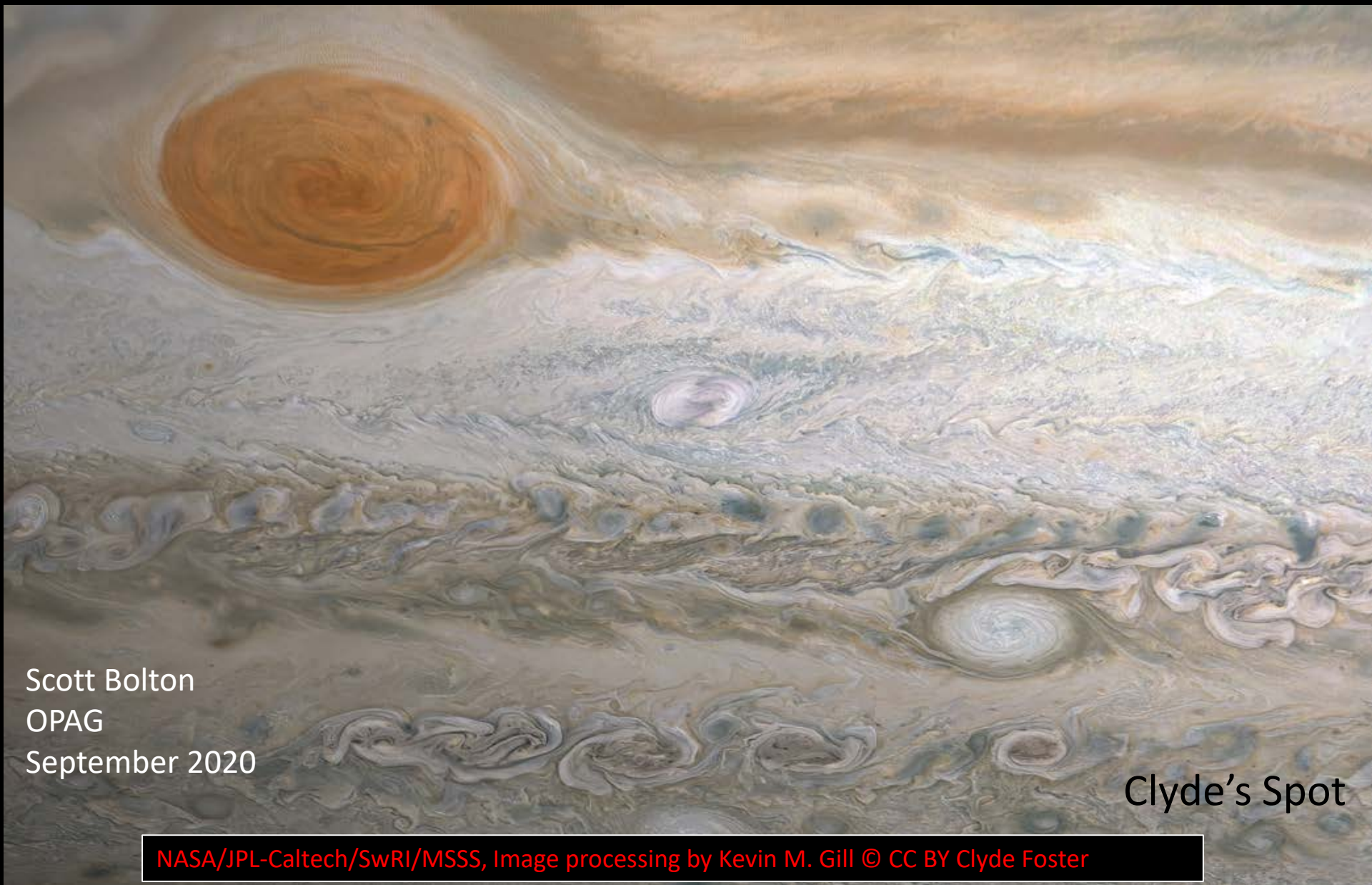
Juno OPAG REPORT



Scott Bolton
OPAG
September 2020

Clyde's Spot

Juno Status

- Launched 2011 and arrived 2016
- Prime mission operations ends July 2021
- 53 day polar orbiter; 34 orbits
- Extended mission proposal due 9/30/2020
- EM decision expected ~12/2020
- EM extends to orbits 34 – 76
- EM last orbit completes September, 2025

Juno EM Science Payload

Gravity	X/Ka band Doppler
MAG	Dual high-accuracy vector fluxgates
ASC	Visible star cameras for MAG
MWR	Six channel microwave sounding (1-50 cm)
JEDI	Energetic particles
JADE	Plasma
Waves	Radio-plasma E/M waves
UVS	Ultraviolet spectral imager
JIRAM	Infrared spectral imager
JunoCam	Visible color imager w/methane filter
SRU	Main star camera

Juno Extended Mission Proposal

Juno evolves to a full Jovian system explorer with close flybys of satellites and rings.

Juno EM provides a diverse OPAG community with data from 2021 to 2025.

The final selection of science objectives & measurements may be limited by NASA budget.

