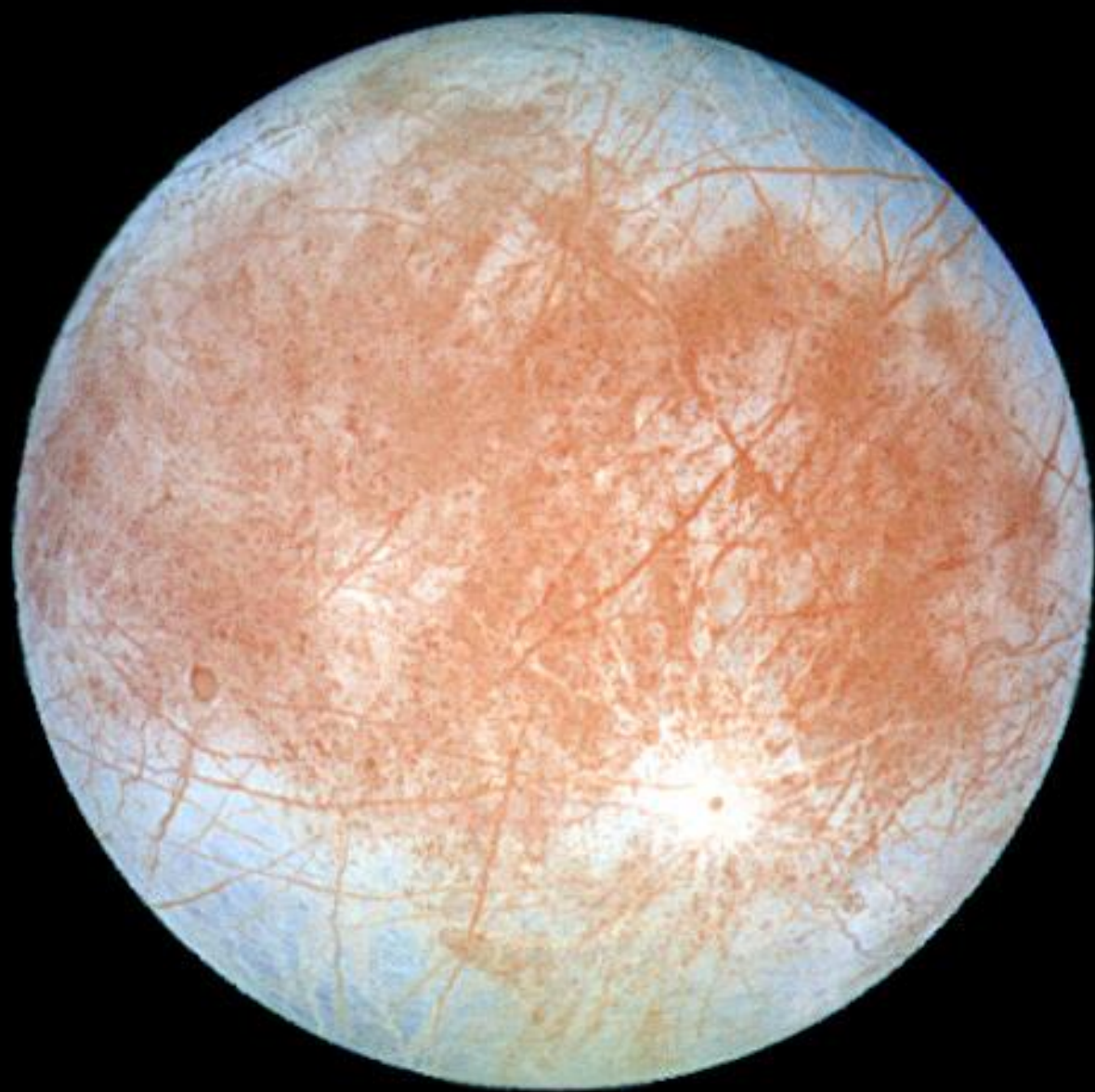


JUICE

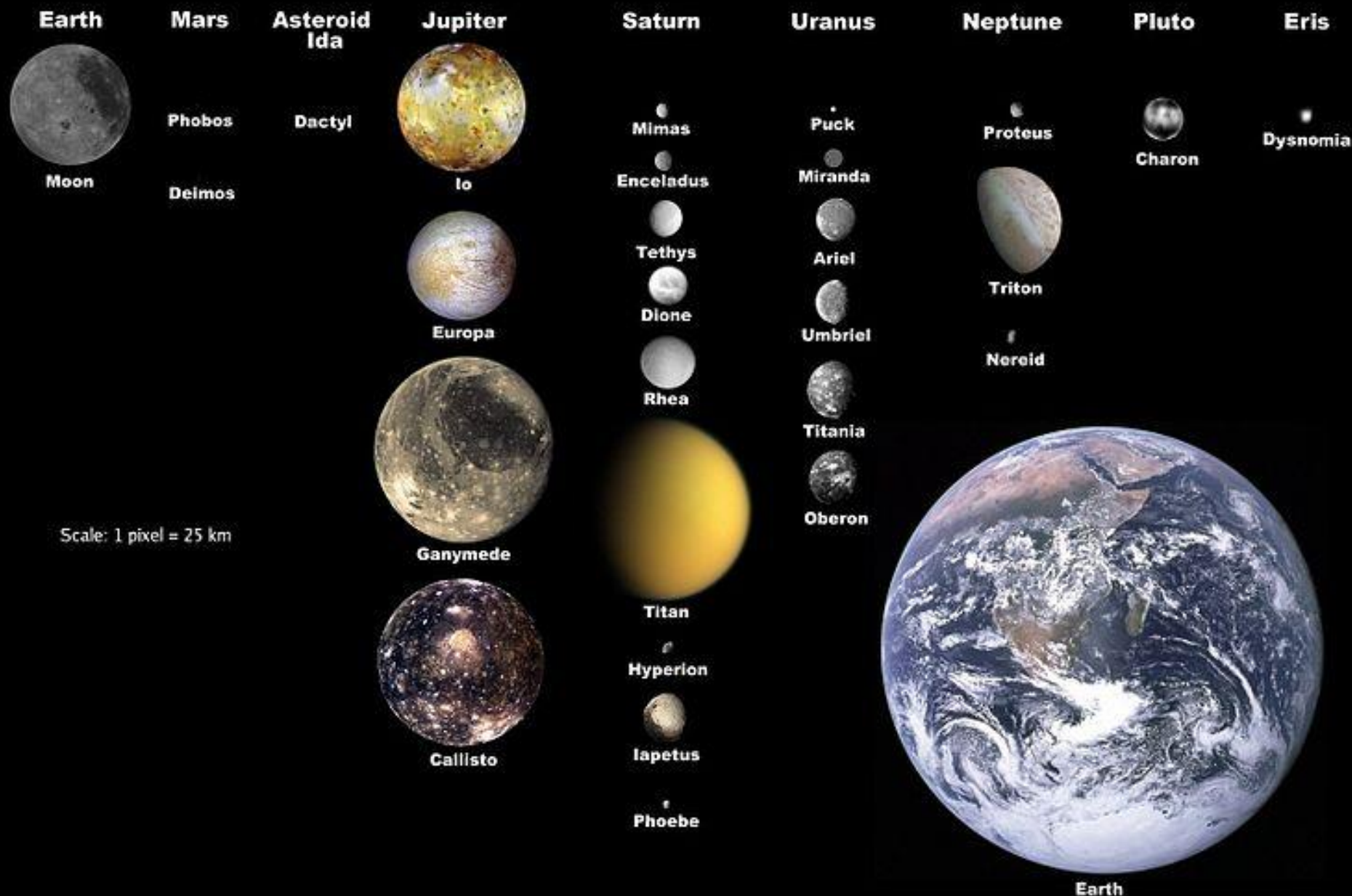
Olivier Witasse

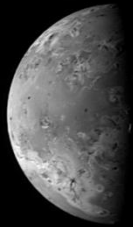
20/04/2016



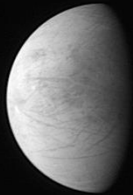


Selected Moons of the Solar System, with Earth for Scale

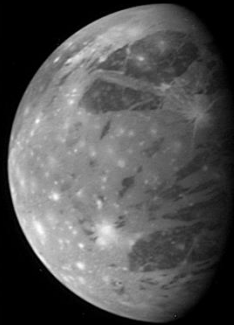




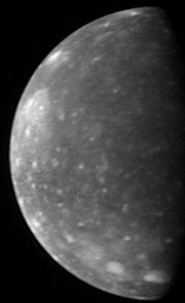
