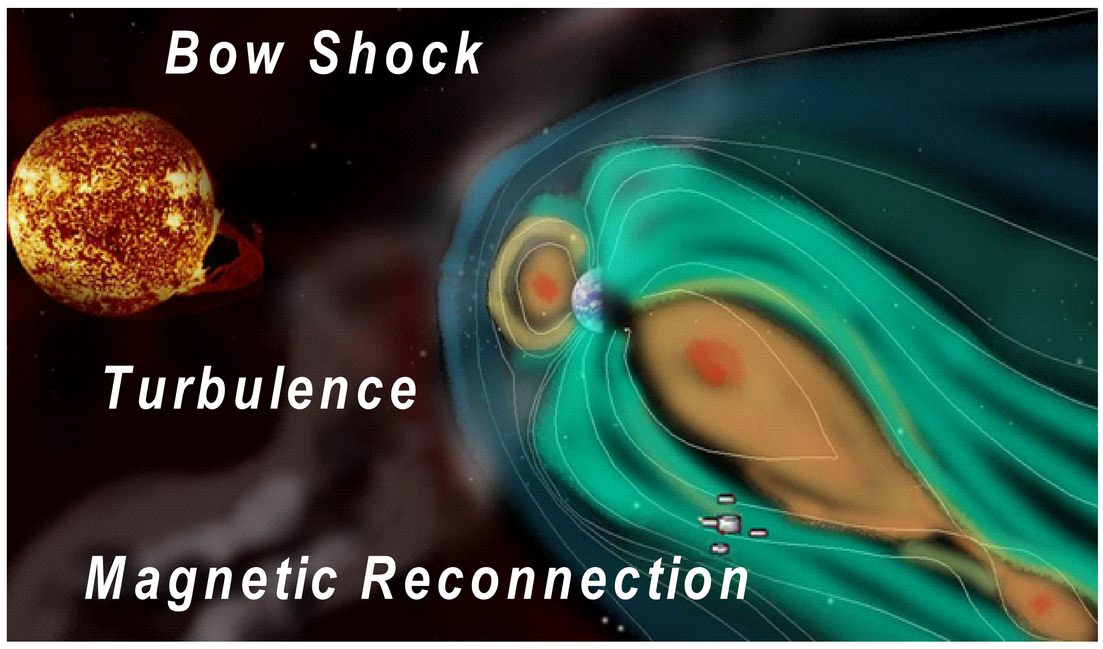
4.2.4 Simulation studies

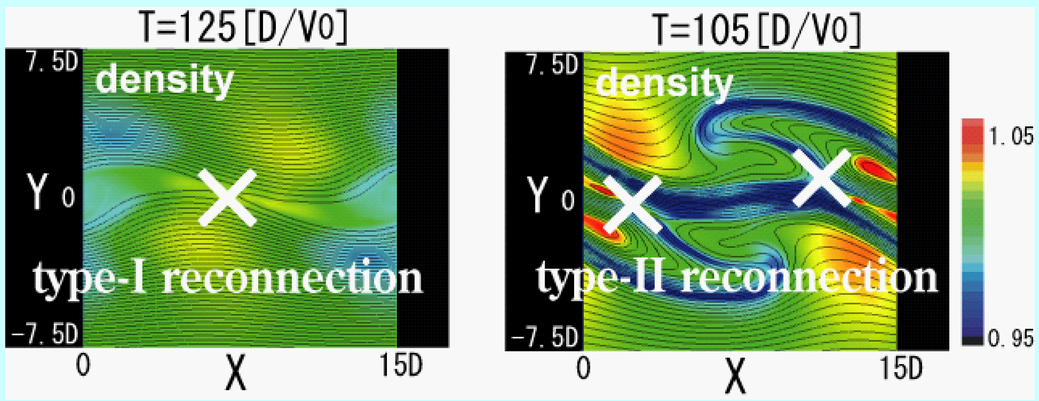
Numerical Simulations of Key Phenomena in Space Plasma Physics



The space plasma simulation group in ISAS/JAXA performs large-scale full kinetic simulations. Simulation studies are sometimes conducted as collaborations with data analysis teams of present and future space plasma missions, e.g. GEOTAIL, ESA Cluster-II, NASA THEMIS, etc.

Turbulence

Kelvin-Helmholtz instability and plasma mixing



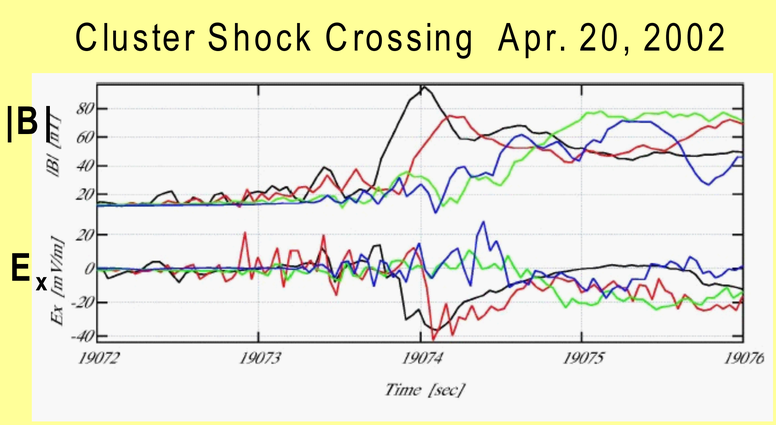
Examples of magnetic reconnection induced by the Kelvin-Helmholtz instability.

