Abstract Submitted
for the DPP17 Meeting of
The American Physical Society

Zonal-flow dynamics from a phase-space perspective[1] D. E. RUIZ, Princeton University, J. B. PARKER, Lawrence Livermore National Laboratory, E. L. SHI, I. Y. DODIN, Princeton University — The wave kinetic equation (WKE) describing drift-wave (DW) turbulence is widely used in the studies of zonal flows (ZFs) emerging from DW turbulence. However, this formulation neglects the exchange of enstrophy between DWs and ZFs and also ignores effects beyond the geometrical-optics (GO) limit. Here we present a new theory that captures both of these effects, while still treating DW quanta ("driftons") as particles in phase space [Ruiz *et al.*, Phys. Plasmas **23**, 122304 (2016)]. In this theory, the drifton dynamics is described by an equation of the Wigner–Moyal type, which is analogous to the phase-space formulation of quantum mechanics. The "Hamiltonian" and the "dissipative" parts of the DW–ZF interactions are clearly identified. Moreover, this theory can be interpreted as a phase-space representation of the second-order cumulant expansion (CE2). In the GO limit, this formulation features additional terms missing in the traditional WKE that ensure conservation of the total enstrophy of the system, in addition to the total energy, which is the only conserved invariant in previous theories based on the traditional WKE. Numerical simulations are presented to illustrate the importance of these additional terms.

[1]Supported by the U.S. DOE through Contract Nos. DE-AC02-09CH11466 and DE-AC52-07NA27344, by the NNSA SSAA Program through DOE Research Grant No. DE-NA0002948, and by the U.S. DOD NDSEG Fellowship through Contract No. 32-CFR-168a.

Daniel Ruiz
Princeton University

Date submitted: 18 Jul 2017 Electronic form version 1.4