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Uncovering Chemical Reaction Mechanisms in the Ultracold Regime

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At ultracold temperatures, we can exhibit perfect quantum state control of reactants in chemical reactions. Additionally, the strongly-correlated, short-range dynamics of a chemical reaction are dramatically enhanced. This combination of extreme control and added complexity makes a rich arena for exploring chemical dynamics. We report the observation of chemical resonances in both atom-molecule and molecule-molecule reactions, in some cases tuning reaction rates by a factor of 1000 using a magnetic field. We also studied the statistics of these resonances, in collaboration with theorists, to uncover details of the short-range dynamics that may be relevant to room-temperature chemistry.

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