

Science target of the SCOPE mission

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The objective of the SCOPE mission is to reveal the nature of the significant role played by cross-scale coupling in dynamic MHD phenomena of space plasmas. Even if the spatial scale of the event is large and is of MHD scale as a whole, the key dynamics within the key region is often at sub-MHD scales (ion and electron scales). Then the true understanding of dynamic MHD-scale phenomena that we are interested in will only come when we understand the cross-scale coupling process. For this purpose, the SCOPE mission is composed of 5 spacecrafts, one mother and four daughters, whose formation flight will, first of all, allow us to identify the spatial structure. The mother spacecraft is equipped with high-time resolution electron detector that will resolve the electron scale dynamics. One of the daughters will stay very close (less than 100 km) to the mother spacecraft so that the cross-correlation study of the plasma wave data is possible, which will also give indispensable information on the electron scale dynamics.

We have been learning a lot on dynamics at ion-scale from the Geotail spacecraft data. The ion-scale dynamics in the close proximity of the reconnection region is one of the key results from the Geotail mission. In May 2003, we have found a fortuitous event in which Geotail seems to have crossed the X-line. The event is better than any others obtained before, for the crossing was completed while the magnitude of the Bx component of the magnetic field remained small (5 nT or so). We do find interesting features in the ion-distribution function data, however, because the crossing was over in 24 sec, and because the Geotail plasma instrument time resolution is 12 sec, we only have two data, one just before and the other right after the X-line crossing, and there is no knowing the electron dynamics right at the X-line. Meanwhile, the plasma wave data, which has 200 msec resolution, suggests that there should have been plenty of electron scale phenomena, which the plasma instrument cannot resolve.

The best event obtained in May 2003 indicates the limitation of the Geotail observations and the need to design and build a new mission to step forward in deepening the understanding of space plasma dynamics. The design of the SCOPE mission is indeed in this direction. Developments that have been made to enable the mission will be reported.