	1.04E+00	1.44E-02	3.26E-03	4.00E-04	6.94E-07
11	1.33E+02	8.71E+01	1.42E+01	5.64E+00	8.76E-01	3.99E-01	4.96E-02	6.79E-03
11 0	8.45E-01	3.51E-01	1.91E-01	6.18E-02	1.64E-02	7.67E-03	1.61E-03	2.12E-04
11 1	2.38E+00	1.21E+00	3.53E-01	2.62E-01	5.63E-02	3.24E-02	3.30E-03	5.01E-04
11 2	3.17E+00	2.27E+00	9.19E-01	2.91E-01	8.77E-02	3.80E-02	7.87E-03	1.28E-03
11 3	3.81E+00	3.69E+00	7.66E-01	5.65E-01	1.04E-01	6.48E-02	7.90E-03	1.20E-03
11 4	4.57E+00	4.70E+00	1.42E+00	4.16E-01	1.43E-01	6.30E-02	9.12E-03	1.42E-03
11 5	5.49E+00	5.12E+00	1.07E+00	6.14E-01	1.27E-01	7.06E-02	1.06E-02	1.37E-03
11 6	7.60E+00	5.40E+00	1.35E+00	6.93E-01	1.46E-01	6.64E-02	5.99E-03	6.29E-04
11 7	1.10E+01	6.03E+00	1.98E+00	5.25E-01	1.07E-01	3.80E-02	1.79E-03	1.49E-04
11 8	1.74E+01	8.21E+00	1.52E+00	7.32E-01	5.97E-02	1.22E-02	4.92E-04	2.14E-05
11 9	3.27E+01	1.35E+01	2.01E+00	9.52E-01	2.42E-02	4.02E-03	5.45E-04	1.85E-06
11 10	4.36E+01	3.66E+01	2.60E+00	5.31E-01	4.68E-03	1.74E-03	3.00E-04	7.93E-08

Table continues on next page.

Data for O^{8+} + H(2s) (cont.)

	impact energies [kev/amu]							
	1.0	10.0	30.0	45.0	90.0	120.0	200.0	300.
	state resolved CX cross sections							
n ℓ								
12	3.09E+01	5.84E+01	1.70E+01	7.77E+00	1.14E+00	4.79E-01	5.76E-02	6.98E-03
12 0	2.26E-01	2.64E-01	3.33E-01	1.41E-01	2.78E-02	1.12E-02	1.81E-03	2.28E-04
12 1	6.81E-01	9.01E-01	7.19E-01	5.14E-01	8.00E-02	4.27E-02	3.89E-03	5.25E-04
12 2	8.96E-01	1.68E+00	1.52E+00	6.10E-01	1.33E-01	5.11E-02	8.68E-03	1.29E-03
12 3	8.80E-01	2.35E+00	1.44E+00	9.62E-01	1.39E-01	7.79E-02	9.70E-03	1.25E-03
12 4	9.73E-01	3.21E+00	2.02E+00	8.16E-01	1.88E-01	7.73E-02	1.07E-02	1.43E-03
12 5	1.18E+00	3.14E+00	1.81E+00	8.43E-01	1.67E-01	7.79E-02	1.22E-02	1.40E-03
12 6	1.65E+00	3.23E+00	1.57E+00	9.42E-01	1.67E-01	7.63E-02	6.81E-03	6.60E-04
12 7	2.85E+00	3.20E+00	1.98E+00	6.16E-01	1.26E-01	4.36E-02	2.07E-03	1.65E-04
12 8	4.14E+00	3.48E+00	1.59E+00	6.49E-01	7.10E-02	1.40E-02	5.02E-04	2.79E-05
12 9	4.89E+00	5.22E+00	1.35E+00	8.11E-01	3.20E-02	4.74E-03	3.44E-04	3.49E-06
12 10	5.16E+00	9.14E+00	1.55E+00	6.42E-01	9.90E-03	1.50E-03	5.41E-04	2.46E-07
12 11	7.37E+00	2.26E+01	1.12E+00	2.26E-01	1.26E-03	8.74E-04	2.42E-04	9.20E-09

Table A.45: Data for O^{8+} + H(2p0)

	impact energies [kev/amu]							
	1.0	10.0	30.0	45.0	90.0	120.0	200.0	300.
	total cross sections							
CX	7.72E+02	4.50E+02	4.94E+01	1.47E+01	1.78E+00	9.88E-01	1.76E-01	2.06E-02
ION	9.26E-03	2.20E-01	9.45E-01	9.16E-01	1.41E+00	2.26E+00	3.07E+00	2.44E+00
	state resolved CX cross sections							
n ℓ								
4	4.65E-02	7.73E-02	3.43E-01	1.25E-01	7.45E-02	4.62E-02	8.92E-03	2.19E-03
4 0	6.74E-03	5.68E-03	1.60E-02	7.66E-03	3.24E-03	1.65E-03	4.00E-04	1.04E-04
4 1	1.69E-02	1.52E-02	2.53E-02	1.66E-02	6.82E-03	4.11E-03	1.38E-03	1.47E-04
4 2	1.66E-02	2.41E-02	9.58E-02	3.43E-02	2.05E-02	6.00E-03	2.90E-03	8.36E-04
4 3	6.26E-03	3.23E-02	2.06E-01	6.62E-02	4.40E-02	3.44E-02	4.23E-03	1.11E-03
5	4.33E-02	4.47E-01	6.31E-01	2.91E-01	7.82E-02	6.16E-02	1.17E-02	2.75E-03
5 0	3.57E-03	1.28E-02	2.81E-02	9.67E-03	2.23E-03	3.07E-03	4.15E-04	1.17E-04
5 1	9.11E-03	5.85E-02	1.25E-01	2.63E-02	9.77E-03	7.85E-03	1.74E-03	2.46E-04
5 2	1.10E-02	6.71E-02	1.29E-01	6.43E-02	1.56E-02	1.28E-02	2.82E-03	6.64E-04
5 3	1.21E-02	1.35E-01	1.47E-01	8.59E-02	1.54E-02	1.95E-02	3.76E-03	6.87E-04
5 4	7.52E-03	1.74E-01	2.02E-01	1.05E-01	3.53E-02	1.83E-02	2.97E-03	1.04E-03
6	2.47E-01	3.13E+00	1.03E+00	3.66E-01	1.03E-01	7.48E-02	1.38E-02	2.82E-03
6 0	8.79E-03	1.32E-01	1.87E-02	4.94E-03	1.73E-03	2.00E-03	5.12E-04	1.19E-04
6 1	4.02E-02	3.74E-01	7.11E-02	1.45E-02	7.45E-03	6.33E-03	1.92E-03	3.00E-04
6 2	3.21E-02	5.04E-01	9.74E-02	3.36E-02	1.17E-02	9.98E-03	2.87E-03	6.05E-04
6 3	5.50E-02	5.94E-01	1.61E-01	6.67E-02	1.02E-02	1.43E-02	4.02E-03	5.68E-04
6 4	4.49E-02	7.36E-01	2.52E-01	7.60E-02	3.21E-02	2.66E-02	3.17E-03	8.42E-04
6 5	6.57E-02	7.86E-01	4.28E-01	1.71E-01	3.94E-02	1.57E-02	1.29E-03	3.86E-04
7	4.95E+00	1.43E+01	1.78E+00	7.68E-01	1.39E-01	1.10E-01	1.88E-02	2.58E-03
7 0	1.89E-01	2.32E-01	1.47E-02	7.52E-03	2.24E-03	3.11E-03	7.33E-04	1.07E-04
7 1	4.31E-01	7.81E-01	4.84E-02	2.14E-02	7.65E-03	9.30E-03	2.56E-03	2.85E-04
7 2	6.13E-01	1.42E+00	7.02E-02	4.29E-02	1.20E-02	1.55E-02	3.54E-03	5.25E-04
7 3	9.54E-01	1.69E+00	1.59E-01	5.80E-02	1.27E-02	2.01E-02	4.84E-03	4.95E-04
7 4	7.51E-01	2.27E+00	2.08E-01	1.22E-01	2.36E-02	3.15E-02	3.94E-03	6.48E-04
7 5	1.03E+00	3.64E+00	5.63E-01	1.40E-01	3.98E-02	1.96E-02	2.10E-03	4.45E-04
7 6	9.81E-01	4.24E+00	7.16E-01	3.75E-01	4.10E-02	1.12E-02	1.05E-03	7.77E-05
8	4.59E+01	3.61E+01	4.01E+00	1.45E+00	1.90E-01	1.17E-01	2.09E-02	2.30E-03
8 0	1.37E+00	3.30E-01	2.73E-02	9.78E-03	3.42E-03	2.99E-03	6.58E-04	9.12E-05
8 1	2.79E+00	9.36E-01	6.87E-02	2.96E-02	1.07E-02	9.20E-03	2.34E-03	2.50E-04
8 2	4.71E+00	1.51E+00	1.28E-01	6.60E-02	1.58E-02	1.42E-02	3.34E-03	4.49E-04
8 3	5.33E+00	3.40E+00	2.59E-01	7.27E-02	1.91E-02	1.81E-02	5.05E-03	4.34E-04
8 4	6.18E+00	5.86E+00	2.70E-01	1.87E-01	2.43E-02	2.72E-02	4.27E-03	5.28E-04
8 5	6.60E+00	8.10E+00	6.92E-01	1.57E-01	3.96E-02	2.22E-02	2.66E-03	4.25E-04
8 6	6.20E+00	9.02E+00	5.59E-01	3.56E-01	5.10E-02	1.57E-02	1.59E-03	1.15E-04
8 7	1.28E+01	6.93E+00	2.00E+00	5.71E-01	2.61E-02	7.64E-03	9.73E-04	1.19E-05
9	2.12E+02	9.82E+01	7.28E+00	2.18E+00	2.31E-01	1.20E-01	2.03E-02	2.09E-03
9 0	2.17E+00	2.99E-01	3.70E-02	1.10E-02	3.57E-03	2.75E-03	4.51E-04	8.03E-05
9 1	6.55E+00	1.23E+00	1.03E-01	4.20E-02	1.11E-02	8.43E-03	1.68E-03	2.21E-04
9 2	9.78E+00	2.40E+00	1.93E-01	8.51E-02	1.67E-02	1.29E-02	2.62E-03	3.92E-04
9 3	1.36E+01	4.96E+00	3.65E-01	1.08E-01	2.00E-02	1.66E-02	4.30E-03	3.86E-04
9 4	2.38E+01	9.20E+00	3.83E-01	2.47E-01	2.90E-02	2.40E-02	4.49E-03	4.57E-04
9 5	3.03E+01	1.21E+01	9.62E-01	2.04E-01	3.74E-02	2.45E-02	2.66E-03	3.94E-04
9 6	3.74E+01	2.30E+01	6.90E-01	3.47E-01	6.43E-02	1.90E-02	1.87E-03	1.30E-04
9 7	4.72E+01	2.78E+01	1.76E+00	6.48E-01	4.08E-02	7.04E-03	1.28E-03	2.37E-05
9 8	4.11E+01	1.72E+01	2.79E+00	4.87E-01	8.64E-03	4.49E-03	9.31E-04	1.95E-06
10	3.34E+02	1.27E+02	1.01E+01	2.75E+00	2.76E-01	1.31E-01	2.26E-02	1.95E-03
10 0	1.92E+00	2.87E-01	4.61E-02	1.40E-02	4.19E-03	2.60E-03	5.43E-04	7.44E-05
10 1	5.54E+00	9.33E-01	1.38E-01	6.71E-02	1.30E-02	8.23E-03	1.86E-03	2.04E-04
10 2	9.31E+00	2.19E+00	2.59E-01	9.95E-02	2.12E-02	1.34E-02	2.76E-03	3.55E-04
10 3	1.45E+01	4.12E+00	4.58E-01	1.43E-01	2.59E-02	1.79E-02	4.11E-03	3.54E-04
10 4	2.24E+01	7.52E+00	4.86E-01	2.93E-01	3.81E-02	2.54E-02	4.53E-03	4.16E-04
10 5	3.30E+01	1.03E+01	1.10E+00	2.33E-01	3.76E-02	2.82E-02	3.03E-03	3.68E-04
10 6	4.56E+01	1.66E+01	7.45E-01	3.65E-01	6.36E-02	2.09E-02	2.08E-03	1.39E-04
10 7	6.00E+01	2.18E+01	1.56E+00	6.48E-01	4.94E-02	9.07E-03	1.33E-03	3.34E-05
10 8	6.87E+01	3.23E+01	2.55E+00	5.70E-01	1.99E-02	3.58E-03	1.36E-03	4.88E-06
10 9	7.24E+01	3.09E+01	2.76E+00	3.15E-01	2.73E-03	1.95E-03	9.43E-04	3.65E-07
11	1.28E+02	1.11E+02	1.15E+01	3.06E+00	3.04E-01	1.47E-01	2.75E-02	1.91E-03
11 0	5.16E-01	2.19E-01	7.41E-02	1.78E-02	4.94E-03	3.73E-03	7.71E-04	7.29E-05
11 1	1.41E+00	8.77E-01	1.61E-01	9.48E-02	1.49E-02	1.11E-02	2.48E-03	1.98E-04
11 2	2.35E+00	1.55E+00	3.66E-01	1.16E-01	2.48E-02	1.70E-02	3.46E-03	3.40E-04
11 3	3.45E+00	3.12E+00	4.99E-01	1.73E-01	2.85E-02	2.06E-02	4.75E-03	3.42E-04
11 4	5.37E+00	4.62E+00	5.40E-01	3.06E-01	4.16E-02	2.64E-02	4.67E-03	4.00E-04
11 5	6.75E+00	6.92E+00	1.10E+00	2.43E-01	3.43E-02	2.77E-02	3.57E-03	3.59E-04
11 6	7.62E+00	8.62E+00	7.37E-01	3.32E-01	5.83E-02	2.09E-02	2.46E-03	1.50E-04
11 7	1.03E+01	1.14E+01	1.30E+00	6.08E-01	6.16E-02	1.26E-02	1.60E-03	4.31E-05
11 8	2.03E+01	1.40E+01	2.11E+00	5.81E-01	2.86E-02	5.23E-03	1.24E-03	8.73E-06
11 9	2.58E+01	2.54E+01	2.47E+00	4.00E-01	5.69E-03	1.33E-03	1.68E-03	1.13E-06
11 10	4.41E+01	3.43E+01	2.16E+00	1.88E-01	1.10E-03	9.20E-04	8.58E-04	5.83E-08

Table continues on next page.

