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THE HD/H_2 RATIO IN THE ATMOSPHERE OF URANUS

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High resolution spectra of HD and H_2 have been brought together to derive the D/H ratio for Uranus. The deuterium concentration in the dominant molecular hydrogen phase is least susceptible to the effects of isotope fractionation in the planetary atmosphere, and the determination of relative abundances of HD and H_2 is unambiguous due to nearness (at 6000 and 6300 Å, respectively) and relative weakness of the chosen spectral lines. The HD 5-0 R(0) and R(1) dipole lines and the H_2 4-0 S(0), S(1), and S(2) quadrupole lines were obtained with a PEPSIOS instrument at the Palomar 5-meter telescope. The H_2 spectra, which resolve the asymmetric line profiles resulting from pressure shifts in the deep stratified Uranus atmosphere, unambiguously define the line-of-sight hydrogen abundance for comparison with the HD spectra. The 5-0 band of HD was chosen to minimize interference from blended CH_4 lines. However, weak interfering lines have been found in the 5-0 bands from Uranus as well, and some uncertainties remain regarding the intrinsic line strengths in molecular hydrogen, complicating the analysis of the HD/H_2 data. Nevertheless, it is established that the D/H ratio in the atmosphere of Uranus is smaller than the Jovian value, and is significantly smaller than recent theoretical predictions for Uranus based on estimates of isotope fractionation in the pre-planetary solar nebula.