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An ion-atom hybrid trap for translational and rotational cooling of molecular ions.

JYOTHI SARALADEVI, duke university

Hybrid ion-atom traps are a good platform for investigating the rich chemical interactions between cold ions and atoms. These traps are also proposed to achieve translationally and internally cold molecular ions. To facilitate these studies, we have developed a hybrid trap by spatially overlapping a linear ion trap with a magneto-optical trap (MOT) for potassium (K) atoms. The laser-cooled calcium (Ca^+) ions can efficiently sympathetically cool the translational motion of the molecular ions. The internal states of the molecular ions can be sympathetic cooled using the laser-cooled neutral atoms. Our ion-atom hybrid trap is integrated with a high-resolution time-of-flight mass spectrometer (TOFMS) for the identification of any reaction products. We present our experimental results on the charge exchange interaction between cold K and Ca^+ . The prospects for rotational cooling of CaH^+ molecular ions by interaction with cold K atoms will be discussed.