Evolution of fast electrons generated during interaction of high intensity laser with structured targets

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Interaction of high-intensity laser pulses with solid targets results in generation of large quantities of energetic electrons that are the origin of various effects such as intense x-ray emission, ion acceleration, and so on. Some of these electrons are escaping the target, leaving behind a significant positive electric charge. The electrons that are accelerated in the backward and forward directions are ejected from the target in vacuum, thus creating a potential drop in the Debye layer at the target surface.. The cooling process through collisions with the surrounding particles defines the maximal time of the target charging and existence of the accelerating potential. It is then important to conduct temporally resolved measurements capable of predicting the residual charge (thus the potential and its temporal profile) of a target irradiated by a short intense laser pulse.

Our, recent measurements related to the field enhancement conducted on FLAME laser will be presented. We realized a spatially - resolved Electro Optical Sampling by using a ZnTe crystal and a laser-probe directly split from the pump laser. Such solution allows monitoring temporal profile (with resolution < 100 fsec). in a non-intercepting and a single-shot way, the field generated by electrons bunch. By analyzing the signal intensity we retrieved the bunch Coulomb electric field, allowing retrieving the temporal profile and the quantity of the escaped electrons and demonstrated the field enhancement process by structured targets. In the case of the planar foil target, the signal shows the presence of a first emitted bunch with charge $\mathbf{Q}_e$ ~1**.** 2 nC and energy 6 MeV followed by a second broadened structure carrying a larger amount o of particles ($\mathbf{Q_e}$ ~3 nC), this bunch has energy of ~ 1 MeV.. For the wedged target first bunch carries a larger charge ($\mathbf{Q}_e$ ~2 nC) while the charge in the second bunch is strongly reduced. Laser interaction with the tip target produced a much larger number of released electrons ($\mathbf{Q}_e$ ~ 7 nC) at higher energies 12 MeV.