Press Release
27 July, 2016

Taking *Combustion* to extreme high-pressure levels

Last July 22, researchers at the Hypersonic Plasmas Laboratory (HPL), one of the research facilities within Instituto de Plasmas e Fusão Nuclear (IPFN), achieved for the first time the laser ignition of a combustible mixture of helium/hydrogen/oxygen ($He/H_2/O_2$) at very high pressures.

Increasing the performance of combustion engines (both internal combustion and cryogenic rocket engines) mandates using more energetic combustibles such as hydrogen, at increasing combustion pressures. Combustible ignition systems have to be effective in this high-pressure range, and high-intensity pulsed lasers have recently been introduced as viable alternatives to spark ignition systems, with several exploratory research programs underway.

This is the first successful experiment in Portugal. In Europe, only a similar experiment has been carried in Austria so far (Vienna University of Technology, 2005). The High-pressure combustion chamber available at HPL (depicted in Fig. 1) is a world-class facility capable of delivering combustible mixtures of $He/H_2/O_2$ mixtures with filling pressures up to 100 atmospheres, and post-combustion pressures exceeding 600 atmospheres. It has been filled with a stoichiometric 8:2:1 $He/H_2/O_2$ mixture with an initial pressure of 20 atmospheres, and ignition of the mixture has been achieved through the focusing of a millisecond pulse of an Nd:YAG laser. A post-combustion pressure of 150 atmospheres has been recorded (see Fig. 2).

This experiment will allow developing a laser ignition system for a combustion-driven shock-tube (the ESTHER facility). Further technological applications of this research program include the improvement of hydrogen internal combustion engines, and cryogenic propulsion engines for Spacecraft propulsion.

Future laser ignition experiments at IPFN are scheduled to be carried at higher pressures, enabling further insight high-pressure laser ignition physics and technologies. If successful, we will be achieving pressure-ranges never before achieved in any other experimental facility in the World.

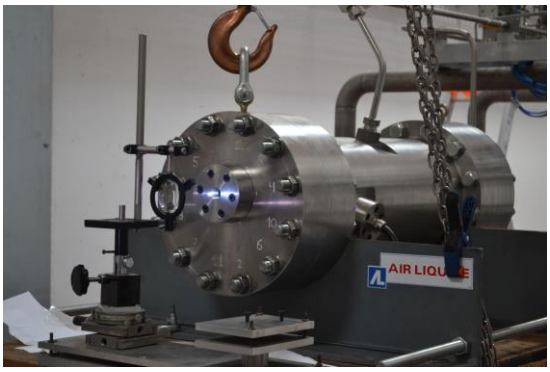

Fig. 1 – Combustion chamber at HPL

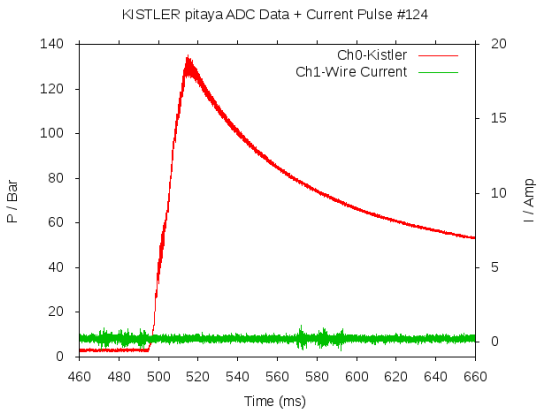

Fig. 2 – Post-combustion pressure


Fig. 3 – Researchers at HPL

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