[Poster 37]

Attosecond spatial control of electronic wave packets

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By the application of orthogonally polarized two-color (OTC) laser fields it is possible to control the motion of field-ionizing electronic wave packets both in time and in space [1,2]. Time and space are connected by the driving OTC laser field and thus an attosecond time scale is established in the angular plane for both the emitted and recolliding electronic wave packets [2].

In this submission we report on measurements of atomic single- and double-ionization using OTC pulses. By varying the relative phase $\Delta\varphi$ of the two colors we controlled the trajectories of emitted electron wave packets in space and time. We measured the three-dimensional momentum vectors of electrons and ions detached from singly and doubly ionized Neon and Helium using the COLTRIMS.

Figs. 1(a,b) show momentum distributions of electrons created by single ionization of Neon in the polarization plane of the OTC field for two field shapes A and B with $\Delta\varphi_A=\Delta\varphi_B+\pi$, where the polarization direction of the ω pulse is along the horizontal direction. The Helium data are very similar. In the OTC pulse the symmetry of electron emission and recollision is broken and electrons are preferentially emitted into one hemisphere [1,2], cf. Fig. 1(a,b). Because the emission angle changes within the laser field cycle, the overall shapes of the electron momentum distributions reflect the attosecond timing of this process, and can be used to read-out the emission time of the electron wave packets, as we will show in our talk.

We now turn to electron recollision, which we study via impact double ionization. We plot the sum momentum of the two emitted electrons in Figs. 1(c,d) for the phases $\Delta\varphi_A$ and $\Delta\varphi_B$, respectively. Because the electrons preferentially recollide from one hemisphere, the momentum distributions show a pronounced asymmetry about the p_z-axis which changes with $\Delta\varphi$, see Fig. 1(e). Very similar to wave packet emission the attosecond timing encoded in the two-dimensional momentum distributions can be exploited for studying the dynamics of non-sequential double ionization.

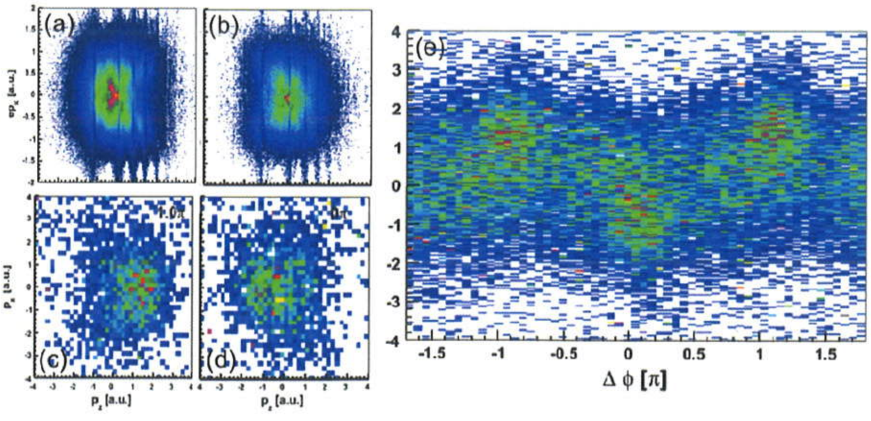

Fig. 1 (a,b) Momentum distributions of electrons from singly ionized Neon for two relative phases $\Delta\varphi$. (c,d) Distributions of the sum-momentum of two electrons created during double ionization of Neon for two $\Delta\varphi$. (e) The sum momentum along the p_z-direction as a function of $\Delta\varphi$.

[1] M. Kitzler and M. Lezius, Phys. Rev. Lett. **95**, 253001 (2005).
[2] M. Kitzler et al., New Journal of Physics **10**, 025029 (2008).