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Vibrational stabilization of cold molecules using a phase coherent train of ultrashort pulses AVI PE'ER, JILA, University of Colorado, EVGENY SHAPIRO, University of British Columbia, MATTHEW C. STOWE, JILA, University of Colorado, MOSHE SHAPIRO, University of British Columbia, JUN YE, NIST and JILA, University of Colorado — Ultracold molecules can be created from atoms by Feshbach resonance techniques. While these molecules are in the electronic ground state, they are highly excited vibrationally. As a result, these molecules are unstable due to virational quenching. We present a general and highly efficient scheme for vibration stabilization using a coherent train of weak pump-dump pairs of shaped ultrashort pulses to perform narrow-band Raman transitions between vibrational levels. The use of weak pulses permits an analytic description within the framework of coherent control in the perturbative regime, while coherent accumulation of many pulse pairs enables near unity transfer efficiency with a high spectral selectivity, thus forming a powerful combination of pump-dump control schemes and the precision of the frequency comb. The feasibility and robustness of this concept is verified by realistic simulations of the molecular dynamics.

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