Plasma Torus & Plasma Disk

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Io Plasma torus Total mass ~ 2 Mton Source @ ~1 ton/s ~3 x 10²⁸ ions/s replaced in 23 days



Torus: Things that are pretty clear...

- 1. Plasma production 500-1500 kg/s
- 2. Source composition O/S^2 (SO₂)
- 3. Density profile $ne^{2000} \text{ cm}^{-3} (R/6)^{-8}$
- 4. 1+3 means Vr<10 km/s until 15-25 RJ
- 5. Transport ~1000 hours from 6-10 RJ *that's 100 Jupiter spins...*
- 6. Density varies by factor ~1.5 at most



Torus: Things that are pretty clear...

- 1. System III modulation
 - S⁺⁺⁺/S⁺ by factor ~5
 - <1% of electrons at ~100eV</p>
 - 30% variation in these hot electrons
- 2. System IV modulation
 - 40% variation in hot electrons with 1.5% subcorotation
- 3. Weak current systems generate hot electrons

Sheet: Things that are pretty clear...

- 1. Ion composition of plasma sheet is consistent with torus composition
- 2. Beyond ~15 RJ the plasma sheet becomes increasingly non-uniform & dynamic
 - cold, dense blobs
 - perturbations in flows

Major Questions – Plasma Sheet

- 1. Plasma heats as it moves out HOW??!!
 - We need testable theories
- 2. Hot (10s keV) plasma different composition to thermal why?
- 3. Protons ~10% of plasma
 - Ionosphere vs. solar wind source(s)?
- 4. How does variable plasma sheet relate to variable main aurora?

In the works...

- Survey of Galileo PLS (& some PWS) data submitted
 - 10-30 RJ there is no persistent System III or Local Time variations
- 2. Re-analysis of Voyager PLS
 - Cold, dense blobs same composition as torus
 - Survey of protons ~10% of density
- 3. Re-analysis fo Voyager UVS
 - Torus composition consistent with Cassini flyby observations with source O/S~2

Complementary to Juno

- Juno JADE, JEDI, WAVES data >10 RJ
- Torus emissions provide plasma conditions in the warm torus – Ne, Te, Ti
- Hisaki/EXCEED key for sulfur ions
 S⁺: S⁺⁺: S⁺⁺⁺
- Ground-based APO observations provide O⁺: S⁺: S⁺⁺