

Vortex bi-layers and the emergence of vortex projectiles in compressible accelerated inhomogeneous flows (AIFs)

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Abstract Vortex bi-layers and “Vortex Projectiles” (VPs) are the essential coherent structures which emerge in the shock accelerated inhomogeneous (Richtmyer-Meshkov) flows, in particular the light ($s/f/s$) planar curtain configuration. In our visiometric mode of working, we identify and quantify several vortex processes which emerge in 2D simulations during four time epochs. In particular: large positive and negative secondary circulations that arise from incompressible baroclinic processes; upstream and downstream moving VPs; and an intermediate stratified decaying turbulent sub-domain containing VPs.

*I use methods visiometric,
And I tell you, this is my pet trick;
If in my pot-boiler
Compressible Euler
Gives a vortex, then I will project it.*

1. Introduction and Overview

Interest in accelerated inhomogeneous flows (AIFs) has recently increased because they can explain hydrodynamic phenomena in supernova astrophysics, supersonic combustion and laser fusion. These flows, often called Rayleigh-Taylor or Richtmyer-Meshkov flows are reported at the biannual International Workshop on Compressible Turbulence Mixing. The eighth “MIX” meeting was held at Pasadena in December 2001. (<http://www.llnl.gov/IWPCTM/>). Reviews are in Zabusky (1999) and Brouillette (2002).

Figure 1 shows several classical configurations where an incoming shock from the left (M for Mach number) strikes an interface (near contact discontinuity) between media of different density. These have been investigated experimentally, theoretically and computationally. From