Juno satellite flux tube crossings

http://lasp.colorado.edu/home/mop/missions/juno/trajectory-information/

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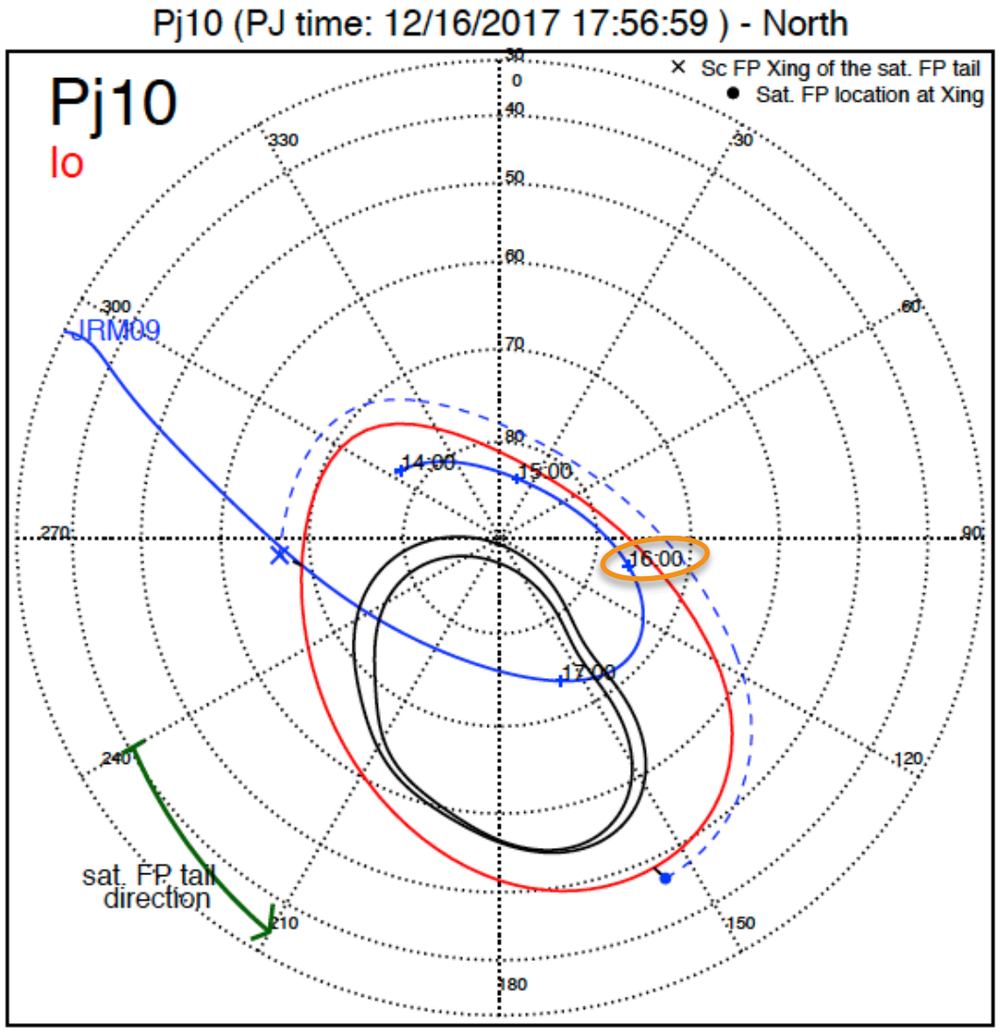
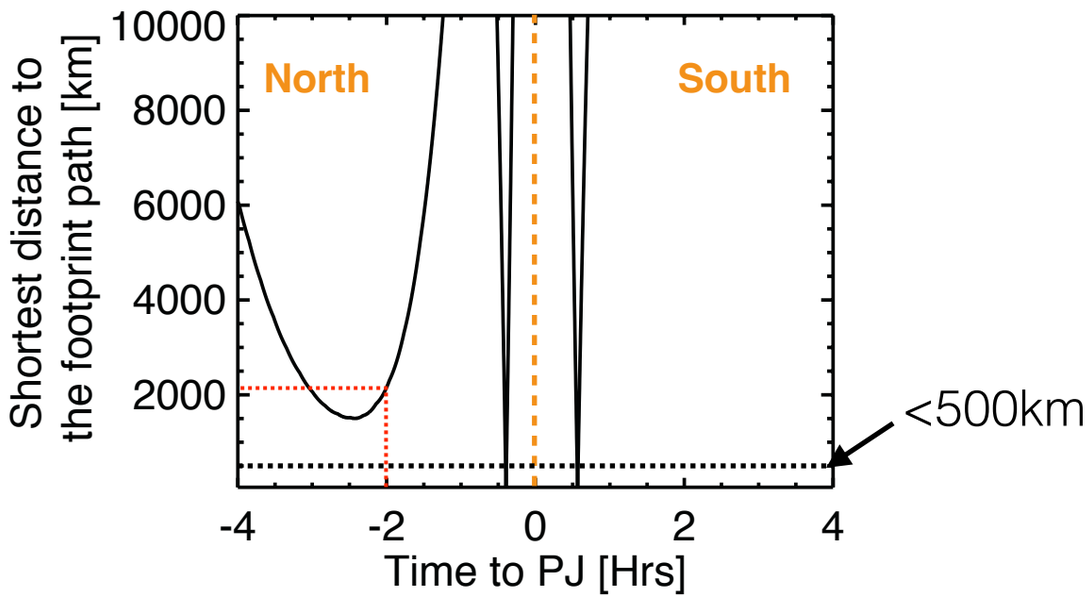
Calculating the flux tube crossing times

