NUCLEAR SPIN OF H_3^+ IN DIFFUSE MOLECULAR CLOUDS

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In diffuse molecular clouds (environments with high molecular fraction, but low CO abundance), the relative populations of the $J = 0$ (*para*) and $J = 1$ (*ortho*) rotational levels of H_2 are often used as a measure of the cloud kinetic temperature, T_{01}. Typically, T_{01} is on the order of 50-70 K, but in similar environments, the excitation temperature $T(H_3^+)$ derived from the (J, K) = (1,0) (*ortho*) and (1,1) (*para*) rotational levels of H_3^+ is 20-40 K. We have extended the number of sight lines in which both T_{01} and $T(H_3^+)$ have been measured from two to five, and in four of the five cases, the two temperatures are discrepant in the same cloud. Using a steady state chemical model based on rate coefficients calculated with a microcanonical statistical approach, we find that the discrepancy between T_{01} and $T(H_3^+)$ likely arises from incomplete thermalization caused by competition between the thermalization reaction $H_3^+ + H_2 \rightarrow H_2 + H_3^+$ and dissociative recombination of H_3^+ with electrons.

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