Measurements of charge-exchange reaction rate constants between Ca\textsuperscript{+} and Na in a hybrid atom-ion trap\textsuperscript{1} JONATHAN KWOLEK, Univ of Connecticut - Storrs, DOUGLAS GOODMAN, Wentworth Institute of Technology, JAMES WELLS, Claremont McKenna, Pitzer, and Scripps Colleges, FRANCESCO NARDUCCI, Naval Postgraduate School, WINTHROP SMITH, University of Connecticut — We present measurements of charge-exchange reaction rate constants between Ca\textsuperscript{+}[\textsuperscript{2}S, \textsuperscript{2}P, \textsuperscript{2}D] and Na[\textsuperscript{2}S, \textsuperscript{2}P] using a hybrid trap. Our hybrid trap consists of a concentric magneto-optical trap MOT and linear Paul trap (LPT). The hybrid apparatus allows us to spatially overlap a trapped Ca\textsuperscript{+} ion cloud or crystal with a cold Na MOT. Ca\textsuperscript{+} ions that undergo charge-exchange or molecular photoassociation reactions with the Na atoms are lost from the LPT. An analysis of the trapped Ca\textsuperscript{+} population’s time-dependence yields the reaction rate constant between the trapped ions and co-trapped atoms. We can isolate the rate-constant for individual reaction pathways by independently controlling the internal electronic states of the Na atoms and/or the Ca\textsuperscript{+} ions. Additionally, we explore the energy dependence of the rate constant by controlling the temperature of the laser-cooled Ca\textsuperscript{+} ions. The reaction channel between Ca\textsuperscript{+}[\textsuperscript{2}S] and Na[\textsuperscript{2}P] is of particular interest, since an analysis of the Born-Oppenheimer potential energy curves reveal a barrier to the reaction for low temperature.

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