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Tertiary instability of zonal flows within the Wigner–Moyal formulation of drift turbulence[1] HONGXUAN ZHU, D. E. RUIZ, Princeton University, I. Y. DODIN, Princeton Plasma Physics Laboratory — The stability of zonal flows (ZFs) is analyzed within the generalized-Hasegawa–Mima model. The necessary and sufficient condition for a ZF instability, which is also known as the tertiary instability, is identified. The qualitative physics behind the tertiary instability is explained using the recently developed Wigner–Moyal formulation [1] and the corresponding wave kinetic equation (WKE) in the geometrical-optics (GO) limit. By analyzing the drifton phase space trajectories, we find that the corrections proposed in Ref. [1] to the WKE are critical for capturing the spatial scales characteristic for the tertiary instability. That said, we also find that this instability itself cannot be adequately described within a GO formulation in principle. Using the Wigner–Moyal equations, which capture diffraction, we analytically derive the tertiary-instability growth rate and compare it with numerical simulations.
[1] D. E. Ruiz, J. B. Parker, E. L. Shi, and I. Y. Dodin, *Zonal-flow dynamics from a phase-space perspective*, Phys. Plasmas **23**, 122304 (2016).

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