A Sampling of EM Science Objectives Addresses discoveries and new targets

Jupiter's northern hemisphere and pole

The shearing of magnetic features

Characterizing the dilute core

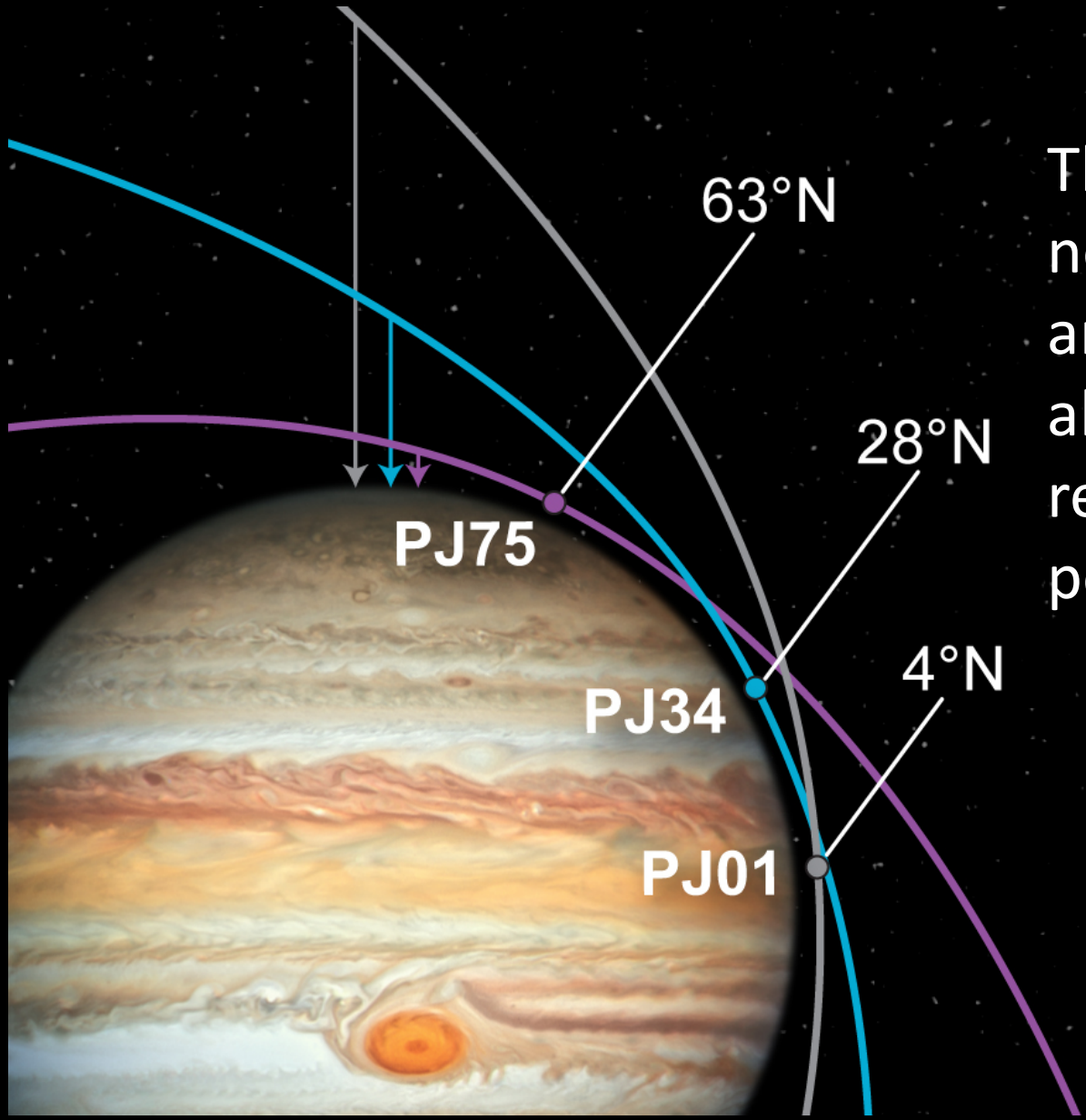
Probing the polar magnetopause

In-situ exploration of the Io-Europa Torus

Multiple flybys of Io, Europa and Ganymede

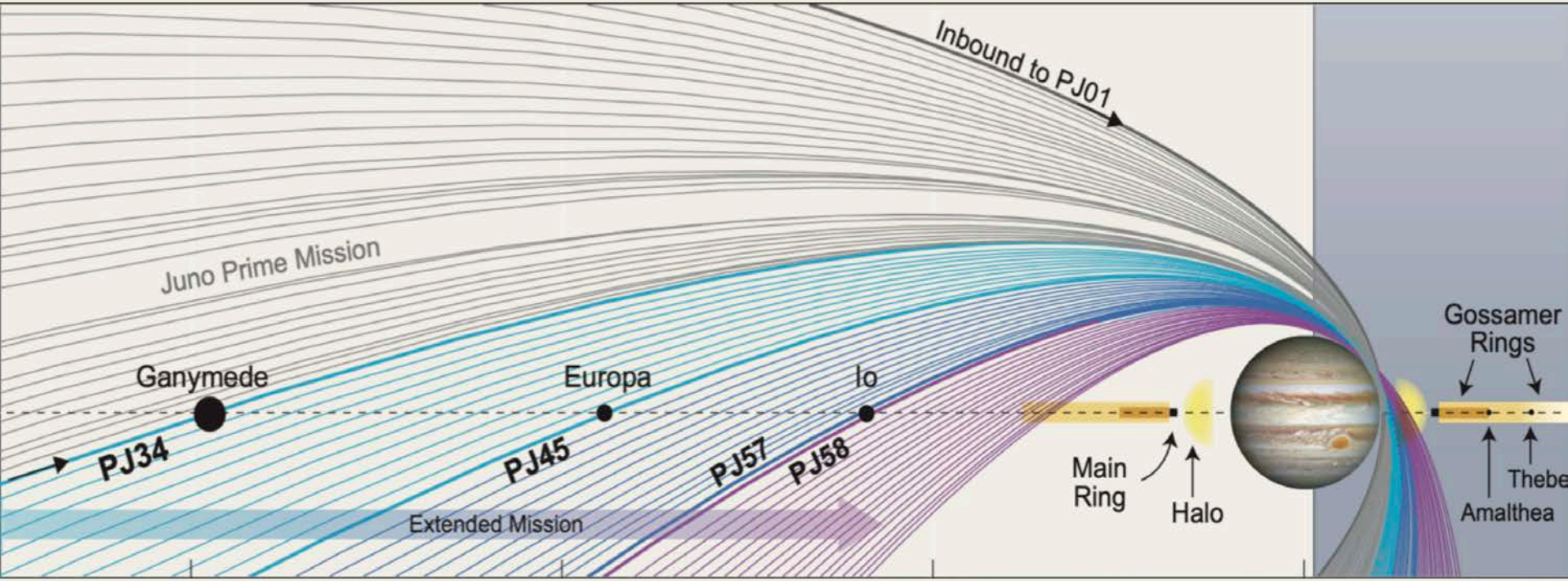
Detailed characterization of the ring system

