NUCLEAR SPIN DEPENDENCE OF THE REACTION OF H_3^+ WITH H_2

KYLE N. CRABTREE, BRIAN A. TOM,[a] CARRIE A. KAUFFMAN, BENJAMIN J. McCALL, *Department of Chemistry, University of Illinois, Urbana, IL 61801.*

The chemical reaction $H_3^+ + H_2 \rightarrow H_2 + H_3^+$ is the simplest bimolecular reaction involving a polyatomic, and is possibly the most common such process occurring in the universe. Recent measurements of interstellar clouds have shown that the temperatures derived from the lowest rotational levels of H_2 and H_3^+ do not agree, and it is expected that this reaction plays a key role in this deviation. To investigate this process, we have measured the $ortho/para$ ratio of H_3^+ produced in this reaction by performing high resolution spectroscopy on its ν_2 fundamental band in plasmas formed from various mixtures of $ortho$ and $para$ H_2. These measurments have been performed in a supersonic expansion discharge source and in a cooled hollow cathode cell to probe the reaction at a variety of temperatures at and below 300 K. Our results provide experimental evidence that the population distribution of the lowest levels of H_3^+ is governed by the steady state of the $H_3^+ + H_2 \rightarrow H_2 + H_3^+$ reaction, not by thermalization.

[a]Current Address: Department of Chemistry, United States Air Force Academy, CO 80840