

Juno OPAG REPORT

Turbulence near GRS July 21, 2019: PJ21



Scott Bolton
OPAG
Aug, 2019

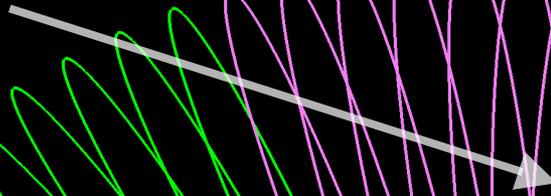
Images: NASA/JPL-Caltech/SwRI/MSSS Juno perijove 21 2019-07-21 Image processing: Björn Jónsson Map-projected

Image Credit : NASA / JPL-Caltech / SwRI / MSSS / Björn Jónsson © CC NC SA

- Spacecraft is healthy and all instruments are working. No indication of radiation issues.
- Juno prime mission operations nominally ends July 2021 (planetary protection de-orbit).
- Extended mission review tentatively in late 2020.
- Participating Scientist review/selection completed and PS are integrating as full Juno Science Teams members.

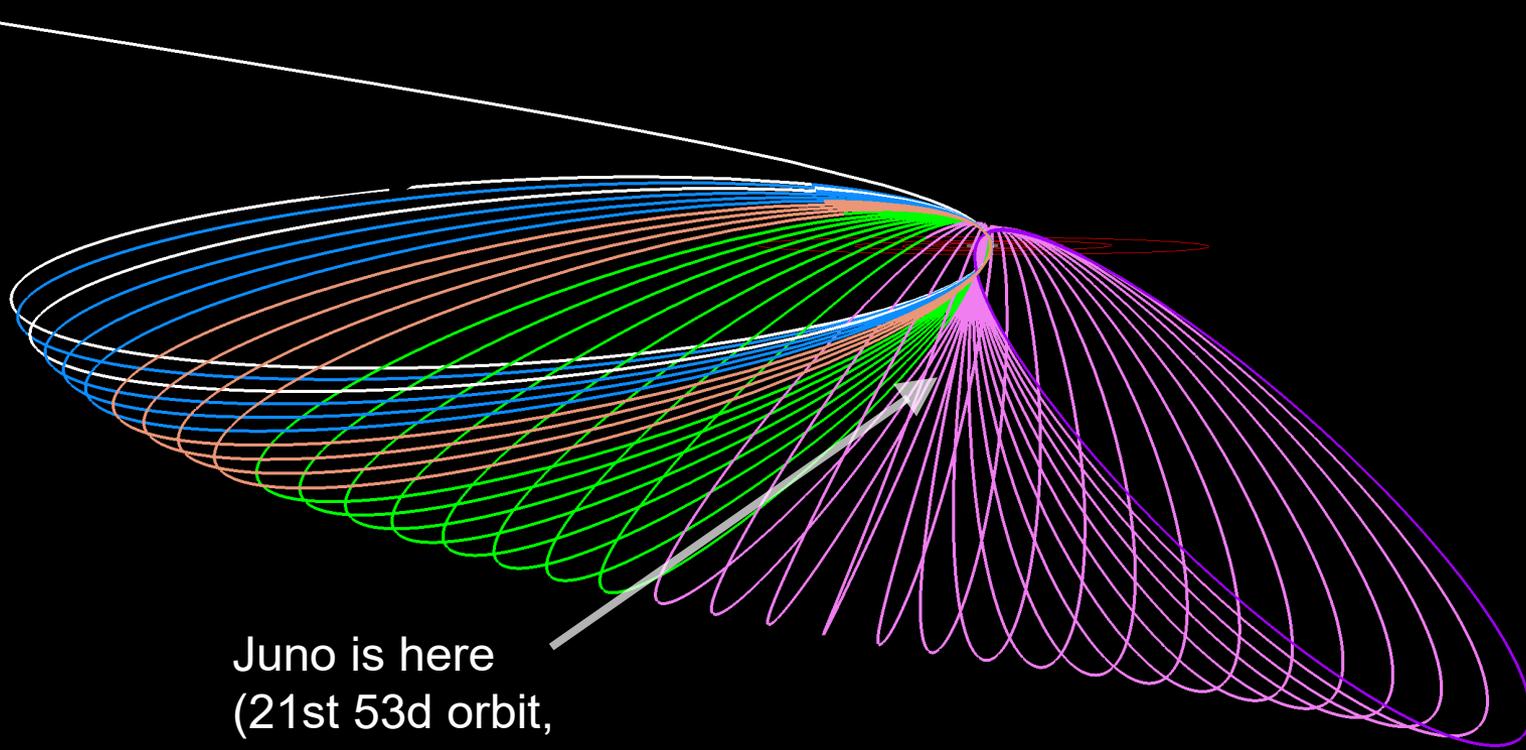
53-day Orbits

Juno is here
(21st 53d orbit,
~PJ21)



Jupiter North Pole view,
Sun direction fixed (down)

53-day Orbits



Juno is here
(21st 53d orbit,
~PJ21)