Data for O^{8+} + H(2p0) (cont.)

	impact energies [kev/amu]							
	1.0	10.0	30.0	45.0	90.0	120.0	200.0	300.
	state resolved CX cross sections							
n ℓ								
12	4.72E+01	6.02E+01	1.27E+01	3.72E+00	3.81E-01	1.79E-01	3.13E-02	2.03E-03
12 0	4.40E-01	1.70E-01	1.37E-01	5.09E-02	6.81E-03	4.71E-03	8.31E-04	7.68E-05
12 1	1.26E+00	8.16E-01	3.84E-01	1.87E-01	1.91E-02	1.37E-02	2.68E-03	2.08E-04
12 2	1.76E+00	1.09E+00	5.75E-01	2.51E-01	3.43E-02	2.09E-02	3.76E-03	3.52E-04
12 3	2.38E+00	2.00E+00	8.43E-01	2.99E-01	3.66E-02	2.44E-02	5.23E-03	3.60E-04
12 4	3.09E+00	2.54E+00	6.39E-01	4.27E-01	5.55E-02	3.06E-02	5.07E-03	4.13E-04
12 5	3.42E+00	3.35E+00	1.21E+00	3.16E-01	4.25E-02	3.17E-02	3.75E-03	3.76E-04
12 6	4.77E+00	3.91E+00	7.27E-01	3.35E-01	6.56E-02	2.68E-02	2.67E-03	1.72E-04
12 7	5.41E+00	4.73E+00	1.04E+00	5.26E-01	7.40E-02	1.71E-02	1.82E-03	5.61E-05
12 8	5.94E+00	5.44E+00	1.57E+00	5.46E-01	3.41E-02	5.60E-03	1.18E-03	1.37E-05
12 9	7.06E+00	7.57E+00	1.90E+00	4.14E-01	1.02E-02	2.39E-03	1.60E-03	2.33E-06
12 10	6.21E+00	8.41E+00	2.33E+00	2.68E-01	2.62E-03	4.70E-04	1.93E-03	2.16E-07
12 11	5.43E+00	2.01E+01	1.32E+00	9.96E-02	3.00E-04	5.57E-04	7.45E-04	1.14E-08

Table A.46: Data for O^{8+} + H(2p1)

		impact energies [kev/amu]							
		1.0	10.0	30.0	45.0	90.0	120.0	200.0	300.
		total cross sections							
CX		7.82E+02	3.95E+02	6.67E+01	2.59E+01	3.37E+00	1.41E+00	2.45E-01	5.65E-02
ION		1.55E-02	1.99E-01	5.06E-01	5.62E-01	2.06E+00	2.58E+00	2.57E+00	2.79E+00
		state resolved CX cross sections							
n	ℓ								
4		5.01E-02	9.29E-02	4.60E-01	1.30E-01	5.99E-02	5.64E-02	2.46E-02	8.77E-03
4	0	6.34E-03	4.93E-03	3.05E-02	9.99E-03	1.88E-03	1.13E-03	2.29E-04	1.55E-04
4	1	1.59E-02	1.92E-02	6.95E-02	2.51E-02	4.90E-03	4.39E-03	1.20E-03	3.94E-04
4	2	1.47E-02	2.82E-02	1.00E-01	4.42E-02	1.25E-02	7.07E-03	2.33E-03	1.78E-03
4	3	1.31E-02	4.05E-02	2.60E-01	5.11E-02	4.06E-02	4.38E-02	2.08E-02	6.44E-03
5		6.29E-02	3.09E-01	1.20E+00	4.68E-01	1.30E-01	9.10E-02	2.48E-02	9.01E-03
5	0	6.67E-03	1.72E-02	6.41E-02	2.53E-02	3.91E-03	1.56E-03	4.44E-04	1.31E-04
5	1	1.65E-02	5.19E-02	1.59E-01	5.21E-02	9.66E-03	7.95E-03	6.68E-04	4.23E-04
5	2	1.14E-02	6.38E-02	2.80E-01	1.09E-01	2.62E-02	9.13E-03	2.37E-03	1.39E-03
5	3	1.34E-02	9.50E-02	3.22E-01	1.40E-01	4.14E-02	2.86E-02	9.92E-03	5.07E-03
5	4	1.49E-02	8.08E-02	3.76E-01	1.42E-01	4.91E-02	4.38E-02	1.14E-02	2.00E-03
6		2.31E-01	3.82E+00	3.60E+00	1.55E+00	2.76E-01	1.41E-01	2.78E-02	8.28E-03
6	0	5.61E-03	1.60E-01	7.88E-02	2.48E-02	4.63E-03	2.19E-03	5.23E-04	9.07E-05
6	1	2.81E-02	4.00E-01	2.75E-01	5.12E-02	1.45E-02	7.96E-03	5.75E-04	3.71E-04
6	2	3.31E-02	4.83E-01	4.47E-01	1.52E-01	3.02E-02	9.47E-03	2.55E-03	9.95E-04
6	3	3.85E-02	6.93E-01	5.99E-01	2.92E-01	2.88E-02	2.13E-02	6.57E-03	3.66E-03
6	4	5.02E-02	1.00E+00	9.60E-01	4.57E-01	7.24E-02	3.11E-02	1.01E-02	2.48E-03
6	5	7.55E-02	1.08E+00	1.24E+00	5.73E-01	1.25E-01	6.91E-02	7.50E-03	6.78E-04
7		4.01E+00	1.66E+01	7.87E+00	2.89E+00	3.88E-01	1.81E-01	2.99E-02	7.01E-03
7	0	1.63E-01	3.08E-01	4.97E-02	2.37E-02	4.89E-03	2.48E-03	6.64E-04	6.11E-05
7	1	4.89E-01	7.32E-01	2.80E-01	5.08E-02	1.18E-02	8.77E-03	5.32E-04	2.59E-04
7	2	7.25E-01	1.47E+00	3.23E-01	1.49E-01	3.08E-02	1.17E-02	2.99E-03	7.13E-04
7	3	9.88E-01	2.46E+00	7.77E-01	1.96E-01	2.66E-02	1.74E-02	3.83E-03	2.50E-03
7	4	4.24E-01	3.69E+00	1.40E+00	3.99E-01	5.90E-02	3.07E-02	9.01E-03	2.32E-03
7	5	6.63E-01	4.11E+00	1.86E+00	7.43E-01	7.43E-02	4.01E-02	9.29E-03	9.61E-04
7	6	5.58E-01	3.88E+00	3.17E+00	1.33E+00	1.80E-01	6.96E-02	3.59E-03	1.97E-04
8		5.09E+01	6.33E+01	1.03E+01	3.74E+00	4.57E-01	1.95E-01	3.02E-02	5.86E-03
8	0	6.00E-01	4.25E-01	3.61E-02	2.89E-02	4.13E-03	2.38E-03	7.69E-04	5.13E-05
8	1	2.27E+00	1.37E+00	1.90E-01	4.45E-02	1.04E-02	9.05E-03	5.26E-04	1.73E-04
8	2	3.99E+00	3.26E+00	2.49E-01	1.53E-01	2.62E-02	1.13E-02	3.44E-03	5.81E-04
8	3	7.62E+00	6.37E+00	5.30E-01	1.62E-01	2.70E-02	1.42E-02	2.96E-03	1.75E-03
8	4	1.10E+01	8.81E+00	7.78E-01	3.50E-01	4.31E-02	2.60E-02	6.08E-03	1.95E-03
8	5	8.24E+00	1.29E+01	1.31E+00	3.96E-01	7.72E-02	3.01E-02	9.58E-03	9.93E-04
8	6	8.58E+00	1.86E+01	2.54E+00	8.71E-01	1.24E-01	5.97E-02	5.44E-03	3.13E-04
8	7	8.56E+00	1.16E+01	4.67E+00	1.74E+00	1.45E-01	4.19E-02	1.42E-03	4.92E-05
9		1.87E+02	9.46E+01	1.07E+01	4.01E+00	4.81E-01	1.92E-01	2.93E-02	5.01E-03
9	0	1.92E+00	2.06E-01	3.29E-02	2.23E-02	3.09E-03	2.42E-03	6.07E-04	5.52E-05
9	1	5.89E+00	9.47E-01	1.38E-01	3.62E-02	8.48E-03	7.41E-03	4.45E-04	1.29E-04
9	2	9.65E+00	1.74E+00	1.95E-01	1.15E-01	2.11E-02	1.16E-02	2.85E-03	5.34E-04
9	3	1.51E+01	3.65E+00	3.62E-01	1.34E-01	2.62E-02	1.02E-02	3.51E-03	1.31E-03
9	4	1.98E+01	6.41E+00	4.71E-01	2.66E-01	3.44E-02	2.47E-02	4.41E-03	1.58E-03
9	5	2.68E+01	1.23E+01	7.88E-01	3.05E-01	7.22E-02	2.54E-02	7.97E-03	9.21E-04
9	6	3.60E+01	2.32E+01	1.12E+00	6.38E-01	9.82E-02	4.44E-02	6.34E-03	3.71E-04
9	7	3.02E+01	2.89E+01	2.09E+00	8.12E-01	1.43E-01	4.91E-02	2.47E-03	9.39E-05
9	8	4.18E+01	1.72E+01	5.53E+00	1.68E+00	7.45E-02	1.70E-02	6.91E-04	9.63E-06
10		3.75E+02	9.11E+01	1.04E+01	4.00E+00	4.93E-01	1.85E-01	2.75E-02	4.42E-03
10	0	1.67E+00	1.44E-01	3.25E-02	2.70E-02	1.94E-03	2.12E-03	3.87E-04	6.52E-05
10	1	5.73E+00	5.05E-01	1.13E-01	5.64E-02	8.21E-03	6.43E-03	3.18E-04	1.14E-04
10	2	1.04E+01	1.16E+00	1.68E-01	1.30E-01	1.63E-02	1.10E-02	1.85E-03	5.22E-04
10	3	1.58E+01	1.85E+00	2.80E-01	1.34E-01	2.74E-02	9.19E-03	3.14E-03	1.07E-03
10	4	2.05E+01	3.67E+00	3.52E-01	2.52E-01	3.09E-02	2.11E-02	4.22E-03	1.29E-03
10	5	3.39E+01	6.62E+00	5.09E-01	2.67E-01	6.61E-02	2.13E-02	6.57E-03	8.19E-04
10	6	5.56E+01	9.98E+00	7.89E-01	4.85E-01	8.70E-02	3.61E-02	6.10E-03	3.91E-04
10	7	7.25E+01	1.57E+01	1.15E+00	5.61E-01	1.27E-01	4.71E-02	3.14E-03	1.26E-04
10	8	7.65E+01	2.44E+01	1.81E+00	9.33E-01	9.97E-02	2.53E-02	1.27E-03	2.30E-05
10	9	8.23E+01	2.71E+01	5.22E+00	1.15E+00	2.85E-02	5.47E-03	4.68E-04	1.53E-06
11		1.05E+02	7.71E+01	1.03E+01	4.11E+00	5.06E-01	1.80E-01	2.57E-02	4.08E-03
11	0	9.41E-01	2.18E-01	4.87E-02	4.25E-02	1.49E-03	2.36E-03	3.37E-04	7.80E-05
11	1	2.43E+00	6.81E-01	1.67E-01	8.47E-02	9.43E-03	6.24E-03	2.76E-04	1.20E-04
11	2	3.51E+00	1.34E+00	2.28E-01	1.85E-01	1.46E-02	1.17E-02	1.50E-03	5.29E-04
11	3	4.33E+00	2.15E+00	3.40E-01	1.72E-01	3.05E-02	8.59E-03	2.20E-03	9.49E-04
11	4	4.95E+00	3.62E+00	3.92E-01	2.69E-01	3.17E-02	1.81E-02	3.65E-03	1.08E-03
11	5	5.82E+00	5.58E+00	4.41E-01	2.97E-01	6.01E-02	2.15E-02	5.95E-03	7.33E-04
11	6	8.46E+00	6.97E+00	6.81E-01	4.10E-01	7.83E-02	2.95E-02	5.57E-03	3.97E-04
11	7	1.22E+01	9.57E+00	8.32E-01	4.81E-01	1.16E-01	4.13E-02	3.29E-03	1.51E-04
11	8	1.76E+01	1.07E+01	9.42E-01	5.91E-01	1.07E-01	2.94E-02	1.56E-03	3.75E-05
11	9	2.10E+01	1.58E+01	2.65E+00	9.55E-01	4.90E-02	9.54E-03	9.49E-04	4.62E-06
11	10	2.35E+01	2.04E+01	3.58E+00	6.24E-01	8.52E-03	1.64E-03	3.67E-04	2.18E-07

Table continues on next page.

