PhD offer

Title	**Simulation and modelling of oxycombustion**
Duration	3 years, full time, starts fall 2024
Supervision	Vincent MOUREAU CNRS, CORIA vincent.moureau@coria.fr Kévin BIOCHE INSA Rouen Normandie, CORIA kevin.bioche@coria.fr
Location	CNRS UMR 6614 – CORIA, Rouen, France
Keywords	Oxycombustion, Carbon Capture, Large Eddy Simulations

Context

This PhD takes part in the national strategy aiming a **CO_2 neutral industry** by 2025 [1]. The two main approaches to obtain a clean combustion are the use of carbon-free fuels, such as hydrogen, and the capture of carbon (CO_2) from exhaust gases. While the interest of the first option is undeniable, the availability of such fuels makes it intractable for widespread industry use yet. As a step towards efficient carbon capture, oxycombustion is a realistic target for burners retrofit. By burning the fuel with pure oxygen and recirculation gases, combustion products present water and concentred CO_2, whose capture is eased. Oxy jet-flames will be studied to provide reference data in collaboration with experimentalists. The **development and consolidation of robust high fidelity numerical methods** will help future technologies design in various sectors.

Work environment

The PhD will take place at CORIA laboratory (CNRS UMR-6614, Rouen). The CFD code used is the high-fidelity multi-physics flows platform **YALES2** [2]. The PhD will be supervised by:

- **Vincent Moureau**, CNRS researcher, awarded by the *Grand Prix de l'Académie des Sciences*, creator and developer of YALES2, and expert in high-fidelity multi-physics flows simulations.
- **Kévin Bioche**, associate professor, co-developer of YALES2 and expert in simulation and modelling of reactive flows.

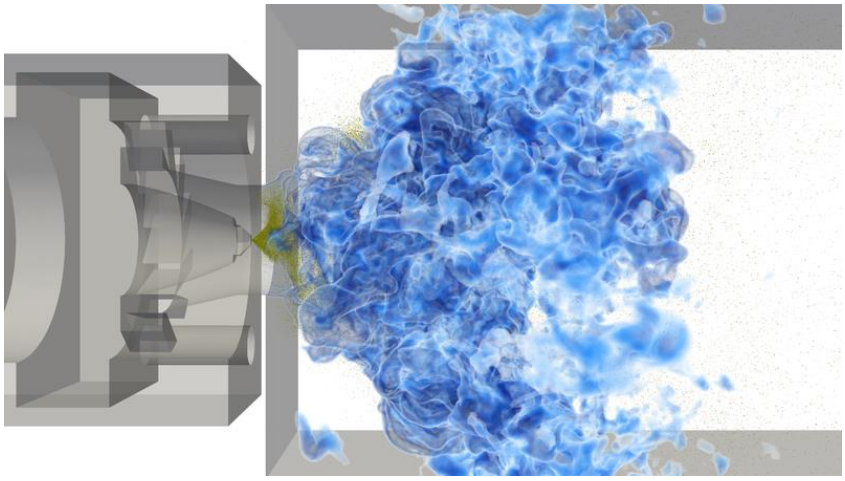
The offer is part of a national project (PEPR SPLEEN), which unites the French combustion scientific community, animating the CNRS research group (GDR TAMARYS), the French section of the Combustion Institute and the International Flame Research Foundation. The project will benefit from interactions between experimentalists and numericians from laboratories CORIA UMR6614, EM2C UPR288, LRGP UMR7274, IMFT UMR 5502, MSME UMR 8208, LGRE UR UHA 2334, PC2A UMR8522 and IFPEN.

PhD objectives

The aim of this PhD is to advance a numerical framework for the high-fidelity and high-performance computations of oxyflames, to favour the development of this technology and contribute to the decarbonation of various industrial sectors.

The experiments, repeated numerically in this PhD, take place in the host laboratory CORIA, favouring discussions with the experimentalists. Results are already available while further experiments are ongoing. Among the work targeted during this PhD, the candidate will work on:

- Optimisation of kinetic source terms computation.
- Coupled radiative heat transfers.
- Automatic mesh refinement and its interaction with reactive flows computations.



Example of reactive flow computation with YALES2 (Credit : Benjamin Farcy)

Hiring

- Gross salary: 26k€ /year + French social system
- Funding: PEPR
- Expected start of the PhD: October 1st, 2024

Candidate profile

- Master or engineer diploma in mechanics or energetics (fluid mechanics, combustion, scientific computation, CFD).
- Good writing and presentation skills in French or English are required.
- **Application:** Send a résumé, motivation letter and the master's first- and second-years marks to kevin.bioche@coria.fr

Bibliography

[1] october 2021 IEA report "net Zero by 2050", report of the French "Conseil Général de l'économie"
[2] Moureau, P. Domingo, L. Vervisch, Design of a massively parallel CFD code for complex geometries, Comptes Rendus Mécanique. 339 (2011) 141–148