PhD Position
« Control of turbulence in rectangular pipe flows. Application to the cooling of Ultra High Intensity laser amplifiers »

Project summary

The domain of Ultra High Intensity lasers (UHI) has experienced a dramatic development these years, thanks to the discovery of the CPA technique invented by the Nobel laureate Gerard Mourou. We can now consider multi-petawatts lasers at high repetition rate, provided that we can master thermal effects. Indeed, if each laser pulse has a modest energy (10 J for a commercial laser PW today), the high repetition rate results in the heating of the amplifiers, so that only forced convection can evacuate the heat generated in the amplifiers. Moreover, as the thermal conductivity of amplifier crystals is higher at low temperature, cryogenic cooling allows to optimize the homogeneity of the temperature in the amplifier crystal, as well as, sometimes (in the case of Yb-doped crystals), it permits to improve the efficiency of the laser. In the case of a "multislab" amplifier, the laser beam passes through the amplifiers and the cooling flow. It is therefore crucial to master and control the turbulence of the flow: indeed, if the turbulence improves the energy transfer between the amplifier and the cooling fluid, it could degrade the quality of the laser beam by scrambling the phase.

Therefore, this PhD project addresses the problem of the control of a turbulent flow between the amplifier slabs. During this PhD we will explore different situations, most often relevant to the cooling of laser amplifiers (in cryogenic conditions, but not only...), also closely related to the onset and control of turbulence in pipe flows, and in boundary layer flows. Thus, in this essentially CFD thesis, we will study different situations, between these two extremes: (i) the situation in which we try to enhance the turbulence by devices arranged upstream of the amplifiers; and (ii) the situation where, on the contrary, it is sought to delay as much as possible the onset of turbulence in the flow, by paying particular attention to the inlet conditions, and possibly by passive devices such as SSH or LEBUS. The numerical simulations will be based on the Direct Numerical Simulation (DNS) of the Navier-Stokes equations, through an in-house massively parallelized Fortran code. From this study we expect to determine the potential impacts of passive devices to enhance the turbulence set-up in the entry zone of a channel, and, oppositely to prevent the turbulence by SSH and LEBUS. More details will be sent on request (contact Sedat.Tardu@legi.grenoble-inp.fr).

Location and practical aspects

The successful applicant will be hosted by the laboratory LEGI (http://www.legi.grenoble-inp.fr/web/) in the “EDT” team. He/she will work under the supervision of Sedat Tardu from LEGI, in collaboration with Olivier Doche from SIMAP and Alain Girard from SBT_CEA.

The gross salary will be 1787 euros/months, equivalent to a net salary of 1414 euros/month (for 36 months).

Qualifications of the applicant

The applicant should have good knowledge in Fluid Dynamics and Turbulence (Master_2 level) and present skills and interest in computational fluid dynamics.

Applications

Interested candidates should send their CV, motivation letter, transcripts with ranks and reference letters to Sedat.Tardu@legi.grenoble-inp.fr Deadline for the application: 1st July 2020.

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