Estimates of Collisional Cooling and Quenching Rates for Atomic and Molecular Ion Collisions with Ultracold Atoms. WINTHROP SMITH, JAMES WELLS, University of Connecticut — Translational cross sections and rate coefficients for cold ion-neutral elastic and charge-exchange collisions (either atomic or molecular) are $>>$ larger ($\sim 10^6$ a.u.) than neutral-neutral collisions at the same CM energy. This is due to the long range polarization potential $V(R) = -C_4/R^4$, where $C_4$ is proportional to the polarizability of the neutral partner. Thus collisions between ultracold alkali atoms (trapped in a magneto-optic trap or MOT) and low-energy ions can be used for sympathetic cooling experiments. We are building a prototype hybrid-trap apparatus [1] that applies these principles to collisions of Ca$^+$ ions (which can be laser pre-cooled) with MOT-trapped ultracold Na atoms. Some calculations on this system and other related ion-neutral systems have been published [2] and some initial experiments on other ion-neutral species have begun [3]. Estimates of cooling and quenching rates in the low K-mK CM energy range for Ca$^+$ on Na and other cases will be presented and possible experiments described.