

P4.1067 Physics of the collisionless microtearing mode

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

See full abstract here

<http://ocs.ciemat.es/EPS2019ABS/pdf/P4.1067.pdf>

Microtearing modes are fine-scale instabilities in magnetised plasma with a sheared magnetic field, typically driven by an electron temperature gradient [1, 2]. They are characterised by large toroidal and poloidal mode numbers, and localised in the vicinity of rational flux surfaces in tokamak plasmas [3, 4]. The key role of the energy dependence of the collisions suggests that they are stable in collisionless plasma, which was widely reported in early theories [1, 2, 3].

However, recent numerical simulations in toroidal geometry have found that microtearing modes can be unstable at low collision frequency [4, 5] of relevance to next step tokamaks such as ITER. This indicates extra physics may be required in theories for microtearing modes. Using the gyrokinetic code GS2 [6, 7] to explore the behaviour of microtearing modes as the geometry evolves from toroidal to slab, we have found unstable microtearing modes even in the collisionless slab limit. This collisionless mode seems to be a different branch with a different mode frequency to the collisional mode. We have carefully re-derived the instability eigenmode equations in slab geometry and checked the assumptions typically employed for the classic microtearing mode to explore which hold or fail for the collisionless mode. Having studied both adiabatic and kinetic ions, the energy dependency in the collision operator and the finite Larmor radius effects, we are gradually starting to shed some light on the possible physics mechanism for driving the collisionless microtearing instability in slab geometry.

References

- [1] N. T. Gladd, et al., Electron temperature gradient driven microtearing mode, *Phys. Fluids* 23, 1182 (1980).
[2] J. F. Drake, et al., Kinetic theory of tearing instabilities, *Phys. Fluids* 20, 1341 (1977) [3] J. W. Connor, et al., Micro-tearing stability in tokamaks, *Plasma Phys. Control. Fusion* 32, 799 (1990). [4] D. Dickinson, et al., Microtearing modes at the top of the pedestal, *Plasma Phys. Control. Fusion* 55, 074006 (2013). [5] D. J. Applegate, et al., Micro-tearing modes in the mega ampere spherical tokamak, *Plasma Phys. Control. Fusion* 49, 1113 (2007) [6] M. Kotschenreuther, et al., Comparison of initial value and eigenvalue codes for kinetic toroidal plasma instabilities, *Comput. Phys. Commun.* 88, 128 (1995) [7] W. Dorland, et al., Electron Temperature Gradient Turbulence, *Phys. Rev. Lett.* 85, 5579 (2000)

Presenter: GENG, C. (EPS 2019)

Session Classification: Poster P4

Track Classification: MCF