GEMSIS-Sun: Modeling of Particle Acceleration and Transport in Solar Flares

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GEMSIS (Geospace Environment Modeling System for Integrated Studies) is one of projects in Solar-Terrestrial Environment Laboratory, Nagoya University. Its final goal is to build a geospace-environment model based on various (satellite and ground-based) observational facts in order to understand the dynamic energy-transport-processes taking place in geospace. In the first three years (2007.4 - 2010.3), we set a few individual scientific targets as fundamental elements/information for the final model. One of them is to know how particles are accelerated, transported, and lose their energies in solar flares.

It is evident from many observations such as X-rays, gamma-rays, and microwaves that a large amount of high-energy particles are produced in solar flares. However, the dynamics of these particles is not completely understood so far. The GEMSIS-Sun group approaches this research topic through integrated studies, i.e., an empirical modeling of particle dynamics and analyses of various data observed with Hinode, RHESSI, Nobeyama Radioheliograph, and so on.

It is widely believed that a solar flare is a consequence of magnetic reconnection. Based on the magnetic reconnection model, we are developing a numerical model for particle acceleration and transport in the flare region. Since the temporal and spatial scales of particles are much shorter than the flare scale (roughly by ten to the six for ions), the full-particle approach is yet unrealistic for the empirical understanding. We therefore employ the guiding-center kinetic equation of particles so that we can perform the calculation in the coronal actual parameter range. By the direct comparison between observations and the calculation, we will empirically discuss the acceleration and transport mechanisms of particles in solar flares.