

JUICE

“rafraîchissement sur une mission juteuse”©

B. Cecconi [LESIA]

M. Cornu

JUICE

“rafraîchissement sur une mission juteuse”[©]

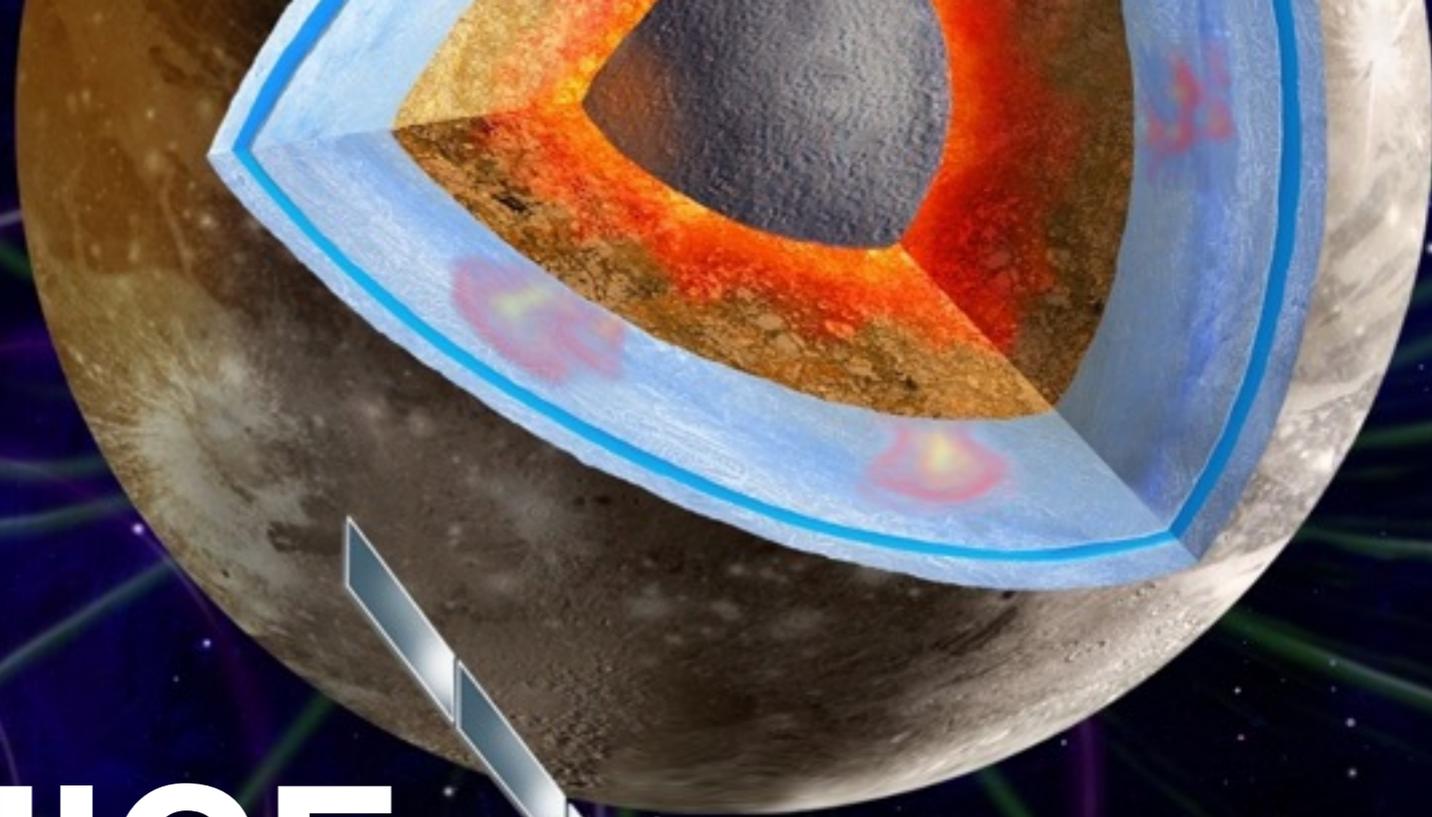
B. Cecconi [LESIA]

nee !!! mijn
sap weer
veranderd in
melk !!

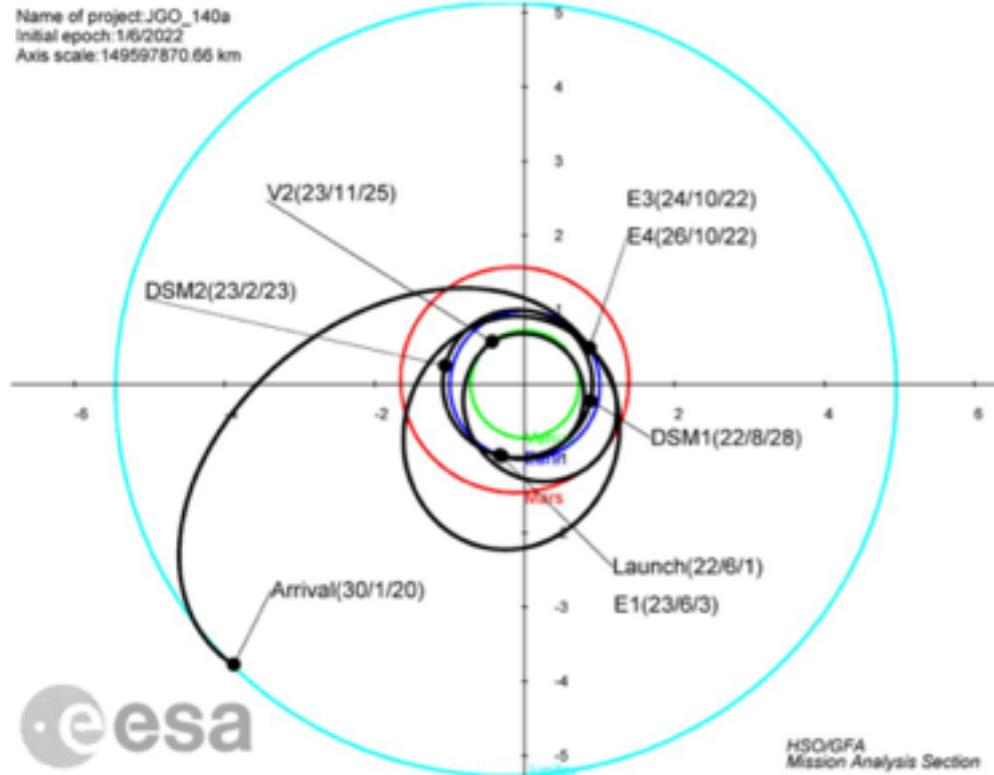
*Un rêve hollandais
qui remonte à Vermeer
et qui devient possible grâce à l'ESA*

EJSM

Laplace

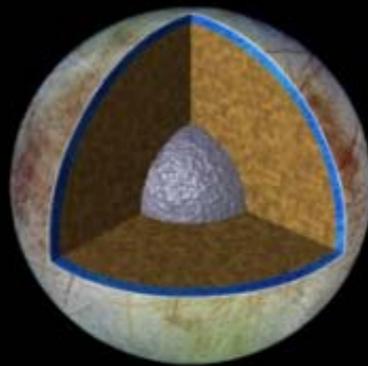


Descriptif sommaire de la mission JUICE



Tour phase	Duration, days	Δv , m/s
1 st orbit (G1 to G2)	186	952
From G2 to departure from Callisto to Europa	193	27
Europa phase	35	30
Inclined phase	208	13
Transfer to Ganymede	353	60
Ganymede orbital phase	284	614
Full tour (JOI to EOM)	1259	1696

Jupiter Icy Moons Explorer	
Key science goals	The emergence of habitable worlds around gas giants Characterise Ganymede, Europa and Callisto as planetary objects and potential habitats Explore the Jupiter system as an archetype for gas giants
Payload	Ten instruments Laser Altimeter Radio Science Experiment Ice Penetrating Radar Visible-Infrared Hyperspectral Imaging Spectrometer Ultraviolet Imaging Spectrograph Imaging System Magnetometer Particle Package Submillimetre Wave Instrument Radio and Plasma Wave Instrument
Overall mission profile	06/2022 - Launch by Ariane-5 ECA + EVEE Cruise 01/2030 - Jupiter orbit insertion <u>Jupiter tour</u> Transfer to Callisto (11 months) Europa phase: 2 Europa and 3 Callisto flybys (1 month) Jupiter High Latitude Phase: 9 Callisto flybys (9 months) Transfer to Ganymede (11 months) 09/2032 - Ganymede orbit insertion <u>Ganymede tour</u> Elliptical and high altitude circular phases (5 months) Low altitude (500 km) circular orbit (4 months) 06/2033 - End of nominal mission
Spacecraft	3-axis stabilised Power: solar panels: ~900 W HGA: ~3 m, body fixed X and Ka bands Downlink ≥ 1.4 Gbit/day High Δv capability (2700 m/s) Radiation tolerance: 50 krad at equipment level Dry mass: ~1800 kg
Ground TM stations	ESTRAC network
Key mission drivers and technology challenges	Radiation tolerance Power budget and solar arrays Mass budget
Responsibilities	ESA: manufacturing, launch, operations of the spacecraft and data archiving PI Teams: science payload provision, operations, and data analysis



