DD fusion neutron generation from low energy, fs-laser interaction with free flowing D_2O

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Laser-Plasma Interactions (LPI) in relativistic regime can generate and accelerate high energy charged particles. These high-energy particles collide each other and trigger nuclear fusion reaction resulting in neutron production. Due to the advance in laser technology, km-size of particle accelerators shrink down to a table-top scale laser based particle accelerator.

Here we demonstrate heavy-water based neutron source. Using several-mJ energy pulses from a high-repetition rate (½ kHz), ultrashort (35 fs) pulsed laser interacting with a ~ 10 μm diameter stream of free-flowing heavy water (D_2O), we get a 2.45 MeV neutron flux of 10^5/s. In the intentionally generated pre-plasma, laser pulse energy is efficiently absorbed, and energetic deuterons are generated [1]. As laser pulse energy increased from 6mJ to 12mJ, the neutron flux increased. From the 2D particle-in-cell simulation, comparable neutron fluxes are shown at the similar laser characteristics to the experiment. Also, simulation shows forward and backward moving deuterons, which are main distributing ions impinging upon D_2O stream and vapor, respectively.

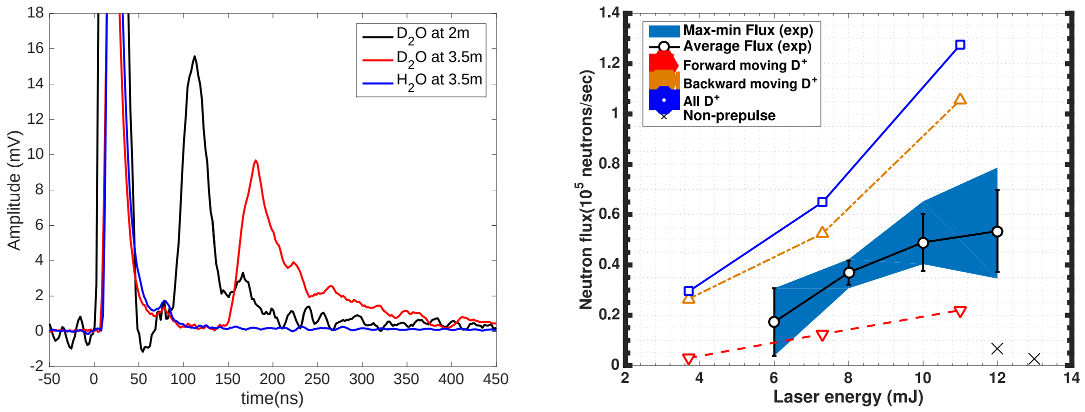

Figure 1. [Left] Neutron-ToF result from H_2O and D_2O target. Right] Neutron flux is measured (blue shaded region) by neutron bubble detectors and 2D PIC simulation (line plots) shows most of neutrons are generated from backward moving deuteron.

References
[1] J. T. Morrison *et al.*, Phys. Plasma **22**, 043101 (2015).