The impact of interplanetary shock on hydrogen ions in the inner magnetosphere

*Hiroki Tsuji[1], Yusuke Ebihara[1], Yoshiharu Omura[1], Takashi Tanaka[2]

1.Research Institute for Sustainable Humanosphere, Kyoto University, 2.SERC, kyushu university

An interplanetary (IP) shock is known to redistribute phase space density of magnetosphereic ions. Cluster satellite observations have shown that, soon after arrival of the IP shock, overall intensity of the ions rapidly increases and multiple energy dispersion appears in an energy-time spectrogram of the ions [Zong et al., 2012]. We have performed test particle simulation under the electric and magnetic fields provided by the global magnetohydrodynamics (MHD) simulation. The solar wind speed is increased from 372 to 500 km/s in order to reproduce the IP shock. The number density in the solar wind was set to a constant to be 5 cm-3, and the Z component of the interplanetary magnetic field (IMF) was turned from +5 to -5 nT. Just after the arrival of the IP shock, a fast mode wave propagates tailward in the magnetosphere. The amplitude of the electric field exceeds 20 mV/m. To reconstruct an energy-time spectrogram of the H+ ions at all MLTs at L = 5 ~ 10, we traced trajectories of the ions backward in time. The ions are accelerated nonadiabatically just after arrival of IP shock. Thus, the guiding center approximation is no longer valid. Knowing initial and final positions in 6-dimensional space, we mapped the phase space density, according to Liouville’s theorem. We assumed that the phase space density of the ions is isotropic Maxwellian before the shock arrival. The calculated temperature anisotropy A (=Pperp/Ppara −1) is increased 0.3, which may favor the excitation of electromagnetic ion cyclotron (EMIC) waves. We will discuss the evolution of the temperature anisotropy and possible growth of the EMIC waves.

Keywords: interplanetary shock, inner magnetosphere, hydrogen ion