ATOMIZATION AND FRAGMENTATION OF FLUIDS

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ABSTRACT

The atomization and fragmentation of spray, droplet and bubbly flows poses remarkable challenges to simulation and computation. These phenomena exhibit an intrinsic multiscale character with length scales ranging from that of the vessels where the flows are confined (tens of cm) to that of the smallest structures that need to be resolved, such as thin liquid or gas sheets, droplets and ligaments (microns or less). Moreover, mass and heat transfer phenomena are mostly affected by the physics of the smaller scales, thus requiring an efficient representation of tiny interfacial structures. Despite its difficulty, the computation of such flows is of great importance in industry and the natural sciences. In combustion technology, the burning of liquid fuels is controlled by the droplet sizes and velocities in the combustion chambers. The mass and heat transfer between the sea surface and the atmosphere is governed by the breakup of waves and the formation of sprays and droplets. Thin liquid and air films are also of great significance for heat and mass transfer, and appear for example in boiling and

the Leidenfrost effect. Many other applications abound, in process engineering, biology, modern manufacturing etc.

The session will bring together a broad range of scientists, including those that develop methods, those that adapt them for computational efficiency and those that systematically use them for developing our understanding of the flows. The breaking and atomizing flows have inspired the development of methods such as Volume of Fluid (VOF) methods, Lattice Boltzmann methods, Level Set (LS) methods and Front Tracking (FT) methods with topology changes. They perform best for complex multiscale flows when coupled with AMR strategies or multiscale methods that take into account local slender structures. Finally engineers and physicists have been using them extensively to analyze typical bubbly or droplet flows with sometimes very intense use of current computer resources, ranging up to the tens of millions of hours of CPU.