Europa

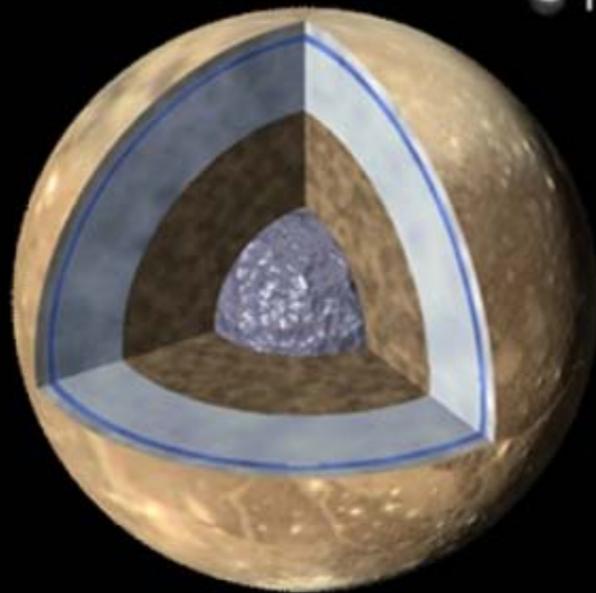


Earth

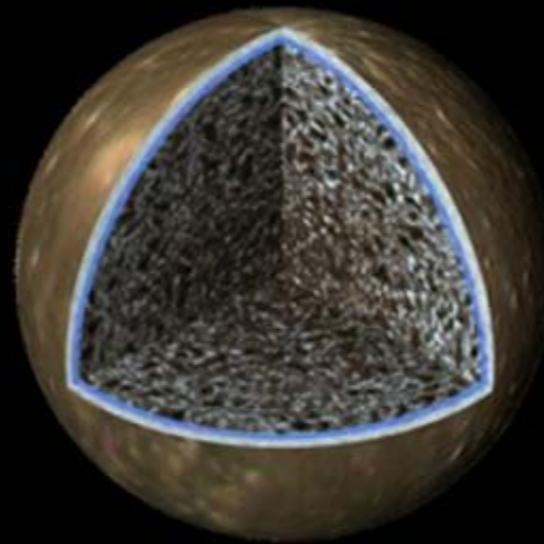
- ice
- water
- rock
- metal



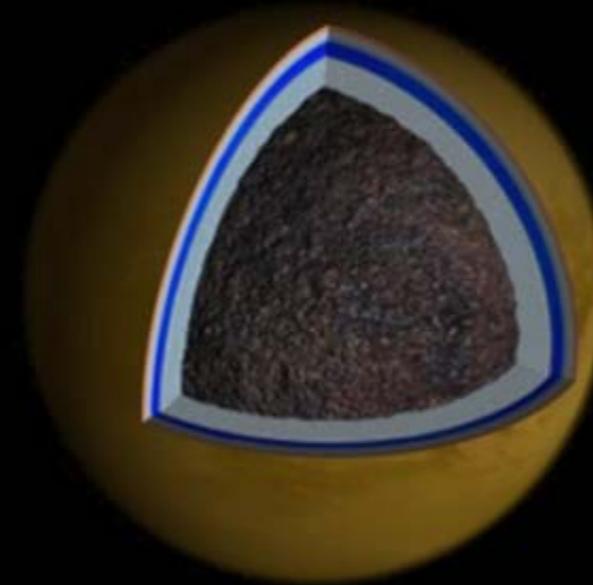
Enceladus



Ganymede



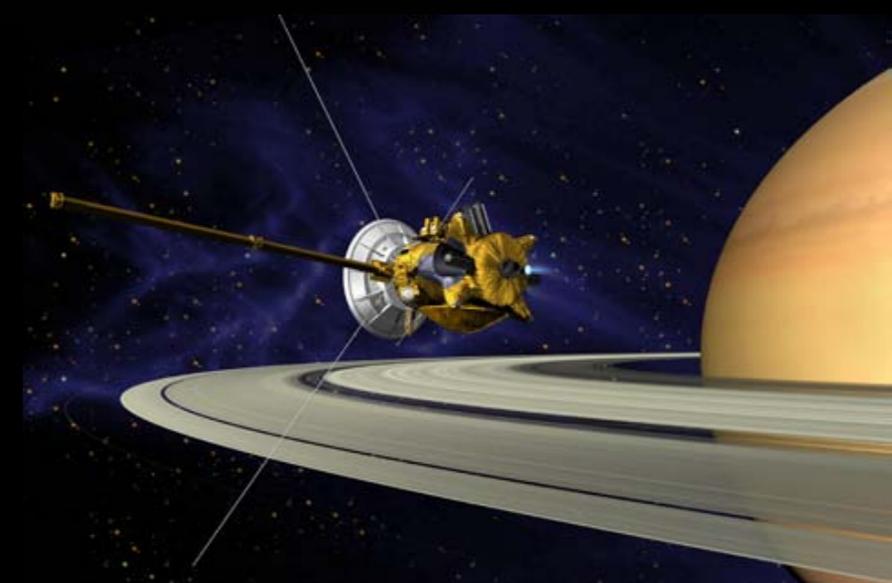
Callisto



Titan

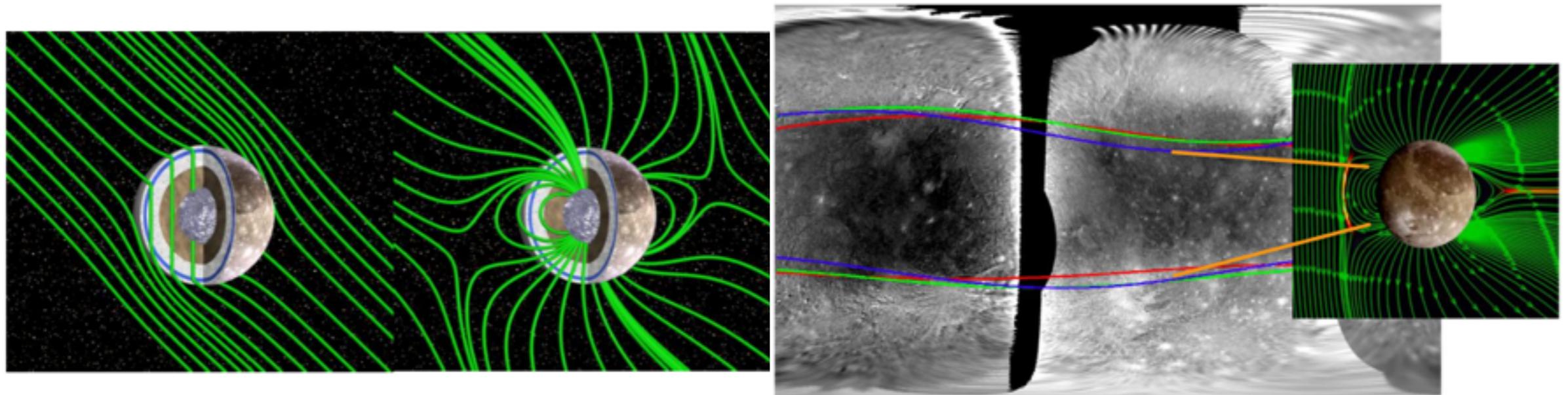


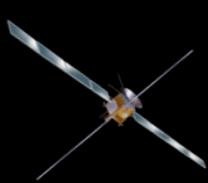
Galileo Begins Jupiter Orbit
Dec. 7, 1995



Exploration de Ganymède

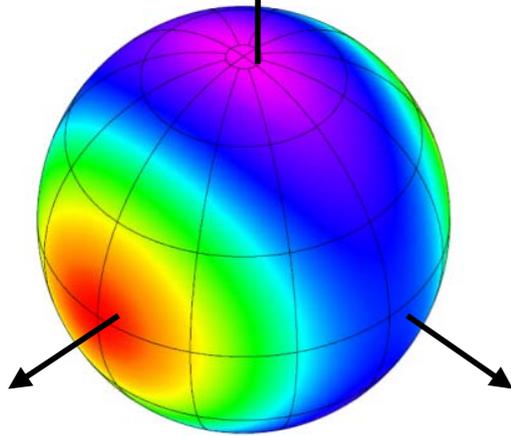
- **Phase orbitale de Ganymede:** orbite circulaire à 500 km d'altitude en fin de mission.
- **Habitabilité.** Détection/caractérisation d'un océan sous la glace [MAG, RPWI]
- **Interaction avec la magnétosphère de Jupiter.**
Caractérisation de son champ magnétique intrinsèque, et de son ionosphère. [MAG, PEP, RPWI]





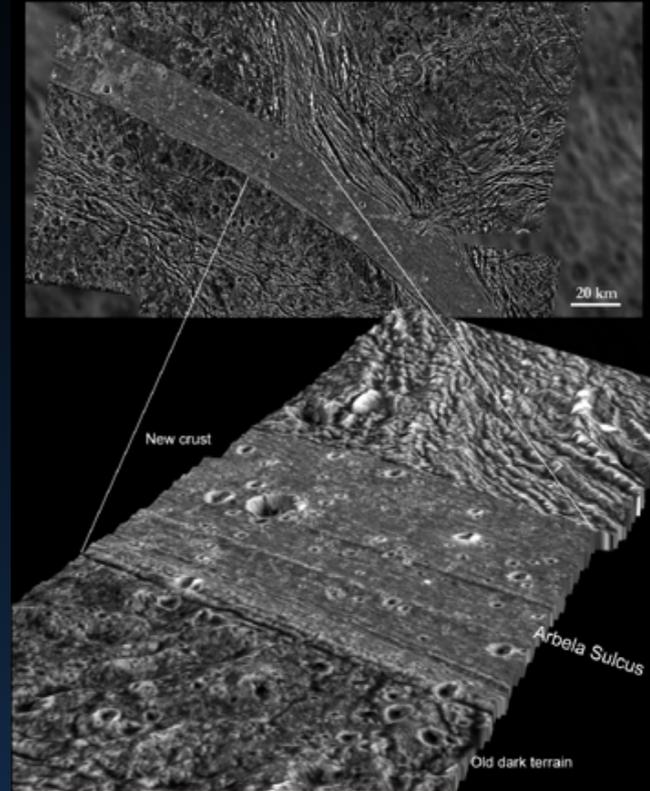
Ganymede studies with JUICE

Tidal deformation

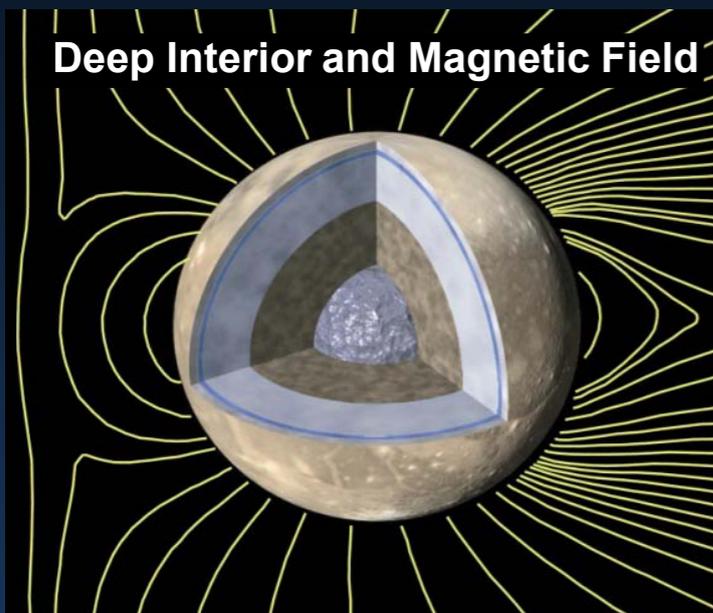


- Presence and extent of a subsurface ocean
- Ice shell and subsurface water
- Deep internal structure, dynamo, magnetic field
- Coupling among surface, exosphere, and magnetosphere
- Surface composition and chemistry
- Surface features, tectonic processes
- Thermal evolution, geology, and the Laplace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

