

Science of the SCOPE mission

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Magnetospheric plasma is collisionless. This means that, unlike the gas that surrounds us, the thermo-dynamical relaxation time scale is much larger than the time scale of interest. Explosive phenomena such as substorms occur because usual relaxation processes are absent and the dissipation processes that trigger them show anomalous behaviors. Most if not all of the fascinating aspects of magnetospheric dynamics have their roots in this collisionless-ness of the plasma that fills the space. Our interest in magnetospheric dynamics is often biased towards large scale phenomena that have global impacts. At scales larger than that of ions, it is said that the MHD equations is a good enough approximation to describe the long term behavior of the system. It is true that MHD equations enable us to visualize easily the time evolution of the system and thus there is no denying the usefulness of the MHD equations. This, on the other hand, does not mean that describing the magnetospheric dynamics by the MHD equations in their present form is the ultimate goal of our research. As long as the fascinating aspects of magnetospheric processes root in the collisionless-ness of the plasma, the true understanding of what we are attracted to comes only when the collisionless effects (kinetic effects or particle effects) are fully appreciated. MHD system in the present form treats sub-MHD scale dynamics only in an ad-hoc manner. On the other hand, previous studies on kinetic effects mostly dealt only with sub-MHD scales. The dynamical coupling among the scales, from the bottom of electron-kinetic up to MHD scales, has been recognized but has not been studied very intensively. A magnetospheric plasma mission of the next generation should have the capability of fully appreciating the wonder of the collisionless plasma and should provide data that enable us to do the research that features the cross-scaling coupling nature of the magnetospheric dynamics. The Japanese planned mission SCOPE is designed in this way. The descriptions of the mission as well as of the shape of the new research style, fusion of data analyses and simulation studies, will be given in this talk.