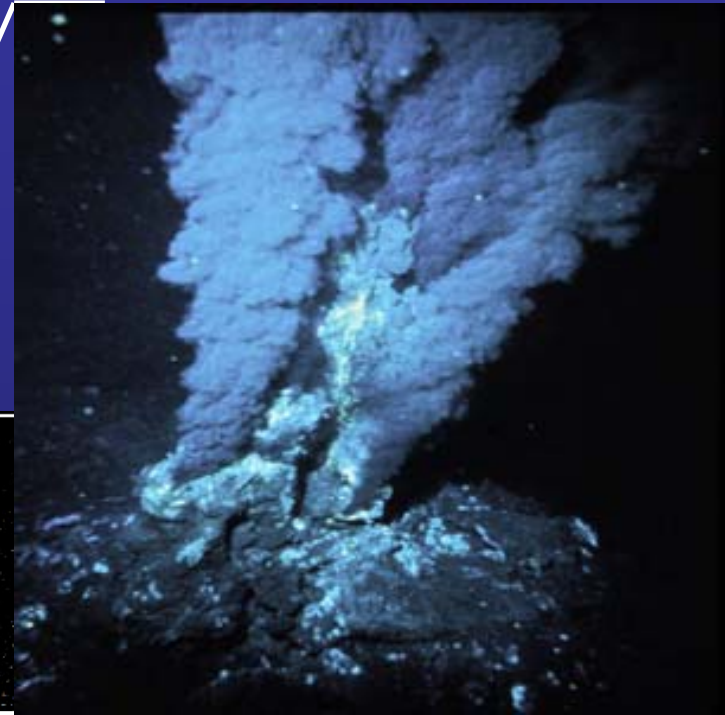
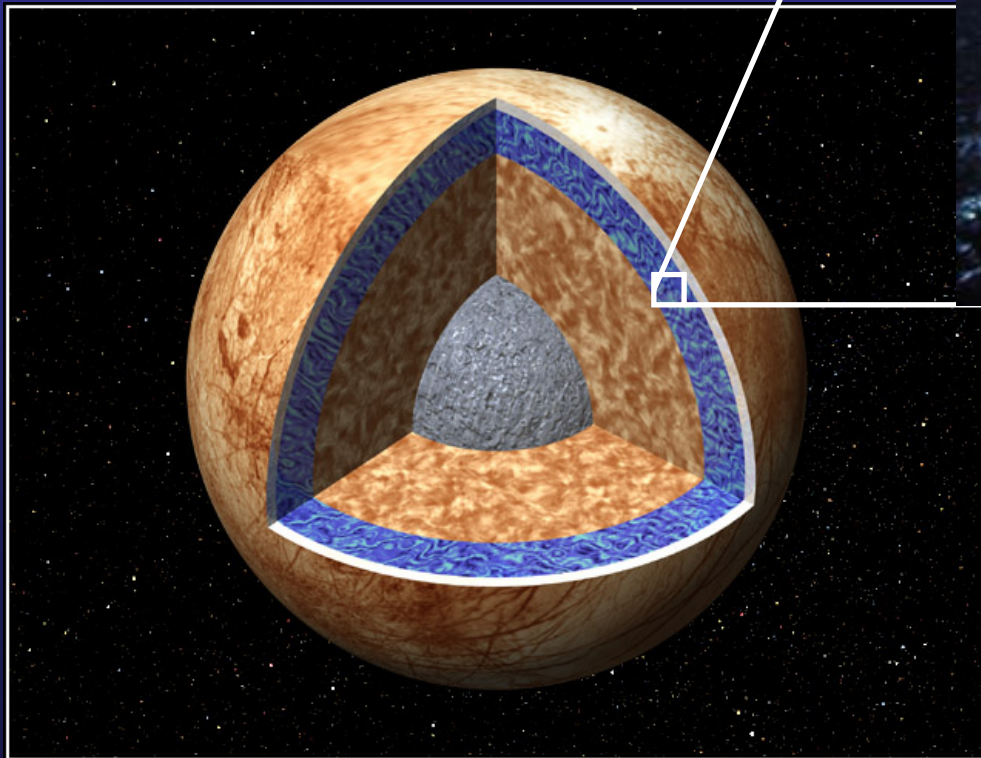


Coupling between Europa's thin atmosphere and surface : a focus on the alkali content

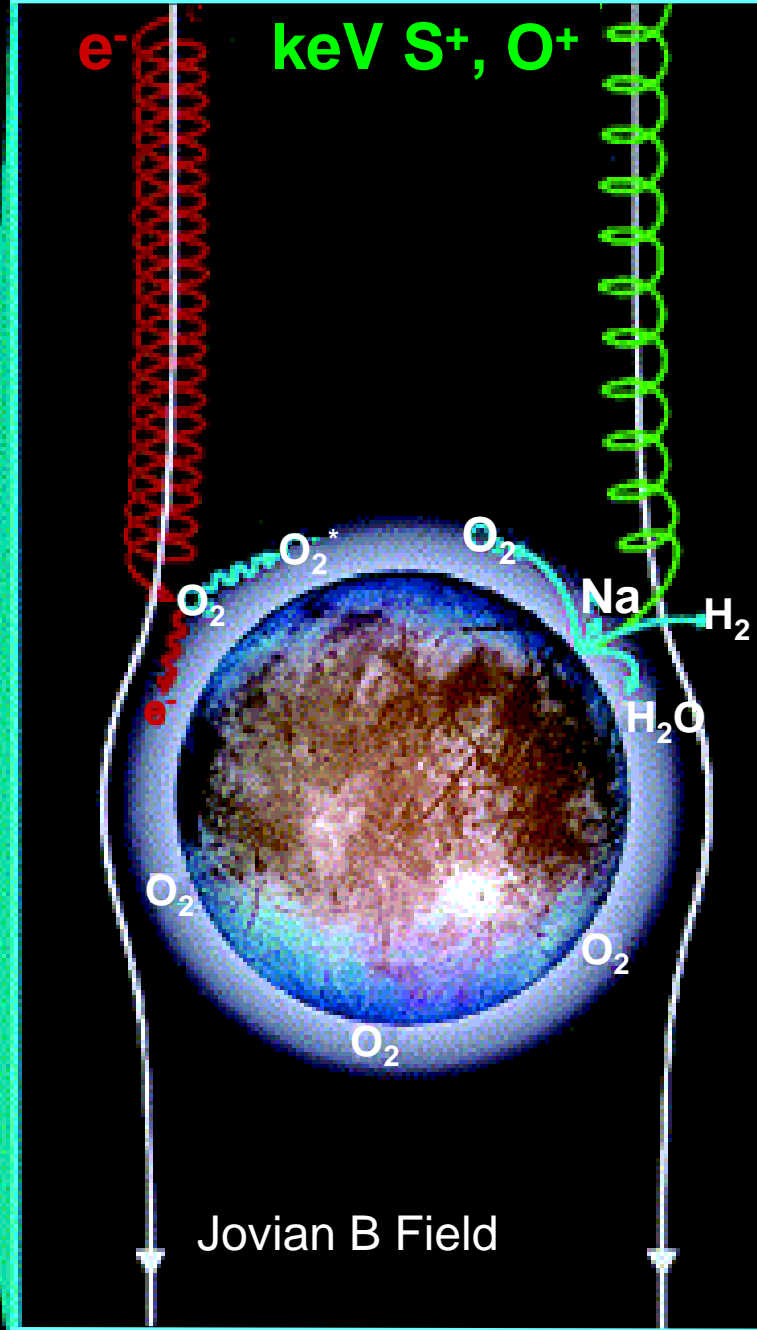
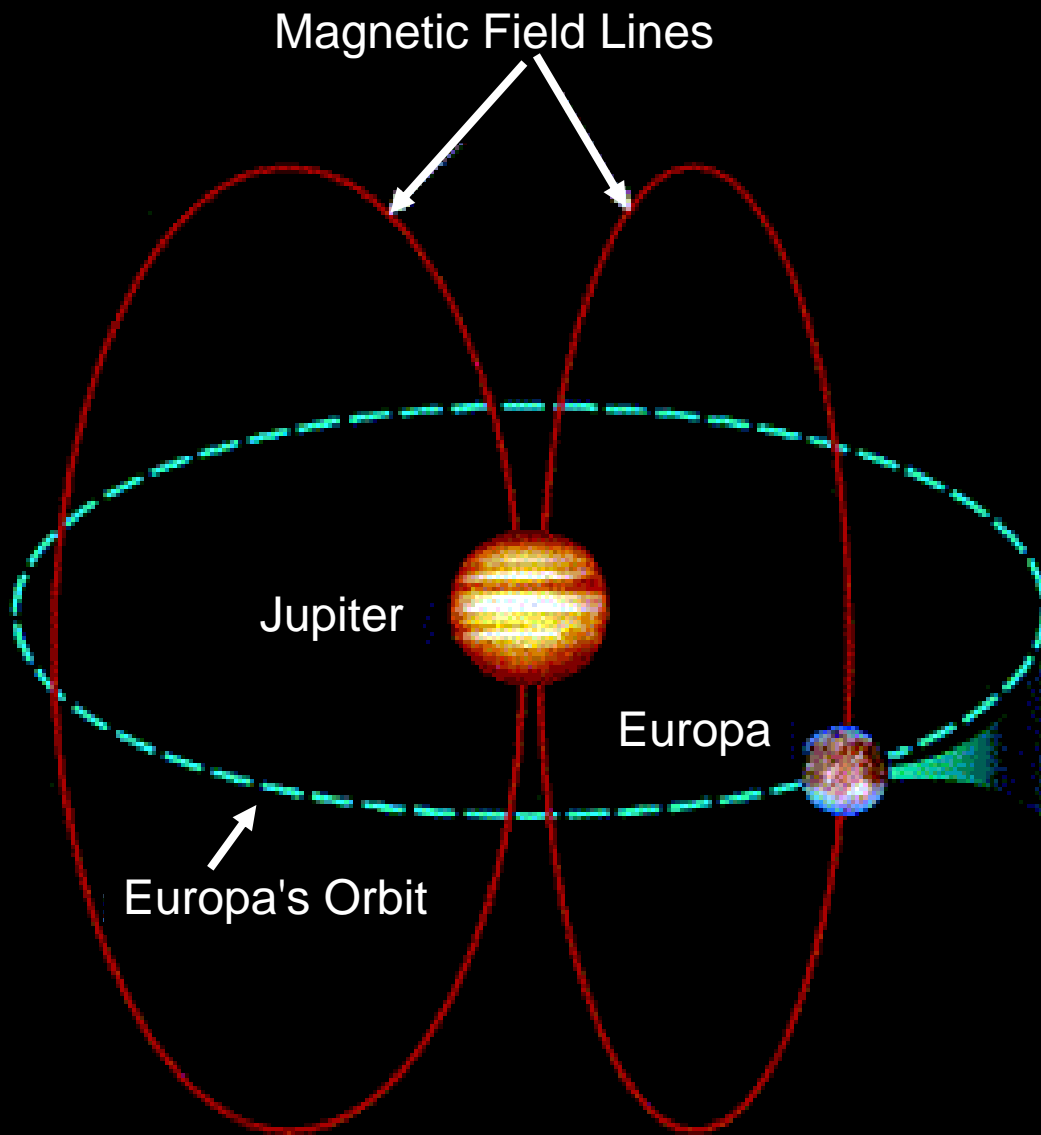
Fabrice Cipriani, Research Fellow,
SRE-SM (Olivier Witasse)
Interdepartmental Science Workshop
ESTEC, 28-29 august 2008

