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Probing Time-Dependent Electron Interactions in Double-Rydberg Wavepackets X. ZHANG, R.R. JONES, Depatment of Physics, University of Virginia — Subpicosecond half-cycle electric field pulses (HCPs) have been used as a time-resolved probe of interactions between electrons in a 3-body Coulomb system.We produce double-Rydberg wavepackets (DRWs) using a multi-step, ultrafast, isolated core excitation of ground-state barium atoms.Two laser pulses first create a 5dnd radial wavepacket. At some time within the first Kepler period of the nd Rydberg electron's motion, additional laser pulses excite the 5d core-electron into a superposition of Ba^+ Ng Rydberg states. Initially, the two electrons in the Ngnd DRW have well defined energies, momenta, and radial positions as they move in singly and doubly-charged Coulomb potentials, respectively.However, the electrons soon become highly correlated as they exchange energy and angular momentum. If left unaltered, the atom eventually autoionizes, creating a free electron and an N'L ionic wavepacket (N' < N).We probe the evolution of the DRW using a HCP that has sufficient strength to impulsively ionize both the initial Ng (ionic) and nd (neutral) wavepackets individually, but insufficient amplitude to efficiently ionize the N'L ions that result from autoionization. We monitor the production of Ba++ ions as a function of the delay between the HCP and the launch of the Ng ionic wavepacket to probe the time-dependent energy-exchange between the two electrons. Classical trajectory Monte Carlo simulations aid in the interpretation of our experimental results. This work has been supported by the NSF.

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