

Internship opportunity

Title: Broadband Modulated Absorption/Emission technique vs. two color pyrometry: application to a flame spreading in microgravity over a coated wire

Terms: Applicants should be motivated individuals and pursue a graduate degree in Chemical or Mechanical Engineering and/or Physics.
The position is expected to start from Spring 2019 and will last 11 weeks.

Contacts: Guillaume Legros, Associate Professor – Sorbonne Université
email : guillaume.legros@sorbonne-universite.fr
web: <http://www.dalembert.upmc.fr/home/legros>

Augustin Guibaud, Ph.D. student – Sorbonne Université
email : augustin.guibaud@sorbonne-universite.fr

Topic context: The main objective that drives the current projects dealing with spacecraft fire safety is to create a comprehensive data set to enable a suitable paradigm for fire safety in spacecraft and space infrastructure. To face this challenge within the context of the future manned mission to Mars, a topical team gathering experts from ESA, NASA, JAXA and ROSCOSMOS, has started working on the definition of a complete series of demonstration and validation experiments. These experiments must capture the fundamental science of ignition, spread and extinction of a flame in both normal and microgravity and enable demonstration of the fire sensing and growth prediction tool that will be developed along the project. The experimental investigation aims for a final validation data set gathered in-situ through a series of large-scale experiments that are being designed for the Cygnus Spacecraft. The French contribution, lead at Sorbonne Université, is especially focused on the radiative heat transfer attributed to soot from the flame to the burning surface.

Scientific objectives: The internship objective is the assessment of the discrepancies in terms of soot volume fraction and temperature that are measured by either the Broadband Modulated Absorption/Emission (B-MAE) technique or two color (2C) pyrometry. While the former has been fully developed within the context of the aforementioned project at Inst. d'Alembert,^{1,2} the latter can also be operated processing the frames delivered by the B-MAE technique.³ From the recordings of flame spreading over the LDPE coating of a wire in microgravity, the fields of soot temperature and volume fractions given by both techniques will be contrasted.

Expected progress: The student will join a team of experimentalists to set up the post-processing required by the 2C-pyrometry. The experimental core of this work is DIAMONDS (Detection of Ignition And Mitigation Onboard for Non-Damaged Spacecrafts),⁴ a rig developed at Inst. d'Alembert (Sorbonne Université) that allows the study of a flame spreading over the coating of electrical wires.

References:

- ¹ A. Guibaud, J.-M. Citerne, J.-M. Orlac'h, O. Fujita, J.-L. Consalvi, J.L. Torero, G. Legros. Broadband Modulated Absorption/Emission technique to probe sooting flames: implementation, validation, and limitations. *Proc. Comb. Inst.* 37:3959-3966, 2019.
- ² A. Guibaud, J.-M. Citerne, J.-L. Consalvi, O. Fujita, J.L. Torero, G. Legros. Experimental evaluation of flame radiative feedback: methodology and application to opposed flame spread over coated wires in microgravity. To appear in *Fire Technol.*, 2019.
- ³ Q. Wang, G. Legros, M. Yao, W. Cai, L. Jiang. Optical measurements of temperature fields in sooting flames: influence of soot self-absorption. *Appl. Phys. B* 125:63, 2019.
- ⁴ Webpage dedicated to the project: <http://www.dalembert.upmc.fr/home/legros/index.php/publications>