Europa : Why do we care about it ?



Kereszturi, A. (2004)

Europa in the Jovian magnetosphere



Why MINOR species are of MAJOR importance ?

Surface Minerals / Salts (Na ...)

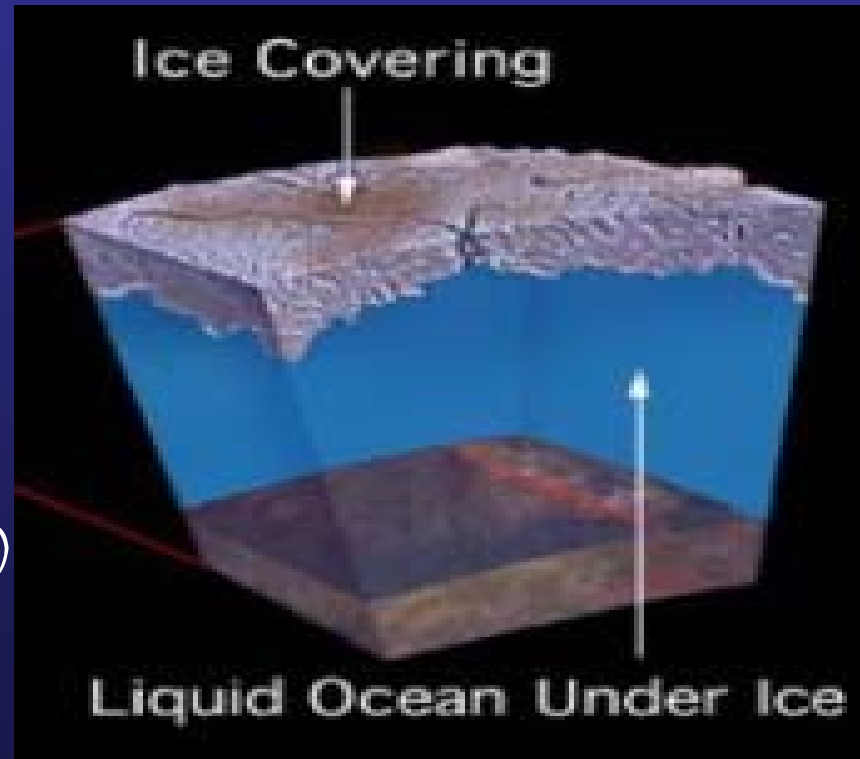


Young/ active
Surface

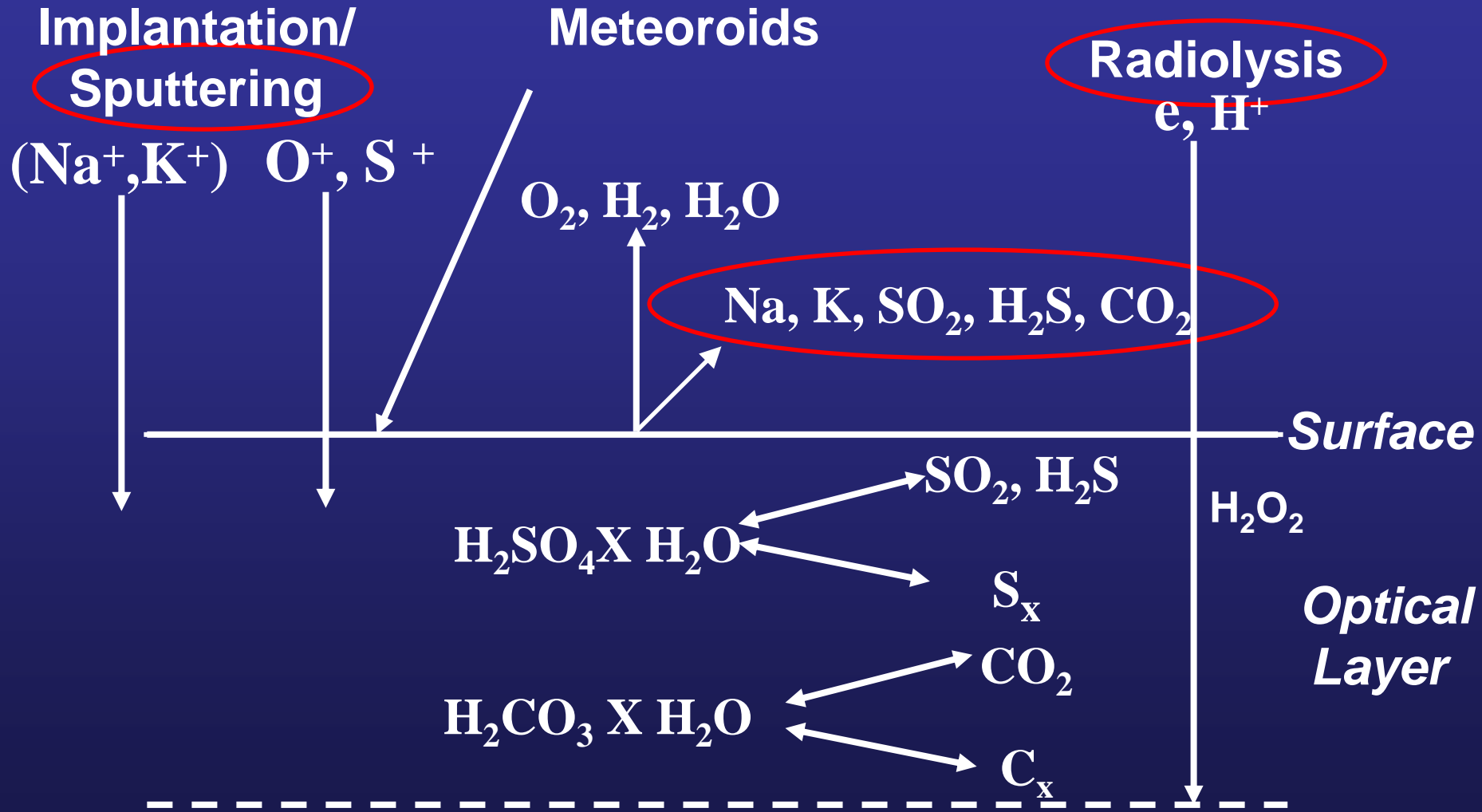
Sulfate rich ocean (Zolotov 2008)

