

# Free-Electron – Bound-Electron Resonant Interaction with a Modulated Electron Beam

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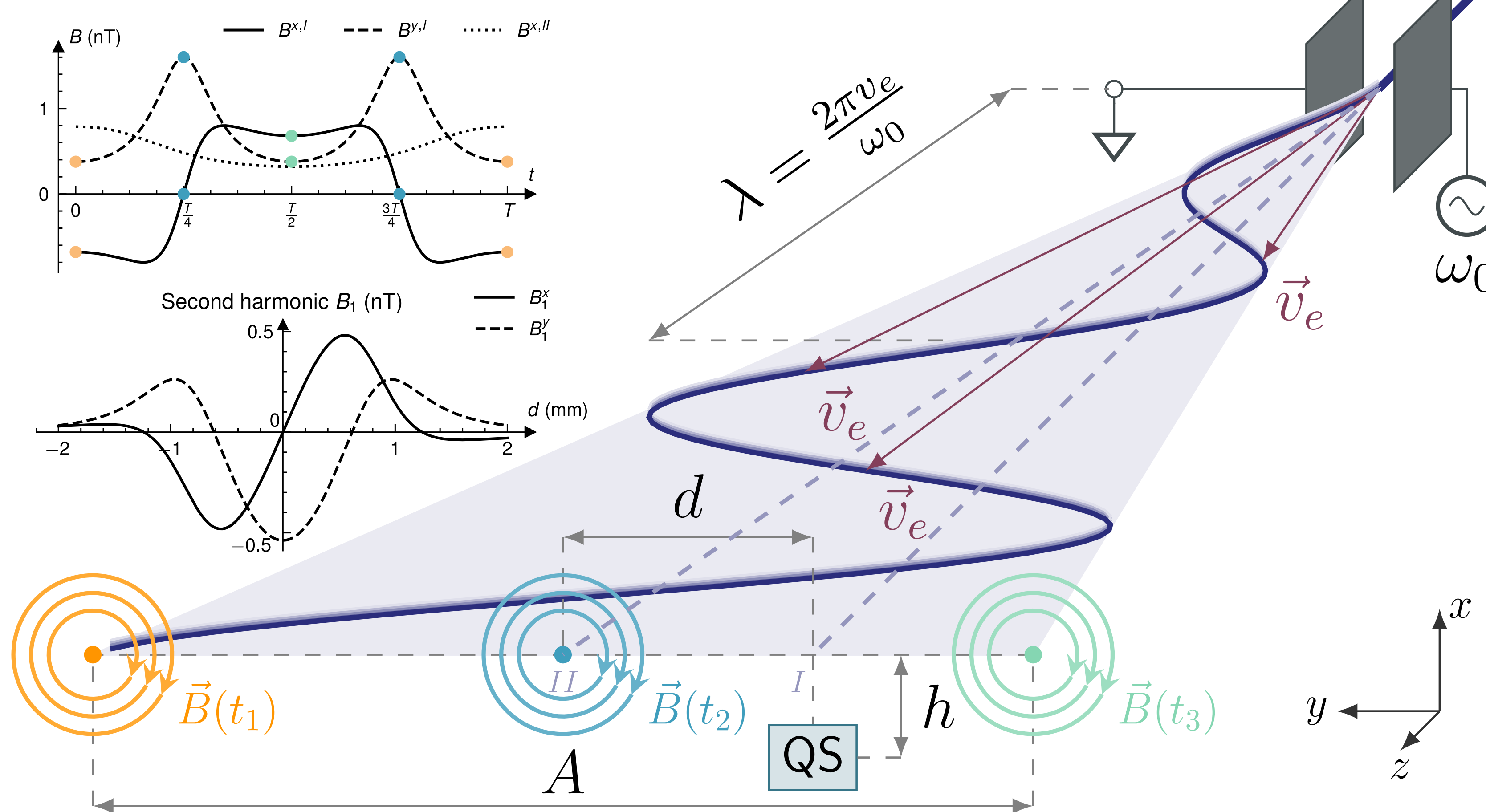
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## Abstract

