PhD position in Prisme Laboratory – DC9 -

Experimental characterization of ignition of liquid ammonia spray under high pressure and temperature by means of optical diagnostics.

Secondment : WINGD

Keywords (for the job offer): hydrogen and ammonia atomization and combustion, optical diagnostics

https://dt-hats-msca.eu

DT-HATS – Digital Twins for Hydrogen and Ammonia injection and ignition in engines for Transport Systems

Context:

The current PhD thesis is part of a new MSCA-Doctoral Network project DT-HATS (Digital-Twins for Hydrogen and Ammonia injection and ignition in engines for Transport Systems), (which is going to start in November 2025. The involvement in this Doctoral Network has as objective, To train excellent researchers, been the ultimate objective of DT-HATS, with the aim to educate them with the most up-to-date knowledge in scientific aspects bridging experimental fluid dynamics, physical chemistry and cutting-edge simulation methods, as well as the H2 and NH3 business environment leading to the rapid penetration of zero-carbon fuel technologies and products to the market and thus, enhance their employability skills. The DCs will be supported by specialised training courses offered by the participating institutions: soft-skill seminars, workshops and conferences, two training summer schools and knowledge exchange with the members of the network through secondments and webinars.

Subject:

This PhD subject is in the context of ammonia internal combustion engine. By considering direct liquid ammonia injection, flash-boiling process is one key parameter which strongly affects the spray atomisation. Even if more and more studies are focused on it, the prediction by CFD simulation remains insufficient. The development and validation of models, requires well-described experimental database.

This PhD subject will first perform a comprehensive investigation of the atomisation, mixing and ignition processes of liquid NH3 injected under high-pressure conditions relevant to ICE by using single and multi-hole GDI injectors. As in most of cases, ammonia as the unique fuel remains very difficult H2 is considered as the main ignition promoter. Therefore, the effect of H2 addition will be also studied as a function of injection parameters. For that, one rapid compression machine (NEW ONE Shot Engine (ECM Test

Benches | Orleans University) up to 60 b/900 K with optical access will be used. At least Several optical techniques will be used (SLIPI, rapid imaging, PIV, Schlieren, LIF…) first to quantify droplet dispersions and spray geometrical characteristics. The second part will concern the compression ignition of NH3-H2 by using chemiluminescence (OH* and NH2*) as a function H2 content and different T-P values. Due to the high heat of vaporization of ammonia and the high auto-ignition temperature, no auto-ignition is expected without H2 addition.

The project of this Phd Student will be complemented by a secondment in WinGD (Switzerland) for 4 months, an marine engine company to evaluate the effect of the size on the mixture preparation process. Moreover, this project is fully complementary to another PHD student, for Univ Stuttgart.

Candidate's desired scientific discipline : Mechanical engineering

Specific skills required: Master in Fluid Mechanics: combustion, turbulent flows; optical diagnostics

Good level in English: ability to read articles and exchange orally on a daily basis and with the other partners of the DN.

Specificities:

Doctoral candidates may be of any nationality, but as PRISME is Restrictive Regime Zone (ZRR), final acceptance will be subject to access authorisation issued by the Senior Defense and Security Officers.

They must not hold a doctoral degree at the date of their recruitment, and they must comply with the mobility rule: they must not have resided or carried out their main activity in the country of the (first) recruiting beneficiary for more than 12 months during the 36 months prior to the date of their recruitment.

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