

## SPRINT-A/EXCEED mission

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### Abstract

EXtreme ultraviolet spectroCope for Exospheric Dynamics (EXCEED) is an earth-orbiting satellite employing an Extreme Ultraviolet (EUV) telescope, and which will be launched in 2013. EXCEED will make observations of plasma space in various planets in our solar system. It is very important to put an observing site beyond the atmospheric absorption when we observe EUV spectral range, and which enables us to study interaction of the solar wind with the upper atmosphere of the planets and their escape, and Io plasma torus of Jupiter. We will introduce the mission overview, its instrument, and the scientific targets.

### 1. Introduction

SPRINT-A/EXCEED is the first mission for the new category small satellite series of ISAS/JAXA in Japan. SPRINT-A/EXCEED mission will address various fundamental scientific questions pertaining to planetary plasma science. The one is plasma escape rates from the terrestrial planets, and the other is Jovian hot plasmas along Io.

One of the unresolved problems in the frame work of the terrestrial atmospheres is “escape of the atmosphere to space”. There were many in-situ observations done by orbiters, but our knowledge has still been severely limited, especially on the total escape rate. SPRINT-A/EXCEED observation will enhance our knowledge on the outward flowing

plasmas (the composition, rate, and dependence on solar activity) in the vicinity of each planet (Mars, Venus, etc). The Io plasma torus which is located in the inner magnetosphere of Jupiter is the other of the primary science targets of the SPRINT-A/EXCEED mission. The Io plasma torus is the main source of plasma for the Jovian magnetosphere and characterizes shape and dynamics of the rapidly rotating magnetosphere. Major ion species such as sulfur and oxygen ions have a lot of allowed transition lines in the spectral range of EUV from 55 nm to 145 nm, and they radiates the energies outward (Delamere and Bagenal 2003, Steffle et al., 2004). The EUV observation enables us to estimate radial distribution of the ion density and hot electron temperature in the inner Jovian magnetosphere and to discuss unresolved electron heating process associated with unsteady plasma transport.

EXCEED employs a new standard bus module developed for the new category of ISAS/JAXA missions. The satellite will be launched in space by the new solid propulsion rocket (Epsilon rocket). The observing module contains a spectrometer of the EUV radiation, a target finding camera, and a mission data processor. The target mass of the space craft is 350 kg.

### 2. Instrument

The SPRINT-A/EXCEED telescope employs an off-axis parabolic chemical vapor deposited silicon carbide (CVD-SiC) mirror with 20 cm entrance diameter, since the spectral range is so wide that no

multilayered mirror is applicable to this instrument. Photons are focused by the primary mirror onto a slit. We set two operation modes to match each scientific purpose. One is named “Planet mode” which observes the outward flowing plasmas in the vicinity of planets such as Mercury, Venus, and Mars. The other is named “Jupiter mode” which observes the Io plasma torus around the Jupiter. The widths of these slits are defined depending on the spectral and spatial resolution for each scientific requirement. After the slit, the photons incident on a laminar type grating with incidence angle about 10 degree. This grating is also made of CVD-SiC. We use the five butt-mounted microchannel plates (MCPs) detector and a resistive anode encoder (RAE) for two dimensional photon counting device. This type of assembly is commonly used for EUV observations. The top MCP surface is covered with cesium iodide (CsI) photocathode to enhance the Quantum detection efficiencies (QED). The CsI coated MCP show 1.5 to 50 times higher QDEs for EUV lights comparing to the bared one. Incoming lights from the grating interacts with the photocathode, resulting in photoelectron emission. The photoelectron impacts the walls causing a charge avalanche, giving an overall charge multiplication of about  $2 \times 10^7$ . We list the major design parameters of the instrument in table 1.

Table 1, major parameter of the instrument onboard SPRINT-A/ EXCEED

Wavelength bands	55 – 145 nm
Slit width for each observation modes	1) 78 um (Planet mode) 2) 233 um (Jupiter mode)
Field of view for each observation modes	1) 120 sec. of arc 2) 400 sec. of arc.
Spectral resolution for each observation modes	1) 0.1 – 1 nm (FWHM) 2) 0.3 – 1 nm (FWHM)
Spatial resolution for each observation modes	1) 10 sec. of arc. 2) 30 sec. of arc.
Primary mirror	20 cm diameter; SiC coating; F = 8
Grating	Laminar type 1800 lines/mm; SiC coating
Detector	MCP with photocathode (CsI) and RAE