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Cold chemistry with cold molecules

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Low temperature chemistry has been predicted to be dominated by quantum effects, such as shape resonances, where colliding particles exhibit wave-like behavior and tunnel through potential barriers. Observation of these quantum effects provides valuable insight into the microscopic mechanism that governs scattering processes. Our recent advances in the control of neutral supersonic molecular beams, namely merged beam experiments, have enabled continuous tuning of collision energies from the classical regime at room temperature down to 0.01 kelvin, where a quantum description of the dynamics is necessary. I will discuss our use of this technique to study how the dynamics change when molecules participate in collisions, demonstrating the crucial role the molecular quantum rotor plays. We have found that at low temperatures rotational state of the molecule can strongly affect collision dynamics considerably changing reaction rates, due to the different symmetries of the molecular wavefunction.