Io



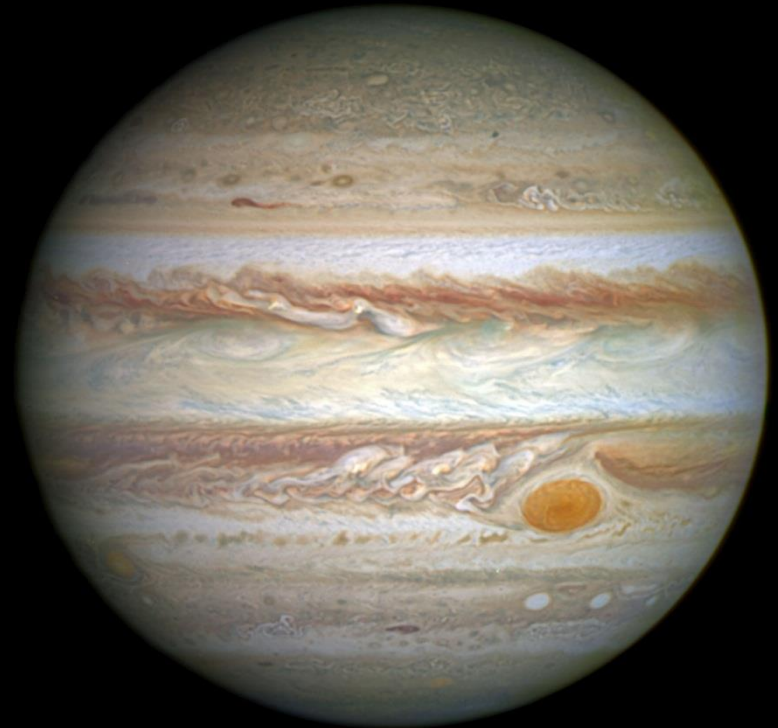
Europa



Ganymede



Callisto

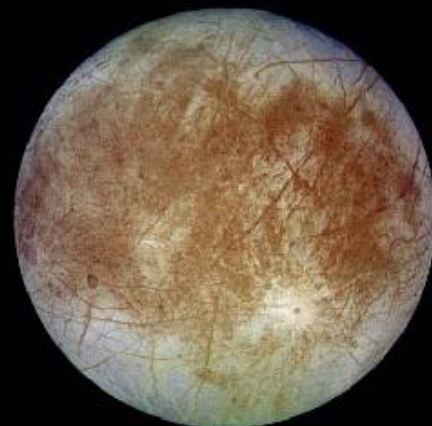
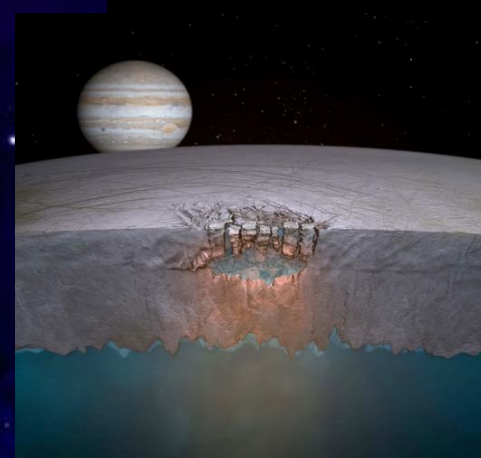
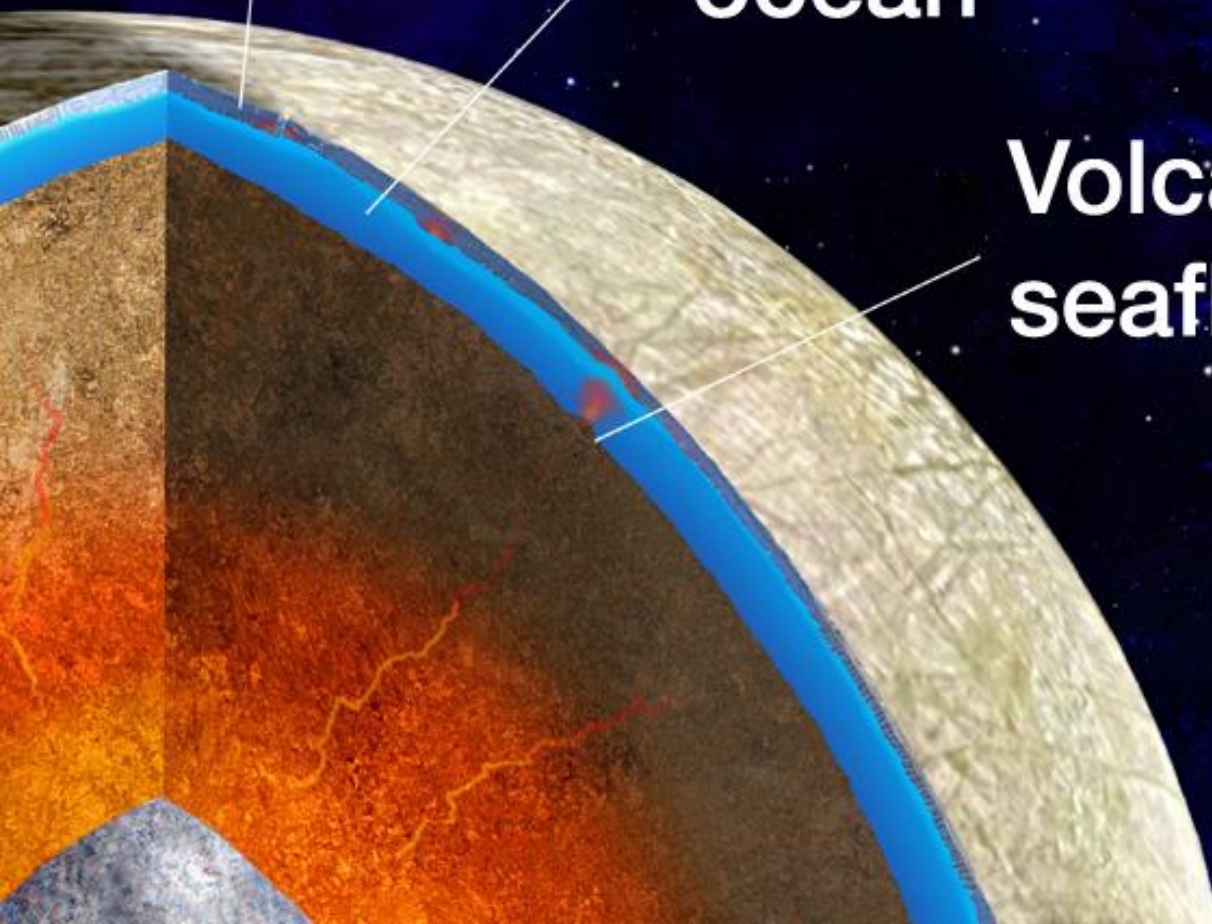


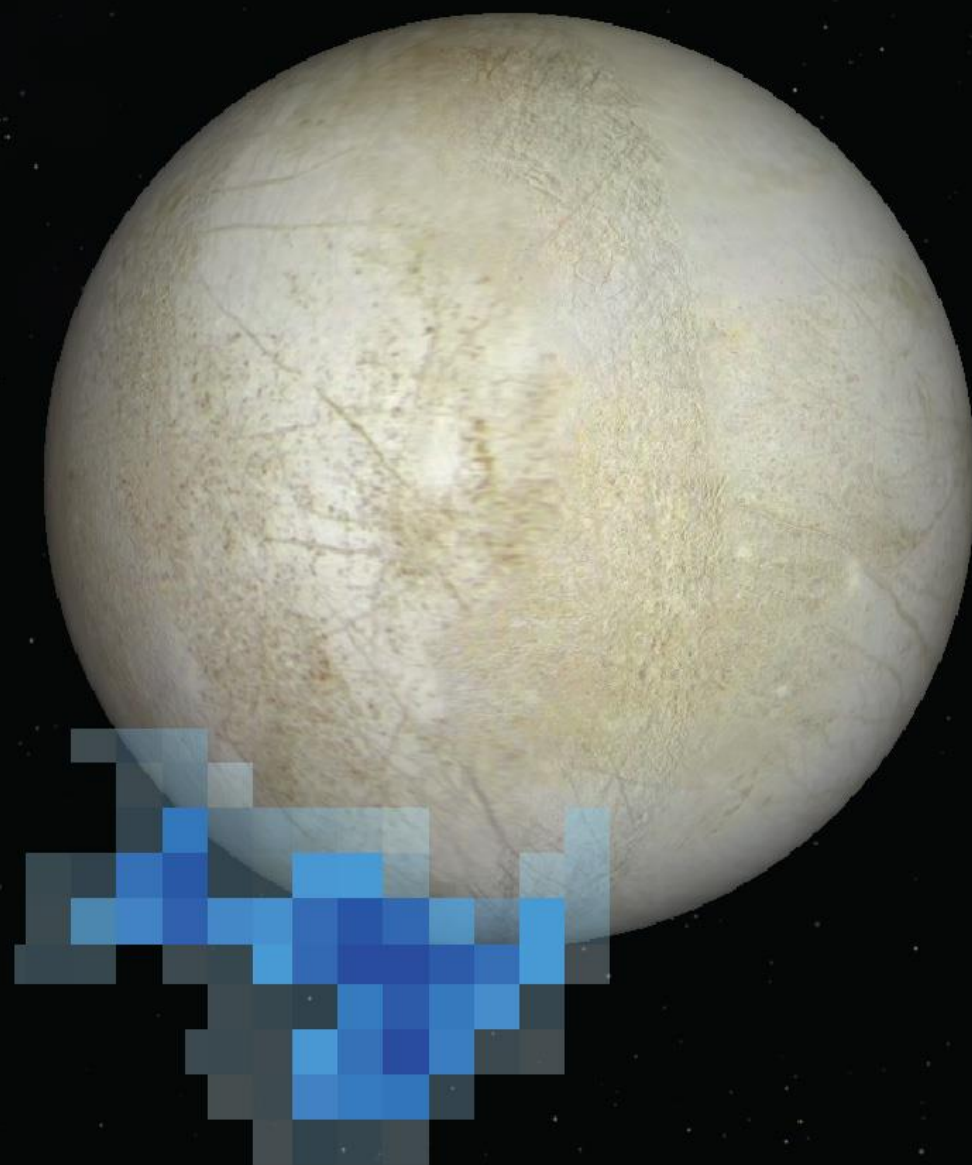
Emergence of habitable worlds around gas giants
Jupiter system as an archetype for gas giants

