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Colloquium Thermo- and Fluid Dynamics

Fragmentation mechanisms in coaxial two-fluid atomization

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The destabilization and subsequent fragmentation of a liquid phase by a turbulent gas phase is at the core of many applications that aim at producing high-quality sprays. Certain underlying physical mechanisms of spray formation remain unresolved, hindering process efficiency and control. I will present a multiscale characterization of these mechanisms in a two-fluid atomizer, where a round liquid jet is fragmented by a highly turbulent annular gas jet. The interfacial instabilities, and resulting large-scale dynamics, are experimentally characterized using two high-speed imaging methods, back-lit optical imaging and synchrotron X-ray radiography. A spatial characterization of the flapping dynamics of the liquid jet indicates that the flapping dimensionality is related to the change between shear break-up to bag break-up. At higher gas velocities, the scaling laws of the transport of the interfacial instabilities highlight the change to fiber-type atomization. Similarly, studying statistics and temporal dynamics of the length of the liquid jet in a broad parameter space poses a framework to quantitively describe changes in fragmentation mechanisms. In addition, I will show how introducing angular momentum (swirl) in the gas co-flow dramatically changes the topology and dynamics of the atomized liquid jet, resulting in drastic changes in the spray.

Nathanaël Machicoane is a CNRS associate research professor in the LEGI research department of the Grenoble Alps University, His research focuses on the fundamental aspects of turbulence and multiphase flows. He also explores the development of experimental techniques and analysis tools. In 2014, he obtained his PhD for the study of the dynamics of large particles in turbulence with heat transfer. After his PhD, he was a post-doc at the FAST laboratory of Paris-Sud University where studied inertial waves and turbulence in rotating fluids and at the University of Washington, to establish Multiphysics controls of gas-assisted atomization.

Date: Wednesday, 27 March 2024
Time: 16:15 - 17:15h
Place: ETH Zurich, ML H 44
Host: Prof. Outi Supponen

Further information: https://ifd.ethz.ch/events/ktf.html

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