

The Jupiter Ganymede Orbiter

the ESA component of the
Europa Jupiter System Mission

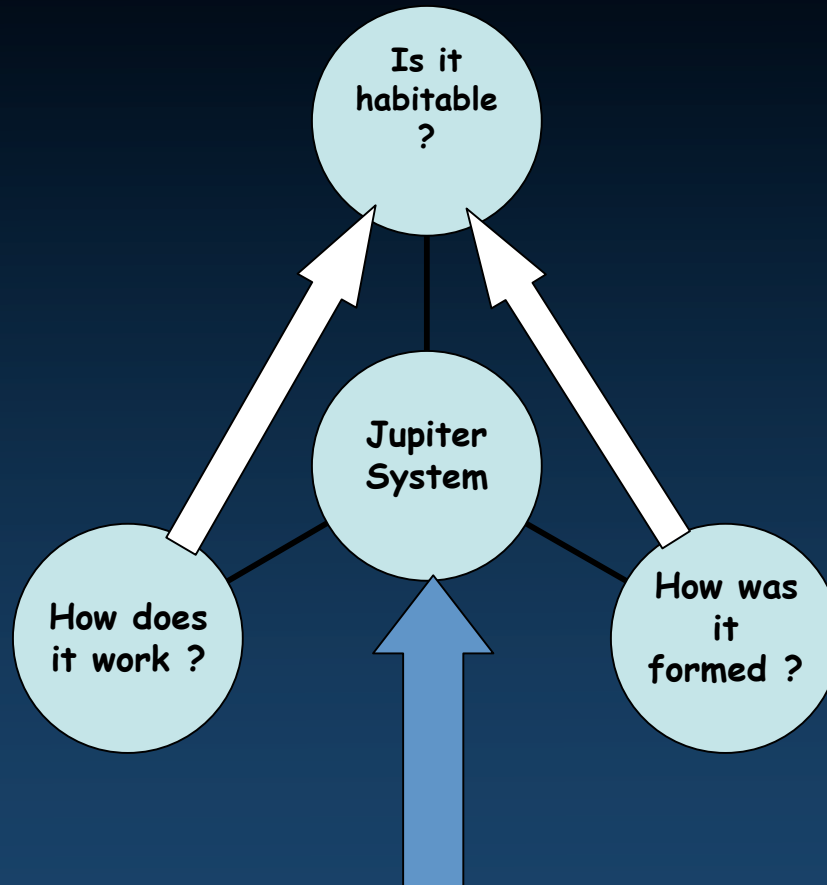
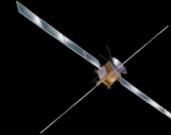
Science objectives and planning payload

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September 22nd, 2009



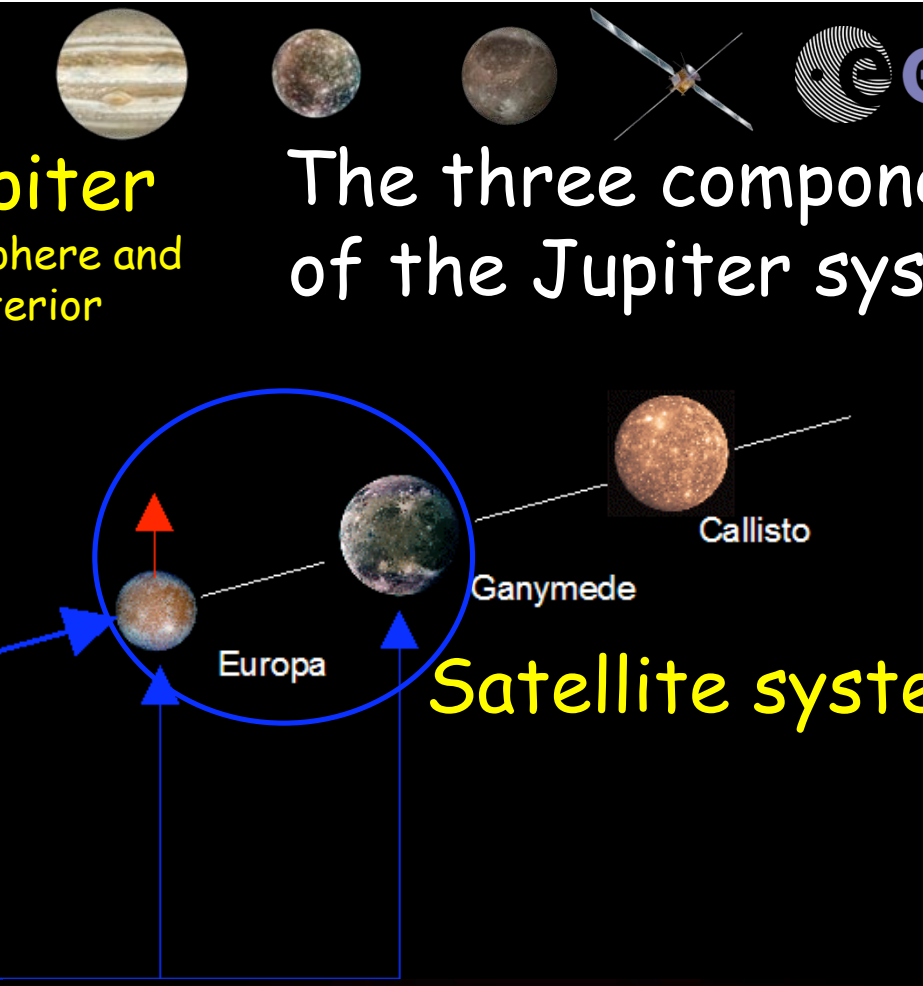
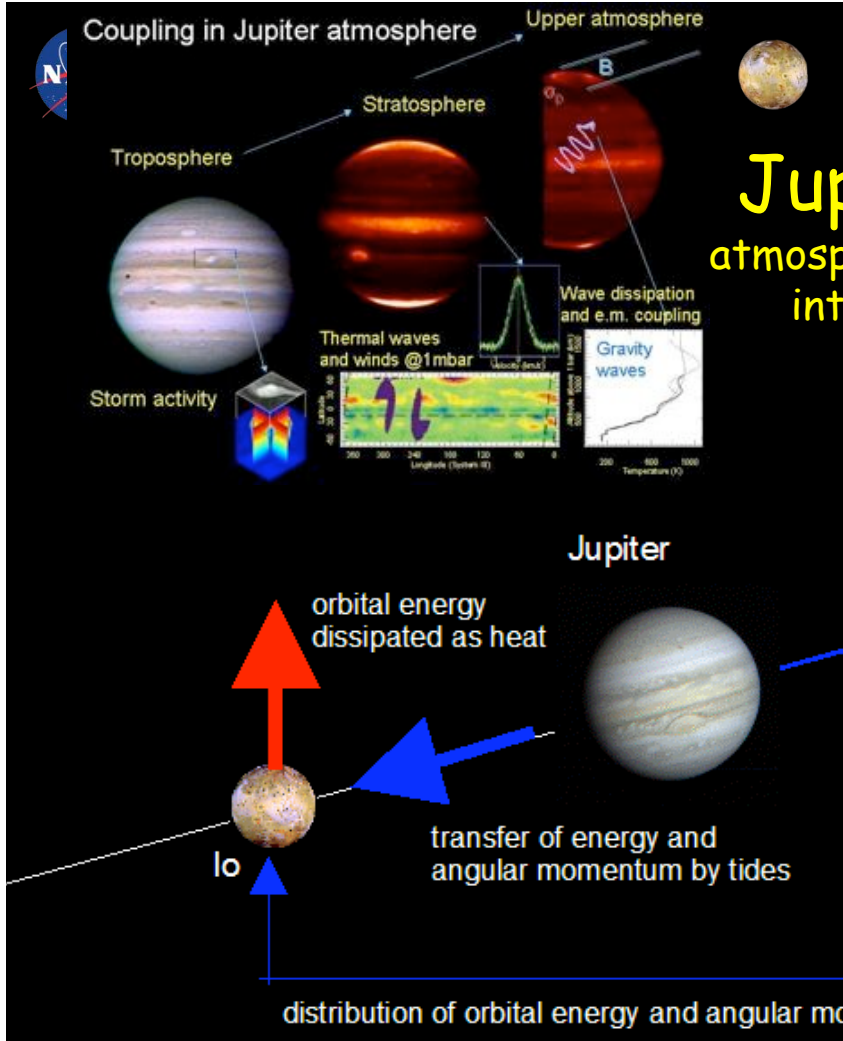
« The emergence of habitable worlds around gas giants »