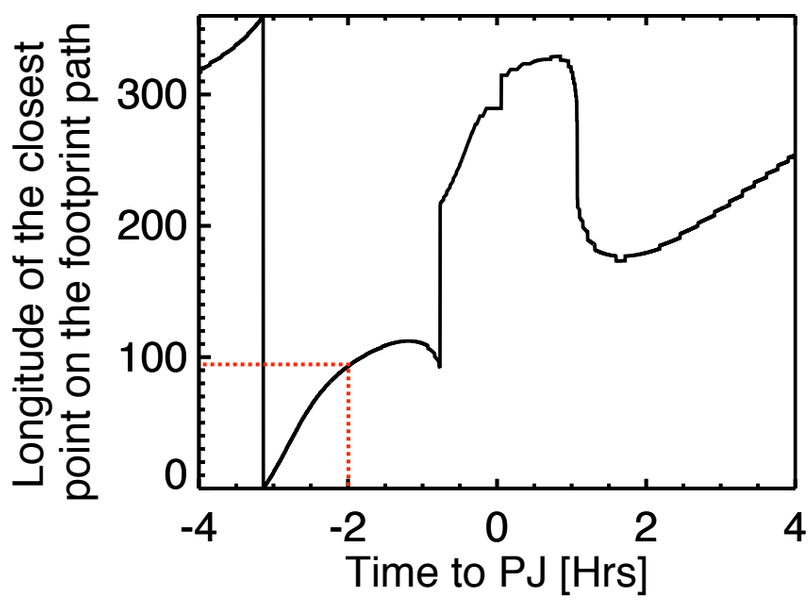


- Use of Masafumi's magnetic footprint data (http://www-pw.physics.uiowa.edu/juno/mwg/hdf5/)
- Use the instantaneous footprint positions (no Alfvén travel time)
- Use a 0.07 sec resolution over the -6:+6 hrs about PJ, calculate the closest points on the footprint path

