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Direct numerical simulations of head-on vortex ring collisions

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ABSTRACT:

We numerically simulate the ring vortex collision experiment of Lim and Nickels (Nature, 357:225-227, 1992) in an attempt to understand the rapid formation of very fine scale turbulence (or 'smoke') from relatively smooth initial conditions. Reynolds numbers of up to $Re=\Gamma/\nu=7500$, where Γ is the vortex ring circulation and ν the kinematic viscosity of the fluid are reached, which coincide with the highest Reynolds number case of the experiments. 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 analyzed, and compared to the dynamics arising from a simple Biot-Savart filament model for the core. The presence of Crow and elliptic instabilities is used to explain the different dynamics: either turbulent reconnection or cloud formation.

BIOGRAPHY:

Rodolfo Ostilla Mónico was born in the Canary Islands, Spain. He obtained a graduate degree in Aerospace Engineering from the University of Sevilla in Spain, and a masters degree in Aerospace Dynamics from Cranfield University, UK. After a brief internship in the European Space Astronomy Center, he started a PhD at the University of Twente, in the Netherlands, under the supervision of Prof. Roberto Verzicco and Prof. Detlef Lohse. He graduated in 2015, and the same year he moved to Harvard University to pursue a post-doc under the advising of Prof. Michael Brenner.