



Jovian Lightning-Induced Electromagnetic Waves Observed by the Juno Waves Instrument

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Two new types of lightning induced electromagnetic signals - low dispersion lightning whistlers and discrete dispersed pulses - were observed by the Waves instrument [1] onboard the Juno spacecraft during close approaches of the spacecraft to the planet below radial distances of 5.5 Jovian radii. The detections of these two emissions show evidence on very low density ionosphere at Jupiter.

More than 2500 of lightning whistlers were detected in electric and magnetic field waveform snapshots recorded by the Low Frequency Receiver from August 2016 to May 2018. The whistlers at frequencies from 50 Hz to 20 kHz have unusually low dispersion which can be, in some cases, explained by dispersion calculations based on existing models of ionospheric plasma density and magnetic field. Some observations, however, indicate low ionospheric density regions predominantly occurring in the northern hemisphere at latitudes between 20° and 70°. We detect peak occurrence rates of more than four whistlers per second, with an average rate of one whistler per second at midlatitudes, similar to thunderstorms at Earth [2]. Additionally, we estimated the whistler propagation distance below ionosphere to be typically one to several thousand kilometers but with a possibility of no sub-ionospheric propagation [3].

We have also found nearly five hundred unusual discrete dispersed pulses in electric field waveform snapshots at millisecond time scales. They were collected by the Low Frequency Receiver between 10 kHz and 150 kHz from August 2016 to October 2017. We propose that these Jupiter dispersed pulses (JDPs) propagate in the free space left-hand ordinary mode. Based on the dispersion and on the cutoff frequency of detected pulses we estimated plasma densities and lengths of plasma irregularities along the line of propagation of JDPs from lightning to Juno. Our findings imply existence of very low density holes ($\leq 250 \text{ cm}^{-3}$) in the night-side ionosphere.

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