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Fast transport in phase space due to nonlinear wave-particle interaction in the radiation belts.

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We present an analytical, simplified formulation accounting for the fast transport of particles in phase space, in the presence of nonlinear wave-particle resonant interactions in an inhomogeneous magnetic field representative of the radiation belts. We show that the general approach for the description of the evolution of the particle velocity distribution based on the Fokker-Plank equation can be modified to consider the process of nonlinear wave-particle interaction, including particle trapping. Such a modification consists in one additional operator describing fast particle jumps in phase space. The proposed approach is illustrated by considering the acceleration of relativistic electrons by strongly oblique whistler waves. We determine the typical variation of electron phase-density due to nonlinear wave-particle interaction and compare this variation with pitch-angle/energy diffusion due to quasi-linear electron scattering. We show that relation between nonlinear and quasi-linear effects is controlled by the distribution of wave-amplitudes. When this distribution has a heavy tail, nonlinear effects can become dominant in the formation of the electron energy distribution.