INDIRECT ROTATIONAL SPECTROSCOPY OF THE D_2H^+ MOLECULAR ION

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The partially deuterated isotopologues of H_3^+ have proven to be valuable probes of interstellar environments. In low temperature regions (< 20 K) such as dark molecular clouds, deuterium fractionation leads the ratios of D_2H^+/H_3^+ and H_2D^+/H_3^+ to be orders of magnitude greater than that of HD/H_2.[a] Unlike H_3^+, D_2H^+ and H_2D^+ have permanent dipole moments and their allowed rotational transitions can be used to probe interstellar conditions and give an indirect method of detection for H_3^+.

There are still unobserved transitions of D_2H^+ that are within the coverage of observatories such as the Stratospheric Observatory for Infrared Astronomy (SOFIA) which have relatively large uncertainties (8–16 MHz). Recently, we have measured over 20 rovibrational transitions of D_2H^+ with MHz-level uncertainty using the technique Noise-Immune Cavity-Enhanced Optical Heterodyne Velocity Modulation Spectroscopy (NICE-OHVMS).[b] These new measurements can be used to improve predicted frequencies of pure rotational transitions using combination differences and an improved fit to an effective Hamiltonian.

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[a] H. Roberts, E. Herbst, and T. J. Millar, *Astrophys. J.*, **591**, L41 (2003).

[b] J. N. Hodges, A. J. Perry, P. A. Jenkins II, B. M. Siller, and B. J. McCall, *J. Chem. Phys*, **139**, 164201 (2013).