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UV and visible planetary auroral emissions: Jupiter and Saturn

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Abstract

In the giant planets upper atmosphere, collisions of auroral electrons with atmospheric H atoms and H_2 molecules, following acceleration along magnetic field lines, give rise to excitation of these primary neutrals. Excited H and H_2 almost immediately loose part of (~15%) their excess energy through radiative decay processes implying emission of FUV, EUV, NUV and visible light. An observer located near Earth orbit will only see the sunlit portion of the giant planets for which the reflected sunlight outshines a large portion of the hydrogen auroral emissions. Fortunately, the solar spectrum drops by several orders of magnitude in the FUV-EUV bandpass and is further attenuated by low altitude hydrocarbon haze produced in the polar regions. This makes it possible to observe Jupiter and Saturn EUV and FUV auroras from Earth orbit with, for example, the UV cameras onboard the Hubble Space Telescope. These cameras provided numerous fantastic views of Jupiter and Saturn's polar auroral emissions. By contrast, the dimmer NUV and visible auroral emissions cannot compete with the solar light and can only be observed on the night side hemisphere of Jupiter and Saturn; out of visibility from Earth orbit. This region is accessible to in situ spacecraft, like Galileo, Cassini or NewHorizons, which have to share their precious observing time among several different scientific topics. As a result, images of the NUV and visible auroral emissions are rare, in comparison with the huge HST database. Nevertheless, the fact that they are only captured in the night side implies that the origin of the energetic particles that gave rise to them is principally found in the immense magnetospheric tail; a vast region where energetic electromagnetic processes and plasma motions are still poorly documented. This makes these emissions invaluable in terms of scientific return.