Overarching science goal of EJSM

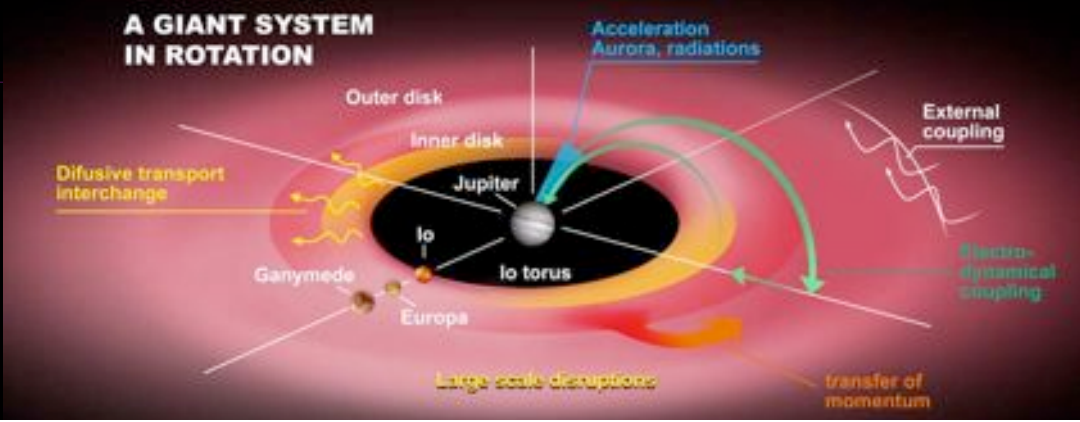
The three components of the Jupiter system

