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Auroral emissions: what do they mean for the atmosphere?

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Abstract

Too often discussions of the auroral emissions from planets consider the upper atmosphere simply as a "t.v. screen" whose sole function is to reflect processes occurring in the magnetosphere. This contribution will look at what auroral emissions can tell us about the physical processes occurring in the upper atmosphere. In particular, it will examine recent attempts to link emissions observed by the VIMS instrument on Cassini from Saturn to model atmospheric profiles.

1. Introduction

In two recent papers, Tao and co-workers [1] and Galand and co-workers [2] have looked at different upper atmospheric profiles and the infrared emission that they predict from the H_3^+ molecular ion. These have been carried out for a limited number of profiles. In this paper, we will present a study which allows for temperature variations on a number of recently produced Saturn upper atmosphere profiles.

2. Method

The profiles studied here were produced using a range of electron precipitation energies and fluxes, from 150eV to 10keV. The profiles from these studies were then varied by varying the final exospheric temperature, and then scaling the temperature at any given altitude. Athough this process is not entirely self-consistent – changing the temperature at any given altitude clearly results in changes to the number density of the gas and the scale height as a function of altitude – this represents a first-order variation study.

Using a development of a method first described by Melin and coworkers [3], we have been able to compute the ion column temperature that would have been observed from ground-based observations, as well as the ratios that the Cassini VIMS instrument would measure in H_3^+-sensitive bins. The results show that there can be considerable detail hidden in the simple assignment of column density / column temperature parameters.

3. Results

Sample results from a profile produced by using a flux of 2keV electrons precipitated into a model Saturn neutral atmosphere profile are shown below. For this run, the exospheric temperature (T_{exo}) was set at 484K, and then varied in steps of 10K from 434K to 534K. The resulting ratio of the VIMS 160 (sensitive to the R(3) line of the H_3^+ ν_2 band) and 168 (sensitive to R(1)) bins shows a linear relationship with T_{exo}. Other profiles show similar linearity, although with different slopes.

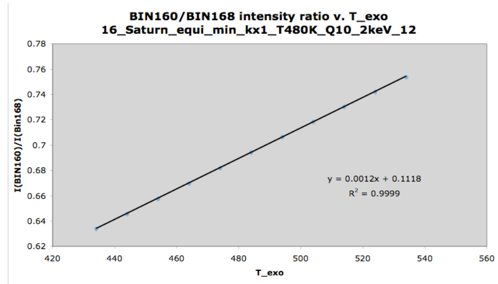

Figure 1: Ratio of intensity in VIMS.

References

[1] Tao C., Badman S.V. and Fujimoto M. U.V. and I.R. emission model for the outer planets: Jupiter and Saturn comparison. Icarus 213, 581-592, 2011.

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