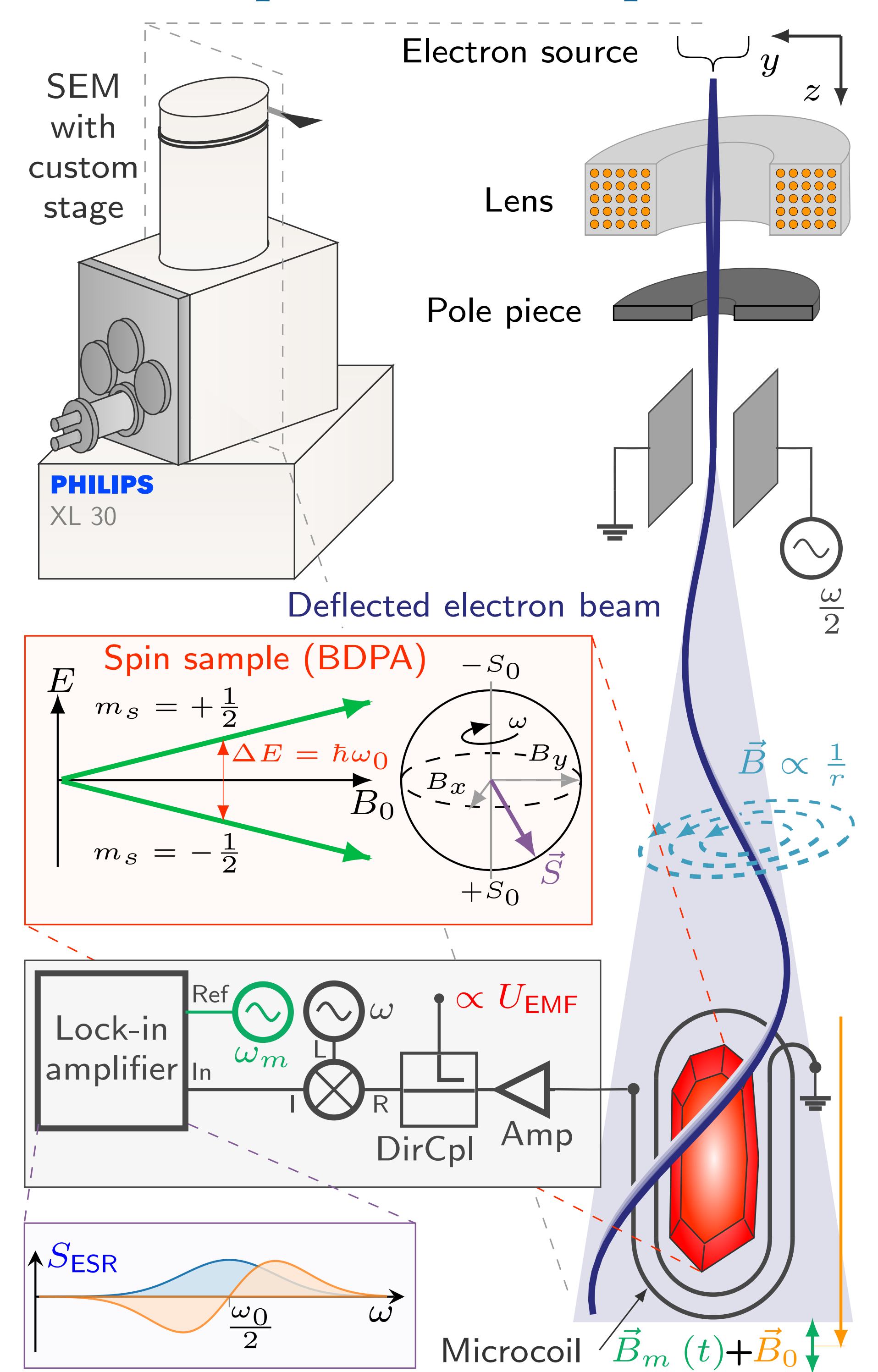
We present the first experimental realization of a novel approach to drive quantum systems (QS) [1], as it was recently proposed [2, 3]. This method utilizes the non-radiating near-field of a spatially modulated electron beam. This way, instead of single electron interaction, many electrons coherently drive the quantum

system, leading to new possibilities for controlling quantum states. For instance, control far below the diffraction limit of electro-magnetic radiation or painted potentials at atomic scales. For this experiment we customized a scanning electron microscope (SEM) to drive Zeeman-levels of an electron spin active sample.

