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# Observations of the Io Plasma Torus with Juno radio science experiment

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The volcanic eruptions of Io launch ionized particles with a velocity high enough to start orbiting around Jupiter, where they interact with the strong Jovian magnetic field. The result is the Io Plasma Torus (IPT), a toroidal cloud of plasma, centered on the centrifugal equator of Jupiter at Io's orbital distance.
Juno is currently orbiting Jupiter in a highly eccentric, 53.5-day orbit, with a perijove altitude of about 4000 km. During each perijove pass, Doppler measurements between Juno and the Earth are acquired for about eight hours centered around Jupiter's closest approach, to estimate the Jupiter gravity field and constrain its interior structure.
Due to the orbital geometry, around each perijove Juno is occulted by the IPT as seen from Earth, so that the radio signal is affected by the charged particles of the torus, yielding a non-dynamical Doppler shift, that, if not properly calibrated, can be a potential source of bias in the Jupiter estimated gravity field coefficients.
The Juno gravity science instrument comprehends a Ka-band Translator System (KaTS), contributed by the Italian Space Agency, which provides a coherent two-way Ka/Ka link (34-32 GHz). The Ka-band link is less affected by dispersive media effects, allowing to reach an end-to-end noise level on two-way range rate measurements of 3 $\mu$m/s over a time scale of 1000 s, and to reduce the Doppler shift induced by the IPT to negligible values.
In addition, the Juno spacecraft telecommunications subsystem supports a standard two-way X/X (7.2-8.4 GHz) link. During the perijove passes dedicated to gravity investigations a dual-frequency link at X and Ka band allows a 75% calibration of dispersive noise in range rate measurements with respect to the Ka band. Moreover, this allows to extract the integrated path delay due to dispersive media, including the one due to the IPT.
However, the discovery of a frequency-dependent instrumental effect prevented the successful application of the dual-frequency calibration procedure. This effect was recently identified and successfully corrected, allowing to extract the Total Electron Content (TEC) of the IPT along the line-of-sight.
Here, we report about the methods adopted in the data analysis and the TEC profiles measured during the Juno passes available to date.