Icy crust

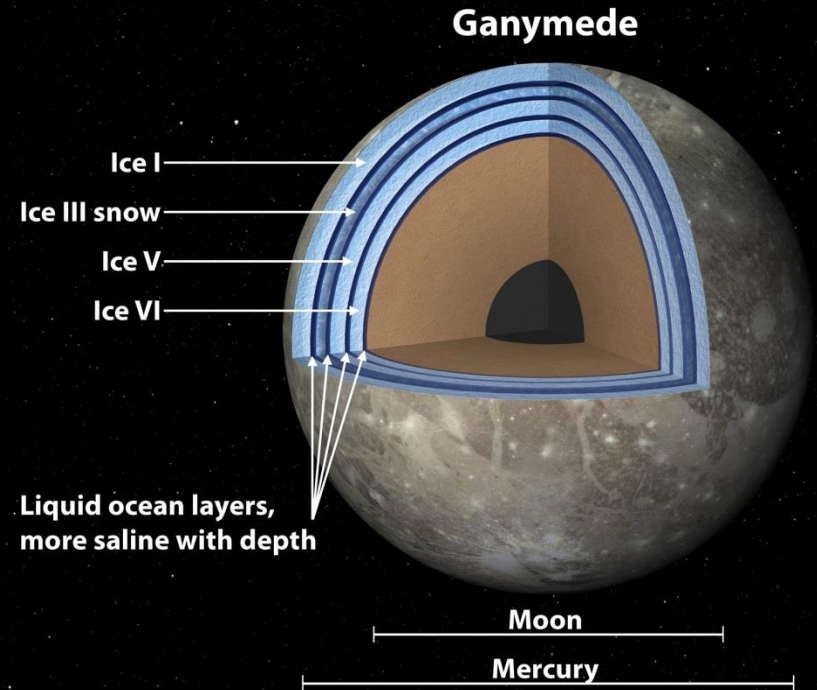
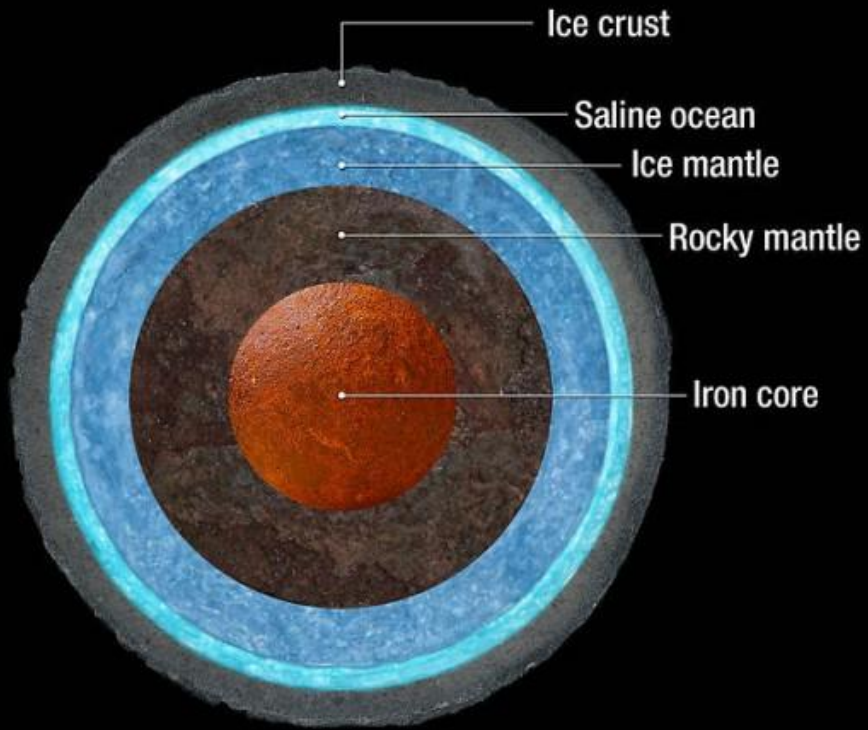
Subsurface
ocean

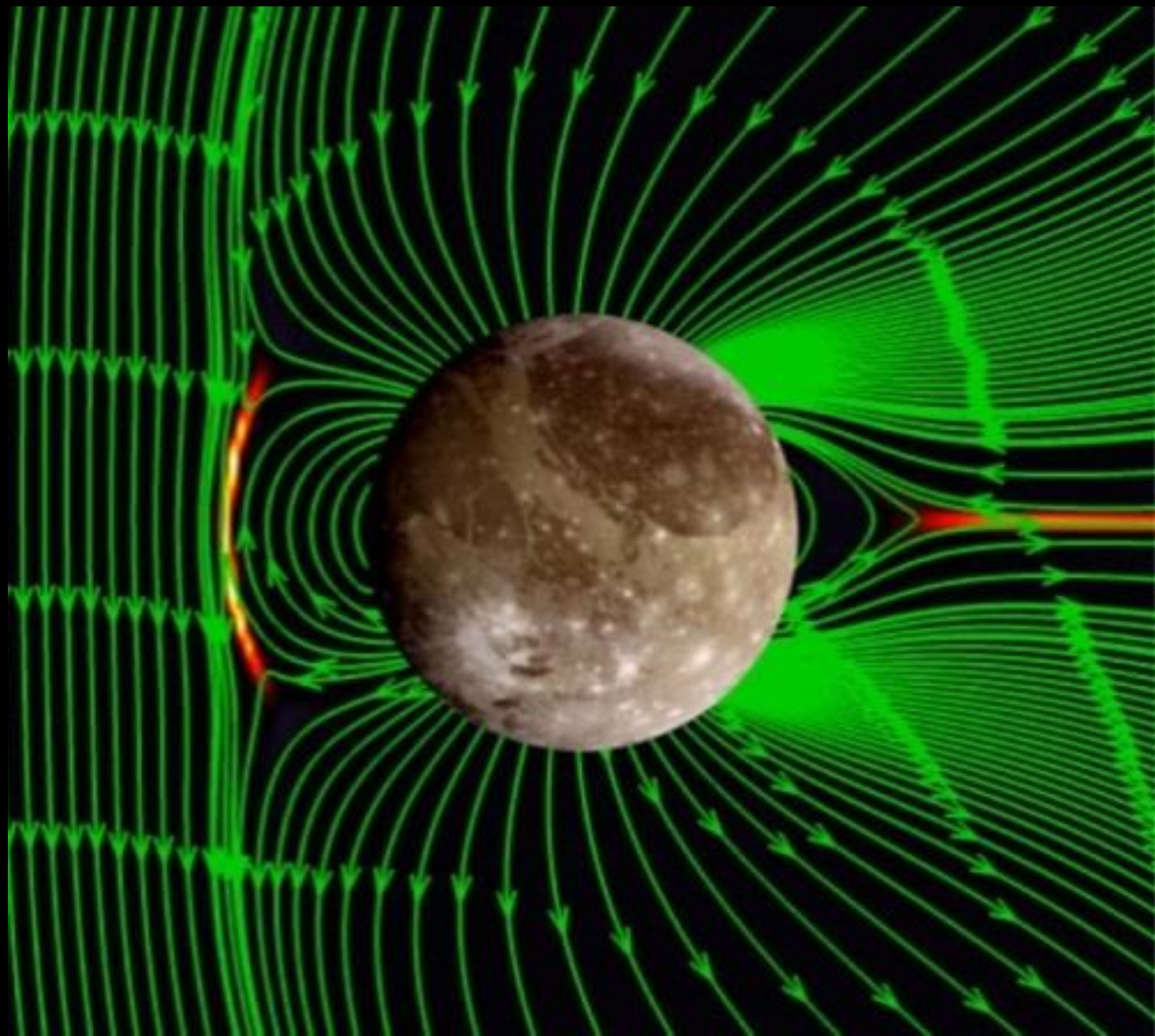
Volcanic
seafloor?

