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P2.1079 A new system of gyro-fluid equations with Onsager symmetry

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Gyro-fluid equations are velocity space moments of the gyrokinetic equation. The damping due to kinetic resonances is included through a closure scheme chosen to match the collisionless density response functions. This damping allows for accurate linear eigenmodes to be computed, even in the collisionless limit, with a relatively low number of velocity space moments compared to gyrokinetic codes. The standard methods [1, 2] use the truncated moments to close the system of equations. An analysis of the gyro-fluid closure schemes will be presented that demonstrates a number of problems with the standard method. In particular, the Onsager symmetries [3] of the resulting quasilinear fluxes are not preserved. Onsager symmetry guarantees that the matrix of diffusivities is positive definite, an important property for a transport model. The constraints on the closure due to Onsager symmetry and other considerations are shown to be very restrictive. A new, simpler scheme for including the kinetic damping is found that preserves the Onsager symmetry and is scalable to higher velocity space moments without change of the damping model. Linear eigenmodes from the new system of equations are compared with gyrokinetic results, with and without collisions, including parallel and perpendicular electromagnetic fluctuations at high beta. The new system of gyro-fluid equations will be used to extend the TGLF quasilinear transport model [4] so that it can compute the energy and momentum fluxes due to parallel magnetic fluctuations, completing the transport matrix. The Onsager symmetries will enable faster transport solvers since the matrix of convection and diffusion coefficients will all be computed by a single call to the quasilinear transport model.

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