Data for O^{8+} + H(2p1) (cont.)

	impact energies [kev/amu]							
	1.0	10.0	30.0	45.0	90.0	120.0	200.0	300.
	state resolved CX cross sections							
n ℓ								
12	6.01E+01	4.83E+01	1.18E+01	4.99E+00	5.82E-01	1.84E-01	2.48E-02	4.03E-03
12 0	2.45E-01	1.83E-01	1.21E-01	7.83E-02	2.25E-03	2.58E-03	3.37E-04	9.53E-05
12 1	8.16E-01	7.88E-01	3.62E-01	1.88E-01	1.35E-02	5.93E-03	3.31E-04	1.45E-04
12 2	1.43E+00	1.06E+00	5.28E-01	3.20E-01	1.88E-02	1.25E-02	1.52E-03	5.58E-04
12 3	2.36E+00	1.98E+00	6.19E-01	3.68E-01	3.88E-02	8.58E-03	2.02E-03	9.14E-04
12 4	4.04E+00	2.72E+00	7.36E-01	3.81E-01	4.24E-02	1.75E-02	2.98E-03	9.77E-04
12 5	6.14E+00	3.40E+00	6.25E-01	4.63E-01	6.23E-02	2.22E-02	5.36E-03	6.93E-04
12 6	6.54E+00	4.53E+00	7.76E-01	4.50E-01	8.35E-02	2.66E-02	5.28E-03	4.08E-04
12 7	7.13E+00	4.59E+00	8.94E-01	4.87E-01	1.20E-01	3.91E-02	3.13E-03	1.74E-04
12 8	6.17E+00	5.43E+00	7.84E-01	4.92E-01	1.15E-01	3.21E-02	1.54E-03	5.29E-05
12 9	5.88E+00	6.20E+00	1.57E+00	7.46E-01	6.41E-02	1.32E-02	1.10E-03	9.04E-06
12 10	7.18E+00	7.52E+00	2.99E+00	7.35E-01	1.90E-02	2.68E-03	8.72E-04	7.91E-07
12 11	1.21E+01	9.93E+00	1.84E+00	2.85E-01	2.08E-03	6.39E-04	2.96E-04	3.16E-08

Table A.47: Data for O^{8+} + H(2p-1)

	impact energies [kev/amu] 1.0	10.0	30.0	45.0	90.0	120.0	200.0	300.
	total cross sections							
CX	7.77E+02	4.08E+02	6.49E+01	1.96E+01	1.90E+00	7.13E-01	1.13E-01	2.90E-02
ION	2.58E-04	3.50E-02	2.71E-01	1.15E+00	1.20E+00	1.28E+00	2.20E+00	2.53E+00
	state resolved CX cross sections							
n ℓ								
4	3.28E-02	2.81E-03	5.14E-01	2.07E-01	3.84E-02	2.47E-02	9.94E-03	3.40E-03
4 1	4.06E-03	7.27E-05	1.80E-02	5.35E-03	1.05E-03	6.58E-04	3.14E-04	9.84E-05
4 2	1.00E-02	5.04E-04	5.04E-02	3.21E-02	6.11E-03	3.03E-03	1.94E-03	1.05E-03
4 3	1.87E-02	2.24E-03	4.45E-01	1.69E-01	3.12E-02	2.10E-02	7.69E-03	2.25E-03
5	1.70E-03	4.53E-02	3.71E-01	2.78E-01	7.83E-02	4.35E-02	1.35E-02	4.10E-03
5 1	1.75E-04	2.45E-03	1.34E-02	2.49E-03	9.88E-04	8.20E-04	2.50E-04	8.12E-05
5 2	4.71E-04	9.71E-03	3.00E-02	2.48E-02	8.57E-03	3.67E-03	1.02E-03	6.19E-04
5 3	5.45E-04	1.80E-02	1.67E-01	8.34E-02	2.14E-02	1.31E-02	5.89E-03	2.13E-03
5 4	5.12E-04	1.52E-02	1.61E-01	1.67E-01	4.73E-02	2.59E-02	6.39E-03	1.27E-03
6	8.04E-02	1.45E+00	1.56E+00	6.93E-01	1.38E-01	6.91E-02	1.49E-02	4.27E-03
6 1	1.96E-03	2.94E-02	1.66E-02	4.13E-03	1.15E-03	7.21E-04	2.22E-04	6.55E-05
6 2	1.05E-02	1.46E-01	3.73E-02	2.19E-02	8.75E-03	3.54E-03	8.01E-04	4.28E-04
6 3	2.80E-02	3.48E-01	2.28E-01	7.22E-02	1.50E-02	8.51E-03	4.13E-03	1.72E-03
6 4	2.26E-02	5.14E-01	5.02E-01	1.70E-01	4.19E-02	3.04E-02	6.72E-03	1.61E-03
6 5	1.74E-02	4.13E-01	7.78E-01	4.24E-01	7.17E-02	2.59E-02	3.02E-03	4.54E-04
7	1.42E+00	1.71E+01	4.47E+00	1.44E+00	2.00E-01	8.65E-02	1.48E-02	3.98E-03
7 1	1.55E-02	9.34E-02	1.53E-02	6.20E-03	9.84E-04	7.73E-04	2.08E-04	5.05E-05
7 2	8.24E-02	5.47E-01	6.75E-02	2.23E-02	8.53E-03	4.10E-03	7.39E-04	3.02E-04
7 3	1.75E-01	1.85E+00	2.51E-01	8.27E-02	1.37E-02	7.60E-03	3.32E-03	1.30E-03
7 4	3.43E-01	3.96E+00	4.64E-01	1.99E-01	4.14E-02	2.77E-02	5.82E-03	1.53E-03
7 5	4.29E-01	5.90E+00	8.55E-01	2.57E-01	8.22E-02	3.06E-02	3.78E-03	6.93E-04
7 6	3.79E-01	4.70E+00	2.82E+00	8.78E-01	5.29E-02	1.57E-02	9.39E-04	9.78E-05
8	3.47E+01	6.64E+01	7.95E+00	2.26E+00	2.47E-01	9.58E-02	1.40E-02	3.50E-03
8 1	2.46E-01	1.03E-01	1.29E-02	7.88E-03	9.31E-04	6.94E-04	1.86E-04	3.88E-05
8 2	1.08E+00	6.44E-01	1.08E-01	2.41E-02	8.84E-03	3.80E-03	6.33E-04	2.16E-04
8 3	2.62E+00	2.17E+00	2.39E-01	9.59E-02	1.45E-02	6.08E-03	2.78E-03	9.80E-04
8 4	4.33E+00	5.65E+00	5.26E-01	2.13E-01	3.65E-02	2.33E-02	5.16E-03	1.32E-03
8 5	8.15E+00	1.26E+01	9.51E-01	2.18E-01	7.91E-02	3.42E-02	3.63E-03	7.46E-04
8 6	1.17E+01	2.23E+01	1.60E+00	7.98E-01	8.14E-02	2.23E-02	1.31E-03	1.78E-04
8 7	6.58E+00	2.30E+01	4.51E+00	9.06E-01	2.61E-02	5.49E-03	3.09E-04	1.62E-05
9	2.51E+02	1.07E+02	1.10E+01	3.04E+00	2.74E-01	9.88E-02	1.30E-02	3.01E-03
9 1	9.24E-01	7.87E-02	1.37E-02	9.08E-03	8.96E-04	5.99E-04	1.57E-04	3.02E-05
9 2	4.02E+00	4.88E-01	1.35E-01	2.67E-02	8.21E-03	3.72E-03	5.22E-04	1.59E-04
9 3	9.95E+00	1.62E+00	2.34E-01	1.10E-01	1.46E-02	5.49E-03	2.20E-03	7.43E-04
9 4	1.82E+01	4.27E+00	5.91E-01	2.23E-01	2.85E-02	2.07E-02	4.56E-03	1.11E-03
9 5	2.94E+01	8.99E+00	1.02E+00	2.23E-01	7.43E-02	3.31E-02	3.54E-03	7.14E-04
9 6	4.87E+01	1.59E+01	1.30E+00	7.23E-01	9.52E-02	2.38E-02	1.35E-03	2.23E-04
9 7	7.64E+01	2.79E+01	3.44E+00	1.08E+00	4.23E-02	9.71E-03	4.82E-04	3.51E-05
9 8	6.38E+01	4.81E+01	4.30E+00	6.40E-01	9.57E-03	1.69E-03	1.56E-04	2.33E-06
10	3.84E+02	1.01E+02	1.29E+01	3.54E+00	2.92E-01	9.86E-02	1.17E-02	2.57E-03
10 1	6.14E-01	5.51E-02	1.58E-02	9.54E-03	8.47E-04	5.43E-04	1.37E-04	2.42E-05
10 2	2.85E+00	3.31E-01	1.40E-01	2.99E-02	7.12E-03	3.60E-03	4.57E-04	1.21E-04
10 3	7.48E+00	1.13E+00	2.27E-01	1.13E-01	1.49E-02	5.07E-03	1.74E-03	5.73E-04
10 4	1.59E+01	2.72E+00	6.11E-01	2.33E-01	2.28E-02	1.72E-02	3.85E-03	9.14E-04
10 5	2.93E+01	5.75E+00	9.77E-01	2.31E-01	7.00E-02	3.05E-02	3.35E-03	6.45E-04
10 6	4.67E+01	8.94E+00	1.20E+00	6.34E-01	1.00E-01	2.58E-02	1.39E-03	2.39E-04
10 7	7.17E+01	1.42E+01	2.62E+00	1.07E+00	5.47E-02	1.23E-02	4.50E-04	4.96E-05
10 8	1.06E+02	2.28E+01	4.02E+00	8.74E-01	1.85E-02	2.99E-03	2.64E-04	5.96E-06
10 9	1.03E+02	4.53E+01	3.05E+00	3.43E-01	2.72E-03	5.28E-04	9.76E-05	3.10E-07
11	9.57E+01	7.52E+01	1.32E+01	3.87E+00	3.04E-01	9.72E-02	1.07E-02	2.22E-03
11 1	1.18E-01	3.92E-02	1.81E-02	9.51E-03	8.37E-04	4.76E-04	1.25E-04	2.01E-05
11 2	5.24E-01	2.03E-01	1.33E-01	3.45E-02	6.03E-03	3.35E-03	4.25E-04	9.52E-05
11 3	1.44E+00	6.77E-01	2.27E-01	1.09E-01	1.57E-02	4.76E-03	1.49E-03	4.55E-04
11 4	2.54E+00	1.59E+00	5.94E-01	2.37E-01	1.97E-02	1.42E-02	3.30E-03	7.64E-04
11 5	4.61E+00	3.14E+00	8.76E-01	2.50E-01	6.31E-02	2.88E-02	3.06E-03	5.75E-04
11 6	6.57E+00	4.85E+00	1.14E+00	5.34E-01	9.92E-02	2.68E-02	1.43E-03	2.40E-04
11 7	1.03E+01	7.41E+00	1.94E+00	9.99E-01	6.64E-02	1.36E-02	4.18E-04	5.93E-05
11 8	1.51E+01	9.47E+00	3.17E+00	9.77E-01	2.61E-02	4.01E-03	2.10E-04	9.82E-06
11 9	2.74E+01	1.63E+01	3.40E+00	5.56E-01	5.89E-03	1.10E-03	1.84E-04	9.26E-07
11 10	2.71E+01	3.15E+01	1.73E+00	1.59E-01	7.12E-04	1.37E-04	6.46E-05	4.06E-08

Table continues on next page.

Data for O^{8+} + H(2p-1) (cont.)

	impact energies [kev/amu]							
	1.0	10.0	30.0	45.0	90.0	120.0	200.0	300.
	state resolved CX cross sections							
n ℓ								
12	9.72E+00	3.90E+01	1.29E+01	4.25E+00	3.27E-01	9.85E-02	1.00E-02	1.95E-03
12 1	9.70E-02	2.78E-02	1.95E-02	1.02E-02	9.42E-04	4.35E-04	1.13E-04	1.71E-05
12 2	3.53E-01	1.03E-01	1.33E-01	4.17E-02	5.35E-03	3.23E-03	3.92E-04	7.70E-05
12 3	5.91E-01	3.93E-01	2.23E-01	1.15E-01	1.74E-02	4.94E-03	1.30E-03	3.70E-04
12 4	7.47E-01	8.06E-01	5.99E-01	2.42E-01	1.96E-02	1.27E-02	2.97E-03	6.51E-04
12 5	5.97E-01	1.53E+00	7.54E-01	3.10E-01	5.73E-02	2.77E-02	2.85E-03	5.18E-04
12 6	6.96E-01	2.30E+00	1.13E+00	4.62E-01	1.01E-01	2.74E-02	1.43E-03	2.36E-04
12 7	5.52E-01	3.48E+00	1.50E+00	8.91E-01	8.04E-02	1.52E-02	4.63E-04	6.56E-05
12 8	9.81E-01	3.55E+00	2.19E+00	1.06E+00	3.39E-02	5.11E-03	1.31E-04	1.34E-05
12 9	1.06E+00	6.63E+00	3.08E+00	7.34E-01	9.39E-03	1.44E-03	1.48E-04	1.77E-06
12 10	1.94E+00	5.12E+00	2.45E+00	3.11E-01	1.76E-03	3.14E-04	1.45E-04	1.46E-07
12 11	2.11E+00	1.51E+01	8.39E-01	6.78E-02	1.62E-04	4.04E-05	4.60E-05	5.07E-09

