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Study of the Jupiter X-ray imaging spectrometer on Jupiter Magnetospheric Orbiter

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In 2000's, the new generation X-ray observatories (Chandra, XMM-Newton and Suzaku) have revealed various new X-ray phenomena in the Jupiter system. The detected objects include Jupiter's aurorae, disk (middle and low-latitude emission), Io, Europa, the Io Plasma Torus, and radiation belts. For example, Jupiter's aurorae emit time variable X-rays via bremsstrahlung by keV electrons and charge exchange by MeV ions (Gladstone et al. 2002 Nature). A diffuse X-ray emission associated with the Jupiter's radiation belts suggests an inverse Compton scattering of tens MeV electrons (Ezoe et al. 2010 ApJ). Hence, the X-ray emission can be a unique diagnostic tool to investigate key fundamental problems on the Jupiter system such as the relativistic particle acceleration and the Jupiter-satellite interaction. However, since these observations have been done with the X-ray astronomy satellites orbiting the Earth, the photon statistics of X-ray spectra and light curves, and the angular resolution of X-ray images were severely limited. In this context, we have started to study design of an X-ray imaging spectrometer for JMO (Jupiter Magnetospheric Orbiter) which is a Jupiter exploration mission led by JAXA descended from international collaboration with JUICE (JUpiter ICy moon Explorer) mission led by ESA in 2020's. JMO is expected to perform high-latitude (10-30 deg inclination) measurements of the Jupiter system and overview the magnetospheric activities. The in-situ measurements by JMO provide us with an unprecedented opportunity to observe Jupiter with extremely high photon statistics, high time and angular resolution. To realize the in-situ X-ray instrument for JMO, stringent mass and power limitations must be fulfilled. Furthermore, the radiation and the contamination of optical lights and debris must be taken care. The base line is a combination of an original ultra-light weight X-ray telescope with the mass to area ratio of 10 kg/m^2 based on the micromachining technologies (Ezoe et al. 2010 Microsystem technologies), and a radiation-hard and low-power DepFET imaging detector (Struder et al. 2010 SPIE). In this presentation, the scientific objectives and current status of instrumental study will be presented.

Keywords: Jupiter, magnetosphere, exploration, X-ray, particle acceleration