# Runaway Electron Production in DIII-D Killer Pellet Experiments, Calculated with the CQL3D/KPRAD Model

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**Abstract**. Runaway electrons are calculated to be produced during the rapid plasma cooling resulting from "killer pellet" injection experiments, in general agreement with observations in the DIII-D tokamak. The time-dependent dynamics of the kinetic runaway distributions are obtained with the CQL3D collisional Fokker-Planck code, including the effect of small and large angle collisions and stochastic magnetic field transport losses. The background density, temperature and $Z_{\rm eff}$ are evolved according to the KPRAD deposition and radiation model of pellet-plasma interactions. Three distinct runway mechanisms are apparent: (1) prompt "hot-tail runaways" due to the residual hot electron tail remaining from the pre-cooling phase, (2) "knock-on" runaways produced by large-angle Coulomb

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collisions on existing high energy electrons, and (3) Dreicer “drizzle” runaway electrons due to diffusion of electrons up to the critical velocity for electron runaway. For electron densities below $\approx 1 \cdot 10^{15}\,\mathrm{cm}^{-3}$, the hot-tail runaways dominate the early time evolution, and provide the seed population for late time knock-on runaway avalanche. For small enough stochastic magnetic field transport losses, the knock-on production of electrons balances the losses at late times . For losses due to radial magnetic field perturbations in excess of ≈0.1% of the background field, i.e., $\delta B_r/B \geq 0.001$, the losses prevent late-time electron runaway.

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