Ph.D Fellowship

Flame acceleration and transition to detonation (FAsTD) in narrow channels

Laboratory: D2: *Département Fluides, Thermique et Combustion*; Équipe: *Détonique*

PhD advisors: Josué Melguizo-Gavilanes; Ashwin Chinnayya

Background and objectives: The materialization of a hydrogen (H_2) economy calls for a thorough practical and fundamental understanding of the risks associated with its production, storage and handling[1]. Accidental combustion events typically include a wide range of phenomena such as ignition (shock-, thermally-, jet- or spark-induced), flame propagation and acceleration, flame-obstacle interactions, shock formation, shock-flame interactions, transition-to-detonation, and detonation propagation. They cover all possible flow regimes from laminar to turbulent, from diffusion driven (flames) to shock driven (detonations) combustion waves, with important physical and chemical processes occurring across more than six orders of magnitude in spatial and temporal scales. Among the phenomena listed above, deflagration-to-detonation transition (DDT) is the most fascinating! From a scientific point of view, DDT is an outstanding, physics-rich fundamental problem in combustion science. From a practical perspective, it is important to study and understand DDT in order to develop engineering correlations and simulation tools that can be applied to propulsion[2], and the prevention and mitigation of explosions[3]. **The ultimate goal of the project is to facilitate the global energy transition by fostering the role of H_2 while understanding, from a fundamental standpoint, the risks associated with its widespread use, in particular the risk of DDT in narrow geometries**. The strategy put forward for this aim is based on integration of novel experiments and visulization techniques, numerical simulations and mathematical analysis to give a clearer picture of the phenomenon. The Ph.D student will come to support the experimental component of the ANR JCJC project FAsTD, and will have access to a unique facility in which the 3-D characterization of DDT is possible. While most of the successful candidate's time (80%) will be devoted to assessing the applicability of current velocity and gas temperature measurement techniques in DDT scenarios, she/he will also be expected to contribute to the development of experimentally informed numerical/mathematical models that provide complementary information that is difficult to obtain experimentally. **If you are in for an intellectually challenging and rewarding journey, Apply now!**

Applicant profile/pre-requisites: strong background in fluid mechanics, thermodynamics, heat transfer and chemistry. Affinity with experimental work, attention to detail, analytical and critical thinking skills. Candidates with experience or keen on compressible flow visualization/optics, experimental data analysis and image post-processing will be given priority.

Additional information: the starting date of fellowship is October 1, 2021 for a duration of three years. Applications (CV + motivation letter) should be sent via e-mail before May 17, 2021. Monthly salary: 2135 EUR gross (1715 EUR net)

Contact: Josué Melguizo-Gavilanes, Ph.D
CNRS Research Scientist
josue.melguizo-gavilanes@cnrs.pprime.fr

[1] Sharma, S. & Ghoshal, S. K. (2015) Hydrogen the future transportation fuel: from production to applications. Renewable and Sustainable Energy Reviews, 43, 1151–1158.

[2] Wolański, P. (2013) Detonative propulsion. Proceedings of the combustion Institute 34(1): 125-158.

[3] Ciccarelli, G., & Dorofeev S. (2008) Flame acceleration and transition to detonation in ducts. Progress in Energy and Combustion Science 34.4 : 499-550.