

# Update on the study for a High Resolution Camera onboard the Jupiter Europa Orbiter (JEO)



**Proposing Institutions:** DLR, with major contributions from INAF

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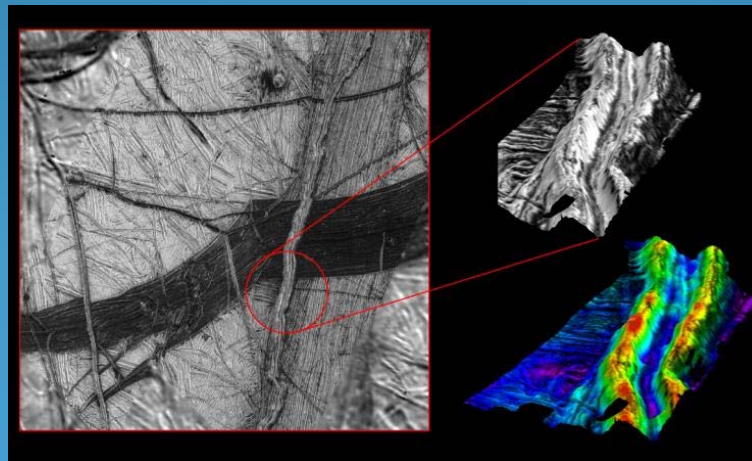
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# Major scientific goals



Highest resolution image of Europa's surface (6m/pxl) acquired by Galileo SSI taken at a distance of ~ 200 km.

1. Investigation of geological processes on **Europa's** surface  
Detailed characterization of potential future landing sites  
Provide the geological context for other JEO measurements
2. Monitoring the volcanic activity of Io
3. Investigation of geological processes on Ganymede's and Callisto's surface
4. Studying of the physical and chemical properties of Jupiter's rings as well as the inner and outer irregular satellites including the discovery of new ones as well as the detailed structure of Jupiter's atmosphere.



Europa's topography derived from Galileo SSI images (~26m/pxl) (PIA01664/ NASA/JPL/DLR).



Io's volcanic activity as seen in Galileo SSI (NASA/JPL/DLR).

# Science Requirements



## Baseline performance requirements for HRC-E in orbit around Europa:

- ground sampling distance of 1 m/pixel at 100 km altitude
- swath width of at least 1000 pixels
- monoscopic imaging for several 1000s of pixels along-track (pushbroom type)
- stereo observations at high spatial resolution of targeted features by multiple observations with camera tilt

## Baseline performance requirements for HRC-E for Jupiter system science:

- monoscopic high-resolution imaging of Io at variable resolutions (< 100 m/pixel to several km/pixel)
- minimum of 3-color monitoring of Io at different temporal scales (< 10 km/pixel)
- multispectral imaging capability with up to 9 colors
- 2D-stable imaging (framing) of distant targets with an astrometric precision < 30 km

**Else: support optical navigation**

# Derived Instrument Requirements



## Main Objectives

High resolution imagery of specific Europa and Jovian system targets  
Optical Navigation Imagery

## Baseline measurement requirements for HRC-E for Jupiter system science:

Spectral Range:	visible
Spectral Bands	9 color + panchromatic
Spatial Resolution	<1m (@100km orbit height)
SNR	>100

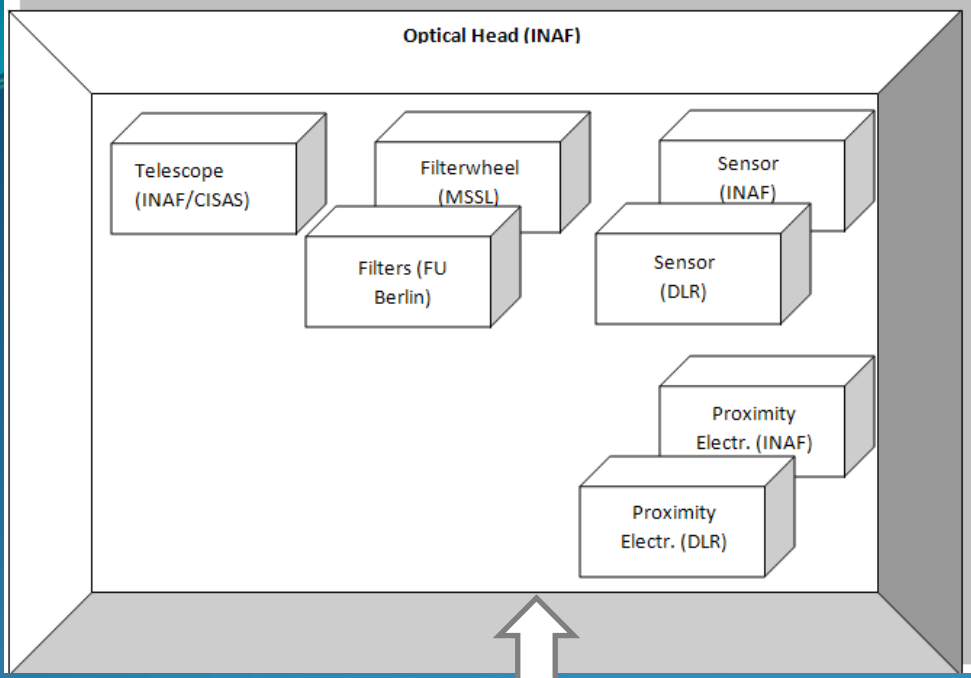
## Baseline Configuration HRC/E

Single detector : pushbroom-type imaging for Europa orbit  
framing mode for Jupiter system imaging and Op-Nav

