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ADVANCES IN COMPUTATIONAL METHODS FOR COMPLEX LIQUID-VAPOR FLOWS

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ABSTRACT

The simulation of multiphase liquid-vapor flows such as cavitating flows, boiling and flashing flows is important in numerous areas of engineering ranging from aerospace technologies to the nuclear energy sector. Liquid-vapor mixtures often involve complex hydrodynamic and thermodynamic multiscale phenomena: vapor cavities formation and collapse, flashing, interfaces, shocks, wave interactions. Significant progress has been made in computational methods for multiphase flows with liquid-vapor transition, based on different multiphase models and different numerical approaches, e.g. [1, 2, 3, 4]. Yet there are many open challenges toward the accurate prediction of these flows in realistic configurations, both for the formulation of appropriate and consistent mathematical and physical models and for the design of accurate and robust numerical methods. Several difficulties concern the precise description of heat and mass transfer processes and possibly associated non-equilibrium thermodynamic effects such as the occurrence of metastable states. Simple thermodynamic closures and simple phase transition models are numerically practical but they might not

provide precise predictions of the complex physical phenomena involved. Further work is needed for instance to account for more realistic equations of state and relaxation time rates associated to thermodynamic transfer. In some problems extra multiphysics and multiscale effects should be also taken into account, for instance turbulence, surface tension, or the presence of additional inert gaseous phases in the liquid-vapor mixture. This entails additional difficulties in the design of robust numerical algorithms. Furthermore, simulation of realistic problems requires time-affordable computational tools applicable to multidimensional complex geometries and to a wide range of Mach number regimes.

The aim of this minisymposium is to bring together scientists working on computational models for liquid-vapor flows to share and exchange ideas, discuss the state of the art, recent advances and challenges. The minisymposium will be open to a broad spectrum of modelling techniques and numerical approaches.

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