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木星探査衛星 EJSM JMO に向けた X 線撮像・分光装置の検討
Design study of Jupiter X-ray imaging spectrometer on EJSM JMO

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We present design and science study of the Jupiter X-ray imaging spectrometer as a payload candidate for the JMO (Jupiter Magnetosphric Orbiter) of EJSM (Europa Jupiter System Mission). EJSM is a joint international mission consisting of two flight elements developed by NASA and ESA to explore Europa and Ganymede, and one element by JAXA to observe the magnetosphere.

Jupiter is the most bright X-ray planet in the solar system. The current generation X-ray observatories (Chandra, XMM-Newton and Suzaku) have revealed various new aspects of Jovian X-ray emission. Jupiter's aurorae emit time variable X-rays via bremsstrahlung and charge exchange by energetic electrons and ions precipitation from the magnetosphere. Its low and middle latitude atmosphere exhibits scattering of solar X-rays. The diffuse X-ray emission seen in Jupiter's radiation belts suggests an inverse Compton scattering of tens MeV electrons. Io, Europa and Io Plasma Torus are also detected in X-rays. Hence, Jupiter and its vicinity is a reservoir of X-ray emissions. However, the low surface brightness and limited observation time hinder us to answer many basic questions such as what determines time variability of X-ray aurorae, what is the emission mechanism of Io, Europa, and Io Plasma Torus, and how necessary particles are accelerated and supplied in the radiation belts.

Driven by these scientific achievements and the remaining big puzzles, we have started to study design of an X-ray imaging spectrometer for EJSM JMO. Since JMO would allow high-latitude (10-30 deg inclination) measurements from large distances (>100 Rj), we can overview the whole Jupiter system in the X-ray band with an imaging and spectral capability. This in-situ measurement provides us with an unprecedented opportunity to observe Jupiter with extremely high photon statistics, time and angular resolution.

To realize the in-situ X-ray instrument for EJSM JMO, stringent mass and power limitations must be fulfilled. Also radiation and contamination of optical lights and debris must be taken care. The base line is a combination of an ultra-light weight X-ray telescope with the mass to area ratio of 10 kg/m2, and an imaging detector with the pixel number of ~1000 and a low power less than several tens W. In this presentation, we present scientific goals, requirements on instruments, and current design candidates for the X-ray telescope and detector.

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