Reconfiguration of electron phase space density in response to interplanetary shock, prolonged southward IMF and substorm

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Electrons are trapped by Earth's inherent magnetic field in the inner magnetosphere. They undergo drift motion depending on the magnetic and electric fields. The drift velocity is disturbed when the solar wind condition, or the magnetospheric condition is rapidly changed, resulting in the reconfiguration of the phase space density (PSD) of the electrons. Most of these processes can be regarded to as adiabatic (adiabatic stage). Some particular configuration of the PSD may favor the excitation of the whistler mode chorus waves that can cause further reconfiguration of the PSD through resonant interaction between the chorus waves and the electrons. This process is non-adiabatic (non-adiabatic stage). To investigate the adiabatic stage, we performed the Comprehensive Inner-Magnetosphere Ionosphere (CIMI) coupled with the global magnetohydronynamics (MHD) simulation (REPPU). We solved the evolution of the PSD of electrons with energy ranging from ~100 eV to ~10 MeV, and pitch angles ranging from ~0 to ~90 deg. When the interplanetary shock arrives at Earth, a compressional wave propagates tailward in the inner magnetosphere. Due to the electric and magnetic fields associated with the compressional wave, the electron flux increases rapidly at all the energy considered. When the interplanetary magnetic field (IMF) turns southward, the cusp/mantle dynamo is activated, resulting in the intensification of the magnetospheric convection. Electrons with energy less than tens of keV are transported sunward. When a substorm occurs, the magnetic field line is dipolarized, and the associated dawn-dusk electric field transports electrons sunward. We will overview the response of the electron environment in the inner magnetosphere in terms of some key parameters, such as temperature anisotropy, and the ratio between the hot electron density and the cold electron density, and specify the temporal and spatial regions where the non-adiabatic stage is initiated.

キーワード：内部磁気圏捕捉電子、シミュレーション
Keywords: Trapped electron in inner magnetosphere, Simulation

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