Short introduction to the conference of Prof. Gérard Mourou from May 20, organized by the Institute of Atomics Physics (IFA) – Bucharest – Magurele

Cristian FLOREA – physicist, HDR at Sorbonne
Professor of Applied Physics at ESIEE – University Paris East
The e-mail address: cristian.florea@univ-paris-est.fr

During the last two decades, we realized a series of important progresses in the field of increase of laser power. Thanks to short impulses, it is now possible to obtain powers of 1000 TW = 1 PW (1PW = 10^{15} watts) and more. N.B. such a power is obtained with a relatively compact laser and it is clearly superior to the worldwide electrical power. This type of ultra intense laser allows, for the first time, for the relative intensities to be reached. It is about accelerations of the « ponderable » matter represented by particles of non-null repose mass that reach in the end in a space of only a few meters, a speed close to the celerity of the light in vacuum. This new physics engenders some fundamentally new effects. This physics will have, without any doubt, a major interest for humanity.

My distinguished colleague and friend, Gérard MOUROU is the scientist who perfected in the ´80-ties the CPA (Chirped-pulse Amplification). The CPA performs, during a first stage (step), an extraction of the light from a laser fascicle. This step is followed by an important power amplification: this amplification is performed in an efficient manner because of the extraction of light. A third and the last step is represented by a strong compression of the fascicle. This succession leads in the end to an enormous increase of the laser power.

I would like to enumerate a few examples of the applications which are evoked during Gérard's expose.

i) Studies of the structures: the light of the relative optics (which is seldom named <<extreme light>>) is a source of X and gamma rays: the interaction of the extreme light with the matter produces fascicles of X and gamma rays which can be used in order to probe the metal parts such as the landing gears of the planes, the hull of a ship and the port infrastructures, the strength structures of buildings, the oil distilleries, the metallurgical furnaces, the road infrastructures such as suspended roadways and bridges…

ii) Study of tension for the mechanical parts highly stressed: the extreme light can be used in order to produce the ultra-short impulses (of thousand of THz). These ones have been used to measure the thickness of the oxides on the turbine blade of the plane engines, of the ship's helix or the excavation blades for the tunnels or the petroleum shafts.

iii) The processing without producing any damages at nano and even pico scale: the extreme light allows the processing without producing any displacement at nanometrical scale and even picometrical. (N.B.: present studies)

iv) The temporary resolution of the solid-liquid phase: for a while, we have the possibility to produce X-ray impulses (10^{-15} s = a millionth of a billionth of a second) perfectly synchronized with a visible impulse. This allowed us to make a temporary study of the phase changes (passage from short order ↔ long range order, passage that is followed in real time).

v) Optical self-guidance: the extreme light may be self-directed. It propagates long distances compensating the diffraction. It allows for the circulation of strong intensities in the distance. A typical application is LIB (Light Induced Breakdown) which allows the analysis of the materials' composition on thousand of meters of distance. The civil and military applications are far to be exhaustive.

vi) Pollution study: this study is also valid in a civil application environment type as well as for military applications.

vii) Treatment of cancer: the ultra-relative lasers open a new way in the treatment of the cancer malady (proton therapy).

viii) The treatment of nuclear wastes: the same ultra-relative lasers used in the exo, yotta and zepta fields could bring a credible and unanimously-accepted answer for the treatment of radioactive wastes that are and will be adopted in mass by the industries of the developed countries obliged to face the latest energy crisis that largely excelled the strict frame of the answer to the menaces traditionally called « energy crisis ».

ix) The « exotic » physics: the creation of particles « starting from vacuum »

x) Astrophysics and the physics of the Universe: exploration in the terrestrial laboratories of the universe troubled by « black holes ».

The generations of scientists from 19^{th} and 20^{th} centuries asked countless questions and they even, brought a few answers that are far to be satisfactory. The physicists were among the pioneers of this step both Socratic and Descartian. The moment has come that the scientists of our generation to synthesize all the steps in order to make available for the future generations a start to the answers of the issues that we knew so well to formulate without knowing how to solve all the time.

Associate our scientific efforts with the worldwide efforts of the human communities that confront themselves systematically with the issues of our epoch, represents a step which is part of a great spiritual inheritance of Europe. Work together in order that France and Romania reunite once again their efforts in their common European history, represents an extraordinary opportunity. At the same this step excels the frame of the opportunism: it represents a duty and an honor. I state this in the hope to make myself understood, in an epoch when the words have seldom been used instead of clothes in order to cover the nudity of so many bizarre ideas.