Particle Environment Package (PEP) for Laplace JGO

Assessment study status report

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Outline

- PEP overview
- Assessment study status
  - Assessment study overview
  - Meetings: kick-off (completed), PM1 (completed), PM2 (scheduled)
- Common for plasma packages issues identified
  - HGA and SA obstruction
  - Funding issues

Unique Jupiter's magnetosphere

- Main source of plasma is the Io's neutral torus
- Due to fast Jupiter's rotation and weak convective electric field of the solar wind the magnetospheric plasma co-rotates, forming a magnetodisk
- Co-rotating plasma interacts with the Moons
  - Callisto (resemble the Moon but the flow of O^+!)
  - Ganymede (remotely resemble Mercury, Earth)
- Co-rotation results in an electric current systems powering Jupiter aurora
- Strongest radiation belts in the solar system

- Unique magnetosphere: a key for understanding plasma Universe

Magnetosphere overview

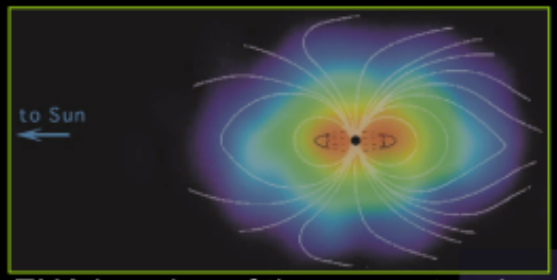
Parameter	**Value**	**Earth's value**
Magnetic moment	4.3e5 (nT x Rj)	0.61e5 (nT x Re)
Magnetic tilt	9.6°	11.5°
Magnetopause (stand-off distance)	70-80Rj (62-110) Rj	10 Re (6-15)Re
Bow shock (stand-off)	80-90Rj (90 – 130) Rj	~15 Re
Main ions	O+, S+, p	O+, p

PEP science objectives

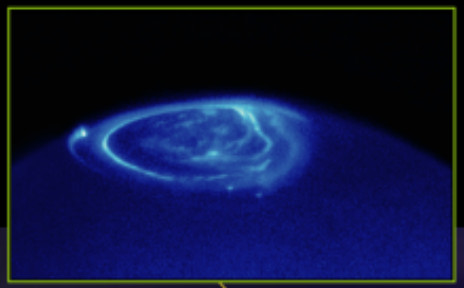
- Study Ganymede magnetosphere
- Ice shell and oceans of Ganymede and Callisto
- Surface composition of Ganymede and Callisto
- Moon-magnetosphere interaction
- Moon exospheres

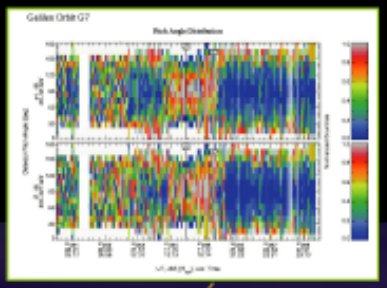
- Characterization of Jupiters's magnetosphere/magnetodisc global configuration and dynamics
- Solar wind influence on Jupiter's magnetosphere

- Study the Jovian system as a giant particle accelerator inside the magnetosphere and outside in the interplanetary medium

