EPSC Abstracts
Vol. 8, EPSC2013-939-1, 2013
European Planetary Science Congress 2013

The peak altitude of H_3^+ auroral emission: comparison with the ultraviolet

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Abstract

The altitude of Saturn's peak auroral emission has previously been measured for specific cases in both the ultraviolet (UV) and the infrared (IR). Gerard et al [2009] concludes that the night side H_2 UV emission is within the range of 800 to 1300 km above the 1-bar pressure surface. However, using colour ratio spectroscopy, Gustin et al [2009] located the emission layer at or above 610 km. Measurements of the infrared auroral altitude was conducted by Stallard et al [2012] on H_3^+ emissions from nine VIMS Cassini images, resulting in a measurement of 1155 ± 25 km above the 1-bar pressure surface. Here we present data analysed in a manner similar to Stallard et al [2012] on the observations of H_3^+ emission in twenty images taken by the Visual Infrared Mapping Spectrometer (VIMS) aboard the spacecraft Cassini from the years 2006, 2008 and 2012. The bins covered were 3.39872, 3.51284, 3.64853, 4.18299 and 4.33280 µm. These observations were selected from a set of 15,000 as they contained a useful alignment of the aurorae on the limb and the body of the planet. The specific conditions that had to be met for each image were as follows; minimum integration time of 75 milliseconds per pixel, minimum number of pixels in the x and y direction of 32, the image must include the latitude range of 70 to 90 degrees for either hemisphere and the sub spacecraft angle must be between 0 and 20 degrees. This alignment allowed for the altitudinal profiles to be analysed in terms of the difference between the latitude of aurorae on the limb and on the body of Saturn; thus permitting an investigation into the effects of misalignment. In this instance, misalignment was defined as the difference between the latitude of the peak emission latitude on the planet and the latitude of the limb; assuming the aurorae to be approximately circular. A statistical study by Badman et al [2011] showed that centre of the oval is on average offset anti sunward of the pole by about 1.6 degrees. To account for this, the acceptable error in misalignment was set to be ± 4 degrees. The accepted error range for the altitudinal profiles was set to ± 250 km.

It was determined that variations in the measured altitude of the aurorae are predominantly shifted by misalignment, though there is also some natural variation. Using a second order polynomial fit, the altitude with zero misalignment is measured at 1215 ± 119 km. Further still, through comparison of the IR and UV altitudinal emission profiles is had been discovered that regardless of the alignment, the Infrared auroral altitudinal profile drops off in intensity much faster and the Ultraviolet counterpart, declining to less than 10% of maximum intensity before reaching an altitude of 2000 km above the 1 bar pressure surface. Further work is currently underway to investigate the implication for the emissive behaviour of H_3^+ with altitude.

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