Postdoctoral fellow position at CORIA

UMR 6614 CNRS – Université et INSA Rouen Normandie

2023 – 2024

Laminar and Turbulent H_2 flames characterization by advanced optical diagnostics to investigate NOx formation

Keywords: hydrogen, laminar and turbulent combustion, optical diagnostics, spectroscopy, PIV, LIF

CORIA, an academic research laboratory, joint research unit (UMR) attached to the Institute of Engineering and Systems (INSIS) of CNRS, the Université Rouen Normandie and INSA Rouen Normandie offers a 2 years-postdoctoral position dedicated to the investigation of NOx production in H_2 flames for a researcher having skills in fluid mechanics, physics of combustion and laser diagnostics.

CORIA researches cover fundamental and applied studies on reactive and complex flows, especially in combustion, metrology and laser sources, and numerical simulation. Through multi-physics and multi-scale approaches, researches in fluid mechanics are conducted with or without chemical reaction by combining theoretical studies, modeling, numerical simulations and experiments at different scales with a striking specificity in the development and application of optical and laser diagnostics. The physical mechanisms and processes leading to the reduction of pollutant emissions in reactive systems and the decarbonation of energy, propulsion, and industry by 2050 are its research priorities.

CORIA is a founding member of organizations, Carnot ESP (Energy and Propulsion Systems) Institute and LabEx EMC3, awarded with national and government labels recognizing its excellence in academic research and industrial partnership.

The post-doctoral position is integrated to the project MONTHY in the research French national program PEPR-H2 (www.pepr-hydrogene.fr) of the governmental action France 2030. Through a collaboration of 3 laboratories (CORIA, EM2C, PC2A) internationally recognized for their researches in combustion, MONTHY aims for a better understanding and modeling NOx formation in turbulent hydrogen flames. The overall objectives of this project are to build a detailed and original experimental database, to clarify the specific respective NO formation kinetics mechanisms in H_2-Air flames, to study the effect of steam on the NO_x emissions, and also to provide a refine data-base to validate NO production simulation in Large Eddy Simulation (LES) of turbulent hydrogen flames.

In CORIA, the postdoctoral fellow will participate in the co-building of the experimental database in hydrogen flames and in its physical interpretation with a postdoc fellow of PC2A laboratory. In collaboration with the other partners, temperature dependence of the measurements will be performed in a laminar flame. For that, the 1D concentration of major species ($[O_2]$, $[N_2]$, $[H_2]$, $[H_2O]$) on a reference Mc Kenna burner for various operating conditions of H_2-O_2-N_2-(H_2O) laminar flames will be measured by Spontaneous Raman Scattering (SRS), an advanced optical technique developed at CORIA laboratory since more than 15 years.

Secondly, instantaneous temperature and major species will be measured by Spontaneous Raman Scattering technique in turbulent non-premixed H_2-air flames with and without H_2O addition and produced by a specific burner representative of industrial geometries, in collaboration with EM2C

researchers. Considering the high amount of steam in high temperature burnt gas in the case of H_2O addition, thermography based on water spectra will reinforce the procedure developed in CORIA [1-2].
These results will allow to identify the local (premixed or not) combustion regime with 3D correlation plots in the frame of density number/radial location/mixture fraction, but also to estimate the instantaneous dissipation rate from the 1D mixture fraction profiles.

In the final step, the 1D Spontaneous Raman Scattering technique will be coupled to nanosecond NO-PLIF technique in the H_2-air turbulent flame, first to evaluate qualitatively for different operating conditions the correlations between NO production, temperature and the different species concentrations and second to reinforce the quantification of NO signal from the simultaneous local composition and temperature measurements.

Candidate:
Applicants will hold a PhD degree in Physics or Mechanical Engineering. Strong background and experience in experimental study in fluids mechanics (reactive or not), optical diagnostics and post-processing of data (C, C++, Python, matlab…) will be considered

Fellowship:
The gross salary is approximately 3000 € per month (depending of experiences) and the employer is CNRS. The 12 months fellowship will start in Mars 2023. An extension will be possible.

Contacts:

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Application procedure:

Candidates must submit their application on the EURAXESS site: https://euraxess.ec.europa.eu/

[1] LO, A., CLÉON, G., VERVISCH, P., A. CESSOU, “Spontaneous Raman scattering: a useful tool for investigating the afterglow of nanosecond scale discharges in air”, Applied Physics B, Lasers and Optics, 107 (2012) 229-242 DOI:10.1007/s00340-012-4874-3

[2] GUICHARD, F., BOUBERT, P., HONORÉ, D., CESSOU, A., “CO2 Spontaneous Raman Scattering: an alternative thermometry for turbulent reactive flows”, 19th International Symposium on the Application of Laser and Imaging Techniques to Fluid Mechanics, Lisbon, Portugal July 16 – 19, 2018.