H₂O, MgSO₄, Na⁺, Cl⁻, SO₄²⁻, Mg²⁺,
CaSO₄, NaSO₄-

Accreted rock, organic matter (past hydrothermal activity?)



Why MINOR species are of MAJOR importance ?



Morphology of Sodium Exosphere/Cloud

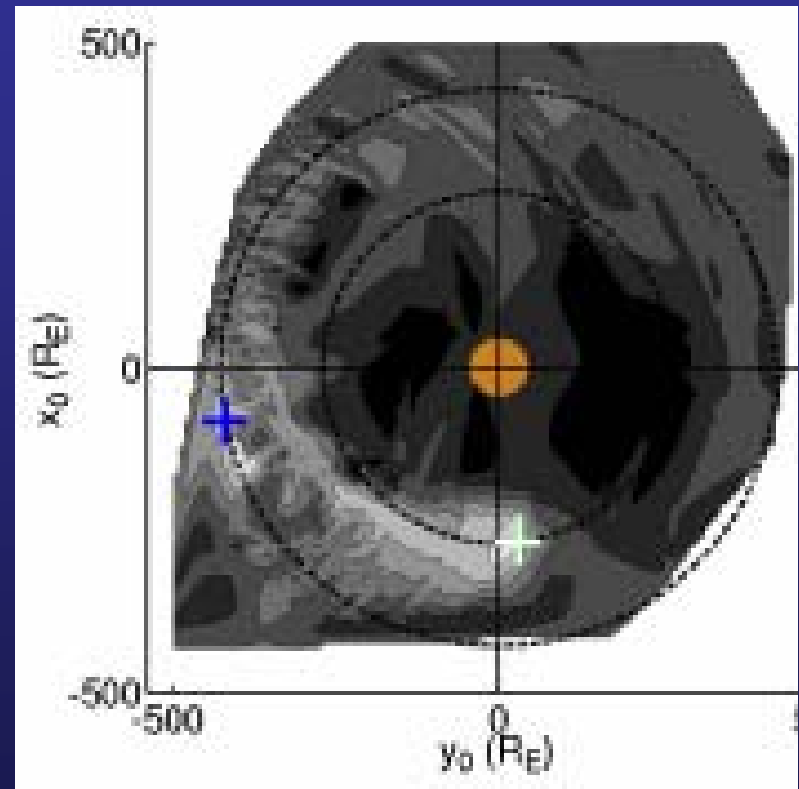
First detection by Brown and Hill (1996) + further ground based observations

↓
Modelling →

↓
Sodium escape rate (1.2×10^7 Na/cm²/s) \gg Implantation rate from Io ($0.2 - 0.8 \times 10^6$ Na/cm²/s)

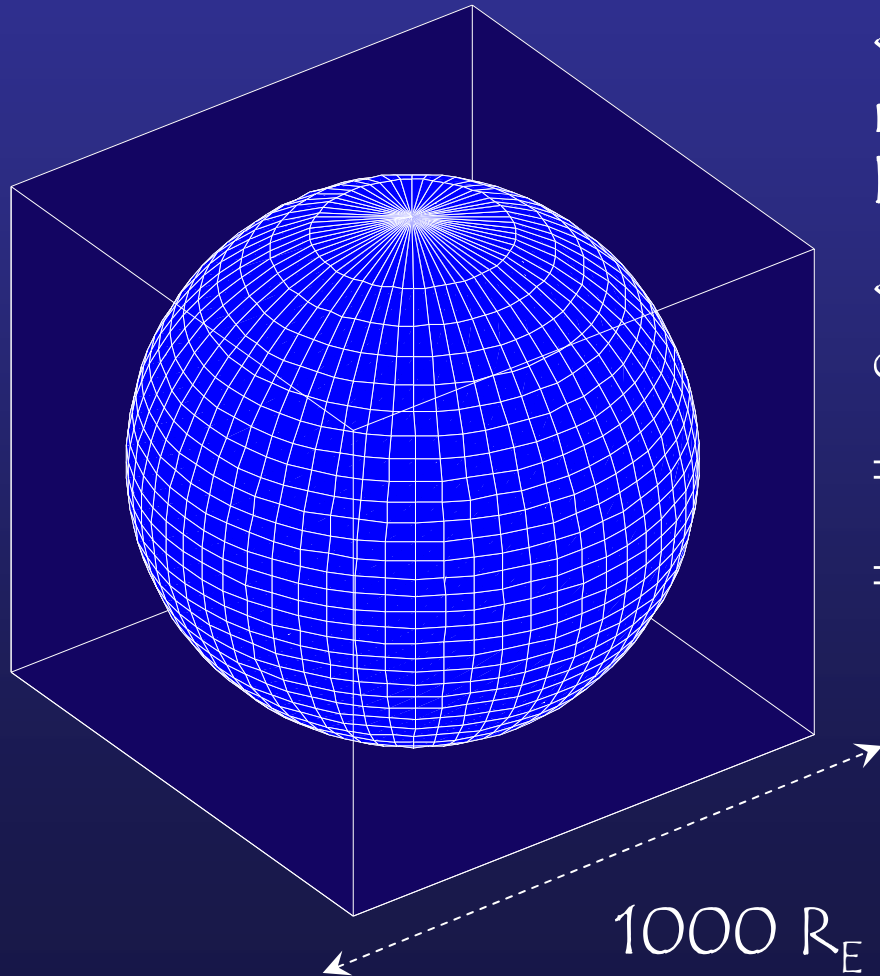
=> Endogenic source ?

Leblanc et al, (2005)



Leblanc et al, 2002

Modelling Europa exosphere/surface : Test Particle !



