Improvement of neutron sources produced by ultra intense laser using a laser-triggered micro-lens

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Neutrons can provide a unique and non-destructive probe. Currently, neutron sources are limited by their flux and their temporal resolution, which is in the multi-ns range. Since several years neutrons have been produced by intense, short-pulse lasers. High-energy laser-accelerated ions interact with a catcher foil (e.g. LiF) and generate neutrons through nuclear reactions. Since the ion beams are generally broadband, the neutron source is also broadband and due to the time-of-flight separation is of long duration. To shorten the duration of the produced neutron bunch at the source, we have performed experiments at ELFIE laser facility (LULI Ecole Polytechnique) and at the LLNL JLF-TITAN laser facility. We used a laser-triggered micro lens and a pinhole to obtain a compact ion energy-selecting device upstream of the catcher. We triggered with a laser beam an hollow micro cylinder. The protons and ions passing through this cylinder are focused by a radial and transient electric field. By changing the delay between the laser producing the protons and the laser triggering the focusing fields in the cylinder, we selected the energy range of the focused protons. A pinhole that was positioned downstream from the cylinder selectively filtered protons within a certain energy range before they hit the catcher. Results from neutron-ToF detectors show a narrowing of the neutron spectrum and a shortening of the neutron pulse duration when using the micro lens.