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Guest Editor's Preface: The Eighth International Workshop on the Physics of Compressible Turbulent Mixing

This issue of *Laser and Particle Beams* contains 27 contributed articles based on presentations given at the eighth International Workshop on the Physics of Compressible Turbulent Mixing (IWPCTM) (see http://www.llnl.gov/IWPCTM), held at the California Institute of Technology, Pasadena, California from December 9 to 14, 2001, and organized jointly by the Lawrence Livermore National Laboratory (LLNL) and the California Institute of Technology. This conference is the eighth in a biennial series of conferences on the general subject of experimental, numerical, and theoretical studies of compressible turbulent mixing, initiated by LLNL in the late 1980s. Previous conferences were held in Princeton, New Jersey (1988), Pleasanton, California (1989), Royaumont, France (1991), Cambridge, United Kingdom (1993), Stony Brook, New York (1995), Marseille, France (1997), and St. Petersburg, Russia (1999). The ninth IWPCTM is to be held at the University of Cambridge in 2004.

The conference format consisted of several one hour review talks at the beginning of experimental, computational, and theoretical sessions. These talks were followed by shorter 20-min talks. Two staggered poster sessions were also held at the end of two of the days. There were a total of 126 presentations: 67 oral presentations and 59 poster presentations. Discussion sessions were also held during the poster sessions. The "workshop" provides a common international forum for the exchange of ideas and results and for establishing scientific collaborations. An objective of the conference is to cross-fertilize several disciplines by bringing together experimentalists, numericists, and theorists working in highly diverse areas: high-energy density physics, inertial confinement fusion, astrophysics, and fluid dynamics. Although the sessions were organized according to experimental, computational, and theoretical categories, most of the presentations combined at least two of these.

There were 123 participants representing Canada (2), France (8), Israel (8), Japan (4), Russia (20), Spain (1), the United Kingdom (6), and the United States (74). Of these, one-third were from universities and the remainder were from national laboratories. The conference was also established as a forum for younger scientists (graduate students and postdoctoral researchers) entering the field. An important objective of this conference is to assemble researchers from a number of interdisciplinary fields of physics and engineering, including astrophysics, plasma physics, fluid dynamics, turbulence, and combustion. While the theme of the conference—compressible turbulent mixing—is exceptionally broad, most of the topics concern the evolution of interfacial instability-induced mixing from the linear, through nonlinear, and finally turbulent regimes, that is, multifluid interpenetration and mixing arising from the Rayleigh–Taylor, Richtmyer–Meshkov, and Kelvin–Helmholtz instabilities. The understanding and control of these mixing processes has important applications in, and implications for, astrophysics and inertial confinement fusion.

The contributed articles are briefly summarized here.

Abarzhi discussed multiple harmonic solutions describing the nonlinear dynamics of bubbles and spikes that evolve from the Richtmyer–Meshkov instability.

Cheng et al. presented and reviewed models developed by the authors to predict the mixing layer front evolution in Rayleigh–Taylor instability-driven mixing, as well as to predict the density profiles inside mixing layers.

George et al. performed front-tracking simulations of multimode Rayleigh–Taylor instability-driven mixing using the FronTier code and an untracked TVD level-set code.

Gupta et al. performed two-dimensional, late-time numerical simulations of the Euler equations using a piecewise-parabolic method (PPM) code to study the morphology of the generation of baroclinic vorticity and circulation deposition in the interaction of a planar, Mach 1.095 shock with an SF_6 gas cylinder.

Holder et al. (first article) performed two-dimensional convergent shock tube experiments with shocks driven by the simultaneous, multipoint detonation of oxygen–acetylene gas (using 30 miniature spark plugs located on the periphery and fed from a capacitor bank) using a triangular, "notch" perturbation imposed on an interface separating air and SF_6, and with no imposed perturbation.

Holder et al. (second article) performed and described conventional, planar geometry 20 cm × 10 cm shock tube experiments (with Mach number 1.26) using a two-dimensional, enlarged "double bump" perturbation (with amplitude 6 mm) imposed on the downstream interface separating air and a dense gas (SF_6); the tube was partitioned into three zones consisting of air, SF_6, and air.

Holford et al. experimentally studied molecular mixing induced by the Rayleigh–Taylor instability in the Boussinesq limit at a tilted interface using saline and fresh water initially separated by a barrier in a tank; the instability was initiated by removing the barrier that is designed to minimize shear at the interface during removal.

