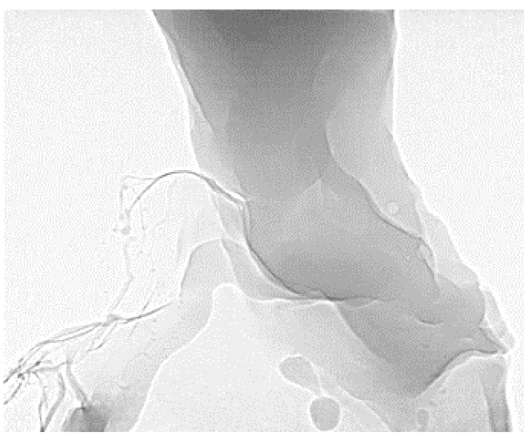
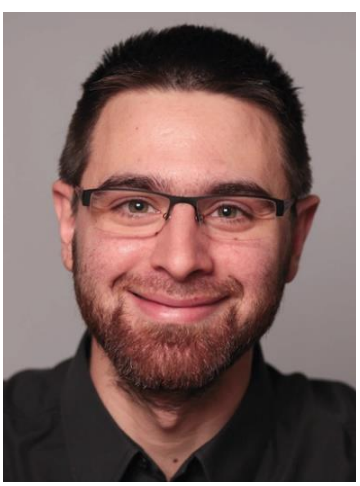
**Multiscale Characterization and Feedback Control of Atomization in a Two-fluid Spray Atomizer**

**ABSTRACT:** A classic problem in multiphase flows is to describe the motion of a fluid, called the continuous or carrier phase, and of one or several other phases – such as solid ash particles in air – referred to as the disperse phase. This is particularly challenging when the dynamics of the phases are fully coupled: the spatio-temporal distribution of mass and momentum of the disperse phase depends on the turbulent carrier flow, and the turbulent carrier flow depends strongly on the location, size and velocity of the disperse phase droplets or particles. My current research focuses on the case where the continuous phase is a turbulent gas jet and the dispersed phase is formed by individual liquid droplets at volume fractions that go from high to very dilute, presenting problems that are important to societal challenges and that include complex, still poorly understood, physics. This talk will present one aspect of such flows and its experimental investigation: the control of liquid break-up and spray formation. I will present a multiscale characterization of the spray produced by a two-fluid atomizer, from the dense region at the exit to the dilute clouds of droplets in the mid and far fields of the spray. The spray instabilities, and resulting large-scale dynamics, are experimentally characterized using two high-speed imaging methods, back-lit optical and synchrotron X-ray absorption, while the droplets spatio-temporal size and velocity distributions are measured through laser interferometry. In particular, I will show how introducing angular momentum in the gas co-flow dramatically changes the topology and dynamics of the atomized liquid jet, resulting in drastic change in the spray. This is important for atomization control applications, such as ensuring engine restart at high altitude in the context of aircraft propulsion. Finally, I will present an implementation of real-time feedback control of the spray structure using the dynamics of the swirled jet described.





**SPEAKER BIO:** Nathanaël Machicoane earned a B.S./M.S. in Physics from École Normale Supérieure de Lyon in 2011, with a focus on out-of-equilibrium systems. In 2014, he obtained his PhD for the study of the dynamics of large particles in turbulence with heat transfer, at the Physics Laboratory of École Normale Supérieure de Lyon. After his PhD, he studied inertial waves and turbulence in rotating fluids thanks to a post-doctoral fellowship at the FAST laboratory of Paris-Sud University. Dr. Machicoane is currently a post-doctoral researcher at the University of Washington, where he helps with the coordination of experimental research to establish Multiphysics controls of gas-assisted atomization through a Multi-University Research Initiative funded by the Office of Naval Research. In February 2020, he joined LEGI as a CNRS researcher to conduct research on turbulent multiphase flows.