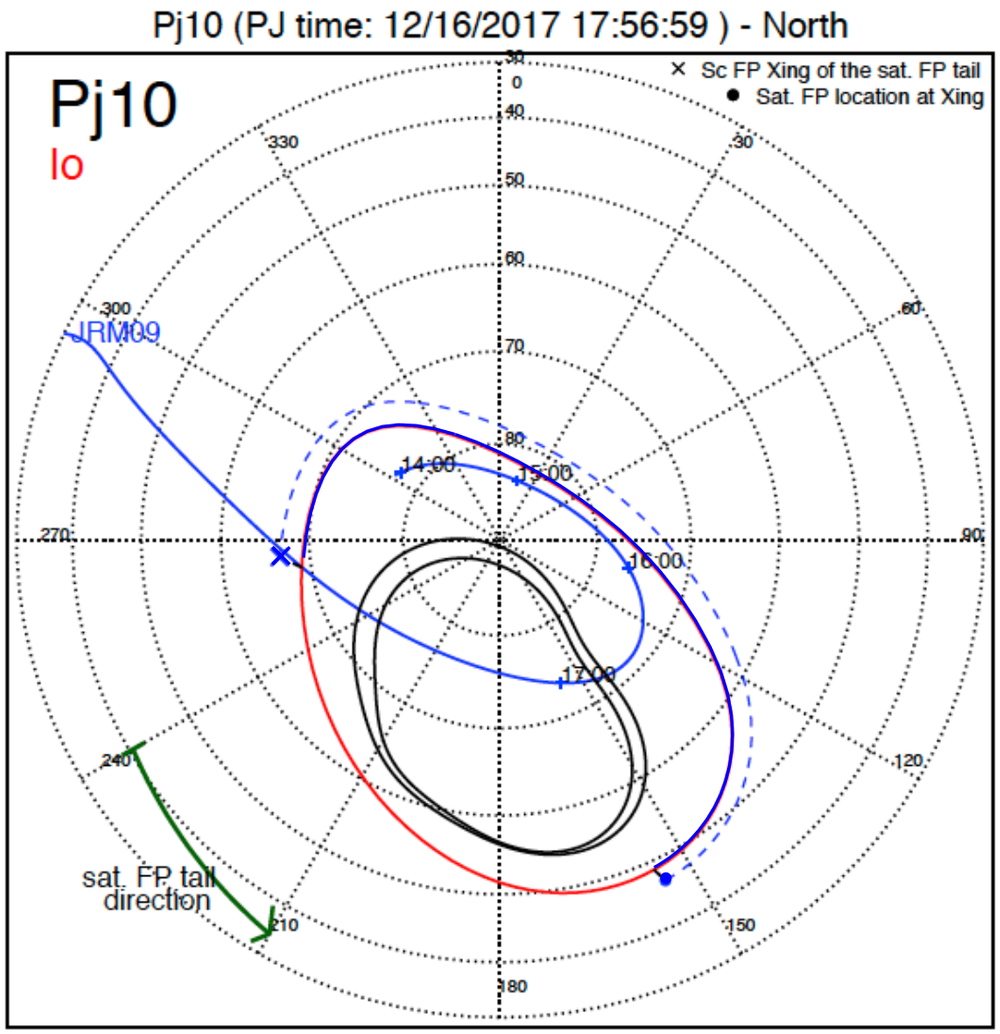
- E.g., at 16:00 (~2 hrs before PJ):
  - longitude of the closest point on the FP path: ~95˚
  - shortest distance: ~2000km

