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Relativistic Quasilinear Theory for Electron Transport by Radio Frequency Waves in Toroidal Plasmas[1] A.K. RAM, PSFC, MIT, Y. KOMINIS, K. HIZANIDIS, NTUA, Athens, Greece — We derive the relativistic quasilinear diffusion equation for momentum and spatial diffusion of electrons due to RF waves and non-axisymmetric magnetic field perturbations in a tokamak. In contrast to previous studies, the diffusion operator is derived without assuming that the underlying electron dynamics is Markovian. We allow for the dynamical phase space to be a mix of correlated regular orbits and decorrelated chaotic orbits, so that the diffusion operator is time dependent. The diffusion equation evolves the distribution function on the same time scale as the diffusion operator. A consequence of our assumption is that there is no resonant delta function in the operator. The singular delta function that has plagued previous studies is not amenable to numerical implementation. The non-axisymmetric magnetic field perturbations included in our studies can be due to magnetic islands as in neoclassical tearing modes. We use the Lie perturbation technique to obtain the non-singular diffusion operator which includes resonant and non-resonant momentum space diffusion leading to current generation, and non-resonant spatial diffusion leading to modifications of the current profile.

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