- ♦ 1 simulated particle $\sim 10^{25}$ real particles

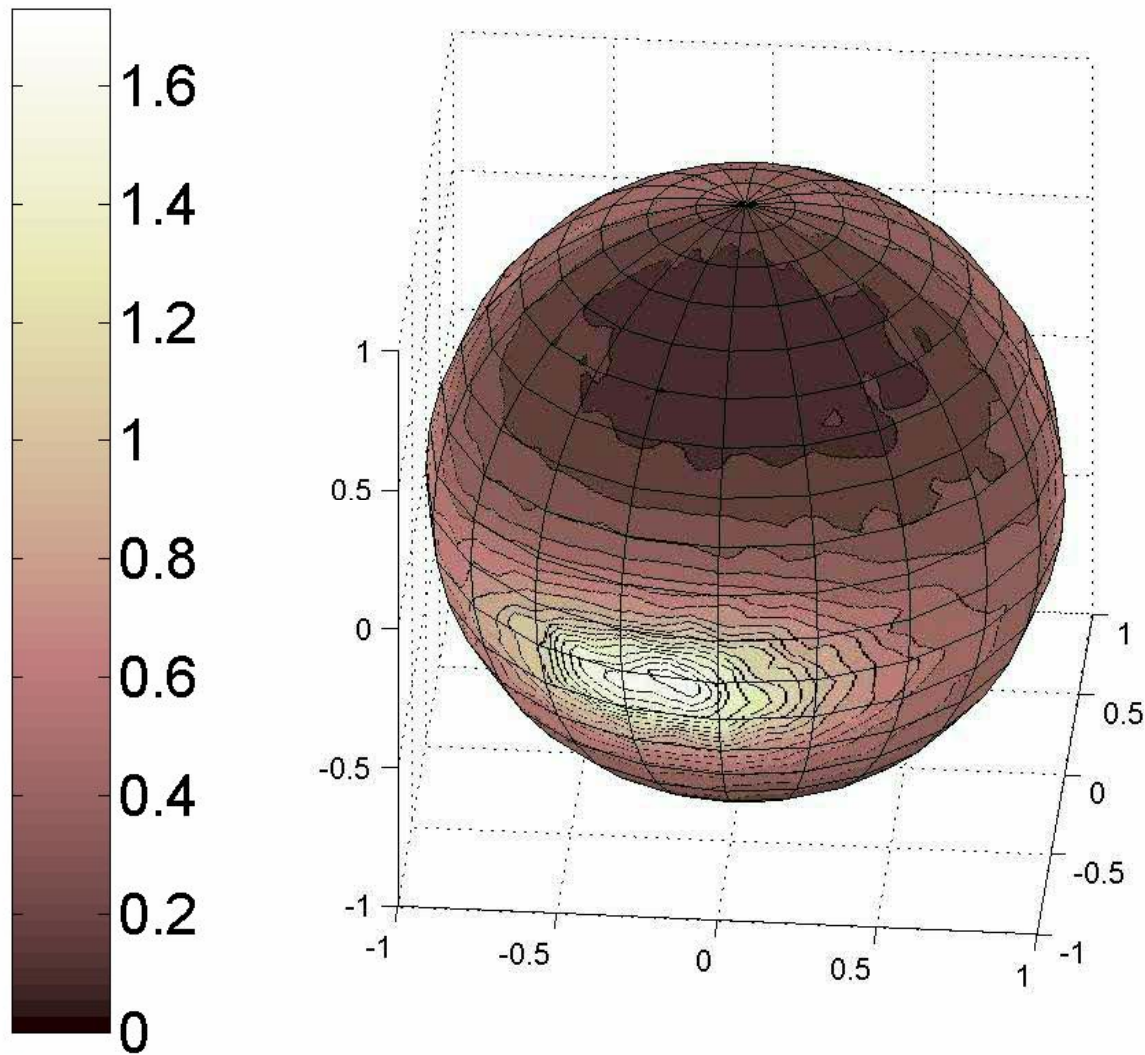
- ♦ particle trajectories (gravitation, radiation pressure, collisions) in background atmosphere

- ♦ Boltzmann equation (not self consistent)

\Rightarrow 3D fdd (Na)

