Dr. Benedetta Franzelli
CNRS Research Scientist
Laboratoire EM2C, CNRS
91190 Gif-sur-Yvette, France
benedetta.franzelli@centralesupelec.fr
Tel: +33 1 75 31 60 73

3-year PhD and 1-year PostDoctoral positions in SOTUF project

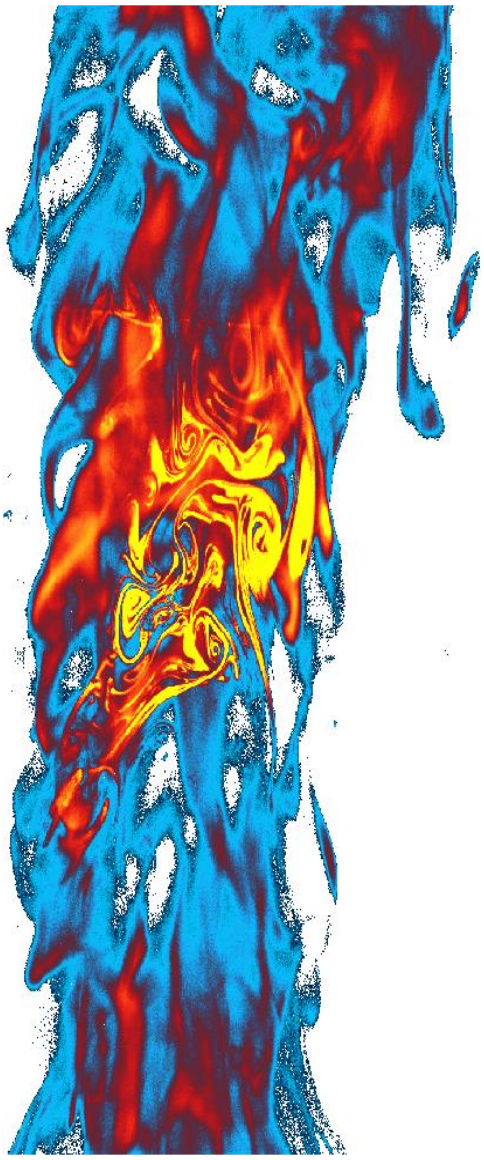

Fig. 1 Soot light scattering in a turbulent jet flame [1].

Many practical systems emit soot into the atmosphere as a result of incomplete combustion of hydrocarbons. This pollutant emission is characterized by a distribution of solid carbon particles with different sizes and shapes, which have negative effects on human health and environment. Controlling such emission represents a societal issue and an industrial challenge that require a deep understanding of the intricate processes underlying soot production in the turbulent flames that generally characterize practical systems. In this context, progress in numerical simulations is essential to the successful design of low-emission combustion systems. Unfortunately, the Large-Eddy Simultation (LES) approach, which has successfully demonstrated its capacity to represent gaseous turbulent combustion processes, is far from being predictive for soot emission. Indeed, soot production in turbulent flames is a complex process which is not easy to be represented with the classical LES strategy: the long time scales and the broad range of length scales place soot processes outside the usual scale ranges of LES subgrid models. In this context, the goal of the SOTUF project is to provide new insights on the processes governing soot production in turbulent flames to develop novel LES models, encompassing the state-of-art and allowing reliable predictions of soot in turbulent flames.

<u>3 PhD and 2 PostDoctoral positions are available starting from September 2020:</u>

The SOTUF activities will address the following points:

1) The characterization of turbulence-flame-soot coupling from novel well-controlled experiments employing advanced space-time resolved optical diagnostics (LII, LIF, PIV, LIP, light scattering) and Direct Numerical simulations (DNS) based on detailed sectional soot models;
2) The development of new subgrid models for LES based on information extracted from experiments and high-fidelity simulations;
3) The validation and application of the developed LES modelling strategy on complex systems.

The EM2C CNRS Laboratory is seeking for highly qualified candidates for a PhD/PostDoctoral fellowship in the area of **experimental characterization and/or numerical modelling of sooting turbulent flames**. The successful candidate will have access to the most advanced experimental equipment and numerical codes for the investigation of soot production in turbulent flows. He/she will also profit of the presence of many experienced researcher scientists (Dr. B. Franzelli, Eng. P. Scouflaire, Dr. Denis Veynante, Pr. N. Darabiha and Pr. S. Candel) and of the active collaborations with experts in physical chemistry from Politecnico di Milano, in experimental activities on laminar sooting flames from UPMC and in massively-parallel LES from Cerfacs.

