

Ion speeds estimated from densities of ionospheric plasma and magnetospheric dusts in Saturn's E ring

Shotaro Sakai[1]; Shigeto Watanabe[1]
[1] CosmoSciences, Hokkaido Univ.

Observations using the particle detectors on Voyager and Cassini showed that the plasma speeds in the Saturn's inner magnetosphere are close to the ideal co-rotation speed around $5 R_S$ and gradually become 70-80% of the ideal co-rotation speed at $7 R_S$ [Bridge *et al.*, 1981, 1982; Richardson, 1986, 1998; Wilson *et al.*, 2008, 2009]. On the other hand, observations using the Langmuir Probe (LP) on board the Cassini spacecraft showed that the ion bulk speeds are close to Keplerian speed in the E ring [Wahlund *et al.*, 2009]. The E ring of Saturn consists of small (micron- and nano- meter sized) dust particles. These dusts are negatively charged inside $7 R_S$ and expected to contribute to the electro dynamics in the plasma disk [Horanyi *et al.*, 2004; Kempf *et al.*, 2008]. Near Enceladus, which is a major source of the E ring dusts, the electron densities are significantly smaller than the ion densities and the ion speeds are near Keplerian [Morooka *et al.*, 2011]. Statistical observations, which are from February 2005 to June 2010, with LP also found that the ion speeds are between co-rotation speeds and Keplerian speed [Holmberg *et al.*, submitted]. According to the latest ion modeling, the ions are slowed down due to the interaction with dust through the magnetosphere-ionosphere coupling and the ion speeds from the modeling are consistent with LP observations when the thickness of dust distribution is larger than $1 R_S$ and/or the dust density is larger than 10^5 m^{-3} [Sakai *et al.*, submitted]. However, this model is only solved in one dimension, which is the radial component, and the effect of the ionosphere is not calculated.

We have calculated the ion speeds in a system expanded in the latitudinal component to investigate the effect of the distributions of density in latitude on the ion speeds. We have estimated the ionospheric conductivities from the ionospheric plasma density and reflected the conductivities in the calculation of ion speeds in Saturn's inner magnetosphere. The ionospheric conductivity especially in the inner magnetosphere is an open question. Cowley *et al.* [2004] and Moore *et al.* [2010] suggested that the conductivity was a few S. On the other hand, Saur *et al.* [2004] suggested that it was $\sim 10^{-2}$ S. Cowley and Bunce [2003] calculated the co-rotation lag due to the ionospheric current in the Saturn's inner magnetosphere. Moore *et al.* [2009] estimated the latitudinal variations of Pedersen conductivity. However, variations of ion speeds due to the changes of the ionospheric conductivities are not estimated.

In this presentation, we discuss importance of role to inner magnetosphere played by dusts and the ionosphere through monitoring the ion speeds.