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Stepped pressure equilibrium with parallel flow and rigid rotation

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The Multiregion Relaxed MHD[1] was successful in the construction of equilibria in 3D configurations, bridging the gap between Taylor relaxation, which allows relaxation but only globally, and ideal MHD, which includes no relaxation at all but infinite constraints. In MRxMHD, the plasma is sliced into sub-volumes separated by ideal interfaces, each undergoes relaxation. Stepped Pressure Equilibrium Code (SPEC) [2] was developed to solve MRxMHD equilibria numerically.

Dennis etal.[3] extended MRxMHD to include equilibrium flow by adding cross-helicity and angular momentum as constraints. Similar to the static case, plasma equilibria are obtained by minimizing the total energy with magnetic helicity fixed. In this work, we have extended the SPEC code to compute MRxMHD equilibria with flow. The code has been verified for convergence and compared to a Grad-Shafranov solver in 2D. We will show examples in simple cylinder columns for Taylor relaxation with flow and more complicated ones such as the reversed field pinch and study the implication of flow. The ultimate goal is to resolve flow in stellarators with quasisymmetry and reduced neoclassical damping[4].

References

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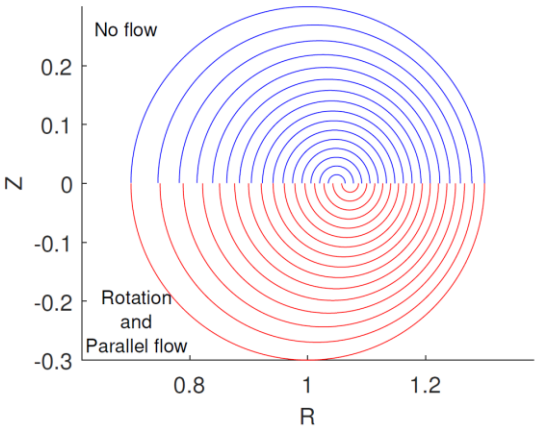

Figure1. Out-shift of the flux surfaces computed by SPEC with flow in tokamak geometry.