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Saturn Auroral Electron Energy-Flux Relation Investigated from the H/H_2 Brightness Ratio

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Abstract

A recent analysis of Saturn's southern aurorae with the UVIS instrument onboard the Cassini spacecraft showed that the brightness ratio of H Lyman-α to H_2 auroral emissions statistically decreases with the brightness of H_2 [1]. This measurement was proposed to provide a sensitive diagnosis for low energy electrons (typically lower than 10keV). Previous models of auroral energy deposition (i.e., [2]) predicted a decrease of this brightness ratio with increasing electron energies. In order to investigate the auroral energy-flux relationship as a result of the magnetosphere-ionosphere coupling and quantify the information brought the above measurements, we compare the observed results with those predicted by our model.

We calculate the H Lyman-α brightness by including self-absorption effect [3] and by assuming the brightness to be directly related with the auroral electron flux. Combined with the H_2 ultraviolet emission model including hydrocarbon absorptions [4], we derive the variations of the brightness ratio and of the total H_2 emission as a function of the auroral electron energy and flux. The observations are then used to constrain the energy-flux relationship, analyzed in the frame of the field-aligned acceleration theory (Knight-relation) with typical plasma parameters of the Saturn magnetosphere (cf. [5]). For electron energies > a few keV, the observational results well agree with the Knight-relation. The agreement is less obvious for electron energies < a few keV, for which possible causes, electrons not accelerated by field-aligned currents and/or role of solar EUV, are discussed.

References

[1] Lamy, L., R. Prangé, W. Pryor, J. Gustin, S. V. Badman, H. Melin, T. Stallard, D. G. Mitchell, P. C. Brandt, Multi-spectral simultaneous diagnosis of Saturn's aurorae throughout a planetary rotation, J. Geophys. Res., in review.

[2] Rego, D., R. Prangé, and J. -C. Gérard (1994), Auroral Lyman α and H_2 bands from the giant planets: 1. Excitation by proton precipitation in the Jovian atmosphere, J. Geophys. Res., 99(E8), 17,075–17,094.

[3] Ménager H., M. Barthélemy, and J. Lilensten (2010), H Lyman α line in Jovian aurorae: electron transport and radiative transfer coupled modeling, Astron. Astrophys., 509, A56.

[4] Tao, C., S. V. Badman, and M. Fujimoto (2011), UV and IR auroral emission model for the outer planets: Jupiter and Saturn comparison, Icarus, 213, 581-592.

[5] Cowley, S. W. H., C. S. Arridge, E. J. Bunce, J. T. Clarke, A. J. Coates, M. K. Dougherty, J.-C. G´erard, D. Grodent, J. D. Nichols, and D. L. Talboys (2008), Auroral current systems in Saturn's magnetosphere: comparison of theoretical models with Cassini and HST observations, Ann. Geophys., 26, 2613-2630.