- Crossings are defined when the distance to the FP path is <500km





Spreadsheet of flux tube crossings

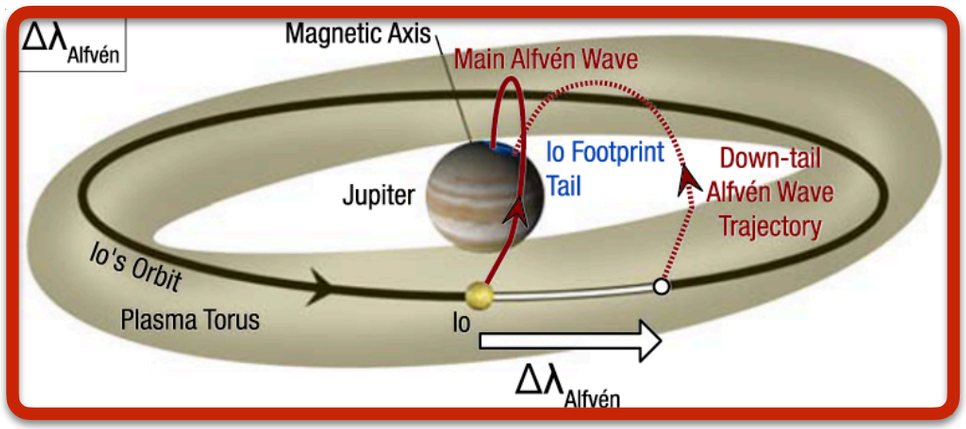


- **Xing distance down the tail [km]**: integrated distance from the instantaneous satellite footprint position up to the crossing location

- **Delta Io Alfvén AVG**: Alfvén angle defined after Szalay et al. (2020):
  - ➡ Angular separation in the moon orbital plane between the moon and an Alfvén wave trajectory back-traced from Juno's footprint
  - ➡ Alfvén angle revised and extended for the other satellites (Io, Europa, and Ganymede) by Hue et al. (2023)

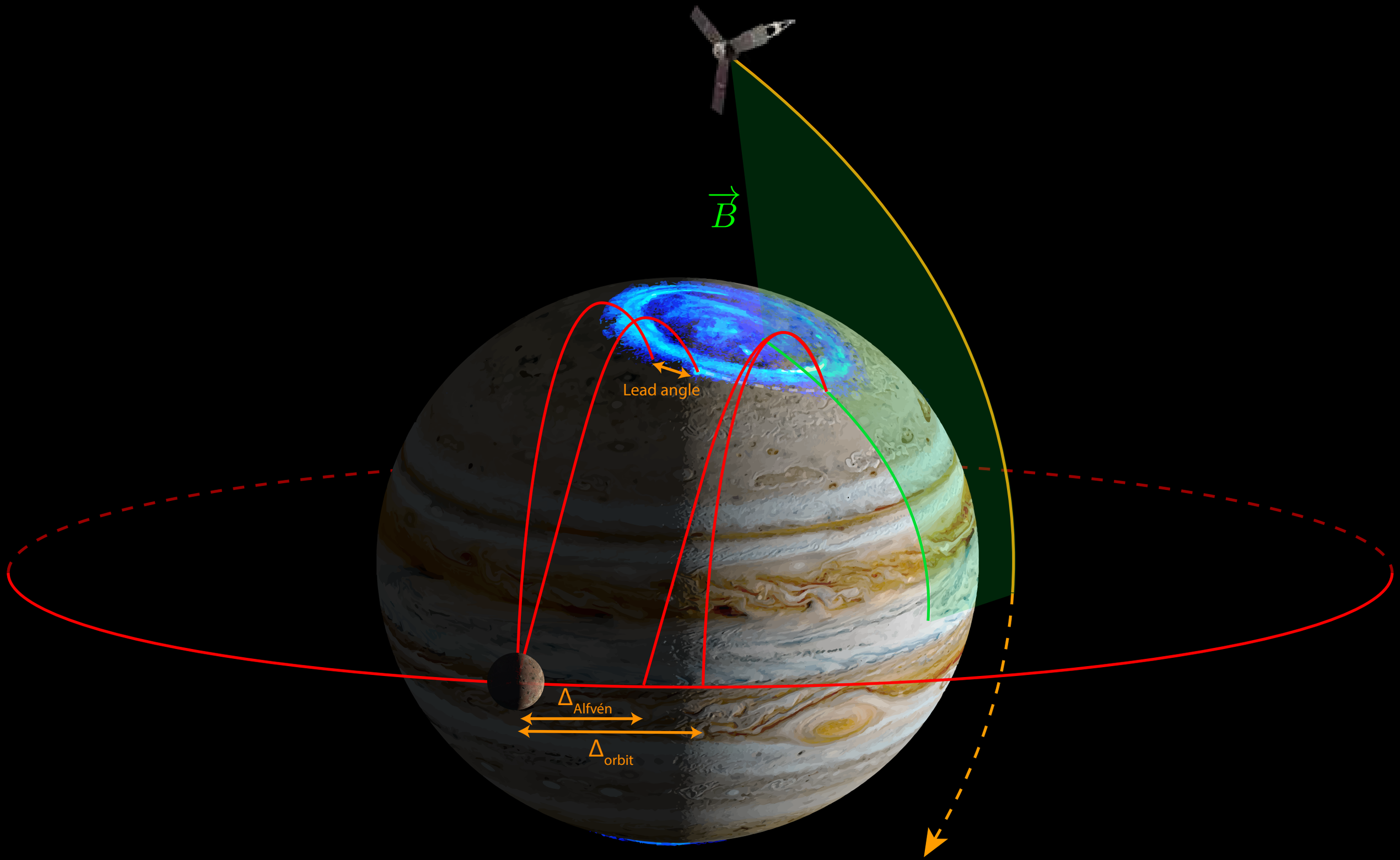
- **Delta Io Alfvén PJ**:
  - ➡ Essentially the same as “Delta Io Alfvén AVG” except that the equatorial lead angle accounted for in the calculation corresponds to the one measured by UVS at the PJ of interest. When no data was available, it reads “N/A”

