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3-year PhD position in ANNULIGht Marie Sklodowska-Curie project

PhD Position ESR1: Experimental investigations into combustion instabilities and ignition in an annular combustor

Description of the ANNULIGht project http://www.ntnu.edu/web/annulight/annulight
ANNULIGhT is an Innovative Training Network for early stage researchers (ESR) in the general area of combustion dynamics in gas turbines. The gas turbine industry is a vital driver of innovation, economic growth, and mobility in the EU and urgently needs a new generation of creative engineers equipped with

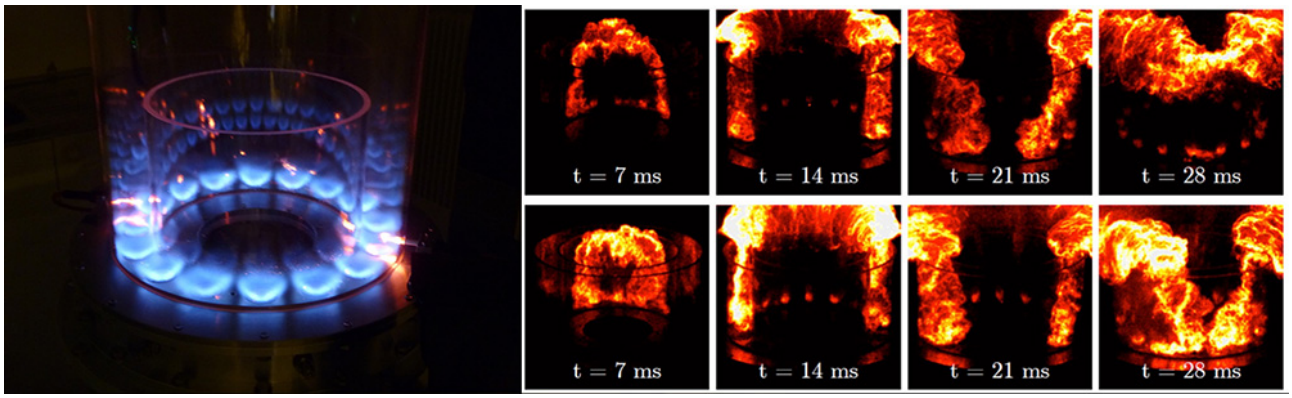

Figure 1: MICCA laboratory scale annular combustor (CNRS/EM2C) [1-6]

multi-disciplinary skills in order to accelerate the development of new innovations needed for flexible, efficient power generation and sustainable aviation.
ANNULIGhT brings together leaders from industry, academia and research institutes to provide an innovative, structured, multi-disciplinary training program in combustion dynamics. ESRs will gain experience outside academia, hence developing innovation and employability skills. From a research perspective, ANNULIGhT adopts an innovative research methodology to combustion dynamics, which is to study them exclusively in annular combustion chambers where all the physics of the problem are present.

15 PhD positions are available. PhD projects and supervision will be based at one of the network partners (NTNU, CERFACS, University of Cambridge, TU Munich, TU Berlin, EM2C-CNRS, ETH Zurich, Ansaldo Energia, Safran Helicopter Engines and Safran Tech) with a strong involvement of industry and will include multiple secondments with network partners (including Rolls-Royce and Siemens). ESRs will receive

training in the state-of-the-art theory, high performance computing, and advanced experimental methods including high-speed laser diagnostics applied to combustion instabilities, ignition and blow-off in annular chambers.

Description of PhD position

The EM2C CNRS Laboratory is seeking a highly qualified candidate for a PhD fellowship in **experimental investigations of combustion instabilities and ignition**. The successful candidate will join the EM2C research team led by Pr. Sébastien Candel to study combustion dynamics in annular combustors.

