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Sympathetic Cooling of Na+ Ions by Ultra-cold Na Atoms in a Hybrid trap[1] ILAMARAN SIVARAJAH, DOUGLAS GOODMAN, JAMES WELLS, WINTHROP SMITH, University of Connecticut — Closed shell ions like Na+, as well as many molecular ions, cannot be easily laser cooled, for spectroscopy, quantum gates, and near zero-K reaction studies. We report on experiments studying collisions between trapped ions and trapped cold atoms. The ion-atom interaction is dominated by long-range polarization forces, principally a term $V \sim -\alpha /R^4$, α being the dipole polarizability of the neutral. The Hybrid trap consists of a linear Paul ion trap, set to trap Na+ ions, centered on a sodium magneto-optical trap (MOT). We investigate the sympathetic cooling of the (equal atomic mass) Na+ ion cloud concentric with the MOT, using either the 3s F=2→3p F′=3 or the 3s F=2→3p F′= 2 MOT transitions. The lifetime of the ions in the Paul trap is observed to be detectably longer when they are sympathetically cooled by the cold neutral MOT atoms, consistent with simulations via SIMION.

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