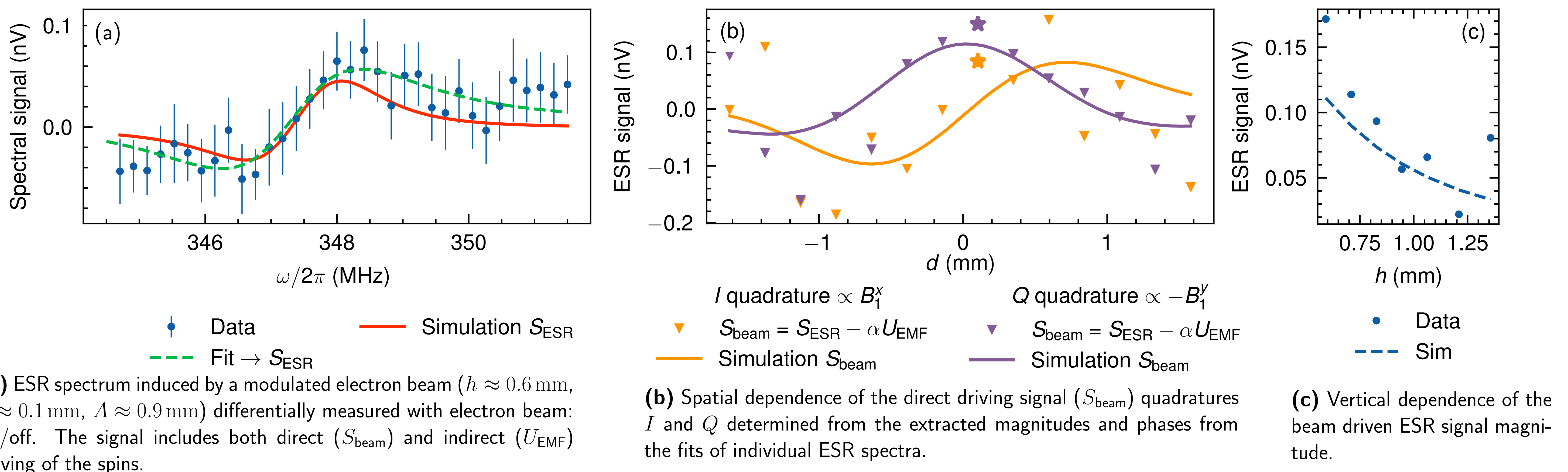
## Near Field of a Modulated Electron Beam