Jupiter atmosphere and interior

Satellite system



Magnetodisk/ radiation belts





The Galilean satellite system: focus of the Jupiter System



ORBITERS

In-depth comparative science

MULTIPLE
FLY-BY's

MULTIPLE
FLY-BY's



Io

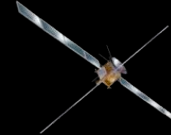
Europa

Ganymede

Callisto

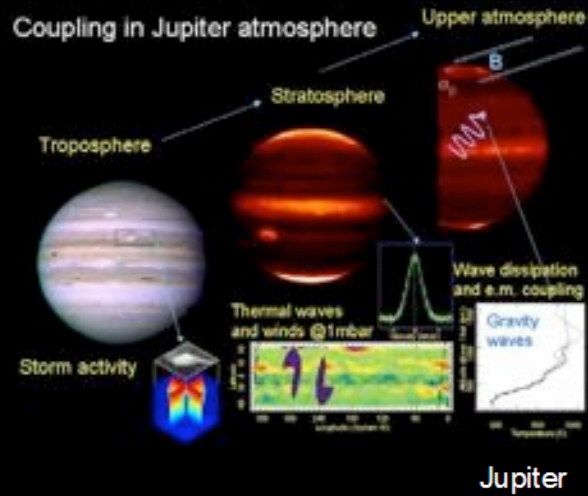
JEO

JGO

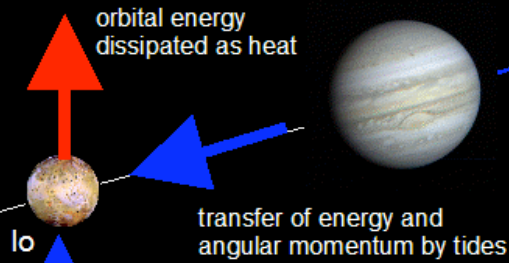
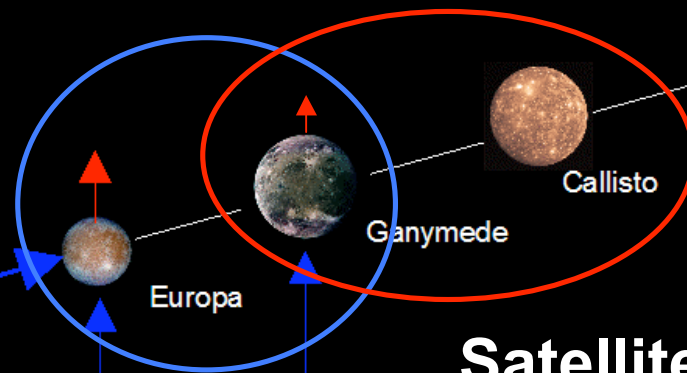


The three components of the Jupiter system

Jupiter



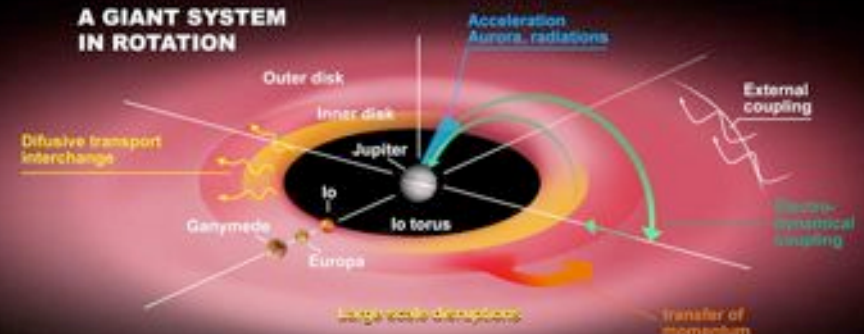
JGO focus

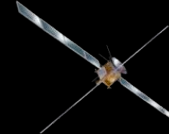


distribution of orbital energy and angular momentum (Laplace resonance)

