Unveiling the effects of the Galilean moons on whistler mode waves and energetic particles at Jupiter

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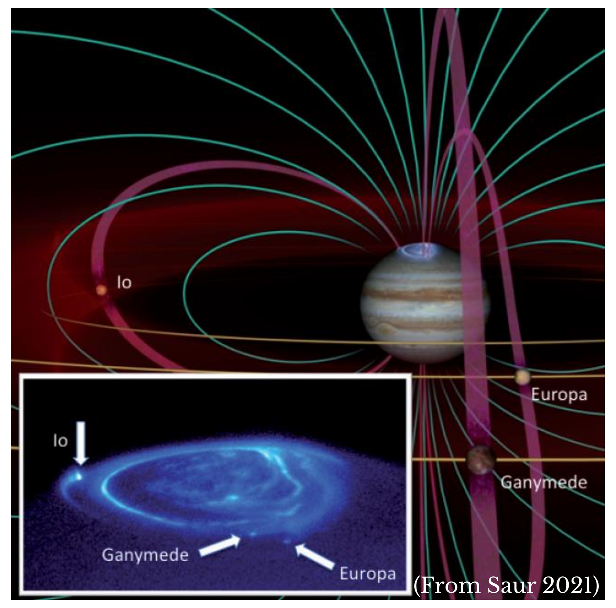
Background



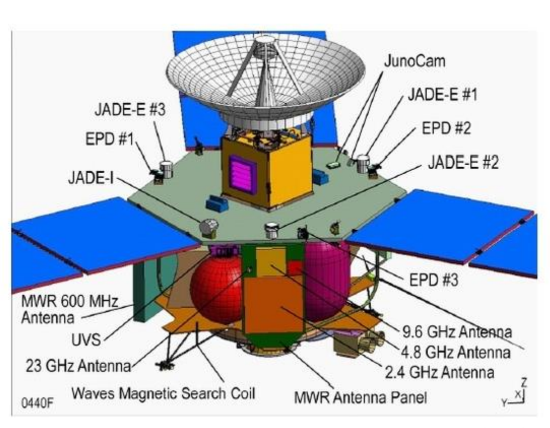
(From Saur 2021)

- The interactions between the Galilean moons and plasma torus in Jupiter's equatorial region cause instabilities that generate plasma wave growth
- Whistler mode waves have been observed to propagate along flux tubes, accelerating particles along magnetic field lines connecting the Galilean moons to Jupiter's auroral region
- Auroral emission at the base of each moon's flux tube indicates that the moons play a role in M-I coupling and energy transport throughout the Jovian magnetosphere

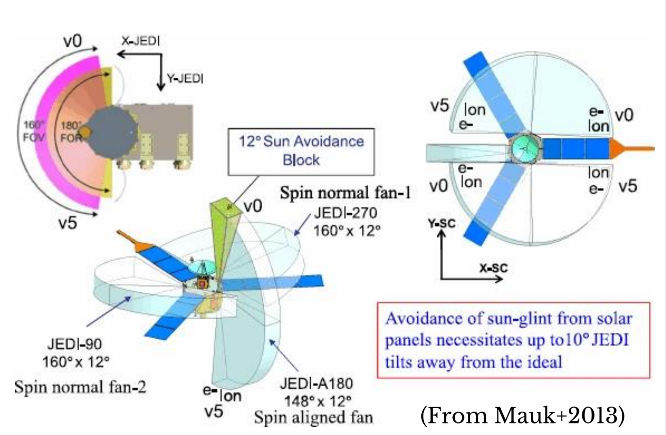
Goal: To identify times when Juno crosses the flux tubes of Io, Europa, and Ganymede and quantify how whistler mode wave amplitude and electron flux depend on latitude, M-shell, and distance from flux tube.