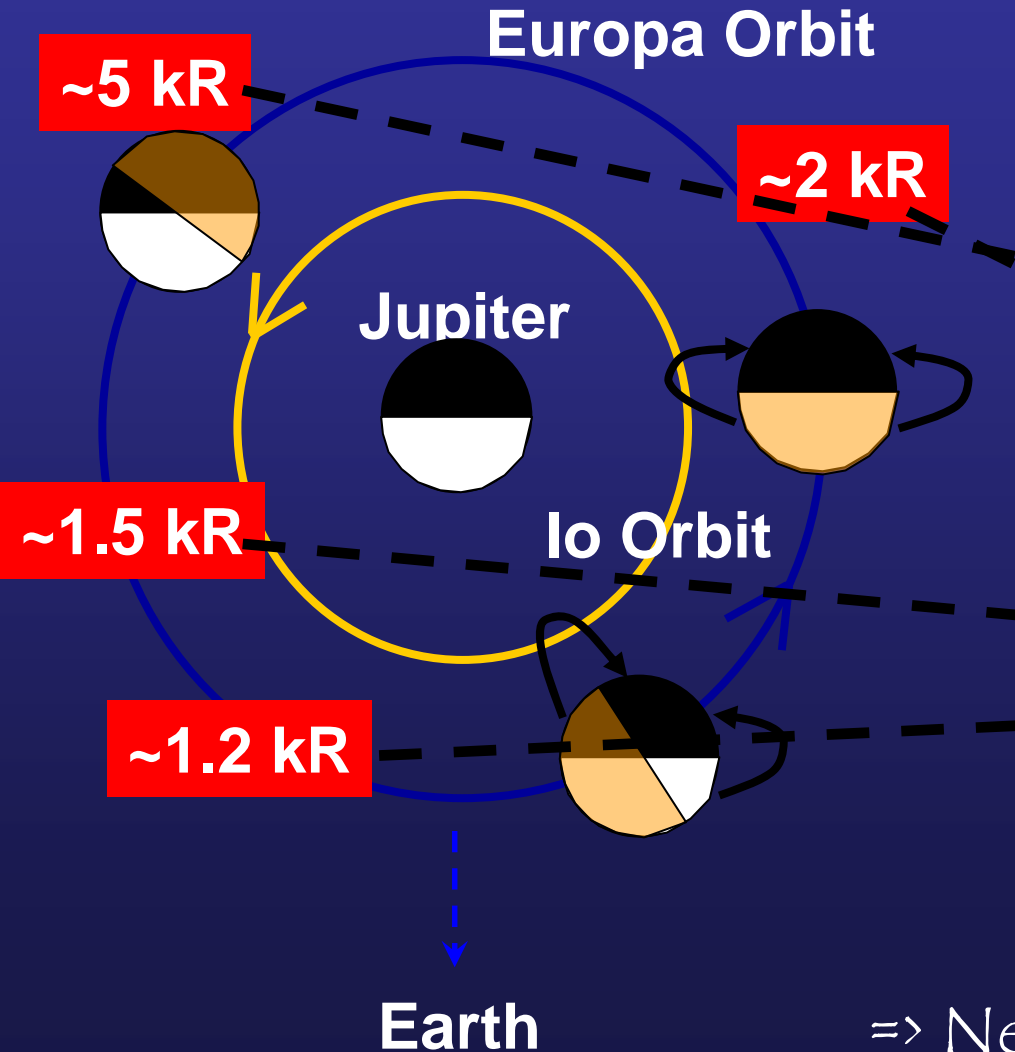
\Rightarrow moments

Typical run time = 1 week

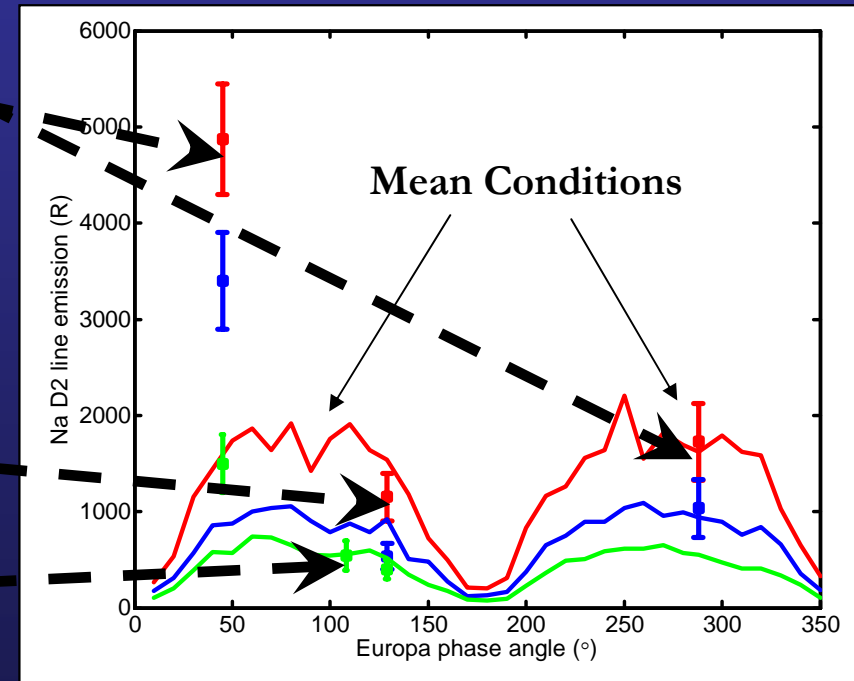


Na density (in 2×10^{13} Na/cm⁻²) at surface and in exosphere

Evidence of a plasma sensitive exosphere on short time scale



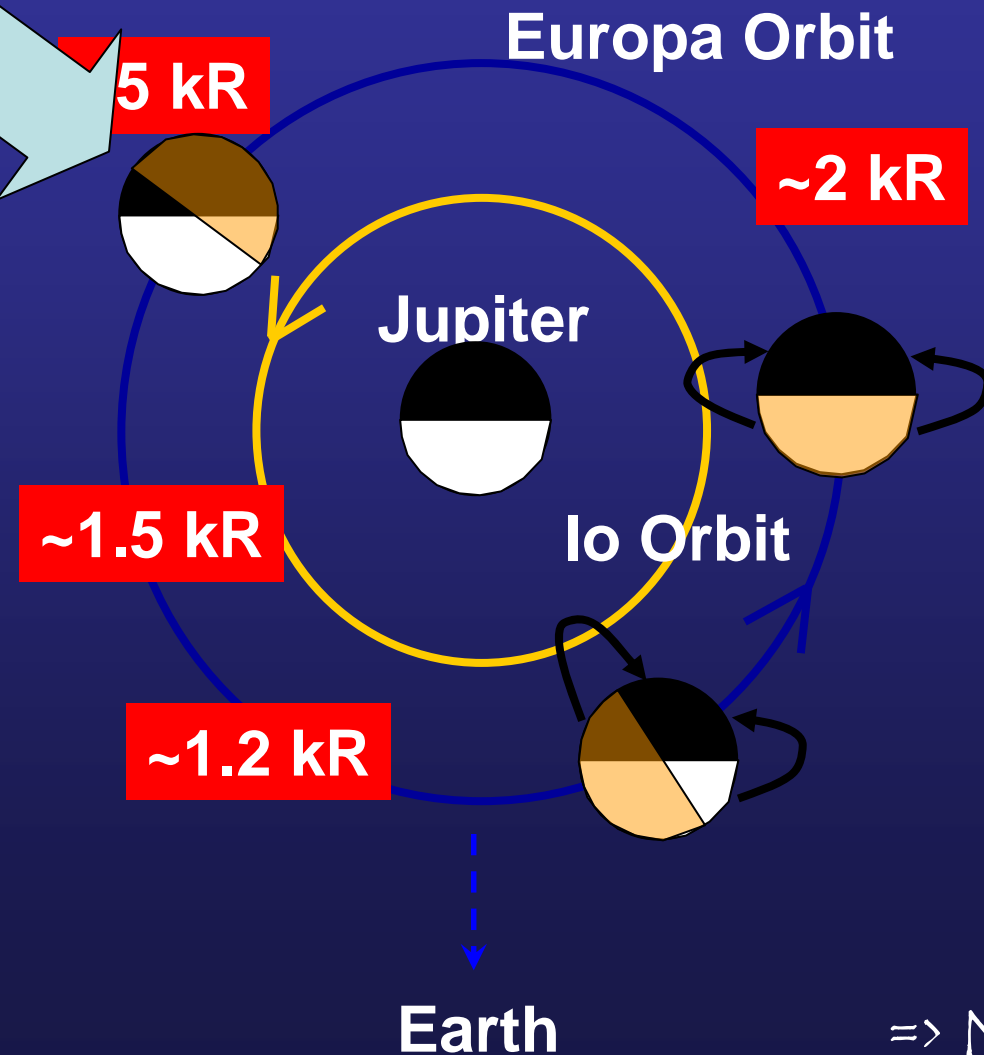
Na emission along the orbit



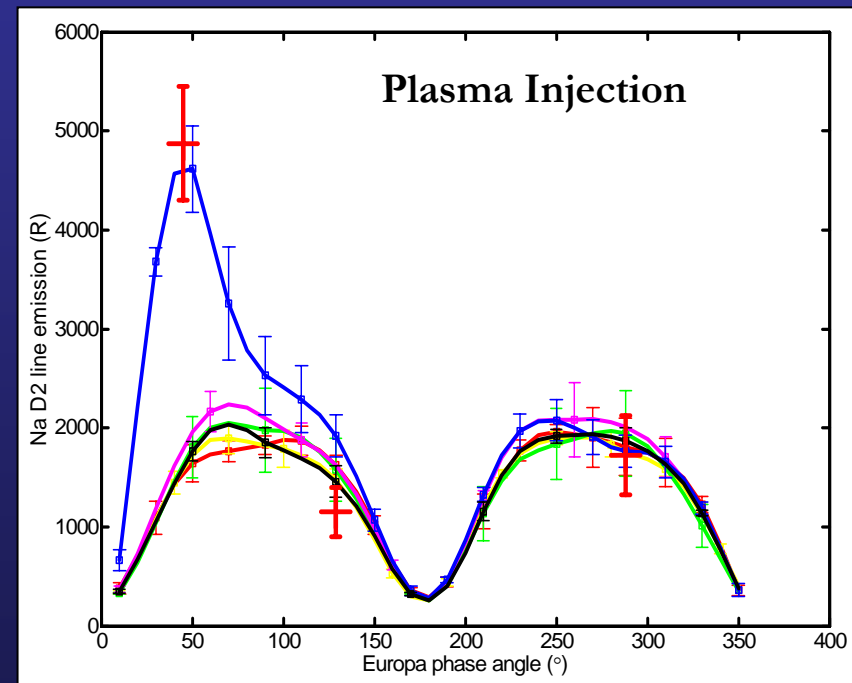
Cipriani et al, GRL, 2008

=> New observations (TNG) ...

Evidence of a plasma sensitive exosphere on short time scale



Na emission along the orbit



Cipriani et al, GRL, 2008

=> New observations (TNG) ...

Atmospheric signatures of interaction processes and surface features ...