Magnetodisk/ radiation belts

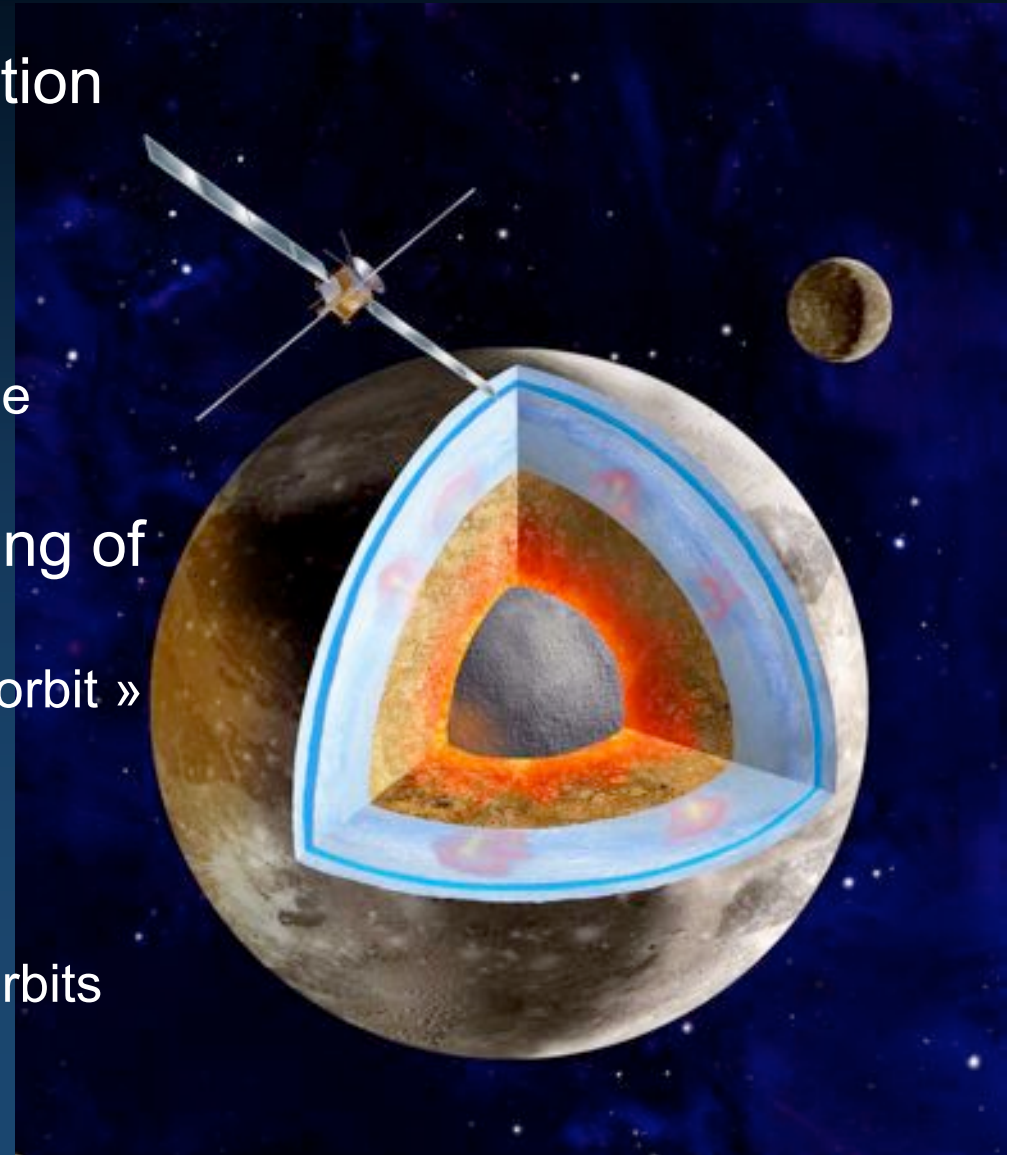
A GIANT SYSTEM IN ROTATION

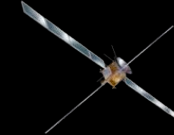




JGO Key Objectives

- In-depth post-Galileo exploration of the **Jupiter system**, synergistically with JEO
En route to Callisto and Ganymede
- In-depth study and full mapping of **Callisto**
Multiple fly-bys using a « pseudo-orbit »
- Detailed orbital study of **Ganymede**
two successive dedicated moon orbits (elliptical first, then circular)

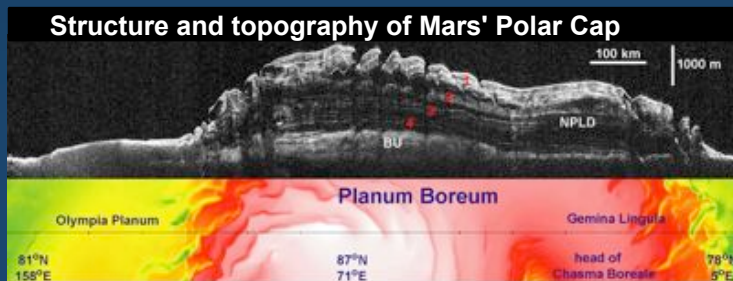
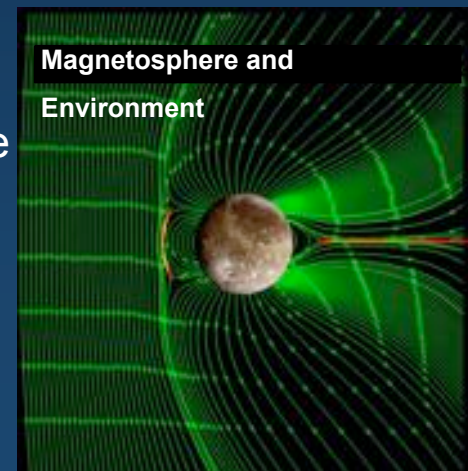
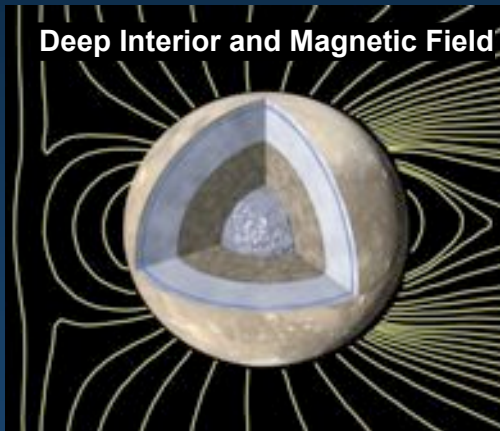
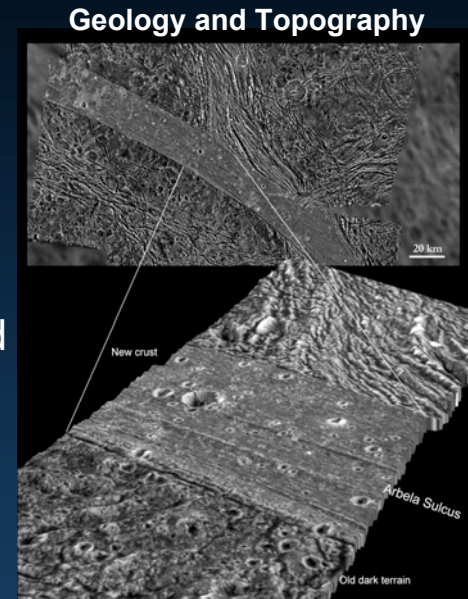
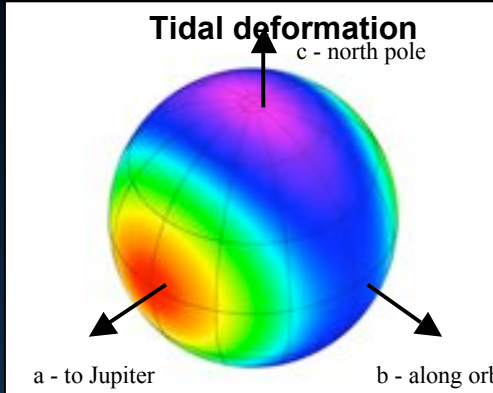


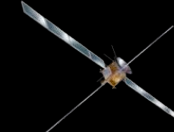


Ganymede:

Europa's "false twin"

- Presence and extent of a subsurface ocean
- Ice shell and subsurface water
- Deep internal structure, dynamo, magnetic field
- Surface/exosphere/magnetosphere coupling
- Surface composition and chemistry
- Surface features, tectonic processes
- Thermal evolution, geology, Laplace resonance

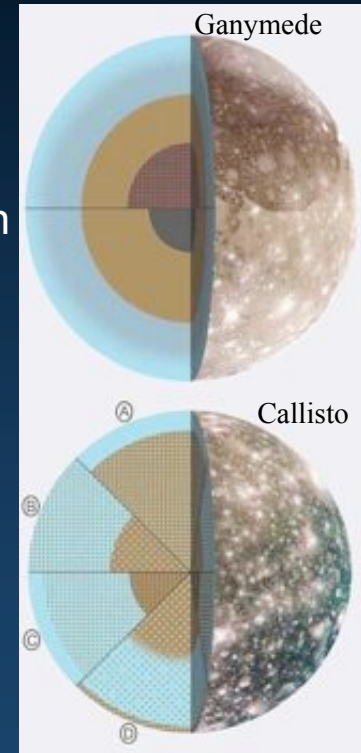




Callisto

A witness of the Early Ages ?