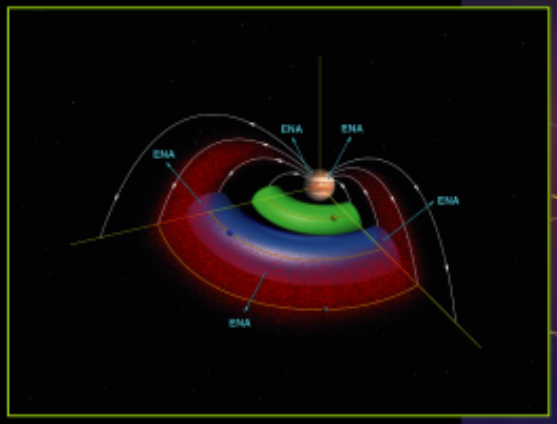


ENA imaging of the magnetosphere, moons, and interactions



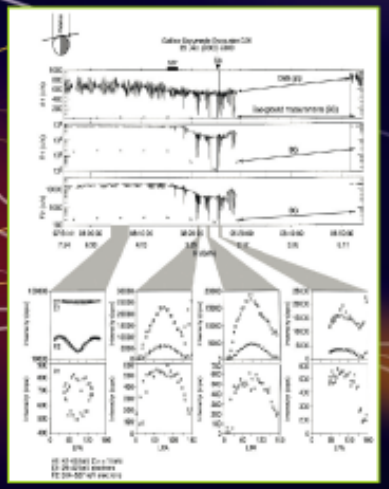


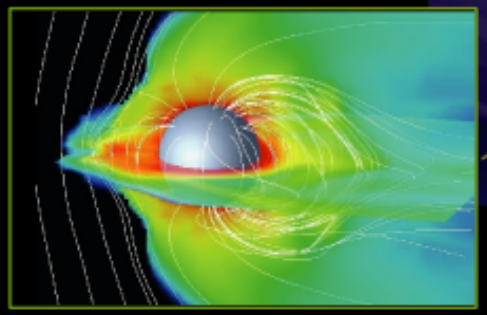
Characterization of Jupiter's magnetosphere including aurora



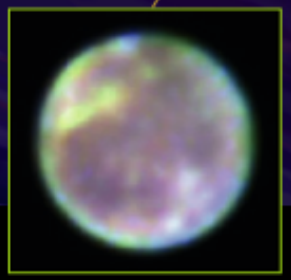
Characterization of the Io and Europa tori

Characterization of magnetosphere/moon interaction

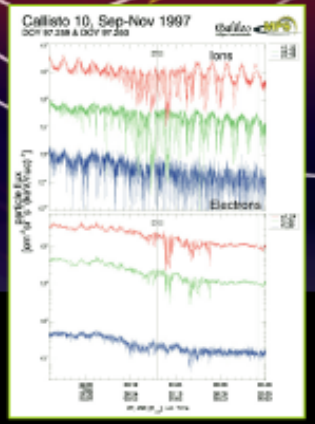




Characterization of Ganymede's magnetosphere



Characterization of atmospheres and exospheres of the Galilean moons



Characterization of Callisto's environment

PEP key points (1)

- PEP is an optimized instrument suite to explore, understand and characterize the Giant Particle Accelerator and its impacts on moons, which makes Jupiter the harshest radiation environment in the solar system.

- The PEP team follows the tasks set forth in the DOI call and works closely with the JJSDT Working Group 3 (“Magnetosphere”) to optimize the flow down from science to measurement requirements

PEP key points (2)

- PEP consists of two units providing the full sphere coverage
- PEP is a set of highly integrated sensors each for specific measurements:
  - a single management interface for ESA
  - the most effective usage of the spacecraft resources via sharing power systems and DPUs
  - the usage of the mutual shielding of sensors and subsystems (dense packaging)
  - Optimal observational and operation strategy
  - Enhancing scientific data exchange within the package

- Team consists of leading European and non-European groups similar but extended to ASPERA-3/4 packages on Mars and Venus Express.

- The assessment study team will be THE proposal team, therefore, confidentiality must be maintained. Also, to avoid the conflict with signed NDAs.

Assessment study overview

- Almost all sensors have flight heritage (TRL≥7)
- For sensors with TRL=4/5, which require technology development, back-up solutions are foreseen
- Two groups of study items:
  - Instrument development
  - Technology development
- Assessment study is broken into study items and study items into individual tasks
- All together 22 study items identified

Assessment study status (1). Kick-off meeting

- Kick-off meeting took place on Sept. 10-11, 2009, Uppsala, Sweden.

- Short summary of study activity, findings and recommendations
  - PEP configuration confirmed as in DOI
  - Face-to-face interface discussion between individual sensor PIs and package system engineers conducted
  - Radiation modeling approach developed and agreed
  - Management interfaces for the instrument packaging and DPU and power system sizing agreed

Assessment study status (2). PM1 report

- Progress meeting no. 1 took place in December 9-10, 2009.

