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Trapping of CaF via Optical Loading and Magnetic Slowing

IVAN KOZYRYEV, HSIN-I LU, BOERGE HEMMERLING, MICHAEL CASSON, LOUIS BAUM, JOHN DOYLE, Department of Physics, Harvard University and Harvard-MIT Center for Ultracold Atoms — General methods for delivering cold, chemically diverse molecules in large quantities could impact research in quantum simulation, cold controlled chemistry, and particle physics. We report the demonstration of a general method for trapping magnetic molecules using few photon scattering in combination with magnetic slowing. Starting from a two-stage helium (He) buffer gas cell, calcium monofluoride (CaF) molecules with an initial velocity of $v_f \sim 30$ m/s are slowed as they enter a 800 mK deep superconducting magnetic trap region. Irreversible trap loading is achieved using two optical pumping stages, where two scattered photons remove molecular potential energy and entropy. CaF molecules in the $X^2\Sigma^+(v = 0, N = 1)$ state are observed in a trap with a lifetime exceeding 500 ms, which is limited by collisions with the background He gas. In future applications, co-loading of atoms with molecules seems straightforward using this method. We will also report the experimental progress towards co-trapping of calcium monohydride (CaH) molecules with lithium (Li) atoms for studying Li-CaH collisions, which should allow us to explore the possibility of sympathetic cooling of molecules and investigation of cold controlled chemistry.

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