Timepix chip interface detectors for X-rays, gammas and electrons monitor on Laser Produced Plasmas

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The physics of Laser Produced Plamas (LPPs) needs some particular diagnostic requirements. In particular the X monitor of the plasma is difficult because typically X-ray emission is concentrated in burst from few tens of ps to few ns, according to the power and pulse time width of the laser. Then a measurement of photon flux is unfeasible. For the X-ray monitor we realized the GEMpix [1], a proportional gas detector based on 3 consecutive Gas Electron Multiplier (GEM) with a front-end electronic based on four Timepix [2] chips, with 512 x 512 squared pixels, 55 micron wide. It can work in a range of X-ray fluence of 6 orders of magnitude. For LPPs, we exploit its ability to work Time over Threshold (ToT) mode: each pixel registers digital counts proportional to the total charge released in the gas. Charge can be amplified from the GEMs with a gain which can change on 4 order of magnitude, and then with a big dynamic range. However, Spatial resolution depends on the intrinsic gain, ranging from one to tens of pixels. In this work, we will present some results obtained on the Eclipse laser facility (CELIA, Bordeaux, France) [3]. Together with X-rays, other particles can be produced from LLPs, especially high energy gamma photons and electrons. In this case we characterized the new Timepix3 [4] chip, based on silicon. It is a single chip of 256 x 256 pixels with a bump-bonded 300 um thick silicon layer. Interaction of gammas with detector releases some characteristic tracks due mainly to the Compton scattered electron. Similar tracks are released by electrons. For each track we defined some parameters: cluster size, total charge (ToT mode), roundness, linearity and so on. Based on these parameters we characterized the response of the detector using some gamma and electron sources, in order to discriminate different energies. In this manner, we defined some energy bands for gamma and electron particles. Then this detector has been applied on VEGA laser facility (Salamanca, Spain) to characterize in energy of the gammas coming from laser plasma interaction. The use of a 2D detector allowed to separate the tracks, then, based on the source detector calibration and defining the track parameters, we distinguished in energy the gamma photons.

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