The migration of Juno's perijove northward

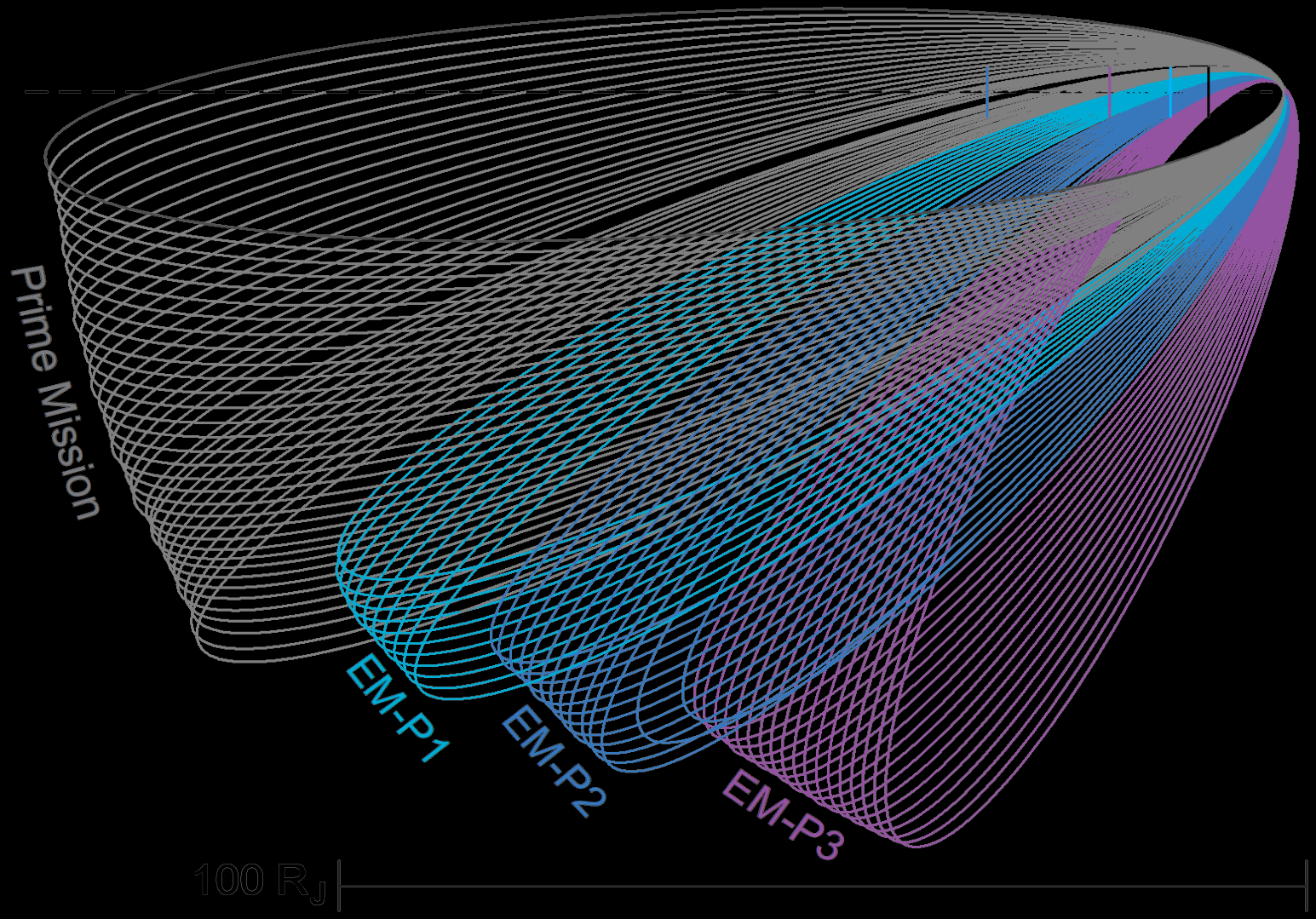


The EM investigates the northern hemisphere and probes the low altitude acceleration region above Jupiter's polar cap aurora

The northern progression of perijove enables Satellite flybys and penetrates Jupiter's ring halo

