



## **The strongly bifurcated H<sub>2</sub> electronic emission system in the Saturn atmosphere**

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Image cubes of the Saturn atmosphere and magnetosphere in EUV/FUV spectra obtained using the Cassini Ultraviolet Imaging Spectrograph (UVIS) show the presence of strongly bifurcated H<sub>2</sub> atmospheric electronic band emission features that are both spatially and spectrally separated. The forks are spectrally distinguished as readily isolated non-resonant and multiple strong resonant feature components. The resonant components are inferred to be directly responsible for upper thermosphere mid latitude heating and the observed escape of atomic hydrogen from the top of the thermosphere. The resonance features apparently require solar photon flux catalysis, but the spatial structure of the emission does not correspond to the uniformity of solar input. Spatially non-uniform electro-dynamic processes are evidently necessary to explain the magnitude of the inferred energy deposition. The resonance features do not appear in the aurora. The non-resonant component shows relatively uniform emission at sunlit mid latitudes and strong polar auroral features, resulting in starkly different surface-brightness images. The Cassini UVIS observations show, for the first time, emission from an activated hydrogenic planetary atmosphere displaying apparently independent properties within the same electronic band system. This behavior internal to a single species is made possible in this case because the emission system is homonuclear, allowing exceedingly long lived states to act as independent systems. The fact that this has occurred at Saturn is remarkable, but what is more important is the physical mechanics of the forcing process that appears to be responsible for explaining the long standing problem of high temperatures in giant outer planet upper thermospheres. The energy deposition rate in the upper thermosphere dayglow is 10 to 50 times the auroral rate. The explanation for the forcing of the inferred electrodynamic system will not be simple given the observed structure and temporal variability of the ionosphere. The next step forward is to identify, through the modeling process, the specific states in the H<sub>2</sub> system that are responsible for the observed spectra.