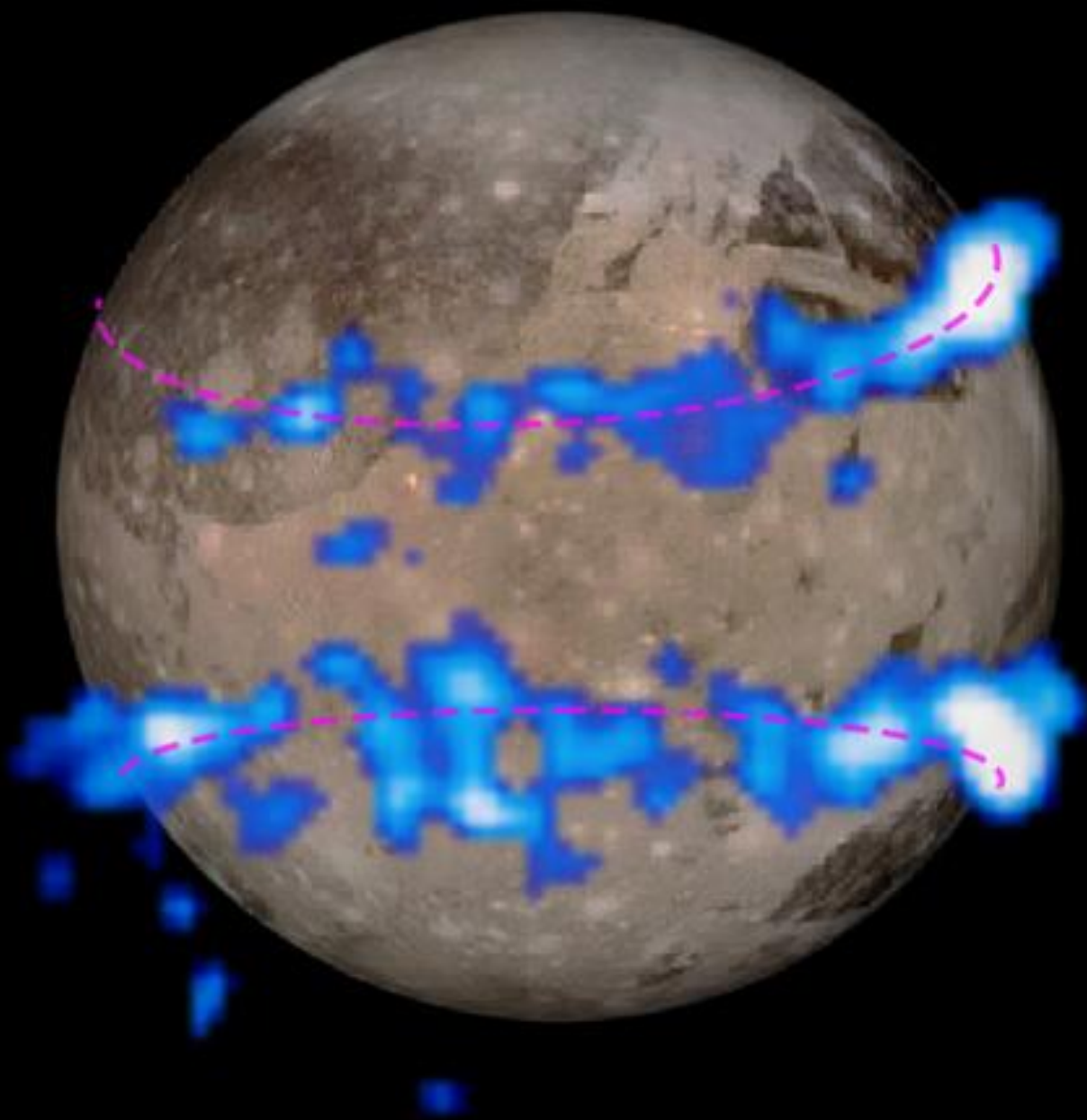


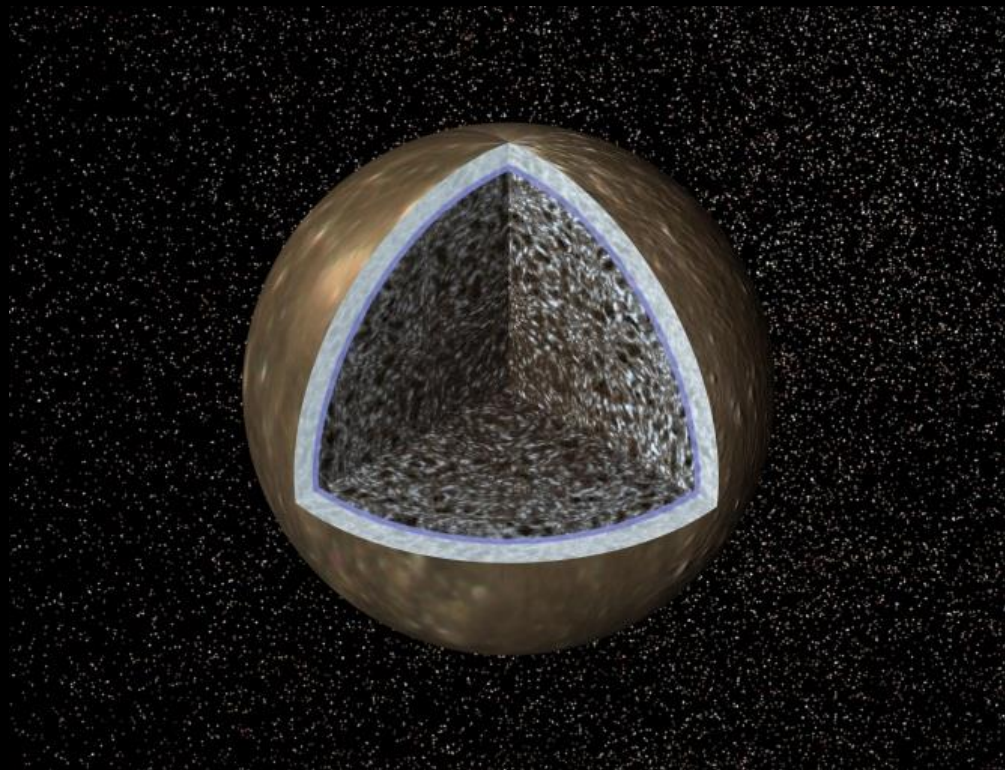


Ganymede Interior



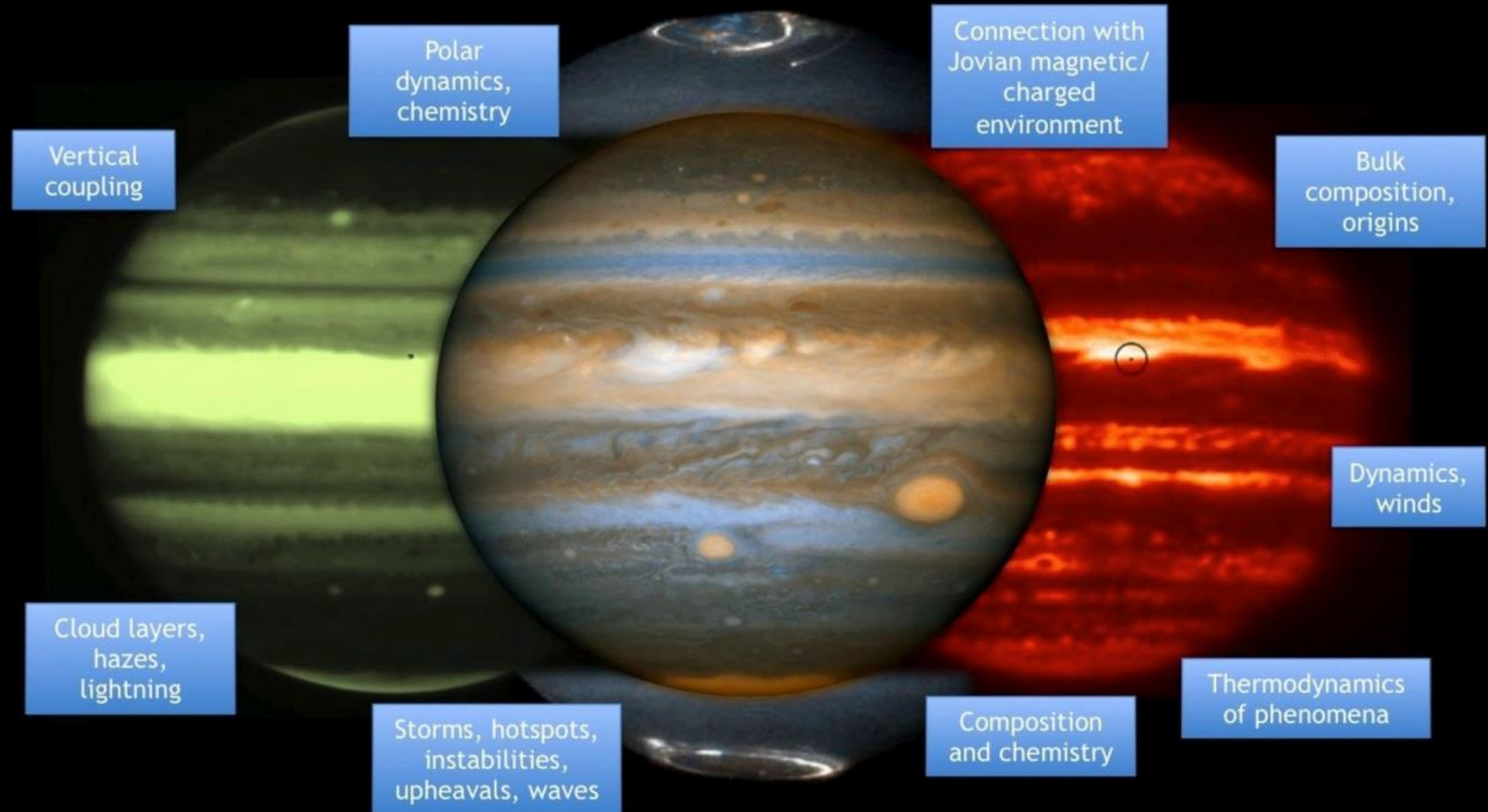






Jupiter atmosphere

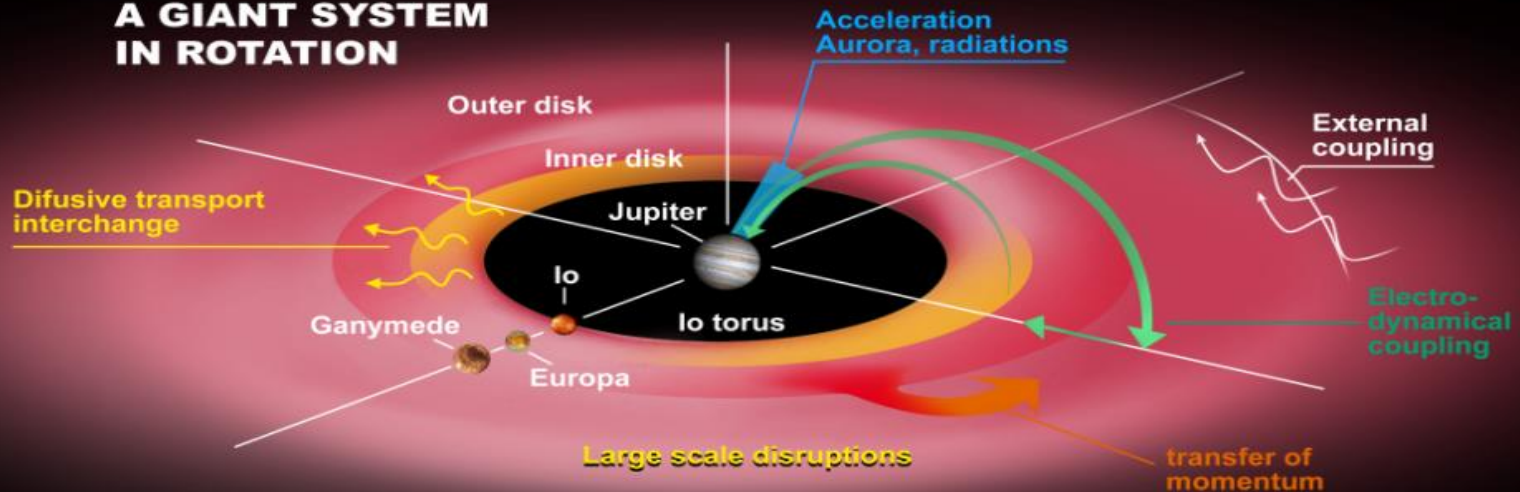
- *Atmospheric structure, composition and dynamics*
- *Coupling between troposphere, stratosphere and thermosphere*