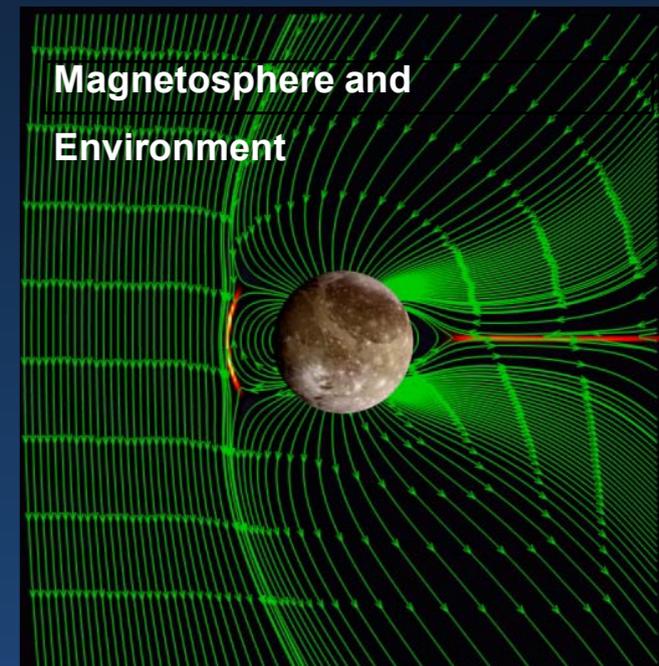
Geology and Topography



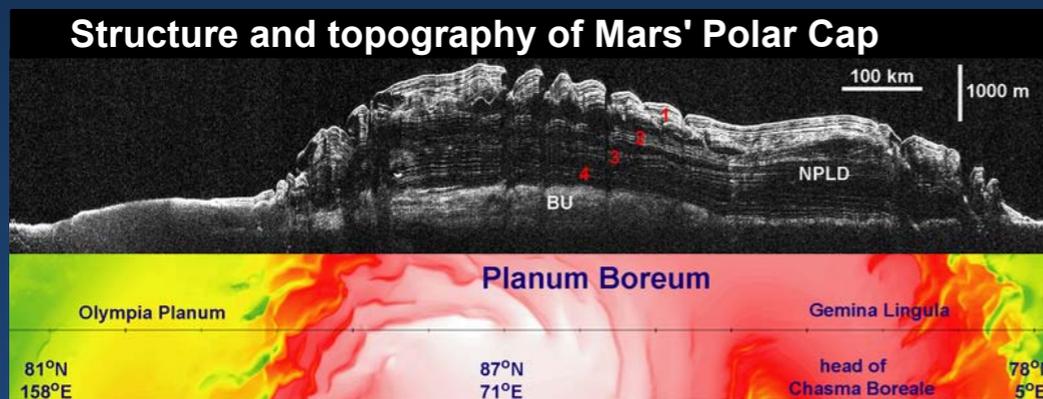
Deep Interior and Magnetic Field



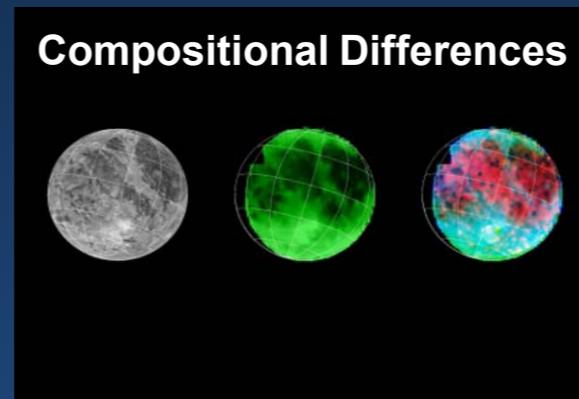
Magnetosphere and Environment



Structure and topography of Mars' Polar Cap

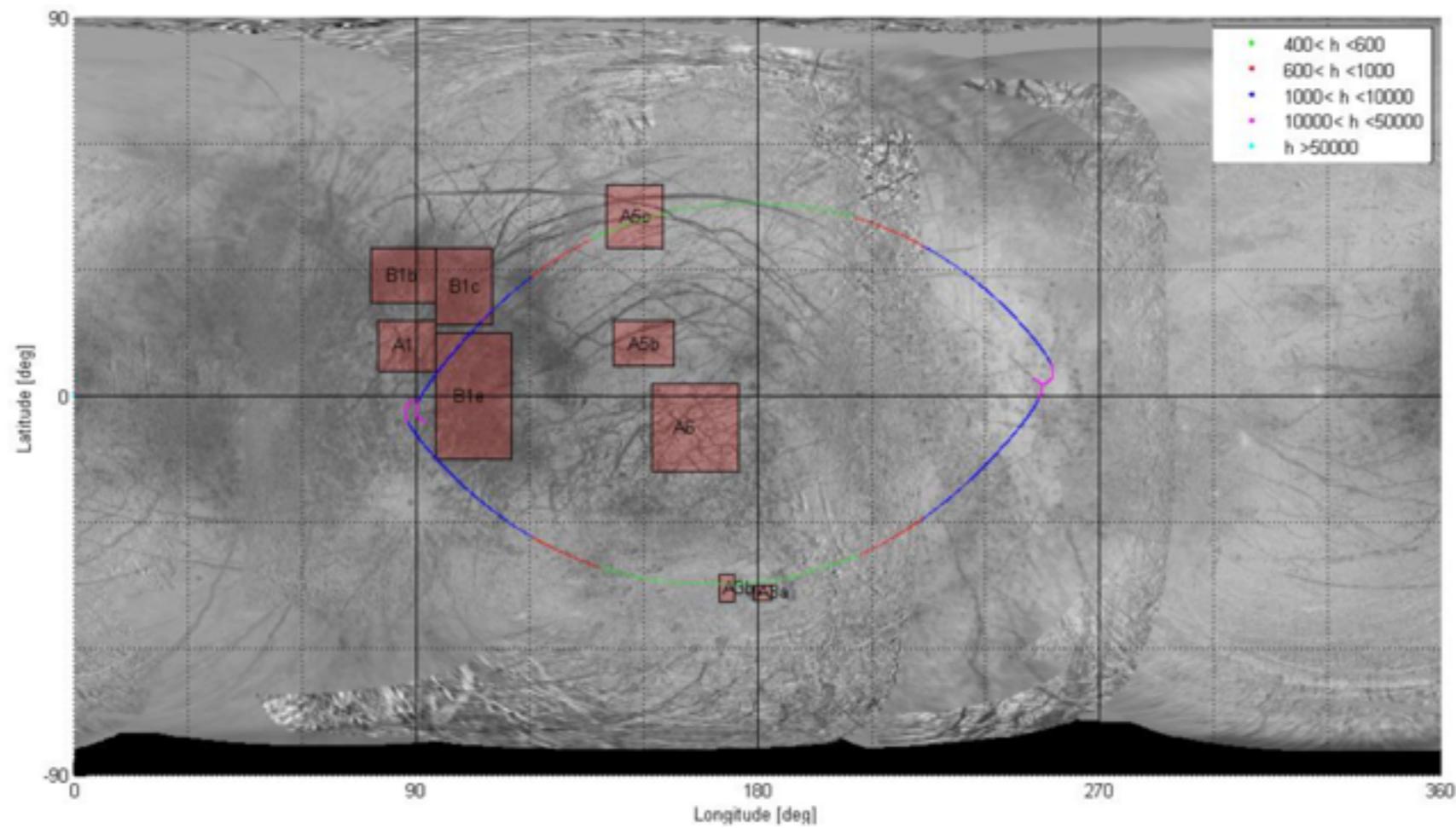


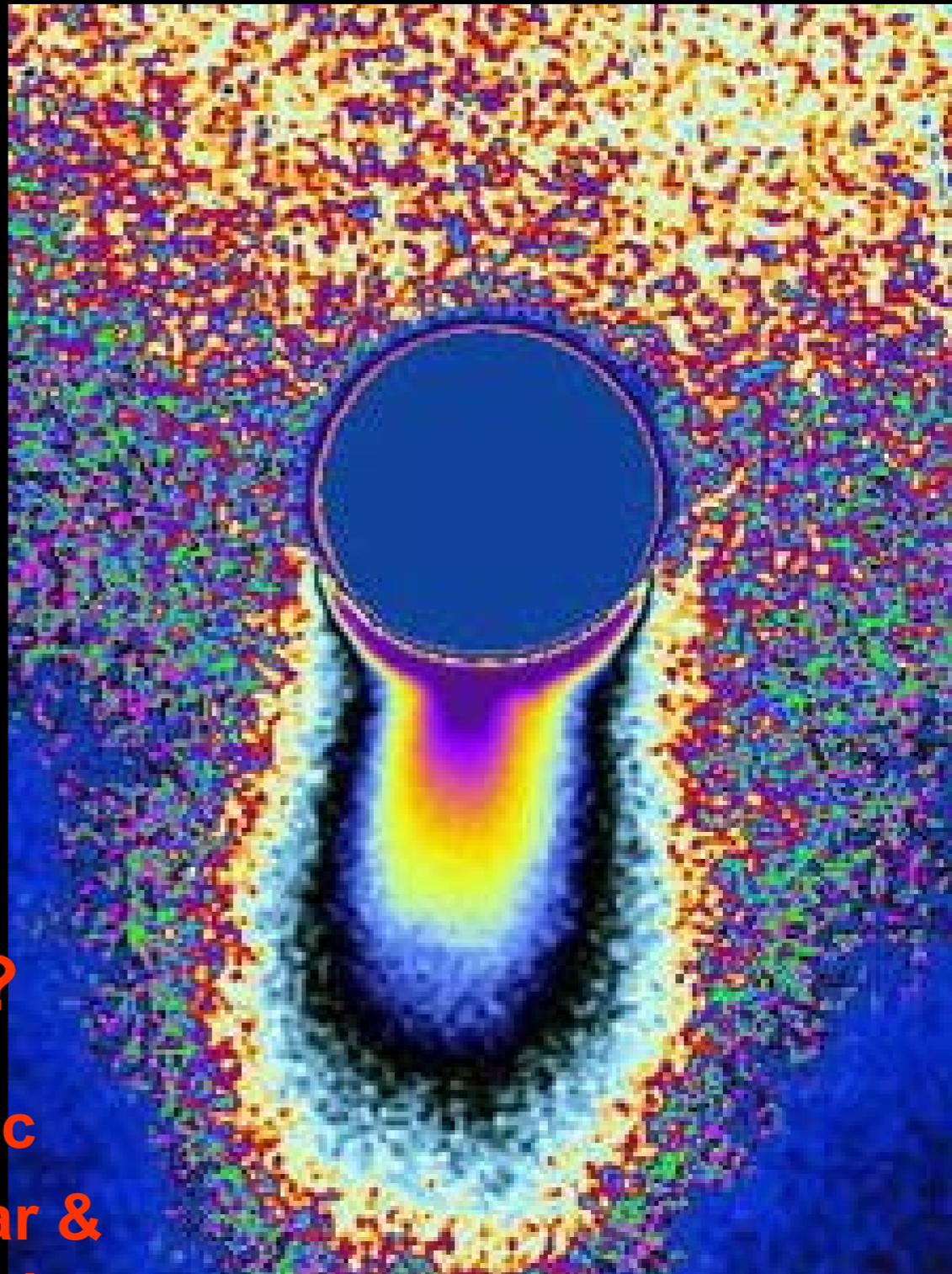
Compositional Differences



Survols d'Europa

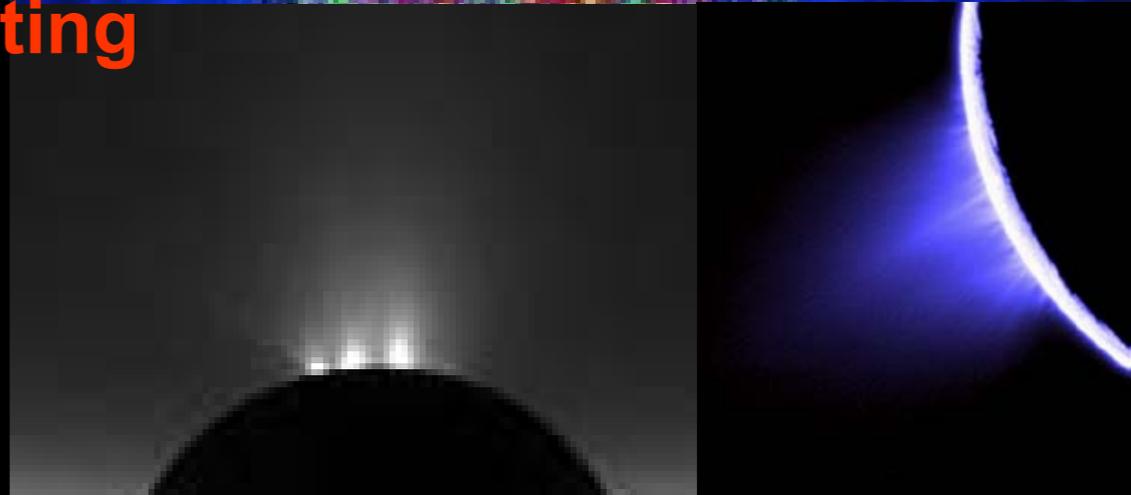
- **Deux survols prévus:** en début de mission.
- **Habitabilité.** Détection/caractérisation d'un océan sous la glace [MAG, RPWI]
- **Interaction avec la magnétosphère de Jupiter.** Caractérisation de son ionosphère. [MAG, PEP, RPWI]





