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Tokamak Turbulence Simulations using BOUT++ in Core Region

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Development of a self-consistent, core-edge integrated simulation capability is a long standing problem in fusion simulation program. Such capability would yield insight into questions related to global profile dynamics originating from L to H transition and internal transport barrier formation. Starting from a tokamak edge plasma simulation code, BOUT++ has evolved into a versatile framework that can be used to simulate a wide range of fluid models in complicated magnetic geometry. To realize self-consistent core-edge coupled simulations, we develop a core gyro-Landau-fluid code using the BOUT++ framework. Initial efforts focus on self-consistent simulations of core electrostatic ion temperature gradient (ITG) driven turbulence and code verification. Verification of the code is realized by comparing linear growth rates calculated from BOUT++ with those from gyrokinetic codes. To include a neoclassical poloidal flow and its effect on poloidal mean flow, we introduce an ad-hoc closure. Global nonlinear simulations are performed for ITG turbulence focusing on the role of zonal flows in turbulence suppression. Details of the code development and preliminary physics results will be presented.

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