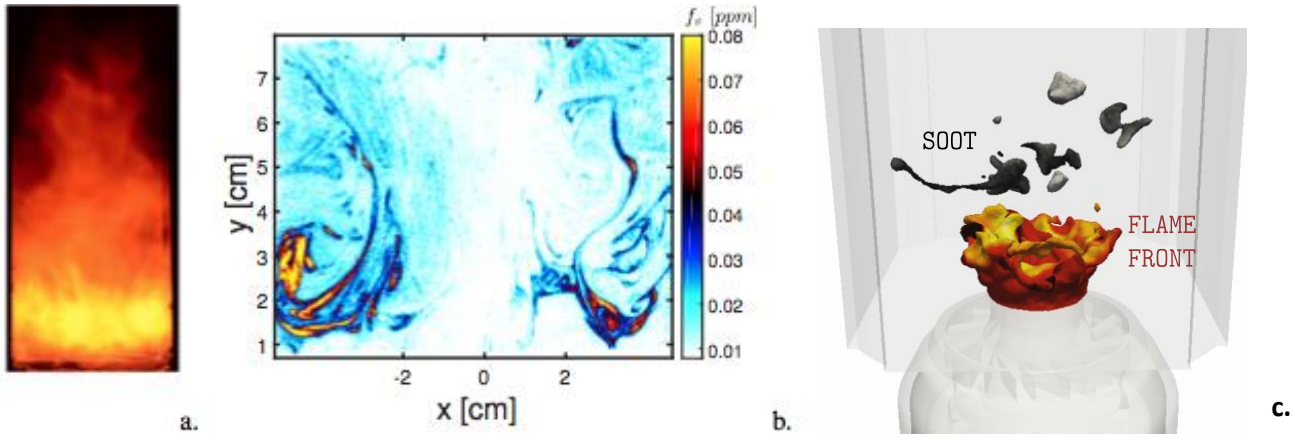

Fig. 2. a) Swirled turbulent perfectly-premixed turbulent rich flame EM2SOOT [2]. b) Instantaneous soot volume fraction field obtained via LII in the EM2SOOT flame [3]. c) Large Eddy Simulation of soot production in a turbulent non-premixed turbulent flame [4,5].

How to apply:

Applicants for PhD/PostDoctoral appointment will hold a M.Sc./PhD degree in Mechanical Engineering/Energetics. The position requires:

- Strong skills in Combustion, Fluid Mechanics, Turbulence, and Thermodynamics.
- Strong willing to develop experimental and/or numerical skills in the combustion field for PhD students.
- Strong competences in optical diagnostics and/or in numerical simulations for Postdoctoral fellows.
- Knowledge about turbulent combustion modeling.
- Good oral and written communication skills to report, to present in congress and to write articles for scientific journals.

Send the following documents to Dr. Benedetta Franzelli at benedetta.franzelli@cnrs.fr:

- Copy of passport
- One-page motivation letter.
- Copies of degree and academic transcript (with grades and rankings)
- One-page summary of master's/PhD thesis
- Your CV with names and contact details of at least two referees
- Reference letters sent separately by the referees

Stipend:

This work is supported by the SOTUF - ERC Starting Grant. The total net salary per month, calculated after deduction of employer contributions, mandatory health insurance and retirement (income tax still have to be paid), is 1400 € for PhD and 2000-2500 € for PostDoctoral fellows (depending on candidate experience).

[1] B. Franzelli, P. Scouflaire, S. Candel, Time-resolved spatial patterns and interactions of soot, PAH and OH in a turbulent diffusion flame, Proc. Comb. Inst. 35, 1921-1929 (2015).

[2] M. Roussillo, P. Scouflaire, N. Darabiha, S. Candel, B. Franzelli, A new experimental database for the investigation of soot in a model scale swirled combustor under perfectly premixed rich conditions, ASME Turbo Expo paper GT2018-76205, Oslo, Norway (2018).

[3] M. Roussillo, P. Scouflaire, S. Candel, B. Franzelli, Experimental investigation of soot production in a confined swirled flame operating under perfectly premixed rich conditions, Proc. Comb. Inst, submitted.

[4] B. Franzelli, E. Riber, B. Cuenot, M. Ihme, Towards the prediction of soot in aero-engine combustors with large eddy simulation, ASME Turbo Expo paper GT2015-43630, Montreal, Canada (2015).

[5] P. Rodrigues, B. Franzelli, R. Vicquelin, O. Gicquel, N. Darabiha, Coupling an LES approach and a soot sectional model for the study of sooting turbulent non-premixed flames, Comb. Flame 190, 477-499 (2018).