Test particles dynamics, quasi-linear and nonlinear transport in low-frequency tokamak turbulence

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In the context of magnetic confinement fusion, we compare the quasi-linear particle and heat fluxes obtained from an analytical expression, to the nonlinear fluxes obtained with a gyrokinetic code. We then study the transport and the diffusion in toroidal turbulent plasma simulations using statistics on a relevant number of test particles.

TERESA is a gyrokinetic code based on the bounce-averaged Vlasov-Poisson model[1], which reduces drastically the numerical computation costs by averaging out the cyclotron and banana bounce motions of trapped particles.

TERESA[2, 3] (Trapped Element REduction in Semi lagrangian Approach) is therefore relevant to study phenomena at the order of the trapped particle precession timescale. Such phenomena include macroscopic anomalous transport driven by the plasma turbulence, which degrades the confinement of the fusion plasma.

We find that the quasi-linear fluxes predictions are accurate for a certain range of parameters and radii. Furthermore test particles diffusion is in qualitative agreement with quasi-linear theory.

References

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