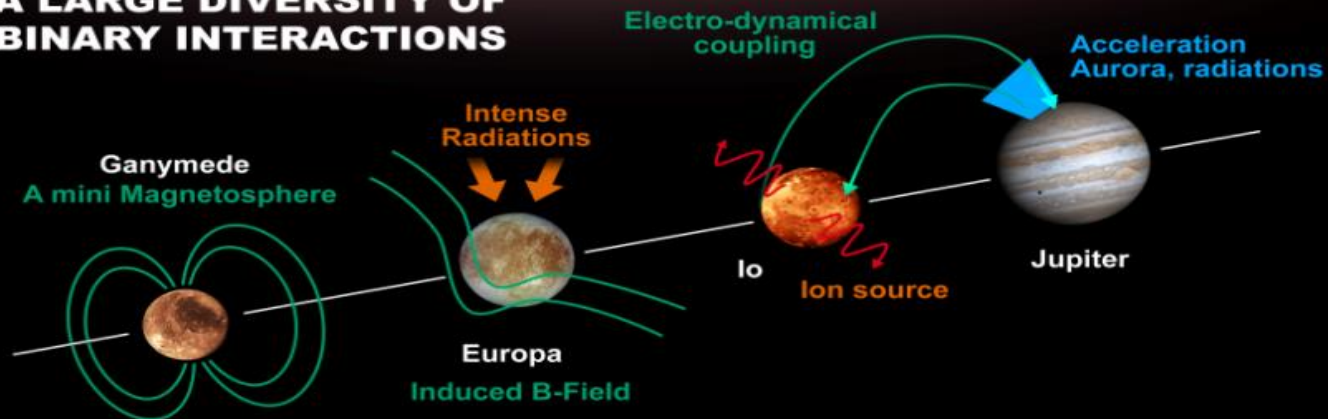
Jupiter magnetosphere

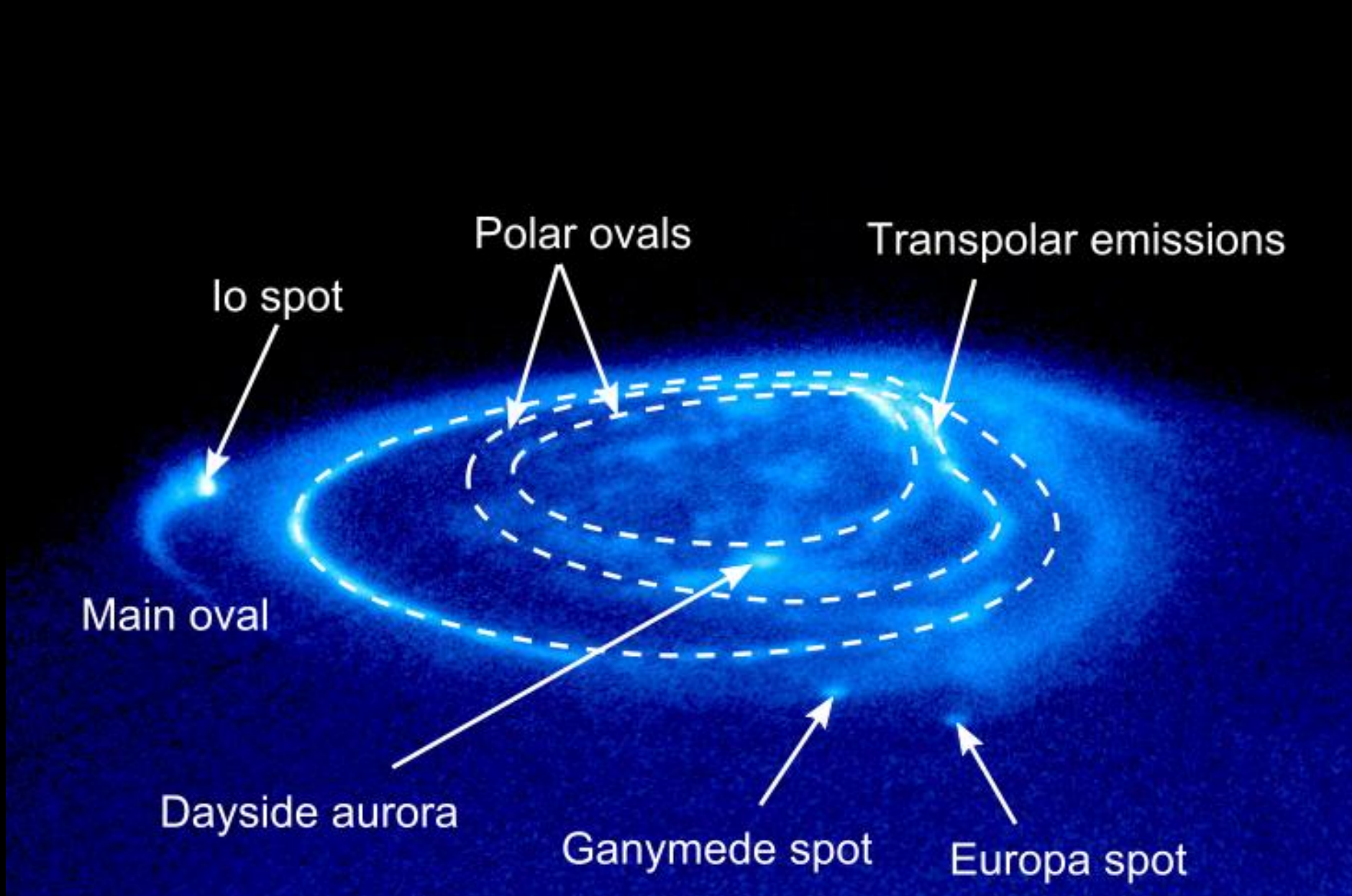
- *Magnetosphere as a fast rotator*
- *Magnetosphere as a giant particle accelerator*
- *Interaction of the Jovian magnetosphere with the moons*
- *Moons as sources and sinks of magnetospheric plasma*

