Detectability of water plumes on icy moons with Earth-orbiting UV telescope

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In this study, we consider the mirror size of UV space telescope, which can detect OI and HI emissions emitted from plumes on icy moons. Hubble Space Telescope (HST) observed the enhancement of HI 121.6 nm and OI 130.4 nm emissions near the Europa South Pole (Roth et al., 2014). They considered the electron impact of H_2O in the plume yields HI and OI emissions. However, geological conditions of emitting gasses form Europa plumes are not known.

The EXCEED (Extreme Ultraviolet Spectroscope for Exospheric Dynamics) spectrometer onboard the Hisaki satellite has conducted long term monitoring of ultraviolet emissions (52.0-148.0 nm) from the Io plasma torus and Jupiter’s aurora since 2013. We also observed OI 130.4 nm around Jupiter moon Io’s orbit, and analyzed spatial distribution and temporal variations of oxygen atoms in Io torus. However, the spatial resolution of Hisaki/EXCEED is too rough (~17”) to resolve Io and Icy moon’s disk (for example, Europa’s diameter is ~1.0”). One of the main goal of post Hisaki UV satellite is to observe icy moon’s atmosphere continuously with high resolution and confine conditions under which plume eruptions occur.

We calculated the OI 130.4 nm and HI 121.6 nm counts of Europa plume (signal) and atmosphere, solar reflection, geocorona and interplanetary medium (noise), and estimated the mirror diameters, which can meet the demand that the signal to noise ratio is over 3 with integration time of 10 hours and spatial resolution of ~0.2 arcsec. Requested mirror diameters are ~140 cm when the altitude of the satellite is 1000 km, and ~100 cm when the altitude is 30,000 km.