Juno Instrumentation

- The Juno spacecraft has collected particle data (JEDI and JADE instruments) and plasma wave data (WAVES instrument) from a highly eccentric orbit around Jupiter from 2016-present:
  - JEDI: 3 fans (160° × 12° view); 20-1000 keV electrons at 1s-res
  - JADE: 3 fans (90° × 10° view); 0.1-50 keV electrons at 1s-res
  - WAVES: EM waves (50 Hz – 20 kHz) at 1s-res
- Throughout the mission, there have been many close fly-by passes and flux tube crossings between the spacecraft and the inner three Galilean moons
- By analyzing the particle and waves measurements during these passes, we can quantify the effects of the Galilean moons on wave activity and particle transport in the Jovian magnetosphere



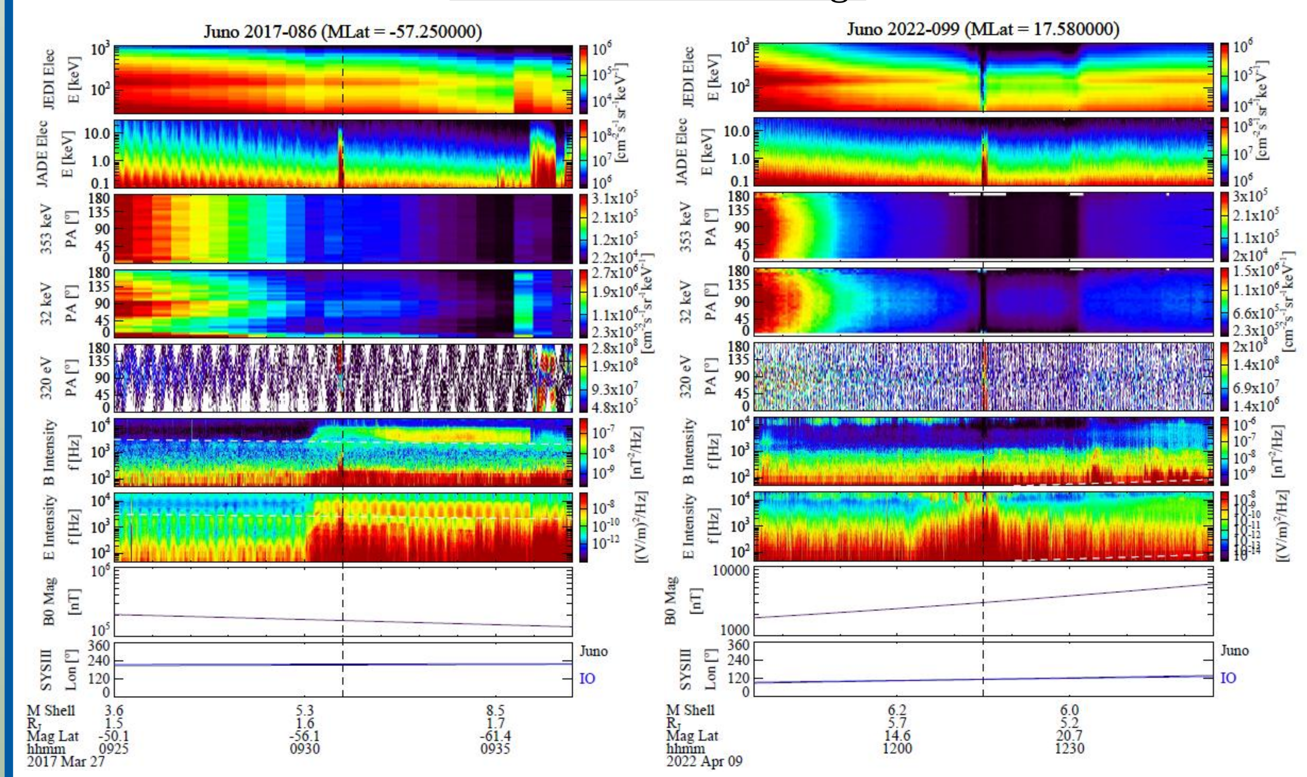
(From NASA/JPL/Caltech)



(From Mauk+2013)

