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Strong Field Ionization Probing of the Transition from a Molecule to Atoms[1] WEN LI, Dept. of Chemistry, Wayne State University and JILA and Dept. of Physics, University of Colorado, AGNIESZKA JARON-BECKER, CRAIG HOGLE, VANDANA SHARMA, XIBIN ZHOU, ANDREAS BECKER, HENRY KAPTEYN, MARGARET MURNANE, JILA and Dept. of Physics, University of Colorado — We use strong-field ionization to probe electron orbital rearrangement in a dissociating molecule. By illuminating a bromine molecule with 400 nm light, the molecule is excited into a dissociative state. A strong 800 nm pulse is then used to directly probe the dissociative state by ionizing the molecule at different times during the breakup process. We observe time-dependent changes in the kinetic energy release spectra and the angular-dependent ionization yield as the molecular bond ruptures, which we attribute to electronic rearrangement within the molecule. Different orbitals are found to respond differently to the nuclear motion. These data are compared with theoretical predictions, which allow us to identify a well-defined transition from the molecular state into separated atoms for the first time, which occurs at the surprisingly long timescale of 140 fs and an internuclear separation of 5.6 Å.

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