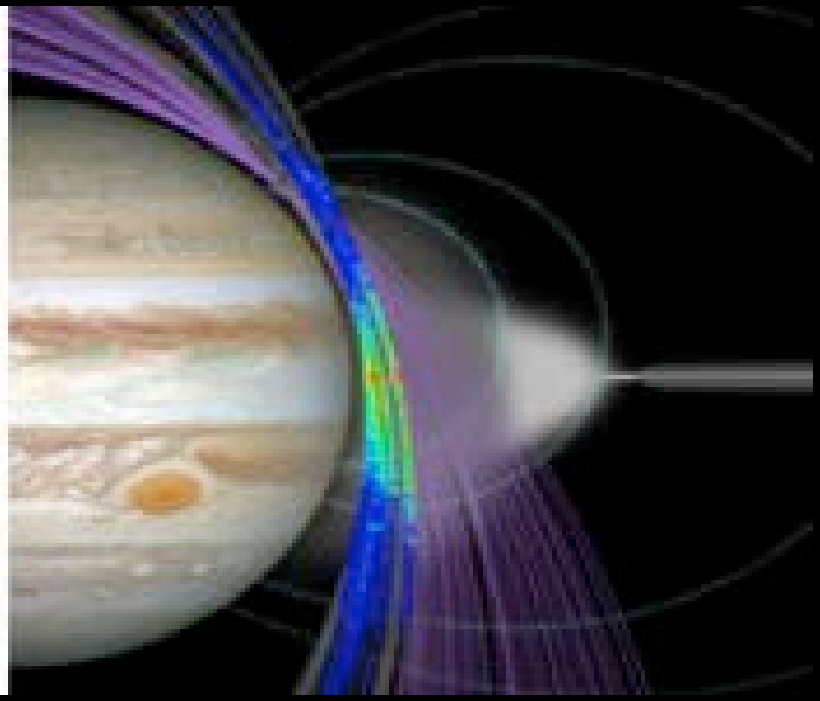


Orbit planet projection: EM orbits reach deep into the southern magnetosphere



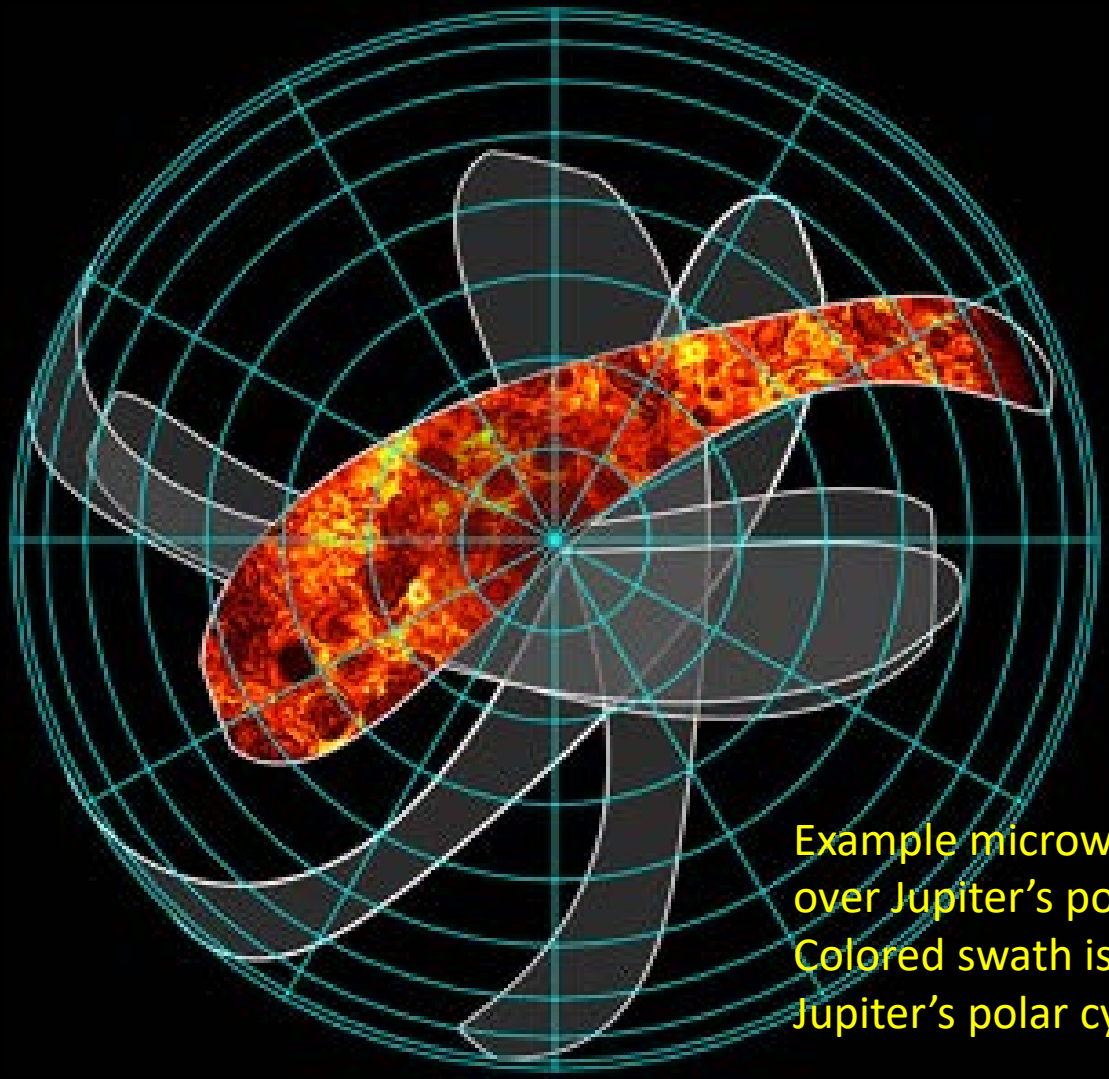
High-resolution views “fill the gap” between the halo and Jupiter

Juno will search for clumps throughout the rings as seen in this image near Adrastea