- **Delta Io orbit**: Angle calculated in the orbital plane of the moons between the moon and Juno's footprint magnetically mapped to the orbital plane of the moon (See Szalay et al. 2020, and Hue et al. 2023)



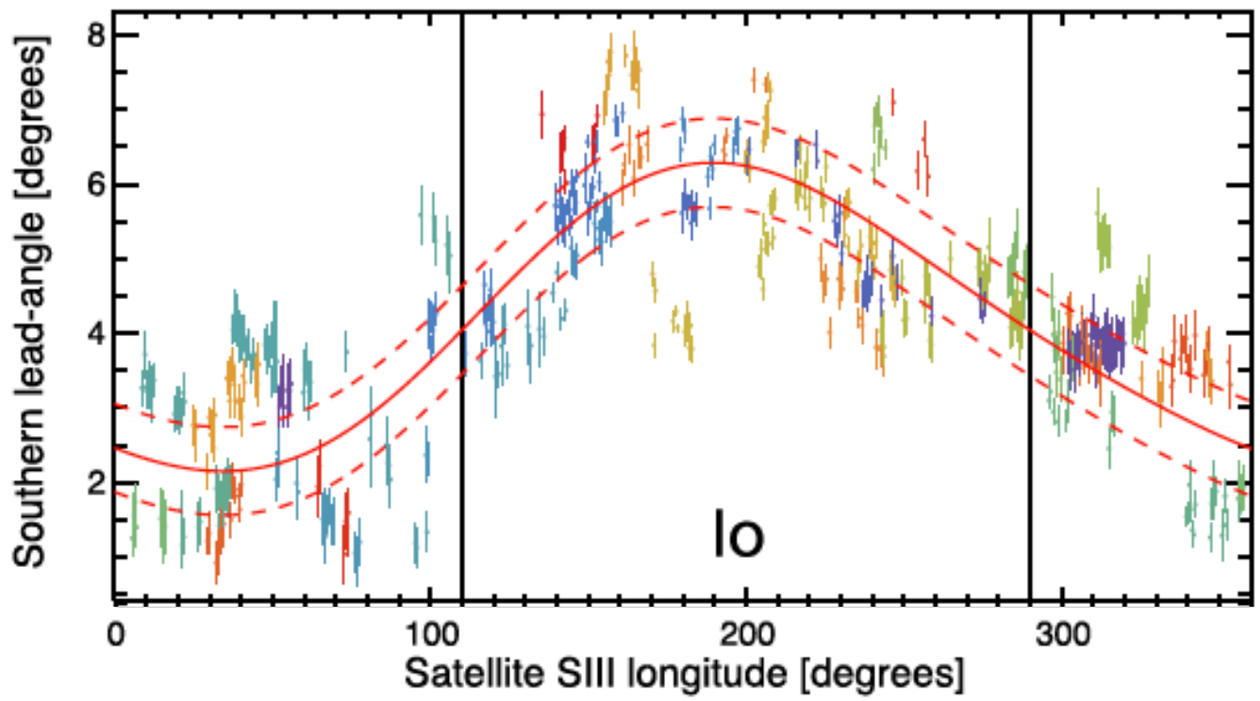
Szalay et al. (2020)

