Fokker-Planck Simulations of Electron Runaway Avalanche and Bursts in Tokamaks

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Abstract

The avalanche of runaway electrons in an Ohmic tokamak plasma triggered by knock-on collisions of traces of energetic electrons with the bulk electrons is simulated by the bounce-averaged Fokker-Planck code, CQL3D. It is shown that even when the electric field is small for production of Dreicer runaways, the knock-on collisions can produce significant runaway electrons in a fraction of a second at typical reactor parameters. The energy spectrum of these knock-on runaways has a characteristic temperature. The growth rate and temperature of the runaway distribution are determined and compared with theory. In simulations of pellet injection into high temperature plasmas, it is shown that a burst of Dreicer runaways may also occur depending on the cooling rate due to the pellet injection. Implications of these phenomena on disruption control in reactor plasmas are discussed.

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