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Institut für Ionenphysik
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Institutsseminar

Magnetic Reconnection – Reading between the (Field)-Lines

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Magnetic reconnection is one of the big riddles in plasma physics and is fundamental to our understanding of the topic. It is a process, where a magnetized fluid is converting field energy into particle energy by a rearrangement of the magnetic field. In general it occurs in a wide variety of magnetized plasmas, ranging from astrophysical ones, like accretion discs, stellar coronae and X-ray pulsars, to laboratory plasmas, e.g. controlled fusion.[1][2][3][4] In ideal magnetohydrodynamics (MHD) the field lines are ”frozen” into the plasma, due to the assumption of infinite conductivity. While it is quite well understood why magnetic fields change their topology in resistive plasmas, it is not entirely clear how the same process happens in collisionless plasmas.[2] Unfortunately most plasmas of interest are of the latter kind. This, and other recurring problems of magnetic reconnection, will be introduced and put into perspective of their occurrences. We briefly introduce a 2D full-f gyrofluid magnetic reconnection model and discuss its applicability. A dispersion relation for the linear tearing mode stability parameter is derived from the model to discuss the initial evolution of a typical equilibrium situation. After introducing the numerical framework briefly, we present the status of our 2D gyrofluid reconnection code GREENY (Gyrofluid Magnetic-Reconnection with electromagnetic Nonlinearity). We present results for Harris-Sheet, including finite Larmor radius (FLR) effects for a relevant parameter regime. Finally, we outline our research plans and sketch an evolution path for GREENY.

[1] Cassak P. A., Liu Y.-H., and Shay M. A. “A Review of the 0.1 Reconnection Rate Problem”. In: arXiv:1708.03449v1 [physics.plasm-ph] (Aug 11, 2017) (cit. on pp. 1, 3).
[2] Jafari A. and Vishniac E. “Introduction to Magnetic Reconnection”. In: arXiv:1805.01347v3 [astro-ph.HE] (June 18, 2018) (cit. on pp. 1, 2, 4, 5)
[3] Lazarian A. et al. “3D turbulent reconnection: Theory, tests, and astrophysical implications”. In: Physics of Plasmas 27 (2020). AIP Publishing (cit. on p. 1).
[4] Boozer A. H. “Why fast magnetic reconnection is so prevalent”. In: Journal of Plasma Physics 84 (2018). Cambridge University Press (cit. on p. 5).

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