Events Study

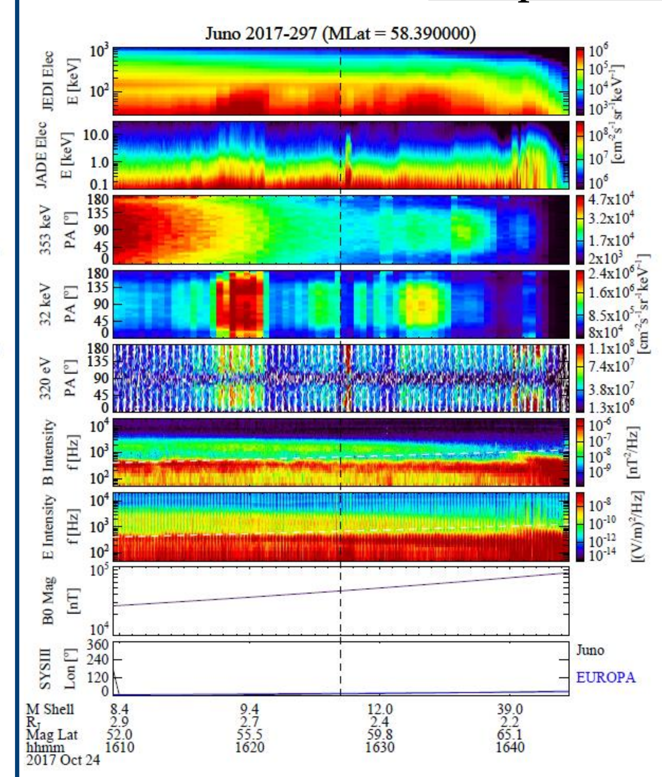
Io Flux Tube Crossings



FT Crossing Events:

1. 9:31 UT on March 27, 2017
   - Enhancement in low energy electrons (no dropout at high energies)
   - Whistler mode wave activity begins __ M-shells before main flux tube; B_{RMS} = ____
   - M-shell extent of flux tube: ΔM = 0.09
2. 12:15 UT on April 09, 2022
   - Enhancement in low energy electrons (dropout at higher energies)
   - Electrostatic wave activity at main flux tube; slight decrease in whistler mode wave magnetic amplitude; B_{RMS} = ____
   - M-shell Extent of flux tube: ΔM = ____

