MITIGATION OF ELECTROMAGNETIC PULSE GENERATED IN SHORT-PULSE LASER EXPERIMENTS

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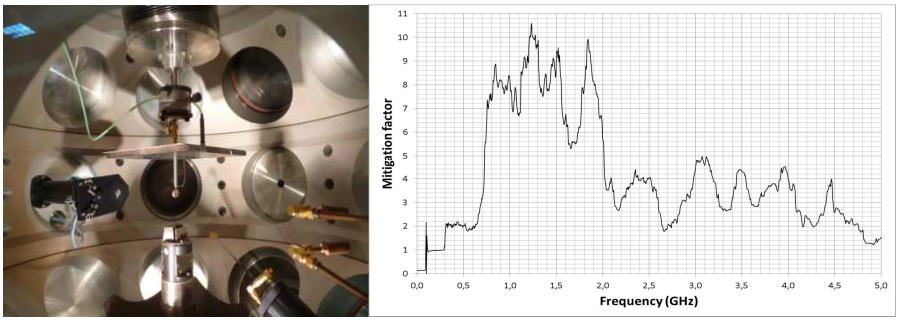
Short-pulse laser experiments on high energy facilities reveal a phenomenon which did not attract much attention at lower intensities. This is the generation of a strong electromagnetic pulse (EMP). The interaction of laser of class Petawatt with a flat target can produce intense electric field [1] which may exceed 1 MV/m. Such a field leads the equipment failures, may damage the diagnostics and produce spurious signals in detectors.

As part of PETAL project[1], we have developed a calculation chain, 3D, multi-scale, multi-physics, in order to identify the EMP generation mechanisms. The basic principles can be described as follows [2]. The laser-pulse accelerates plasma's electrons at the target surface. They spread in and out of the target creating an electric potential at the surface. This potential is a barrier that the electrons must overcome to escape. The number of escaped electrons defines the net positive charge left on the target. The return to balance is realized by the means of a discharge in the target holder. Finally, the set [target + target holder] acts as a dipole antenna.

From this analysis, we have defined, by numerical simulation, new mitigation concepts of the electromagnetic pulse without any local protection of shielding type. An experimental campaign dedicated to validation of these concepts has been conducted on the EQUINOX laser facility[2]. at low energy of 100 mJ, pulse duration of 80 fs and an intensity of 10^{18} W/cm^2. We succeeded to reduce the EMP by a factor of [6-10] for different concepts. Higher energy (100 J) tests are planned on the LULI 2000 laser facility[3] with 1 ps pulse duration.



[1] "Analysis of EMP measurements in the NIF's chamber", Brown & al., EPJ 59, 2013.
[2] "Target charging in short-pulse-laser experiments", Dubois & al., Phys. Rev. E 89, 2014.

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