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A Modified Monte Carlo Method for Carrier Transport in Germanium, Free of Isotropic Rates[1] KYLE SUNDQVIST, University of California, Berkeley, CRYOGENIC DARK MATTER SEARCH COLLABORATION — We present a new method for carrier transport simulation, relevant for high-purity germanium $< 100 >$ at a temperature of 40 mK. In this system, the scattering of electrons and holes is dominated by spontaneous phonon emission. Free carriers are always out of equilibrium with the lattice. We must also properly account for directional effects due to band structure, but there are many cautions in the literature about treating germanium in particular. These objections arise because the germanium electron system is anisotropic to an extreme degree, while standard Monte Carlo algorithms maintain a reliance on isotropic, integrated rates. We reexamine Fermi's Golden Rule to produce a Monte Carlo method free of isotropic rates. Traditional Monte Carlo codes implement particle scattering based on an isotropically averaged rate, followed by a separate selection of the particle's final state via a momentum-dependent probability. In our method, the kernel of Fermi's Golden Rule produces analytical, bivariate rates which allow for the simultaneous choice of scatter and final state selection. Energy and momentum are automatically conserved. We compare our results to experimental data.

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