Modified Hydrogen Broadening Parameters for Ammonia Under Jovian Atmospheric Conditions

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ABSTRACT

New mscmator-based microwave spectra] measurements have been made on small amounts of gaseous ammonia in hydrogen, under conditions applicable to the atmospheres of the giant planets. Data were taken on mixtures of -1 % by number ammonia in molecular hydrogen at temperatures of 203 and 298 K, pressure from 0.5 to 4.5 atm, and frequencies from 2.5 to 17.7 GHz. The 1 % ammonia mixing ratio ensures that hydrogen broadening dominates inversion linewidths, as it does in giant planet atmospheres. 'l'he data are in good agreement with previous data taken at Stanford covering a smaller range of frequencies and temperatures [Spilker, 1990]. "l'hey show that the opacity formalism published by Berge and Gulkis tends to overestimate hyctrogen-broadened linewidths, especially at lower pressures, while a Van Vleck/Weisskopf formalism predicts absorptivities that arc consistently less than those observed, with the greatest disagreements at the highest pressures. The 1990 formalism by Spilker, based on the Stanford data, shows good agreement with the new data at 203 K but slightly overestimates absorptivities at 298 K, indicating that the formalism's empirical correction to the line intensity factor maybe too large at higher temperatures. Slight errors in predicted frequency dependencies suggest minor changes to parameters in its line-width calculation algorithms, At 203 K it appears that calculated linewidths may be about 5% low for the higher pressures, while at 298 K the calculated linewidths match well with the observed frequency dependencies. In all cases the accuracy of the 1990 formalism is better than either the Berge and Gulkis or the Van Vleck/Weisskopf formalisms. Modifications based on the new data should provide, further improvement. Results from this program will find immediate application in the interpretation (or reinterpretation) of radio astronomical and radio occultation data from observations of the. giant planets, especially Jupiter and Saturn. They will also play an important role in planning radio observation strategies for tnext year's collision of comet Shocmakcrfl,evy9(1993c) with Jupiter.

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