Noise control in global gyrokinetic particle simulations.

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The primary goal of global gyrokinetic simulation is to model the self-consistent turbulence, profile and flow structure in tokamaks; this requires simulation techniques which can efficiently perform long simulations. The use of gyrokinetic PIC codes for long simulations is hindered by the accumulation of noise: we explore the use of a relaxation operator to prevent this noise accumulation. We consider the Krook operator, which acts somewhat like an artificial collisionality, and can effectively control noise; it also introduces an unphysical dissipation, which may damp the zonal flows and significantly modify simulation results even when the relaxation time is very long. We describe a method for projecting out the effects of the Krook operator on the zonal flows. We use the ORB5 code to demonstrate how this modified Krook operator can be used to prevent the secular accumulation of noise without introducing a large inaccuracy in the model. We present simulations with calculated fluxes which match the flux tube results; numerical efficiency is greatly improved due to the smaller number of markers required per mode compared to long simulations without a relaxation operator.

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