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Control of atom-ion interactions at low temperatures[1] MICHAEL MILLS, PRATEEK PURI, ELIZABETH WEST, CHRISTIAN SCHNEIDER, ERIC HUDSON, University of California, Los Angeles — We discuss experiments performed in the MOTion trap, a hybrid atom-ion trap comprised of a linear quadrupole trap and a co-located magneto-optical trap. We describe our studies of excited-state atom-ion interactions at low temperatures, where we observe a suppression of collisions due to the electric field of the ion shifting the transition energies of the neutral. This low-temperature suppression of excited-state collisions is important for the prospect of sympathetically cooling molecular ions with ultracold atomic gases, where unwanted excited-state chemistry would otherwise destroy the molecular ion. We propose a general method to eliminate this suppression by introducing a laser resonant with the shifted transition, addressing the atom-ion pair at a specified internuclear separation, enabling the study of these interactions in the ultracold regime and allowing control of low-temperature atom-ion reactions. We also introduce a new method of controlling collision energy. By varying the axial confinement voltages of our ion trap, we shuttle the ions through the cloud of neutral atoms at a precise velocity, providing a general technique with energy resolutions improved over current methods by an order of magnitude for collision temperatures ranging from a few mK to 10s of K.

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