OBSERVATION OF H_3^+ IN THE DIFFUSE INTERSTELLAR MEDIUM

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H_3^+, the cornerstone molecule of interstellar chemistry, was first detected in interstellar space in 1996[b] in the dense molecular clouds GL2136 and W33A. We have now extended this ion's diagnostic powers to the diffuse interstellar medium with the detection of H_3^+ along the line of sight to the visible star Cygnus OB2 No. 12[c]. Three rovibrational transitions in the 3.7 μm region were observed using the CGS4 infrared spectrometer at the United Kingdom Infrared Telescope and the high-resolution Phoenix spectrometer at the Kitt Peak National Observatory.

We have developed a simple chemical model of interstellar chemistry which describes the abundance of H_3^+ in both diffuse and dense clouds. The application of this model to Cygnus OB2 No. 12 shows that this line of sight has H_3^+ number density $[H_3^+] \sim 4 \times 10^{-7}$ cm^{-3}, effective path length L $\sim$ 300 pc, and hydrogen number density [H] + 2[H_2] $\sim$ 20 cm^{-3}. The H_3^+ absorptions also provide an estimate of the effective kinetic temperature of the medium T $\sim$ 27 K.

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[b] T.R. Geballe and T. Oka, *Nature* 384, 334 (1996)

[c] B.J. McCall, T.R. Geballe, K.H. Hinkle, and T. Oka, *Science,* in press