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Mapping of the Jovian auroral electron energy with HST/STIS observations

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Abstract

The ultraviolet Jovian aurora is produced by the interaction between the H_2 atmosphere and precipitating electrons. Between 1200 and 1700 Å (FUV), the emission is dominated by the Lyman-α line from atomic hydrogen and H_2 vibronic lines from the Lyman (B→X) and Werner (C→X) system bands. The auroral signal is known to interact with the atmosphere through hydrocarbon absorption. Since the level of absorption is very wavelength-dependent, a study of the FUV spectra allows the determination of the altitude of the aurora relative to the hydrocarbon homopause, which is related to the energy of the primary electrons precipitating in the atmosphere. The main absorber, methane, attenuates the auroral emission below 1400 Å and leaves the emission above 1400 Å unabsorbed. This absorption is measured by the color ratio CR=I(1550-1620 Å)/I(1230-1300 Å), thus relating the observed absorption with the energy of the primary electrons creating the aurora.

In the past, observed spectra either covered a very limited portion of the aurora (due to the small size of the aperture projected onto the planet, e.g. Voyager/UVS, HST/GHRS, HST STIS), or integrated the whole polar region without spatial resolution (e.g. FUSE). The ongoing HST/STIS GO 12883 program includes two innovative observations, where the STIS slit in the spectral mode scans the north polar region in the time-tag mode. This technique provides spatially-resolved measurements of the CR for the entire auroral region and is used to map the energy of the precipitating electrons. Preliminary results show that the CR distribution is far from uniform, with regions barely absorbed (e.g. the Io footprint) while others are strongly attenuated (e.g. the main oval morning arc). This anisotropy in the properties of the auroral electrons is a key point for the understanding of the acceleration processes responsible for the aurora, and an important constraint for all ionosphere-magnetosphere coupling models under development.