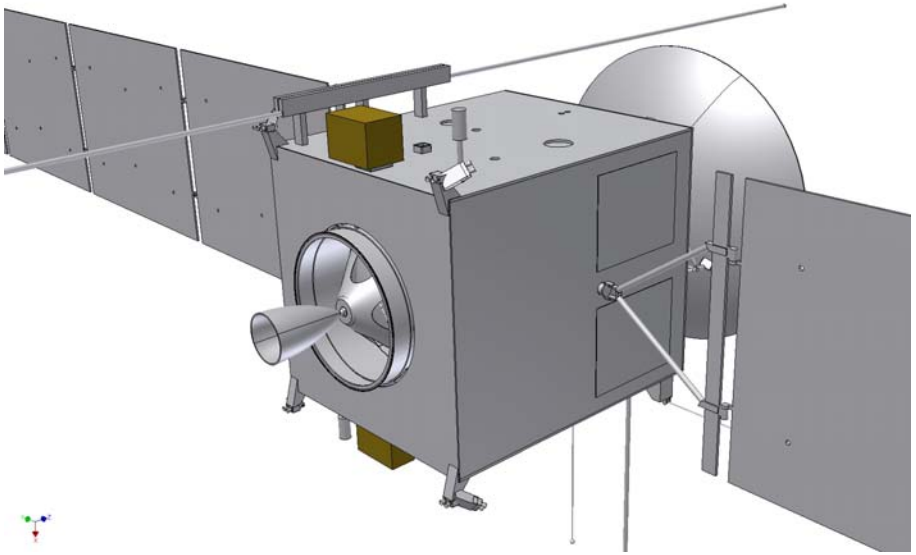
- Short summary of study activity, findings and recommendations
  - Science requirements for the PEP measurements presented and discussed
    - More detailed science flow down is a critical part of our study. Established collaboration with WG3. Work across instruments and (later) disciplines to use synergistic approach to optimize the way we address the science themes.

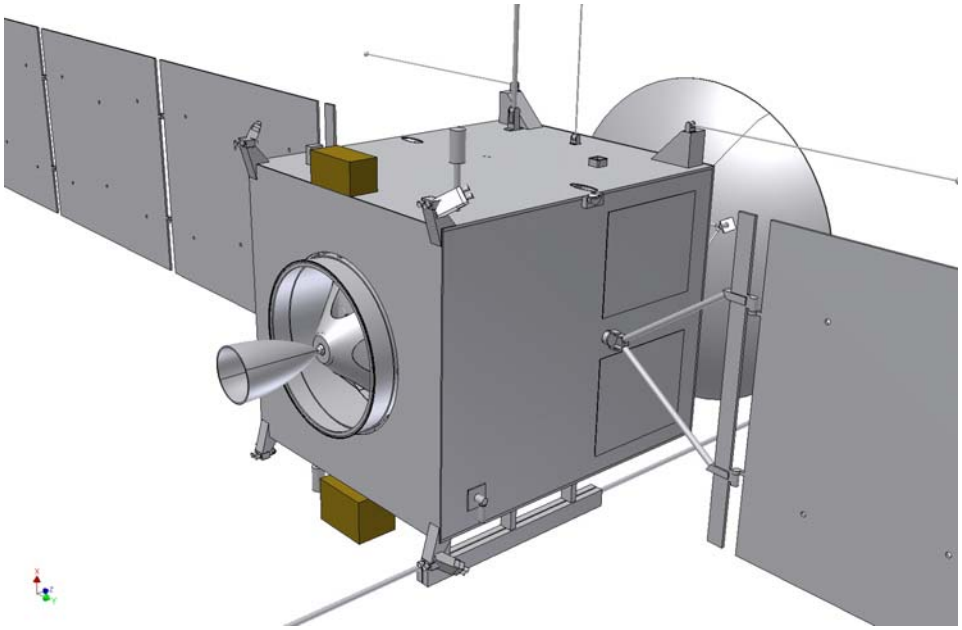
  - First results of the radiation analysis on the package level presented and discussed
    - Radiation mitigation is to be made not only by shielding and EEE part selection. Increasing SNR by using coincidence techniques is required (at least, double, triple for low intensity signals).

