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TH/4-1: Energetic Particle Long Range Frequency Sweeping and Quasilinear Relaxation

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Investigating the relaxation of energetic particles (EP) with MHD modes is an area where ideal and kinetic theories need to be investigated to enable credible planning for future self-sustained burning plasmas. These theories need to be tested with predictions of present day experiments. Here we discuss two aspects to the relaxation. A. The effect of frequently observed long-range frequency sweeping events attributed to the formation of clump and hole phase space structures. B. Progress of modified quasi-linear theories for including the validation of a simple quasi-linear of EP relaxation in a comparison with experimental data. Long-range frequency sweeping, within the purview of adiabatic theory, requires an intrinsic improvement in the description of the background plasma response far from the mode's linear frequency which causes change in the mode structure. Improved adiabatic descriptions, which will be presented, enables an accurate efficient tool for study of the consequences of chirping in energetic particle relaxation. Quasilinear (QL) Theory is studied with two different models. In one we report on a truncated phase space model that is reduced to 1.5 dimensions and has produced predictions that correlate well with the experimental data on DIII-D, even though the predicted relaxed EP distribution function is not fully resolved. In a more complete second QL model we report on the progress of a full QL phase space code that is able to bridge the gap between isolated mode interactions to the typical QL theory where mode overlap is intrinsically assumed.

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