PROBING SPATIAL EVOLUTION OF ULTRAFAST ELECTRONIC WAVEPACKETS WITH TWO-ELECTRON ANGULAR STREAKING

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Coherence among several electronic states can produce electronic wavepackets. Due to the delocalized nature of electronic orbitals, electronic wavepackets initiated by strong field ionization have significant spatial evolution. However, the spatial evolution was not previously accessible to experimental investigations at the attosecond time scale. Using the two-electron-angular-streaking (2eAS) method, we carried out measurements on xenon and krypton, in which the yields of double ionization were measured with a time range between 0 and 2.4 fs. A clear difference in the time-resolved double ionization yield between xenon and krypton was observed: at around 1.3 fs, xenon shows a higher double ionization yield than that of krypton. At this time, the ionization site by the laser field is roughly about 180 degrees from that of the first ionization. This suggests that the second ionization is modulated by a dynamical process evolving at one femtosecond time scale. We attribute this to a spin-orbit electronic wave packet produced by the first ionization. A simulation using the time dependent configurational interaction with single excitation (TDCIS-IP-CAP) method was carried to model the ionization yield of a coherent superposition between two spin-orbit (SO) states. The calculation shows that due to the energy difference in SO splitting, the wavepackets evolves different temporally and spatially and the measured ionization yields have captured these detailed dynamics.