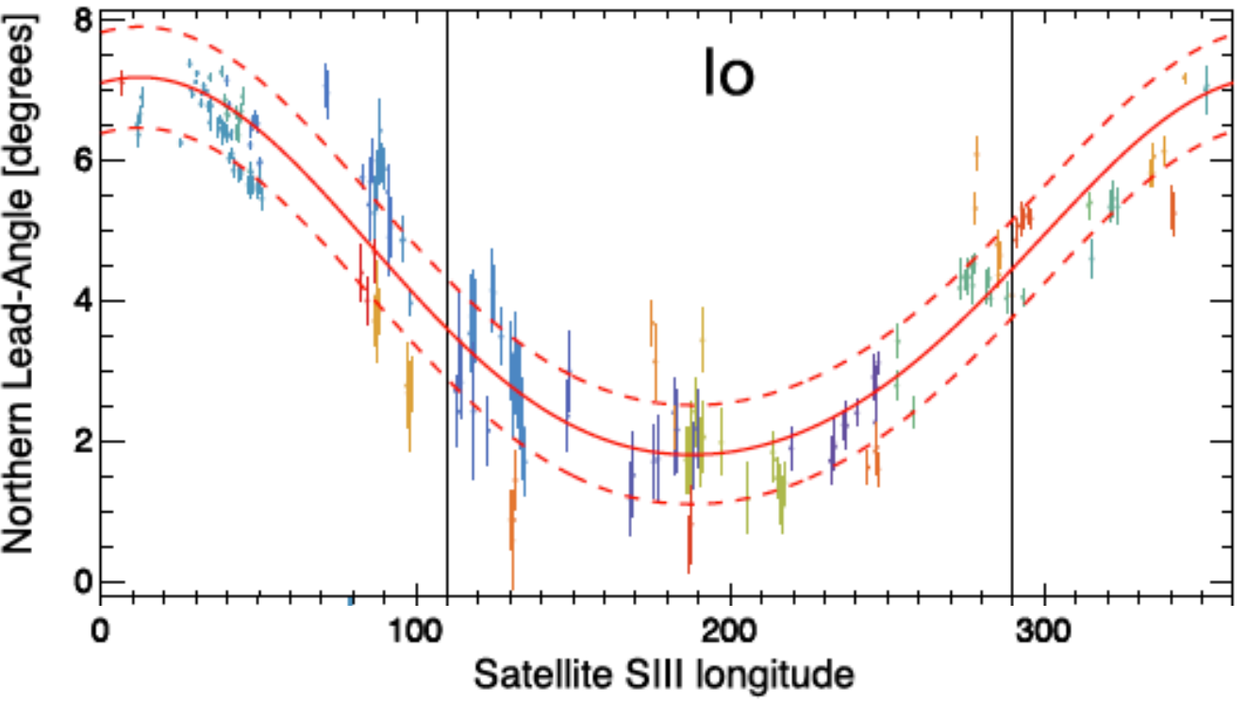
PJ	Moon	Xing time (UTC)	Xing time (ET)	Xing distance down the tail [km]	Delta Io Alfven AVG	Delta Io Alfven PJ	Delta Io orbit	Sc Altitude [km]	Duration Xing [s]	Mag. Model	Hemisphere	SC Mapping
Pj10	Io	2017-12-16T17:33:02	566717652	42563.7	204.7	204.46	208.4	27045.7	30.2	JRM33	North	JunoFoot_Ext_PJ10_20220614_all.hdf5



