

INTERNSHIP PROPOSAL

Laboratory name: Laboratory of Physics of Plasmas
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Internship location: Ecole Polytechnique, Palaiseau
Thesis possibility after internship: YES
Funding: YES If YES, which type of funding: ANR

Plasma Shchelkin sPiral: Initiation of DEtonation by nanosecond dischaRge (SPIDER)

Scientific context

How do detonation waves arise? Can they be suppressed when they are dangerous - or harnessed when they are useful? From next-generation Pulsed and Rotating Detonation Engines to catastrophic explosions and even supernovae, detonation physics spans engineering, safety and astrophysics. The challenge is fundamental: what triggers a detonation, how does it become self-sustained, and, the most important, how can we control it? In this M2/PhD, a new approach is suggested to be explored: using pulsed nonequilibrium plasma to control the initiation and propagation of detonation waves. The PhD project is experimental and will be carried out at two sites: plasma physics and laser diagnostics in Paris, and detonation experiments in Poitiers. Particular attention will be paid to the link between plasma-induced chemical reactivity and detonation cell size, as well as to the role of the Zeldovich gradient mechanism in the transition from deflagration to detonation. Advanced laser techniques as TALIF, E-FISH, Thomson scattering will be used to control plasma parameters. Close collaboration with CERFACS will provide, on the basis of complex 2D and 3D-numerical modeling, an access to parametric study and better understanding of conditions of the experiments.

Profile and skills required:

The selection criteria for students are as follows: excellent knowledge of physics/quantum mechanics/engineering, intellectual capacity, ability to generate ideas to solve problems, ability to make decisions, interest in experimental work, basic programming skills, English at B2 level, responsibility.

Positioning and funding

This M2/PhD project is 100% funded within the research project SPIDER financed by French National Research Agency (ANR). Starting in 2027, SPIDER involves three partners: the Laboratory of Plasma Physics (LPP) at École Polytechnique near Paris, the Pprime detonation laboratory near Poitiers, Dr. Pierre VIDAL, and CERFACS (European Center for Advanced Research and Training in Scientific Computing), Dr. Omar DOUNIA, in Toulouse. Collaboration with Cambridge Combustion Center in Singapore (Dr. Victor LAFAURIE) is planned.

Please, indicate which speciality(ies) seem(s) to be more adapted to the subject:

Condensed Matter Physics:	YES	Soft Matter and Biological Physics:	YES/NO
Quantum Physics:	YES/NO	Theoretical Physics:	YES/NO