Waves dust impacts through PJ21 (color), future observations are shown in purple

The EM provides 3D maps probing the depths of Jupiter's polar cyclones

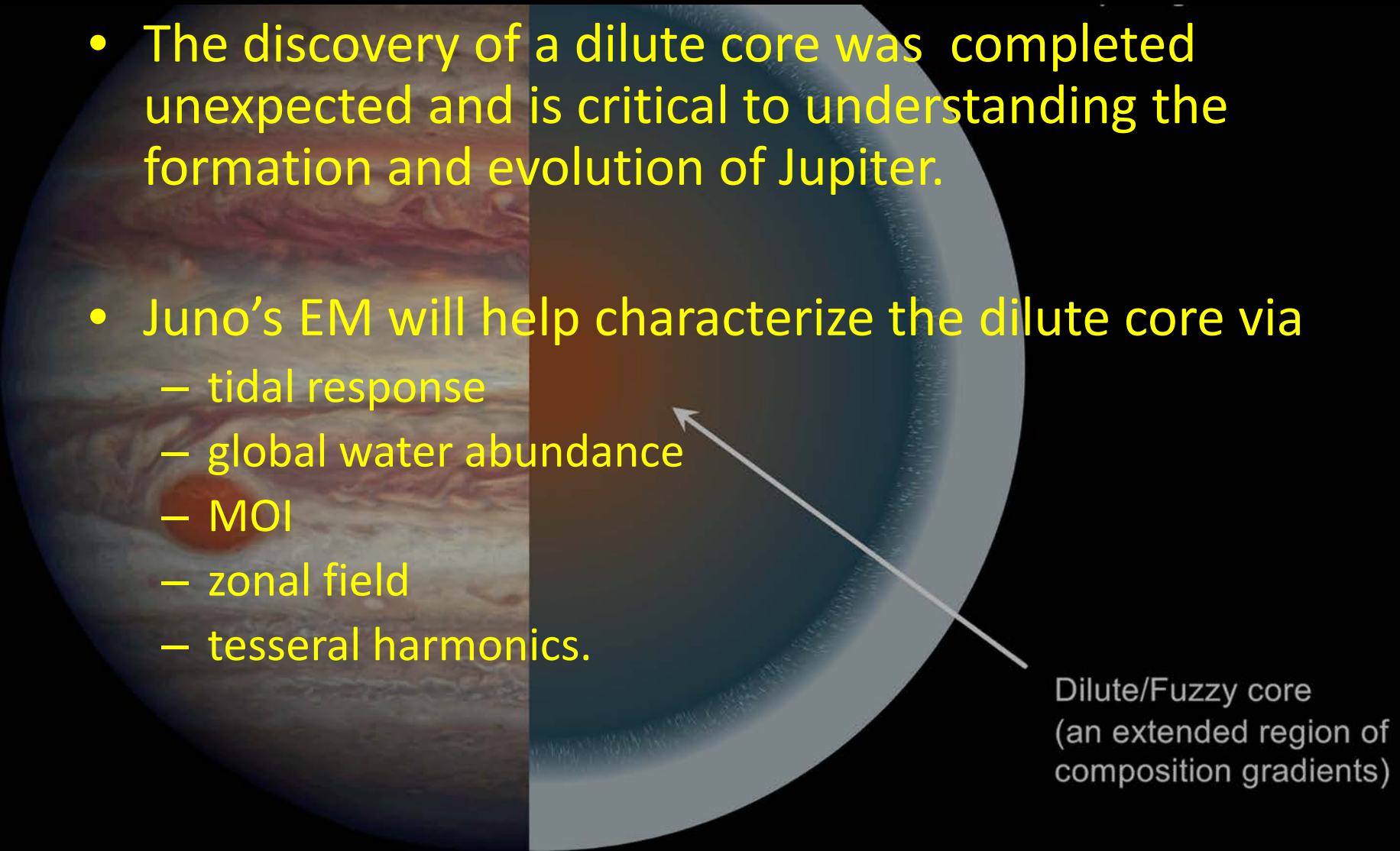


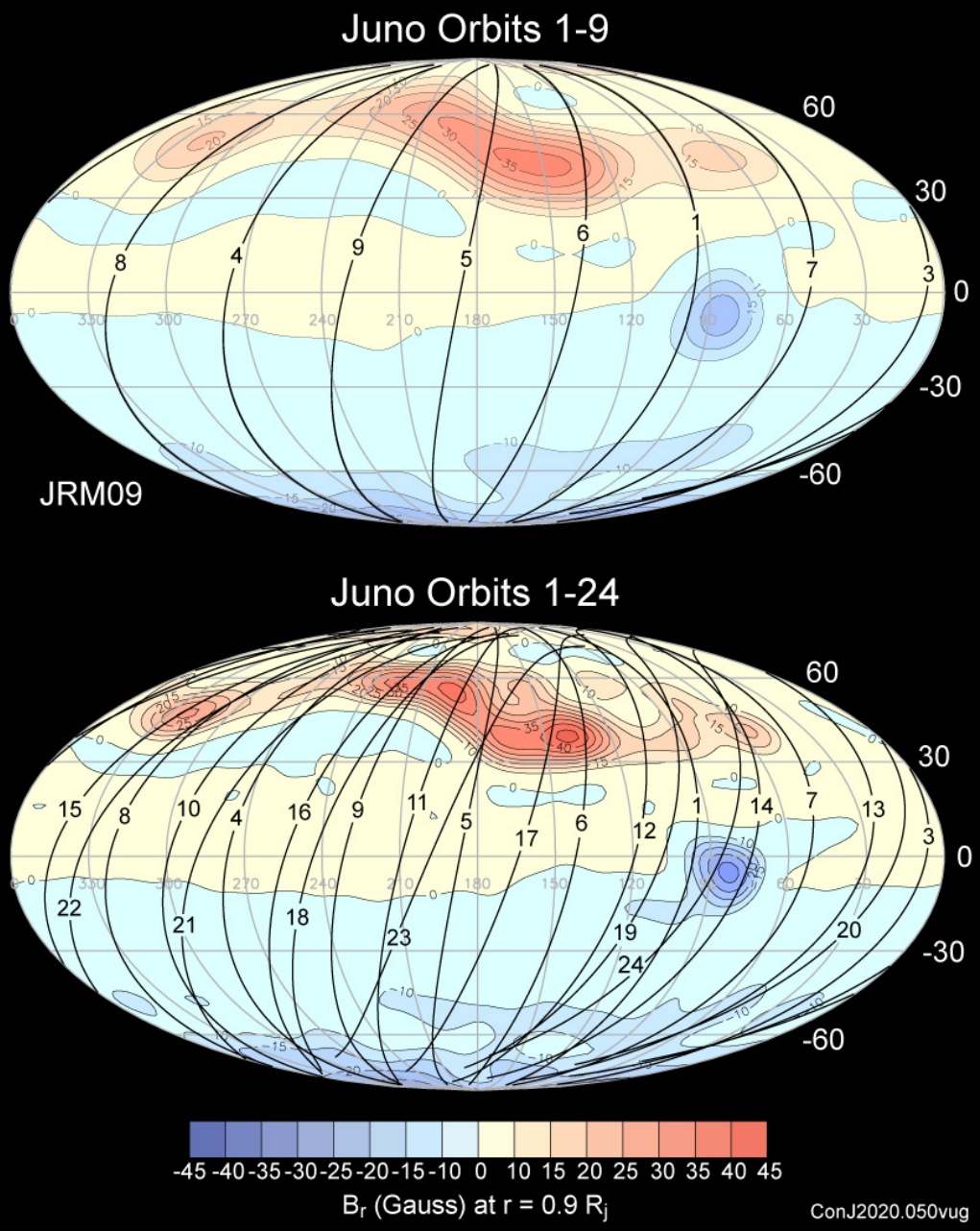
Example microwave mapping coverage over Jupiter's poles during the EM. Colored swath is JIRAM data showing Jupiter's polar cyclones

Characterizing the Dilute Core

- The discovery of a dilute core was completed unexpected and is critical to understanding the formation and evolution of Jupiter.

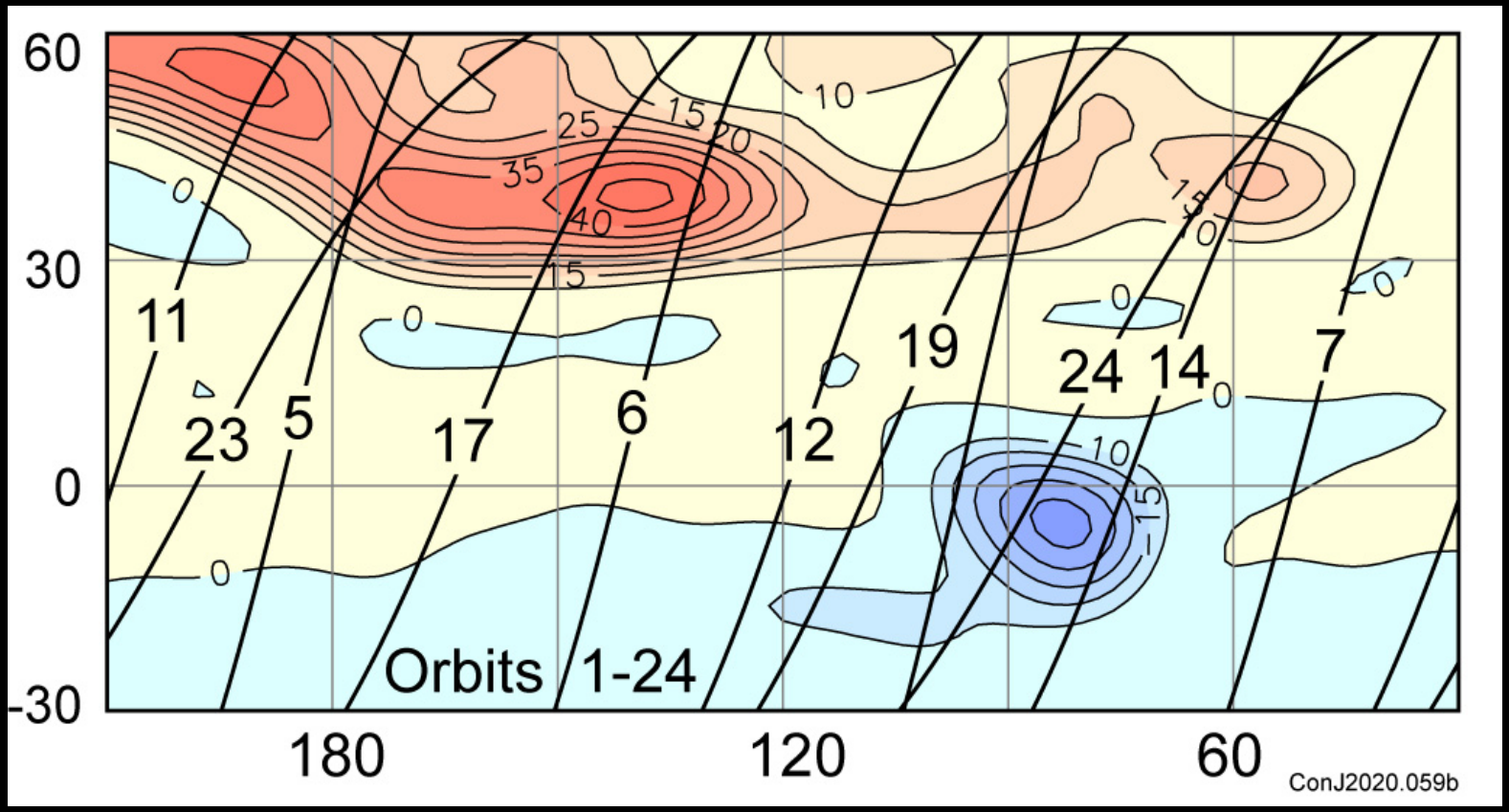
- Juno's EM will help characterize the dilute core via
  - tidal response
  - global water abundance
  - MOI
  - zonal field
  - tesseral harmonics.