A GIANT SYSTEM IN ROTATION

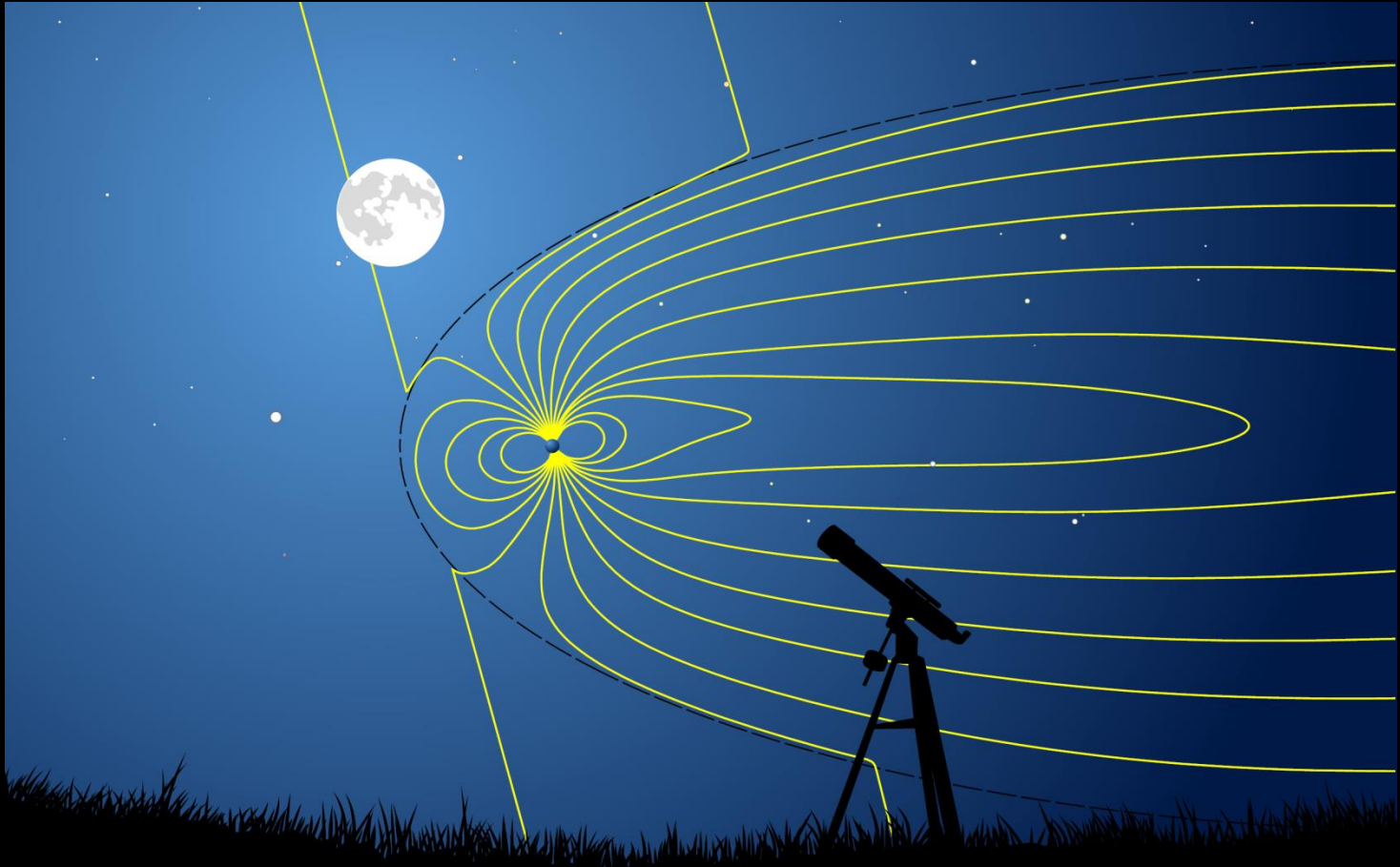


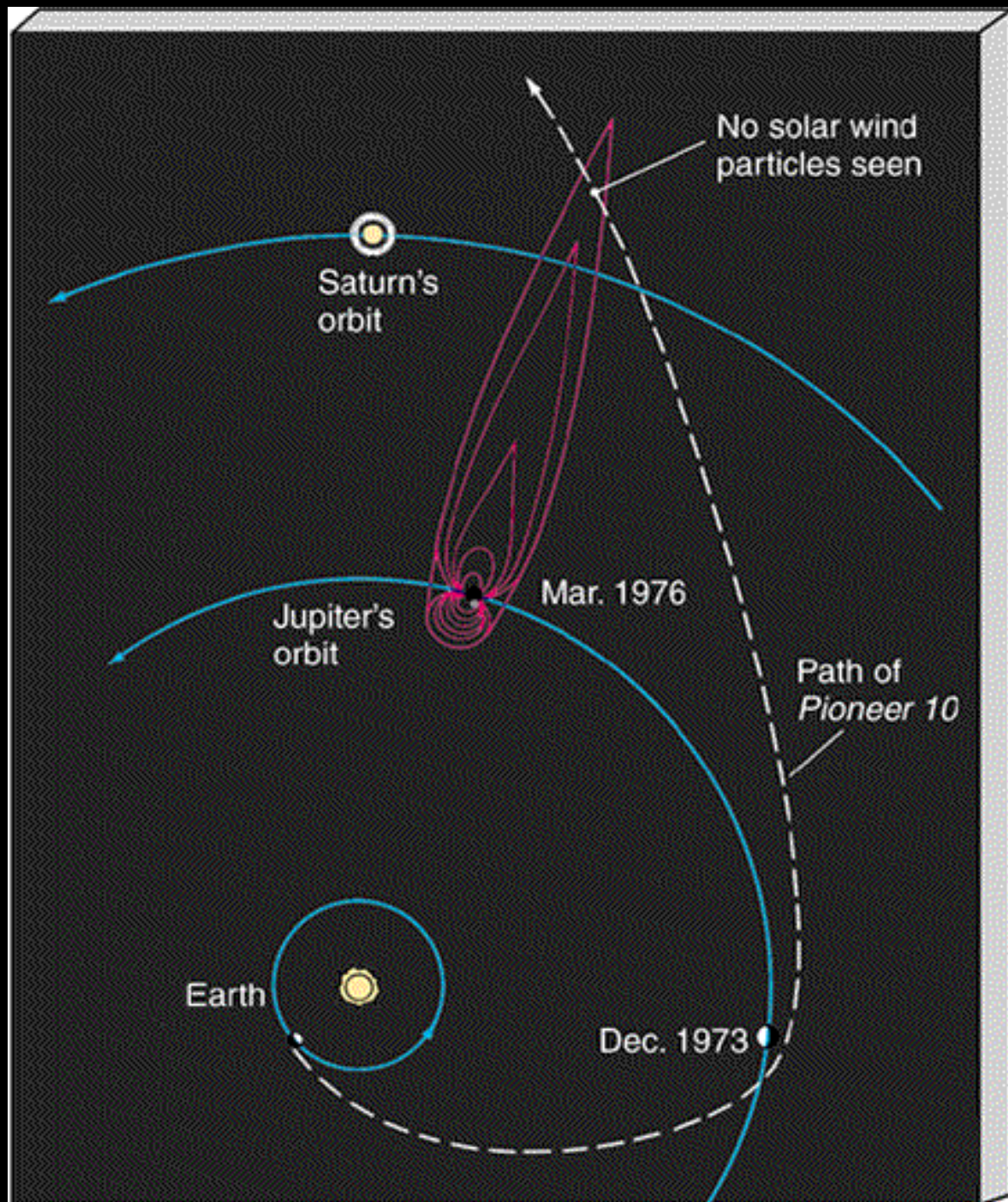
A LARGE DIVERSITY OF BINARY INTERACTIONS





Jovian magnetosphere





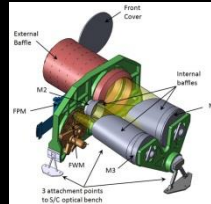
JUICE Payload

JANUS: Visible Camera System

PI: Pasquale Palumbo, Parthenope University, Italy.

Co-PI: Ralf Jaumann, DLR, Germany

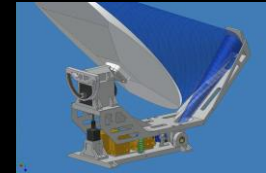
- ≥ 7.5 m/pixel
- Multiband imaging, 380 - 1080 nm
- Icy moon geology
- Io activity monitoring and other moons observations
- Jovian atmosphere dynamics



SWI: Sub-mm Wave Instrument

PI: Paul Hartogh, MPS, Germany

- 600 GHz
- Jovian Stratosphere
- Moon atmosphere
- Atmospheric isotopes

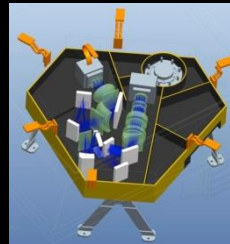


MAJIS: Imaging VIS-NIR/IR Spectrograph

PI: Yves Langevin, IAS, France

Co-PI: Guiseppe Piccioni, INAF, Italy

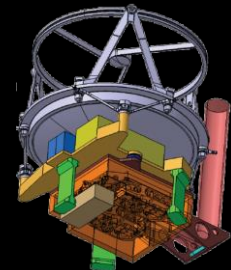
- 0.9-1.9 μ m and 1.5-5.7 μ m
- ≥ 62.5 m/pixel
- Surface composition
- Jovian atmosphere



GALA: Laser Altimeter

PI: Hauke Hussmann, DLR, Germany

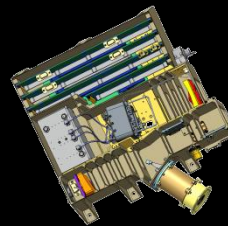
- ≥ 40 m spot size
- ≥ 0.1 m accuracy
- Shape and rotational state
- Tidal deformation
- Slopes, roughness, albedo



UVS: UV Imaging Spectrograph

PI: Randy Gladstone, SwRI, USA

- 55-210 nm
- 0.04° - 0.16°
- Aurora and Airglow
- Surface albedos
- Stellar and Solar Occultation



RIME: Ice Penetrating Radar

PI: Lorenzo Bruzzone, Trento, Italy

Co-PI: Jeff Plaut, JPL, USA

- 9 MHz
- Penetration ~ 9 km
- Vertical resolution 50 m
- Subsurface investigations



JUICE Payload

JMAG: JUICE Magnetometer

PI: Michele Dougherty, Imperial, UK

- Dual Fluxgate and Scalar mag
- ± 8000 nT range, 0.2 nT accuracy
- Moon interior through induction
- Dynamical plasma processes



3GM: Gravity, Geophysics, Galilean Moons

PI: Luciano Iess, Rome, Italy

Co-PI: David J. Stevenson, CalTech, USA

- Ranging by radio tracking
- $2 \mu\text{m/s}$ range rate
- 20 cm range accuracy
- Gravity fields and tidal deformation



PEP: Particle Environment Package

PI: Stas Barabash, IRF-K, Sweden

Co-PI: Peter Wurz, UBe, Switzerland

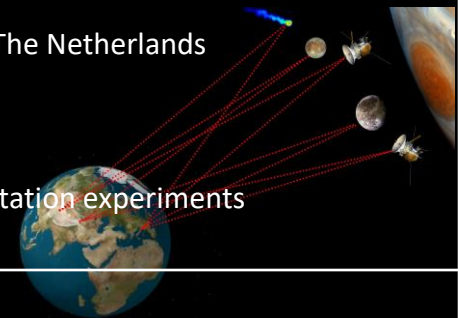
- Six sensor suite
- Ions, electrons, neutral gas (in-situ)
- Remote ENA imaging of plasma and torus



PRIDE: Planetary Radio Interferometer & Doppler Experiment

PI: Leonid Gurvits, JIVE, EU/The Netherlands

- S/C state vector
- Ephemerides
- bi-static and radio occultation experiments



RPWI: Radio and Plasma Wave Investigation

PI: Jan-Erik Wahlund, IRF-U, Sweden

- Langmuir Probes
- Search Coil Magnetometer
- Tri-axial dipole antenna
- E and B-fields
- Ion, electron and charged dust parameters



- Prime industrial Contractor: Airbus Defence & Space (Toulouse, France), selected in July 2015
- Spacecraft:
 - 3-axis stabilised
 - Mass:
 - Launch mass~ 5300 kg
 - Instruments~ 220 kg
 - Fuel~ 2850 kg
 - Solar array 97 m² (~850 W at Jupiter)