Hidden Energy Sources ?

Radiolytic Chemistry vs Solar & Tidal Heating ?



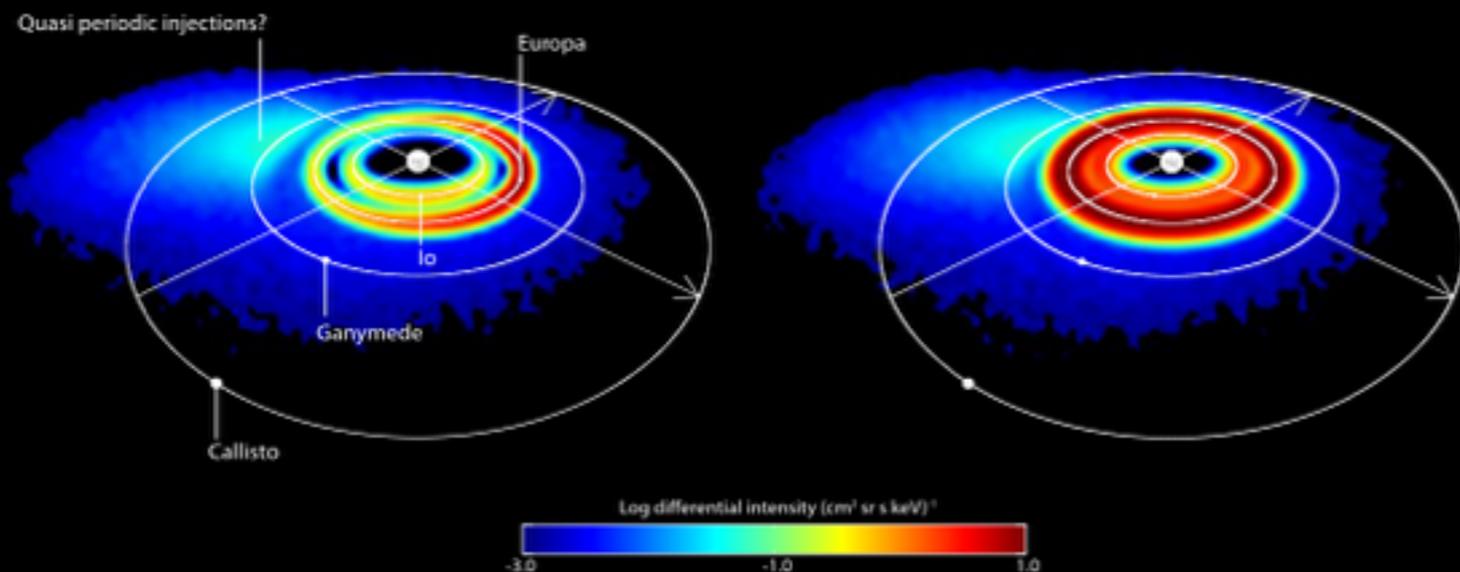
Magnetosphère de Jupiter

- **Phases équatoriales + Phases orbitales inclinées** jusqu'à $\sim 22^\circ$ latitude (grâce aux survols de Callisto)
- **Dynamique.** Particules (électrons, ions, ENA), champs continus 3D (E et B), ondes plasma (E jusqu'à 1.6 MHz et B jusqu'à 20 kHz), ondes radio (80 kHz - 45 MHz)

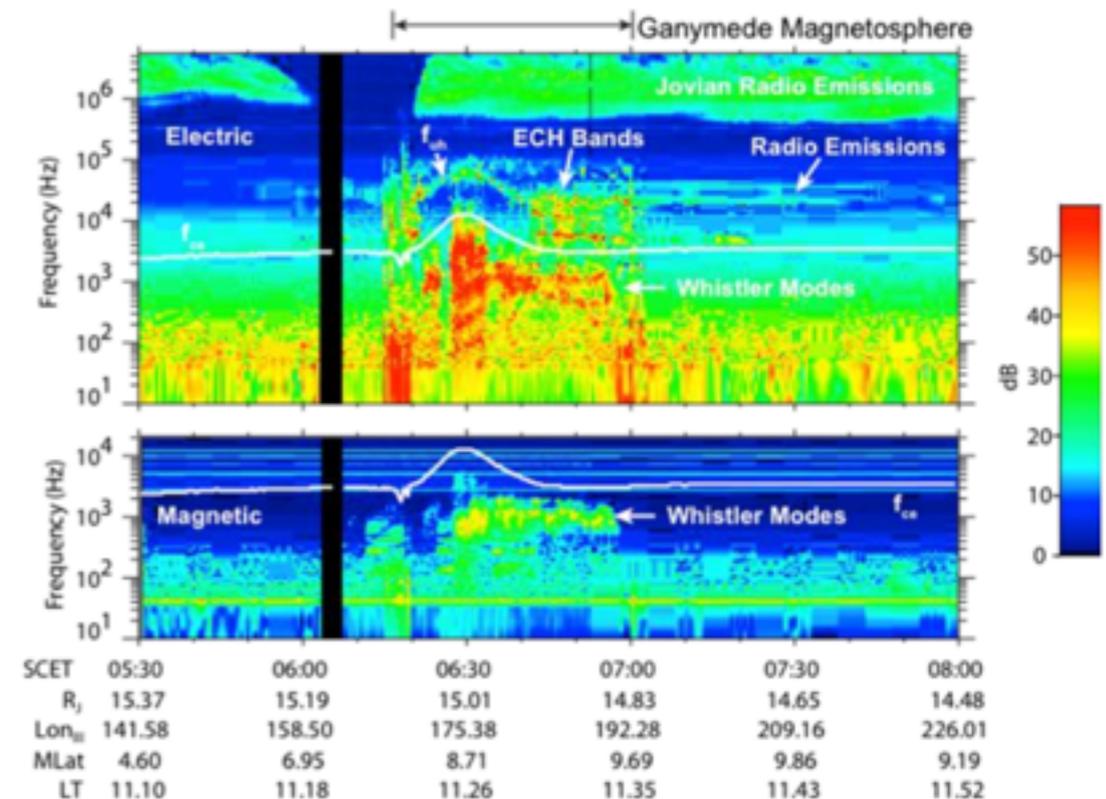
Global view of the giant accelerator and its interaction with the moons

(a) Two separate, asymmetric Europa and Io Torii

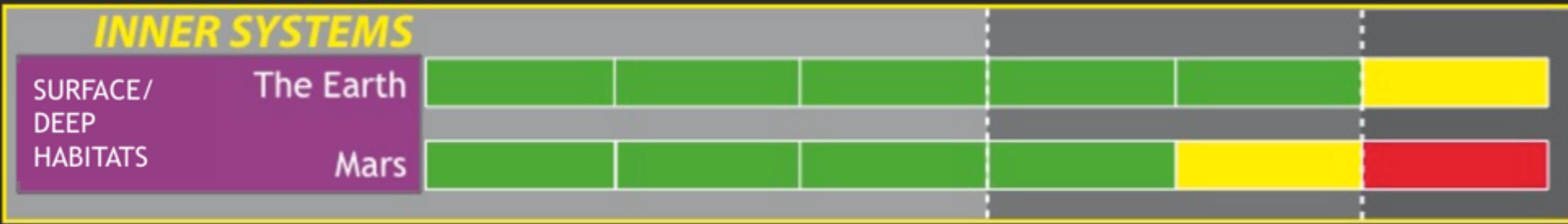
(b) One merged, symmetric Europa-Io Torus