Table A.48: Data for O^{8+} + H(2p)

	impact energies [kev/amu]							
	1.0	10.0	30.0	45.0	90.0	120.0	200.0	300.
	total cross sections							
CX	7.77E+02	4.18E+02	6.03E+01	2.01E+01	2.35E+00	1.04E+00	1.78E-01	3.54E-02
ION	8.34E-03	1.51E-01	5.74E-01	8.76E-01	1.55E+00	2.04E+00	2.61E+00	2.59E+00
	state resolved CX cross sections							
n ℓ								
4	4.31E-02	5.76E-02	4.39E-01	1.54E-01	5.76E-02	4.24E-02	1.45E-02	4.79E-03
4 0	4.36E-03	3.54E-03	1.55E-02	5.88E-03	1.70E-03	9.27E-04	2.10E-04	8.64E-05
4 1	1.23E-02	1.15E-02	3.76E-02	1.57E-02	4.26E-03	3.05E-03	9.67E-04	2.13E-04
4 2	1.38E-02	1.76E-02	8.22E-02	3.69E-02	1.30E-02	5.37E-03	2.39E-03	1.22E-03
4 3	1.27E-02	2.50E-02	3.04E-01	9.56E-02	3.86E-02	3.31E-02	1.09E-02	3.27E-03
5	3.60E-02	2.67E-01	7.34E-01	3.46E-01	9.56E-02	6.54E-02	1.67E-02	5.29E-03
5 0	3.41E-03	1.00E-02	3.07E-02	1.17E-02	2.05E-03	1.55E-03	2.86E-04	8.25E-05
5 1	8.60E-03	3.76E-02	9.88E-02	2.70E-02	6.81E-03	5.54E-03	8.87E-04	2.50E-04
5 2	7.62E-03	4.69E-02	1.46E-01	6.60E-02	1.68E-02	8.54E-03	2.07E-03	8.93E-04
5 3	8.68E-03	8.28E-02	2.12E-01	1.03E-01	2.61E-02	2.04E-02	6.52E-03	2.63E-03
5 4	7.65E-03	8.99E-02	2.46E-01	1.38E-01	4.39E-02	2.93E-02	6.92E-03	1.44E-03
6	1.86E-01	2.80E+00	2.06E+00	8.69E-01	1.72E-01	9.50E-02	1.88E-02	5.12E-03
6 0	4.80E-03	9.73E-02	3.25E-02	9.91E-03	2.12E-03	1.39E-03	3.45E-04	7.00E-05
6 1	2.34E-02	2.68E-01	1.21E-01	2.33E-02	7.70E-03	5.00E-03	9.05E-04	2.46E-04
6 2	2.53E-02	3.78E-01	1.94E-01	6.92E-02	1.69E-02	7.66E-03	2.07E-03	6.76E-04
6 3	4.05E-02	5.45E-01	3.29E-01	1.43E-01	1.80E-02	1.47E-02	4.91E-03	1.98E-03
6 4	3.92E-02	7.51E-01	5.72E-01	2.34E-01	4.88E-02	2.94E-02	6.66E-03	1.64E-03
6 5	5.28E-02	7.60E-01	8.14E-01	3.89E-01	7.88E-02	3.69E-02	3.94E-03	5.06E-04
7	3.46E+00	1.60E+01	4.71E+00	1.70E+00	2.42E-01	1.26E-01	2.12E-02	4.52E-03
7 0	1.17E-01	1.80E-01	2.14E-02	1.04E-02	2.38E-03	1.86E-03	4.66E-04	5.59E-05
7 1	3.12E-01	5.35E-01	1.14E-01	2.61E-02	6.83E-03	6.28E-03	1.10E-03	1.98E-04
7 2	4.73E-01	1.14E+00	1.53E-01	7.13E-02	1.71E-02	1.04E-02	2.42E-03	5.13E-04
7 3	7.06E-01	2.00E+00	3.95E-01	1.12E-01	1.76E-02	1.51E-02	4.00E-03	1.44E-03
7 4	5.06E-01	3.31E+00	6.92E-01	2.40E-01	4.13E-02	3.00E-02	6.26E-03	1.50E-03
7 5	7.07E-01	4.55E+00	1.09E+00	3.80E-01	6.54E-02	3.01E-02	5.06E-03	7.00E-04
7 6	6.40E-01	4.27E+00	2.24E+00	8.61E-01	9.14E-02	3.22E-02	1.86E-03	1.24E-04
8	4.38E+01	5.53E+01	7.42E+00	2.48E+00	2.98E-01	1.36E-01	2.17E-02	3.89E-03
8 0	6.57E-01	2.52E-01	2.11E-02	1.29E-02	2.52E-03	1.79E-03	4.76E-04	4.75E-05
8 1	1.77E+00	8.04E-01	9.06E-02	2.73E-02	7.36E-03	6.31E-03	1.02E-03	1.54E-04
8 2	3.26E+00	1.81E+00	1.62E-01	8.10E-02	1.70E-02	9.78E-03	2.47E-03	4.15E-04
8 3	5.19E+00	3.98E+00	3.43E-01	1.10E-01	2.02E-02	1.28E-02	3.60E-03	1.05E-03
8 4	7.17E+00	6.78E+00	5.25E-01	2.50E-01	3.46E-02	2.55E-02	5.17E-03	1.27E-03
8 5	7.66E+00	1.12E+01	9.84E-01	2.57E-01	6.53E-02	2.88E-02	5.29E-03	7.22E-04
8 6	8.81E+00	1.66E+01	1.57E+00	6.75E-01	8.54E-02	3.26E-02	2.78E-03	2.02E-04
8 7	9.30E+00	1.38E+01	3.73E+00	1.07E+00	6.59E-02	1.84E-02	9.00E-04	2.58E-05
9	2.17E+02	1.00E+02	9.68E+00	3.08E+00	3.29E-01	1.37E-01	2.09E-02	3.37E-03
9 0	1.36E+00	1.68E-01	2.33E-02	1.11E-02	2.22E-03	1.72E-03	3.53E-04	4.52E-05
9 1	4.45E+00	7.52E-01	8.48E-02	2.91E-02	6.81E-03	5.48E-03	7.62E-04	1.27E-04
9 2	7.82E+00	1.54E+00	1.74E-01	7.55E-02	1.53E-02	9.40E-03	2.00E-03	3.61E-04
9 3	1.29E+01	3.41E+00	3.20E-01	1.17E-01	2.02E-02	1.08E-02	3.34E-03	8.15E-04
9 4	2.06E+01	6.63E+00	4.82E-01	2.45E-01	3.07E-02	2.31E-02	4.49E-03	1.05E-03
9 5	2.88E+01	1.11E+01	9.24E-01	2.44E-01	6.13E-02	2.77E-02	4.73E-03	6.76E-04
9 6	4.07E+01	2.07E+01	1.04E+00	5.70E-01	8.59E-02	2.91E-02	3.19E-03	2.41E-04
9 7	5.13E+01	2.82E+01	2.43E+00	8.48E-01	7.53E-02	2.19E-02	1.41E-03	5.09E-05
9 8	4.89E+01	2.75E+01	4.21E+00	9.36E-01	3.09E-02	7.74E-03	5.93E-04	4.64E-06
10	3.64E+02	1.06E+02	1.11E+01	3.43E+00	3.53E-01	1.38E-01	2.06E-02	2.98E-03
10 0	1.20E+00	1.44E-01	2.62E-02	1.37E-02	2.04E-03	1.57E-03	3.10E-04	4.65E-05
10 1	3.96E+00	4.98E-01	8.89E-02	4.43E-02	7.37E-03	5.07E-03	7.71E-04	1.14E-04
10 2	7.54E+00	1.23E+00	1.89E-01	8.63E-02	1.49E-02	9.34E-03	1.69E-03	3.33E-04
10 3	1.26E+01	2.37E+00	3.22E-01	1.30E-01	2.27E-02	1.07E-02	3.00E-03	6.66E-04
10 4	1.96E+01	4.64E+00	4.83E-01	2.59E-01	3.06E-02	2.12E-02	4.20E-03	8.72E-04
10 5	3.20E+01	7.55E+00	8.62E-01	2.44E-01	5.79E-02	2.67E-02	4.32E-03	6.11E-04
10 6	4.93E+01	1.18E+01	9.11E-01	4.95E-01	8.35E-02	2.76E-02	3.19E-03	2.57E-04
10 7	6.81E+01	1.72E+01	1.78E+00	7.59E-01	7.69E-02	2.28E-02	1.64E-03	6.98E-05
10 8	8.37E+01	2.65E+01	2.79E+00	7.92E-01	4.61E-02	1.06E-02	9.64E-04	1.13E-05
10 9	8.60E+01	3.44E+01	3.68E+00	6.03E-01	1.13E-02	2.65E-03	5.03E-04	7.36E-07
11	1.09E+02	8.78E+01	1.17E+01	3.68E+00	3.71E-01	1.42E-01	2.13E-02	2.74E-03
11 0	4.86E-01	1.46E-01	4.09E-02	2.01E-02	2.14E-03	2.03E-03	3.69E-04	5.03E-05
11 1	1.32E+00	5.32E-01	1.15E-01	6.30E-02	8.38E-03	5.95E-03	9.61E-04	1.13E-04
11 2	2.13E+00	1.03E+00	2.43E-01	1.12E-01	1.51E-02	1.07E-02	1.79E-03	3.21E-04
11 3	3.07E+00	1.98E+00	3.55E-01	1.51E-01	2.49E-02	1.13E-02	2.81E-03	5.82E-04
11 4	4.29E+00	3.28E+00	5.08E-01	2.71E-01	3.10E-02	1.96E-02	3.88E-03	7.49E-04
11 5	5.73E+00	5.21E+00	8.06E-01	2.63E-01	5.25E-02	2.60E-02	4.19E-03	5.56E-04
11 6	7.55E+00	6.82E+00	8.52E-01	4.25E-01	7.86E-02	2.57E-02	3.15E-03	2.62E-04
11 7	1.09E+01	9.47E+00	1.36E+00	6.96E-01	8.12E-02	2.25E-02	1.77E-03	8.45E-05
11 8	1.77E+01	1.14E+01	2.07E+00	7.17E-01	5.39E-02	1.29E-02	1.00E-03	1.87E-05
11 9	2.47E+01	1.92E+01	2.84E+00	6.37E-01	2.02E-02	3.99E-03	9.39E-04	2.22E-06
11 10	3.16E+01	2.87E+01	2.49E+00	3.24E-01	3.45E-03	8.98E-04	4.30E-04	1.06E-07

Table continues on next page.

Data for O^{8+} + H(2p) (cont.)

	impact energies [kev/amu]							
	1.0	10.0	30.0	45.0	90.0	120.0	200.0	300.
	state resolved CX cross sections							
n ℓ								
12	3.90E+01	4.92E+01	1.25E+01	4.32E+00	4.30E-01	1.54E-01	2.20E-02	2.67E-03
12 0	2.28E-01	1.18E-01	8.61E-02	4.31E-02	3.02E-03	2.43E-03	3.89E-04	5.74E-05
12 1	7.23E-01	5.44E-01	2.55E-01	1.28E-01	1.12E-02	6.70E-03	1.04E-03	1.23E-04
12 2	1.18E+00	7.51E-01	4.12E-01	2.04E-01	1.95E-02	1.22E-02	1.89E-03	3.29E-04
12 3	1.78E+00	1.46E+00	5.62E-01	2.61E-01	3.09E-02	1.27E-02	2.85E-03	5.48E-04
12 4	2.63E+00	2.02E+00	6.58E-01	3.50E-01	3.92E-02	2.02E-02	3.67E-03	6.81E-04
12 5	3.39E+00	2.76E+00	8.62E-01	3.63E-01	5.40E-02	2.72E-02	3.99E-03	5.29E-04
12 6	4.00E+00	3.58E+00	8.78E-01	4.15E-01	8.33E-02	2.69E-02	3.13E-03	2.72E-04
12 7	4.36E+00	4.27E+00	1.14E+00	6.35E-01	9.16E-02	2.38E-02	1.80E-03	9.86E-05
12 8	4.36E+00	4.80E+00	1.51E+00	7.01E-01	6.09E-02	1.43E-02	9.52E-04	2.67E-05
12 9	4.67E+00	6.80E+00	2.19E+00	6.31E-01	2.79E-02	5.69E-03	9.49E-04	4.38E-06
12 10	5.11E+00	7.01E+00	2.59E+00	4.38E-01	7.81E-03	1.15E-03	9.81E-04	3.85E-07
12 11	6.55E+00	1.51E+01	1.33E+00	1.51E-01	8.47E-04	4.12E-04	3.62E-04	1.60E-08

