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New Interference Mechanism Controls Ultracold Chemistry[1]
BRIAN K. KENDRICK, Theoretical Division (T-1, MS B221), Los Alamos National Laboratory, JISHA HAZRA, N. BALAKRISHNAN, Department of Chemistry, University of Nevada Las Vegas — A newly discovered interference mechanism has been shown to control the outcome of ultracold chemical reactions. The mechanism originates from the unique properties associated with ultracold collisions, namely: (1) isotropic (s-wave) scattering and (2) an effective quantization of the scattering phase shift (which originates from the bound state structure of the molecule). These two properties can lead to maximum constructive or destructive interference between two interfering reaction pathways (such as exchange and non-exchange in systems with two or more identical nuclei). If the molecular system exhibits a conical intersection, then the associated geometric phase is shown to act as a "quantum switch" which can turn the reactivity on or off. Reaction rate coefficients for the O + OH $\rightarrow$ H + O_2 and H + H_2, reactions are presented which explicitly demonstrate the effect. Experimentalists might exploit this new mechanism to control ultracold reactions by the application of external electric or magnetic fields or by the selection of a particular nuclear spin state.

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