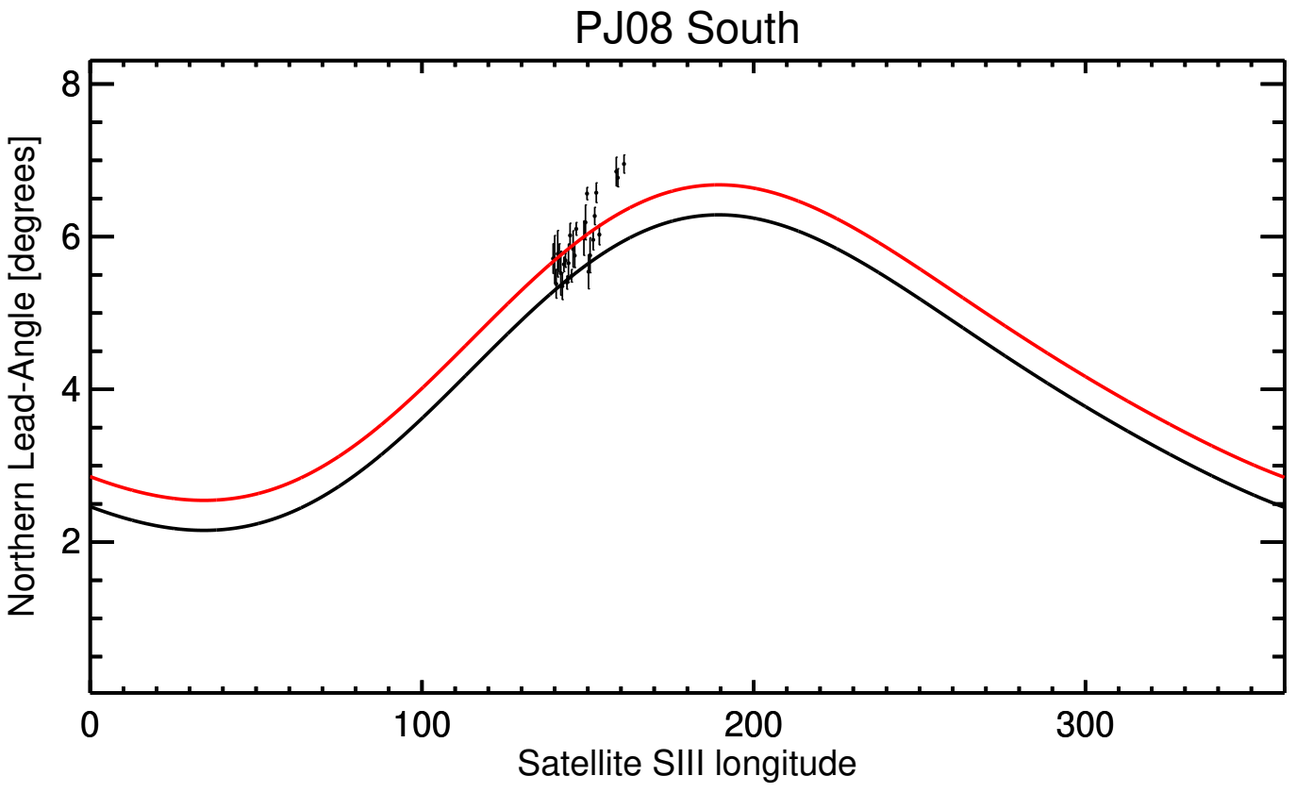
$\Delta_{Alfvén} = \Delta_{orbit}$ - Equatorial Lead Angle