Galileo PWS Ganymede 1 Flyby
June 27, Day 179, 1996

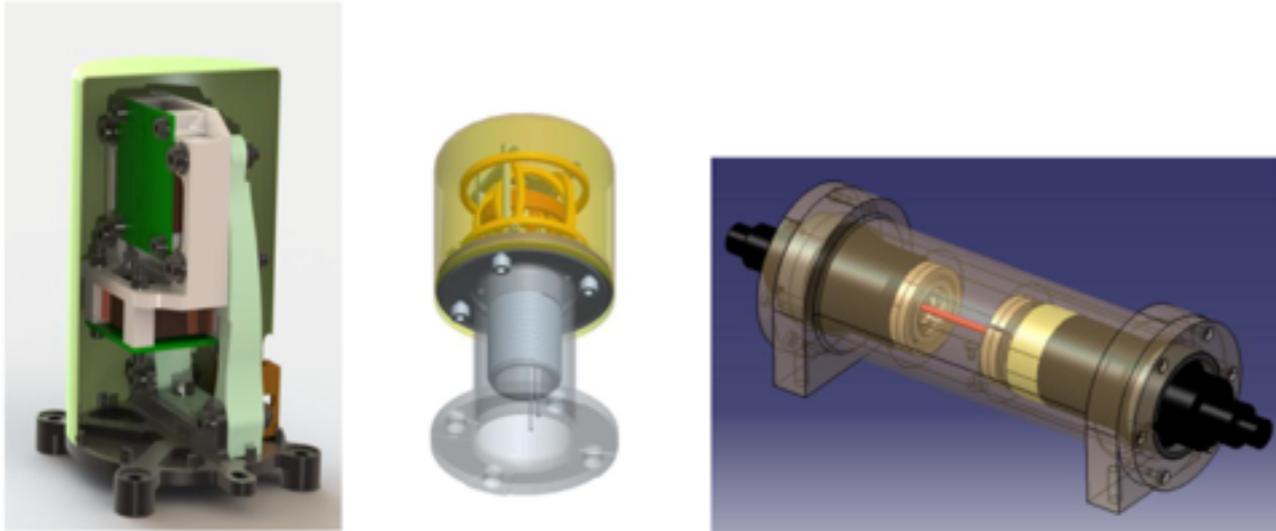


The Emergence of Habitable Worlds: Different destinations, the same steps...



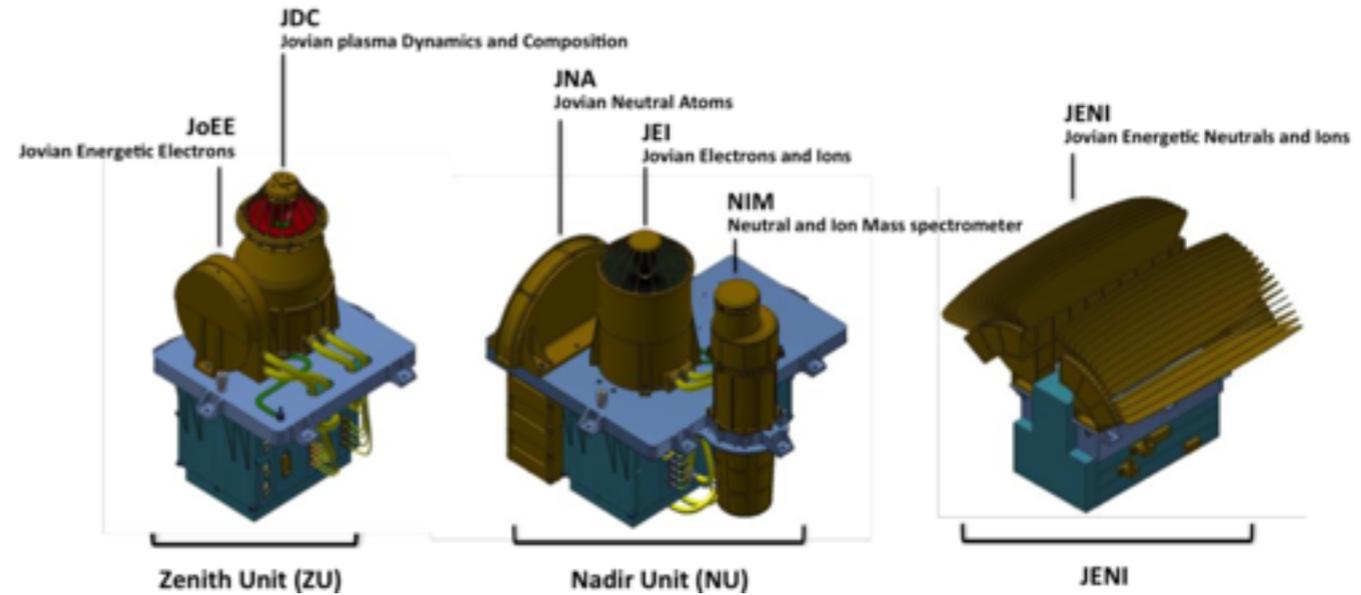
J-MAG

PI: Michele Dougherty (R-U)



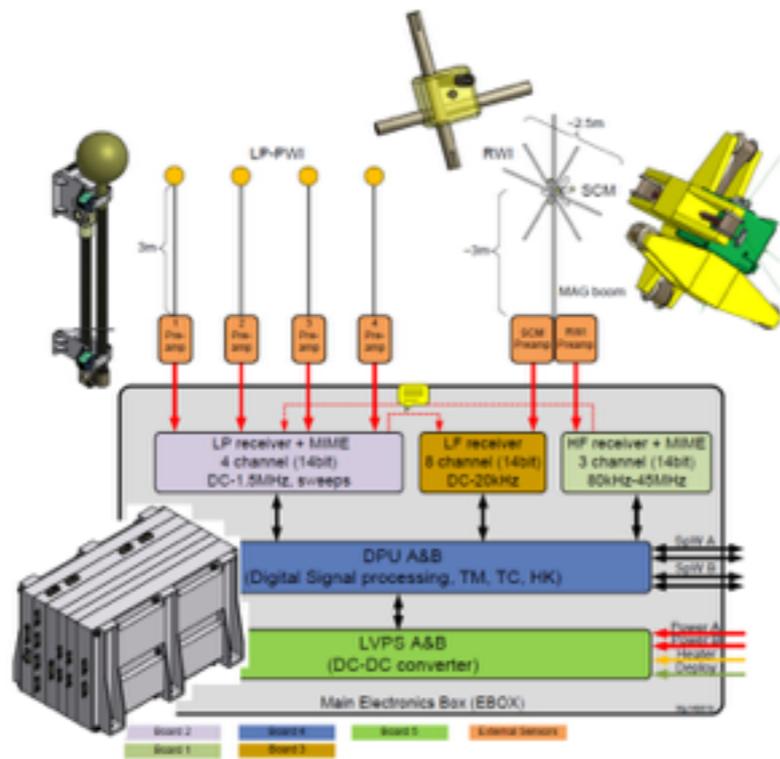
PEP

PI: Stas Barabash (Suède)



