

Investigation of surface and plasma environment of Europa and its interaction with Jovian magnetosphere

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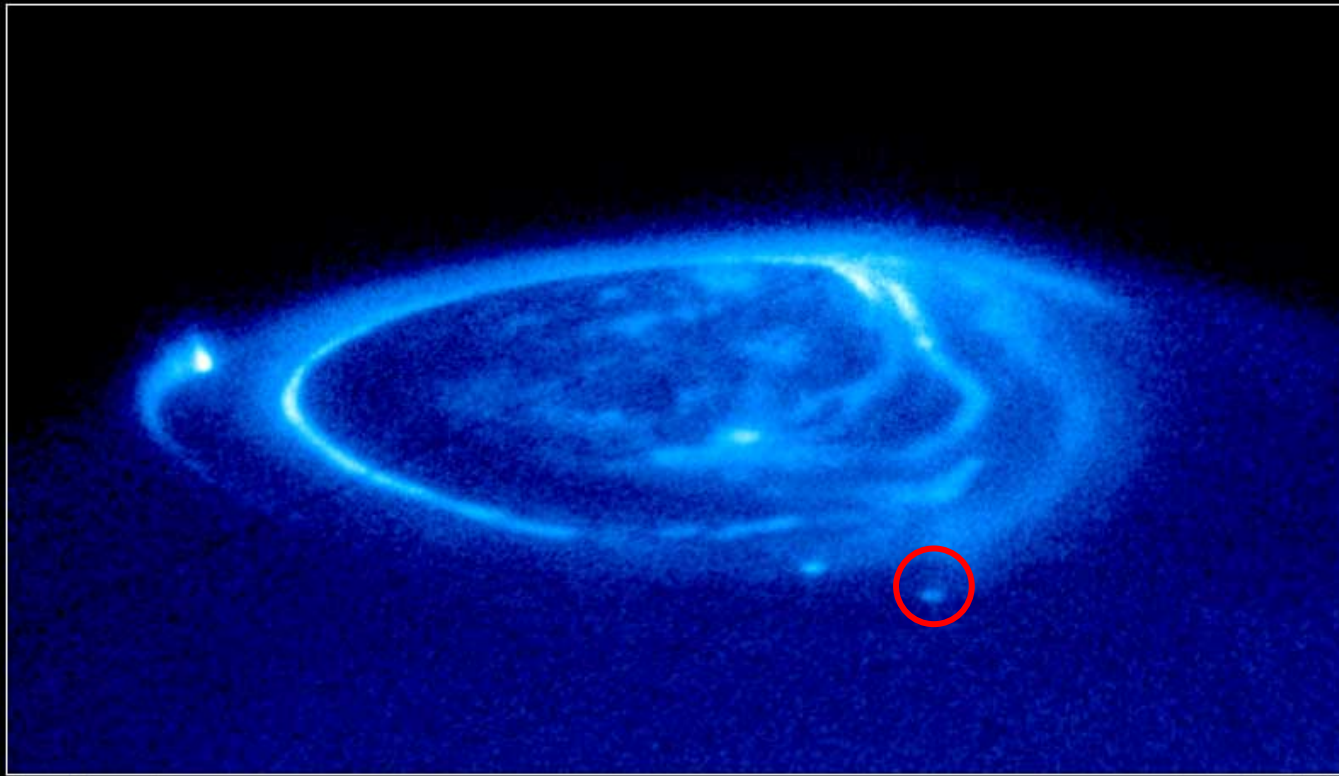
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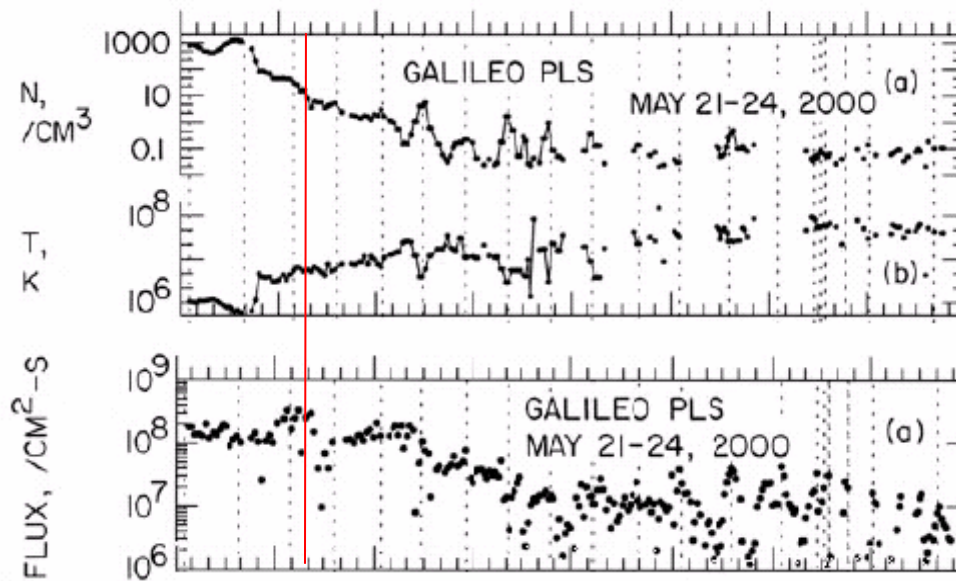
Interaction of satellites with Jovian magnetosphere



