ETH zürich

Institute of Fluid Dynamics
Institute of Energy and Process Engineering

Colloquium Thermo- and Fluid Dynamics

Spontaneous Symmetry Breaking of Thermo- and Aero-Acoustic Instabilities in Hydrogen Aircraft Engines

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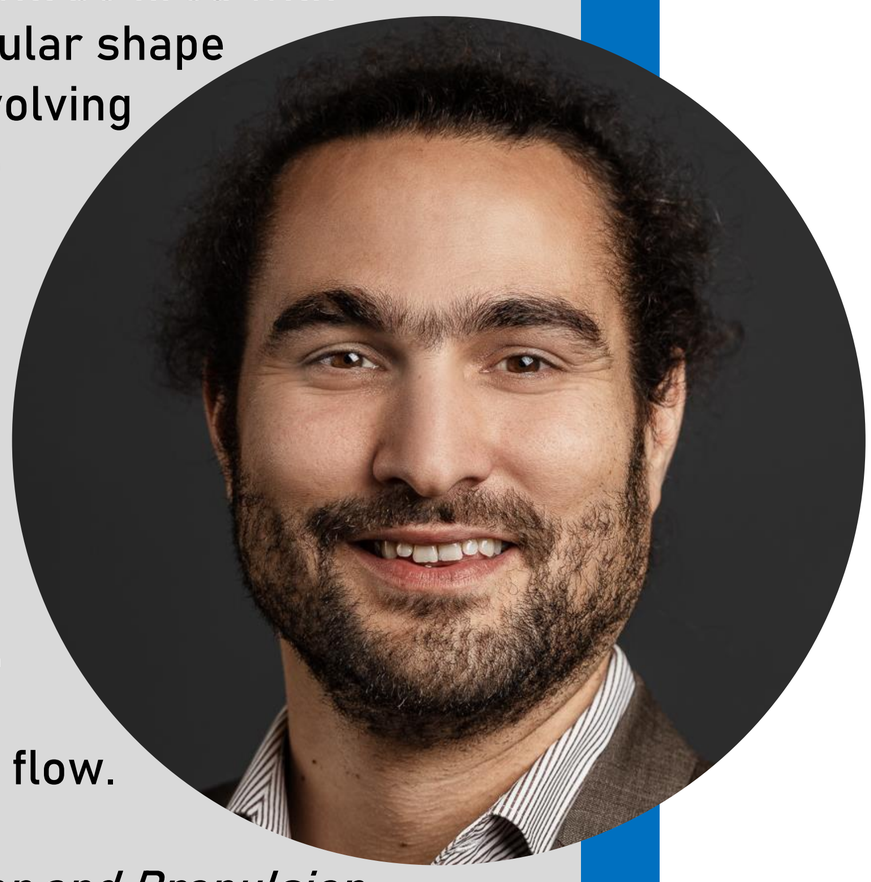
A key challenge in the development of tomorrow's aircraft engines, which will be fired with hydrogen, is the control of thermo- and aero-acoustic instabilities. The annular shape of the compressor, combustor and turbine typically leads to instabilities involving azimuthal modes. They are unwanted because the induced vibrations cause mechanical fatigue and sometimes even components destruction. Using an annular combustor and a cylindrical cavity, both nominally symmetric, different types of spontaneous and explicit symmetry breaking of the modes, as well as intriguing beating modes associated to heteroclinic orbits in the phase-space, have been discovered. In this talk we will present these experiments (acoustic field reconstruction, high-speed chemiluminescence and stereoscopic particle image velocimetry), and we will discuss how we modelled these complex phenomena with quaternions, coupled Langevin equations and their Fokker-Plank counterparts, and with the Navier-Stokes equations linearized around the turbulent mean swirling flow.



Nicolas Noiray leads the laboratory of "Combustion and Acoustics for Power and Propulsion Systems" since 2014. He obtained his Ph.D. from the Ecole Centrale Paris in 2007, and then worked in the Gas Turbine Research Division of Alstom. His research focuses on the modeling and control of reacting and non-reacting flows, and on the development of new technologies for the energy and transport sectors. He has received the Silver Medal and the Hiroshi Tsuji Early Career Researcher Award of the International Combustion Institute, and he was awarded a Consolidator Grant by the European Research Council. A key theme of the experimental, theoretical and numerical research performed by his group is the study of flow instabilities at various time and length scales.

Date: Wednesday, 30 November 2022
Time: 16:15 – 17:15
Place: ETH Zurich, ML F 36
Host: Prof. Filippo Coletti, IFD

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

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