JUICE Spacecraft

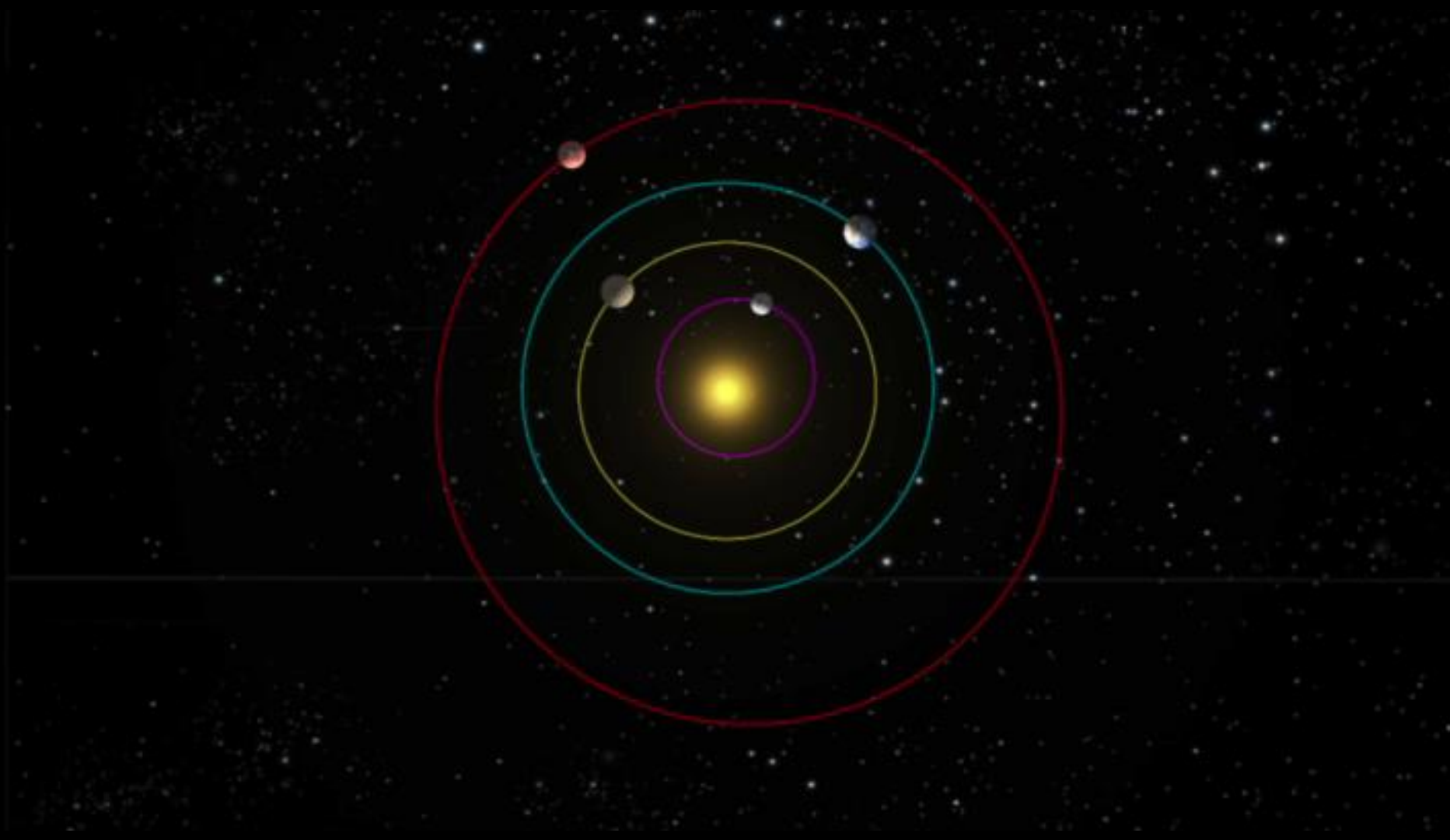


Courtesy Airbus D&S

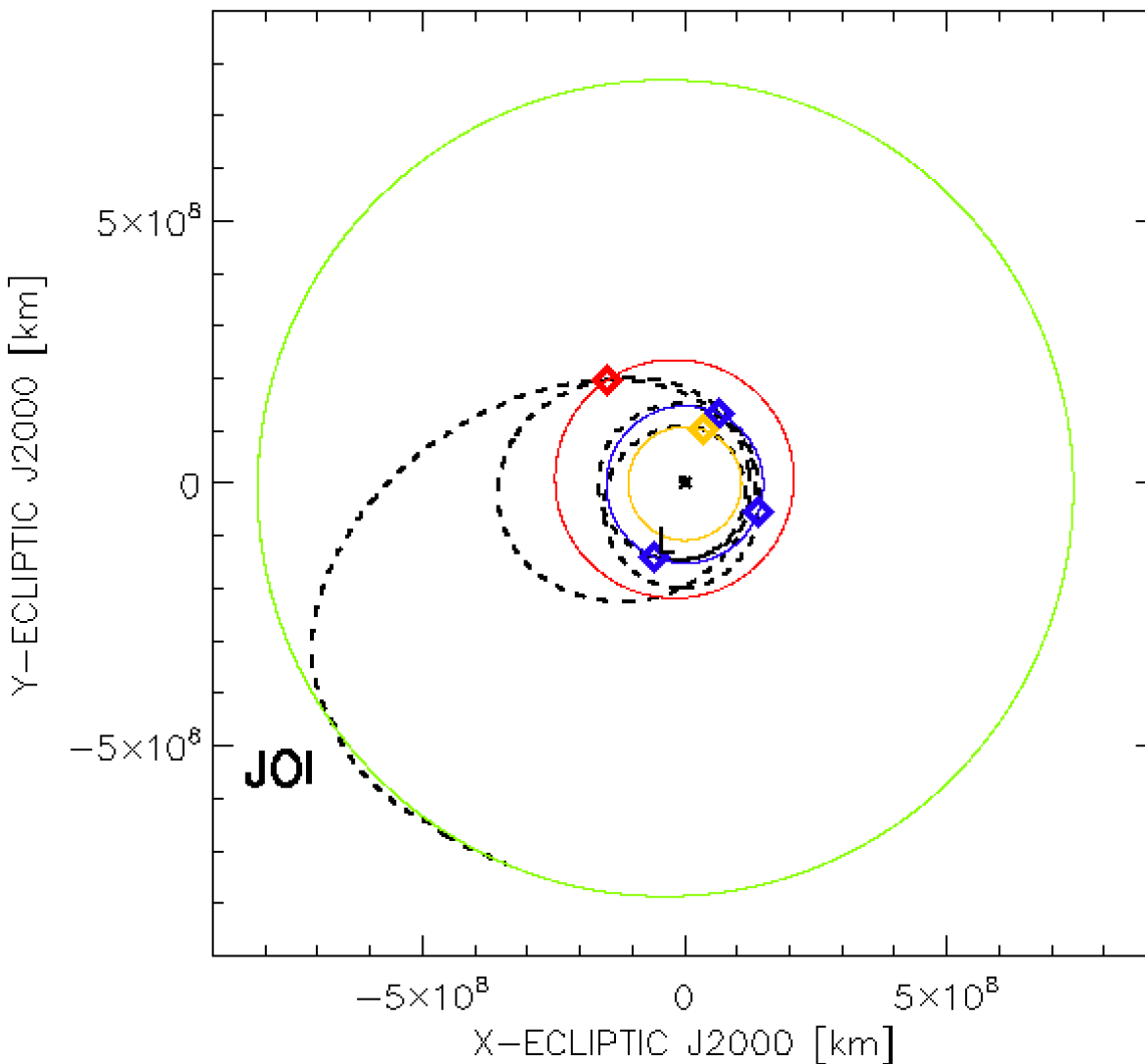
Overall Mission Profile



Launch	May/June 2022
Interplanetary transfer (Earth-Venus-Earth-Mars-Earth)	7.6 years
Jupiter orbit insertion	October 2029
2 Europa flybys	October 2030
Jupiter high-latitude phase	Dec 2030-May 2031
Transfer to Ganymede	June 2031-July 2032
Ganymede orbit insertion	August 2032
Ganymede elliptical orbit/5000 km circular orbit	August-Dec 2032
Ganymede 500 km Circular Orbit	January-June 2033
End of mission	June 2033



