Geophysical Research Abstracts
Vol. 15, EGU2013-5706, 2013
EGU General Assembly 2013

Ion distribution functions with velocity space holes and their instabilities

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Study of particle dynamics in the Earth's magnetotail has shown that nonadiabatical ion acceleration in the neutral sheet may lead to the formation of the non-maxwellian ion distribution functions. The general stability properties of such ion distributions with velocity space holes of the type expected in the vicinity of the field reversal region in the Earth's magnetotail is investigated. The unique feature of such distribution is the space hole centered on 90° pitch angle so the distribution is not symmetrical about magnetic field direction. Empty region in velocity space represents a source of free energy for excitation as plasma waves as electromagnetic waves.

It was shown that such distributions are unstable to the electromagnetic waves with wave vector directed along the Sun-Earth line. The growth rate of the excited waves is strongly depended on ion hole parameters and electron and ion temperatures. Also the investigation of the general stability properties of such ion distribution was performed.