Table A.49: Data for O^{8+} + $H(n = 2)$

	impact energies [kev/amu]							
	1.0	10.0	30.0	45.0	90.0	120.0	200.0	300.
	total cross sections							
CX	7.72E+02	4.19E+02	6.91E+01	2.48E+01	3.25E+00	1.46E+00	2.35E-01	4.14E-02
ION	1.03E-02	2.04E-01	5.65E-01	8.05E-01	1.42E+00	1.89E+00	2.83E+00	2.72E+00
	state resolved CX cross sections							
n ℓ								
4	5.08E-02	4.88E-02	4.99E-01	1.61E-01	7.50E-02	5.23E-02	1.59E-02	4.74E-03
4 0	5.26E-03	3.04E-03	2.26E-02	9.40E-03	2.05E-03	1.07E-03	4.07E-04	1.17E-04
4 1	1.47E-02	9.57E-03	5.45E-02	2.34E-02	8.35E-03	4.58E-03	1.36E-03	4.18E-04
4 2	1.62E-02	1.50E-02	1.25E-01	4.16E-02	2.16E-02	1.15E-02	3.57E-03	1.36E-03
4 3	1.47E-02	2.12E-02	2.97E-01	8.65E-02	4.30E-02	3.51E-02	1.06E-02	2.84E-03
5	4.80E-02	2.43E-01	9.41E-01	6.16E-01	1.55E-01	8.82E-02	2.24E-02	5.43E-03
5 0	4.72E-03	1.12E-02	4.73E-02	1.97E-02	2.90E-03	1.81E-03	5.37E-04	1.13E-04
5 1	1.04E-02	3.70E-02	1.50E-01	6.65E-02	1.23E-02	7.14E-03	1.28E-03	3.94E-04
5 2	1.01E-02	4.52E-02	2.09E-01	1.50E-01	2.30E-02	1.26E-02	3.78E-03	1.09E-03
5 3	1.37E-02	7.17E-02	2.57E-01	1.95E-01	4.26E-02	2.26E-02	7.22E-03	2.37E-03
5 4	9.07E-03	7.83E-02	2.77E-01	1.85E-01	7.41E-02	4.40E-02	9.57E-03	1.46E-03
6	2.30E-01	3.00E+00	3.42E+00	1.52E+00	2.64E-01	1.33E-01	2.54E-02	5.54E-03
6 0	8.12E-03	1.43E-01	5.76E-02	2.04E-02	3.40E-03	1.96E-03	5.49E-04	1.03E-04
6 1	3.10E-02	3.89E-01	1.99E-01	6.05E-02	1.57E-02	7.61E-03	1.15E-03	3.62E-04
6 2	3.48E-02	5.19E-01	3.89E-01	1.30E-01	2.50E-02	1.23E-02	3.46E-03	9.05E-04
6 3	4.96E-02	6.02E-01	7.42E-01	2.39E-01	3.68E-02	2.20E-02	5.54E-03	1.87E-03
6 4	4.64E-02	6.97E-01	1.02E+00	4.55E-01	6.10E-02	3.75E-02	8.74E-03	1.71E-03
6 5	6.04E-02	6.54E-01	1.00E+00	6.14E-01	1.22E-01	5.13E-02	5.96E-03	5.88E-04
7	3.31E+00	2.02E+01	6.67E+00	2.45E+00	3.44E-01	1.72E-01	2.74E-02	5.18E-03
7 0	9.91E-02	3.52E-01	4.76E-02	2.04E-02	4.01E-03	2.41E-03	6.86E-04	9.10E-05
7 1	2.80E-01	1.19E+00	1.76E-01	6.02E-02	1.56E-02	9.59E-03	1.39E-03	3.04E-04
7 2	4.54E-01	2.42E+00	2.99E-01	1.27E-01	2.53E-02	1.50E-02	3.79E-03	7.62E-04
7 3	6.55E-01	3.52E+00	6.30E-01	2.02E-01	3.62E-02	2.50E-02	4.70E-03	1.44E-03
7 4	5.67E-01	4.21E+00	1.07E+00	3.52E-01	5.75E-02	3.72E-02	7.75E-03	1.60E-03
7 5	6.89E-01	4.55E+00	1.80E+00	5.49E-01	9.41E-02	4.55E-02	6.73E-03	8.38E-04
7 6	5.62E-01	4.01E+00	2.64E+00	1.14E+00	1.12E-01	3.77E-02	2.35E-03	1.49E-04
8	4.30E+01	5.90E+01	9.02E+00	3.13E+00	4.05E-01	1.88E-01	2.89E-02	4.72E-03
8 0	6.99E-01	4.32E-01	4.57E-02	2.21E-02	4.06E-03	2.84E-03	7.41E-04	8.48E-05
8 1	2.05E+00	1.42E+00	1.62E-01	5.82E-02	1.58E-02	1.09E-02	1.45E-03	2.55E-04
8 2	3.31E+00	2.94E+00	2.92E-01	1.27E-01	2.58E-02	1.57E-02	3.98E-03	6.72E-04
8 3	4.62E+00	5.45E+00	5.08E-01	1.92E-01	3.87E-02	2.39E-02	4.69E-03	1.13E-03
8 4	6.48E+00	8.58E+00	7.68E-01	3.09E-01	5.76E-02	3.18E-02	6.94E-03	1.40E-03
8 5	7.34E+00	1.20E+01	1.16E+00	4.04E-01	8.76E-02	4.20E-02	7.07E-03	8.93E-04
8 6	1.03E+01	1.50E+01	2.12E+00	7.42E-01	1.05E-01	4.14E-02	3.14E-03	2.52E-04
8 7	8.19E+00	1.32E+01	3.97E+00	1.28E+00	7.07E-02	1.90E-02	9.04E-04	2.91E-05
9	2.26E+02	9.46E+01	1.08E+01	3.65E+00	4.37E-01	1.90E-01	2.83E-02	4.30E-03
9 0	1.80E+00	2.97E-01	4.61E-02	2.20E-02	4.08E-03	2.65E-03	6.03E-04	8.39E-05
9 1	5.88E+00	1.14E+00	1.45E-01	6.33E-02	1.63E-02	9.99E-03	1.20E-03	2.26E-04
9 2	1.13E+01	2.38E+00	2.91E-01	1.23E-01	2.65E-02	1.43E-02	3.36E-03	6.15E-04
9 3	1.81E+01	4.68E+00	4.34E-01	2.03E-01	3.96E-02	2.15E-02	4.41E-03	9.34E-04
9 4	2.37E+01	7.88E+00	6.82E-01	2.83E-01	5.62E-02	3.04E-02	6.12E-03	1.20E-03
9 5	2.87E+01	1.17E+01	9.82E-01	3.69E-01	7.83E-02	4.13E-02	6.85E-03	8.66E-04
9 6	3.64E+01	1.83E+01	1.34E+00	6.20E-01	1.03E-01	3.91E-02	3.82E-03	3.12E-04
9 7	5.10E+01	2.30E+01	2.43E+00	8.64E-01	8.11E-02	2.36E-02	1.35E-03	5.93E-05
9 8	4.94E+01	2.52E+01	4.42E+00	1.10E+00	3.23E-02	7.68E-03	5.71E-04	4.86E-06
10	3.46E+02	1.02E+02	1.19E+01	3.93E+00	4.66E-01	1.96E-01	2.72E-02	3.96E-03
10 0	1.60E+00	2.27E-01	5.57E-02	2.33E-02	4.53E-03	2.70E-03	5.61E-04	8.60E-05
10 1	5.07E+00	7.98E-01	1.48E-01	8.33E-02	1.77E-02	1.04E-02	1.22E-03	2.11E-04
10 2	9.01E+00	1.72E+00	3.26E-01	1.29E-01	2.88E-02	1.50E-02	2.98E-03	5.78E-04
10 3	1.44E+01	3.25E+00	4.20E-01	2.20E-01	4.17E-02	2.27E-02	3.95E-03	8.07E-04
10 4	2.21E+01	5.24E+00	6.85E-01	2.88E-01	5.66E-02	3.02E-02	5.41E-03	1.03E-03
10 5	3.27E+01	7.70E+00	8.87E-01	3.46E-01	7.38E-02	3.86E-02	6.12E-03	8.10E-04
10 6	4.49E+01	1.12E+01	1.10E+00	5.49E-01	9.99E-02	3.70E-02	3.98E-03	3.40E-04
10 7	5.79E+01	1.59E+01	1.89E+00	7.23E-01	8.33E-02	2.57E-02	1.63E-03	8.26E-05
10 8	7.66E+01	2.20E+01	2.54E+00	8.56E-01	4.73E-02	1.07E-02	8.84E-04	1.19E-05
10 9	8.19E+01	3.41E+01	3.85E+00	7.12E-01	1.21E-02	2.80E-03	4.77E-04	7.26E-07
11	1.15E+02	8.76E+01	1.23E+01	4.17E+00	4.98E-01	2.06E-01	2.84E-02	3.75E-03
11 0	5.76E-01	1.97E-01	7.84E-02	3.05E-02	5.71E-03	3.44E-03	6.80E-04	9.07E-05
11 1	1.58E+00	7.02E-01	1.75E-01	1.13E-01	2.04E-02	1.26E-02	1.55E-03	2.10E-04
11 2	2.39E+00	1.34E+00	4.12E-01	1.57E-01	3.33E-02	1.75E-02	3.31E-03	5.60E-04
11 3	3.26E+00	2.41E+00	4.58E-01	2.55E-01	4.47E-02	2.47E-02	4.08E-03	7.36E-04
11 4	4.36E+00	3.64E+00	7.35E-01	3.07E-01	5.90E-02	3.04E-02	5.19E-03	9.17E-04
11 5	5.67E+00	5.19E+00	8.72E-01	3.51E-01	7.10E-02	3.71E-02	5.81E-03	7.60E-04
11 6	7.56E+00	6.46E+00	9.76E-01	4.92E-01	9.54E-02	3.59E-02	3.86E-03	3.54E-04
11 7	1.09E+01	8.61E+00	1.51E+00	6.53E-01	8.77E-02	2.64E-02	1.78E-03	1.01E-04
11 8	1.76E+01	1.06E+01	1.93E+00	7.21E-01	5.54E-02	1.27E-02	8.76E-04	1.94E-05
11 9	2.67E+01	1.78E+01	2.63E+00	7.16E-01	2.12E-02	4.00E-03	8.40E-04	2.13E-06
11 10	3.46E+01	3.07E+01	2.52E+00	3.76E-01	3.75E-03	1.11E-03	3.98E-04	9.91E-08

Table continues on next page.

Data for $O^{8+} + H(n=2)$ (cont.)

	impact energies [kev/amu]							
	1.0	10.0	30.0	45.0	90.0	120.0	200.0	300.
	state resolved CX cross sections							
n ℓ								
12	3.70E+01	5.15E+01	1.36E+01	5.18E+00	6.08E-01	2.35E-01	3.09E-02	3.75E-03
12 0	2.28E-01	1.54E-01	1.48E-01	6.76E-02	9.21E-03	4.63E-03	7.44E-04	1.00E-04
12 1	7.13E-01	6.33E-01	3.71E-01	2.25E-01	2.84E-02	1.57E-02	1.75E-03	2.24E-04
12 2	1.11E+00	9.82E-01	6.89E-01	3.06E-01	4.79E-02	2.19E-02	3.59E-03	5.70E-04
12 3	1.55E+00	1.68E+00	7.81E-01	4.36E-01	5.79E-02	2.90E-02	4.56E-03	7.23E-04
12 4	2.21E+00	2.32E+00	9.99E-01	4.67E-01	7.63E-02	3.45E-02	5.44E-03	8.67E-04
12 5	2.83E+00	2.85E+00	1.10E+00	4.83E-01	8.22E-02	3.99E-02	6.05E-03	7.48E-04
12 6	3.41E+00	3.50E+00	1.05E+00	5.47E-01	1.04E-01	3.93E-02	4.05E-03	3.69E-04
12 7	3.99E+00	4.00E+00	1.35E+00	6.30E-01	1.00E-01	2.87E-02	1.87E-03	1.15E-04
12 8	4.31E+00	4.47E+00	1.53E+00	6.88E-01	6.34E-02	1.42E-02	8.39E-04	2.70E-05
12 9	4.72E+00	6.41E+00	1.98E+00	6.76E-01	2.89E-02	5.45E-03	7.98E-04	4.16E-06
12 10	5.12E+00	7.54E+00	2.33E+00	4.89E-01	8.33E-03	1.24E-03	8.71E-04	3.50E-07
12 11	6.76E+00	1.69E+01	1.28E+00	1.70E-01	9.49E-04	5.27E-04	3.32E-04	1.43E-08

A.6 Ar^{q+} + H(1s)

Table S^{16+} + H(1s)

Table Cl^{17+} + H(1s)

Table A.50 Ar^{18+} + H(1s)

Table A.50: Data for Ar^{18+} + H(1s)

