Curvature of Radial Electric Field Aggravates Edge Magnetohydrodynamics Mode in Toroidally Confined Plasmas

Y. Zhang[1], Z. B. Guo and P. H. Diamond[2]
[1] School of Physics, Peking University, Beijing, China
[2] University of California San Diego, California, USA
e-mail (speaker): y.zhang4869@pku.edu.cn

The concept of vortex wave coupling in fluid dynamics is utilized to analyze the excitation of joint mode in the edge toroidally confined plasmas. In addition to the commonly observed decoupling of perturbed radial velocity and displacement by radial electric field (E_r) shear, it is found that the E_r curvature tends to make the perturbed radial velocity and displacement coherent, thus driving the MHD mode. As a highlighted result, we analytically demonstrates that E_r curvature can destabilize an otherwise stable kink mode, and so form a joint vortex-kink mode. The synergetic effects of E_r shear and E_r curvature in edge MHD dynamics will have a great impact on the stability boundary of joint vortex-peeling ballooning mode, which provides a possible transition mechanism between ELMy H mode and Quiescent(Q)H mode.

References
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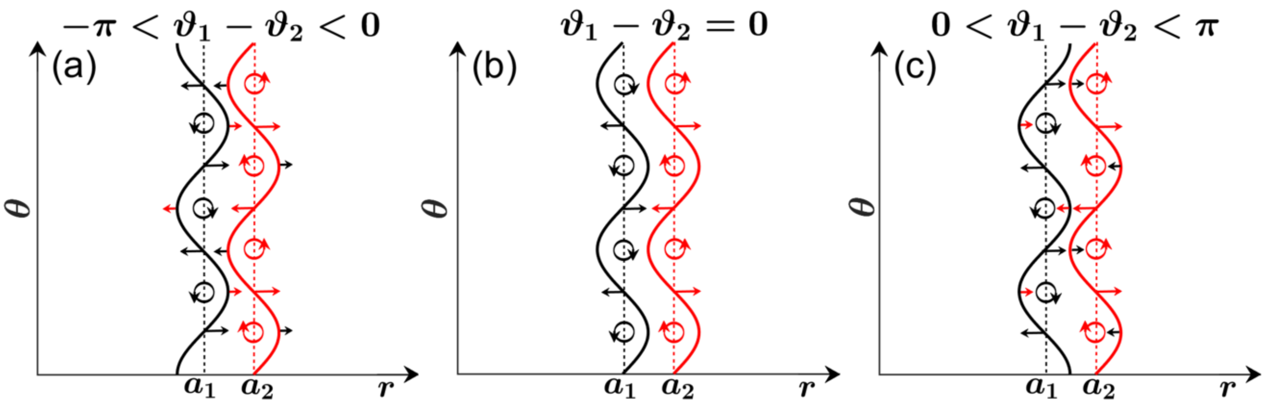

Figure 1. A schematic illustration of the relationship between vortex-wave interaction and joint mode instability. The red horizontal arrows at the peaks and troughs of the black wave field represent the displacement induced by the red wave field. The black arrows at the red wave field are induced by the black wave field. The two vortex waves are phase locked, and depending on the phase difference ($\vartheta_1 - \vartheta_2$), the joint mode could be (a) unstable, (b) neutrally stable, (c) stable.