Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Turbulence generation through an iterative cascade of the elliptical instability[1] RYAN MCKEOWN, Harvard University, RODOLFO OSTILLA-MONICO, Houston University, ALAIN PUMIR, ENS Lyon, MICHAEL BRENNER, SHMUEL RUBINSTEIN, Harvard University — We demonstrate the existence of a novel mechanism in which two counter-rotating vortices violently collide and break down, leading to the rapid development of a turbulent energy cascade mediated by iterations of the elliptical instability. We probe the full 3D dynamics of this breakdown by conducting both experimental visualizations of colliding vortex rings and numerical simulations of colliding vortex rings and vortex tubes. We observe how the onset of the elliptical instability causes the vortex cores to develop antisymmetric perturbations, which give rise to an ordered array of secondary vortex filaments, perpendicular to the original cores. Adjacent secondary filaments counter-rotate and interact with each other in the same manner as the original configuration. In the high-Reynolds number limit, we observe another iteration of this instability, whereby a new generation of tertiary filaments forms perpendicular to the interacting secondary filaments. The energy spectrum of this turbulent breakdown exhibits $\sim k^{-5/3}$ scaling, a hallmark of homogeneous isotropic turbulence. We find that the elliptical instability must play a major role in the formation and sustenance of turbulent flows by providing a means through which energy is conveyed down to dissipative scales.

[1]National Science Foundation: DMR-1420570, DMS-1411694, and DMS-1715477.

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Date submitted: 31 Jul 2019 Electronic form version 1.4