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Direct frequency comb measurement and control of vibrational dynamics in ultracold molecular samples AVI PE'ER, JILA, University of Colorado, EVGENY SHAPIRO, MOSHE SHAPIRO, University of British Columbia, Vancouver, JUN YE, JILA, University of Colorado and NIST — We propose a new class of control schemes for robust transfer of population between quantum states via a wave packet that utilize trains of coherent pulses (optical frequency comb). Our approach draws from analogy to adiabatic passage techniques in three-level systems, but is more general. We show that breaking a slow adiabatic passage into a train of short, perturbative pulses, enables highly efficient population transfer between single states through an arbitrary wave packet. Alternatively, it is possible to directly deduce the intermediate multi-state structure by a simple scan of the pulse train parameters (repetition rate and envelope phase), in a method similar to two-dimensional Fourier spectroscopy. Viewed in the spectral domain, these techniques rely on quantum pathway interference in an adiabatic passage. The scheme is most suitable for applications in cold and ultracold molecular samples.

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