火山活動活発期における木星衛星イオの酸素原子中性雲の分布

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Spatial distribution of Jupiter moon Io’s neutral oxygen cloud during a volcanically active period

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A Jupiter’s moon Io is the most volcanically active body in the solar system, and its thin atmosphere is formed by volcanism and sublimation from the surface frost. Neutral particles in the Io’s atmosphere (oxygen and sulfur atoms, and their components) escape from Io’s gravity mainly by atmospheric sputtering, and form neutral clouds around Io’s orbit. The previous modeling studies showed the equilibrium spatial distibution of the neutral oxygen and sulfur clouds. The relationship between infrared emissions of Io’s volcanoes and sodium nebula emissions by ground-based observations showed that the amount of neutrals escaped from Io increases during major volcanic eruptions. If the spatial distribution of the neutal clouds during a volcanically active period is found, other parameters such as profile of exosphere, speed distribution and direction are constrained, and it is understood how the change in the volcanic activity of Io affects the escape process of neutrals. In this study, we aim to understand the spatail distribution of Io’s neutral oxygen cloud by using the ultraviolet spectral data obtained with the Hisaki satellite.

Atomic oxygen emission at 130.4 nm aroud Io’s orbit was weak from November to December in 2014, but it was intense from January to April in 2015 (the brightness was 2-2.5 times as large as usual). de Kleer and de Pater [2016] reported the enhancement of infrared emissions at Mithra Patera in 10 January 2015, and at Kurdalagon Patera in 26 January and 5 April 2015. These volcanoes may increase the source of the neutral clouds. Using the data taken by Hisaki, we analyzed the Io phase angle dependece of atomic oxygen emission during volcanically quiet (from November to December in 2014) and active periods (from January to April in 2015). The azimuthal distribution duirng the volcanically quiet period shows Io’s neutral oxygen cloud consists of two components, a cloud concentrated around Io that spreads leading and Jupiterword direction (called ””banana cloud””) and a longitudinally uniform, diffuse distribution along Io’s orbit. However, the distirbution of the banana cloud changed from March to April in 2015. The banana cloud spreads mainly in the trailing and anti Jupiterward direction, or spreads in the both leading and trailing direction. The speed distribution and direction in the case that only oxygen atoms collide with torus ions is different from those in the case that SO_2 collide with torus ions and then oxygen atoms are escaped. A possible explaniation is that variations of the profile of Io’s exosphere or the plasma temperature around Io may change the ratio of SO_2 and O which collide with torus ions, and then change the shape of the banana cloud.