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Europa has a tenuous atmosphere composed mostly of molecular oxygen generated through sputtering of the water-ice surface by magnetospheric ions. Roth et al. [2016] analyzed a large set of FUV images of Europa' s atmosphere taken by the Hubble Space Telescope and derived the spatial morphology and time variability of the OI] 135.6 nm emissions. They found that there is north-south asymmetry of the OI] 135.6 nm brightness when Europa is located above or below the plasma sheet. Since the OI] 135.6 nm emissions on Europa are produced mainly through the interaction with the Jovian magnetospheric electrons, they concluded that the asymmetry is the result of an inequality of electron energy flux into the atmosphere.

This asymmetry is driven by the bounce period of electrons moving along a field line, the velocity of the longitudinal plasma flow in the Jovian magnetosphere, and the position of the moon. Retherford et al. [2003] explains that most electrons in a flux tube collide with the moon before the flux tube convects past the moon since the convective plasma flow slows down near the moon by the plasma-atmosphere interaction. This divides the electron energy column density at the moon into the northern and southern parts asymmetrically when the moon is far from the plasma sheet center. However, this theory has never been evaluated by tracing the motion of individual magnetospheric electrons.

Here we show the results of the evaluation of correlation between the decelerated flow velocity and the asymmetric electron flux to Europa. We trace the motion of Jovian magnetospheric electrons around Europa with a particle simulation. We assume that Jupiter has a tilted dipole magnetic field and a corotational electric field. We consider Europa' s induced magnetic field negligible. Europa is located at the magnetic latitude of 10 degrees. The motion of each magnetospheric electron is treated as a superposition of the cyclotron motion around a field line, the bounce motion along the field line and the longitudinal convection in the Jovian magnetosphere. Since the gyro radius of these electrons (< 2 km) is sufficiently smaller than Europa' s radius (1560 km), we use the equation of motion for the guiding center of the gyration formulated by Northrop and Birmingham [1982]. This enables us to reduce the computational costs immensely. We also use a model by Ip [1996] for the deceleration of the convective plasma flow near Europa. In the model, the deceleration is expressed with the strength of the plasma-atmosphere interaction, α , with $\alpha=0$ corresponding to the maximum interaction and $\alpha=1$ to no interaction. We trace the electrons by solving the guiding center equation backward in time with the 4th Runge-Kutta method. The backward tracing is more computationally efficient for this study because we are interested only in the trajectories of electrons that intersect Europa. We calculate the spatial distribution of electron precipitation and derive the electron flux to Europa' s surface.

We found that an α close to unity, corresponding to the weak plasma-atmosphere interaction, cannot

reproduce the inequality of electron flux. On the contrary, we found that a smaller α , a stronger interaction, causes more pronounced north-south asymmetry of electron precipitation: with an $\alpha < 0.02$, equivalent for the flow velocity of 2.0 km/s, the ratio of electron flux between the northern and southern hemisphere is estimated to be larger than 2. The results, however, do not fully explain the observed north-south ratio of 135.6 nm brightness, < 5 .

Our results demonstrate how the motion of the precipitating electrons yields the morphology of the electron-impact driven OI] 135.6 nm emissions and how the magnetospheric energetic electrons interact with Europa's atmosphere. The results could be a constraint for the study of energy transportation from the Jovian magnetosphere to Europa's environment.

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