Resonance broadening in quasilinear theory: towards Kubo >1

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Charged particle velocity-space diffusion is investigated in a one-dimensional Gaussian turbulent electric field. Measurement from numerical trajectories are compared with quasi-linear theory including resonance broadening [1] [2]. Ion acoustic and Langmuir dispersion relations are investigated.

First we initialize N test particles in a turbulent electric field. We then calculate the mean square velocity of these test particles as a function of time in order to determine the numerical diffusion coefficient. We observe quantitative and qualitative agreements between theory and numerical results, as shown in Fig. (1) for the Langmuir case, in the regime of Kubo number $K \ll 1$. The impact of resonance broadening becomes significant for Kubo of the order of a few percent.

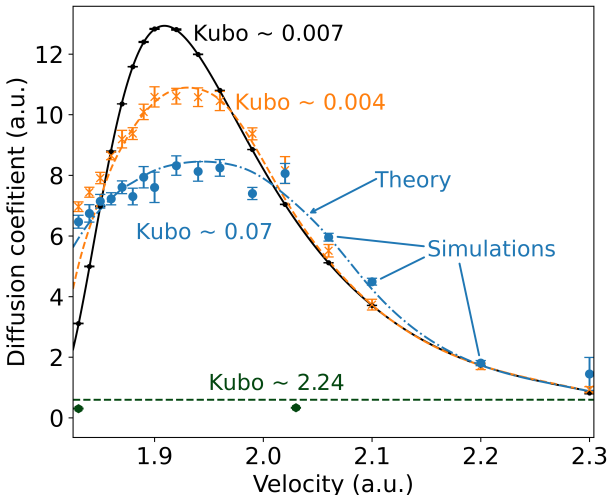

Figure 1: *Quasi-linear diffusion coefficient and numerical diffusion in the small Kubo number regime for a random electric field of Gaussian amplitude with Langmuir dispersion.*

In addition, we study the diffusion of particles outside quasi-linear theory regime $K \geq 1$, for a larger range of particle velocities. We find qualitative agreement with theory around the resonance velocity ($v < 4v_T$). For fast particles ($v > 4v_T$), we measure a non-zero diffusion from numerical simulations, while negligible diffusion is predicted by quasi-linear theory and resonance broadening.

References

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