M2 Internship in PC2A (CNRS/ULille)

Implication of the introduction of hydrogen on the safety of gas turbines

Because of the share of thermal power plants in the worldwide energy mix, the mitigation of the effect of power generation on the emission of greenhouse gases is of timely importance. The use of "green" hydrogen as a fuel is widely regarded as one of the impactful existing solutions to preserve the production of electricity in the short-term. It is therefore the subject of combustion studies that evaluate the impact of hydrogen addition on the fundamental combustion properties, such as burning velocity, pollutant formation or ignition delay.

In the high pressures and moderate temperatures representative of the auxiliaries of gas turbines, one must ensure that adding hydrogen does not result in increased safety risks. The wide flammability limits, high laminar burning velocity can indeed be problematic when flame conditions are created. To evaluate this possibility, a collaborative study has been initiated between the PC2A laboratory and General Electric.

During this internship, the selected candidate will perform experiments using the ULille Rapid Compression Machine to measure the ignition delays of blends of natural gas and hydrogen in well-controlled conditions representative of the auxiliaries of gas turbines: high pressures, temperatures below 1000 K, and wide mixture compositions ranging from very fuel-lean to highly fuel-rich. The obtained experimental results will be compared to simulation results obtained using the state-of-the-art kinetic models from the literature, to demonstrate which model is the most valid in such conditions, and propose improvements to such models.

Keywords: Hydrogen, natural gas, ignition delay times, combustion, gas turbines

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About PC2A

PC2A (Physico-Chimie des Processus de Combustion et de l'Atmosphère) is a joint laboratory of the CNRS and the University of Lille, in which transdisciplinary research has been performed for more than 60 years in the fields of combustion and atmospheric chemistry. Based on a strong interaction between experimental and modeling work, the researchers in PC2A crave at building better understanding of the science behind the challenges of the current society, such as clean and safe energy, and the mitigation of, and adaptation to climate change.