Advanced methods in global gyrokinetic full f particle simulation of tokamak transport

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Abstract

A new full f nonlinear gyrokinetic simulation code, named ELMFIRE[1], has been developed for simulation of transport phenomena in tokamak plasmas. The code is based on a gyrokinetic particle-in-cell algorithm with direct implicit treatment of ion polarization and consideration for either kinetic or adiabatic electrons, and impurities. The full f method allows for simulations of strongly perturbed plasmas including wide orbit effects, steep gradients and rapid dynamic changes.

The code has been successfully validated against linear growth of unstable modes and nonlinear saturation levels both in the electron kinetic and abiabatic cases[2]. The present nonlinear method can provide a rigorous treatment of such global and dynamic transport phenomena like transport barrier generation.

The code is being prepared for large-scale simulations in order to be able to simulate real tokamak systems like ASDEX-U or JET. ELMFIRE has been prepared for massively parallel execution taking special care to scalability to powerful multiprocessor computers. With that purpose specific algorithms have been developed to minimize memory and communication requirements.

Here the algorithms in ELMFIRE are presented in more detail, as well as benchmarking data and results on transport analysis involving the pedestal region and also internal structure of developed turbulence.

References

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