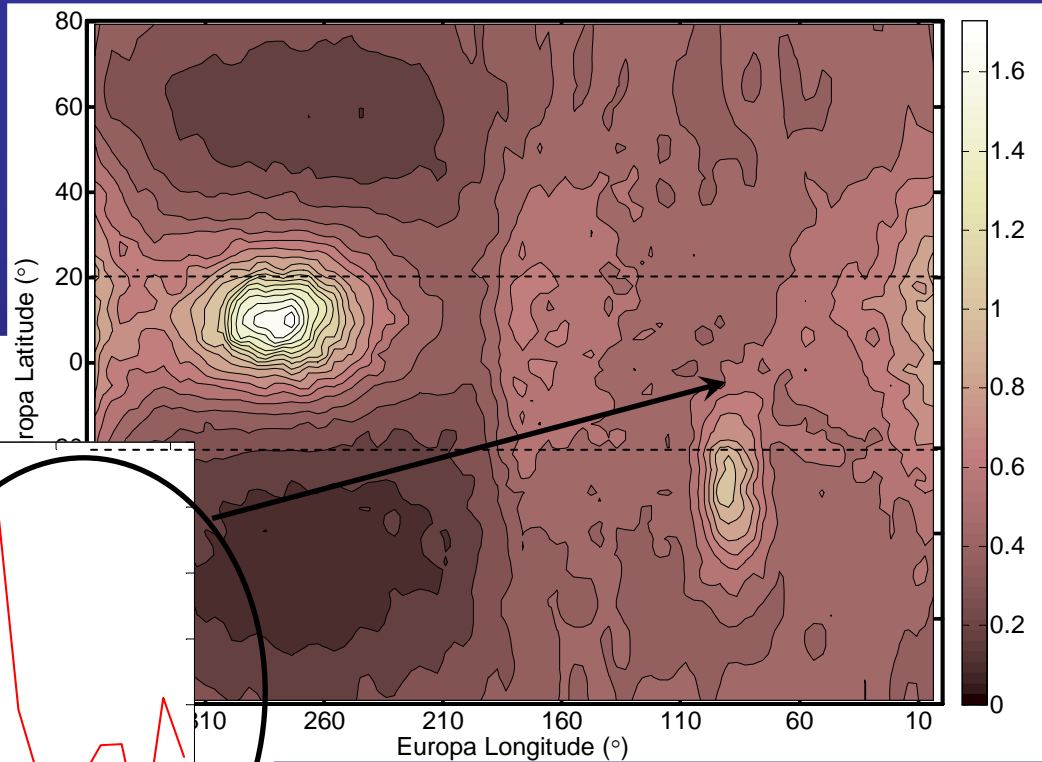
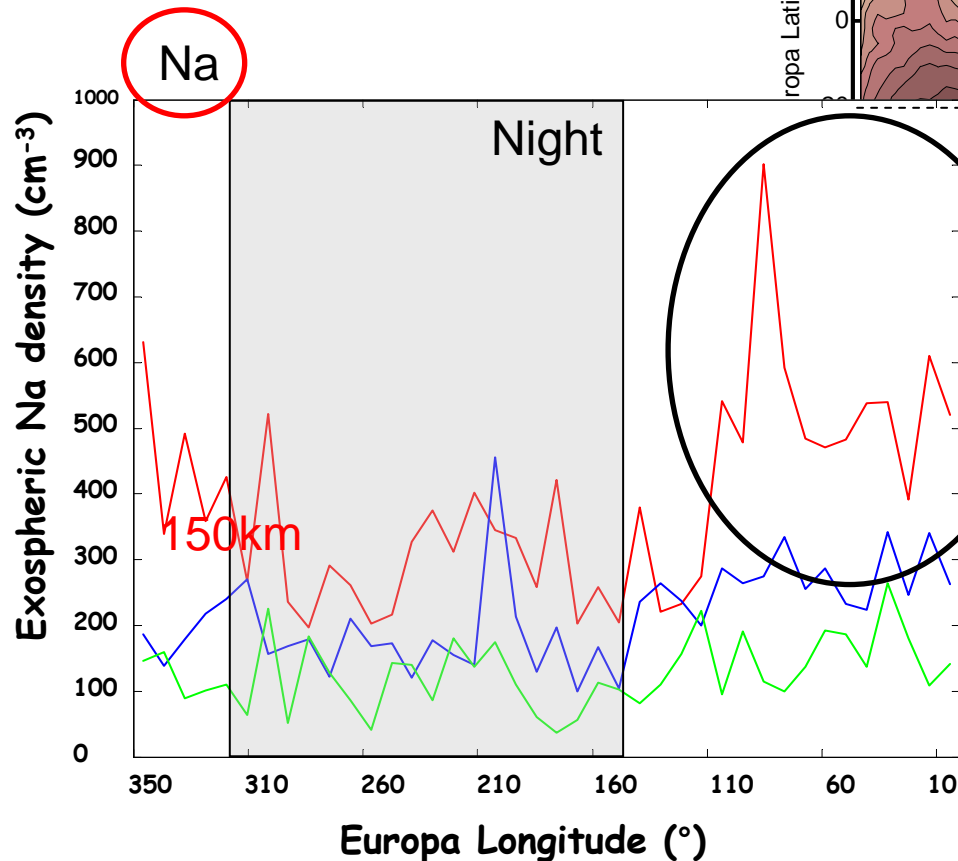
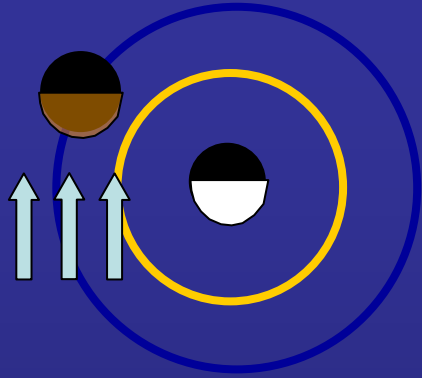
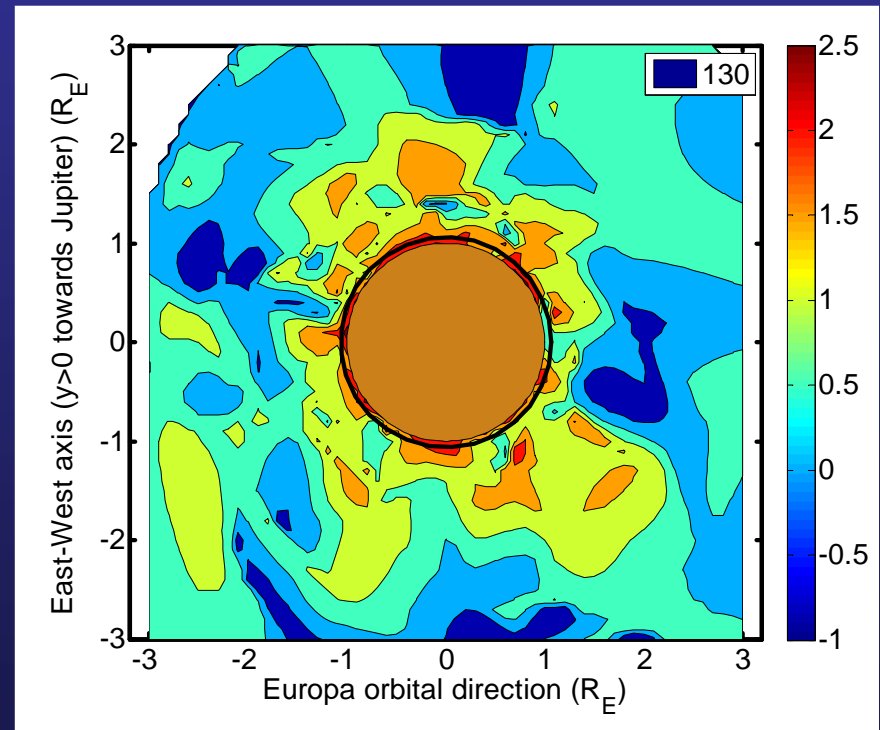
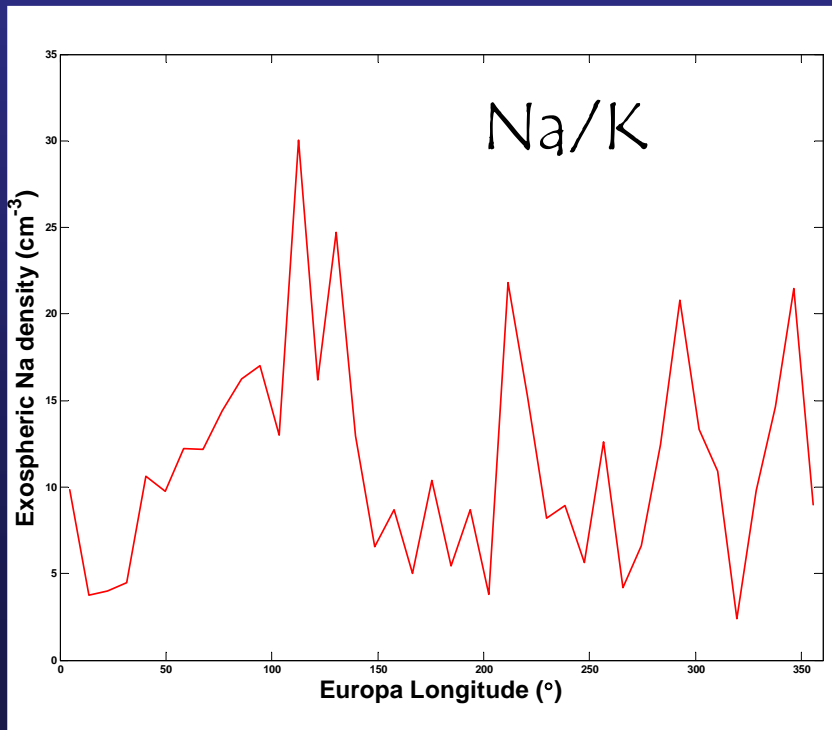


Photo desorption
of Na from the
leading
hemisphere !!

