International Zeptosecond Exawatt Science and Technology Scientific and Socio-Economic Outlook IZEST Fall Meeting, November 2017, INP Orsay

Extreme light is one of the most exciting domains in the laser field today. It relies on the generation of ultra-high peak power obtained by delivering the energy over a short time. Today, laser peak power exceeds typically the PW or thousand times the world grid power. The ability to produce and focus this gargantuan power over a size 10 times smaller than a hair offers unfathomable possibilities in science, technology, medicine and is a harbinger to a floodgate of socio-economic applications.

France is a well-established academic and industrial leader in lasers. Under the initiative of the Ecole Polytechnique, we proposed 10 years ago to the EU and Ile de France the construction of a Pan-European Infrastructure capable to generate the highest peak power ever produced and explore laser mater interaction at the highest possible intensities with the aim to carry out fundamental research and promote new societal applications. The infrastructure research within the framework of the 10 PW project named Apollon is currently performed on the plateau of Palaiseau.

While the LULI has the responsibility of implementing Apollon, IZEST was created in 2011 to be the prospective branch with the aim to look beyond the horizon set by ELI in terms of peak power and average power. IZEST is also looking at novel applications in science and engineering.

During the conference we described the most avant-garde laser concepts under development to segue from the petawatt to the exawatt, giving access to extremely short time structures down to the attosecond-zeptosecond regime. Pulses will be so short that the highest peak power in the x-ray regime could be reached with a modest amount of energy in the joule level yielding intensities in the Schwinger regime enough to materialize light.

The intensity of the X-ray pulse could generate gargantuan accelerating gradients in solids enough to accelerate electrons over a centimetre to the TeV level or relativistic protons widening the range of applications in subatomic physics, cosmology, vacuum physics and the like.

IZEST is always seeking new applications for the lasers they develop. For example, a few years ago, we proposed as new laser (ICAN) XCAN that could deorbit millions of small debris circling around the globe. The first test could be on the Space Station.

The infrastructures are now halfway through completion. As the initiator of both projects, ELI and Apollon, the EcolePolytechnique has carried out a study to gauge the socio academic impact of these world-class projects at all levels, regional, national and international. The conclusion of this report made at the meeting was one of the conference highlights.