View from Sun

Orbit #	PJ date	
PJ1	08/27/16	✓
PJ2	10/19/16	X
PJ3	12/11/16	✓
PJ4	02/02/17	✓
PJ5	03/27/17	✓
PJ6	05/19/17	✓
PJ7	07/11/17	✓
PJ8	09/01/17	✓
PJ9	10/24/17	✓
PJ10	12/16/17	✓
PJ11	02/07/18	✓
PJ12	04/01/18	✓
PJ13	05/24/18	✓
PJ14	07/16/18	✓
PJ15	09/07/18	✓
PJ16	10/29/18	✓
PJ17	12/21/18	✓
PJ18	02/12/19	✓
PJ19	04/06/19	✓
PJ20	05/29/19	✓
PJ21	07/21/19	✓
PJ22	09/12/19	✓
PJ23	11/03/19	✓
PJ24	12/26/19	✓
PJ25	02/17/20	✓
PJ26	04/10/20	✓
PJ27	06/02/20	✓
PJ28	07/25/20	✓
PJ29	09/16/20	✓
PJ30	11/08/20	✓
PJ31	12/30/20	✓
PJ32	02/21/21	✓
PJ33	04/15/21	✓
PJ34	06/07/21	✓
PJ35	07/30/21	✓

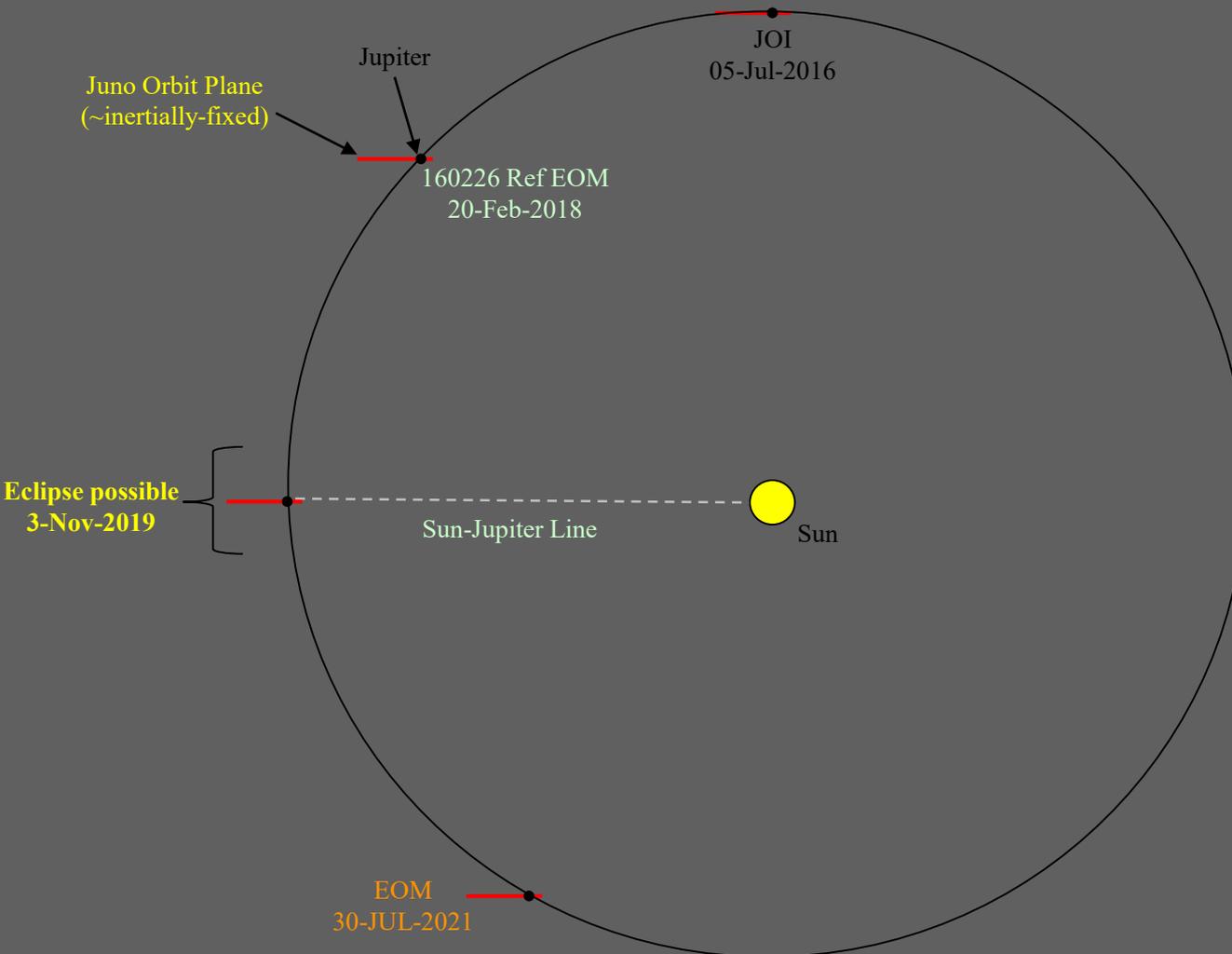


Juno will jump eclipse in November

Eclipse maneuver is Sept 30, 2019



Jupiter orbital period = 11.9 years



Original 14-day orbit mission ended before Juno/Jupiter approached 'Eclipse' season

Current 53-day orbit mission extends through 'Eclipse' season

Plan to avoid eclipse entirely by passing on either side of the penumbral cone prior to two successive perijove passes (PJ-22 & PJ-23)

