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DYNAMIC BEHAVIORS OF THE MAGNETOSPHERE BASED ON A LABORATORY SIMULATION

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We have performed a laboratory simulation of the magnetosphere. The experiment is made to understand the dynamic behaviors of the global structure of the magnetosphere due to the temporal change of the dynamic pressure of the solar wind. It is pointed our previously by Minami et al. [1993] that the earthward electric field in the nightside magnetosphere is a key value to control the substorm. The electric field is measured on the sun-earth line in the nightside of the magnetosphere. The result shows that the earthward electric field exists on the tail current sheet stably. The value is consistent to the predicted electric field in the magnetospheric current sheet based on the Hall current generation. In this paper, it is pointed out here that the multipoint electric field measurement reveals dynamic structural form of the magnetosphere by the change of the solar wind dynamic pressure. The estimated electric field in the real nightside magnetosphere is too small to detect. So a laboratory simulation has made to measure the temporal and spatial changes of the electric field To simulate the magnetosphere, vacuum chamber (0.6 m in dia. and 1.7 cm long) is used. The velocity and the density of the simulated solarwind produced by a plasma gun and the intensity of the dipole magnetic at the equator are 100 km/s, 101^(3) cm^(-3) and 10 kG respectively. It is confirmed that our laboratory simulation satisfies the MHD scaling law [Rahman et al, 1989]. The experimental results show that the earthward electric field is strongly controlled by the measured dynamic pressure of the simulated solar wind. It means that the magnetosphere is shrinked and expanded alternatively by the solar wind resulting the intensification of the tail sheet current, Jy, .The x-component of the electric field, Ex, is theoretically expressed as: Ex = Jy / n e Bz [Minami et al., 1993]. Where Jy, n, Bz are the dawn-dusk current, the plasma density and the z-component of the magnetic filed in the current sheet. The value, Ex, is about 1[V/m] in the laboratory. The result suggests that the earthward electric field increases the Birkeland current during the change of the dynamic pressure. The results also show that the magnetospheric current in the plasmapause exists rather longer time after the disappearance of the solar wind. The result is related the to the confinement mechanism of the high-energy plasma in the radiation belt. The value is consistent with the Spitzer's magnetic field diffusion time.