SPECTROSCOPIC STUDIES OF THE H_3^+ + H_2 REACTION AT ASTROPHYSICALLY RELEVANT TEMPERATURES

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H_3^+ is the key precursor to ion chemistry in the interstellar medium. It has been employed as an astrophysical probe of conditions of temperature and density due to its ubiquity in a variety of environments. The distribution of ortho- and para- spin modifications of H_3^+ is particularly interesting in this regard. Consequently, it is important to understand the pathways through which changes to the H_3^+ spin distribution can occur. One possible pathway is the $H_3^+ + H_2 \rightarrow H_2 + H_3^+$ reaction, which proceeds by proton hop and proton exchange and is governed by the conservation of nuclear spin. Cordonnier et al.[a] studies this reaction at high temperature in a pulsed hollow cathode cell, but to facilitate the understanding of astronomical observations, we need lower temperature measurements. Recently, we have constructed a liquid nitrogen-cooled hollow cathode discharge source and coupled it with multipass absorption spectroscopy to measure the ortho:para ratio of H_3^+ in plasmas at a variety of para-H_2 enrichment levels at $\sim$160 K. Previously, we have reported[b] experimental measurements of the branching ratio between proton hop and exchange in a hydrogenic plasma at $\sim$80 K. Together, these experiments have allowed us to explore the temperature dependence of this branching ratio and provide valuable information for the interpretation of astronomical observations.

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[a] M. Cordonnier et al., J Chem Phys, **113**, 3181 (2000)

[b] B. A. Tom, M. B. Wiczer, A. A. Mills, K. N. Crabtree, and B. J. McCall, "Observation of nuclear spin selection rules in supersonically expanding plasmas containing H_3^+," 63rd International Symposium on Molecular Spectroscopy (2008).