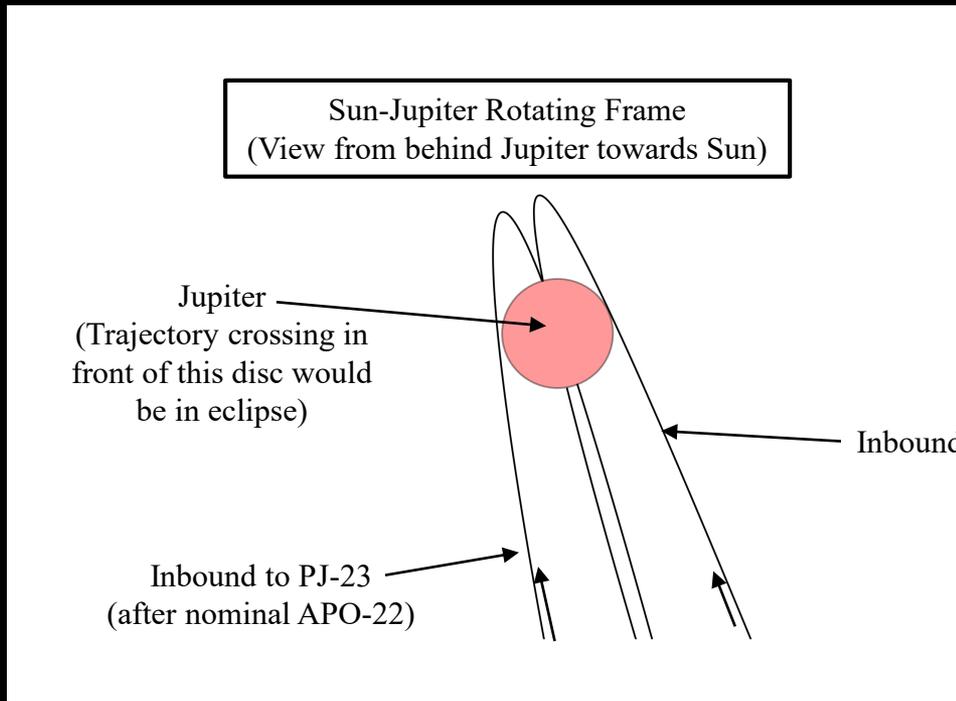
Figure not to scale



Eclipse Avoidance Maneuver



- The eclipse avoidance maneuver (APO-22) alters the orbit plane enough to ensure that the spacecraft will not fly through the Jupiter shadow cone on approach to PJ-23 (Nov 3, 2019)
 - APO-22 is scheduled for Sep 30, 2019
- Without this maneuver, the spacecraft will enter the shadow cone for approximately 12 hours



Spacecraft & Payload



JunoCam

UVS

Waves
(2 detectors)

JIRAM

SPACECRAFT DIMENSION:
Diameter: 80 feet (20 meters)
Height: 15 feet (4.5 meters)

Gravity Science
(2 sensors)

JEDI
(6 sensors)

JADE
(4 sensors)

Magnetometer
(2 sensors, 4 support cameras)

MWR
(6 sensors)



Some recent science results:

Water abundance in equatorial zone (Cheng et al)

Polar cyclones (Adriani et al)

Shallow Lightning (Becker et al)

MWR maps from PJ19 (Bolton et al)

High Latitude Ionospheric Ions (Valek et al)

South Pole Clouds (Moriconi et al)

Formation of Diluted Core by Impact (Liu et al)

Jovian Aurora Juno, HST, and HISAKI (Yao et al)

Whistler Mode Waves (Elliott et al)

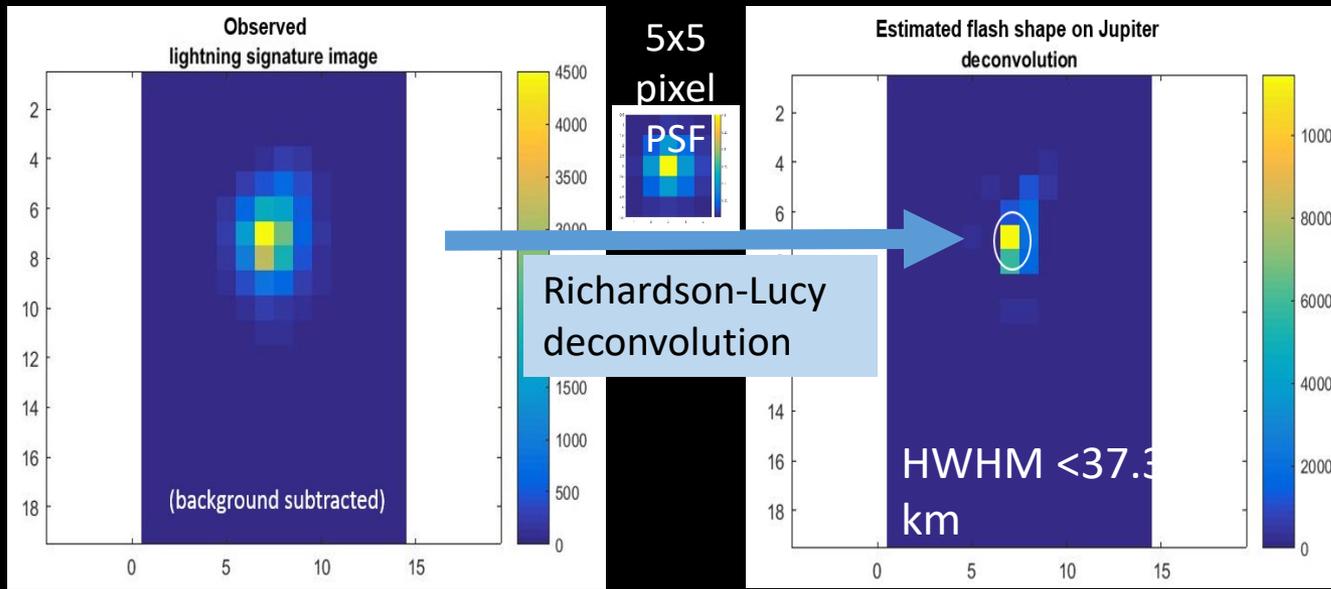
Proton Acceleration by Io Interaction (Szalay et al)

Jupiter's gravity field (Kulowski et al)

Ion Escape (Mauk et al)

UVS-JEDI Auroal Correlations (Gerard et al)

Smaller Flashes > Higher Clouds?



