The influence of shear flow on nonlinear tearing mode

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A quasilinear model \cite{1} was developed to study the nonlinear tearing mode which including the inertia effect, and quasilinear effects of both the current density and the magnetic field. The quasilinear model keeps the nonlinear convective term in the magnetic induction equation so that the physical problems including the shear flow, zonal flow etc. can be investigated for nonlinear tearing mode. This shows that our model has some advantage comparing with the Rutherford’s model \cite{2} where the nonlinear convective term was eliminated so that the vortex flow cannot play a role at all. Meanwhile, we have analytically derived the expression of instability criteria for tearing mode for arbitrary magnetic shear configuration. \cite{3} Recently, we have extended the instability criteria to consider the influence of energetic ions on tearing modes. \cite{4}

Presently, the influence of shear flow on the nonlinear evolution of tearing mode is investigated by using the quasilinear model. The dimensionless form of the reduced resistive MHD equations is employed as a starting point. The mode equations include the vorticity equation and the induction equations for magnetic flux perturbation and quasilinear modification. The nonlinear evolution is derived for tearing mode including the shear flow. It is shown that the shear flow plays a stabilizing or destabilizing effect for nonlinear tearing mode depending on the direction of poloidal shear slow. The expression of instability criteria $\Delta'$ is extending to include the effect of shear flow which is still a challenge for us.

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