Generation of electron hot tubes in low-beta small-scale magnetic flux ropes

Hironori Shimazu[1]; Motohiko Tanaka[2]

[1] NICT; [2] NIFS

We use a three-dimensional macro-particle code (implicit-particle simulation) to examine the evolution of a small magnetic flux rope, where 'small' means that its radius is close to the kinetic length scale of protons or electrons. Small flux ropes have been observed in the dayside ionospheres of Venus and Mars. The simulation results show that electrostatic two-stream (Buneman) instability is generated around the flux rope axis where the velocity of the electron beam is higher than the electron thermal velocity. Electrons there are heated considerably in the direction parallel to the magnetic field by the instability, and an electron hot tube is formed.

Not only the beam energy but the magnetic energy is converted to the heat there, which is different from the situation of the Buneman instability in the non-flux rope geometry.

These results indicate the existence of electron hot tubes around the flux rope axis in the dayside ionospheres of Venus and Mars.