Auroral footprints can be seen in this image from Io (along the left hand limb), Ganymede (near the center), and Europa (just below and to the right of Ganymede's auroral footprint). These emissions, produced by electric currents generated by the satellites, flow along Jupiter's magnetic field, bouncing in and out of the upper atmosphere. This ultraviolet image of Jupiter was taken with the Hubble Space Telescope Imaging Spectrograph (STIS) on November 26, 1998 In this ultraviolet view.

Magnetospheric plasma near Europa

FRANK AND PATERSON: PLASMAS IN JOVIAN DAYSIDE MAGNETOSPHERE



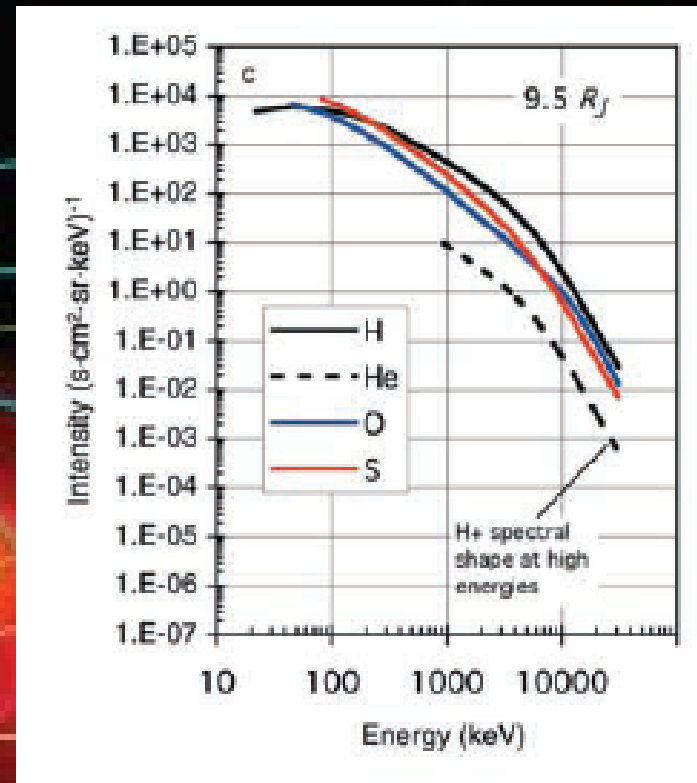
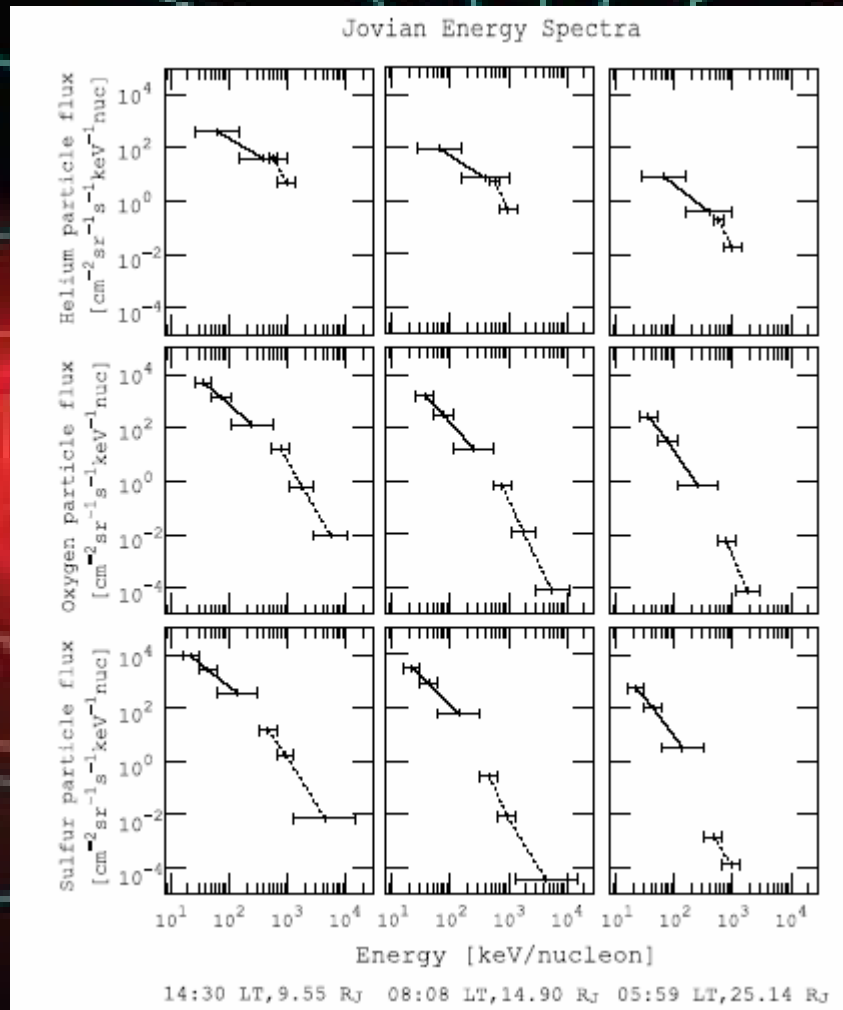
the energy range 1.9 keV to 52 keV,

