ONERA

THE FRENCH AEROSPACE LAB

PROPOSITION DE POST-DOCTORAT

Title: Experimental study of the influence of the insertion geometry of an injector on the extinction limit of an aeronautical combustion chamber under representative engine conditions

Reference : **PDOC-DMPE-2023-02** *(to be included in all correspondence)*

Starting date : January 2023 | **Application dead line:** 31/01/2023

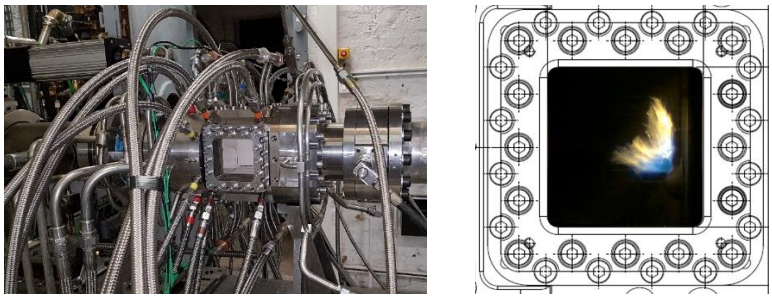
Duration : 12 months – Net Salary : approx. 25 k€ / year

Keywords: Combustion, flame structure, high-speed optical diagnostics

Profile and skills needed: PhD in Combustion, Strong background in thermodynamics, experimental measurements and data analysis.

To meet increasingly stringent operability requirements and environmental challenges, helicopter gyratory combustion chambers must be efficient, fit into the engine environment, be able to reactivate quickly and minimize pollutant emissions. In these combustion chambers, the confinement necessary to the compactness of the engine and the gyratory flow, the interaction between the flame and the cooling air of the wall probably slows down the chemistry and contributes to high-level emissions of fine particles. In this new concept of combustors, the injection system is placed at the bottom of the chamber. In this zone, the so-called primary zone, a rich flame is generated, and the lean stabilization and the extinction limit are controlled. The design and the geometry of the combustion chamber are key parameters in the lean operation of the combustion chamber. The study of these parameters relies on advanced numerical tools and experimental data representative of the physical phenomena involved. The objective of the proposed research topic is to characterize the interaction between the flame in the primary zone and the dilution air injected near the injector, as well as to analyze the impact on the flame extinction characteristics. To study these phenomena, ONERA is equipped with an experimental research facility (MICADO) that can representatively reproduce the thermodynamic conditions of aircraft engine combustion and enable the implementation of advanced diagnostics [1]. The experimental part of the work will take place during a test campaign on the MICADO facility, which consists of coupling optical techniques used to characterize the flame front by OH* radical imaging and the fuel evaporation/mixing ratio by laser-induced fluorescence [2]. These experimental data will complete a database of experimental data already established during previous projects. All these data will provide substantial information for flame behavior analysis during operation conditions of the combustor in lean extinction phases.

This research is conducted in collaboration with Safran Helicopter Engines and is subject to publication. The post-doctoral fellow will work with the ONERA team that runs the combustion test facilities and the advanced optical metrology team.



MICADO test facility and image of a flame at the lean blow off limit.

[1] Cochet, A., et al. "ONERA test facilities for combustion in aero gas turbine engines, and associated optical diagnostics." Aerospace Lab 11 (2016): 16-pages.

[2] Malbois, P., et al. "Quantitative measurements of fuel distribution and flame structure in a lean-premixed aero-engine injection system by kerosene/OH-PLIF measurements under high-pressure conditions." Proceedings of the Combustion Institute 37.4 (2019): 5215-5222.

Collaborations: Safran Helicopter Engines

ONERA host laboratory: Département : Département Multi-Physique pour l'Energétique

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