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Selecting interfaces for Multi-region Relaxed MHD

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The Multiregion Relaxed MHD[1] model has been shown to be 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. The Stepped Pressure Equilibrium Code (SPEC) [2] has been developed to solve MRxMHD equilibria numerically.

However, to date, the interfaces in MRxMHD have a degree of arbitrariness: the only requirement is that their rotational transform be sufficiently irrational. In this work, we investigate numerical and physical criteria that indicate if a certain interface should be deleted. First, an interface should not be a boundary circle [3], i.e. an interface that has chaos in its neighborhood. This leads to a numerical criterion to compute the analytic width [4] of the interface Fourier harmonics or the Lyapunov exponent in its vicinity. The second method makes use of the pressure jump Hamiltonian (PJH) technique [5], originated from the work of Berk et al. [6], and proposed to determine the maximum pressure jump that a flux surface can be supported by studying the existence of KAM surfaces in the phase space of PJH. We report and discuss the implementation of methods to determine the existence and non-existence of KAM surfaces. These results have implications for the interface selection in MRxMHD.

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