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Juno/Waves Observations of flux tubes connected to Io's orbit

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Abstract

During each perijove pass, the Juno spacecraft crosses magnetic flux tubes connected to Io's orbit at least once in each hemisphere. The Waves instrument onboard detects a variety of plasma wave emissions characteristic of the coupling between Io and Jupiter's ionosphere. These emissions have a clear upper frequency cutoff, understood to be the electron plasma frequency, thus making the electron number density calculable. Cutoffs related to other fundamental plasma frequencies are also visible. Interestingly, the ultra-high magnetic field of Jupiter makes lower frequencies in the ion and possibly Aflvénic range measurable, and provides a new view of the structure of moon-ionosphere plasma waves. Further, the total power in the plasma waves is roughly equally partitioned between the electric and magnetic components, confirming their electromagnetic nature. This offers clues to the beam speeds at play to sustain the coupling. We present such plasma wave observations pertaining to Io flux tubes and discuss their dependence with longitudinal separation (i.e. distance downtail), as well as distance from the moon. We also examine the physics of wave mode propagation and the relative contributions of particles (electrons, protons, possibly heavies) in generating plasma wave instabilities within their corresponding frequency ranges.