Title : **Plasmas for energy and aerospace applications**

Acronym : D1

EU Coordinator : Christophe LAUX, Laboratoire d'Énergétique Moléculaire et Macroscopique, Combustion (EM2C)

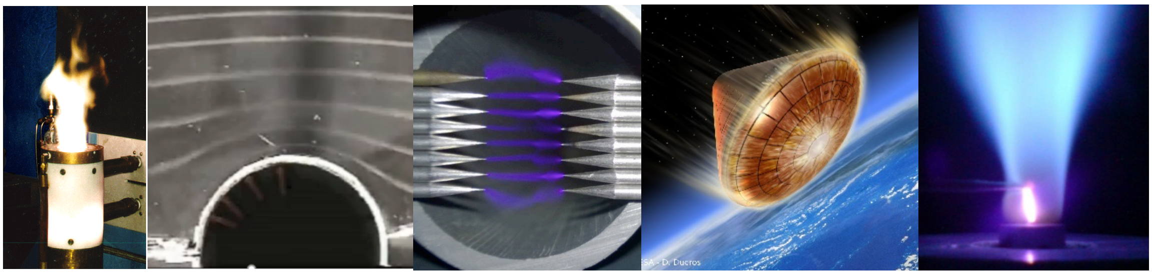
Teaching staff :Christophe LAUX, Paul-Quentin ELIAS, Denis PACKAN

Pre-requisites : First year of MSc in Physics or Engineering Schools.

Credits : 3 ECTS

Language : French/English

Keywords : Energy conversion, plasma-assisted combustion, ionic wind, air treatment, atmospheric reentry, propulsion.



From left to right: plasma torch of the EM2C laboratory, plasma-assisted flow control (Stanford), nanosecond discharge in cold air, planetary entry (D. Ducros, ESA), plasma-assisted combustion (EM2C)

The objective is to understand the principles and physical models of cold plasmas based on application examples in the fields of energy and aerospace. Recent advances and scientific and technical challenges are presented. The course alternates between a review of the basic principles and models and practical examples.

Program

1. Introduction to applications of cold plasmas.
2. Generation of plasmas: discharge types and reactors – DC discharges – AC and pulsed discharges (RF, MW, DBD, plasma jets, nanosecond discharges).
3. Fluid equations – Conservation equations–Drift-diffusion –Transport properties: mobility, free diffusion, ambipolar diffusion, electric conductivity, dielectric permittivity.
4. Two-temperature kinetic mechanisms. Generation of weakly ionized air plasmas.
5. Application A: DC and nanosecond discharges in air.
6. Application B: electro-hydrodynamic effects, ionic wind.
7. Application C: plasma-assisted combustion.
8. Application D: introduction to atmospheric reentry. Radiative flux on spacecraft during atmospheric entry.
9. Application E: absorption, reflection of waves. Blackout.
10. Application F: plasma propulsion.