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Modeling of Nonlinear Wave-Particle Interactions

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Resonant interactions of radiation belt electrons with chorus waves are usually treated with quasi-linear diffusion in global, multidimensional models, although it is widely appreciated that large amplitude waves can readily yield nonlinear behavior. One reason is that diffusion coefficients conveniently describe the detailed wave-particle interactions in a semi-analytical way (as multiple integrals), while nonlinear interactions are typically studied with much more fine-grained simulations, such as particle-in-cell codes. Here an analytical approach to nonlinear modeling is developed, improving on earlier work, describing changes in pitch angle and energy in the presence of phase bunching (though not phase trapping). The results are easily-evaluated advection coefficients in velocity space, which can be included in a combined diffusion-advection equation. Sample calculations will be presented.