Cruise Phase with 5 Planetary Flybys



EARTH ORBIT

VENUS ORBIT

MARS ORBIT

JUPITER ORBIT

JUICE TRAJECTORY

Fbs: 2023-150T20:34:17 EARTH 12725 km

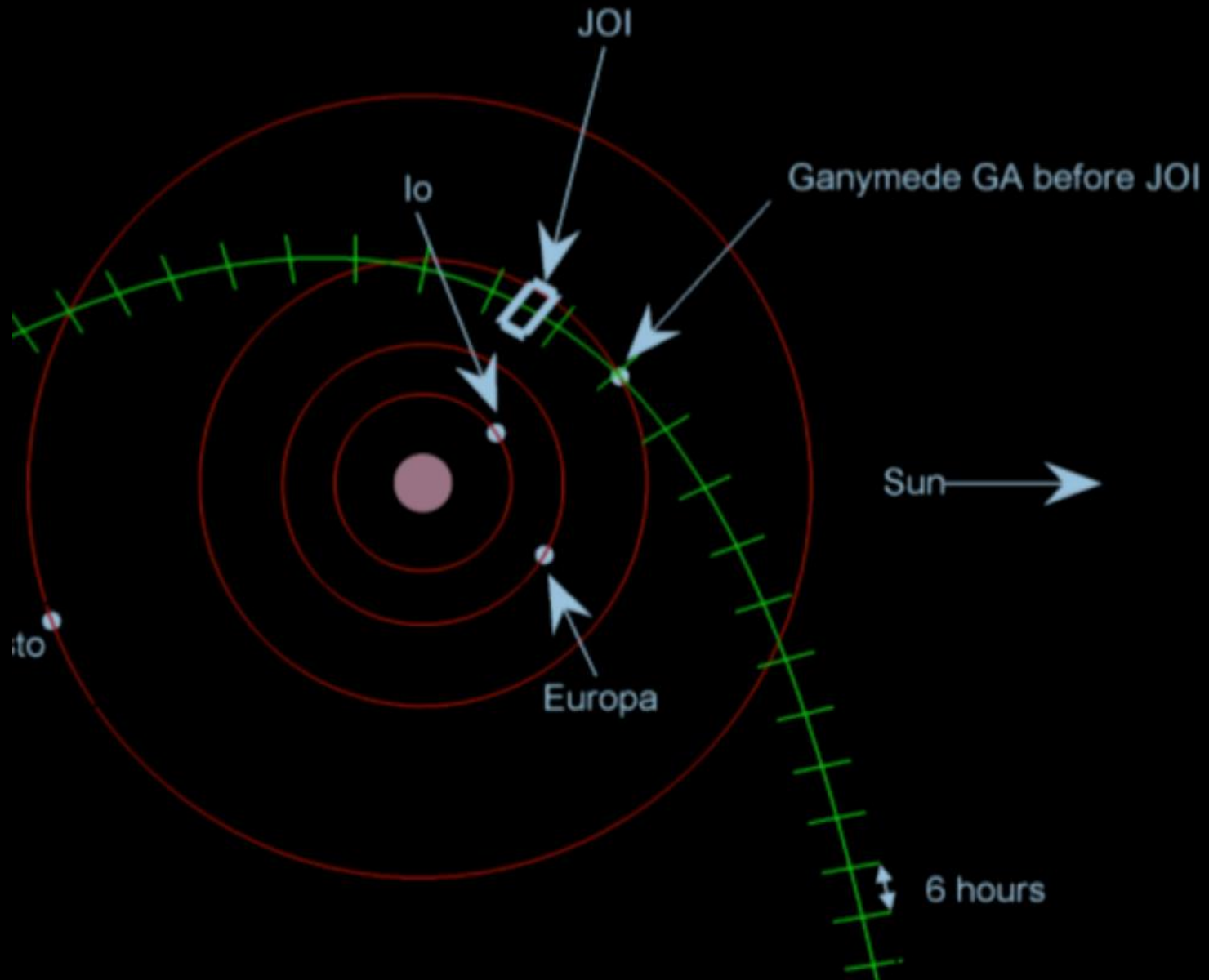
Fbs: 2023-295T14:22:33 VENUS 9538 km

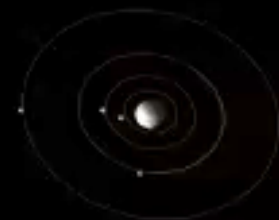
Fbs: 2024-245T19:24:31 EARTH 1945 km

Fbs: 2025-041T17:57:47 MARS 1118 km

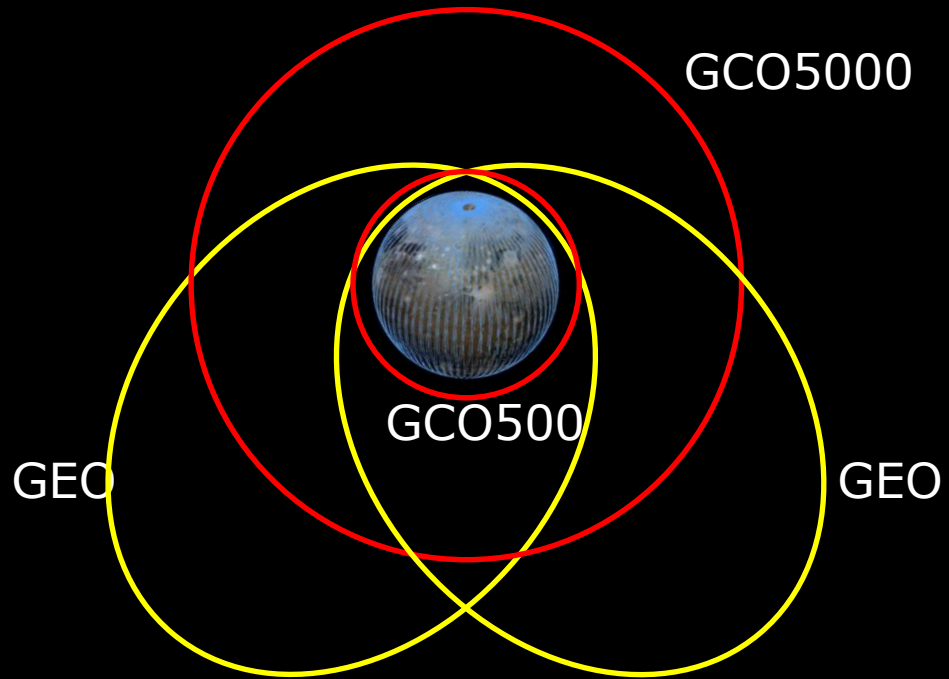
Fbs: 2026-330T01:25:08 EARTH 3683 km

Jupiter Orbit Insertion





- **2 EUROPA @ 400 km**
- **11 GANYMEDE @ 400-33 000 km**
- **13 CALLISTO @ 200-6000 km**

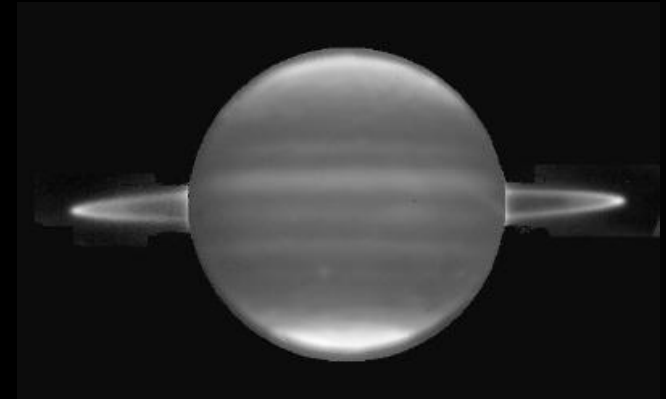
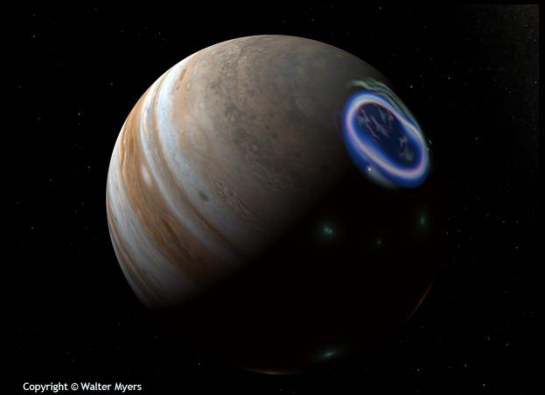
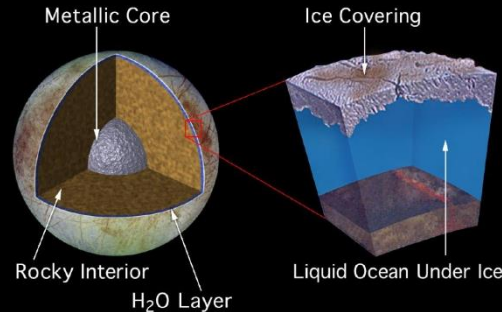


Challenges

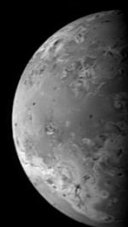
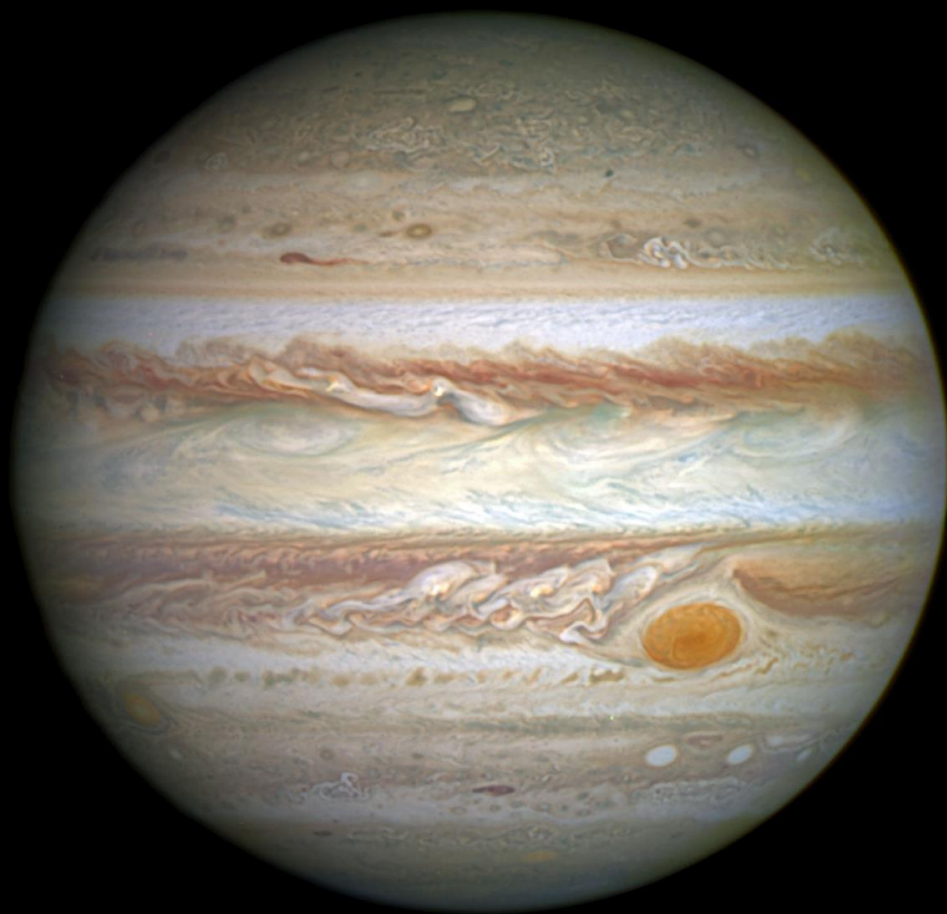
- Large mission, large teams
- Long cruise phase
- Complex navigation in the Jupiter system
- Radiation environment
- Power and thermal (cold)
- Spacecraft electromagnetic cleanliness
- Broad science
- (relatively low) data rate

Topics:

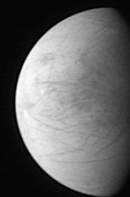
- Interior
- Subsurface
- Geology
- Atmosphere
- Plasma
- Planet, moons, rings
- Habitability
- Link to exoplanets



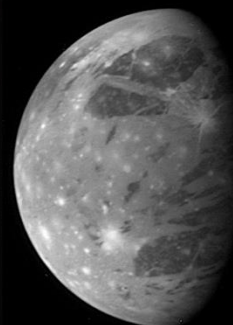
Jupiter system: largest planet, largest storm, fastest rotation, largest magnetic field, largest moon, largest moon system, most active moons



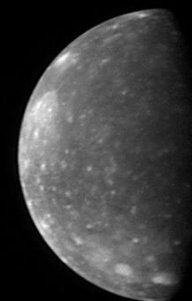
Io



Europa



Ganymede



Callisto

Thank you for your attention
Olivier.Witasse@esa.int