Short term variation of Jupiter's synchrotron radiation at 325MHz: Comparison of the observation with a physical model

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We performed numerical calculation of structures of Jupiter's electron radiation belt by using 1-dimensional Fokker-Planck transport equation in order to examine physical processes which drive the time variation of the Jupiter's synchrotron radiation (JSR). JSR is the radio emission from relativistic electrons trapped in the inner part of Jupiter's radiation belt and has been observed by ground based radio telescopes to investigate dynamic behaviors of the radiation belt (Miyoshi et al. 1999, Bolton et al. 2002, Dunn et al. 2003). We had carried out continuous total flux observation of JSR at the frequency of 325MHz from March to August in 2007 with IITATE Planetary Radio Telescope (IPRT) and found the short term variations of JSR and their correlation with the solar F10.7 flux with a few days delay. A goal of this study is to interpret these observed characteristics by using a physical modeling.

For the purpose of this, we adapt the lossy radiation diffusion model which has been used to investigate time variation of JSR (Miyoshi et al. 1999, de Pater et al. 1993). In the Jupiter's radiation belt, there are many electron loss processes such as satellite and ring sweeping effects, synchrotron radiations, coulomb collisions, and so on. For the first step, we adapted the loss coefficients introduced by Hood (1993) and confirmed to reproduce the radial structure of Jupiter's electron radiation belt at the energy of 20MeV. However, Hood (1993) did not take into account the energy dependence of the satellite sweeping effect (Santos-Costa et al. 2001) and electron energy degradation by the synchrotron radiation (Birmingham et al. 1974). We therefore examined the energy degradation effect using an empirical electron distribution model (Devine and Garrent 1983), and it is found that the synchrotron process acts not only as an energy loss process but as a source for below 20MeV electrons. This is because that the synchrotron process make electron energy spectrum soften and the spectra of relativistic electron in the Devine and Garrent model are highly hard enough to increase electron density below 20MeV.

We will introduce such an energy dependent processes in the radial diffusion model and show the initial result of the numerical calculation of Jupiter's electron radiation belt and the comparison with the observation result.