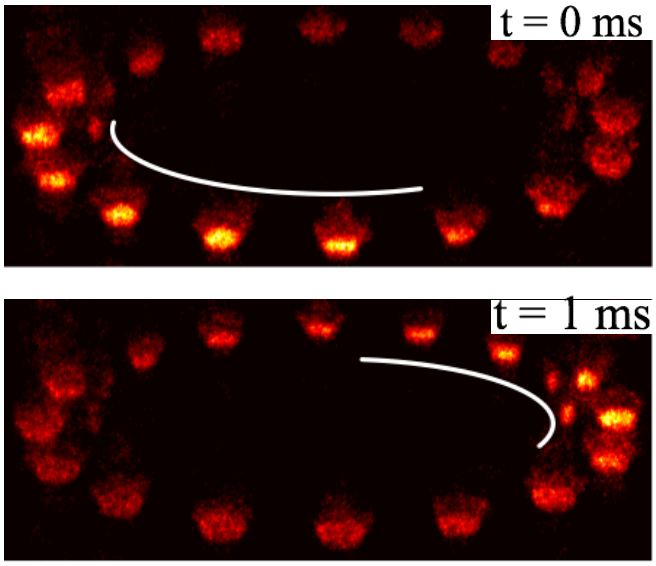

Figure 1: Azimuthal thermo-acoustics instabilities in the MICCA annular combustor [1-5]

The ESR will investigate how premixed and liquid fuel injectors affect: (A) the nature of combustion instabilities and (B) the ignition and light-round process in the MICCA annular combustor. The experimental dataset will include statistical and time-resolved measurements of the flame during various stages of ignition, light-round time-scales, and the effect of injector type on the various stages of ignition. Further analysis of the data will identify the different coupling mechanisms leading to combustion dynamics and resonant coupling with rotating and standing azimuthal modes. Measurements of Flame-Describing Functions (FDF) and of the response of individual injectors will complete the analysis of the combustor stability.

The secondment is planned at TUM to investigate alternative methods of FDF measurements and implement findings into low-order models

How to apply:

The starting date of the PhD position is September 2018. Send the following documents to Dr. Antoine Renaud at antoine.renaud@centralesupelec.fr before May 31st. The candidate must comply with the mobility rule (details here).

- Copy of passport
- One-page motivation letter.
  Please, specify which ESR position you are applying to (here: ESR 1).
- Copies of degree and academic transcript (with grades and rankings)
- One-page summary of master's thesis
- Your CV with names and contact details of at least two referees
- Reference letters sent separately by the referees
- Proof of English language skills

Stipend: For the present position in France, the ESR gross salary is **2550€ per month** (family allowance not accounted for).

[1] **J.-F. Bourgouin, D. Durox, T. Schuller, J. Beaunier, and S. Candel.** *Ignition dynamics of an annular combustor equipped with multiple swirling injectors. Combustion and Flame, 160(8):1398 – 1413, 2013*

[2] **J. F. Bourgouin, D. Durox, J. P. Moeck, T. Schuller, and S. Candel.** *A new pattern of instability observed in an annular combustor: The slanted mode. Proceedings of the Combustion Institute, 35(3):3237–3244, 2015.*

[3] **D. Laera, K. Prieur, D. Durox, T. Schuller, S. M. Camporeale, and S. Candel**. *Impact of heat release distribution on the spinning modes of an annular combustor with multiple matrix burners. Journal of Engineering for Gas Turbines and Power, 139(5):051505–051505–10, 01 2017.*

[4] **D. Laera, K. Prieur, D. Durox, T. Schuller, S. Camporeale and S. Candel** *Flame describing function analysis of spinning and standing modes in an annular combustor and comparison with experiments. Combustion and Flame. 184, 136-152, 2017.*

[5] **K. Prieur, D. Durox, J. Beaunier, T. Schuller, and S. Candel.** *Ignition dynamics in an annular combustor for liquid spray and premixed gaseous injection. Proceedings of the Combustion Institute, 36(3):3717– 3724, 2017.*

[6] **K. Prieur, D. Durox, T. Schuller, and S. Candel.** *A hysteresis phenomenon leading to spinning or standing azimuthal instabilities in an annular combustor. Combustion and Flame, 175:283–291, 2017.*