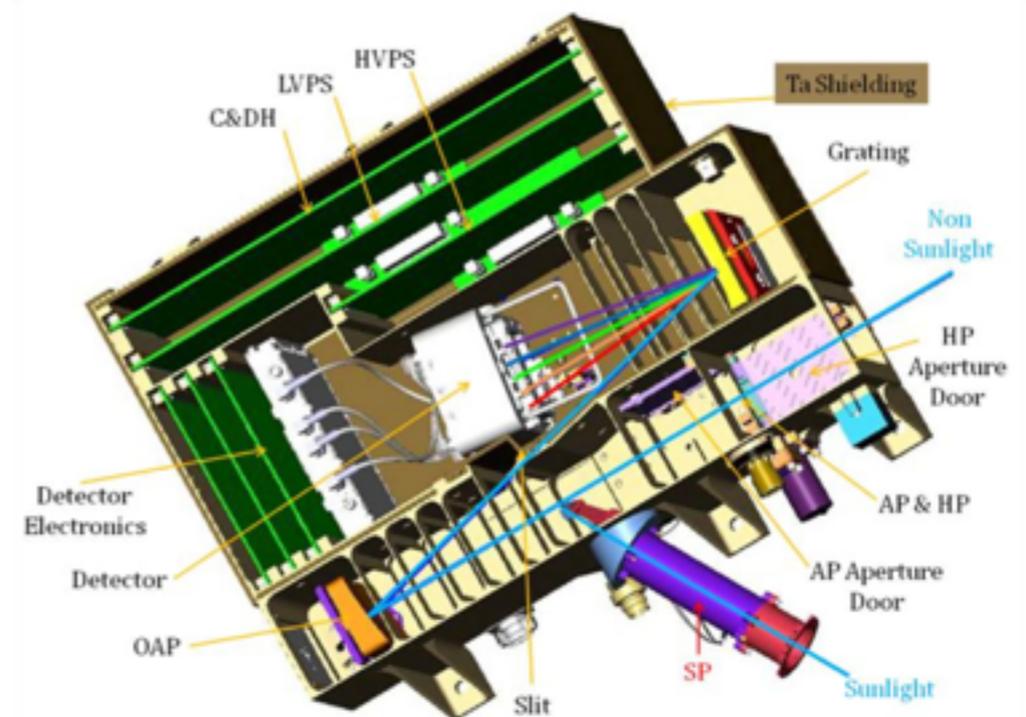
RPWI

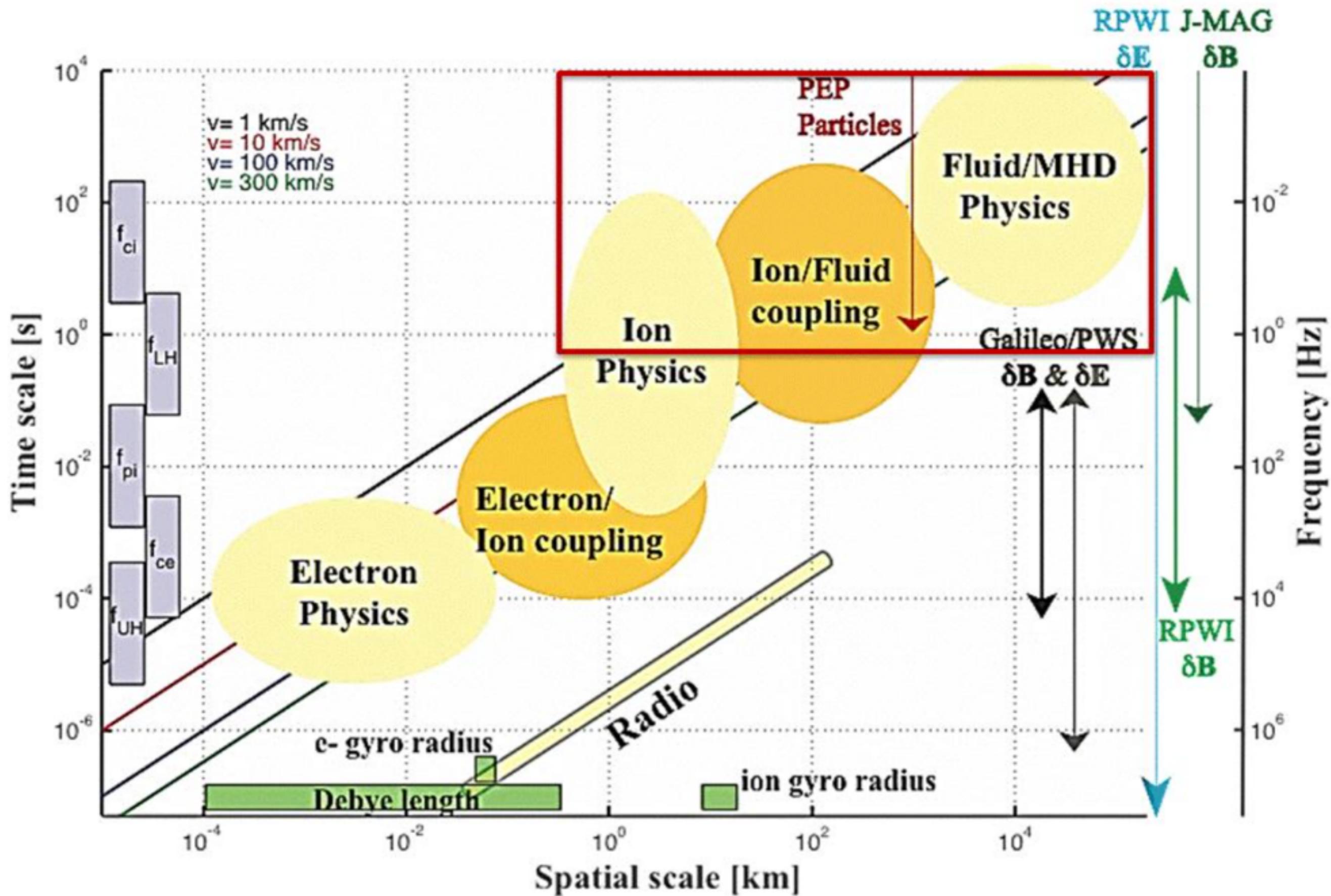
PI: Jan-Erik Wahlund (Suède)



UVS

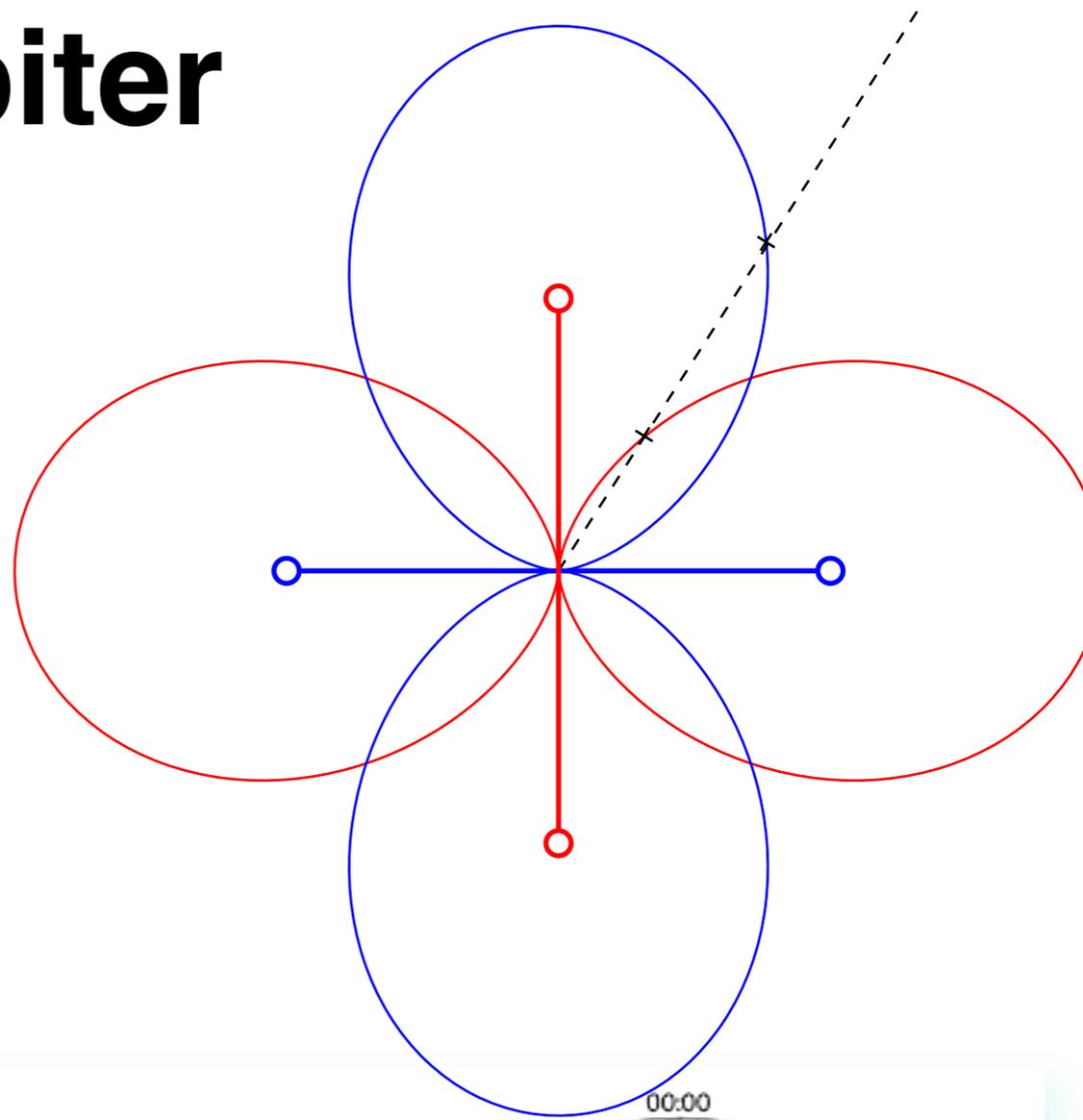
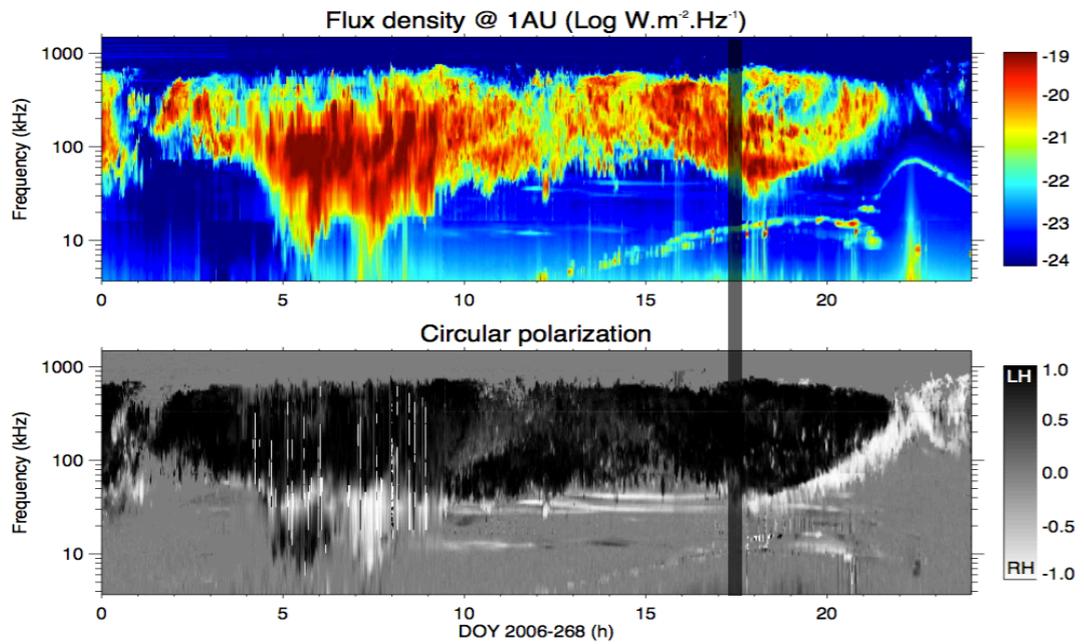
PI: Randy Gladstone (USA)



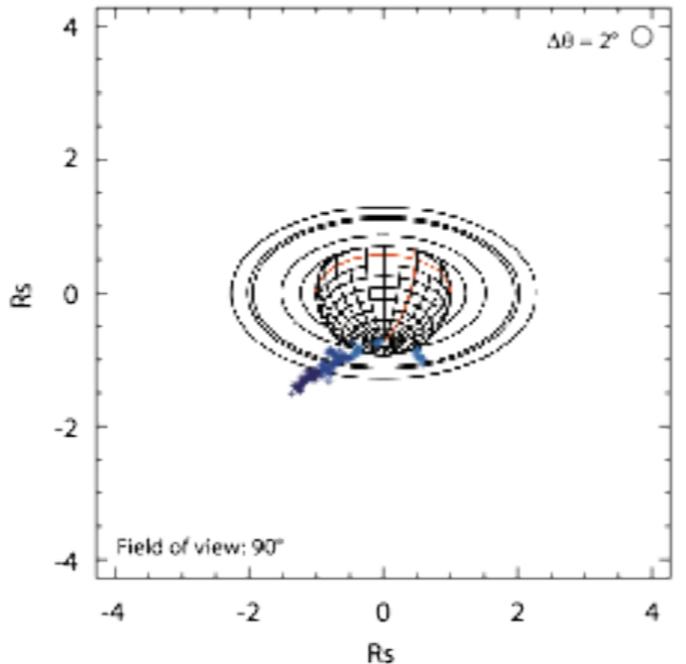
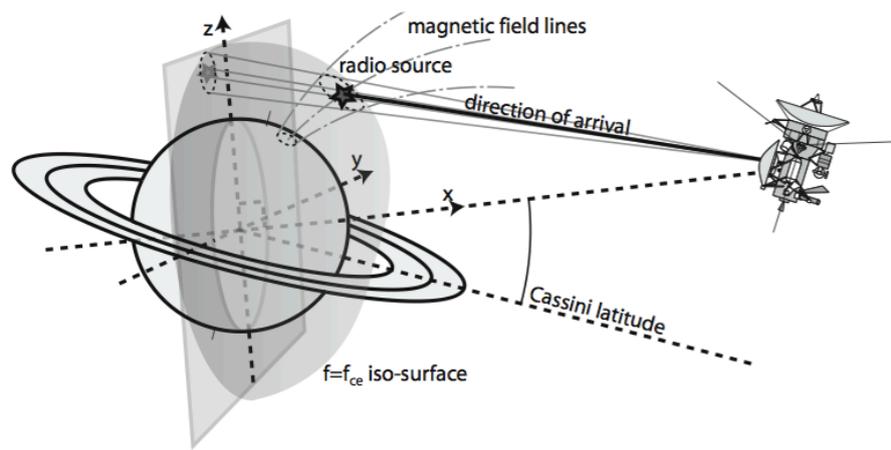


