Abstract Submitted
for the DFD13 Meeting of
The American Physical Society

Noise and Turbulence Generate 3D Zombie Vortices in Stably Stratified Rotating Shear Flows SUYANG PEI, PHILIP S. MARCUS, CHUNG-HSIANG JIANG, University of California, Berkeley, PEDRAM HASSANZADEH, Harvard University, DANIEL LECOANET, University of California, Berkeley, JOSEPH A. BARRANCO, San Francisco State University — We showed previously that a linearly stable shearing, rotating, stably stratified flow has a finite-amplitude instability creating "zombie vortices" that self-replicate and fill the domain. Our flows were initialized with perturbations of one or two vortices. Our motivation was to determine whether "dead zones" in protoplanetary disks were stable, or whether they could be de-stabilized to produce vortices necessary for the final part of star formation and for planet formation. To be more relevant to astrophysics, we choose the initial conditions to be noise or turbulence with a Kolmogorov spectrum with small kinetic energy and Mach number. In a Kolmogorov spectrum, the largest eddies determine the kinetic energy and Mach number, while the smallest determine the vorticity and Rossby number $Ro \equiv \omega/f$, where ω is the vertical vorticity and f is the Coriolis parameter. The protoplanetary disks (which have large inertial ranges due to their large Reynolds numbers), can have large Rossby numbers, but weak Mach numbers and kinetic energies. It is important to know whether the triggering of the finite-amplitude instability that creates zombie vortices depends on threshold values of Mach number, kinetic energy, or the Rossby number. Here, we show it is the latter.

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Date submitted: 01 Aug 2013 Electronic form version 1.4