Ghost Imaging with Free Electron-Photon Pairs

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Coincidence imaging, also known as ghost imaging, is a technique that exploits correlations between two particles to reconstruct information about a specimen. The particle that relays the spatial information about the object remains completely non-interacting, while the particle used to probe the object is not spatially resolved. While ghost imaging has been primarily implemented on photonic platforms [1], it becomes particularly intriguing when applied to particles with fundamentally different properties, such as massive, charged electrons and massless, neutral photons, especially considering the role of both particles as cornerstones of highly advanced microscopic platforms. Utilizing a custom-built free-space cathodoluminescence setup integrated within a transmission electron microscope (see Fig. 1), we demonstrate electron–photon ghost imaging of complex patterns with a spatial resolution down to 2 µm [2]. These advances have also enabled the first experimental demonstrations of entanglement between photons and free space electrons [3],[4].

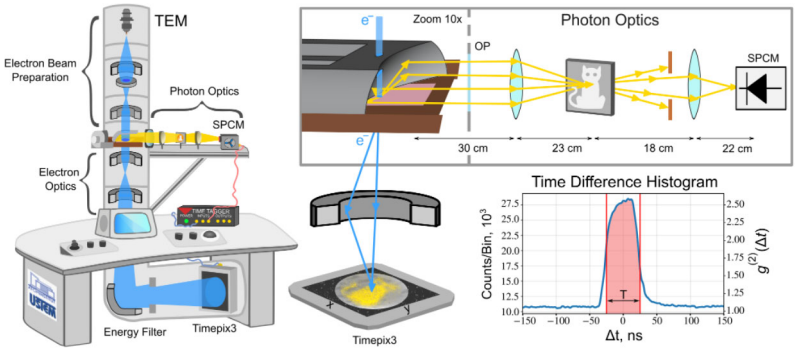


Fig. 1: Experimental setup for electron-photon pair coincidence (ghost) imaging [2].

References

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