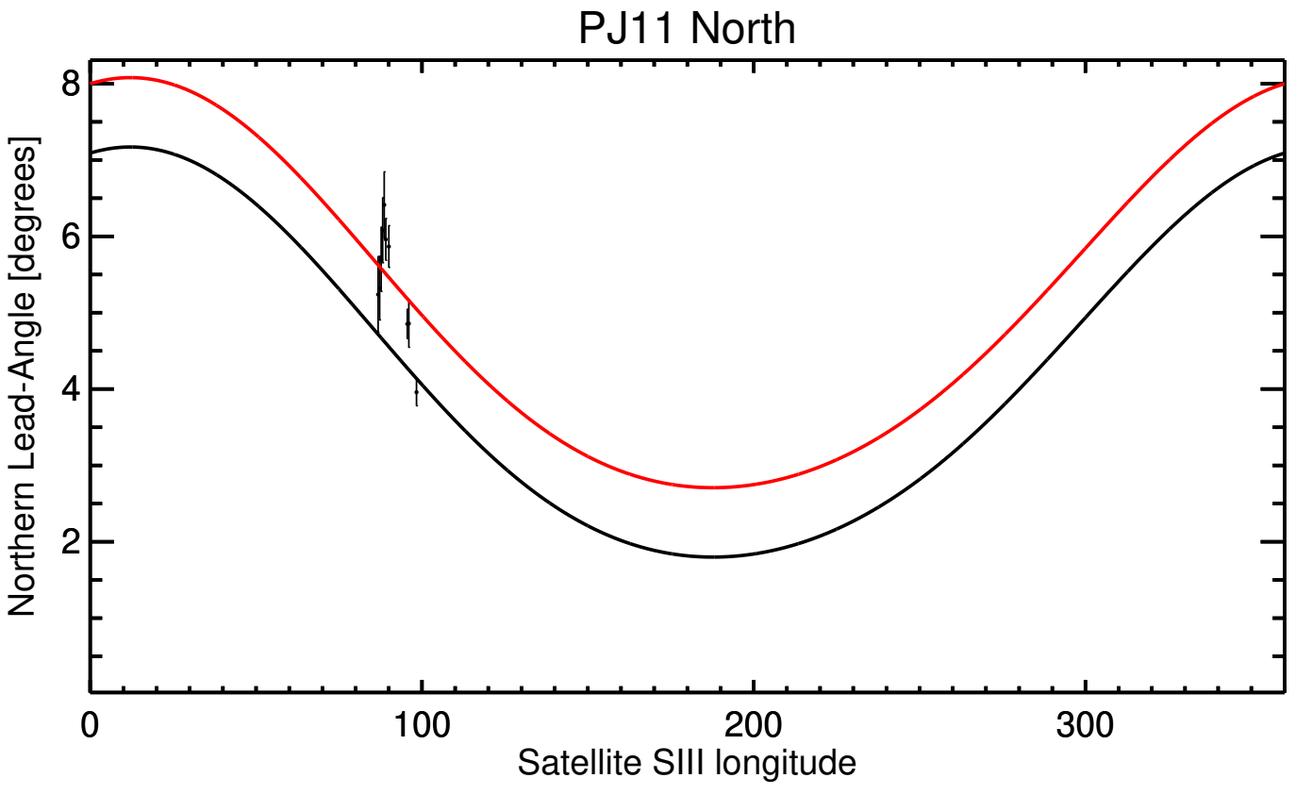
Average lead angle
(Derived from many Juno-UVS
MAW observations)





PJ-measured lead angle
(Rescaling the averaged lead angle
on a single PJ Juno-UVS dataset)





References

- Szalay, J. R., Allegrini, F., Bagenal, F., Bolton, S. J., Bonfond, B., Clark, G., et al. (2020b). A new framework to explain changes in Io's footprint tail electron fluxes. Geophysical Research Letters, 47(18), e89267. https://doi.org/10.1029/2020GL089267

- Hue, V., Gladstone, G. R., Louis, C. K., Greathouse, T. K., Bonfond, B., Szalay, J. R., et al. (2023). The Io, Europa, and Ganymede auroral footprints at Jupiter in the ultraviolet: Positions and equatorial lead angles. Journal of Geophysical Research: Space Physics, 128, e2023JA031363. https://doi.org/10.1029/2023JA031363