PJ11 Image 12
Signature 1

1-2 pixel flash
(estimate)

SRU flash widths: $\sim 33\text{-}250$ km

At least 4 of the 14 flashes have HWHM < 39 km

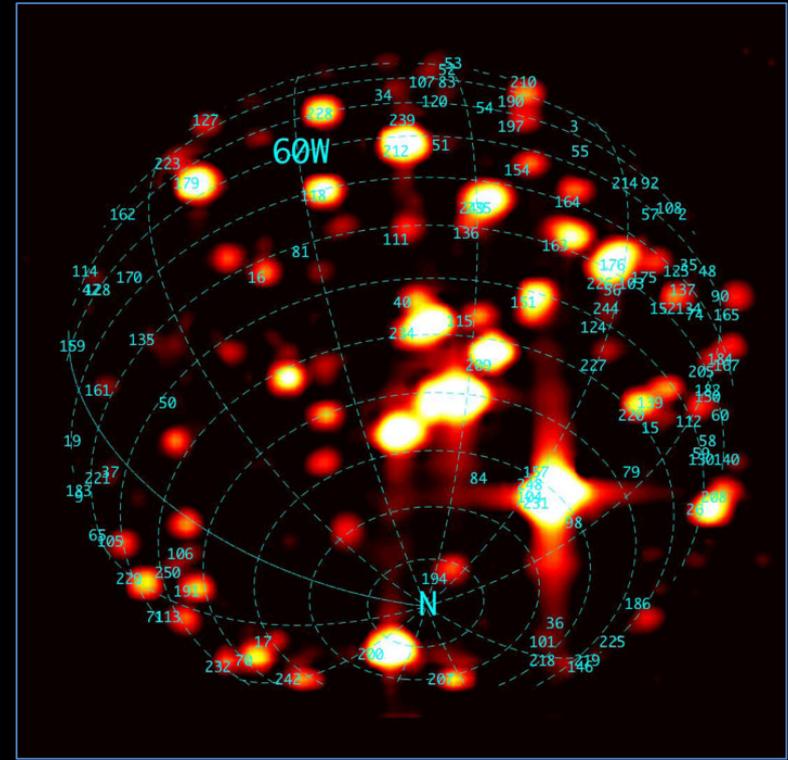
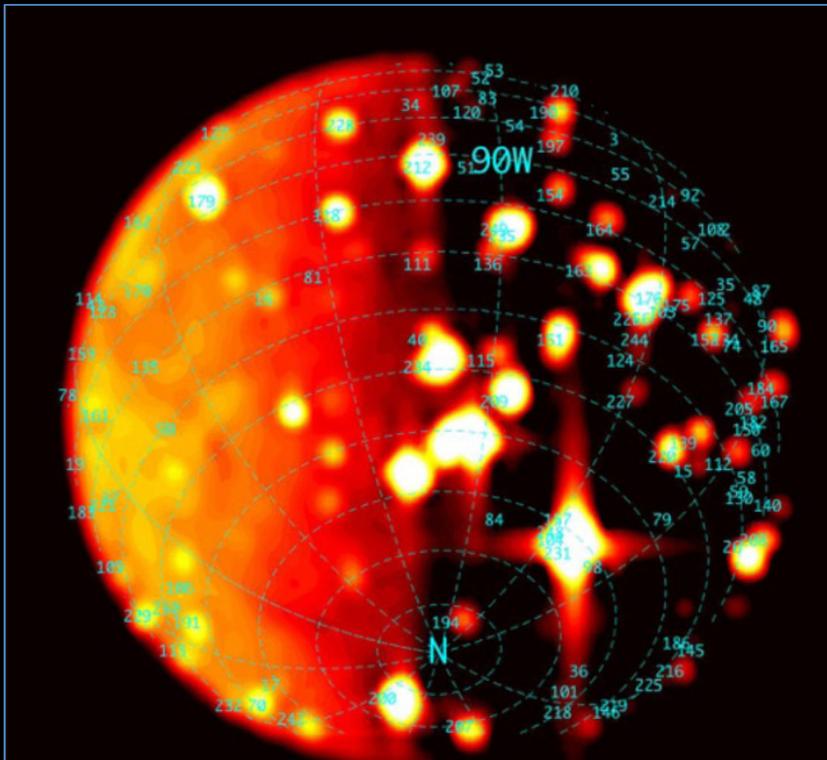
Suggesting a discharge origin higher than previously modeled...



Io's Volcanoes Glow in the Dark (and in Sunlight)



Jupiter's moon Io observed during orbit 17 before and during the eclipse.
The numbers identify the known volcanoes on the surface of Io.



