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Distribution of Iogenic sodium atoms - Observation results in 2002 at Haleakala -

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We have performed imaging observations of the D-line emission of Iogenic sodium atoms to study the Iogenic volcanic gas distribution since 1997. The method of the observation is the 2-dimensional imaging observation whose field of views are 20Rj (narrow FOV observation, hereafter) and 400Rj (wide FOV observation, hereafter) around Jupiter. In the narrow FOV observation before 2001, emission distribution expanding along the equatorial plane was observed, which is classified into band-shaped and spray-shaped distributions. On the other hand, in the wide FOV observation, the elongated oval-like emission distribution expanded to as much as 400Rj along the equatorial plane was observed. The east-west intensity asymmetry was also observed, with a dependence on the Io phase angle.

Based on the observed images, we then made model analyses to investigate supply processes of sodium atoms and time variation of sodium distribution, and presented the comprehensive source process which can consistently reproduce the observed characteristics both in the narrow and wide FOV observations. In this study, the neutralization of ions trapped in the Jovian magnetic field, namely charge exchange and molecular ion destruction processes, is regarded as a source mechanism of widely expanded sodium distribution. As a result of our model analyses, it was concluded that sodium atoms produced through the charge exchange process have a double-peaked bulk velocity distribution (fast and slow components), and that the lifetime of ions in the molecular ion destruction process are estimated to be an order of 10 hours.

To discuss the Iogenic sodium atoms distribution more in detail, we performed an additional observation in 2002 at the summit of Mt. Haleakala of Maui. In this observation, some observation methods were modified to improve the observed data comparing to that before 2001. In the narrow FOV observation before 2001, the data in the anti-Io hemisphere with respect to Jupiter was supposed to contain only the background light components and was used to reduce the background level from the Io-hemisphere. However, as mentioned above, it has been concluded that the lifetime of molecular ions is order of 10 hours. This means that the Iogenic sodium D-line emission should be observed not only in the region close to Io but also on the elongated fresh ion streamline from Io (namely, in the anti-Io hemisphere with respect to Jupiter). Thus we performed imaging observations through the narrow band interference filter of 620.0nm (background filter) in addition to that through the D-line filter. An image through the background filter contains only the scattered light from Jupiter's disk, so that we can obtain real Iogenic D-line emission distribution by reducing the background image from the D-line image.

In the wide FOV observation, we performed observations using a new imaging camera covering wide field of view which has been developed by our group. The mask for Jupiter's disk in our former imaging camera before 2001 was band-shaped because of the limitation of optical system. This band-shaped mask caused diffracted light from Jupiter's disk and the contamination of data. In the new camera, the Jupiter's mask is made circularly by vacuum evaporation of metal on the optical glass, so that the influence of diffracted light can be reduced.

In the presentation, we report the results of the data analyses of 2002 observation, and discuss the release mechanisms of sodium atoms using model calculations.