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THREE-DIMENSIONAL SPATIAL DEVELOPMENT OF ATOMIZING JETS: THEORY, SIMULATION AND ELEMENTARY PROCESSES.

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ABSTRACT

Many processes of multiphase flow are poorly understood. Better understanding requires detailed calculations of the basic, Navier-Stokes equations. Droplet formation and breakup in turbulent flows is one of the most basic fluid dynamical processes in multiphase flow. It is essential to the understanding of atomizers, complex liquid gas flows in pipes or spray formation of wave crests. Droplet splashing and bouncing on liquid and solid surfaces is another fundamental phenomenon that poses a striking challenge to simulation. The direct simulation of flows with large number of bubbles is another rapidly developing area of CFD.

The three widely spread methods for tracking interfaces are the Volume of Fluid, Level Set and Surface Marker methods. They each have their advantages and drawbacks in terms of mass conservation, ease of coding and use, accuracy, and speed. Several methods combine those two methods. Moreover, an interesting class of radically different methods are particle methods and Lattice-Boltzman methods.

One important issue in all methods is the treatment of capillary terms and the computation of surface tension.

The lecture will emphasize recent advances in the modelling and theory of atomization, droplet splashing and bubble motion. For atomization, recent theoretical developments show that viscosity plays an important role in the selection of unstable wavelength and thus in the determination of the size of the resulting droplets. Viscosity also plays a subtle role in splashing, as some characteristics of the splashing droplets are dependent on viscous effects in a small region near the base of the droplet crown.

Finally, the conference will discuss future perspective for the direct numerical simulation of droplets and bubbles, through advanced methods such as adaptive mesh refinement on quad and oct-trees.