8th Asia-Pacific Conference on Plasma Physics, 3-8 Nov, 2024 at Malacca

Relaxed magnetohydrodynamics with weak ideal-Ohm's-law constraint

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Relaxed magnetohydrodynamics (RxMHD) employs the phase space Lagrangian and Hamilton's action principle to formulate an MHD theory with relaxed frozen-in constraints of the ideal MHD. This results in a generalization of Taylor's relaxation theory, addressing additional effects such as pressure gradient and plasma flow, while allowing for changes in magnetic topology. To establish a well-posed problem, R. L. Dewar and Z. S. Qu1 have adapted the augmented Lagrangian method from optimization theory to enforce a weak version of the ideal Ohm's law (IOL) in the RxMHD. Here, we present the first numerical solution of the equilibrium problem predicted by RxMHD with the IOL constraint, using a slab geometry. We examine the characteristics of this solution, compare it to solutions of multiple relaxed region MHD and ideal MHD, and discuss how RxMHD might capture the wider class of allowable equilibria in toroidal confinement. Finally, we comment on the relevance of the RxMHD with weak IOL constraint to the problem of Stellarator optimization.

1. Dewar, R.L. and Qu, Z.S., 2022. Relaxed magnetohydrodynamics with ideal Ohm's law constraint. Journal of Plasma Physics, 88(1), p.835880101.

Acknowledgement: We acknowledge Simons Foundation and The Simons Collaboration on Hidden Symmetries and Fusion Energy.

References
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Note: Abstract should be in (full) double-columned one page.