



Sprite discharges on Jupiter, Saturn and Venus: Laboratory Experiments in Planetary Gas Mixtures

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Lightning was optically observed on Jupiter and recently on Saturn. Indirect evidence suggests that some electrical activity occurs on Venus. The charge accumulated within the thunderclouds, and the strong electric fields induced by this charge prior (and after) the flash may initiate sprite-like discharges in the planetary atmosphere above the clouds and below the planetary ionosphere [Yair et al., 2009]. Sprites at mesospheric altitudes on Earth have been found to be physically similar to streamer discharges in air at sea level density. Based on this understanding, we investigated possible sprite discharges in the atmospheres of the gas giant planets and on Venus through laboratory experiments on streamers in appropriate CO₂-N₂ and H₂-He mixtures at variable pressures. Streamer diameters, velocities, radiance and overall morphology were investigated, by means of fast ICCD camera images [Dubrovin et al., 2010]. Scaling laws were confirmed by examining minimal diameters of streamers. The spectrum of the discharges was measured and found to be dominated by the minority species N₂ on Venus, and by the radiative dissociation continuum of H₂ in the near UV on the gas giants. The spectrum of a fully developed spark was also measured. The spectrum in the hot plasma discharge (equivalent to lightning) is markedly different from the spectrum created by the cold plasma of the streamers.

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