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Gamma photons energy measurement in Laser Produced Plasmas: a novel approach using a Timepix3 detector and Geant4-based simulations

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The plasma's X-ray monitoring in Laser Produced Plasmas (LPPs) experiments is troublesome since the X-ray emissions impinge the detector in a too short time window (from a few tens of ps to few ns,) depending on the power and pulse time width of the laser. Hence the measure of the non-integrated photon flux is a problem hard to handle. To this end, we have used the Timepix3 (TPX3) chip, in a side-on configuration, in order to get a quick estimate of the gamma photons energy. TPX3 is a single chip detector, Silicon based, 256 x 256 pixels bump-bonded with 300 μm thick silicon layer and a long side of 14 mm. Using the long side for the interaction of gammas, it is possible to obtain some characteristic tracks or pixels clusters mainly due to Compton electrons. Thanks to many different parameters that can be defined as Cluster Size (CS), Time over Threshold (ToT), Linearity, Roundness, etc. the detector response was studied and compared with some known gamma sources and some Geant4 simulations in the energy range of interest. This new approach, through a Landau distribution comparison between simulations and experimental data, allows discriminating the various energy bands for the gamma photons (also with a single experimental run provided it produces enough statistics).

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