Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

Nonlinear hydrodynamic instability and turbulence in eccentric astrophysical discs with vertical structure AARON WIENKERS[1], GORDON OGILVIE, University of Cambridge — The classical theory of astrophysical discs (including Saturn's rings, protoplanetary systems, and high-energy accretion discs around black holes) assumes circular orbital motion around a central mass. However, certain systems are known to contain eccentric forcing, necessitating a generalization to the shearing box model to include the oscillatory local geometry associated with this eccentricity. The hydrodynamic equations in this model are non-standard because of the use of time-dependent, non-orthogonal coordinates, and are known to lead to hydrodynamic instability involving the growth of internal waves. Here we present the results of the first ever local nonlinear simulations in an eccentric shearing box representing an elliptic disc with vertical structure. The nonlinear saturation of this parametric instability inherent to eccentric discs generates further self-regulating azimuthal zonal flows, and results in stable limit cycle behavior. We explore this energy pathway from the global eccentric mode into turbulence and finally the zonal flows, and discuss the viability of this instability to balance the eccentricity growth in systems exhibiting mean-motion orbital resonances such as the eccentric Lindblad resonance.

[1]NSF GRFP

Aaron Wienkers
University of Cambridge

Date submitted: 31 Jul 2017

Electronic form version 1.4