DATE	5/21/00	5/22/00	5/23/00	5/24/00	5/25/00				
R, R_J	7.7	8.7	15.2	21.6	27.5	32.9	38.0	42.7	47.2
LT	04:23	1:10	13:51	14:55	15:30	15:53	16:10	16:22	16:33

21–24 May 2000.

Perijove occurred at 0452 UT at a radial distance of $6.75 R_J$.

Energetic particles flux in the magnetosphere



Mauk et al., 2004

Radioti et al., 2005

Some important issues

Europa moves relative to magnetospheric magnetic field with velocity ~ 105 km/sec (subsonic velocity)

Europa has induced magnetosphere and Alfvén wings

Europa has atmosphere (5×10^{14} cm $^{-2}$) and ionosphere ($\sim 10^3 - 10^4$ cm $^{-3}$)

Energetic particles hit Europa's surface that leads to sputtering rate of $\sim 3 \times 10^{27}$ molecules/sec

Europa is an important source of neutrals particles (50kg of O $_2$) and ionized particles in Jovian magnetosphere

Mass and isotopic composition of these particles reflects the mass composition of Europa's surface

Scientific goals of experiment

Europa's surface and atmosphere

Atmospheric/ion composition and its losses to the magnetosphere

Fluxes of accelerated ions and electrons near Europa and/or at its surface.