1.1. 3.0 6.3 11.5 19.2 30.0

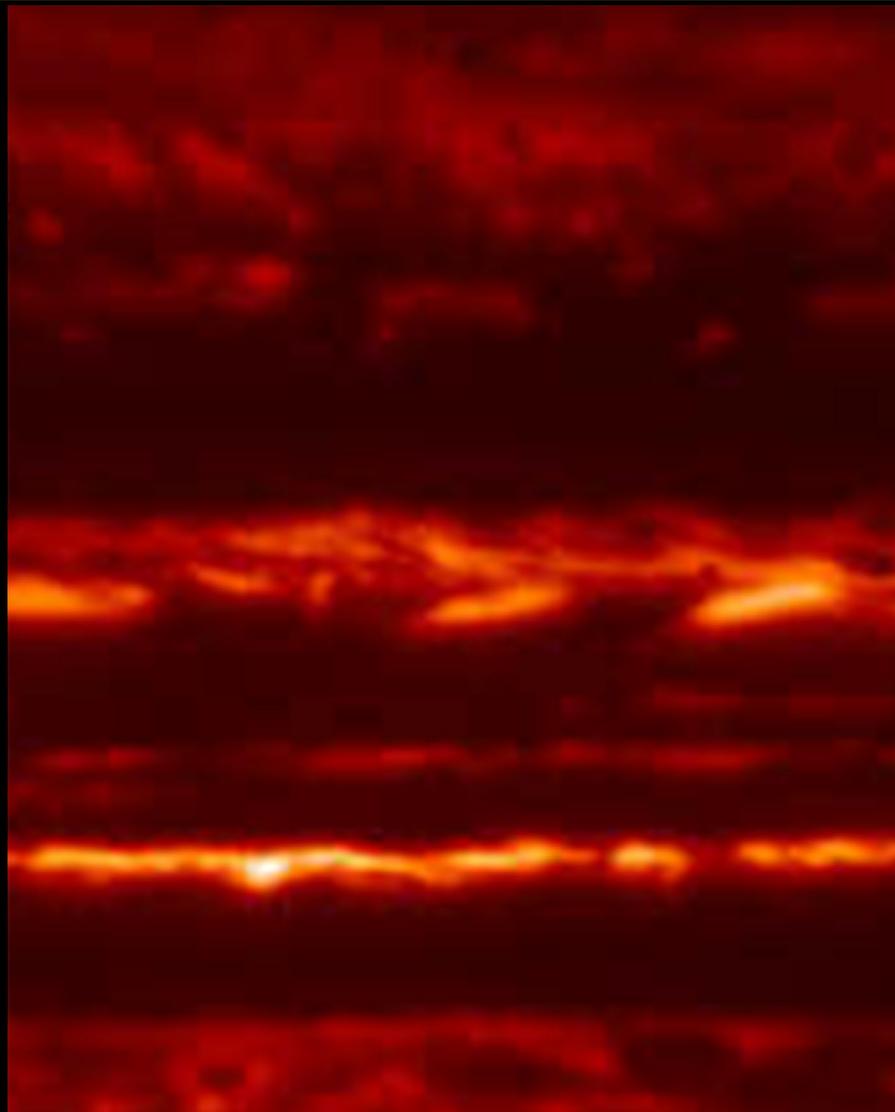
Radiance ($\text{mW sr}^{-1} \text{m}^{-2}$)



First MWR Maps



IRTF 5 micron
2019/04/06
(G. Orton)