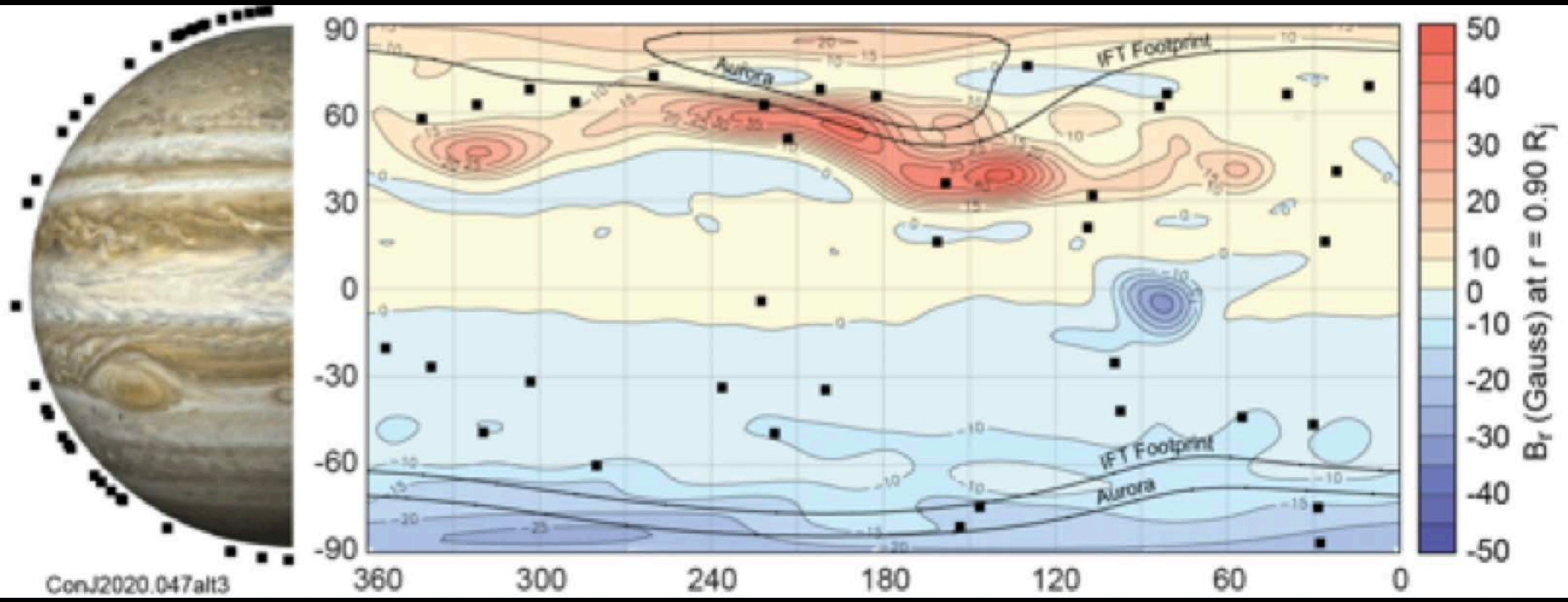


The EM bisects Prime mission longitudes to create a magnetic map with ever-increasing spatial resolution; appropriate to sources that we now know are more shallow than anticipated.

The EM performs a high-resolution magnetic survey above the Great Blue Spot (GBS) to characterize the distortion (shear) of the GBS due to zonal winds at few 1,000 km depths.



