JUICE/PEP instrument and its science

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Abstract

European Space Agency (ESA) explores the Jupiter system. As its first Large-class mission, the spacecraft, named JUpiter ICy moons Explorer (JUICE), is to be launched in 2022. JUICE will be inserted to Jupiter orbit in 2030 after 7.6 years cruise. The nominal mission is over 2.5 years, including many moon flybys and Ganymede orbiting. Its key science is 1) Characterize icy moons as planetary objects and potential habitats and 2) explore the Jupiter system as an archetype for gas giants [Grasset et al., 2013].

JUICE studies icy moons and Jovian magnetosphere with three in-situ measurement instrument (particles, magnetic field, and plasma waves). The particle package is named Particle Environment Package (PEP), and is under the development of the lead by Swedish Institute of Space Physics (IRF). PEP is an international effort with 13 countries, including Japan. Main scientific objectives of PEP are: magnetospheric Ganymede, inert Callisto, moons (Io and Europa) with plasma source, and fast-rotating Jovian magnetosphere. To address these objectives, PEP consists of six sensors measuring all the charge states (ions, neutrals, and electrons) with wide energy from MeV down to thermal energy (<1 eV).

Particular focus here is the sensor Jovian Neutrals Analyzer (JNA). This is developed by IRF with a strong Japanese collaboration (Asamura et al., 2015). JNA is an Energetic Neutral Atom (ENA) sensor that covers the energy between 10 eV and 3300 eV. No sensors measuring ENAs in this energy range have ever visited the giant planets. The primary objective is to map the Ganymede surface via scattered and/or sputtered ENAs. Such mapping had been proposed (Futaana et al., 2006) and was conducted successfully at the Moon (Barabash et al., 2009). We now know that the ENA measurement can be used to characterize the precipitating plasma (flux, energy, and so on). Thus, JNA can visualize the precipitation of Ganymede magnetospheric ions into the surface. High energy particles are precipitating at the polar cap (Khurana et al., 2007), but we do not understand how the bulk plasma precipitate the surface. In addition, JNA images the Io torus. A significant fraction of Io torus plasma are transported outward in a form of ENAs. By directly measuring the generated ENAs near the Io torus, we can discuss the energy and mass transport of Jovian magnetospheric plasma [Futaana et al., 2015].

Reference

Asamura, K., et al., 遊星人、2015年2月号, p. 113–.

Barabash, S., et al., Current Science, 96(4), 526–532, 2009.

Futaana, Y., et al., Planet. Space Sci., doi:10.1016/j.pss.2005.10.010, 2006.

Futaana, Y., et al., Planet. Space Sci., doi:10.1016/j.pss.2014.12.022, 2015.

Grasset, O., et al., Planet. Space Sci., doi:10.1016/j.pss.2012.12.002, 2013.

Khurana, K. K., et al., Icarus, doi:10.1016/j.icarus.2007.04.022, 2007.