1C39

Double tearing mode in plasmas with anomalous electron viscosity

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Abstract

The linear behavior of double tearing mode in plasmas with anomalous electron viscosity is investigated within the framework of MHD theory. A two-space-scale analysis is performed and an approximate dispersion relation for the mode is obtained. For large Reynolds number $R = \tau_v/\tau_h$ with τ_v and τ_h being the viscosity penetration time of magnetic field and Alvén time for a plasma sheet of width a, respectively, it is shown that the growth rate scales as $R^{-1/5}$ if the two resonant surfaces, at $x = \pm x_s$, of the mode are close enough such that $x_s/a \ll (k_y a)^{-11/15} R^{-1/15}$. The growth rate scaling transits to $R^{-1/3}$ scaling when the distance between the resonant surface increases. The transition occurs at $x_s/a \sim (k_y a)^{-11/15} R^{-1/15}$. The $R^{-1/5}$ is shown to be closely correlated with violation of the contant-ψ approximation. It is also shown that the high saturated sheared poloidal velocity may be a trigger for the formation of transport barriers observed in advanced tokamaks.