A statistical study of the Moon's magnetotail plasma environment

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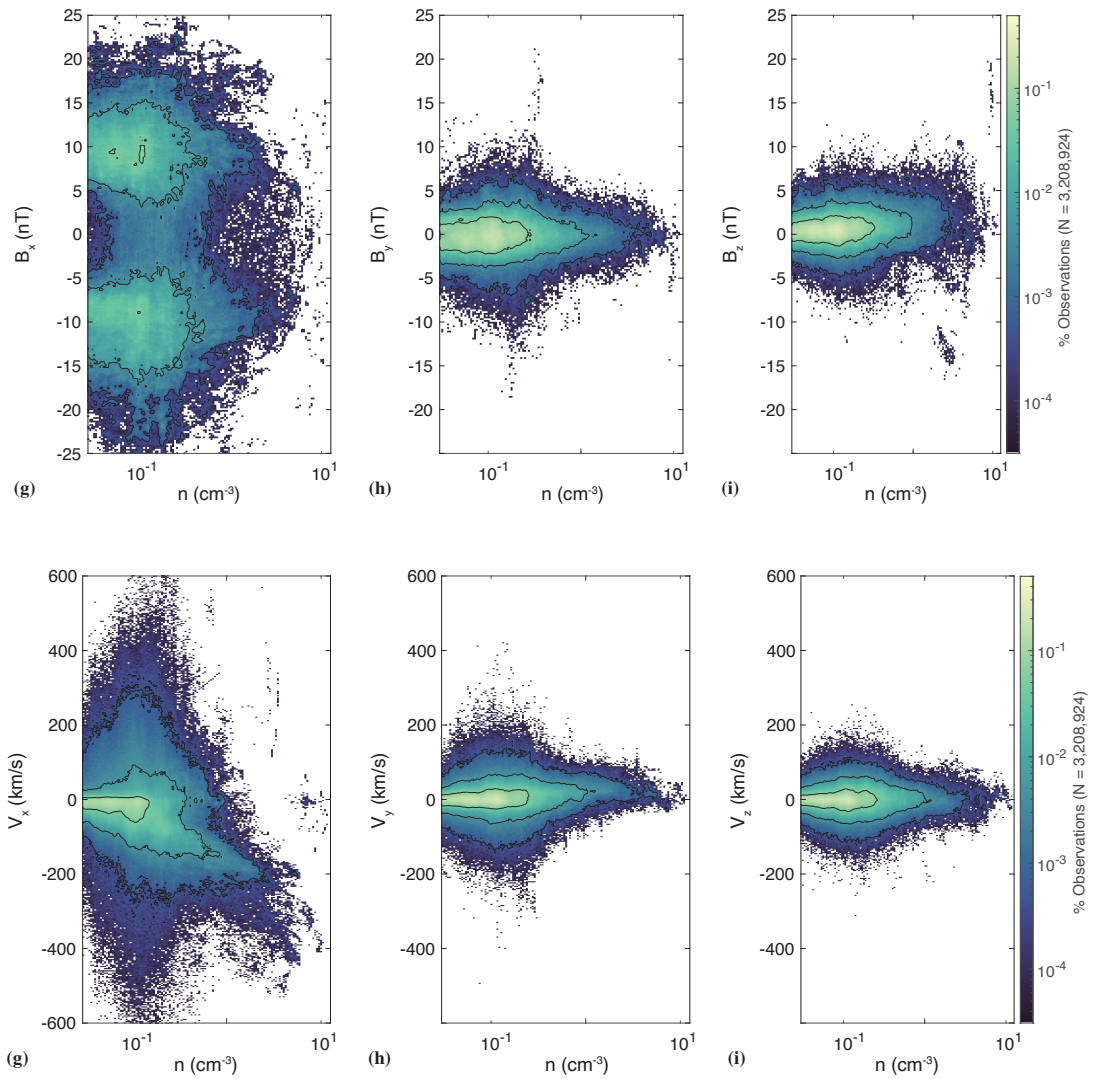
What are the average properties of the magnetotail plasma?

- 10 years of ARTEMIS data (late 2011-2021): 126 tail crossings per probe
- Separate plasma into three regions:
  - Magnetosheath
  - Magnetotail lobes
  - Magnetotail plasma sheet
- Investigate statistical parameters of the magnetotail environment
- Here: magnetotail *lobes*, but full publication has much more!
  - L. Liuzzo, A.R. Poppe, and J.S. Halekas, A statistical study of the Moon's magnetotail plasma environment, *JGR Space* (submitted)

Distributions of magnetic field & velocity vs. density

- **Heatmaps of the distributions:**
  - % of time ARTEMIS detected a given value set
  - ~3 million "lobe-like" measurements out of >40 million total (over the mission)
- **B vs. n_e**
  - B_x forms two-peaked structure (N & S lobes), peaks near ±10 nT
  - B_y, B_z near 0 nT
  - Lobes characterized by low densities ($\lesssim 0.1$ cm^{-3})
- **V vs. n_e**
  - Velocities on average centered around 0 km/s
  - High-velocity flows (near $n \approx 0.1$ cm^{-3}) may indicate reconnection passing the probes



Dimensionless parameters: M_A vs. β

- Clear separation between sheath, lobes, and plasma sheet
- Comparison to outer planet moons:
  - Unique magnetosheath plasma
  - Lobes and plasma sheet resemble outer planet moon environments
- Use ARTEMIS data as a proxy for outer planet moon environments?
  - Different obstacles (dense atmospheres, magnetic fields)
  - Different magnetospheric dynamics (corotating plasma, neutral density sources)