

Energy loss and pitch angle scattering of runaway electrons due to kinetic instabilities

Friday 26 October 2018 14:00 (20 minutes)

The effects of kinetic instabilities on the dynamics of runaway electrons in momentum space is investigated using a newly-developed simulation model, and the anomalous dissipation and the fast pitch angle scattering of runaway electrons in low energy are explained. The interaction of runaway electron avalanche and the kinetic instabilities are studied self-consistently using quasilinear model. Results show that excited whistler waves can cause runaway electrons to be scattered to large pitch angle and form vortices in momentum space, creating a new energy loss channel, which explains the higher-than-expected critical electric field and the loss of runaway electron population in low energy regime identified experimentally. This finding also explains the fast growth of electron cyclotron emission (ECE) signals observed in experiments.

Country or International Organization

United States of America

Paper Number

TH/P8-16

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Session Classification: P8 Posters