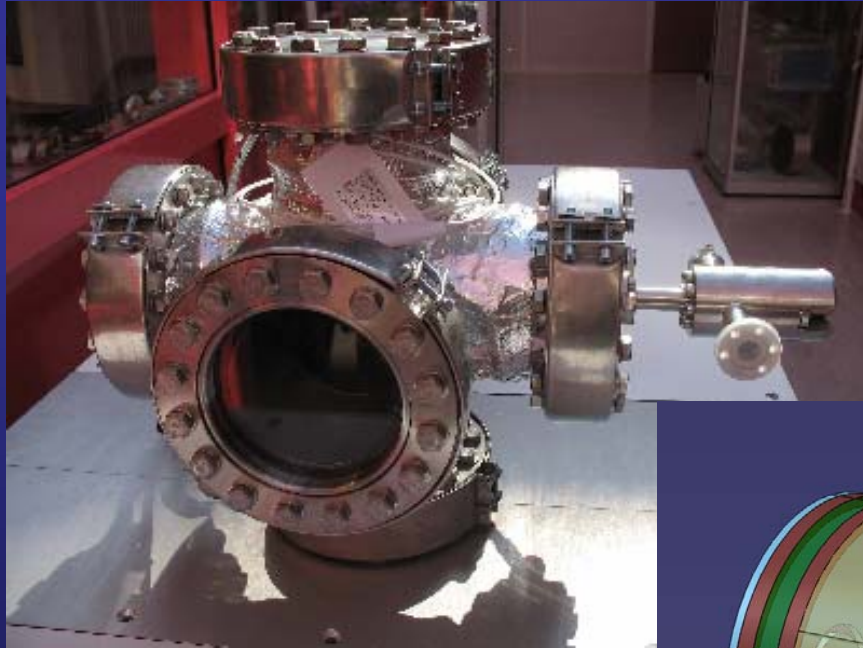
Study of Na/K surface inhomogeneities

Na/ K ratio (~ 25) differs from that at Io (~ 10) (Brown 2001)

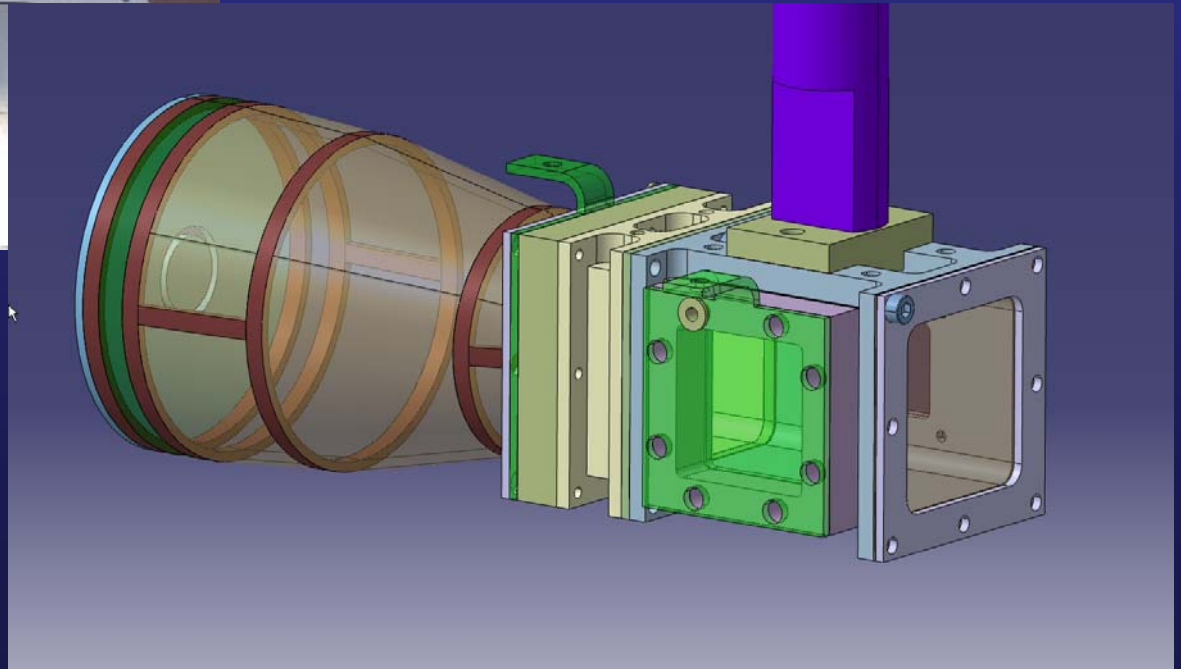
How surface density gradient translate in the exosphere ?
Minimal gradient detectable from an orbiter ?



Some R&D related work in Mass Spectrometry at ESTEC ...



Tenuous environments :
Need for high sensibility !



Thanks Fritz !

