The vertical profile of the Io footprint in the far-ultraviolet from Juno

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Abstract

The interaction between Io and the Jovian magnetosphere produces the auroral "Io footprint," which can be observed in the ultraviolet thanks to the deexcitation of atmospheric H and H_2 under electron precipitation. Since 2016, Jupiter has been explored with Juno's Ultraviolet Spectrograph, which monitors the emission from 68 to 210 nm. We used Juno observations of the Io footprint near the planetary limb to determine its vertical ultraviolet emission profile. We simulated the UV emission as a function of the altitude and the mean energy of the precipitating electrons, and we used the results to determine the energy spectrum associated with the footprint profile. The results were compared with the in situ measurements from Juno's particle detectors. The main spot emission peaks around ~500 km, with a variability of ~200 km correlated with longitude. The emission of the footprint tail within 20 degrees from the main spot peaks around ~500±300 km, and it is moderately correlated with the magnitude of the magnetic field near Jupiter. The trans-hemispheric electron beam spot is located at ~300 km, and the associated precipitation appears depleted at low energy. The retrieved energy spectrum of the precipitation shows remarkable agreement with the particle measurements. The longitudinal modulation of the Io footprint altitude suggests that the morphology of the torus affects the transmission of the Alfvén waves responsible for the acceleration of auroral electrons. The dependency of the footprint tail altitude on the magnetic field strength indicates that the magnetic field also plays a role in the acceleration mechanism.

Thanks to Juno-UVS spectral capability, we also used the observations of the Io footprint near the planetary limb to measure the distribution of hydrocarbons in Jupiter's ionosphere. Indeed, methane, ethane, ethylene and acetylene absorb UV light produced by the aurora, therefore we used their absorption signature to investigate their distributions and possibly determine the altitude of the hydrocarbon homopause.