Surface sputtering and implantation of energetic ions

Mapping of surface composition

Jovian magnetosphere and its interaction with Europa

Ion composition of plasma and accelerated particles

Europa's role in magnetospheric plasma population

Magnetospheric plasma dynamics

Electromagnetic interaction with Jupiter

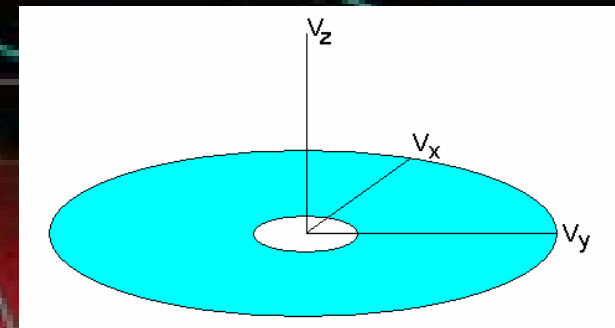
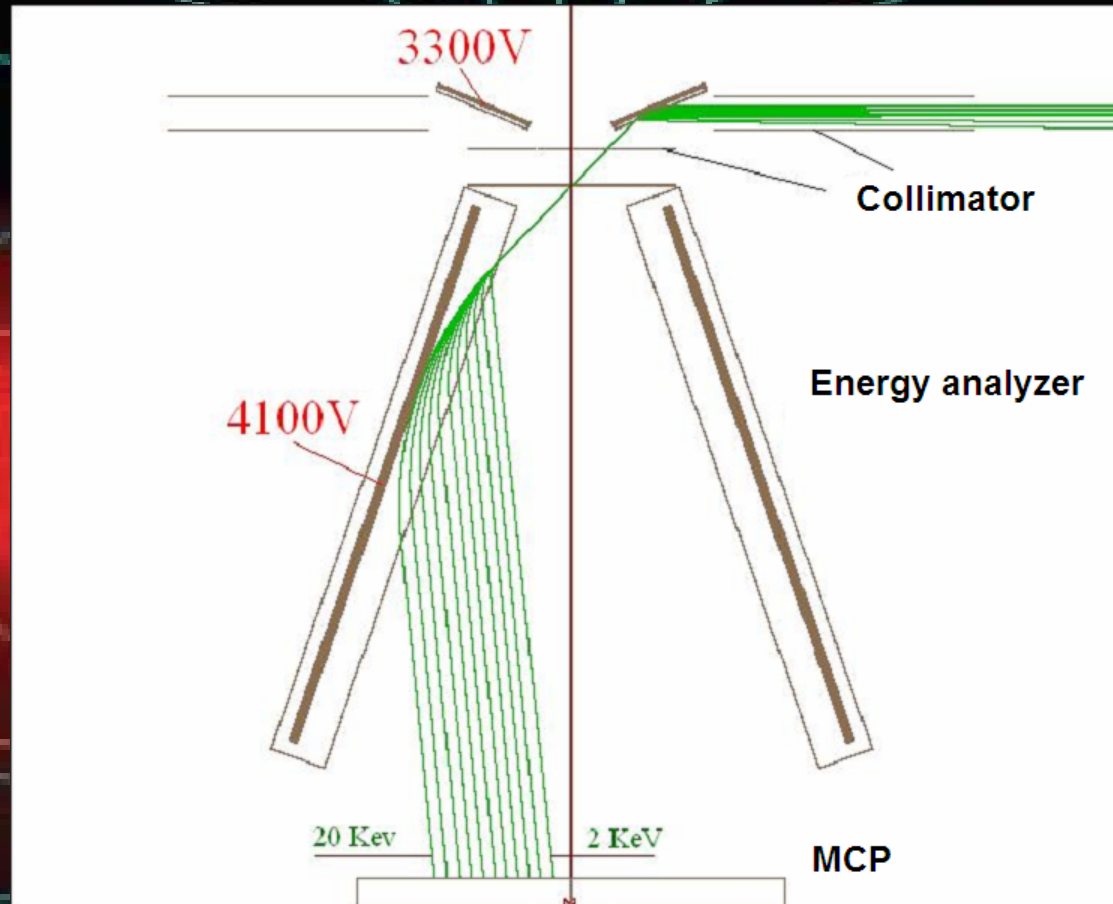
Proposed experiment

Measurements of flux and velocity distribution of suprathermal and energetic ions and electrons, and mass/charge ion composition for investigation:

- influence on Europa's surface**
- surface composition**
- Europa's atmospheric losses**
- composition of Europa and its atmosphere**
- Jovian magnetospheric plasma dynamics and the role of Europa in Jovian magnetosphere**