Goniopolarimétrie à Jupiter

Exemple de Cassini/RPWS
Flux et Polarisation



Localisation des sources Radio



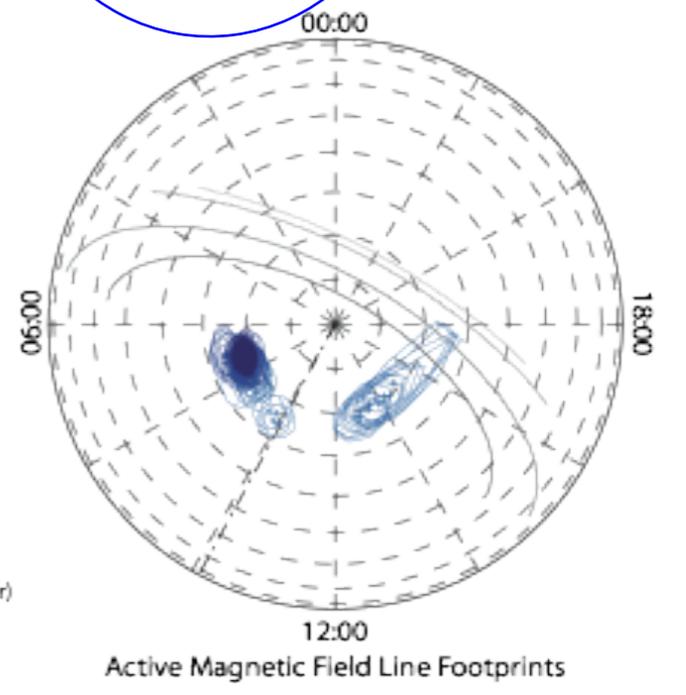
Ephemeris
2006268 - 17:20
2006268 - 17:25
LT = 10:06
Lat = -34.5°
Dist = 4.3 Rs

Color Code

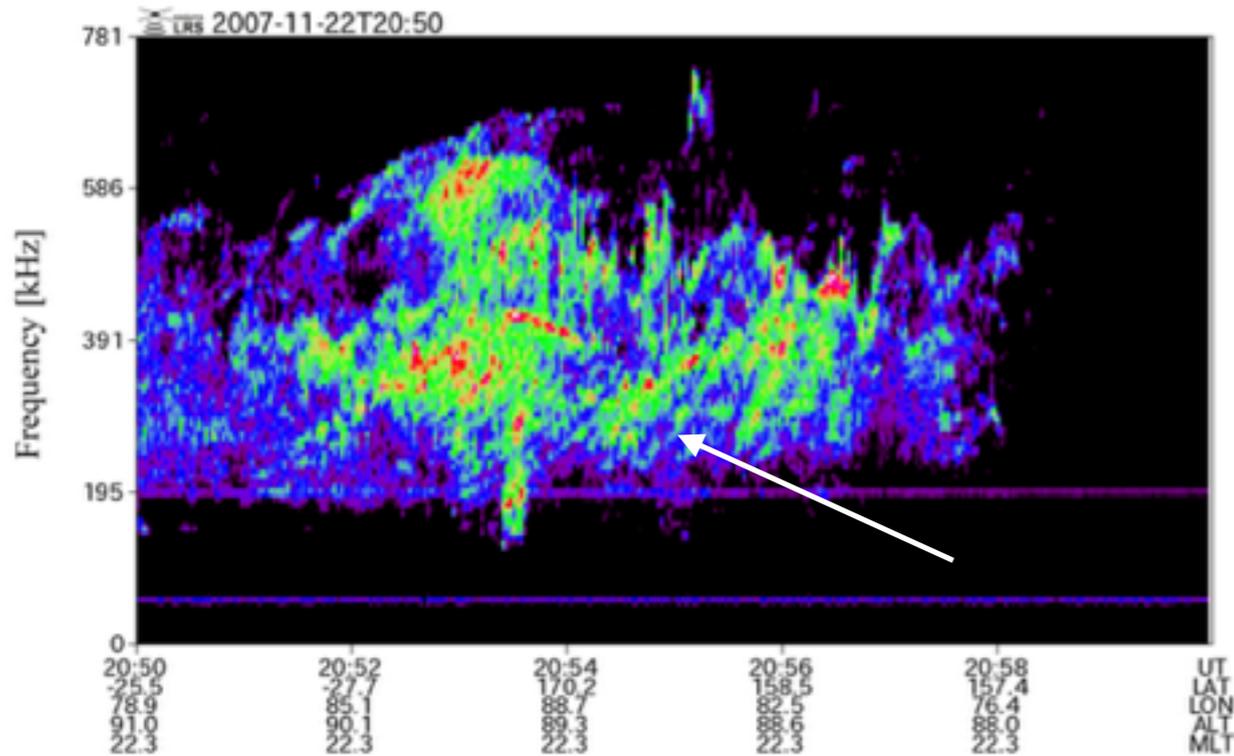
Frequency Range	LH	RH
100 - 200 kHz	Dark Blue	Dark Red
200 - 400 kHz	Medium Blue	Medium Red
400 - 800 kHz	Light Blue	Light Red
800 - 1000 kHz	Very Light Blue	Very Light Red

Symbol Code

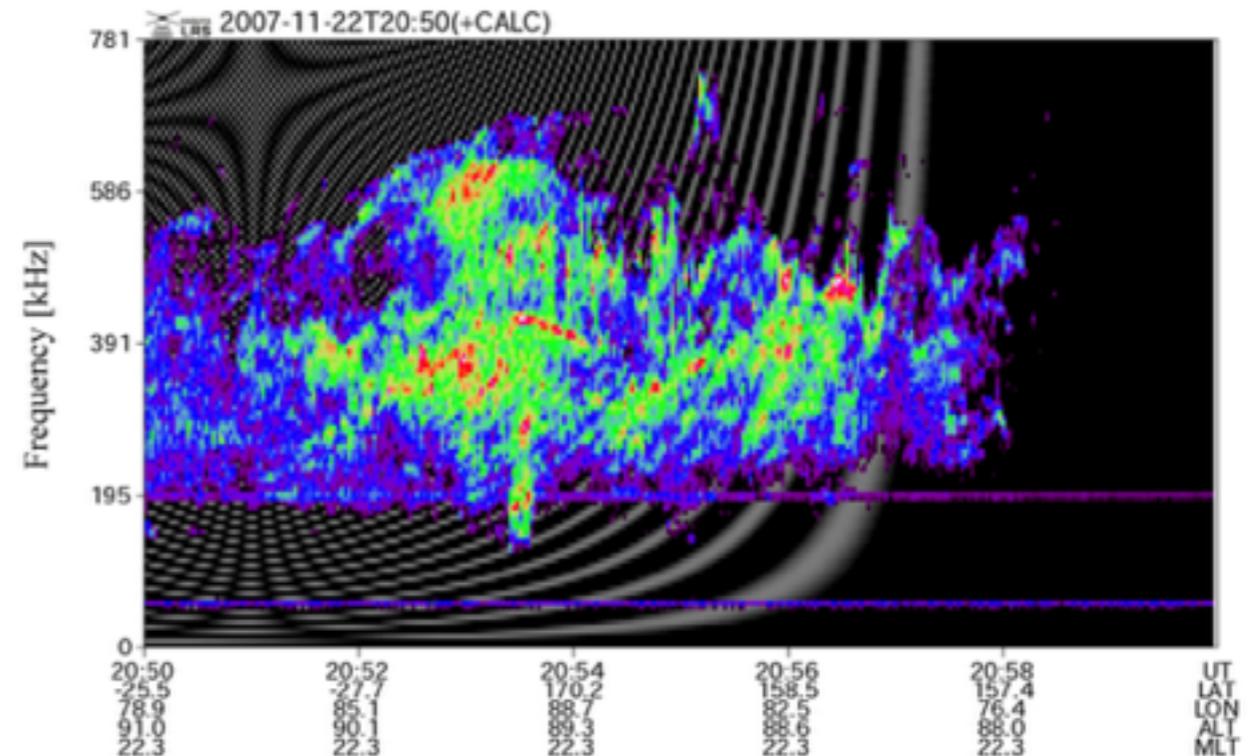
- out of iso-fc
- ⊙ within iso-fc (2° error contour)



Moon Surface reflexion



LRS/SELENE observations of AKR
Observations close to surface.
Interference pattern ?

