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Laser-driven neutron sources and their applications

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The neutron sources produced by employing intense laser-driven ion beams have recently received a great deal of attention. Intense lasers can produce 10s of MeV protons in a small divergence cone by, for instance, Target Normal Sheath Acceleration (TNSA) mechanism, which is highly efficient in producing fast neutrons via fusion reaction with low mass atomic nuclei. Employing a neutron converter in close proximity to the laser driven ion source, a beamed neutron flux can be obtained which is highly suitable for applications and further transport. While fast neutrons are useful in many applications, such as fast neutron therapy [2], material testing in fission and fusion reactor research [3], a laser driven short bursts of moderate energy (~MeV) neutrons can be efficiently moderated to thermal and epithermal region for a wide range of applications, such as imaging [4], nuclear resonance spectroscopy [5], Boron neutron capture therapy [6] etc. Characterisation of the fast and moderated neutrons produced in an experiment at Rutherford Appleton laboratory employing 100 TW Vulcan laser will be presented. In addition, proof-of-principle study on neutron imaging of static objects will be discussed based on experimental data and simulations.

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