- Presence and extent of a subsurface ocean
- Ice shell and subsurface water
- Deep internal structure, degree of differentiation
- Cratering record and early geological history
- Surface composition: hydrocarbons and CO₂
- Surface degradation processes (erosion and sublimation)

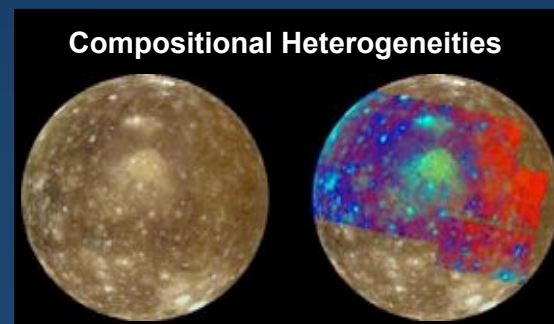
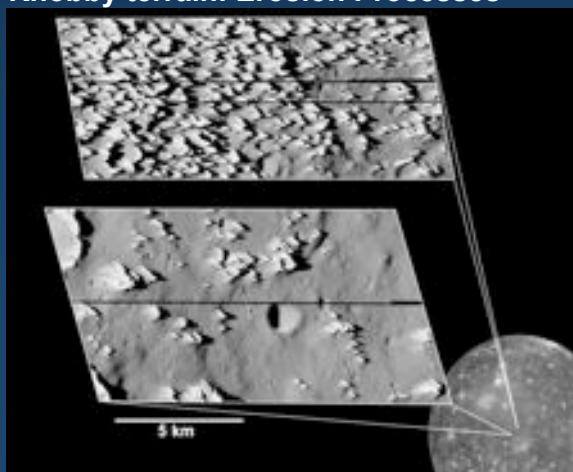


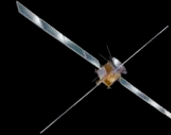
**Internal differentiation:
Where is Callisto ?**

Image: Bagenal et al., 2004



Knobby terrain: Erosion Processes





Coupling in Jupiter atmosphere

In-depth study of three key layers by JGO

Upper atmosphere

Stratosphere

Troposphere

Magnetosphere coupling

Energy balance

Circulation

Winds

Minor species

Origin of H₂O

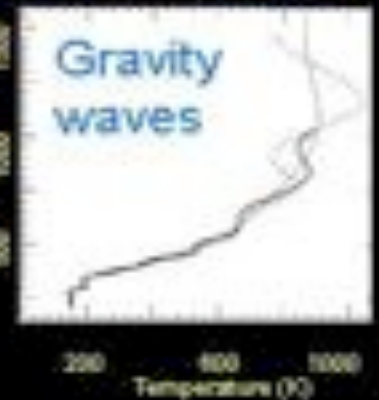
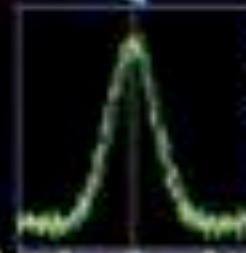
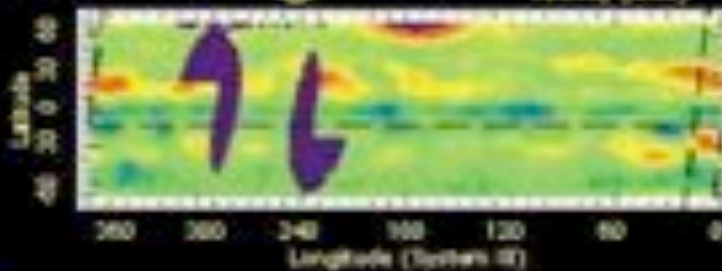
From cloud-level to deep circulation
• Role of internal waves