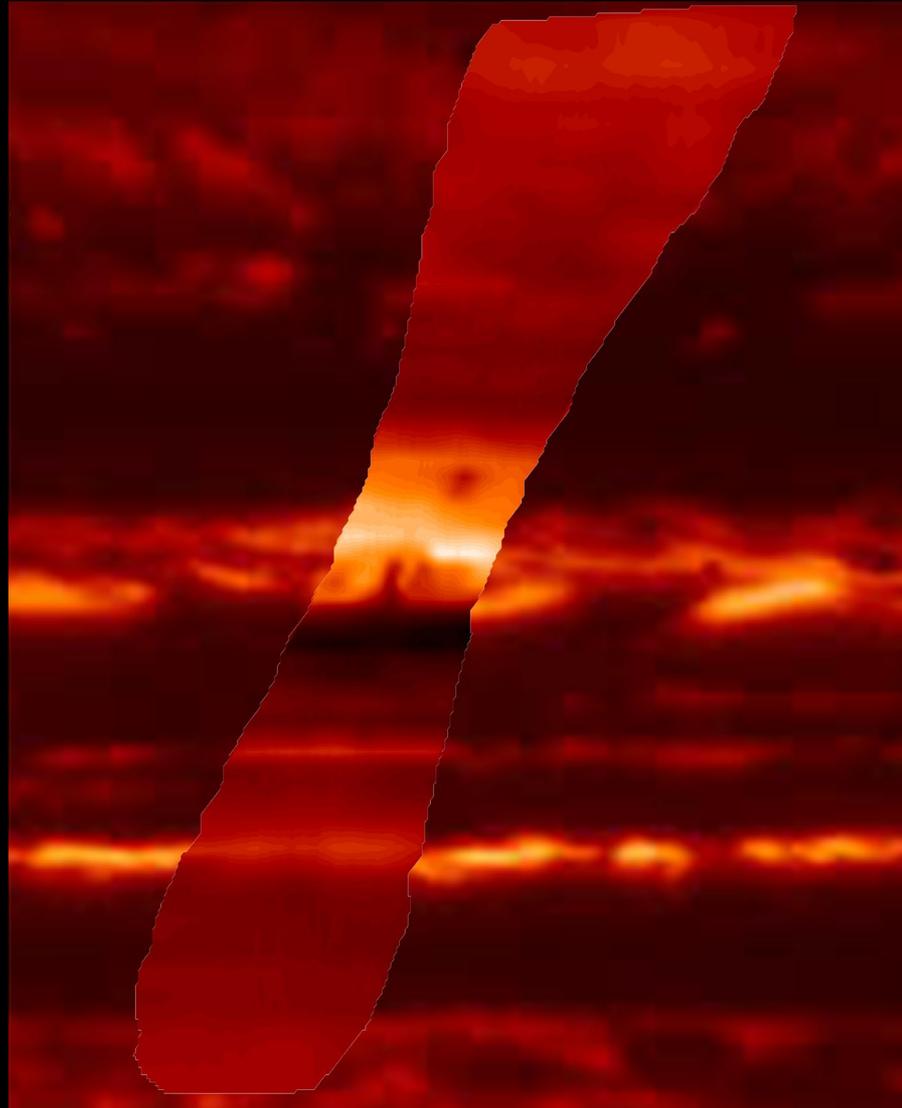




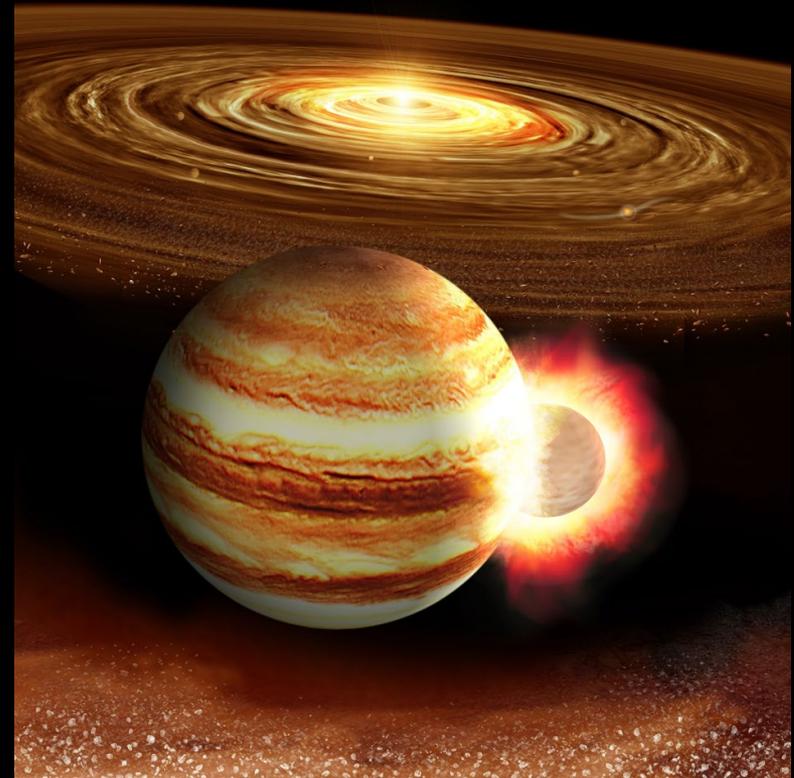
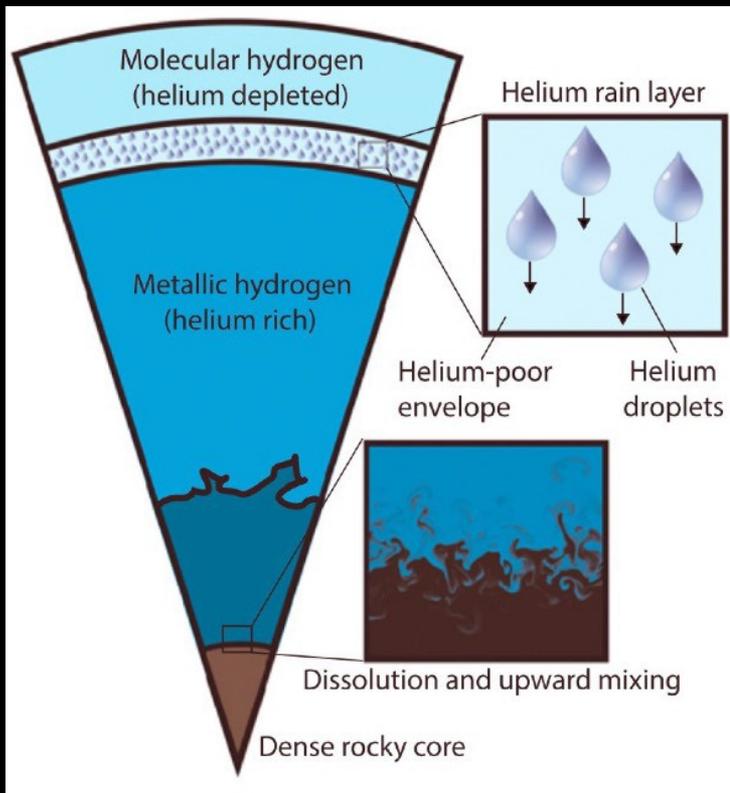
First MWR Maps 6 Frequencies, 6 different depths