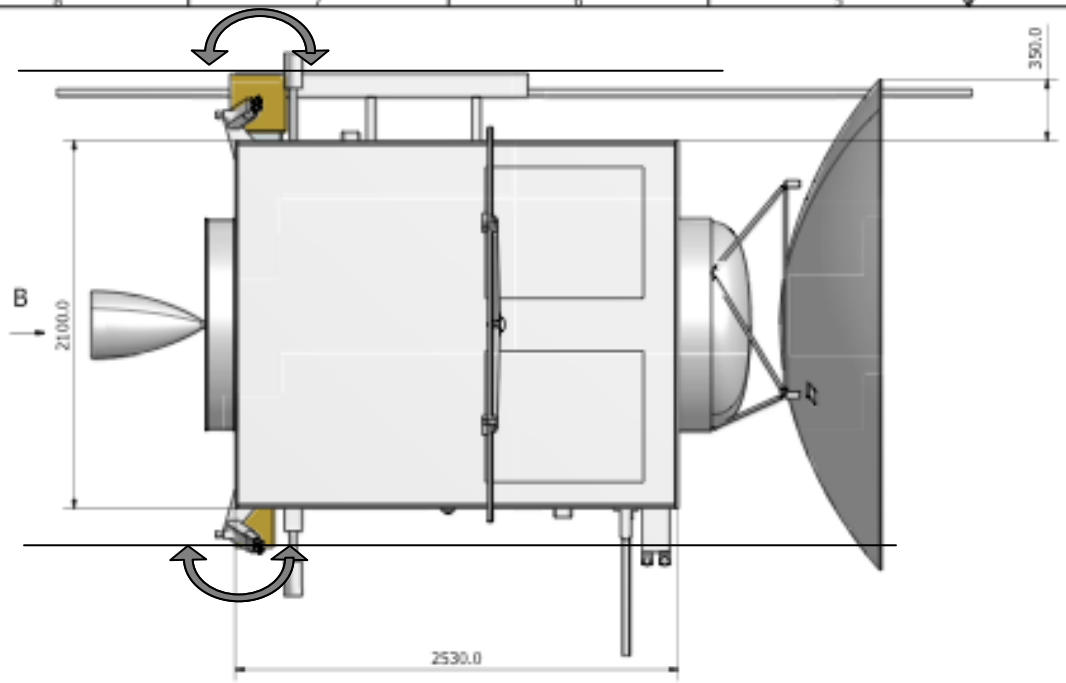
Assessment study status (3). PM1 report

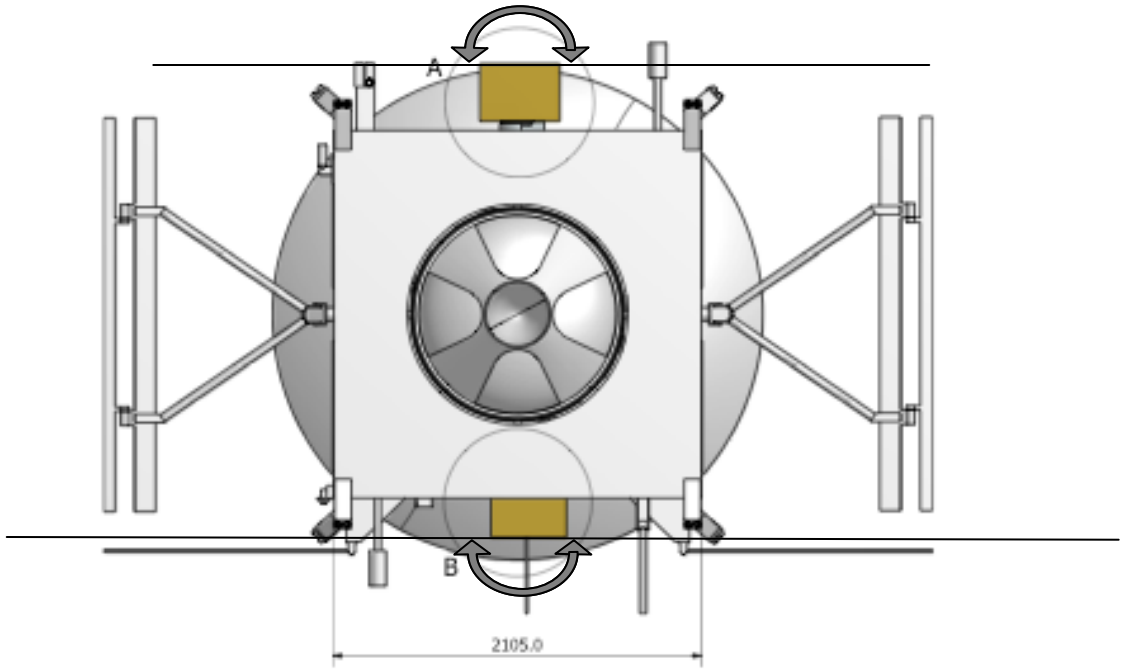
- Short summary of study activity, findings and recommendations (cont.)
  - First proposal for the PEP mechanical layout presented and discussed
  - Power and data handling systems architecture discussed and defined
  - First proposals on the sensor designs based on completed ray-tracing of the electrostatic optics presented and discussed
  - Management structure updated
- Next meeting (PM2) on March 3–4, 2010
- PM3 (last before the study report) June, 2010