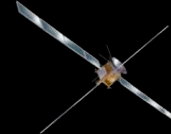
Wave dissipation and e.m. coupling

Storm activity



Thermal waves and winds @1mbar

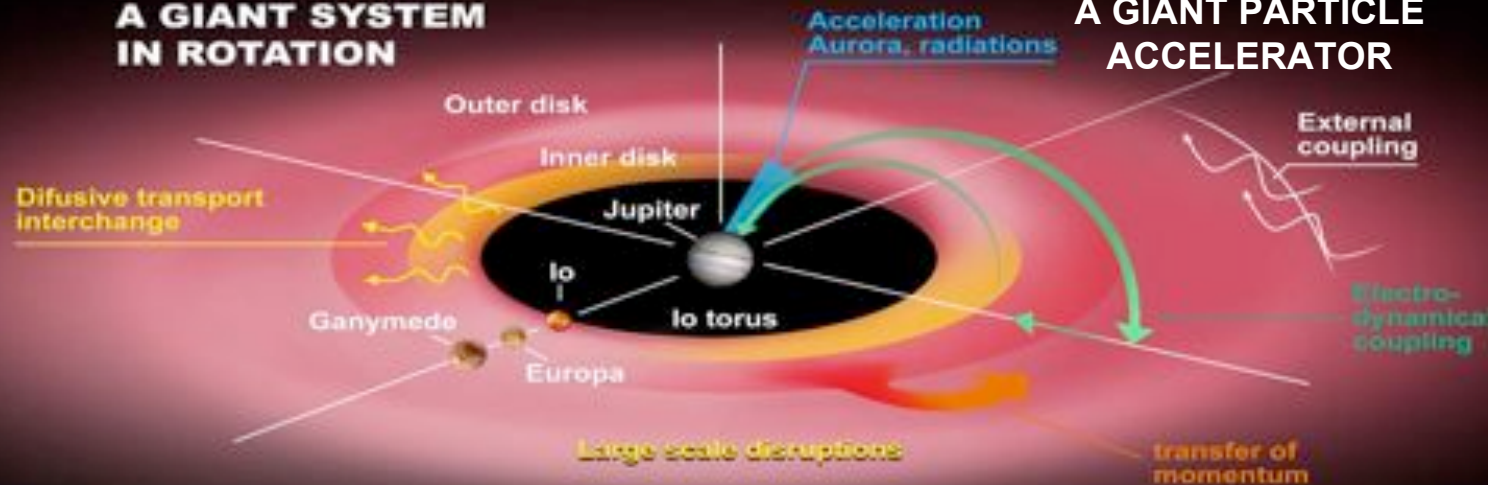




The Magnetosphere of Jupiter:

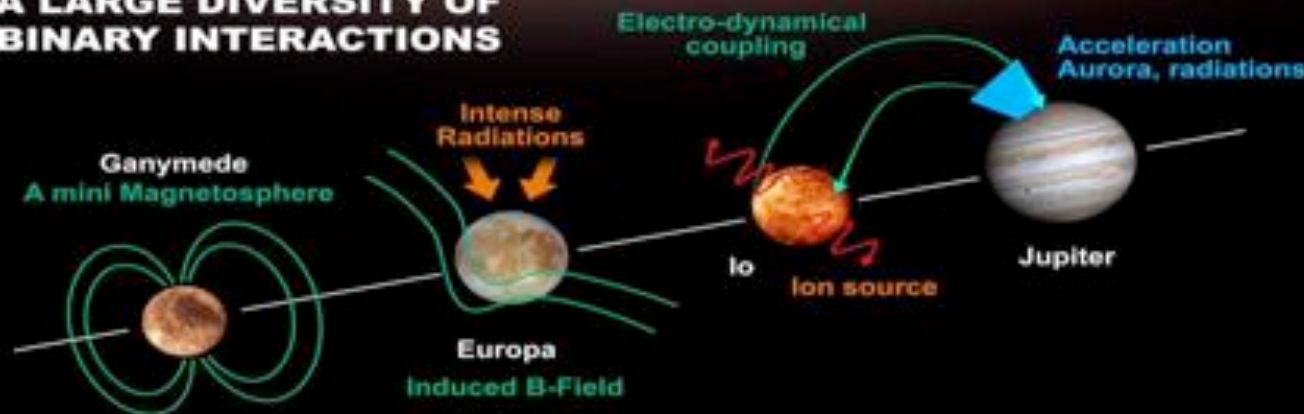
Studying an astrophysical magnetodisk in situ

A GIANT SYSTEM IN ROTATION



A GIANT PARTICLE ACCELERATOR

A LARGE DIVERSITY OF BINARY INTERACTIONS

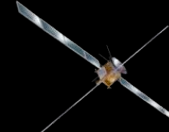


- Angular momentum transfer

- Energy dissipation

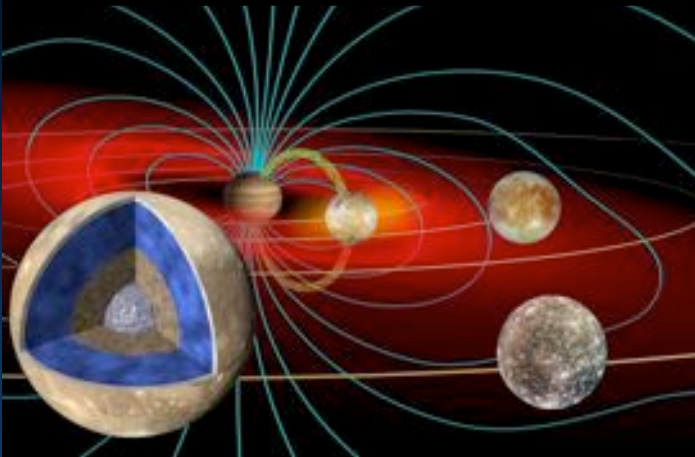
- Formation of Radiation Belts

- Effects on moons and habitability



Studying the Jovian World as a Coupled System: *where JGO, JEO (and JMO?) unite*

Electrodynamic coupling



Comparative geology of the Galilean Satellites

- **ELECTRODYNAMIC COUPLING**

Studying “astrophysical” binary systems in situ



Irregular Satellites?



Inner satellites and rings

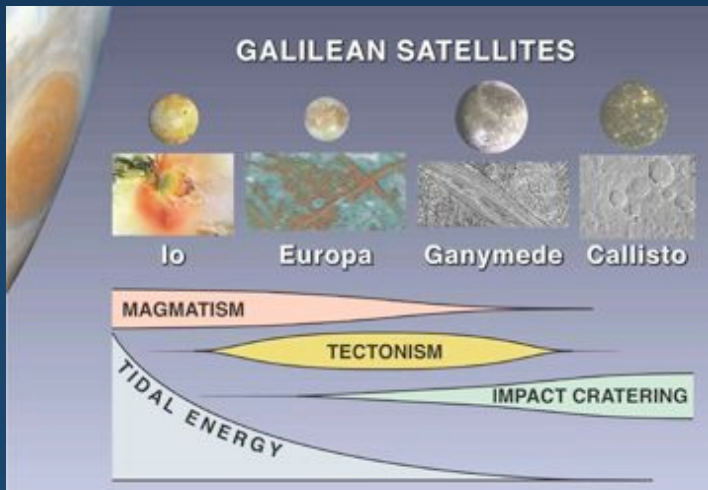


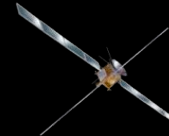
Image: Greeley et al., 2004

- **CHEMICAL EVOLUTION OF THE SATELLITE SYSTEM**

From formation to habitability ?

