The Abundances of CH_4 and Ortho/Para H_2 in Neptune and Uranus: Implications of New H_2 4-0 Linestrength Measurements

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The *ortho/para* hydrogen ratio and tropospheric methane molar fraction (f_{CH_4}) are presented for Uranus and Neptune based on new linestrength determinations for key hydrogen features recently reported by Ferguson *et al* (1993, *J. Mol. Spec* **160**, 315-325). In comparison to analyses adopting theoretical linestrengths, the relatively weak laboratory linestrengths (approximately 30% and 15% smaller than the theoretical 4-0 S(0) and S(1) linestrengths, respectively) results in a ~30% decrease in the tropospheric methane ratio and a comparable increase in the pressure level of the optically-thick cloudtop marking the bottom of the visible atmosphere (P_{cld}). The increase in the ratio of S(1)/S(0) linestrengths from 4.4 (theoretical) to ~ 5.9 (measured) results in a decrease in the range of viable *ortho/para* ratios; an equilibrium hydrogen distribution is now the best fit for both planets. For Uranus, we find $f_{CH_4} = 0.019 \pm 0.005$, $P_{cld} = 3.4 \pm 0.5$ bars, and $0.88 < f_{eH_2} < 1.00$ (where f_{eH_2} and $1\text{-}f_{eH_2}$ denote the fraction of H_2 in the equilibrium and normal state, respectively) compared to the Baines and Bergstralh (1986 *Icarus* **65**, 406-441) values of $f_{CH_4} \sim 0.030 \pm 0.013$, $P_{cld} = 2.7 \pm 0.5$ bars, and $0.63 < f_{eH_2} < 0.95$. For Neptune, we find $f_{CH_4} = 0.023 \pm 0.005$, $P_{cld} = 3.8 \pm 0.5$ bars, and $0.89 < f_{eH_2} < 1.0$ compared to the Baines and Smith (1990 *Icarus* **85**, 65-108) values of $f_{CH_4} = 0.03 \pm 0.007$, $P_{cld} \sim 3.3 \pm 0.3$ bars, and $0.85 < f_{eH_2} < 1.0$. The methane mixing ratios derived here are in agreement with values derived from Voyager radio occultation measurements, i.e., 0.023 for both Uranus (Lindal *et al*, 1987, *JGR* **92**, 14987 - 15001) and Neptune (Lindal 1992, *Astron J* **193**, 967-982).