Steering attosecond electron wavepackets with an intense laser field

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When an atom is exposed to a strong laser field, an electron can be tunnel-ionized. The freed electron takes different pathways depending on its ionization time. The electron ionized before the crest of the laser field can be directly driven away, leading to above threshold ionization. The electron ionized near the crest stays near the parent atom when the laser field is off. This electron contributes to frustrated tunneling ionization. The electron ionized after the crest of the laser field can be driven backward in the next half optical cycle of the laser field. High order harmonics can be generated when the backward driven electron is recombined to the parent atom or laser induced electron diffraction occurs when the backward driven electron is re-scattered by the parent atom. Here we thoroughly discuss strong field phenomena occurring during interactions between an atom and an intense laser field. In addition, we demonstrate how the quantum path of the freed electron can be manipulated. These techniques allow us to directly measure the space time property of attosecond EUV/x-ray pulses and driving laser pulses. They also provide vital information on a target atom with an unprecedented temporal resolution.