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Observing Collisions of Two Ultracold Ground State CaF Molecules[1]

LAWRENCE CHEUK, Princeton University

In the past decades, many advances have been made in producing and controlling molecules at ultracold temperatures. An important research frontier for ultracold molecules is understanding how they collide. Compared to collisions between atoms, molecular collisions are much richer and can exhibit qualitatively new phenomena such as "sticky collisions." Experimentally, much work has been done to explore inelastic collisions for both reactive and non-reactive bi-alkali molecules in bulk samples. Recent advances in laser-cooling $^2\Sigma$ molecules have made them available for experimental studies. In contrast to bi-alkalis, $^2\Sigma$ molecules have unpaired electron spins, leading to new features such as a large hyperfine splitting, spin-rotational structure, and intermolecular electronic spin-spin coupling. In this talk, I will present our recent work on measuring collisional loss between two laser-cooled $^2\Sigma$ CaF molecules in their absolute internal ground state. By merging two optical tweezers, each containing a single CaF molecule, we control the exact number of molecules participating in the collision. This tweezer-based approach allows exquisite control over the internal state, and together with laser-cooling, allows one to approach temperatures near the single partial wave regime. I will report on the collisional loss rates measured in a variety of different hyperfine states and discuss the results.

[1]The work presented here was done at Harvard University.