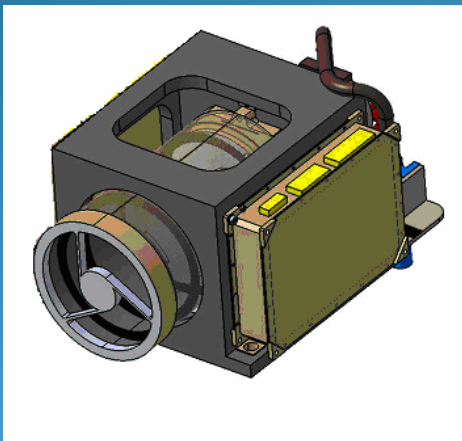
Filter wheel : motorized, with stripe filter for color imaging during  
Europa orbit and for Jupiter system science

Baseline Concept based on relevant experience of the study team: i.e. MEX HRSC, HRIC  
BepiColombo, Dawn FC, Rosetta ROLIS

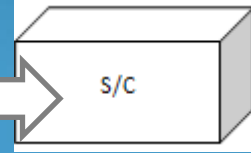
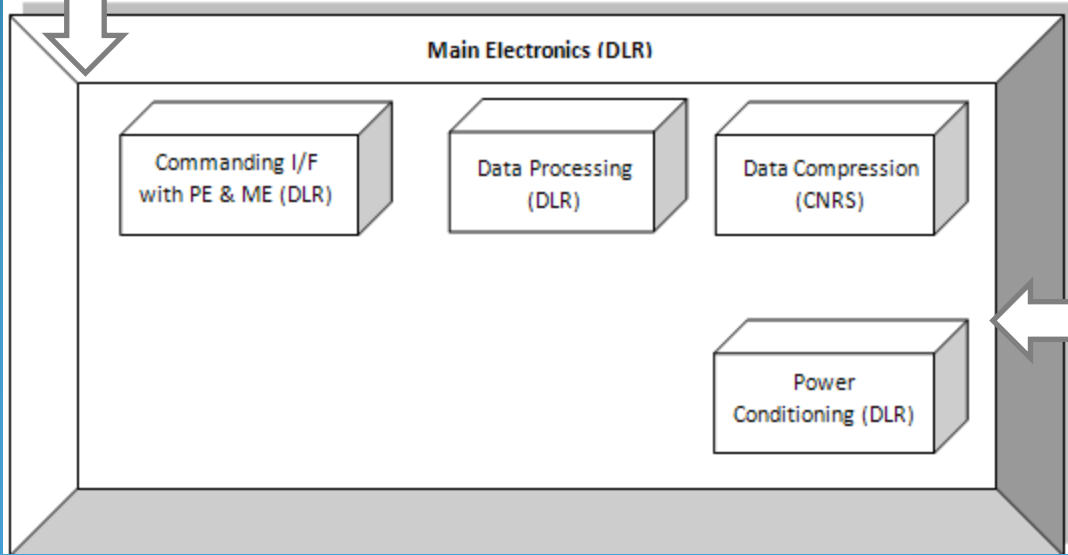
# Instrument Study Team Responsibilities



Dawn Framing Camera, credit: MPS/DLR



BepiColombo HRIC SIMBIO-SYS, credit: INAF



# *Instrument Study*



## **Formal Project Steps:**

- Letter of Intent submitted 15 April 2009
- Declaration of Interest submitted 11 May 2009
- DOI Assessment by ESA received Sep 2009:
  - Funding the study by national agencies recommended
- DOI Assessment by JEO system team (JPL/APL) received Dec 2009
- JEO AO (Step 1) expected 2011

## **Study Status:**

- study is currently underway under DLR R&D funding (in parallel with HRC/JGO study)
- present study activities focus on trade-offs of key aspects of instrument design (e.g., detector, optics, front end and main electronics), focus on radiation mitigation & PP
- Study based on heritage from past successful camera projects and ongoing camera developments (e.g. MEX HRSC, BepiColombo HRIC, DAWN FC, Rosetta ROLIS).

# Design Study – Baseline Concept



## Key Characteristics

- Visible pushbroom imager
- Visible framing imager
- Filter wheel (9 color bands + panchromatic+stripe filter for Europa orbit color imaging)
- f/10 catadioptric
- Focal Length = 2000 mm
- Cross-track pixels = 2048 (tbc)
- Field of View = 0.6°
- IFOV = 5  $\mu$ rad

## Optics

- Baseline configuration based on HRIC detector
- Catadioptric Ritchey Chretien (2000 mm FL, with field corrector)

## Detector

- Detector Selection is part of Study Phase I
  - Candidates:
    - HRIC SIMBIO-SYS Hybrid array detector (2048 x 2048, 70krad),
    - Star 1000 CMOS array (1024 x 1024, >230 krad)
    - tbd (under study with support from OU Milton Keynes (and e2V)
- (... further details in next presentation on detector study)

## Electronics

- minimize electronics packaged with the sensors and outside of the Science Electronics Chassis
- miniaturize focal plane electronics and package in a rad-hard ASIC OR upgrade components to 300 krad (RDF=2) and shield
- Main Electronics: combination of radiation-hardened parts and accommodation in central (shielded) Science Electronics Chassis