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Trapping cold molecules and atoms: Simultaneous magnetic deceleration and trapping of cold molecular Oxygen with Lithium atoms
NITZAN AKERMAN, MICHAEL KARPOV, YAIR SEGEV, NATAN BIBELINK, JULIA NAREVICIUS, EDVARDAS NAREVICIUS, Chemical Physics Department, Weizmann Institute of Science. — Cooling molecules to the ultra-cold regime remains a major challenge in the growing field of cold molecules. The molecular internal degrees of freedom complicate the effort of direct application of laser cooling. An alternative and general path towards ultra-cold molecules relies on sympathetic cooling via collisions with laser-cooled atoms. Here, we demonstrate the first step towards application of sympathetic cooling by co-trapping of molecular Oxygen with Lithium atoms in a magnetic trap at a temperature of 300 mK. Our experiment begins with a pulsed supersonic beam which is a general source for cold high-flux atomic and molecular beams. Although the supersonic expansion efficiently cools the beam to temperatures below 1K, it also accelerates the beam to high mean velocities. We decelerate a beam of O_2 in a moving magnetic trap decelerator from 375 m/s to a stop. We entrained the molecular beam with Li atoms by laser ablation prior to deceleration. The deceleration ends with loading the molecules and atoms into a static quadrupole trap, which is generated by two permanent magnets. We estimate 10^9 trapped molecules with background limited lifetime of 0.6 Sec. Our achievement enables application of laser cooling on the Li atoms in order to sympathetically cool the O_2.

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