	impact energies [kev/amu]							
	13.333	20.0	23.333	35.0	40.0	70.0	83.333	125.0
	total cross sections							
CX	1.50E+02	1.40E+02	1.35E+02	1.21E+02	1.14E+02	7.44E+01	5.96E+01	2.93E+01
ION	4.26E-02	5.94E-02	5.88E-02	8.00E-02	1.23E-01	4.35E-01	7.69E-01	2.30E+00
	state resolved CX cross sections							
n ℓ								
5	2.01E-03	6.70E-03	7.12E-03	1.86E-02	2.54E-02	5.83E-02	7.43E-02	8.24E-02
5 0	1.86E-04	6.41E-04	6.88E-04	1.92E-03	2.53E-03	3.81E-03	4.76E-03	4.12E-03
5 1	1.64E-04	1.17E-03	1.99E-03	5.16E-03	7.39E-03	1.52E-02	1.67E-02	1.86E-02
5 2	4.14E-04	1.54E-03	1.82E-03	5.95E-03	6.79E-03	1.92E-02	2.08E-02	2.79E-02
5 3	4.59E-04	1.79E-03	1.46E-03	3.32E-03	5.70E-03	1.16E-02	2.01E-02	1.68E-02
5 4	7.85E-04	1.56E-03	1.16E-03	2.20E-03	3.01E-03	8.49E-03	1.19E-02	1.49E-02
6	1.16E-01	2.66E-01	3.45E-01	5.59E-01	6.20E-01	7.07E-01	7.40E-01	5.23E-01
6 0	6.12E-03	1.50E-02	1.94E-02	2.77E-02	2.98E-02	2.38E-02	1.97E-02	9.46E-03
6 1	1.99E-02	4.42E-02	5.62E-02	8.26E-02	8.68E-02	7.43E-02	6.58E-02	2.86E-02
6 2	2.67E-02	6.13E-02	7.93E-02	1.27E-01	1.34E-01	1.37E-01	1.34E-01	6.18E-02
6 3	2.62E-02	6.37E-02	8.46E-02	1.42E-01	1.59E-01	1.87E-01	1.94E-01	1.21E-01
6 4	2.05E-02	5.26E-02	6.97E-02	1.18E-01	1.40E-01	1.81E-01	2.05E-01	1.82E-01
6 5	1.60E-02	2.95E-02	3.58E-02	6.17E-02	6.99E-02	1.04E-01	1.20E-01	1.20E-01
7	2.66E+00	3.75E+00	4.05E+00	4.19E+00	4.01E+00	3.11E+00	2.82E+00	1.57E+00
7 0	8.62E-02	1.05E-01	1.10E-01	8.77E-02	7.54E-02	2.92E-02	2.84E-02	1.16E-02
7 1	2.61E-01	3.38E-01	3.44E-01	2.97E-01	2.61E-01	1.22E-01	8.91E-02	4.26E-02
7 2	4.30E-01	5.79E-01	6.13E-01	5.82E-01	5.31E-01	2.90E-01	1.91E-01	8.62E-02
7 3	5.45E-01	7.95E-01	8.70E-01	8.73E-01	8.16E-01	5.18E-01	3.92E-01	1.51E-01
7 4	5.62E-01	8.55E-01	9.41E-01	1.01E+00	9.91E-01	7.50E-01	6.49E-01	2.48E-01
7 5	4.66E-01	7.17E-01	7.85E-01	8.87E-01	8.75E-01	8.46E-01	8.27E-01	4.52E-01
7 6	3.10E-01	3.62E-01	3.84E-01	4.51E-01	4.60E-01	5.56E-01	6.40E-01	5.82E-01
8	1.84E+01	1.79E+01	1.71E+01	1.35E+01	1.21E+01	7.25E+00	5.91E+00	2.79E+00
8 0	2.37E-01	1.95E-01	1.70E-01	1.11E-01	9.66E-02	4.32E-02	2.96E-02	1.36E-02
8 1	8.41E-01	7.48E-01	6.72E-01	4.19E-01	3.50E-01	1.32E-01	1.07E-01	4.30E-02
8 2	1.79E+00	1.65E+00	1.50E+00	9.55E-01	7.90E-01	3.19E-01	2.09E-01	8.71E-02
8 3	2.99E+00	2.79E+00	2.56E+00	1.75E+00	1.48E+00	5.24E-01	4.00E-01	1.59E-01
8 4	3.74E+00	3.70E+00	3.52E+00	2.60E+00	2.23E+00	8.27E-01	5.83E-01	2.37E-01
8 5	3.78E+00	3.97E+00	3.86E+00	3.10E+00	2.79E+00	1.46E+00	9.62E-01	3.97E-01
8 6	3.21E+00	3.26E+00	3.20E+00	2.87E+00	2.69E+00	2.07E+00	1.65E+00	5.44E-01
8 7	1.76E+00	1.57E+00	1.57E+00	1.66E+00	1.68E+00	1.88E+00	1.97E+00	1.31E+00
9	4.46E+01	3.62E+01	3.27E+01	2.38E+01	2.10E+01	1.09E+01	8.40E+00	3.62E+00
9 0	2.81E-01	1.79E-01	1.58E-01	1.00E-01	8.25E-02	4.56E-02	2.44E-02	1.28E-02
9 1	8.49E-01	6.34E-01	5.45E-01	3.33E-01	2.96E-01	1.16E-01	1.07E-01	4.27E-02
9 2	2.02E+00	1.57E+00	1.33E+00	8.21E-01	6.66E-01	2.85E-01	1.79E-01	8.65E-02
9 3	4.62E+00	3.44E+00	2.94E+00	1.65E+00	1.30E+00	4.79E-01	3.55E-01	1.44E-01
9 4	7.52E+00	5.51E+00	4.62E+00	2.55E+00	2.03E+00	6.73E-01	4.80E-01	2.21E-01
9 5	8.85E+00	6.71E+00	5.82E+00	3.64E+00	2.98E+00	1.08E+00	7.43E-01	3.18E-01
9 6	8.73E+00	7.54E+00	6.96E+00	5.08E+00	4.42E+00	1.50E+00	1.12E+00	4.39E-01
9 7	7.69E+00	6.99E+00	6.66E+00	5.67E+00	5.27E+00	2.71E+00	1.77E+00	7.37E-01
9 8	4.02E+00	3.64E+00	3.69E+00	3.95E+00	3.95E+00	4.03E+00	3.62E+00	1.62E+00
10	4.82E+01	3.91E+01	3.57E+01	2.70E+01	2.40E+01	1.22E+01	9.18E+00	4.00E+00
10 0	1.42E-01	1.15E-01	1.06E-01	7.46E-02	7.03E-02	3.22E-02	2.25E-02	9.40E-03
10 1	5.71E-01	4.26E-01	3.50E-01	2.53E-01	2.12E-01	1.09E-01	8.00E-02	4.20E-02
10 2	1.24E+00	7.53E-01	6.81E-01	4.97E-01	4.55E-01	2.01E-01	1.61E-01	7.04E-02
10 3	1.98E+00	1.56E+00	1.45E+00	1.08E+00	9.13E-01	4.04E-01	2.71E-01	1.31E-01
10 4	4.09E+00	3.54E+00	3.05E+00	1.69E+00	1.40E+00	5.00E-01	3.84E-01	1.80E-01
10 5	8.05E+00	5.18E+00	4.09E+00	2.07E+00	1.69E+00	7.74E-01	5.66E-01	2.80E-01
10 6	9.65E+00	6.06E+00	5.21E+00	3.48E+00	2.81E+00	1.03E+00	7.61E-01	3.56E-01
10 7	9.26E+00	8.32E+00	7.80E+00	5.29E+00	4.24E+00	1.57E+00	1.12E+00	5.39E-01
10 8	8.77E+00	8.38E+00	7.91E+00	6.44E+00	5.83E+00	2.25E+00	1.72E+00	9.48E-01
10 9	4.42E+00	4.73E+00	5.08E+00	6.11E+00	6.38E+00	5.35E+00	4.09E+00	1.44E+00
11	2.56E+01	2.52E+01	2.48E+01	2.20E+01	2.04E+01	1.16E+01	8.88E+00	3.95E+00
11 0	5.44E-02	4.36E-02	4.07E-02	4.02E-02	3.74E-02	2.01E-02	1.86E-02	8.13E-03
11 1	1.40E-01	1.42E-01	1.56E-01	1.53E-01	1.50E-01	9.03E-02	6.20E-02	3.61E-02
11 2	3.48E-01	4.13E-01	3.98E-01	3.10E-01	2.76E-01	1.38E-01	1.31E-01	6.12E-02
11 3	8.77E-01	7.13E-01	6.12E-01	5.27E-01	5.10E-01	3.04E-01	2.06E-01	1.10E-01
11 4	1.44E+00	9.67E-01	1.03E+00	1.02E+00	9.16E-01	3.60E-01	3.07E-01	1.44E-01
11 5	1.88E+00	2.21E+00	2.05E+00	1.16E+00	9.51E-01	5.41E-01	4.09E-01	2.35E-01
11 6	3.72E+00	2.86E+00	2.10E+00	1.57E+00	1.48E+00	7.05E-01	5.63E-01	2.79E-01
11 7	5.16E+00	3.11E+00	3.07E+00	2.47E+00	2.14E+00	9.58E-01	7.73E-01	4.17E-01
11 8	4.62E+00	5.08E+00	4.82E+00	2.97E+00	2.56E+00	1.34E+00	1.05E+00	7.02E-01
11 9	4.64E+00	5.41E+00	5.42E+00	5.23E+00	4.61E+00	2.24E+00	1.91E+00	9.33E-01
11 10	2.71E+00	4.26E+00	5.10E+00	6.57E+00	6.76E+00	4.89E+00	3.44E+00	1.02E+00

Table continues on next page.

Data for Ar^{18+} + H(1s) (cont.)

	impact energies [kev/amu]							
	13.333	20.0	23.333	35.0	40.0	70.0	83.333	125.0
	state resolved CX cross sections							
n ℓ								
12	7.87E+00	1.13E+01	1.25E+01	1.44E+01	1.45E+01	9.90E+00	7.75E+00	3.66E+00
12 0	9.34E-03	1.67E-02	1.90E-02	2.08E-02	1.97E-02	1.59E-02	1.83E-02	7.62E-03
12 1	4.27E-02	6.26E-02	6.78E-02	7.26E-02	7.93E-02	6.69E-02	4.20E-02	3.21E-02
12 2	1.05E-01	1.08E-01	1.20E-01	1.71E-01	1.71E-01	1.04E-01	1.12E-01	5.58E-02
12 3	1.53E-01	2.52E-01	3.22E-01	2.78E-01	2.54E-01	2.19E-01	1.46E-01	9.01E-02
12 4	2.77E-01	4.82E-01	4.13E-01	4.42E-01	4.87E-01	2.66E-01	2.49E-01	1.30E-01
12 5	6.32E-01	4.65E-01	5.80E-01	6.89E-01	5.77E-01	3.84E-01	2.92E-01	1.88E-01
12 6	6.64E-01	9.90E-01	1.06E+00	6.26E-01	6.62E-01	4.87E-01	4.16E-01	2.37E-01
12 7	8.52E-01	1.05E+00	8.21E-01	1.12E+00	1.14E+00	6.45E-01	5.49E-01	3.09E-01
12 8	1.40E+00	1.18E+00	1.53E+00	1.24E+00	1.09E+00	8.88E-01	7.11E-01	5.42E-01
12 9	1.24E+00	1.99E+00	1.88E+00	1.98E+00	2.03E+00	1.20E+00	1.14E+00	6.60E-01
12 10	1.44E+00	2.30E+00	2.67E+00	2.73E+00	2.56E+00	2.16E+00	1.77E+00	7.99E-01
12 11	1.05E+00	2.37E+00	3.04E+00	5.04E+00	5.44E+00	3.46E+00	2.31E+00	6.06E-01
13	1.79E+00	4.11E+00	5.33E+00	8.36E+00	9.17E+00	7.82E+00	6.38E+00	3.31E+00
13 0	4.30E-03	5.24E-03	7.86E-03	1.14E-02	1.50E-02	1.31E-02	1.61E-02	5.67E-03
13 1	1.22E-02	2.08E-02	2.39E-02	4.41E-02	4.17E-02	5.58E-02	3.00E-02	2.87E-02
13 2	2.23E-02	4.74E-02	6.12E-02	7.69E-02	9.56E-02	7.62E-02	9.02E-02	4.95E-02
13 3	3.70E-02	7.26E-02	6.88E-02	1.55E-01	1.46E-01	1.59E-01	1.14E-01	8.80E-02
13 4	8.25E-02	1.22E-01	2.05E-01	1.90E-01	2.24E-01	1.98E-01	1.92E-01	1.03E-01
13 5	7.83E-02	2.37E-01	1.84E-01	3.54E-01	3.70E-01	2.79E-01	2.13E-01	1.63E-01
13 6	1.57E-01	1.78E-01	3.03E-01	3.30E-01	2.94E-01	3.42E-01	3.08E-01	1.88E-01
13 7	2.08E-01	3.85E-01	3.94E-01	4.65E-01	6.23E-01	4.41E-01	3.95E-01	2.51E-01
13 8	1.54E-01	3.19E-01	3.56E-01	6.26E-01	5.16E-01	5.96E-01	4.89E-01	4.15E-01
13 9	2.68E-01	4.96E-01	6.61E-01	7.55E-01	9.86E-01	7.15E-01	7.32E-01	5.06E-01
13 10	2.33E-01	5.93E-01	6.88E-01	1.02E+00	9.94E-01	1.24E+00	1.07E+00	5.86E-01
13 11	2.99E-01	7.33E-01	9.91E-01	1.49E+00	1.69E+00	1.62E+00	1.36E+00	6.08E-01
13 12	2.36E-01	9.06E-01	1.39E+00	2.84E+00	3.18E+00	2.09E+00	1.37E+00	3.16E-01
14	4.20E-01	1.38E+00	2.03E+00	4.49E+00	5.36E+00	6.05E+00	5.19E+00	2.97E+00
14 0	1.96E-03	3.12E-03	2.97E-03	4.90E-03	6.28E-03	1.00E-02	1.34E-02	5.46E-03
14 1	5.93E-03	9.46E-03	1.07E-02	2.37E-02	2.86E-02	3.91E-02	2.18E-02	2.50E-02
14 2	8.23E-03	1.60E-02	2.00E-02	3.99E-02	4.74E-02	6.24E-02	8.35E-02	5.24E-02
14 3	1.55E-02	2.87E-02	3.61E-02	7.77E-02	1.03E-01	1.27E-01	8.35E-02	1.01E-01
14 4	1.64E-02	3.91E-02	4.08E-02	1.13E-01	1.01E-01	1.43E-01	1.66E-01	1.02E-01
14 5	3.17E-02	6.64E-02	1.10E-01	1.40E-01	2.21E-01	2.06E-01	1.53E-01	1.30E-01
14 6	3.51E-02	9.55E-02	6.83E-02	2.17E-01	1.56E-01	2.42E-01	2.45E-01	1.59E-01
14 7	3.14E-02	7.23E-02	1.65E-01	1.83E-01	3.30E-01	3.22E-01	2.81E-01	1.98E-01
14 8	5.25E-02	1.49E-01	1.24E-01	3.59E-01	2.78E-01	4.18E-01	3.54E-01	3.35E-01
14 9	3.55E-02	1.12E-01	2.17E-01	3.20E-01	5.09E-01	4.54E-01	5.01E-01	3.97E-01
14 10	4.78E-02	1.79E-01	1.98E-01	5.00E-01	4.66E-01	7.84E-01	7.01E-01	4.28E-01
14 11	4.81E-02	1.63E-01	2.71E-01	5.41E-01	7.33E-01	8.88E-01	8.21E-01	5.03E-01
14 12	4.78E-02	2.00E-01	3.20E-01	7.16E-01	8.66E-01	1.24E+00	1.04E+00	3.91E-01
14 13	4.22E-02	2.44E-01	4.47E-01	1.25E+00	1.51E+00	1.12E+00	7.22E-01	1.48E-01
15	1.47E-01	5.49E-01	8.42E-01	2.55E+00	3.17E+00	4.80E+00	4.30E+00	2.79E+00
15 0	9.19E-04	1.57E-03	1.73E-03	2.91E-03	3.10E-03	1.15E-02	1.91E-02	1.09E-02
15 1	2.00E-03	3.25E-03	5.18E-03	1.59E-02	2.74E-02	3.96E-02	2.07E-02	4.00E-02
15 2	3.82E-03	9.30E-03	7.39E-03	2.84E-02	2.32E-02	5.15E-02	7.77E-02	6.09E-02
15 3	6.68E-03	1.38E-02	2.16E-02	4.73E-02	8.35E-02	1.14E-01	6.92E-02	1.07E-01
15 4	8.31E-03	2.36E-02	2.52E-02	8.04E-02	5.61E-02	1.13E-01	1.42E-01	1.06E-01
15 5	1.02E-02	2.91E-02	4.25E-02	7.29E-02	1.44E-01	2.01E-01	1.48E-01	1.46E-01
15 6	1.43E-02	4.68E-02	5.63E-02	1.51E-01	1.06E-01	1.96E-01	1.99E-01	1.66E-01
15 7	1.40E-02	4.25E-02	5.48E-02	1.04E-01	1.88E-01	2.43E-01	2.29E-01	1.78E-01
15 8	1.25E-02	5.59E-02	8.83E-02	2.28E-01	1.79E-01	3.34E-01	2.66E-01	2.51E-01
15 9	1.91E-02	6.12E-02	7.18E-02	1.73E-01	2.85E-01	3.05E-01	3.71E-01	3.30E-01
15 10	1.20E-02	5.37E-02	9.67E-02	2.94E-01	2.66E-01	5.57E-01	4.97E-01	3.18E-01
15 11	1.32E-02	6.26E-02	8.41E-02	2.48E-01	3.61E-01	5.41E-01	5.10E-01	4.02E-01
15 12	1.25E-02	5.26E-02	8.05E-02	3.32E-01	3.82E-01	6.85E-01	6.88E-01	3.88E-01
15 13	1.00E-02	4.67E-02	9.83E-02	3.03E-01	4.58E-01	8.78E-01	7.30E-01	2.23E-01
15 14	7.63E-03	4.59E-02	1.07E-01	4.74E-01	6.11E-01	5.30E-01	3.39E-01	6.47E-02

Appendix B

Acronyms

ADAS	Atomic Data & Analysis Structure
AOCC	atomic-orbital close-coupling
AUG	ASDEX-Upgrade
CCFE	Culham Centre for Fusion Energy
CFC	carbon-fibre composites
COBM	classical over-barrier model
CTMC	classical trajectory Monte Carlo
CX	charge exchange
CXS	charge exchange spectroscopy
CXRS	charge exchange recombination spectroscopy
DEMO	demonstration power plant
ETF	electron translational factors
FZJ	Forschungszentrum Jülich
HPC-FF	High Performance Computing for Fusion
IAP	Institute of Applied Physics
ION	ionization
IPP	Max-Planck-Institute of Plasma Physics
JET	Joint European Torus
MOCC	molecular-orbital close-coupling
NERSC	National Energy Research Scientific Computing Center

OEAW Austrian Academy of Sciences

ORNL Oak Ridge National Laboratory

PFC plasma facing components

PSS perturbed stationary state

RPEC radiative plasma edge cooling

TBM test blanket modules

TU Wien Vienna University of Technology

UA united atom states

VSC Vienna Scientific Cluster

List of Figures

List of Tables

You may not know it
I don't always show it
But you're so important to me
So much that we've shared
You've always been there
Dolly Parton - Something Special

Appendix C

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Bibliography

[1] T. Pütterich, R. Dux, M. Janzer, R. McDermott, ELM flushing and impurity transport in the H-mode edge barrier in ASDEX Upgrade, Journal of Nuclear Materials (2010) –.
URL `http://www.sciencedirect.com/science/article/pii/S0022311510005623`

[2] A. Kallenbach, et al., Overview of ASDEX Upgrade results, Nuclear Fusion 51 (2011) 094012.
URL `http://stacks.iop.org/0029-5515/51/i=9/a=094012`

[3] R. C. Isler, An overview of charge-exchange spectroscopy as a plasma diagnostic, Plasma Physics and Controlled Fusion 36 (1994) 171–208.
URL `http://stacks.iop.org/0741-3335/36/171`

[4] H. Ryufuku, K. Sasaki, T. Watanabe, Oscillatory behavior of charge transfer cross sections as a function of the charge of projectiles in low-energy collisions, Phys. Rev. A 21 (1980) 745–750.

