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Measurements of charge-exchange reaction rate constants between Ca^+ and Na in a hybrid atom-ion trap[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-exchage reaction rate constants between $Ca^+[^2S, ^2P, ^2D]$ and $Na[^2S, ^2P]$ using a hybrid trap. Our hybrid trap consists of a concentic magneto-optical trap MOT and linear Paul trap (LPT). The hybrid apparatus allows us to spatially overlap a trapped Ca^+ ion cloud or crystal with a cold Na MOT. Ca^+ ions that undergo charge-exchange or molecular photoassociation reactions with the Na atoms are lost from the LPT. An analysis of the trapped Ca^+ 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^+ ions. Additionally, we explore the energy dependence of the rate constant by controlling the temperature of the laser-cooled Ca^+ ions. The reaction channel between $Ca^+[^2S]$ and $Na[^2P]$ 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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