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Imaging and Controlling Ultrafast Ionization Processes[1]

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We describe how the combination of an attosecond pulse train (APT) and a synchronized infrared (IR) laser field can be used to image and control ionization dynamics in atomic systems. In two recent experiments, attosecond pulses were used to create a sequence of electron wave packets (EWPs) near the ionization threshold in helium. In the first experiment[†], the EWPs were created just below the ionization threshold, and the ionization probability was found to vary strongly with the IR/APT delay. Calculations that reproduce the experimental results demonstrate that this ionization control results from interference between transiently bound EWPs created by different pulses in the train. In the second experiment[‡], the APT was tailored to produce a sequence of identical EWPs just above the ionization threshold exactly once per laser cycle, allowing us to study a single ionization event stroboscopically. This technique has enabled us to image the coherent electron scattering that takes place when the IR field is sufficiently strong to reverse the initial direction of the electron motion causing it to re-scatter from its parent ion.
[†]P. Johnsson, *et al.*, PRL **99**, 233001 (2007).
[‡]J. Mauritsson, *et al.* PRL, to appear (2008).
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