[5] W. Fritsch, C. Lin, The Semiclassical Close-Coupling Description of Atomic Collisions: Recent Developments and Results, Physics Review (Review Section of Physics Letters) 202 (1991) 1–97.

[6] B. Bransden, M. McDowell, Charge Exchange and the Theory of Ion-Atom Collisions, Oxford University Press, 1992.

[7] A. Boileau, M. von Hellermann, L. Horton, J. Spence, H. Summers, The deduction of low-Z ion temperature and densities in the JET tokamak using charge exchange recombination spectroscopy, Plasma Phys. & Contr. Fusion 31 (1989) 779 – 804.

[8] J. V. Hofmann, Spektroskopische Analyse von Umladungsprozessen hochionisierter Rydberg-Atome am Experiment ASDEX, Ph.D. thesis, Technische Universität München (January 1989).

[9] R. C. Isler, Observation of the Reaction $H^0 + O^{8+} \rightarrow H^+(O^{7+})$ during Neutral-Beam Injection into ORMAK, Phys. Rev. Lett. 38 (1977) 1359–1362.

[10] W. Mandl, R. C. Wolf, M. G. von Hellermann, H. P. Summers, Beam emission spectroscopy as a comprehensive plasma diagnostic tool, Plasma Physics and Controlled Fusion 35 (1993) 1373.

[11] M. G. von Hellermann, W. G. F. Core, J. Frieling, L. D. Horton, R. W. T. Konig, W. Mandl, H. P. Summers, Observation of alpha particle slowing-down spectra in JET helium beam fuelling and heating experiments, Plasma Physics and Controlled Fusion 35 (1993) 799.

[12] H. D. Falter, M. Proschek, S. Menhart, F. Aumayr, H. Winter, D. Ciric, S. Cox, A. Dines, D. Godden, N. Hawkes, T. T. C. Jones, Helium doped hydrogen or deuterium beam as cost effective and simple tool for plasma spectroscopy, Rev. Sci. Instrum. 71 (2000) 3723.

[13] F. Aumayr, R. Schorn, M. Pöckl, J. Schweinzer, E. Wolfrum, K. McCormick, E. Hintz, H. Winter, Tokamak edge plasma densities measured by means of active lithium beam diagnostics, Journal of Nuclear Materials 196-198 (1992) 928 – 932.

[14] R. Schorn, E. Wolfrum, F. Aumayr, E. Hintz, D. Rusbuldt, H. Winter, Radial temperature distributions of C 6+ ions in the TEXTOR edge plasma measured with lithium beam activated charge exchange spectroscopy, Nuclear Fusion 32 (1992) 351.

[15] E. Wolfrum, J. Schweinzer, D. Bridi, K. Igenbergs, J. Kamleitner, F. Aumayr, A sodium (Na) beam edge diagnostic, Journal of Nuclear Materials 390-391 (2009) 1110 – 1113.

[16] K. Igenbergs, J. Schweinzer, I. Bray, D. Bridi, F. Aumayr, Database for inelastic collisions of sodium atoms with electrons, protons, and multiply charged ions, Atomic Data and Nuclear Data Tables 94 (2008) 981 – 1014.

[17] Atomic Data and Analysis Structure (ADAS), ADAS Manual 2.6, online at http://www.adas.ac.uk/manual.php (2008).

[18] D. G. Whyte, R. C. Isler, M. R. Wade, D. R. Schultz, P. S. Krstic, C. C. Hung, W. P. West, Argon density measurements from charge-exchange spectroscopy, Physics of Plasmas 5 (1998) 3694–3699.

[19] L. F. Errea, C. Illescas, L. Mendez, B. Pons, A. Riera, J. Suarez, Accuracy of the classical trajectory Monte Carlo method for electron capture in Li^{3+} and Ne^{10+} + H(1s) collisions, Phys. Rev. A 70 (2004) 052713.
URL `http://link.aps.org/abstract/PRA/v70/e052713`

[20] C. Maggi, L. Horton, T. Pütterich, J. Schirmer, L. Errea, C. Illescas, L. Mendez, B. Pons, A. Riera, J. Suarez, M. OMullane, H. Summers, A. Whiteford, M. von Hellermann, Quantitative CXRS spectroscopy for Ar, internal proposal at ASDEX-Upgrade (2006).

[21] M. Merola, D. Loesser, A. Martin, et al., ITER plasma-facing components, Fusion Engineering and Design 85 (2010) 2312 – 2322, proceedings of the Ninth International Symposium on Fusion Nuclear Technology.
URL `http://www.sciencedirect.com/science/article/pii/S0920379610004060`

[22] P. Andrew, P. Brennan, J. Coad, et al., Tritium retention and clean-up in JET, Fusion Engineering and Design 47 (1999) 233 – 245.
URL `http://www.sciencedirect.com/science/article/pii/S0920379699000848`

[23] G. F. Matthews, P. Edwards, the ITER-like Wall Project Team, et al., Overview of the ITER-like wall project, Physica Scripta 2007 (2007) 137.
URL `http://stacks.iop.org/1402-4896/2007/i=T128/a=027`

[24] R. Neu, V. Bobkov, R. Dux, A. Kallenbach, T. Pütterich, H. Greuner, O. Gruber, A. Herrmann, C. Hopf, K. Krieger, C. Maggi, H. Maier, M. Mayer, V. Rohde, K. Schmid, W. Suttrop, Final steps to an all tungsten divertor tokamak, Journal of Nuclear Materials 363-365 (2007) 52 – 59, plasma-Surface Interactions-17.
URL `http://www.sciencedirect.com/science/article/pii/S0022311506006337`

[25] G. Federici, J. Brooks, D. Coster, G. Janeschitz, A. Kukuskhin, A. Loarte, H. Pacher, J. Stober, C. Wu, Assessment of erosion and tritium codeposition in ITER-FEAT, Journal of Nuclear Materials 290-293 (2001) 260 – 265, 14th Int. Conf. on Plasma-Surface Interactions in Controlled Fusion D evices.
URL http://www.sciencedirect.com/science/article/pii/S0022311500006279

[26] C. H. Skinner, Atomic physics in the quest for fusion energy and ITER, Physica Scripta 2009 (2009) 014022.
URL http://stacks.iop.org/1402-4896/2009/i=T134/a=014022

[27] C. H. Skinner, G. Federici, Is carbon a realistic choice for ITER's divertor?, Physica Scripta 2006 (2006) 18.
URL http://stacks.iop.org/1402-4896/2006/i=T124/a=004

[28] E. Vietzke, A. Haasz, Physics of Plasma-Wall Interactions in Controlled Fusion, Academic, San Diego, New York, Boston, London, Sydney, Tokyo, Toronto, 1996, p. 135.

[29] M. Balden, J. Roth, New weight-loss measurements of the chemical erosion yields of carbon materials under hydrogen ion bombardment, Journal of Nuclear Materials 280 (2000) 39 – 44.
URL http://www.sciencedirect.com/science/article/pii/S0022311500000313

[30] M. Mayer, V. Philipps, P. Wienhold, H. Esser, J. von Seggern, M. Rubel, Hydrogen inventories in nuclear fusion devices, Journal of Nuclear Materials 290-293 (2001) 381 – 388, 14th Int. Conf. on Plasma-Surface Interactions in Controlled Fusion D evices.
URL http://www.sciencedirect.com/science/article/pii/S0022311500004864

[31] G. Federici, R. Anderl, P. Andrew, J. Brooks, R. Causey, J. Coad, D. Cowgill, R. Doerner, A. Haasz, G. Janeschitz, W. Jacob, G. Longhurst, R. Nygren, A. Peacock, M. Pick, V. Philipps, J. Roth, C. Skinner, W. Wampler, In-vessel tritium retention and removal in ITER, Journal of Nuclear Materials 266-269 (1999) 14 – 29.
URL http://www.sciencedirect.com/science/article/pii/S0022311598008769

[32] G. Janeschitz, P. Barabaschi, G. Federici, K. Ioki, P. Ladd, V. Mukhovatov, M. Sugihara, R. Tivey, ITER-JCT, H. Team, The requirements of a next step large steady state tokamak, Nuclear Fusion 40 (2000) 1197.
URL http://stacks.iop.org/0029-5515/40/i=6/a=316

[33] H. Bolt, V. Barabash, W. Krauss, J. Linke, R. Neu, S. Suzuki, N. Yoshida, the ASDEX Upgrade Team, Materials for the plasma-facing components of fusion reactors, Journal of Nuclear Materials 329-333 (2004) 66 – 73, proceedings of the 11th International Conference on Fusion Reactor Materials (ICFRM-11).
URL http://www.sciencedirect.com/science/article/pii/S0022311504001242

[34] M. Mayer, V. Rohde, K. Sugiyama, J. Chen, X. Gong, C. Hopf, J. Likonen, S. Lindig, R. Neu, G. Ramos, E. Vainonen-Ahlgren, A. Wiltner, Carbon balance and deuterium inventory from a carbon dominated to a full tungsten ASDEX Upgrade, Journal of Nuclear Materials 390-391 (2009) 538 – 543, proceedings of the 18th International Conference on Plasma-Surface Interactions in Controlled Fusion Device.
URL http://www.sciencedirect.com/science/article/pii/S0022311509001755

[35] nick@tokamak.info, Conventional tokamaks (Aug. 2011).
URL http://www.toodlepip.com/tokamak/conventional-large-tokamaks.htm

[36] A. Kleyn, N. L. Cardozo, U. Samm, Plasma-Surface interaction in the context of ITER, Phys. Chem. Chem. Phys. 8 (2006) 1761–1774.

[37] A. Messiaen, J. Ongena, U. Samm, et al., Improved Confinement with Edge Radiative Cooling at High Densities and High Heating Power in TEXTOR, Nuclear Fusion 34 (1994) 825–836.

[38] U. Samm, G. Bertschinger, P. Bogen, J. Hey, E. Hintz, L. Könen, Y. Lie, A. Pospieszczyk, D. Rusbüldt, R. Schorn, B. Schweer, M. Tokar, B. Unterberg, Radiative edges under control by impurity fluxes, Plasma Phys. Control. Fusion 35 (1993) B167–B175.

[39] H. Kubo, S. Sakurai, N. Asakura, S. Konoshima, H. Tamai, S. Higashijima, A. Sakasai, H. Takenaga, K. Itami, K. Shimizu, T. Fujita, Y. Kamada, Y. Koide, H. Shirai, T. Sugie, T. Nakano, N. Oyama, H. Urano, T. Ishijima, K. Hill, D. Ernst, A. Leonard, the JT-60 Team, High radiation and high density experiments in JT-60U, Nucl. Fusion 41 (2001) 227–233.

[40] O. Gruber, A. Sips, R. Dux, T. Eich, J. Fuchs, A. Herrmann, A. Kallenbach, C. Maggi, R. Neu, T. Pütterich, J. Schweinzer, J. Stober, the ASDEX Upgrade Team, Compatibility of ITER scenarios with full tungsten wall in ASDEX Upgrade, Nuclear Fusion 49 (2009) 115014.
URL http://stacks.iop.org/0029-5515/49/i=11/a=115014

[41] A. Kallenbach, R. Dux, J. C. Fuchs, R. Fischer, B. Geiger, L. Giannone, A. Herrmann, T. Lunt, V. Mertens, R. McDermott, R. Neu, T. Pütterich, S. Rathgeber, V. Rohde, K. Schmid, J. Schweinzer, W. Treutterer, the ASDEX Upgrade Team, Divertor power load feedback with nitrogen seeding in ASDEX Upgrade, Plasma Physics and Controlled Fusion 52 (2010) 055002.
URL http://stacks.iop.org/0741-3335/52/i=5/a=055002

[42] the International Atomic Energy Agency, Technical Basis for the ITER-FEAT Outline Design, ITER EDA Documentation Series No.19, IAEA (2000).

[43] N. Bohr, J. Lindhard, Electron Capture and Loss by Heavy Ions Penetrating Trough Matter, Kgl. Danske Videnskab. Selsk. Mat.-fys. Medd. 28 (1954) 1 – 30.

[44] A. Bárány, G. Astner, H. Cederquist, H. Danared, S. Huldt, P. Hvelplund, A. Johnson, H. Knudsen, L. Liljeby, K. G. Rensfelt, Absolute cross sections for multi-electron processes in low energy Arq+-Ar collisions: Comparison with theory, Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms 9 (1985) 397 – 399.

