Particle-in-cell simulation on the dayside magnetopause in a small-scale magnetosphere

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By performing three-dimensional full particle-in-cell plasma simulations, we have been studying a small magnetosphere formed by the interaction between a weakly magnetized small body and the solar wind. In this study, we particularly focus on the electron dynamics at the dayside magnetopause in the equatorial plane. In the simulation model, a weakly magnetized small body is set in the center, and the solar wind having the southward IMF is injected from the boundary of the simulation domain. We define D_p as the distance between the dipole center and a position where the solar wind dynamics pressure balances the magnetic pressure at the dayside. We focus on a small-scale magnetosphere with $\lambda_i/D_p=1$ where we define λ_i as the ion inertia length in the solar wind. When we define R_b as the radius of the sphere, we set $R_b/D_p=0.6$ which implies a relatively large proportion of sphere in the magnetosphere. In the simulation results, we found dawn-dusk asymmetry characteristics of the plasma spatial distribution in the equatorial plane. It is also interesting to observe intense electron flux along the dayside magnetopause in the equator. We found that this intense flux is due to the electrons accelerated by the electric field enhanced at the magnetopause. They encounter the inner region where the southward IMF and the northward magnetic dipole field cancel each other, and they start making meandering motions toward the dawn side between the region of different orientations of the magnetic fields. We examined the mechanism of the intense electron flux in terms of electron trajectory as well electron velocity distribution in detail.

Keywords: small body, particle-in-cell simulation, small scale magnetosphere

