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Gamma ray bursts from relativistic laser plasma interaction with solids

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Electrons accelerated under action of relativistically intense laser pulses onto solids produce bremsstrah-lung X-rays and G-rays. This might happen inside a bulk target or by using special convertors – thick plates of W, Ta, Au, etc. The paper discusses two issues of gamma-ray production: (i) optimization of the interaction regime by target & preplasma design and (ii) gamma-ray detection schemes with special address to a single shot gamma spectrum assessment. The latter task is of special importance with low repetition rate PW lasers such as the GSI PHELIX laser.

The first part of the talk overviews our activity on gamma-ray bursts generation using small-scale 10 Hz Ti:Sa laser facility at MSU. Maximum intensity reaches 5x1018 W/cm2 in these experiments, while nano- and picosecond (10 ps in advance) contrasts were better than 108. This was enough to exclude target sur-face damage before the main pulse arrival even for the metal plate targets. The 10 ns nanosecond laser pulse with controlled energy and advancing time was used to optimize the preplasma plume extent at the instant of the main femtosecond pulse arrival. Huge increase in the hard X-ray and Gamma-ray yields were observed at the proper prepulse & target parameters [1]. We also obtained high efficient hard X-ray produc-tion if the femtosecond pulse was stretched to a few picoseconds without changing its energy. D(g,n) photonuclear reaction was used to estimate Gamma ray flux above the reaction threshold.

The second part is devoted to the numerical simulations of experimental setup for a single shot gamma ray spectrum assessment using two different complimentary techniques: (i) multichannel filtered measure-ment with an array of scintillations detectors and (ii) secondary electron detection. The first setup is suit-able for gamma ray measurements below 10 MeV, while the second one – above this value. The GEANT4 modelling allowed us to establish optimal setup configurations in both schemes.

References

[1] K. Ivanov et al, Physics of Plasmas, 2017, submitted.

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