ME Seminar

The Lean Azimuthal Flame (LEAF) combustor concept: exhaust emissions and flame topology

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ABSTRACT

Developing low NOx and soot-free combustors is vital for achieving sustainability goals in the power/propulsion sector. Hence, it is imperative to explore alternative combustor concepts to push the limits of low pollutant emissions, improving stability, and reducing noise. Nevertheless, achieving this goal while burning sustainable aviation fuels (SAFs) and Hydrogen poses a significant technical challenge for the combustion community. Recently, the Lean Azimuthal Flame (LEAF) concept has shown encouraging outcomes for achieving low NOx and soot-free combustion of kerosene/hydrogen blends by swiftly diluting reactants with burnt gas and fresh oxidizer. The LEAF concept is a reactive multi-phase system; hence, its operability limits and global behavior can be predicted from the underlying physics of their subgrids (droplets), i.e., transport and combustion of droplets/droplet clusters. For instance, the ratio of spray evaporation and convective timescales in the LEAF combustor is significant in predicting the flame topology. The talk will encompass the spatiotemporal scales, spray Sauter mean diameters (SMDs), convective length scales, and convective/mixing timescales, pivotal for understanding the flame stability and combustor operability limits for liquid fuel operations. Furthermore, the talk will focus on the fuel flexibility of the LEAF concept and its full hydrogen operations. The underlying mechanism of NOx formation in Hydrogen LEAF will be elucidated using Large Eddy Simulation results.

ABOUT THE SPEAKER

Dr. Khushboo Pandey is the Lecturer in Experimental Thermofluids at the School of Engineering, University of Edinburgh. Dr. Pandey completed her MSc (Engg.) and Ph.D. (May 2020) from the Interdisciplinary Center for Energy Research (ICER), Indian Institute of Science. Dr. Pandey was a Postdoctoral Researcher at the Combustion, Acoustics & Flow Physics (CAPS) Lab at ETH Zurich, Switzerland between October 2022-September 2023. At Edinburgh is heading the Experimental Multi-Physics and Multi-Phase flow group, The E(MP)2 group. Her research focuses on multi-physics and multi-phase flows to establish clean and low-emission combustion of Sustainable Aviation Fuels (SAF) and Hydrogen with a prime focus on power generation and aircraft propulsion technologies. Dr. Pandey works with state-of-the-art optical diagnostics such as Particle Image Velocimetry (PIV), Planar Laser-induced Fluorescence (PLIF), Emission Spectroscopy, Phase Doppler Anemometry (PDA), High-speed imaging to predict flame/spray instabilities and topological transitions. Recently, Dr Pandey has been awarded the UK's Engineering and Physical Sciences Research Council (EPSRC) New Investigator Award where she will be working on the complex particle dynamics for emission control.

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