

P4.1048 Dispersion relations for resistive wall modes in tokamaks

Thursday, 11 July 2019 14:00 (2 hours)

See full abstract here

<http://ocs.ciemat.es/EPS2019ABS/pdf/P4.1048.pdf>

It is well known that the ideal MHD cannot describe the resistive wall mode (RWM) dynamics in the DIII-D tokamak [1, 2]. This is true, in particular, with respect to the rotational stabilization [1] that makes plasma stable essentially above the no-wall stability limit predicted by the ideal MHD. The uncertainty in the underlying physics illustrated by detailed analysis [2] of a wide spectrum of competing models still remains unresolved. Ultimately, the main challenge to theory is to find the energy sink that could be effective without exponential growth of the magnetic perturbation. Facing a necessity of expanding the search beyond the limits of conventional MHD, it is natural to move consistently so that the well established results would be strictly reproduced as proper asymptotes. This requires an approach with new elements introduced as extensions of the MHD, both physically and mathematically. The latter means the use of the MHD equations as a kernel of the model and the energy principle algorithm [3] as the guide in derivations.

Such a strategy has been outlined in [4, 5]. We use it here with a focus on the dispersion relations for RWMs in tokamaks. A general approach discussed here is constructed to provide a universal backbone for possible extensions of interest. If the resistive wall is incorporated as proposed in [6], the resulting dispersion relations for slow modes will be in the form first introduced in [6], but with additional terms representing the non-MHD mechanisms [4]. The representation of the magnetic perturbation in vacuum in the method of [6] is the approximation which has never been analyzed for consistency. This will be discussed here, the limitations of the plasma-wall coupling model of [6] will be exposed and better solutions proposed.

[1] E.J. Strait, J. Bialek, N. Bogatu, M. Chance, M.S. Chu, et al., Nucl. Fusion 43, 430 (2003). [2] M.S. Chu and M. Okabayashi, Plasma Phys. Control. Fusion 52, 123001 (2010). [3] I.B. Bernstein, E.A. Frieman, M.D. Kruskal and R.M. Kulsrud, Proc. R. Soc. Lond. A 244, 17 (1958). [4] V.D. Pustovitov, J. Plasma Phys. 81, 905810609 (2015). [5] V.D. Pustovitov, Phys. Plasmas 24, 112513 (2017). [6] S.W. Haney and J.P. Freidberg, Phys. Fluids B 1, 1637 (1989).

Presenter: PUSTOVITOV, V.D. (EPS 2019)

Session Classification: Poster P4

Track Classification: MCF