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Collisionless Zonal Flow Saturation for Weak Magnetic Shear

ZHIXIN LU, University of California, San Diego, WEIXING WANG, Princeton Plasma Physics Laboratory, PATRICK DIAMOND, ARASH ASHOURVAN, GEORGE TYNAN, University of California, San Diego — The damping of the zonal flow, either collisional or collisionless, plays an important role in regulating the drift wave-zonal flow system, and can affect the transport and confinement. The tertiary instability, e.g., a generalized Kelvin-Helmholtz (KH) instability driven by flow shear, has been suggested theoretically as a possible damping mechanism [Rogers 2000 PRL, Diamond 2005 PPCF]. The sensitivity of the tertiary mode to magnetic shear has not been quantified, especially in weak magnetic shear regimes. In this work, parametric scans using gyrokinetic simulation demonstrate that the zonal electric field energy normalized by the turbulence electric field energy decreases as magnetic shear decreases. With ITG drive artificially eliminated, the time evolution of the zonal structure indicates that the zonal electric field damps more rapidly at weak shear. This suggests larger collisionless zonal flow damping or larger effective turbulent viscosity at weak magnetic shear. The effects of the zonal components of specific variables, e.g., the parallel shear flow and the radial electric field, on tertiary instability, are also studied. Quantitative studies on the magnetic shear scaling of tertiary instability excitation and the collisionless zonal flow saturation are ongoing.

Zhi Xin Lu
Univ of California - San Diego

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