(type-I) Reconnection is triggered by locally enhanced current in K-H vortices, and it makes plasma mixing with in the vortices.

(type-II) Reconnection is triggered in highly rolled-up vortices, and it largely collapses the vortex structure.

Shock

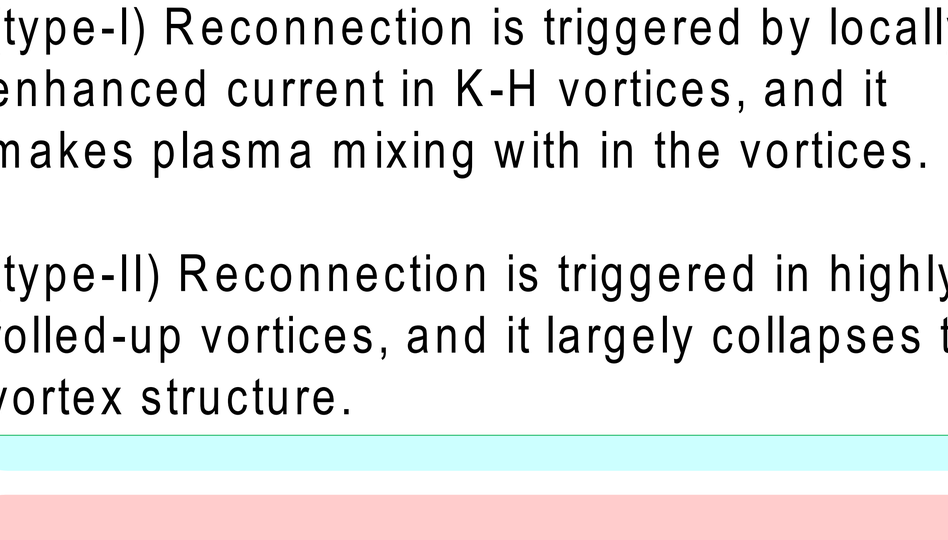
Identification of non-stationary structure



The observation qualitatively agrees with the simulation results of the shock reformation.

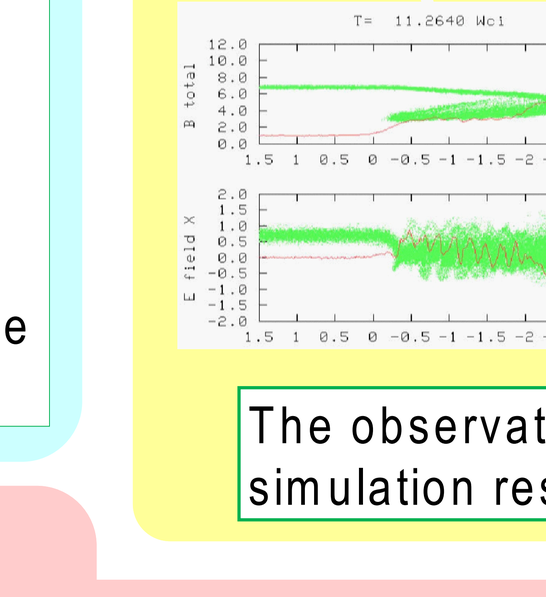
Magnetic Reconnection

Identification of sub-ion-scale structure around the reconnection site



We can speculate sub-ion scale dynamics with the help of simulation results.

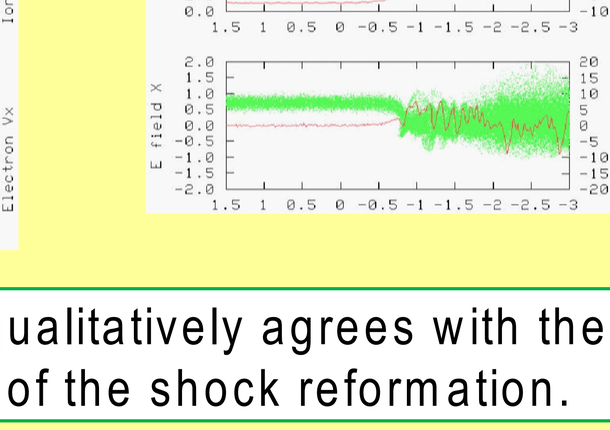
High-resolution observation



Low-resolution observation

Understanding triggering mechanism of reconnection

Schematic diagram of quick-reconnection triggering



3D large-scale particle simulation results help improving theories.