E014-007 Room: C501 Time: May 30 10:45-11:00

Particle simulation of electrostatic solitary waves in a two-dimensional open system

Takayuki Umeda[1], Yoshiharu Omura[1], Hiroshi Matsumoto[1], Hideyuki Usui[1]

[1] RASC, Kyoto Univ.

http://www.kurasc.kyoto-u.ac.jp/plasma-group/index-j.html

We study formation process of electrostatic solitary waves (ESW) by one- and two-dimensional electrostatic particle simulations with open boundaries. ESW are observed by recent spacecraft in various regions of the Earth's magnetosphere as bipolar electric pulses longitudinal to the geomagnetic field. The previous simulation studies have shown that ESW correspond to BGK electron holes formed by electron beam instabilities. Since the previous simulations were performed in uniform periodic systems, wave-particle interaction of the electron beam instability was taking place uniformly in the systems. In the present study, we inject a weak electron beam from an open boundary into the background plasma to study spatial development of an electron bump-on-tail instability from the localized source of the electron beam.

In the open system, spatial structure of electron holes varies depending on distance from the source of the electron beam. In a region close to the source of the electron beam, the potential structure becomes two-dimensional through modulation by oblique beam modes excited by the instability. As the two-dimensional potentials propagate along the magnetic field, they are aligned in the direction perpendicular to the magnetic field through coalescence. The potential structure becomes one-dimensional in regions far from the source.

In a long time evolution of the instability, ion dynamics becomes important in determining the spatial structure of electron holes. Quasi-perpendicular ion modes are excited locally in the region close to the source of the electron beam through coupling with electron holes at the same parallel phase velocity. The quasi-perpendicular ion mode modulates the electron holes in the perpendicular direction. As a result the one-dimensional electron holes are accompanied by perpendicular electric fields.