



AAPPS-DPP 2018 Plenary speaker Name: Prof. Fulvio Zonca

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Rationale: This work discusses a possible first step in developing a first principle based reduced model for fluctuation induced transport in fusion plasmas. The weak collisionality of high temperature magnetized plasmas naturally introduces the importance of phase space structures and the deviation of the system from local thermodynamic equilibrium, which are addressed here.

Talk Title: On the nonlinear dynamics of phase space zonal structure

Short abstract: Phase space zonal structures (PSZS) are long-lived formations in the particle phase space; that is, PSZS are undamped by (fast) collisionless dissipation mechanisms due to wave-particle interactions [1]. They play important roles in transport processes, since they describe the deviation from local thermodynamic equilibrium and affect the nonlinear dynamic evolution of the system [1,2].

In this work, we adopt a non-perturbative description [3] of PSZS, showing their implications to transports, the role of zonal structures on wave-particle resonances and the effect of more complex nonlinear interactions on resonance broadening [4]. We further adopt the fishbone paradigm [1,3] and focus on precession resonance to elucidate the effects of toroidal geometry and keep the formal analysis at a tractable level. This allows us to derive the renormalized expression of the particle distribution function in the form of a Dyson-like equation [3], which illuminates the self-consistent nonlinear evolution of resonance structures in the phase-space.

List of related published papers

- [1] F. Zonca, L. Chen, S. Briguglio, G. Fogaccia, G. Vlad and X. Wang, *New J. Phys.* 17, 013052 (2015).
- [2] M. Falessi, arXiv:1701.02202 [physics.plasm-ph]
- [3] L. Chen and F. Zonca, *Rev. Mod. Phys.* 88, 015008 (2016).
- [4] T. H. Dupree, *Phys. Fluids* 9, 1773 (1966).