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Photoelectron Holography[1]

YMKJE HUISMANS, Fom-Institute AMOLF, Science Park 104, 1098 XG Amsterdam, The Netherlands

New techniques using High Harmonic Generation (HHG) or attosecond pulses have proven to be successful in following the ultrafast motion of electrons and holes inside a molecule [1, 2]. We introduce a complementary technique; photoelectron holography [3]. This uses the phase and amplitude of the rescattered electrons to encode the structure and dynamics of the studied atom or molecule. Since photoelectron holography benefits from longer wavelengths, i.e. small photon energies, it is very suitable for systems with a small ionization potential. To demonstrate photoelectron holography, both measurements and calculations on atomic Xenon will be shown. Metastable Xenon was ionized with 7μm light from the FELICE-free electron laser [4]. The three dimensional momentum distribution of the photoelectrons was recorded by a Velocity Map Imaging (VMI)-spectrometer. In these momentum maps interference structures are observed that can be identified as an interference of direct and scattered electrons; a hologram of Xenon. Semi-classical calculations have demonstrated that in the hologram dynamical information of the electron and the atom is stored with a femtosecond to attosecond time resolution.

[1] O. Smirnova et al. Nature 460 972 (2009)
[2] G. Sansone et al. Nature 465 763 (2010)
[3] Y. Huismans et al. Science 331 61 (2011)
[4] J. M. Bakker et al., J. Chem. Phys. 132 074305 (2010)

[1]Supervisor: Prof. Dr. M.J.J. Vrakking