- **GRAVITATIONAL COUPLING**

The coupled history of the Laplace resonance, thermal evolution, differentiation and geological activity



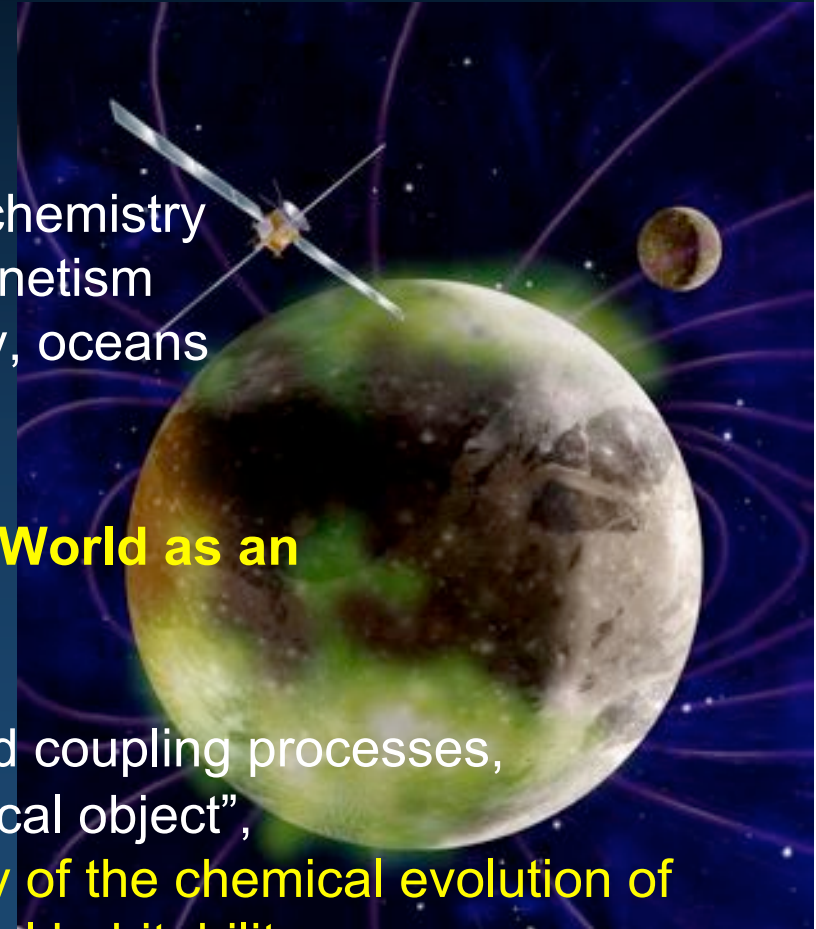
JGO SCIENCE HIGHLIGHTS

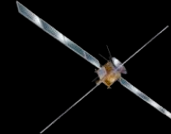
A major step forward in our understanding of the two “icy” Galilean satellites, Ganymede and Callisto:

- Ocean detection/characterisation
- State of internal differentiation
- Global surface mapping: morphology and chemistry
- Comprehensive study of Ganymede’s magnetism
- Relations between thermal history, geology, oceans and the Laplace resonance

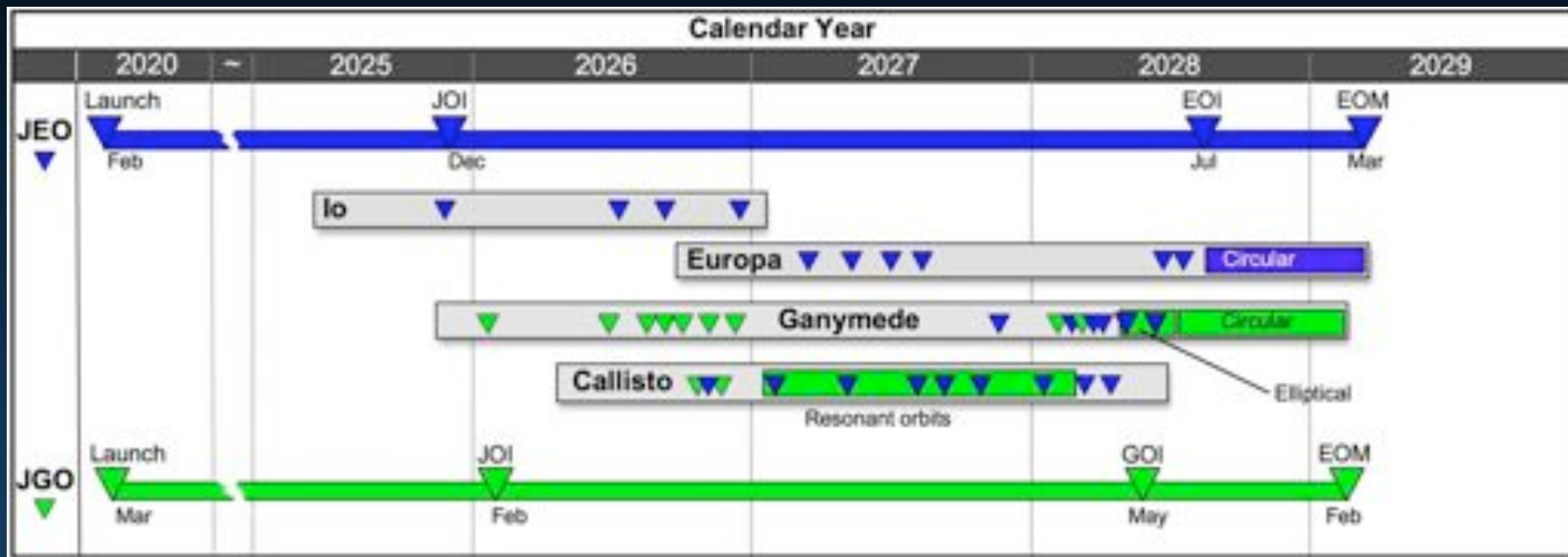
The first global description of the Jovian World as an “integrated system”, together with JEO:

- Jupiter’s atmosphere 3-D meteorology and coupling processes,
- Jupiter’s magnetosphere as an “astrophysical object”,
- A major step towards **untangling the history of the chemical evolution of the Jupiter system, from formation to potential habitability**

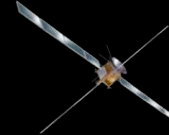




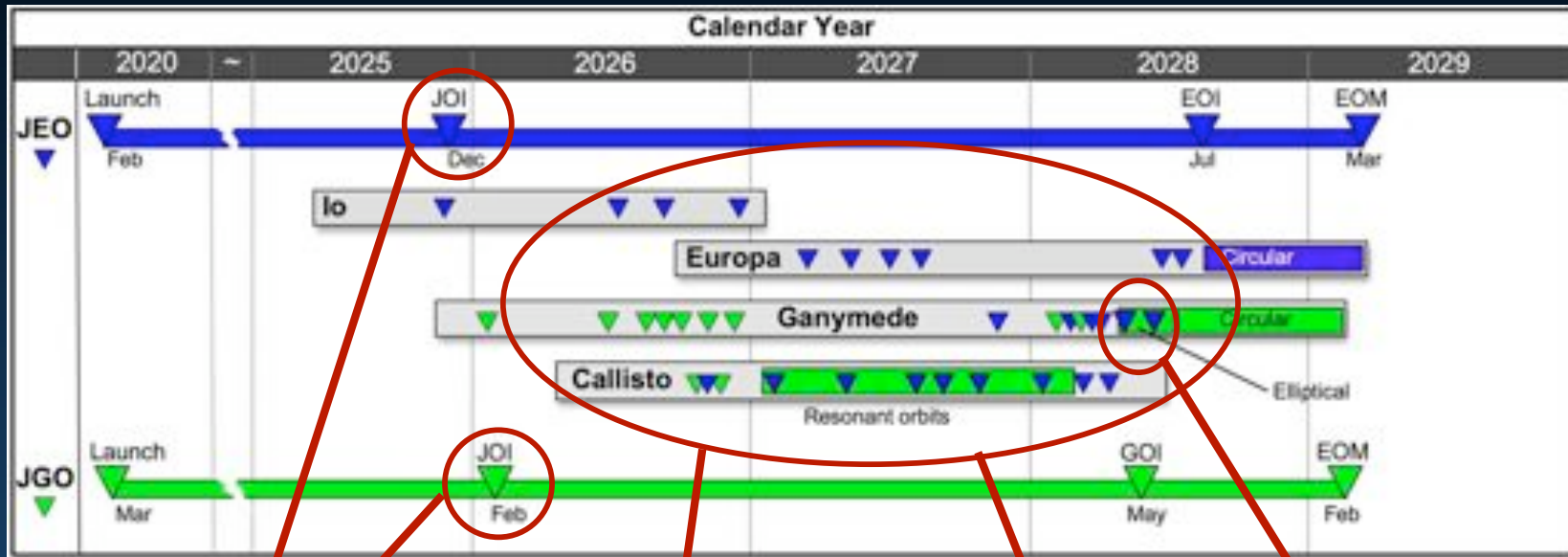
EJSM Mission profile



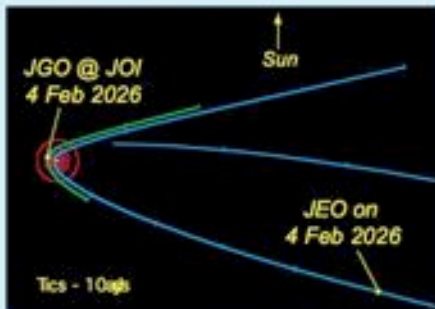
- JEO and JGO explore/characterise different objects and parts of the system
- Comparative science (Europa vs Ganymede vs Callisto)
- JGO and JEO perform **synergistic observations**



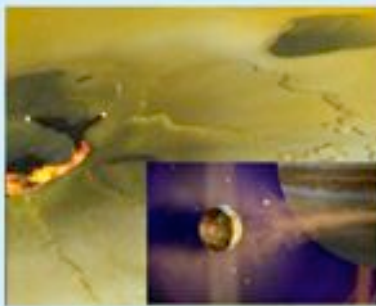
EJSM synergistic observations



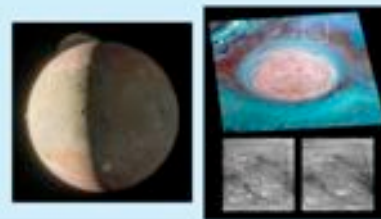
Jupiter Magnetosphere Studies



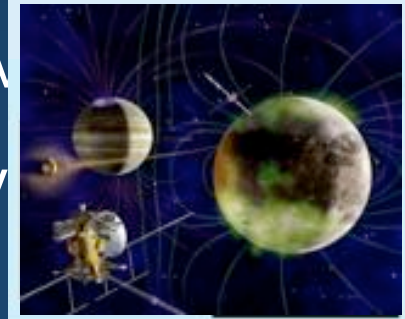
Io Volcanism & Io Torus Dynamics

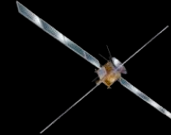


Satellite/Jupiter Monitoring



Ganymede Magnetosphere Studies





Ganymede Magnetosphere Studies