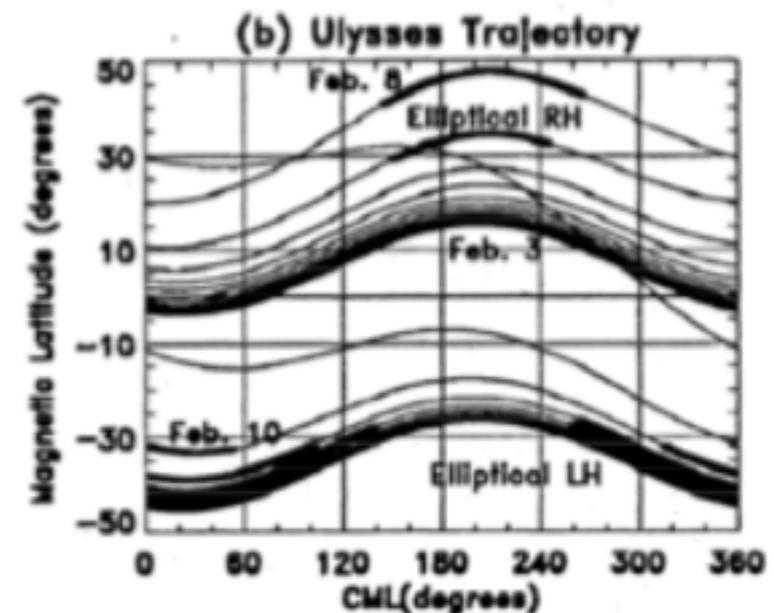
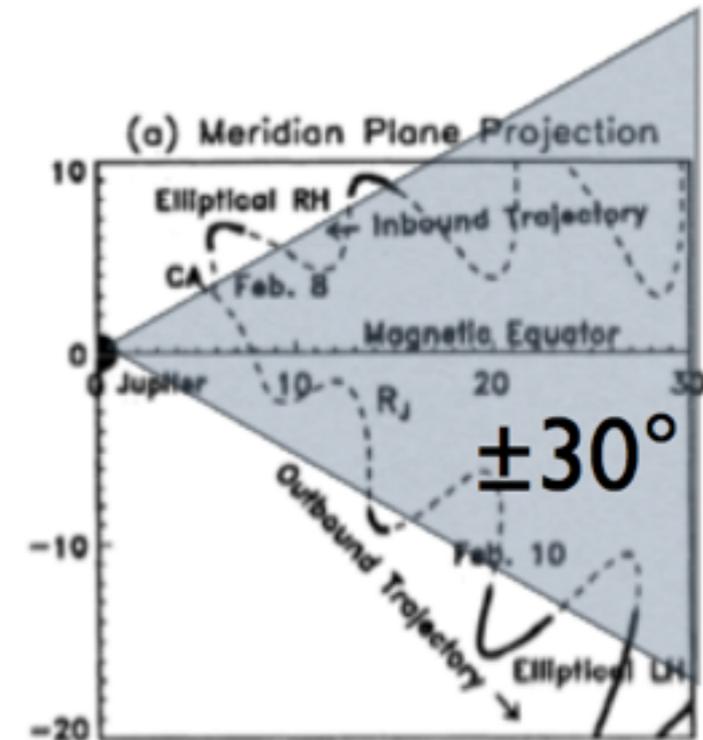


LRS/SELENE observations of AKR
theoretical interference pattern superimposed for reflexion on lunar surface.

Discussions initiées lors du dernier SWT à l'ESTEC pour réfléchir à utiliser cet effet à Ganymede.

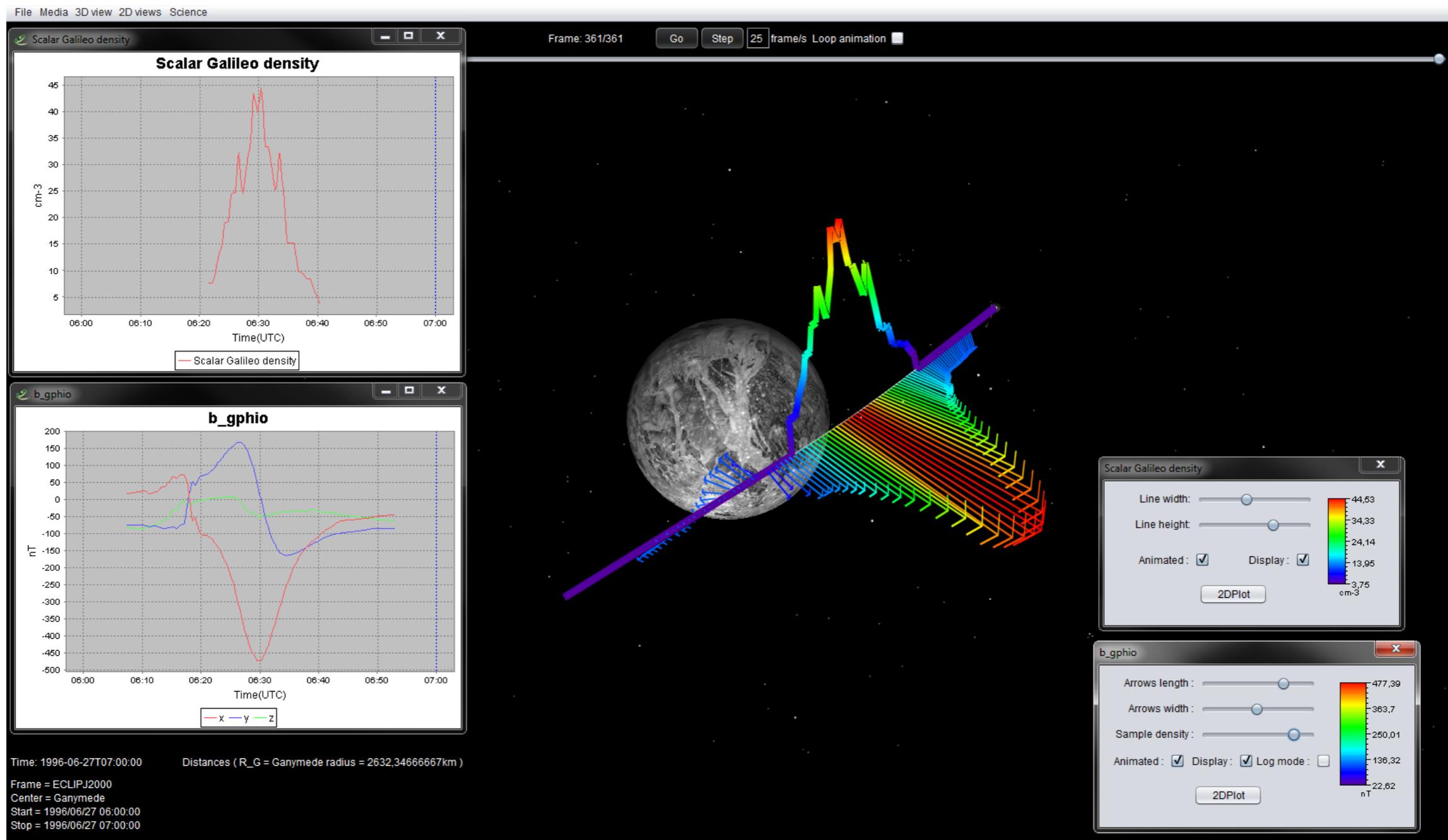
Extensions à négocier

- **Orbites à plus hautes latitudes** (jusqu'à 30° orbital, soit ~40° magnétique).
Meilleure visibilité aurorale: images, ENA, et radio (dont polarisation).
- **Orbites finales à 200 km** autour de Ganymède.
Meilleure détermination du champs magnétique interne par J-MAG et RPWI



Outils fournis par le CDPP pour la communauté magnétosphère

- 3Dview, pour la visualisation

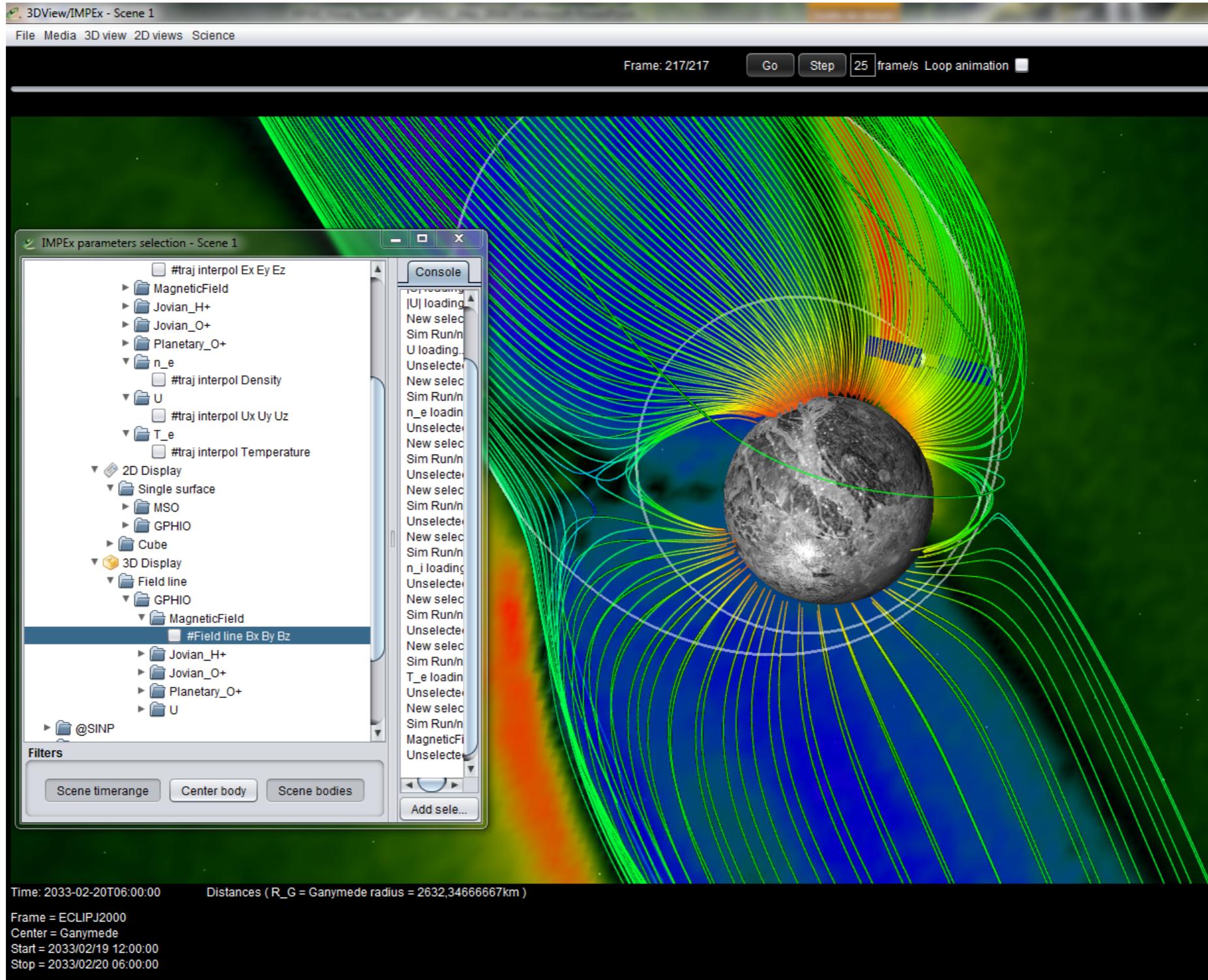


Outils fournis par le CDPP pour la communauté magnétosphère

- 3Dview, pour la préparation des observations:



Outils fournis par le CDPP pour la communauté magnétosphère



23rd Oct 2014 @ Pub 19 (Nitton)

IF U NEED

S P A C E

JOIN

RPWI

BABY

K3
DISTANCE
BETWEEN