First radio occultations to cover a wide range of latitude and longitude

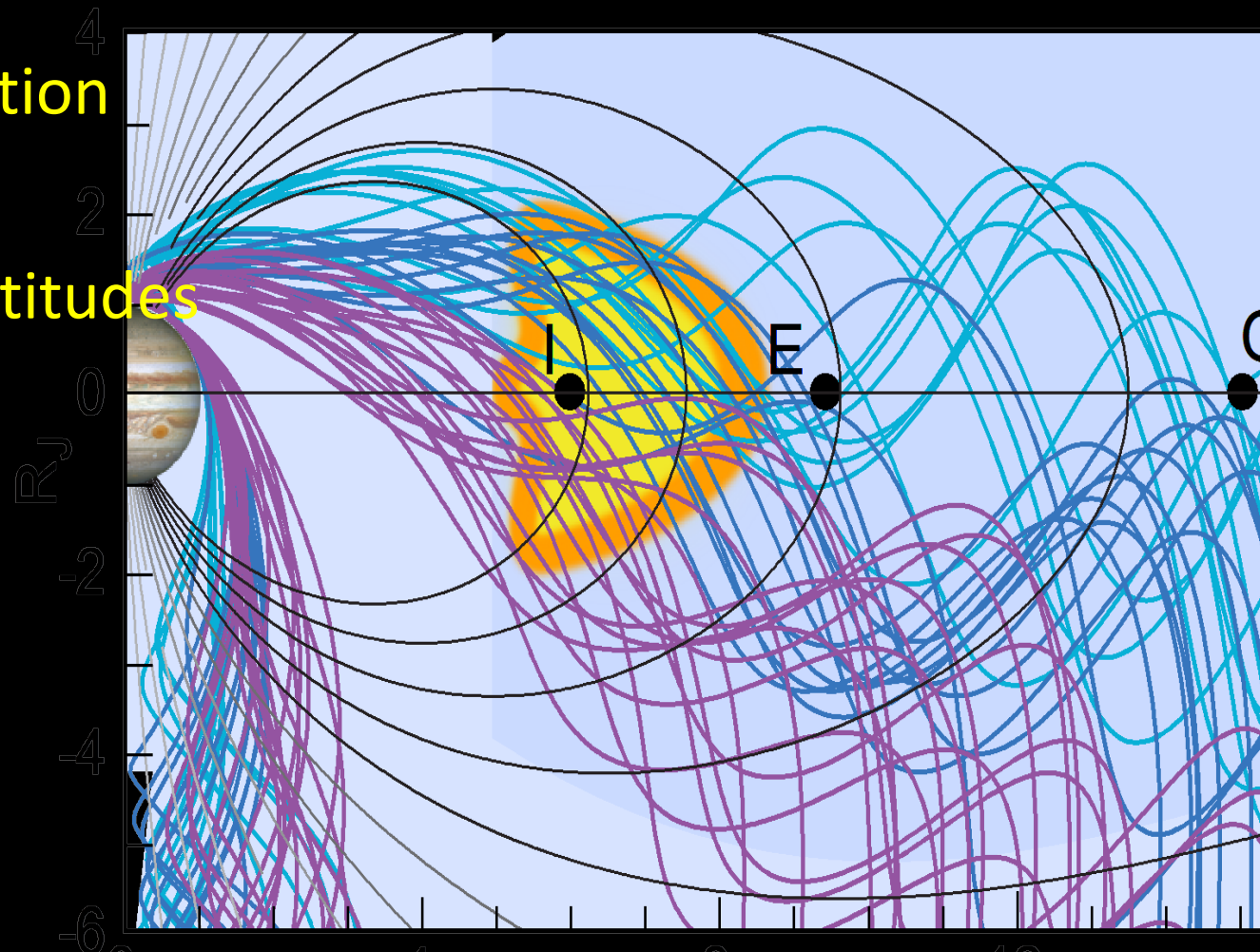


Probing upper atmosphere and ionosphere along the Io Flux Tube footprint, polar auroral oval, and mid-latitudes

Clipper-JUICE Radiation Environment

Dissecting the Io-Europa-Ganymede Torus:

- In-situ F&P
- Update radiation
- Coverage of
- low & high latitudes



Juno's Satellite Encounters

- Ganymede
  - Surface composition, space weathering maps, ,magnetospheric interaction (thru wake)
- Europa
  - Ice shell, plume search, organics maps, surface sputtering
- Io
  - Magma ocean, polar volcanoes & SO_2 maps, magnetospheric interaction
- Semi-major axis of each moon to compare with astrometry from other missions (LaPlace resonance)

Moon	~Alt (km)	YR
Ganymede	1000	mid 2021
Ganymede	50000	mid 2021
Europa	88000	late 2021
Europa	47000	early 2022
Io	85000	mid 2022
Europa	320	late 2022
Io	63000	late 2022
Io	51000	early 2023
Io	35000	mid 2023
Io	22000	mid 2023
Io	11000	late 2023
Io	1500	early 2024
Io	1500	early 2024
Io	18000	early 2024
Io	83000	late 2024
Io	94000	mid 2025

Ganymede Science

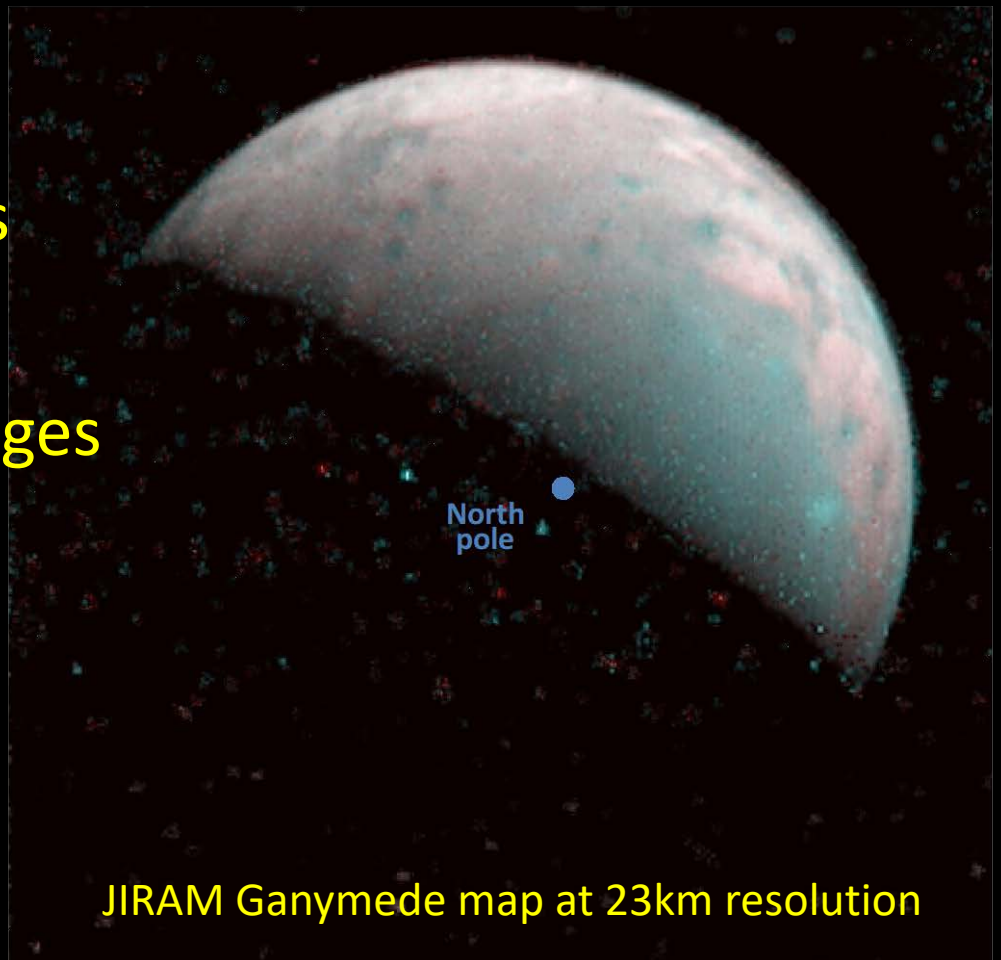
- Investigate the 3-D structure of Ganymede's magnetosphere
- Surface composition,