MWR Channel 5

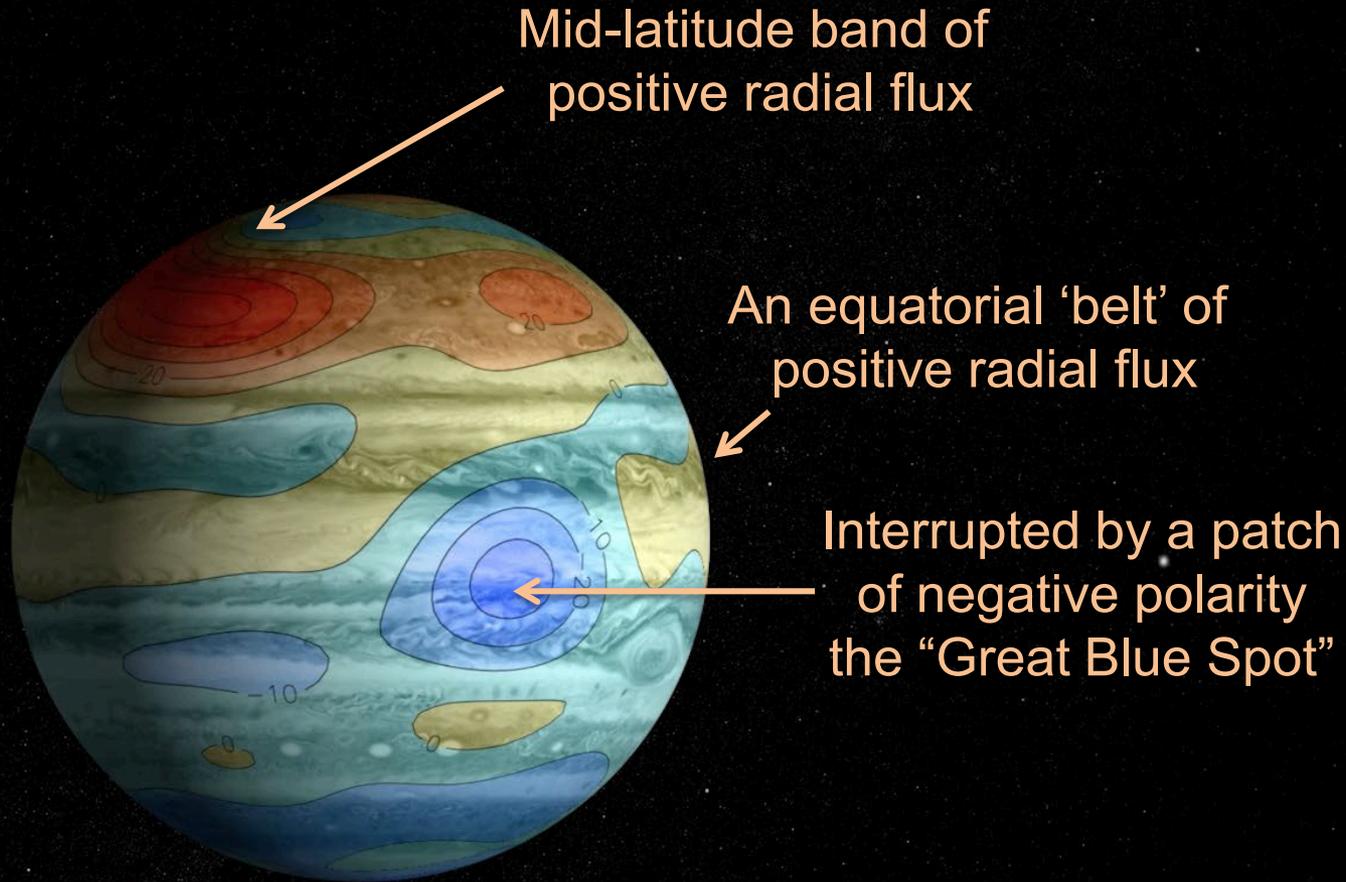


- Gravity science results: a diffuse, fuzzy core
- Possibly indicates early collision
 - Bolton et al. Science, 2017, Folkner et al. 2017, less, et al. 2018, Wahl, S. M., et al. (2017), Helled, R., & Stevenson, D. (2017), Liu et al (2019)





Juno Reveals a Complex Magnetic Field



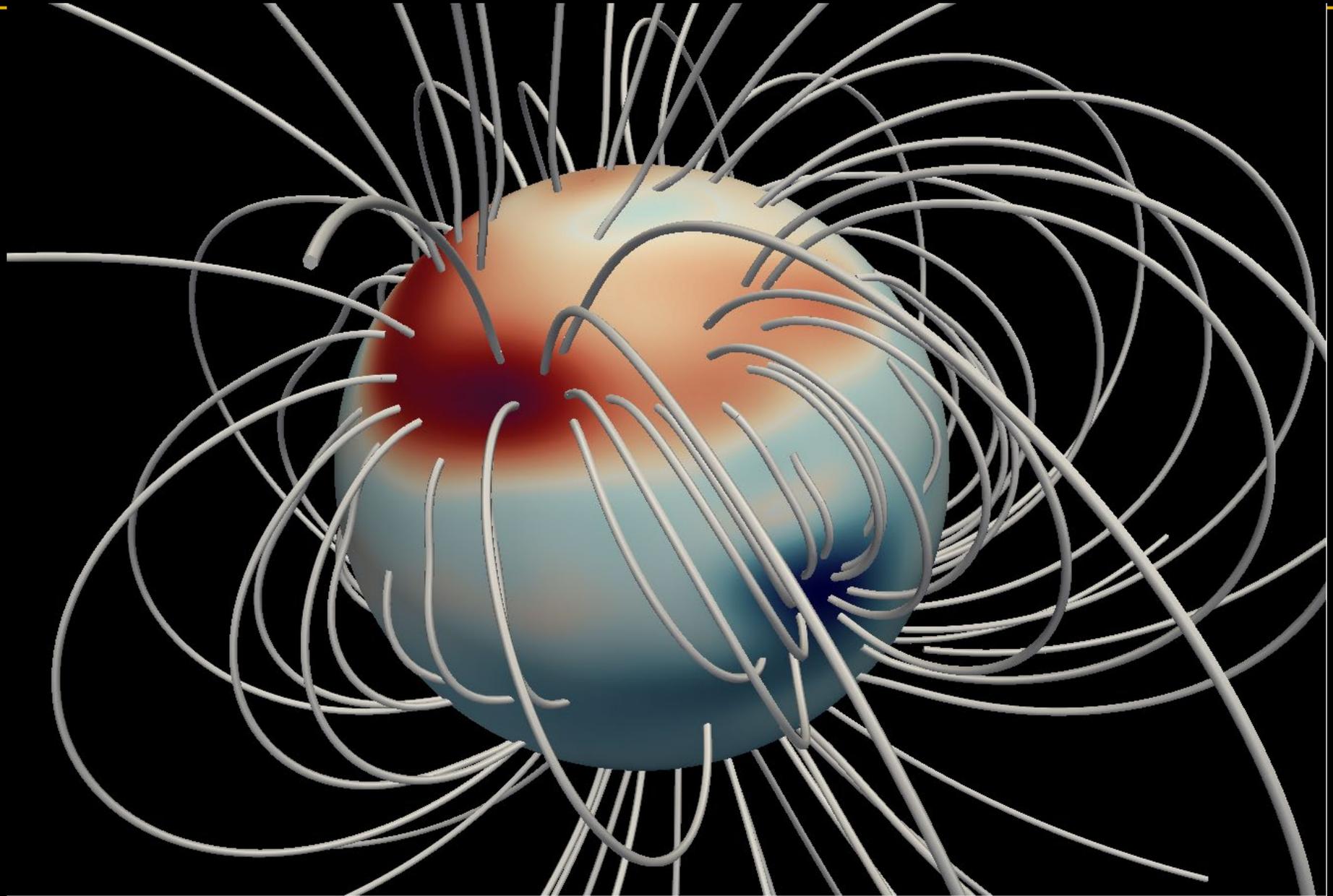
JRM09, a degree 10 spherical harmonic
Radial field contoured at $r_c = 0.85 R_j$



