Numerical modeling of turbulent transport at the edge

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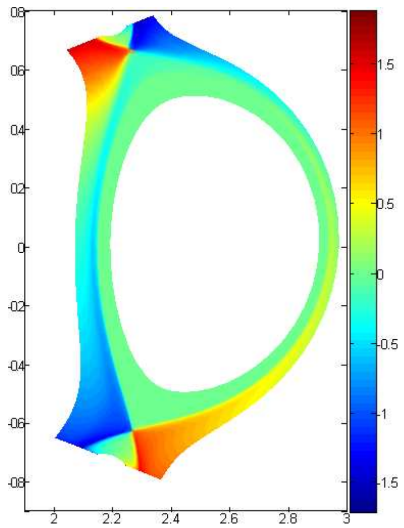
The present work is focused on a simulation effort that addresses the edge physics in tokamaks. Dealing with the space and time scales associated with large-scale instabilities fluid-like equations are resolved. Plasma equilibriums of the Scrape-Off layer (SOL) have been firstly addressed for electrostatic turbulence assuming or not constant electronic and ionic temperatures in a 3D cylindrical geometry. A special interest has been focused on plasma-wall interaction. An original and computationally efficient penalization technique [1] has been developed to model solid plasma facing components that treats a solid obstacle as a sink region corresponding to the strong plasma recombination in the solid state material. A remarkable result was that such a technique tends to recover boundary conditions that are similar to those governed by the asymptotic matching of the presheath conditions to the Bohm condition within the sheath. This asymptotic matching results from a bifurcation from the subsonic to the supersonic regime for continuous functions of the density and the Mach number as shown in Ref. [2]. This transition from subsonic to supersonic regime has been also investigated for 2D regimes in the vicinity of X-point using a multi-domain approach (Figure). Also, in evaluating heat flux on divertor plates, simulations of SOL in ITER geometry are being achieved. In the perspective of a precise description of field line geometry, the equations have been re-written in a curvilinear system of coordinates where the metric coefficients are computed from the magnetic equilibrium, the latter being provided by a Grad-Shafranov solver. Aside this work on the model, a special effort has been made to develop multi-threading and parallel computing.



[1] L. Isoardi *et al.*, J. Comp. Phys. **229(6)** (2010)
[2] Ph Ghendrih *et al.,* Plasma Phys. Control. Fusion **53** (2011)