THE INFRARED SPECTRUM OF H_3^+ IN SPACE PLASMAS

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Protonated hydrogen, H_3^+, is the simplest polyatomic molecule which is abundantly produced in hydrogen dominated plasmas. Its presence in interstellar space was predicted by McDaniel and colleagues in 1961 and the need for its laboratory spectrum was stressed by Herzberg in 1967. In 1973 the science of H_3^+ acquired a new dimension when Herbst and Klemperer and independently Watson proposed the ion-neutral reaction scheme initiated by cosmic ray ionization in which H_3^+ plays a central role in molecular formation.

As soon as its laboratory spectrum was obtained in 1980, a search for interstellar H_3^+ was initiated. The serendipitous discovery in 1989 of strong H_3^+ emission in Jupiter diverted this effort to studies of planetary ionospheres including those of Saturn and Uranus. After the SL-9 Comet event in 1994, the project was revived. In 1996 weak absorption of interstellar H_3^+ was detected in dense clouds containing deeply embedded young stars[a] and this gave the most direct support of the ion-neutral reaction scheme. Subsequent observations of abundant H_3^+ also in diffuse clouds introduced new mystery in the chemistry of the diffuse interstellar medium.[bcd] The current status of observations and analysis will be presented.

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[a] T. R. Geballe, and T. Oka, Nature 384, 334 (1996).
[b] B. J. McCall, T. R. Geballe, K. H. Hinkle and T. Oka, Science 279, 1910 (1998).
[c] B. J. McCall, T. R. Geballe, K. H. Hinkle and T. Oka, Faraday Discuss 109, 267 (1998).
[d] T. R. Geballe, B. J. McCall, K. H. Hinkle and T. Oka, Astroph. J. 510, 251 (1999).