Onboard of lander, satellite of Europa or satellite of Jupiter

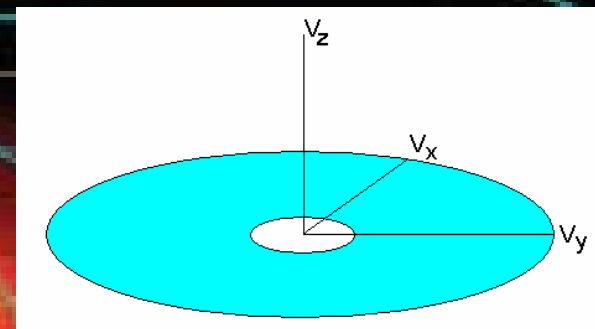
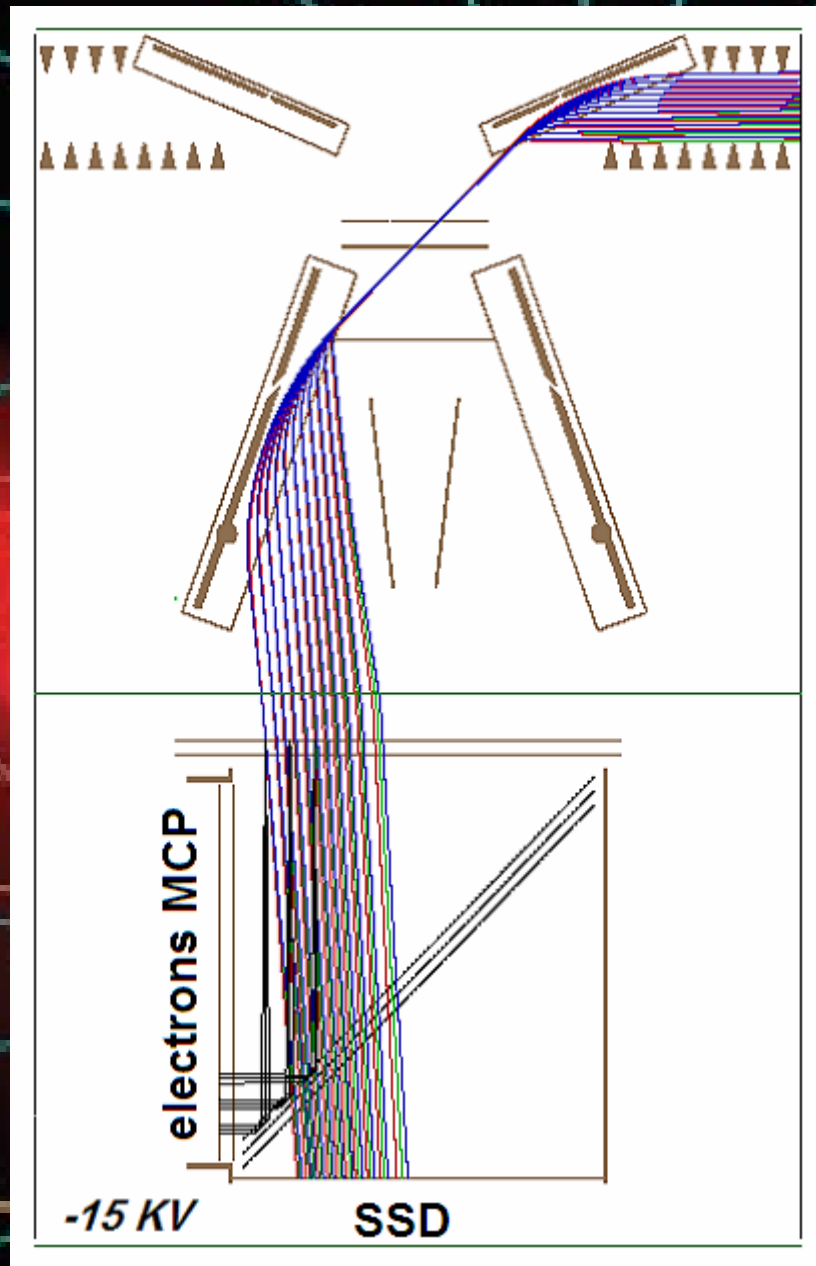
Electro-optics of electron spectrometer



Instantaneous
sampling of
velocity space,
 $E_{\max}/E_{\min} = 10$

Cross-section of cylindrically-symmetric scheme

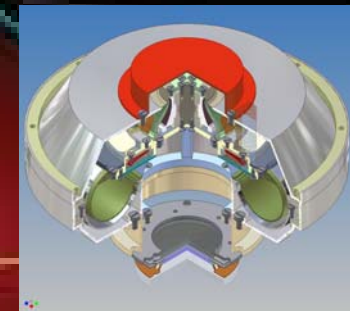
Electro-optics outlay of ion energy- mass-spectrometer



Instantaneous sampling of
velocity space, $E_{\max}/E_{\min} = 10$

Characteristics of instruments

- Two analyzers – ions and electrons
- Instant 2-dimensional measurements in velocity space
- Energy range : 10 eV – 50 keV
- Energy resolution: 10%
- Field of view: $5^\circ \times 360^\circ$
- Instant energy range: $E_{\max}/E_{\min} = 10$
- Mass resolution of ion spectrometer, $M/\Delta M$: ~ 60
- Total mass of 2 analyzers : 3.5 kg
- Status: development of laboratory prototype
- Heritage: SCA-1/Interball, FONEMA/Mars-96, PICAM/BepiColombo, DI/Phobos-soil
- Importance of simultaneous magnetic field measurements



DI/Phobos Soil

Team: IKI, CETP, Service d'Aeronomy St. Patrick University