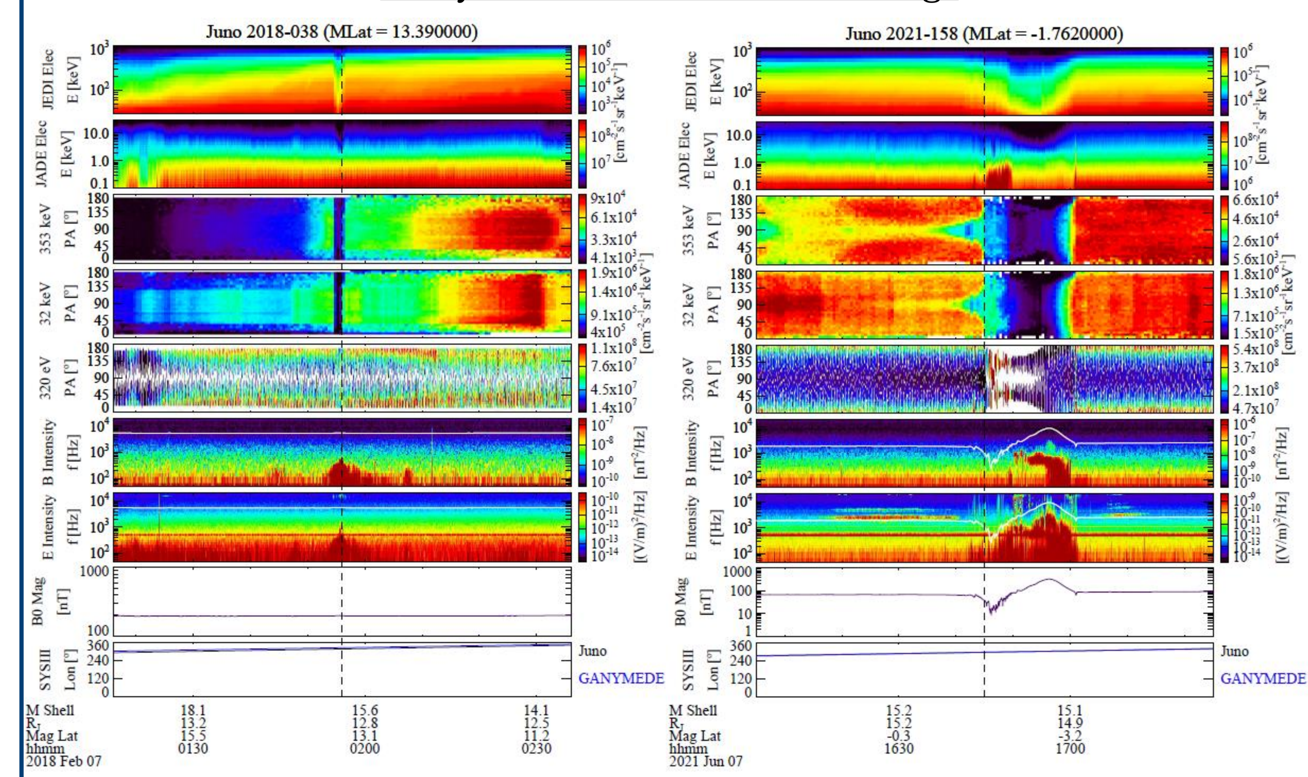
Europa Flux Tube Crossings



FT Crossing Events:

1. 16:27 UT on October 24, 2017
   - Injection of ~32 keV electrons preceding main flux tube
   - No distinct change in whistler mode wave activity throughout flux tube crossing
   - M-shell extent of flux tube: ΔM = ____
2. __:__ UT on September 29, 2022 (Europa Fly-by)
   - [ADD INFO]
   - M-shell extent of flux tube: ____

Ganymede Flux Tube Crossings

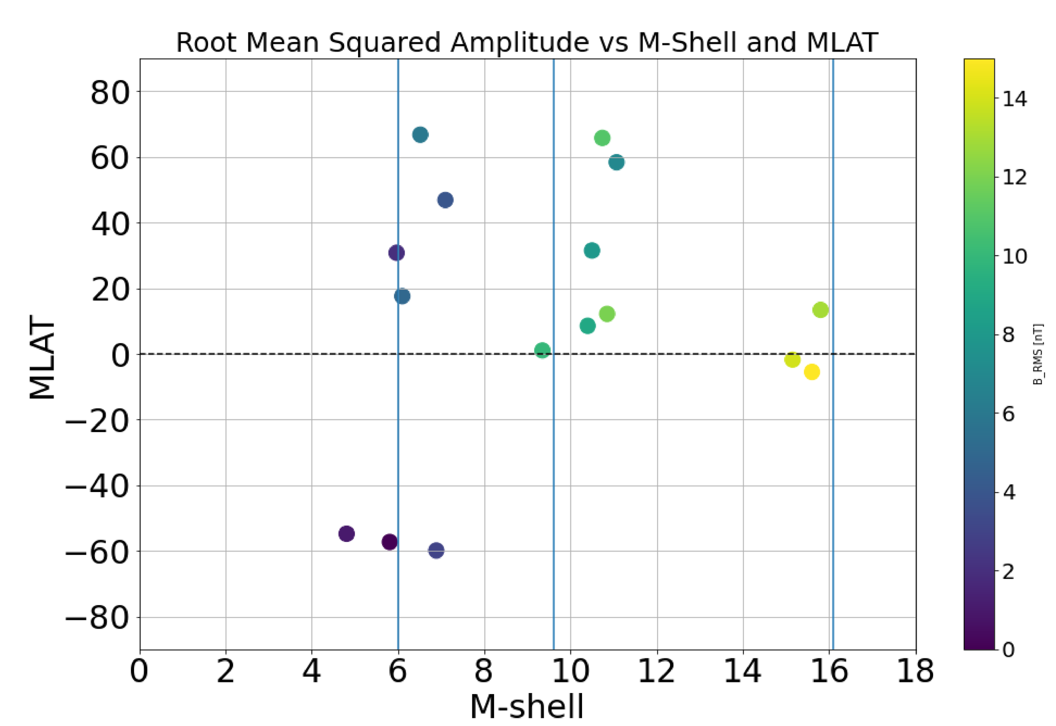


FT Crossing Events:

1. 1:56 UT on February 7, 2018
   - Dropout in both high and low energy electrons during flux tube crossing
   - Intensification of whistler mode wave activity during flux tube crossing ; B_{RMS} = ____
   - M-shell extent of flux tube: ΔM = ____
2. 16:45 ET on June 7, 2021 (Ganymede Fly-by)
   - [ADD INFO]
   - M-shell extent of flux tube: ____

Statistical Analysis

- [ADD INFO]



Conclusions

- [ADD INFO]