Development of the small EUV imaging device PHOENIX for the EQUULEUS mission

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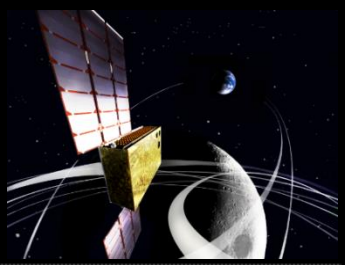
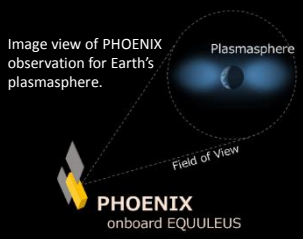
EQUULEUS/PHOENIX

The nano-spacecraft mission **EQUULEUS (6U)** as one of the 12 "secondary payloads" of **Space Launch System (by NASA)** which will be launched in Sep. 2018 is now under development. EQUULEUS will fly to a libration orbit around the **Earth-Moon L2 point**. The EUV telescope which is named **PHOENIX** will be boarded on the nano-spacecraft to observe the Earth's plasmasphere. [EQUULEUS size: 10 x 20 x 30 cm]



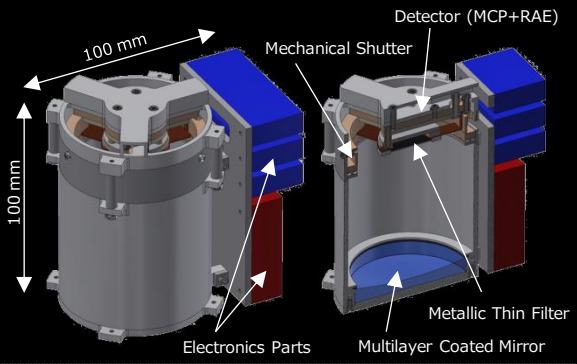
PHOENIX objectives

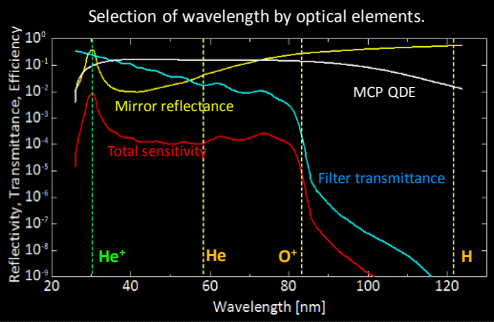
By flying far from the Earth, **the entire image of plasmasphere** can be obtained. The image **from the equatorial plane** helps us to understand the dynamics of plasmas along the magnetic field. The behavior of plasmas which is related to the solar activity is key for understanding the physics and evolution of the Earth's environment.



PHOENIX design

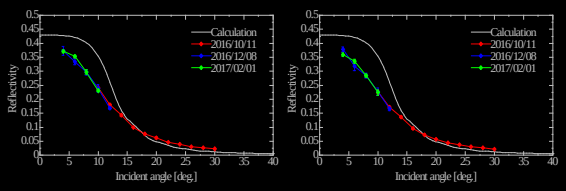
PHOENIX consists of a entrance mirror (ϕ55mm), metallic thin filter, photon counting detector, and electronics. The mirror is optimized for the emission line of **He^+ (λ=30.4 nm)**. The lights from another sources (HI 121.6nm, OI 83.4nm, HeI 58.4nm and etc.) are eliminated by metallic thin filter. The quantum efficiency which is higher at 30.4 nm than longer ones also select the wavelength. The design concept is almost identical to the UPI/TEX on KAGUYA (2007), and IMAP/EUVI on ISS (2012).





Mg/SiC multilayer coated mirror

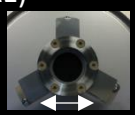
- Mg/SiC mirror has the fairly high reflectivity of **35%** at the wavelength of 30.4 nm.
- **No aging degradation** of the high reflectivity of the mirror was found.



Storage environment: Under vacuum | Under atmosphere

Other parts of PHOENIX

- Detector (MCP + RAE)
  - MCP
    - 3-stage
    - Diameter: Φ14.5 mm
    - Spherical surface
      - Curvature : 210 mm
    - Input voltage: 3.0 kV
  - RAE
    - Triangle shape




RAE modification (rectangle → triangle)

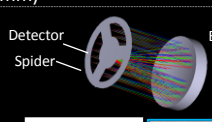
- Mechanical shutter
  - Iris diaphragm
  - Material
    - Plates: PEEK
    - Holder: Al

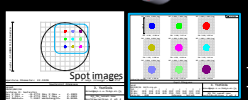

(mechanical test model)

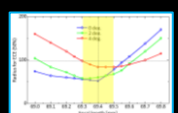
- Metallic thin filter
  - Affective area: Φ20.5 mm
  - Material (Thickness)
    - Film: C/Al/C (15/160/15 nm)
    - Holder: SUS304 (2 mm)

PHOENIX status

- The shutter mechanism (sun shield) is now under development …
- EM will be integrated until April 2017.
- FM will be integrated until August 2017.
- EQUULEUS will be sent for NASA summer in 2018.






Tolerances analysis for the focal length. The accuracy of 0.1mm is enough.