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**RECENT RESEARCH ACTIVITIES**

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**Simulations and modeling of geospace environment****(Laboratory of Computer Simulation for Humanospheric Sciences, RISH, Kyoto University)****Yoshiharu Omura and Yusuke Ebihara**

We numerically obtained Green's functions to model evolution of the electron distribution function after all of the possible interactions with the waves. In both wave models with and without subpackets, electrons undergoing the cyclotron resonance with the waves are efficiently accelerated by nonlinear wave trapping. Modifying the numerical Green's function method with the simplified model of chorus waves uniform in longitude, we compute the formation process of the outer radiation belt electron fluxes induced by the interaction with the chorus waves localized in longitude. The formation of MeV electron fluxes is characterized by large acceleration rates and butterfly pitch angle distributions [1]. We performed test particle simulations with parameters at  $L = 5$  and a small wave normal angle 10 degrees to study the wave-particle interactions via the Landau resonance. We show that effective wave damping occurs near half the electron gyrofrequency. This nonlinear wave damping is contributed by Landau resonance rather than cyclotron resonance. This damping is dominated by perpendicular components of the wave electric field [2]. By analyzing the induction coil magnetometer data in Antarctica, we have found that amplitude-frequency dependence of EMIC subpacket structures is unaltered during their propagation to the ground. EMIC waves observed on the ground are mainly (>70%) associated with right-handed elliptical polarization. Duration of subpacket structure is found to be proportional to its maximum amplitude [3].

The Earth receives energy from the Sun in different forms. The solar wind and the magnetic field are known to drive the magnetic storms and substorms that are major disturbances in near-Earth space. On the basis of the results obtained by global magnetohydrodynamics (MHD) simulation, we found that 37-88% of the magnetic energy coming into the magnetosphere originates from the solar wind kinetic energy. This is fully different from the previously believed idea. The amount of stored/released energy in the tail region is also found to depend on the solar wind condition. This is different from the previous view that the stored/released energy cannot be predicted. The magnitude of the westward auroral electrojet and the Joule heating rates during the substorm expansion phase are correlated with the amount of intake magnetic energy, suggesting that the magnitude of the substorm expansion can be predicted [4]. We also calculated the geomagnetically induced current (GIC) flowing in the Japanese power grid on the basis of 3-dimensional Finite Difference Time Domain method. The simulated GIC is well consistent with the observation conducted at substations [5].

**References**

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