Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

From vortex tubes to vortex rings: reconnections and the turbulent cascade RODOLFO OSTILLA MONICO, RYAN MCKEOWN, SHMUEL RUBENSTEIN, Harvard Univ, ALAIN PUMIR, ENS Lyon, MICHAEL P. BRENNER, Harvard Univ — We numerically simulate the head-on vortex ring collision experiment of Lim and Nickels (Nature, 357:225-227), and of McKeown et al. (APS-DFD talk) in an attempt to understand the rapid formation of very fine scale turbulent fluctuations (or 'smoke') from relatively smooth initial conditions. Reynolds numbers of up to $Re = \Gamma/\nu = 7500$ are reached, where Γ is the vortex ring circulation, and ν the kinematic viscosity of the fluid. Different perturbations to the ring vortex are added, and their effect on the generation and amplification of turbulence is quantified. The underlying dynamics of the vortex core is isolated, and compared to that arising from a simple Biot-Savart filament model. The presence of Crow and elliptic instabilities is used to explain the different dynamics: either vortex reconnection or cloud" formation. Finally, the links between head-on vortex ring collision to finite-time singularities in the Biot-Savart equations, and to their possible relationship to finite-time singularities in the Euler equations and the turbulent cascade is analyzed.

Rodolfo Ostilla Monico
Harvard Univ

Date submitted: 25 Jul 2017 Electronic form version 1.4