Hard X-ray sources using a picosecond laser driven plasma accelerator

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X-ray photon beams in the keV to MeV energy range are essential to study high energy density (HED) matter and to improve the understanding of inertial confinement fusion and astrophysical systems. HED experiments produce highly transient matter under extreme states of temperatures and pressures and it is essential to develop light sources that are: in the hard x-ray energy range (0.01-1 MeV), directional, high-yield, low-divergence, and short-duration (ps and sub-ps). In this work we show that by using a laser plasma accelerator (LPA) driven by a kJ-ps class laser it is possible to generate a broadband (0.01-1 MeV) hard x-ray source that satisfies the previous requirements. A series of experiments were conducted on the Titan laser at Lawrence Livermore National Laboratory where a >10 nC electron beam in the 10-400 MeV energy range was generated through LPA. The electrons generate x-rays via their betatron motion (few-30 keV) [1,2] and hard x-rays rays through inverse Compton scattering [3] (10-300 keV) and/or Bremsstrahlung [4] (up to 100 MeV). Due to its unique characteristics this source can be an important tool on large-scale international laser facilities opening up the prospect for many applications.

[1] N. Lemos, et al, Plasma Phys. Control. Fusion 58, 034018 (2016)

[2] F. Albert, N. Lemos et al, Phys. Rev. Lett. 118, 134801 (2017)

[3] N. Lemos, F. Albert et al, submitted to Phys. Rev. Lett.

[4] N. Lemos, F. Albert et al, Plasma Phys. Control. Fusion 60, 054008 (2018)