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Controlling and stopping vibrational wave packets in D_2^+ with fs laser pulses[1] UWE THUMM, Kansas State University, THOMAS NIEDERHAUSEN, University of Madrid — Ionization of neutral D_2 molecules by a short pump laser pulse may create a vibrational wave packet on the lowest ($1s\sigma_g^+$) adiabatic potential curve of the D_2^+ molecular ion. We investigated the possibility of manipulating the bound motion, dissociation, and vibrational–state composition of D_2^+ nuclear wave packets with a sequence of ultra–short, intense, near infrared control laser pulses. Our numerical results show that a single control pulse with an appropriate time delay can quench the vibrational state distribution of the nuclear wave packet by increasing the contribution of a selected stationary vibrational state of D_2^+ to more than 50%. We also demonstrate that a second control pulse with a carefully adjusted delay can further squeeze the vibrational-state distribution, suggesting a multi–pulse control protocol for preparing stationary excited nuclear wave functions. With the subsequent fragmentation of the molecular ion with a probe pulse, we suggest a scheme for experimentally assessing the degree at which the nuclear motion in small molecules can be controlled, cf., Phys. Rev. **77**, 013407 (2008).

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