Asymmetry in Magnetic Field

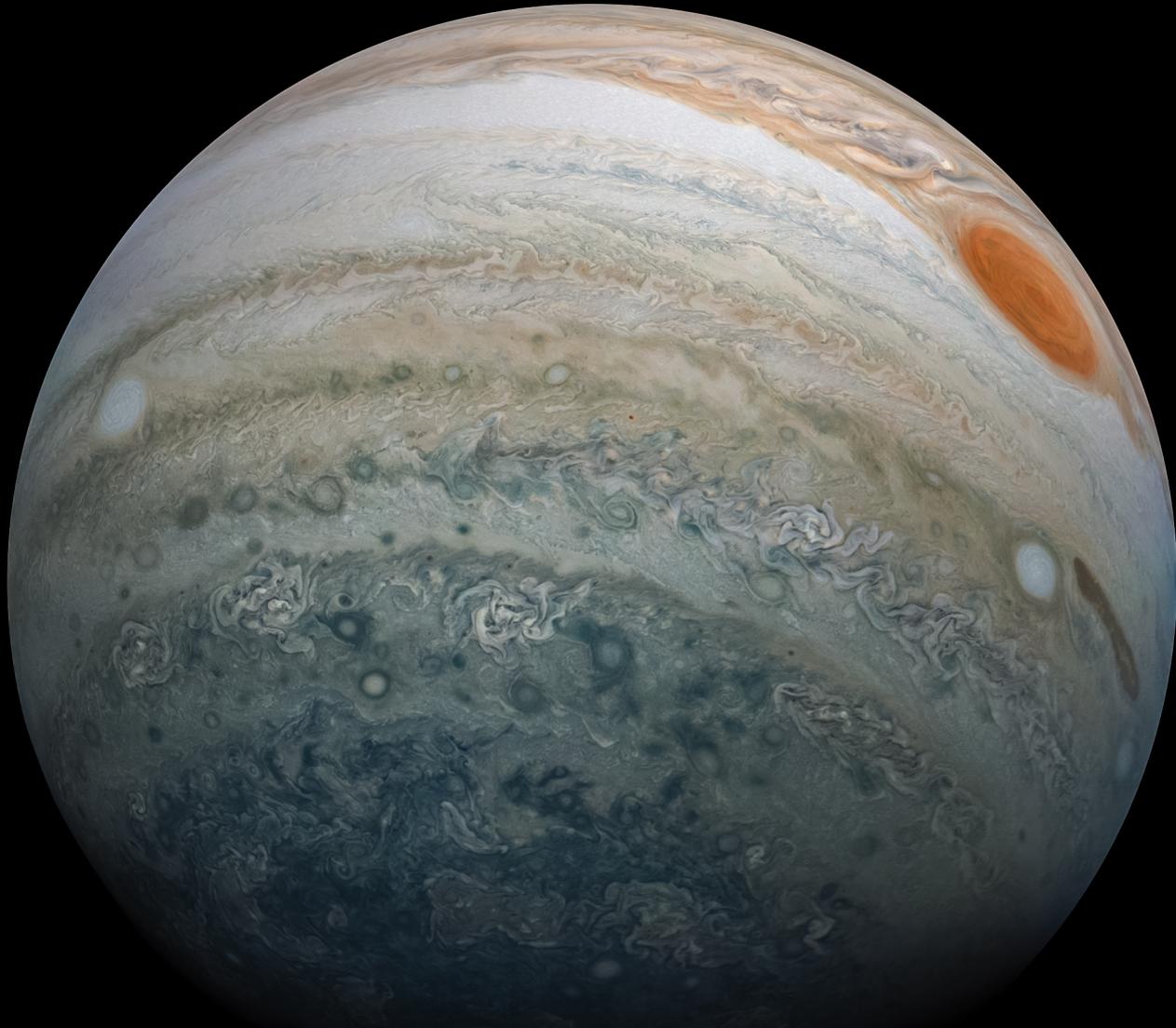


JUNO





JUNO



South Pole Composite Image Credit : NASA/JPL-Caltech/SwRI/MSSS/Kevin M. Gill © CC



Extended Mission 2022+



- Answering questions related to discoveries
- New science not originally envisioned
- Variability studies
- Improving knowledge in prime science
- Investigating new territory not possible during primary mission phase.
- Radiation/Environment relevant to Clipper and JUICE.