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Echo in a single vibrationally excited molecule ILIA TUTUNNIKOV, Weizmann Institute of Science, Rehovot, Israel, JUNJIE QIANG, PEIFEN LU, KANG LIN, WENBIN ZHANG, FENGHAO SUN, State Key Laboratory of Precision Spectroscopy, ECNU, Shanghai, China, YARON SILBERBERG, YEHIAM PRIOR, ILYA AVERBUKH, Weizmann Institute of Science, Rehovot, Israel, JIAN WU, State Key Laboratory of Precision Spectroscopy, ECNU, Shanghai, China — Echo is a ubiquitous phenomenon found in many physical systems, ranging from spins in magnetic fields to particle beams in hadron accelerators. Here, we report experimental observation of quantum wave packet echoes in a single isolated molecule [1]. In contrast to conventional echoes, here the entire dephasing-rephasing cycle occurs within a single molecule without any inhomogeneous spread of molecular properties, or any interaction with the environment. In our experiments, we use a short laser pulse to impulsively excite a vibrational wave packet in an anharmonic molecular potential, and observe its oscillations and eventual dispersion with time. A second delayed pulsed excitation is applied, giving rise to an echo - a partial recovery of the initial coherent wavepacket. The vibrational dynamics of single molecules is visualized by time-delayed probe pulse dissociating them one at a time. Interplay between the optically induced echoes and quantum revivals of the vibrational wave packets is observed and theoretically analyzed. The single molecule wave packet echoes may lead to the development of new tools for probing ultrafast intramolecular processes in various molecules.
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