Global 3D Electromagnetic Particle Simulation for Satellite observed sash event

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Abstract We made our efforts to parallelize the global 3D HPF Electromagnetic particle model (EMPM) for several years and have also reported our meaningful simulation results that revealed the essential physics involved in interaction of the solar wind with the Earth's magnetosphere using this EMPM in our PC cluster and supercomputer.

Sash phenomena was observed and reported in some satellite observation. And some MHD simulations for it was accomplished. We investigate it with this global 3D parallelized HPF EMPM and recently new simulation for it was run in the new VPP5000 supercomputer.

In the new simulations were performed on the new VPP5000 supercomputer of Tsukuba University, we used larger domain size, 305x205x205, smaller grid size Δ, 0.5RE (the radium of the Earth), more total particle number, 220,000,000 (about 8 pairs per cell). And other parameters used in this simulation are, solar wind speed is 0.5c, the mass ratio of ion to electron is 16, the position of the Earth is at x=100, y=100, z=100, electron thermal velocity is v_the=0.01, electron plasma frequency is about 0.01, the electron Debye length is about λ_De=1.0Δ. The position of magnetopause is at about x=20Δ=10RE. At first, we run this code upto 1000 time steps without IMF, and get the called quasi-stationary status; After the quasi-stationary status was established, we applied a northward IMF (Bz=0.4), then run it for 800 time steps, at this time, the IMF arrives at about x=-50RE, and then we change the IMF from northward to dawnward (IMF By=0.4). The results revealed that the groove structure at the day-side magnetopause, that causes particle entry into inner magnetosphere and the cross structure or S-structure at near magneto-tail are formed.

Moreover, in contrast with MHD simulations, kinetic characteristic of this event is also analyzed self-consistently with this simulation. The new simulation provides new and more detailed insights for the observed sash event.