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**Dynamic and Optical Control of Sympathetically Cooled Chemistry in a Hybrid Trap** PRATEEK PURI, MICHAEL MILLS, ELIZABETH WEST, CHRISTIAN SCHNEIDER, ERIC HUDSON, Univ of California - Los Angeles — We present a series of experiments conducted with the MOTion trap – an atom-ion hybrid apparatus consisting of a linear quadrupole trap (LQT) and co-located magneto-optical trap. We investigate chemistry occurring between neutral Ca atoms and sympathetically cooled molecular ions and non-laser cooled atomic ions. While much work has been performed on understanding the effect of electronic excitation on ion-neutral processes, such as charge-exchange collisions, comparatively less work has been dedicated to understanding how these processes depend on the collision energy of the system. We find collision energy can profoundly impact the outcomes of atom-ion reactions. In particular, we find that when the collision timescale approaches that of the spontaneous emission timescale of the neutral atom, certain reactions can be suppressed. We also explore how this suppression effect can be reversed through laser control. We also develop a method for controlling atom-ion collision energy by manipulating the axial equilibrium position of the ion in the LQT, demonstrating order of magnitude increases in energy resolution over alternative techniques. We also detail recent work on the synthesis of the first mixed hypermetallic oxide from reaction of a $BaOCH_3^+$ molecule with a triplet Ca atom.

Prateek Puri
Univ of California - Los Angeles

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