=> Development and testing of a very high sensibility mass spectrometer

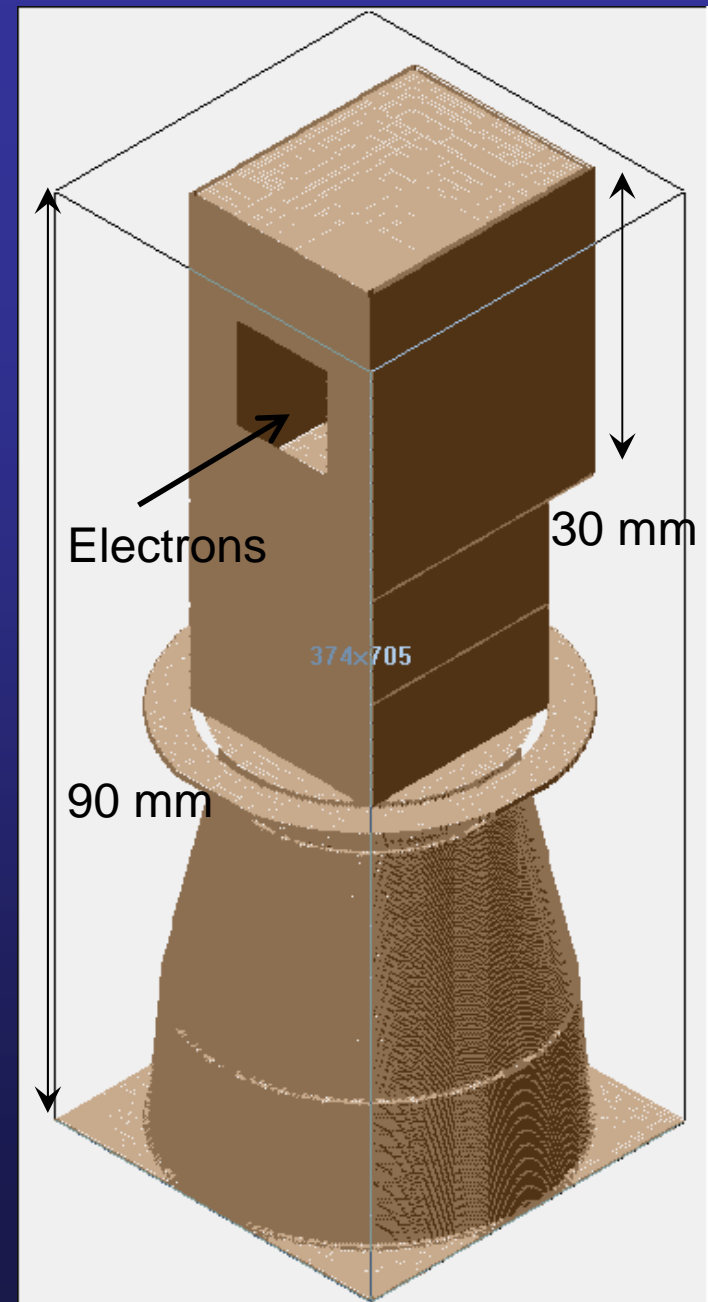
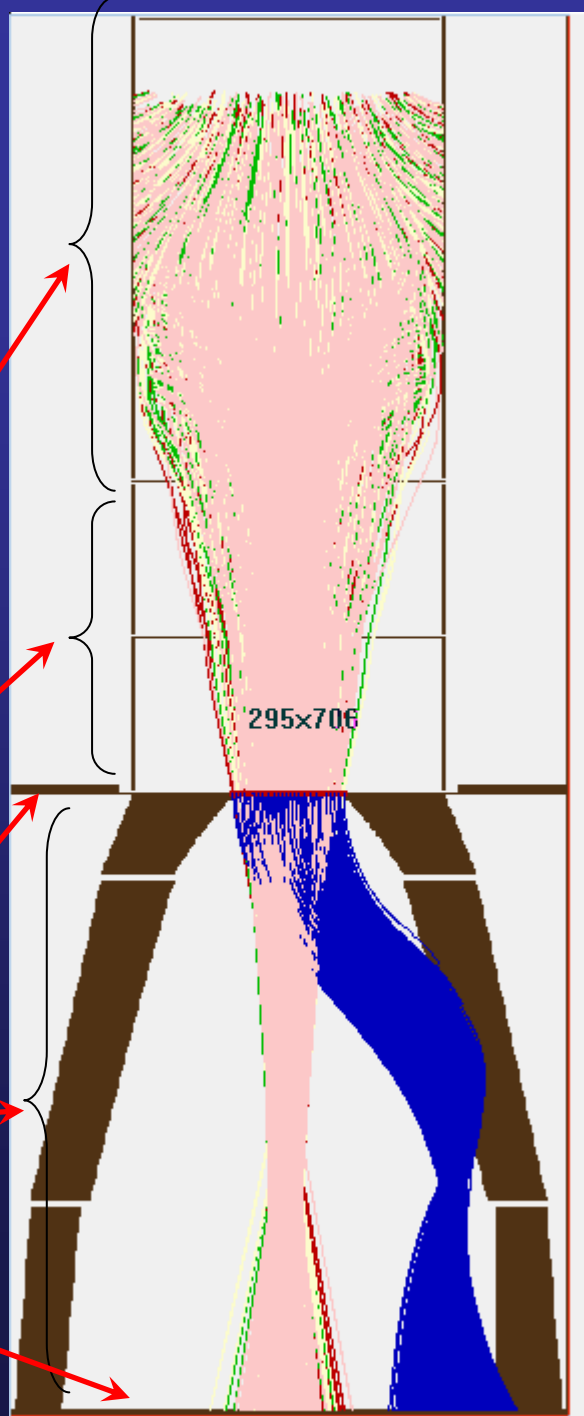
Ion source

Extraction lens

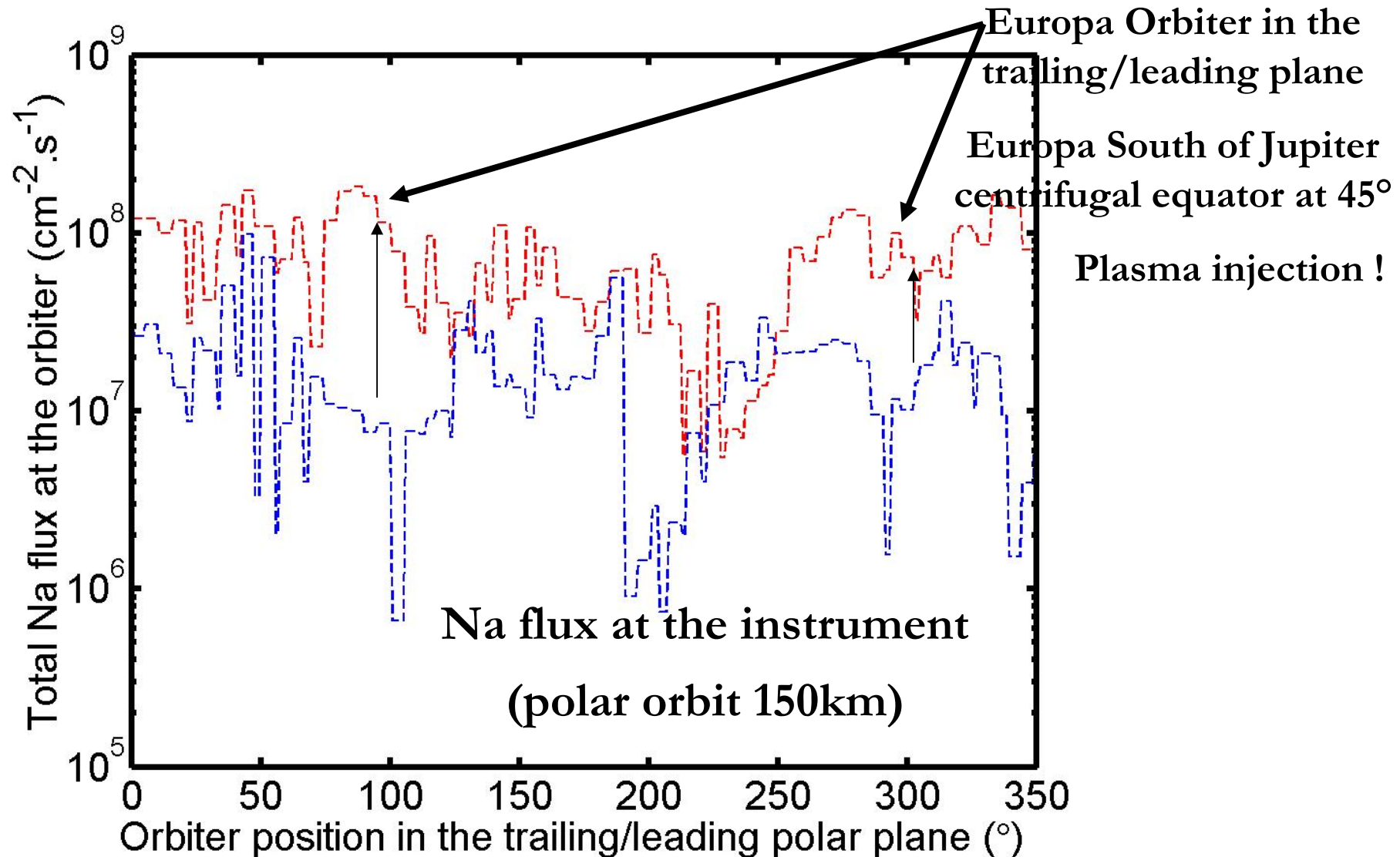
Carbon Foil

TOF

Detector (MCP)



Europa's atmosphere sounding from an orbiter : what can we expect ?



Wide applicability ...

⇒ Of the modelling approach : Mars, Europa , Callisto, Ganymede ,Titan, Enceladus, the Moon, Mercury, Asteroides, any object subject to sputtering/radiative fields ...

⇒ Of the instrumental concept : high sensitivity opening new observational window for solar system object missions

⇒ Complementarity instrument/planetary environments helping to refine feasibility of measurements and scientific objectives