Toroidal Drift Waves Revisit: Completed Solutions of the One and Two Dimensional Eigen System*

H. S. Xie[1, †] and et al[2]

[1] *Fusion Simulation Center, School of Physics, Peking University, Beijing, 100871, China*
[2] *to add*

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The unconventional mode structures and non-ground eigenstates of toroidal drift wave, with multi-peaks or asymmetric poloidal localization, are found to be important recently and especially become dominate at strong gradient edge plasmas [c.f., Xie and Xiao, Phys. Plasmas, 22, 090703 (2015)]. The quest for the most general solutions of the local and global eigen system should be important to clarify observations in simulations and to understand the experiments. A model toroidal drift waves equation for ion temperature gradient mode and trapped electron mode is numerically solved by a matrix method, which can yield all solutions in the system and thus give us the full spectra. We clarify the debate in different theoretical groups and show the general mode structures in one- and two-dimensions (2D). Essentially, we find the global 2D solutions can be described by three parameters: radial quantum number l_r determining the radial peak numbers, poloidal quantum number l_θ and a poloidal angle parameter ϑ_k determining the poloidal behavior such as poloidal peak numbers and the poloidal localize position. Analytical investigations and several consequences of these general solutions, such as to turbulent transport reduction, are also discussed.

*For Sherwood 2016 meeting.
†Email: huashengxie@gmail.com