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A backward Monte Carlo method for efficient computation of runaway probabilities in runaway electron simulation[1] GUANNAN ZHANG, DIEGO DEL-CASTILLO-NEGRETE, Oak Ridge National Laboratory — Kinetic descriptions of RE are usually based on the bounced-averaged Fokker-Planck model that determines the PDFs of RE. Despite of the simplification involved, the Fokker-Planck equation can rarely be solved analytically and direct numerical approaches (e.g., continuum and particle-based Monte Carlo (MC)) can be time consuming specially in the computation of asymptotic-type observable including the runaway probability, the slowing-down and runaway mean times, and the energy limit probability. Here we present a novel backward MC approach to these problems based on backward stochastic differential equations (BSDEs). The BSDE model can simultaneously describe the PDF of RE and the runaway probabilities by means of the well-known Feynman-Kac theory. The key ingredient of the backward MC algorithm is to place all the particles in a runaway state and simulate them backward from the terminal time to the initial time. As such, our approach can provide much faster convergence than the brute-force MC methods, which can significantly reduce the number of particles required to achieve a prescribed accuracy. Moreover, our algorithm can be parallelized as easy as the direct MC code, which paves the way for conducting large-scale RE simulation.

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