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The effect of hyper-resistivity on nonlinear resistive tearing modes

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The effects of hyper-resistivity on nonlinear tearing modes [1], on the nonlinear peeling-ballooning modes [2], and on magnetic reconnection in astrophysical plasma [3] was investigated. In this presentation, the nonlinear tearing modes with resistivity and hyper-resistivity H has been analytically investigated. In contrast to the flux average method used by previous works, the quasilinear method [4] has been extended to obtain the time evolution equation for nonlinear tearing modes.

Starting from the reduced MHD equations, the mode equation for nonlinear tearing mode including resistivity and hyper-resistivity can be derived by using the perturbation theory and boundary layer theory. The nonlinear evolution equation can be obtained by using the Fourier transforms and the asymptotic matching condition. This equation could describe the time evolution of nonlinear tearing modes with resistivity and hyper-resistivity. However, it is very difficult to get its analytical solution directly. At moment, two solutions for limiting cases and one solution for general case are presented here.

For the case where resistivity dominates in the inner region, one obtains , while for the case which is dominated by hyper-resistivity, one has [5]. For the general case where hyper-resistivity and resistivity are in the same order, recently we obtain a time evolution of perturbed magnetic flux as .

It is found that the destabilized effect of hyper-resistivity is lesser than that of resistivity on the growth of nonlinear tearing mode.

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