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The ejection process of Iogenic "fast" sodium atoms

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We have made imaging observations of Iogenic sodium atoms. Observations covering R < 20Rj at Alice Springs until 1999 and model analysis confirmed the initial condition of atoms ejection. On the other hand, we made observations of extended sodium (R < 500Rj), and these observations were simultaneous with narrow (R < 20Rj) observations on 1999 at Alice Springs. The observed distribution of the extended sodium up to 500Rj could not be reproduced from the model calculation when the same initial velocity conditions mentioned above were used. In this presentation, we will re-consider the ejection process and initial velocity distribution using the observed sodium distribution data of R < 20Rj, R < 500Rj, and R < 50Rj (new observation from 1999 to 2000 at Sendai).

We have made 2-dimentional imaging observations of sodium D-line emissions originated from Jovian satellite Io by using transportable telescope system. From observations at Alice Springs until 1999 by using 28cm and 35cm Schmidt-Cassegrain type telescopes, it has been clarified that (1) spatial distribution of sodium atoms shows band-shaped structure expanding to about 20Rj and sometimes it shows wavy structure, (2) this band-shaped distribution has the north-south asymmetry with respect to the rotational equatorial plane of Jupiter, and (3) this north-south asymmetry varies with magnetic longitude of Io. As for the north-south asymmetry of sodium distribution outside Io's orbit, some observations and model analyses have been done in past studies. However, when we use the same initial conditions used in the previous works, the model results can not reproduce our observation. The essential facts derived from our observation are (1) the tilt of sodium distribution depend on the magnetic longitude of Io, and (2) sodium atoms have enough fast initial velocity to escape from the gravity of Jupiter. Therefore, we considered that the ejection process of atoms is related to the neutralization of corotating pickup ions (namely, the charge exchange reaction of corotating sodium ions). In this case, the initial velocity of ejected atoms is the sum of bulk velocity of ion flow and thermal velocity of ions with respect to the magnetic field. Therefore the wavy form and the widh of band-shaped distribution depend on bulk velocity and thermal velocity, respectively. Our model analysis confirmed that bulk velocity vector is perpendicular to the local magnetic field (parallel to E x B direction) with the value from 40 to 57km/sec in the reference frame rotating with Io's orbital motion. And the parallel and perpendicular component of thermal velocity with respect to the magnetic field is 10 eV and 60 eV, respectively.

On the other hand, we made observations of extended sodium (R < 500Rj) by using 58mm camera lens, and these observations were simultaneous with narrow (R < 20Rj) observations on 1999 at Alice Springs. The observed distribution of the extended sodium up to 500Rj could not be reproduced from the model calculation when the same initial velocity conditions mentioned above were used. Therefore, further investigation is neccesary to determine the initial condition of atoms ejection. In this presentation, we will re-consider the ejection process and initial velocity distribution using the observed sodium distribution data of R < 20Rj, R < 500Rj, and R < 50Rj (new observation from 1999 to 2000 at Sendai).