Accommodation problem (1)









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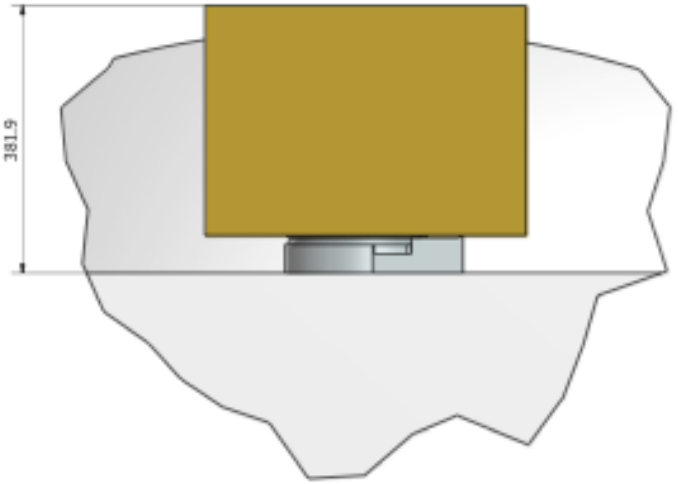

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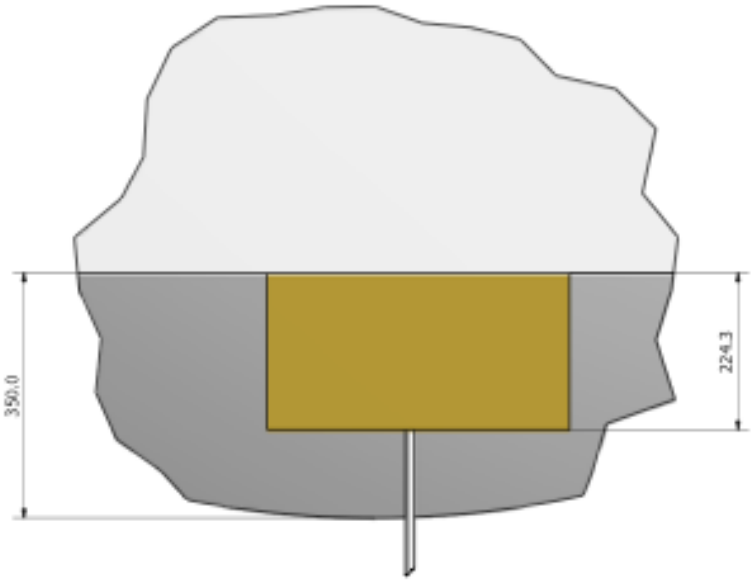

Satellite structure.iam	Item	Qty	Description	Mtrl	Drawing no. / Dim.	Kg
Solid model geometry file	Designed by: Magnus Oja	Checked by	Approved by	Date: 2010-01-14	Scale	
Surface finish Ra	General tolerance ISO 2768-1	Swedish Institute Of Space Physics, Box 812, SE 981 28 Kiruna, SWEDEN		Su Nu envelope	Edition	Sheet 1 / 1

Accommodation problem (2)

- HGA and SA obscure a plasma package 2π (hemispheric field of view)
- Possible solution is introducing an extending bracket. Note, the impact on radiation shielding from the s/c.
- The issue should be addressed on the s/c level.

Funding issues

- The conflict with the requirement for the assessment study results by August 31, 2010 and established funding cycles in some groups.
- Initial work in all groups is founded internally
- External funding in Sweden available. A new proposal for new funding will be submitted by the end of January.
- Despite applications submitted funding in Germany and France could be available only from March-May 2010.