The Jupiter Ganymede Orbiter

the ESA component of the Europa Jupiter System Mission

Science objectives and planning payload

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How does it work?

How was it formed?

Is it habitable?

Jupiter System

« 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

Io
Europa
Ganymede
Callisto

JEO
JGO
The three components of the Jupiter system

Satellites

Magnetodisk/radiation belts

Jupiter

JGO focus

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

Tidal deformation

a - to Jupiter
b - along orbit
c - north pole

Deep Interior and Magnetic Field

Structure and topography of Mars’ Polar Cap

Compositional Differences

Geology and Topography

Magnetosphere and Environment

Deep Interior and Magnetic Field
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)

* Image: Bagenal et al., 2004 *
In-depth study of three key layers by JGO

- Coupling in Jupiter atmosphere
- Troposphere
- Stratosphere
- Upper atmosphere

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

- Winds
- Minor species
- Origin of H2O

- Magnetosphere coupling
- Energy balance
- Circulation

- Storm activity
- Thermal waves and winds @1mbar
- Wave dissipation and e.m. coupling

- Gravity waves
The Magnetosphere of Jupiter:
Studying an astrophysical magnetodisk in situ

- 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**
  Studying “astrophysical” binary systems in situ

- **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
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
• 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

- JEO and JGO explore/characterise different objects and parts of the system:
  - Comparative science (Europa vs Ganymede vs Callisto)
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- EJSM synergistic observations:
  - Io Volcanism & Io Torus Dynamics
  - Satellite/Jupiter Monitoring
  - Ganymede Magnetosphere Studies
  - Jupiter Magnetosphere Studies
Ganymede Magnetosphere Studies