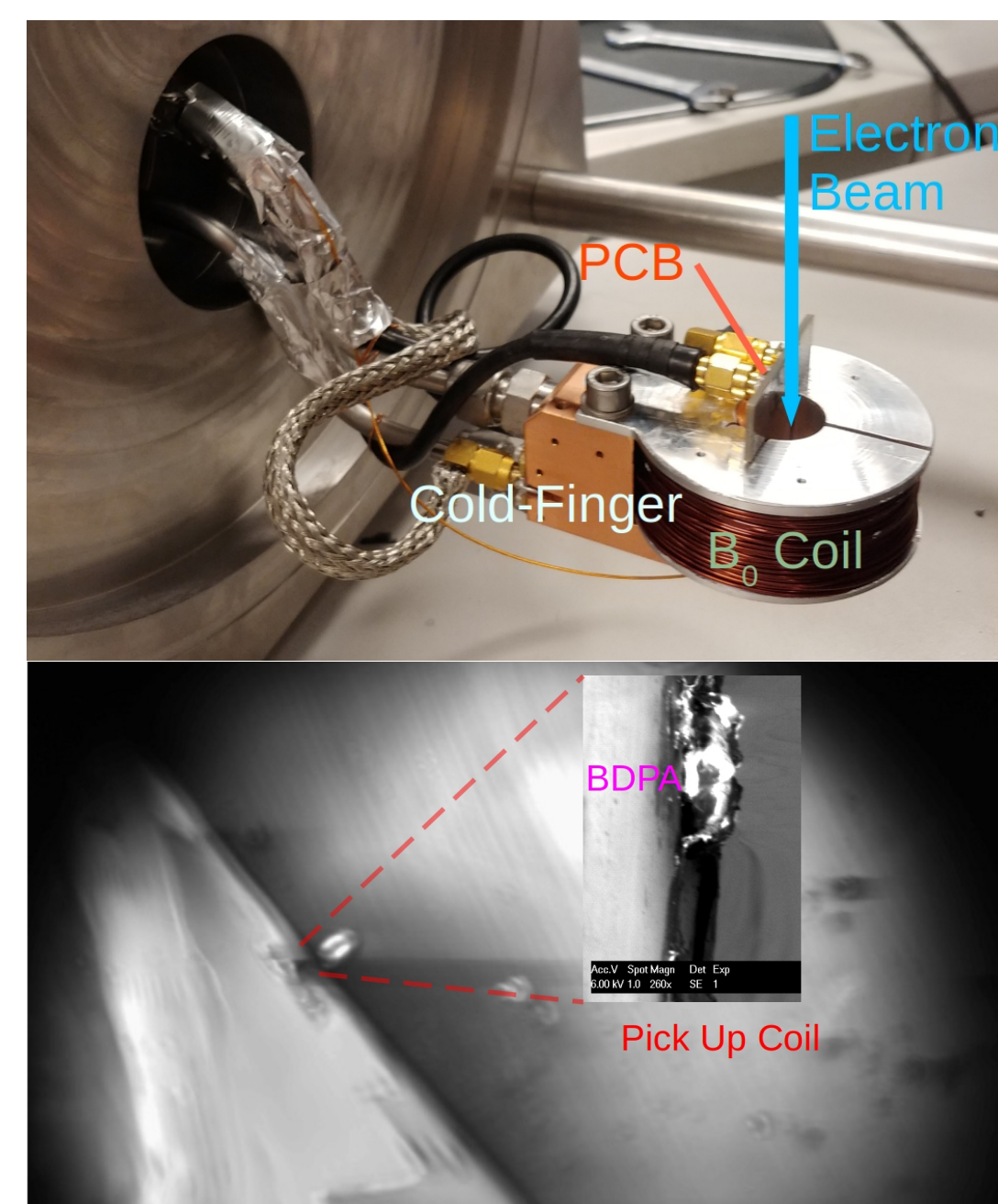
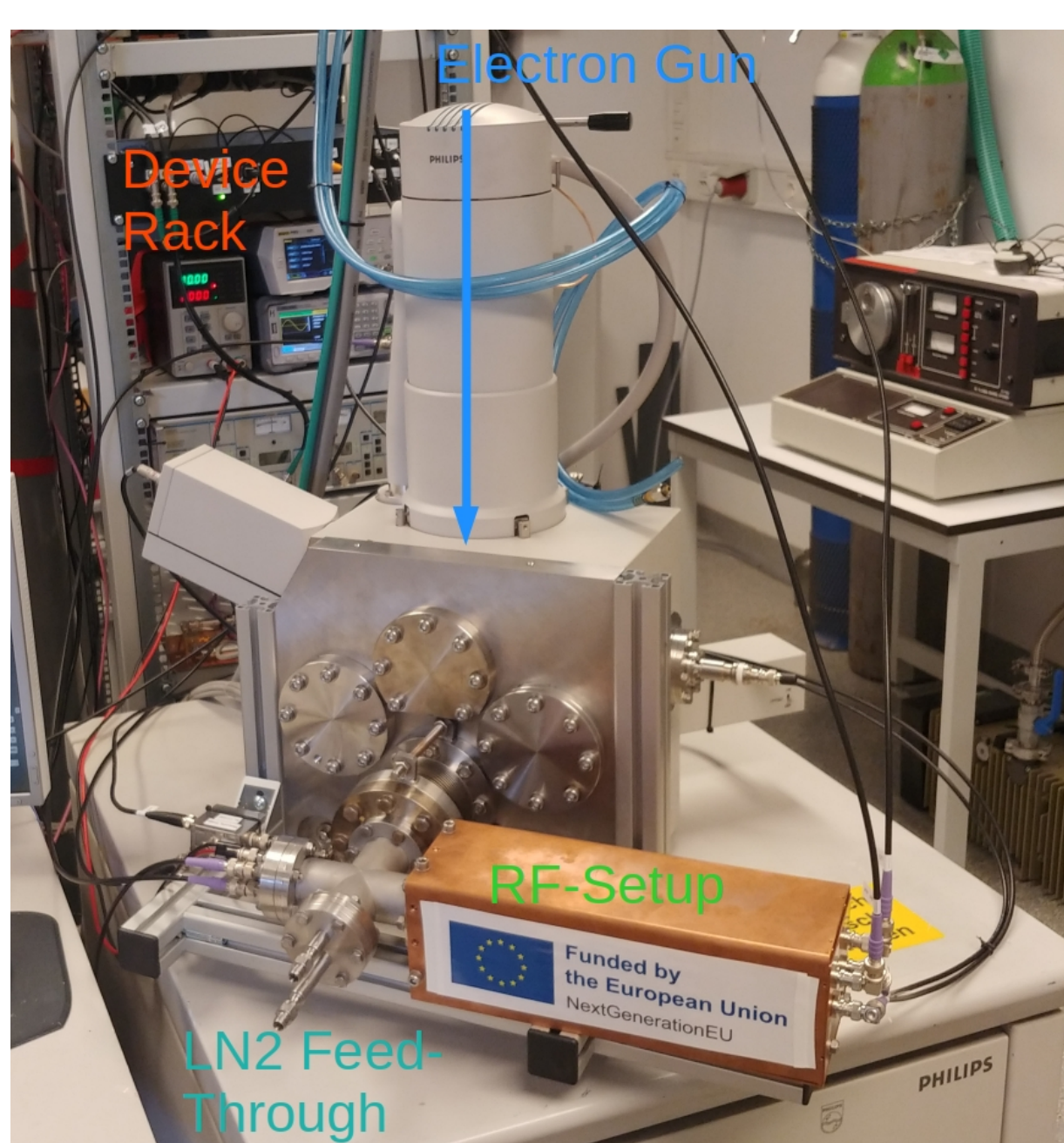
## Experimental Setup



## Results



## Implementation in SEM



## Supported by



## References

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- D. Rätzel, D. Hartley, O. Schwartz, and P. Haslinger, "Controlling quantum systems with modulated electron beams," Phys. rev. res. **3**, 023247 (2021).
- A. Gover and A. Yariv, "Free-Electron-Bound-Electron Resonant Interaction," Phys. rev. lett. **124**, 064801 (2020).

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