Symmetry Breaking Induced Plasma Viscosity and Resistive Wall Mode

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Magnetohydrodynamic (MHD) activity, such as a magnetic island, or a resistive wall mode, breaks the toroidal symmetry in tokamaks. This leads to enhanced dissipation, especially in the toroidal direction, through the symmetry-breaking-induced plasma viscosity. We have developed an approach to investigate the symmetry-breaking effects on MHD activity in tokamaks. As illustrated in the theory for the magnetic island rotation frequency, we use the averaged plasma viscosity over the distorted magnetic surface to determine the bulk plasma flow, and use the local plasma viscous force (*i.e.* not surface averaged) to calculate the dispersion relation. Here, we apply the same approach for the resistive wall mode in tokamak plasmas. It is shown that the local viscous force is linear in the perturbed field in contrast to the surface-averaged viscosity, which is non-linear. We calculate a dispersion relation with the symmetry breaking induced viscosity as the main dissipation mechanism. General expression for the local viscous force that is useful for the low frequency resistive MHD activity will also be presented.

This work was supported by US Department of Energy under Grant No. DE-FG02-01ER54619 with the University of Wisconsin.