PhD position
Start : April/October 2023

Analysis of a dual swirl hydrogen burner at high-pressure and high- temperature injection conditions

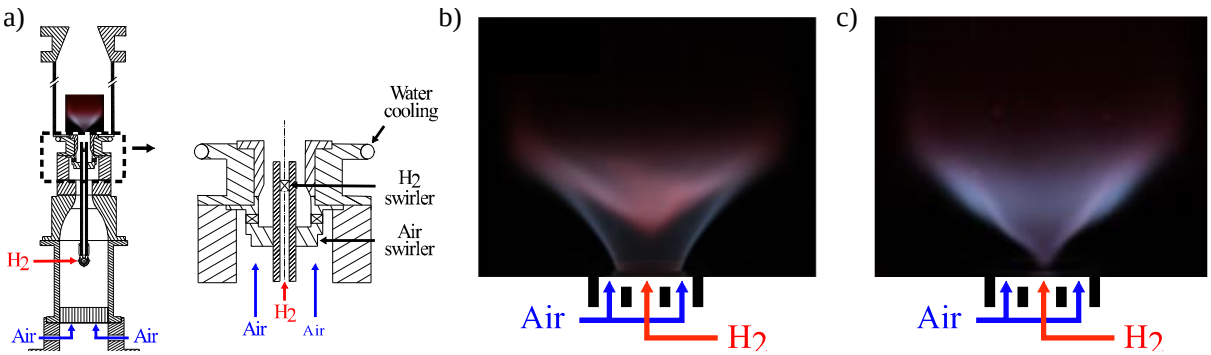

Figure 1: a) Schematical representation of the HYLON (HYdrogen LOw Nox burner) injector b) Bluff-body stabilized diffusion H2/air flame c) Lifted partially premixed H2/air flame.

Context: The European aeronautics industry is pushing the development of cutting-edge technologies based on green hydrogen combustion to reduce GHG emissions. However, burning hydrogen in gas turbine raises several difficulties from both safety and performance perspectives. To address these problems, the design of the injector needs to be optimized and this is done by performing both experiments and high-fidelity simulations (LES). SAFRAN and IMFT have teamed up to develop an injector technology named HYLON, HYdrogen LOw Nox burner [1,2]. This injector produces diffusion bluff-body stabilized flames or partially premixed lifted flames as illustrated in Fig. 1b-c [2]. Experiments [1,2] and simulations [3] conducted at atmospheric pressure already enabled to gather a large database that already represents a unique benchmark. The objective is to expand this characterization at pressures and temperatures relevant to gas turbine operation.

Objectives: The candidate will take part of a joint research program HYFEE (HYdrogen Flames at ElEvated thermodynamic conditions) between KAUST and IMFT to support the experimental and numerical activities carried out on HYLON at IMFT, interacting with experienced PhDs and researchers. The work will be focused on the operability and dynamics of the HYLON injector for flow conditions relevant to gas turbines. Experiments will be made on IMFT test benches with optical access for laser diagnostics and large eddy simulations will be carried out with the AVBP code developed by Cerfacs. Strong interactions with other PhDs from the group are expected including also interactions with the industrial partners (SAFRAN,…) and academic partners (KAUST,…) working on HYLON around the world. The candidate will also be responsible for the organization of the data with a unified methodology in order to share it with other research groups around the world for the validation of numerical tools.

Profile: Student with M2 Master of Sciences in Mechanical Engineering or Chemical Engineering having an interest for combustion, numerical flow simulations and optical diagnostics in fluids.

Contacts : thierry.schuller@imft.fr, thierry.poinsot@imft.fr, Laurent.selle@imft.fr

[1] S. Marragou, H. Magnes, A. Aniello, L. Selle, T. Poinsot, T. Schuller (2022). Experimental analysis and theoretical lift-off criterion for H2/air flames stabilized on a dual swirl injector. Proc. Combust. Inst., https://doi.org/10.1016/j.proci.2022.07.255.

[2] S. Marragou, H. Magnes, T. Poinsot, L. Selle, T. Schuller, Stabilization regimes and pollutant emissions from a dual CH4/H2 and dual swirl low NOx burner, Int. J. Hydrogen Energy 47 (44) (2022) 19275—19288

[3] D. Laera, P.W. Agostinelli, L. Selle, Q. Cazères, G. Oztarlik, T. Schuller, L. Gicquel, T. Poinsot, Stabilization mechanisms of CH4 premixed swirled flame enriched with a non-premixed hydrogen injection, Proc. Combust. Inst. 38 (2021) 6355--6363