Kartoon et al. compared the predictions of a three-dimensional statistical binary interaction (competition) model of bubble and spike amplitude growth in multimode Rayleigh–Taylor and Richtmyer–Meshkov instability-generated mixing to those given by 80^3 Eulerian numerical simulations using the LEEOR3D ALE code.

Kucherenko et al. (first article) described experiments conducted on the EKAP facility at the Russian Federal Nuclear Center–VNIITF, concerning the stabilization of Rayleigh–Taylor instability-induced mixing in miscible liquids by the formation of a molecular diffusion (or transitional) layer between the liquids initially. Kucherenko et al. (second article) described experiments conducted on the SOM facility at the Russian Federal Nuclear Center–VNIITF, concerning the turbulent mixing induced by the Rayleigh–Taylor instability in a three-layer system of immiscible liquids. Kucherenko et al. (third article) described the design, operation, and functionality of the multifunctional shock tube (MST) facility at the Russian Federal Nuclear Center–VNIITF. Kucherenko et al. (fourth article) described experiments on self-similar Rayleigh–Taylor instability-induced mixing in gases in the Earth's gravity conducted on the OSA facility at the Russian Federal Nuclear Center–VNIITF. Kucherenko et al. (fifth article) described experiments conducted on the OSA shock tube facility at the Russian Federal Nuclear Center–VNIITF to investigate the compressible turbulent mixing of argon and krypton gases induced by the Rayleigh–Taylor instability.

Levy et al. performed experiments (in air–helium and in air–SF_6) and numerical simulations using the two-dimensional ALE code LEEOR2D to study the passage of a shock through a spherical bubble in a shock tube, and the subsequent evolution of the vortex ring that emerges from this interaction.

Llor and Llor and Bailly presented a recently developed modified K-ε model and a two-structure, two-fluid, two-turbulence model, which were considered with respect to their predictions of turbulent transport in a general class of "self-similar variable acceleration Rayleigh–Taylor" flows (in which the classical Rayleigh–Taylor and Richtmyer–Meshkov instabilities are special cases).

Peng et al. performed numerical simulations to design a vertical shock tube experiment for the study of vortical and jet flows induced by the Richtmyer–Meshkov instability.

Sadot et al. performed two sets of experiments (in air and SF_6 initially separated by a thin membrane) in an 8 cm × 8 cm cross section double-diaphragm shock tube to investigate the effects of both large initial perturbation amplitude and Mach number on the evolution of the single-mode Richtmyer–Meshkov instability.

Srebro et al. (first article) developed a buoyancy–drag model for the linear, nonlinear, and late-time Rayleigh–Taylor and Richtmyer–Meshkov instability growth, in which the evolution of a multimode spectrum is modeled by a single characteristic wavelength.

Srebro et al. (second article) performed one- and two-dimensional simulations of inertial confinement fusion implosions, which were compared to experimental data obtained on the OMEGA laser to study the effect of mixing on the neutron yield.

Vandenboomgaerde developed a simplified perturbation approximation for the weakly nonlinear amplitude growth of the single-mode Richtmyer–Meshkov instability, and Vandenboomgaerde et al. applied this methodology to the Richtmyer–Meshkov and Rayleigh–Taylor instabilities.

Weber et al. performed two- and three-dimensional arbitrary Lagrangian–Eulerian simulations of Rayleigh–Taylor instability evolution using the HYDRA code for ideal gases having a density ratio of three at spatial resolutions of 256×512, 512×1028, 1028×2048, and $256^2 \times 512$.

Yosef-Hai et al. performed shock tube experiments with two- and three-dimensional single-mode perturbations and a shock with Mach number 1.2 for different Atwood numbers (in air/SF_6 and air/argon) to study the late-time growth of the Richtmyer–Meshkov instability.

Zaytsev et al. described experiments on Rayleigh–Taylor instability-induced mixing in gases (a combustible hydrogen–oxygen mixture and argon, krypton, xenon, helium, or SF_6) undergoing variable acceleration, and the interaction of the mixing layer with compression and shock waves conducted in a vertical shock tube at the Krzhizhanovsky Power Engineering Institute.

Zhang and Zabusky performed two-dimensional (800×160) numerical simulations of the interaction of a shock with a planar, inclined "curtain" (essentially, a three-layer system consisting of a helium curtain surrounded by air) using the PPM for Mach numbers 1.5, 2.0, and 5.0 and for long evolution times. Zhang et al. performed numerical simulations (800×200) of the interaction between a cylindrical or spherical bubble and a complex planar blast (shock) wave using the PPM.

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