role of radiolytic processes

in surface weathering

- Investigate surface changes

since Voyager and Galileo



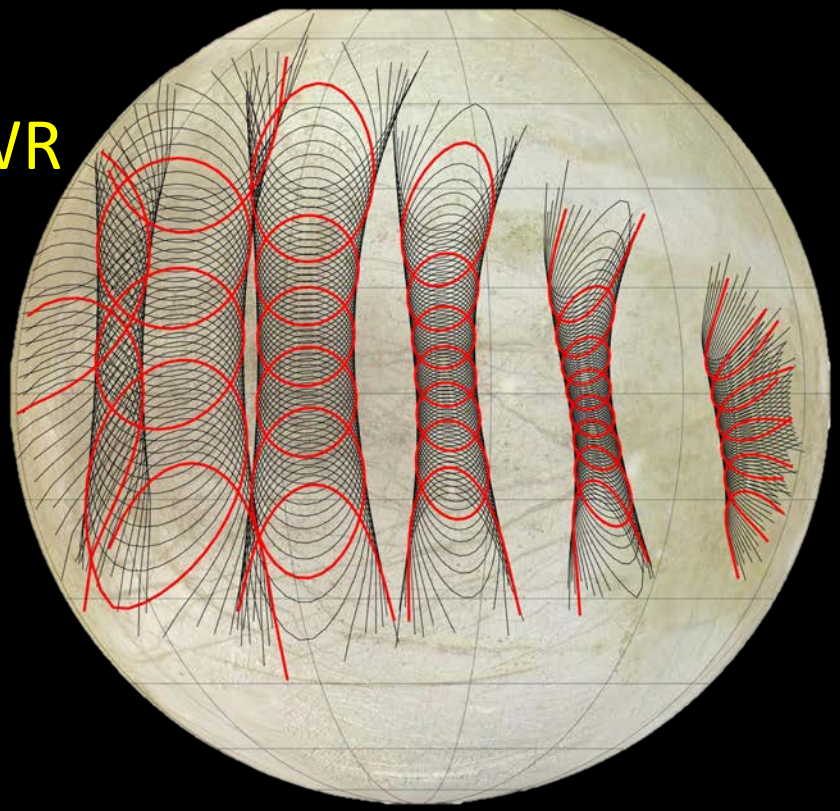
JIRAM Ganymede map at 23km resolution

Juno Europa Science

Ice shell characterization:

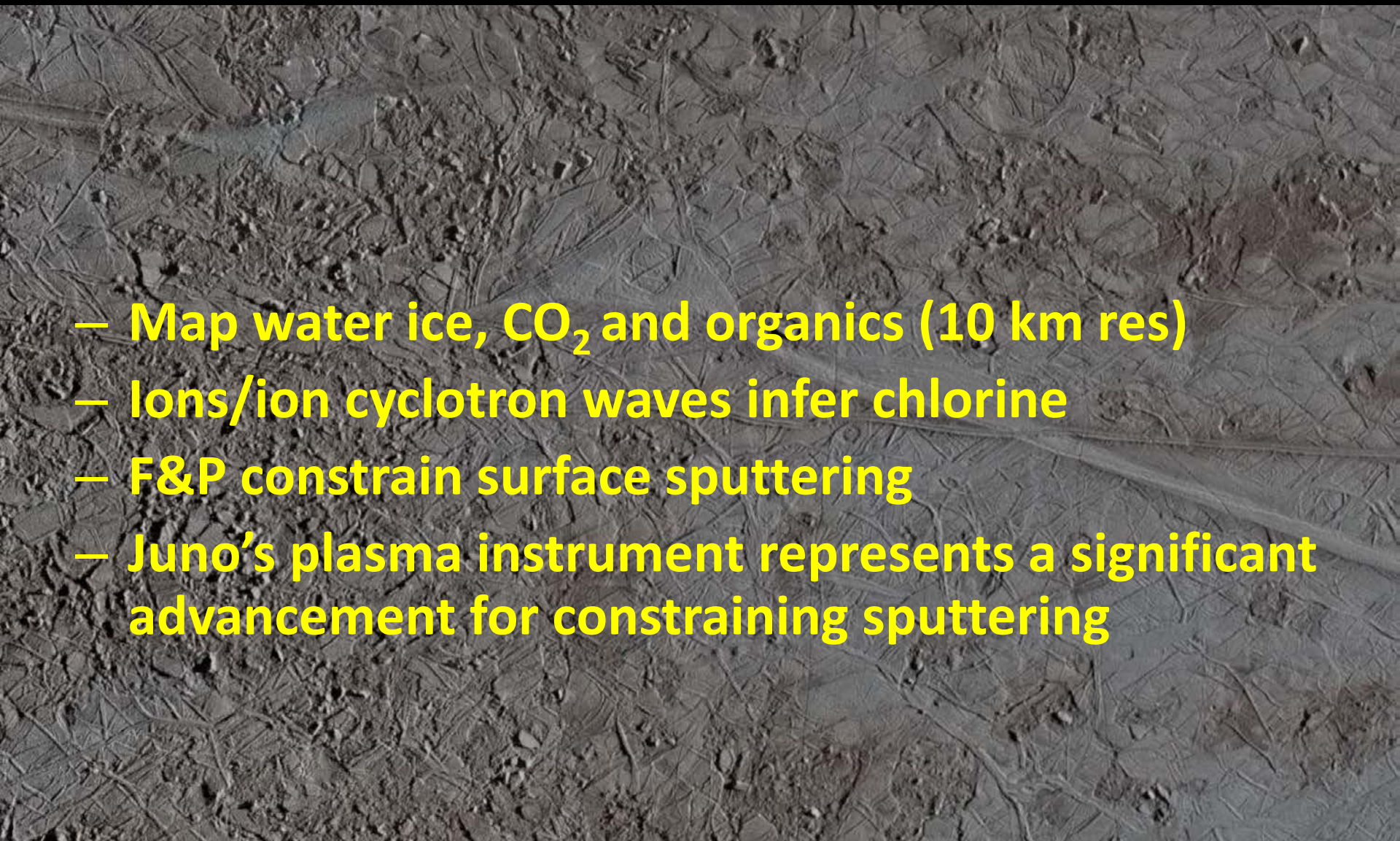
- Identify regions where ice is thick, thin or has subsurface liquid
- Map surface with MWR

~120-200 km resolution



Europa Science

Surface Composition and Sputtering



- Map water ice, CO_2 and organics (10 km res)
- Ions/ion cyclotron waves infer chlorine
- F&P constrain surface sputtering
- Juno's plasma instrument represents a significant advancement for constraining sputtering

Juno Europa Science

Plume Search:

- Search for surface changes (1-2 km resolution)
- JunoCam, SRU (High phase forward scattering)
- In-situ F&P to characterize mag field, wave emissions, electron densities and dust environment

Io Science

- **Juno will constrain k_2 to help clarify the physical origin of Io's volcanism**

- **Juno will monitor Io volcanic activity, including the polar region. Global mapping addresses where internal dissipation of tidal heating occurs.**