[45] A. Niehaus, A classical model for multiple-electron capture in slow collisions of highly charged ions with atoms, Journal of Physics B: Atomic and Molecular Physics 19 (1986) 2925–2937.
URL http://stacks.iop.org/0022-3700/19/2925

[46] V. N. Ostrovsky, Rydberg atom-ion collisions: classical overbarrier model for charge exchange, Journal of Physics B: Atomic, Molecular and Optical Physics 28 (1995) 3901–3914. URL http://stacks.iop.org/0953-4075/28/3901

[47] S. F. da Silva, Charge-exchange processes in collisions of slow ions with atoms and molecules, Ph.D. thesis, Vienna University of Technology (2007).

[48] J. Schweinzer, H. Winter, Single electron capture from alkali atoms by slow doubly charged ions: I. He^{2+} (0.5–6 keV)–Li, Na, K – one-electron processes, J. Phys. B: At. Mol. Opt. Phys. 23 (1990) 3881–3898.

[49] J. Schweinzer, Ein- und Zweielektronenprozesse beim Einelektroneneinfach von Alkaliatomen in doppelt geladene Edelgasionen, Ph.D. thesis, Technische Universität Wien (January 1990).

[50] R. Mann, F. Folkmann, H. Beyer, Selective electron capture into highly stripped Ne and N target atoms after heavy-ion impact, J. Phys. B: At. Mol. Opt. Phys. 14 (1981) 1161–1181.

[51] J. Schweinzer, H. Winter, State-selective preparation of long-lived highly excited ions by means of single electron capture, J. Phys. B: At. Mol. Opt. Phys. 22 (1989) 893–905.

[52] R. K. Janev, H. Winter, State-selective electron capture in atom-highly charged ion collisions, Physics Reports 117 (1985) 265–387.

[53] J. Burgdörfer, R. Morgenstern, A. Niehaus, Angular momentum distribution in the classical over-barrier model for electron capture into highly charged slow projectiles, J. Phys. B: At. Mol. Opt. Phys. 19 (1986) L507–L513.

[54] W. Fritsch, Atomic-basis study of electron transfer in H^+ + Na and H^+ + K collisions, Phys. Rev. A 30 (1984) 1135–1138.

[55] W. Fritsch, Theoretical study of Na excitation and ionization in H^+ + Na collisions, Phys. Rev. A 35 (1987) 2342–2344.

[56] F. Aumayr, M. Gieler, J. Schweinzer, H. Winter, J. P. Hansen, Electron capture in He^{2+} collisions with aligned Na*(3p) atoms, Phys. Rev. Lett. 68 (1992) 3277–3280.

[57] U. I. Jellen-Wutte, Translationsspektroskopische Studien zum Elektroneneinfang von Li(2s) in langsame zweifach geladene Edelgasionen, Ph.D. thesis, Vienna University of Technology (1987).

[58] D. Bates, R. McCarroll, Electron Capture in Slow Collisions, Proc. Royal Soc. London A: Math. Phys. Sciences (1934-1990) 245 (1958) 175–183.

[59] C. Froese-Fischer, T. Brage, P. Jönsson, Computational atomic structure, Institute of Physics Publications, Bristol, 1997.

[60] M. Wallerberger, K. Igenbergs, J. Schweinzer, F. Aumayr, Fast computation of close-coupling exchange integrals using polynomials in a tree representation, Computer Physics Communications 182 (2011) 775 – 778.
URL http://www.sciencedirect.com/science/article/pii/S0010465510004285

[61] M. Wallerberger, Effective calculations of fusion-relevant highly-charged ion collisions, diploma (master) thesis, Vienna University of Technology (2011).

[62] L. Kocbach, R. Liska, Closed form formula for the exchange integrals in the impact-parameter treatment of heavy-particle collisions, J. Phys. B: At. Mol. Opt. Phys. 27 (1994) L619–L624.

[63] R. Shakeshaft, A note on the exchange integrals in the impact-parameter treatment of heavy-particle collisions, J. Phys. B: At. Mol. Opt. Phys. 8 (1975) L134–L136.

[64] J.-P. Hansen, A. Dubois, Procedures for analytical and numerical calculation of Coulombic one- and two-centre integrals (JANAL), Comput. Phys. Commun. 67 (1992) 456 – 464.

[65] W. H. Press, B. P. Flannery, S. A. Teukolsky, W. T. Vetterling, Numerical Recipes in Fortran 77: The Art of Scientific Computing, 2nd Edition, Cambridge University Press, 1992.

[66] H. Hulett, Monomials and the lexicographic order, in: S. K. Jain, R. S. Tariq (Eds.), Advances in Ring Theory, 1st Edition, Birkhäuser Boston, 1997, pp. 145–150.

[67] D. E. Knuth, The Art of Computer Programming, Volume 1: Fundamental Algorithms, 3rd Edition, Addison-Wesley, 1997, binary Tree Representations (ch. 2.3.2), Preorder Sequential Representation (ch. 2.3.3).

[68] J.-P. Hansen, General subroutines for the calculation of atomic and molecular two-centre integrals (ALAIN), Comput. Phys. Commun. 58 (1990) 217–221.

[69] K. Igenbergs, J. Schweinzer, F. Aumayr, Charge exchange in Be^{4+}+ H($n = 1, 2$) collisions studied systematically by atomic-orbital close-coupling calculations, Journal of Physics B: Atomic, Molecular and Optical Physics 42 (2009) 235206 (8pp).
URL `http://stacks.iop.org/0953-4075/42/235206`

[70] K. Igenbergs, J. Schweinzer, A. Veiter, L. Perneczky, E. Frühwirth, M. Wallerberger, R. E. Olson, F. Aumayr, Charge exchange and ionisation in N^{7+}, N^{6+}, C^{6+} - H($n = 1, 2$) collisions studied systematically by theoretical approaches, J. Phys. B: At. Mol. Opt. Phys.Submitted.

[71] T. A. Green, A proof of detailed balancing for the impact parameter method, Proc. Phys. Soc. 86 (5) (1965) 1017–1029.

[72] C. Illescas, A. Riera, Classical study of single-electron capture and ionization processes in A$q + +$(H,H_2) collisions, Phys. Rev. A 60 (1999) 4546–4560.

[73] T. Minami, M. Pindzola, D. Schultz, Lattice, time-dependent Schrödinger equation approach for charge transfer in collisions of Be^{4+} with atomic hydrogen, J. Phys. B: At. Mol. Opt. Phys. 39 (2006) 2877 – 2891.

[74] R. Janev, R. Phaneuf, H. Hunter, Recommended cross sections for electron capture and ionization in collisions of C^{q+} and O^{q+} ions with H, He, and H_2, Atomic Data & Nuclear Data Tables 40 (1988) 249–281.

[75] H. J. Lüdde, R. M. Dreizler, Electron capture with He^{2+}, Li^{3+}, Be^{4+} and B^{5+} projectiles from atomic hydrogen, Journal of Physics B: Atomic and Molecular Physics 15 (1982) 2713–2720.
URL http://dx.doi.org/10.1088/0022-3700/15/16/019

[76] L. F. Errea, C. Harel, H. Jouin, L. Mendez, B. Pons, A. Riera, Quantal and semiclassical calculations of charge transfer cross sections in Be^{4+} + H collisions for impact energies of 2.5 ev $amu^{-1} < E < 25$ kev amu^{-1}, Journal of Physics B: Atomic, Molecular and Optical Physics 31 (1998) 3527–3545.
URL http://stacks.iop.org/0953-4075/31/3527

[77] J. I. Casaubon, Charge exchange between bare beryllium and boron with metastable hydrogen atoms at low energies, Phys. Rev. A 48 (1993) 3680–3683.

[78] R. Hoekstra, H. Anderson, F. Bliek, M. von Hellermann, C. Maggi, R. Olson, H. Summers, Charge exchange from $D(n = 2)$ atoms to low-Z receiver ions, Plasma Phys. & Contr. Fusion 40 (1998) 1541–1550.

[79] J. P. Coleman, S. Trelease, Electron capture into excited states in the impulse approximation, Journal of Physics B: Atomic and Molecular Physics 1 (1968) 172–180.
URL http://dx.doi.org/10.1088/0022-3700/1/2/306

[80] H. P. Summers, W. J. Dickson, A. Boileau, P. G. Burke, B. Denne-Hinnov, W. Fritsch, R. Giannella, N. C. Hawkes, M. von Hellerman, W. Mandl, N. J. Peacock, R. H. G. Reid, M. F. Stamp, P. R. Thomas, Spectral emission from beryllium in plasmas, Plasma Physics and Controlled Fusion 34 (1992) 325–352.
URL http://stacks.iop.org/0741-3335/34/325

[81] L. Perneczky, Comparison of CX Cross Sections of C^{6+} - H(1s) and N^{6+} - H(1s) Collision Using the AOCC Method, bachelor thesis, Vienna University of Technology (2010).

[82] E. Früwirth, Calculations of Effective Emission Cross Sections, project work, Vienna University of Technology (2010).

[83] S. Bashkin, J. O. Stoner, Atomic energy-levels and Grotrian diagrams. Volume I. Hydrogen I - Phosphorus XV, North-Holland Publishing Company, Amsterdam, New York, Oxford, 1978.

[84] F. W. Meyer, A. M. Howald, C. C. Havener, R. A. Phaneuf, Low-energy total-electron-capture cross sections for fully stripped and H-like projectiles incident on H and H_2, Phys. Rev. A 32 (1985) 3310–3318.

[85] T. V. Goffe, M. B. Shah, H. B. Gilbody, One-electron capture and loss by fast multiply charged boron and carbon ions in h and h_2, Journal of Physics B: Atomic and Molecular Physics 12 (1979) 3763.
URL http://stacks.iop.org/0022-3700/12/i=22/a=021

[86] H. F. Busnengo, S. E. Corchs, A. E. Martínez, R. D. Rivarola, Single electron capture by impact of multicharged ions, Physica Scripta T73 (1997) 242.
URL http://stacks.iop.org/1402-4896/1997/i=T73/a=078

[87] A. Veiter, Calculation of Cross Sections for Charge-Exchange Processes during the Collisions of Hydrogen Atoms with Fully Stripped Nitrogen Ions, bachelor thesis, Vienna University of Technology (2009).

[88] A. Kallenbach, R. Dux, the ASDEX Upgrade Team, et al., Non-boronized compared with boronized operation of ASDEX Upgrade with full-tungsten plasma facing components, Nuclear Fusion 49 (2009) 045007 (10pp).
URL `http://stacks.iop.org/0029-5515/49/045007`

[89] D. Dijkkamp, D. Ćirić, F. J. d. Heer, Total Capture and Line-Emission Cross Sections for C^{6+}-, N^{7+}-, O^{8+}-H Collisions in the Energy Range 3-7.5 kev/u, Phys. Rev. Lett. 54 (1985) 1004–1007.

[90] A. Foster, On the Behaviour and Radiating Properties of Heavy Elements in Fusion Plasmas, Ph.D. thesis, University of Strathclyde, online at http://www.adas.ac.uk/theses.php (2008).

[91] L. Errea, C. Illescas, L. Méndez, B. Pons, A. Riera, J. Suárez, Classical and semiclassical treatments of highly charged ions + H(1s) collisions, Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms 235 (2005) 315 – 320.

[92] A. Schmidt, M. Horbatsch, R. M. Dreizler, Semiclassical phase space description of ionisation and capture for ions colliding with hydrogen-like targets, Journal of Physics B: Atomic, Molecular and Optical Physics 23 (1990) 2327S.

[93] K. Igenbergs, M. Wallerberger, J. Schweinzer, F. Aumayr, Atomic-Orbital Close-Coupling Calculations for Collisions Involving Fusion Relevant Highly Charged Impurity Ions Using Very Large Basis Sets, AIP Conference Proceedings: Proceedings of the 17th International Conference on Atomic Processes in Plasmas *accepted*.

[94] V. M. Leonov, V. E. Zhogolev, Simulation of high-Z impurity behaviour for ITER operational scenarios using the ZIMPUR impurity code, Plasma Physics and Controlled Fusion 47 (2005) 903.
URL `http://stacks.iop.org/0741-3335/47/i=6/a=011`

[95] B. J. Green, the ITER International Team, the Participant Teams, ITER: burning plasma physics experiment, Plasma Physics and Controlled Fusion 45 (2003) 687.
URL `http://stacks.iop.org/0741-3335/45/i=5/a=312`

[96] D. R. Schultz, T.-G. Lee, S. D. Loch, Calculations and analysis of cross sections required for argon charge exchange recombination spectroscopy, J. Phys. B 43 (14) (2010) 144002.

[97] K. R. Cornelius, K. Wojtkowski, R. E. Olson, State-selective cross section scalings for electron capture collisions, Journal of Physics B: Atomic, Molecular and Optical Physics 33 (2000) 2017.
URL `http://stacks.iop.org/0953-4075/33/i=11/a=304`

Curriculum Vitae

Particulars

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Academic track

2007	PhD position (project assistant) at the Institute of Applied Physics at Vienna University of Technology
2007	Dipl.-Ing. (M.Sc.) with distinction in Technical Physics from Vienna University of Technology
2001	Change to Vienna University of Technology (also for Technical Physics)
2000	Enrollment in Technical Physics at Munich University of Technology
2000	High school graduation with distinction
1991	Enrollment in high school
1987	Enrollment in primary school

Extended stays abroad

2007-10	Frequent, extended stays at the Max-Planck-Institute of Plasma Physics in Garching, Germany
2004	Summer internship at the Max-Planck-Institute of Plasma Physics in Garching, Germany
2003/4	Exchange to Uppsala University, Sweden within the frameworks of the European Erasmus Exchange Programme
2002	Summer internship at the Swedish Institute of Space Physics at Uppsala University, Sweden
1997	Exchange to Cheyenne Mountain High School in Colorado Springs, USA

Language skills

German	excellent, mother tongue
English	excellent
French	good
Swedish	good
Fortran	excellent
MPI & OpenMP	excellent
C++	good
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