Three dimensional flux-coordinate independent field aligned full-F two field gyrofluid model

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We present numerical simulations of an isothermal electromagnetic full-F two field gyrofluid model in an axisymmetric low-beta tokamak equilibrium. The gyrofluid model is derived from the full-F gyrokinetic theory [1]. This yields evolution equations for the gyrocenter densities and parallel velocities, which are closed by the full-F versions of the polarization and induction equations and by parallel resistivity.

The presented model equations retain ion FLR effects up to 1st order. We incorporate all non-linear, parallel and curvature terms consistently so that an exact energy theorem follows. The underlying coordinates are based on a flux-coordinate independent field aligned approach [2], which fits best into the numerical implementation. This casts the perpendicular operators into a minimal form while allowing the treatment of an axisymmetric X-point geometry. The discretization of spatial derivatives is undertaken by discontinuous Galerkin methods, which are very versatile in the choice of the desired order of accuracy, while retaining a high degree of parallelism in the resulting algorithm. We exploit this in an implementation for GPUs [3].

First results and differences to the delta-F gyrofluid approach [4] and to flux coordinate treatments are discussed.

References

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