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Ultrafast Light-Induced Amplitude and Phase Modulations of Free-Electron Wavepackets

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Electron-based spectroscopy tools are excellent tools for investigating materials excitations ranging from phonons to excitons and plasmons with excellent spatial resolutions. Moreover, by the advent of ultrafast electron microscopy, lasers and electron beams have been combined to explore structural dynamics with femtosecond temporal resolutions [1]. These technological advancements, have pushed the frontiers of the electron microscopy to the horizons of exploring physical, chemical, and biological processes in matters, but also to investigate quantum mechanics from first principles [2].

In this talk, we review fundamental aspects of electron-light interactions from first-principles and beyond adiabatic approximations [3,4]. We first propose methods for correlative electron-photon spectroscopy to investigate temporal dynamics in an indirect way, using the concept of electron-driven photon sources [5,6]. We also discuss free-space electron-light interactions and demonstrate quantum coherent optical interference paths happening due to the competition between photon absorption/emission rates and ponderomotive interactions [7]. Finally, we switch into the near-field mediated electron light interactions, and explore the domains of strong and weak interactions between electrons and near-field light.

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- [5] N. Talebi, *Spectral Interferometry with Electron Microscopes*, *Scientific Reports* **6**, 33874 (2016).
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Für diese Zeit steht eine Kinderbetreuung nach vorheriger Anmeldung zur Verfügung.

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