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Sub-Grid-Scale Description of Turbulent Magnetic Reconnection in MHD

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Magnetic reconnection requires, at least locally, a non-ideal plasma response. In collisionless space and astrophysical plasmas, turbulence could permit this instead of the too rare binary collisions. The possible influence of turbulence on the reconnection rate is investigated in the framework of a single fluid compressible MHD approach through simulations of a double Harris and force free current sheets, with finite guide magnetic fields. The goal is to find out, whether unresolved, sub-grid for MHD simulations, turbulence can enhance the reconnection process in high Reynolds number astrophysical plasma including force free and guide magnetic field. For this sake, evolution equations for the sub-grid turbulent energy and cross helicity according to Yokoi's (2013) model is solved simultaneously with the grid-scale MHD equations. Dependence on resistivity for large Reynolds number for the tested equilibria is interpreted obtaining the limit of fast magnetic reconnection and important relation between the molecular and turbulent resistivity is obtained. The turbulence timescale parametrising the sub-grid model controls the regime of reconnection rate in both equilibria, deciding whether reconnection takes place or if the system is just turbulent. This implies that turbulence play an important role on fast reconnection at situation of large Reynolds number while the amplitude of turbulence can still be small.

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