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Recent progress in diagnostics development for laser driven fast and epithermal neutrons

Abstract:

Neutrons generated using intense laser driven ion beams has recently received a great deal of attention. Intense lasers can produce 10s of MeV protons in a small divergence cone by Target Normal Sheath Acceleration (TNSA) mechanism, which is highly efficient in producing fast neutrons via fusion reaction with low mass atomic nuclei. Employing neutron converter in a close proximity to the ion source, a beamed neutron flux can be obtained [1] which is highly suitable for a range of application, such as neutron therapy [2], material testing [3]. Laser driven short neutron bursts can also 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. A review of recent developments in neutron diagnostics made by our group will be presented. Plastic scintillators in a time-of-flight arrangement are most widely used spectrometers for fast neutrons. Absolute calibration of three types of plastic scintillators (such as EJ232Q, BC422Q and EJ410) in a time-of-flight arrangement using laser driven neutrons will be presented, which was obtained against gamma insensitive, absolutely calibrated bubble detector spectrometer fielded in-situ [7]. High flux of Epithermal neutron were produced using a compact moderator in an recent experiment at Rutherford Appleton laboratory employing 100 TW Vulcan. Spectral and spatial profiles of the epithermal neutrons were measured respectively by ^3He proportional counters and Kodak LR films backed by boron nitride sheet. The epithermal neutrons flux measured by the both diagnostics are in agreement, which is comparable to the state-of-art epithermal flux currently delivered at the sample locations in many large-scale spallation facilities.

References

1. S. Kar et. al., "Beamed neutron emission driven by laser accelerated light ions." arXiv preprint arXiv:1507.04511 (2015).
2. D. R. Welch, D. V. Rose, C. Thoma, R. E. Clark, C. B. Mostrom, W. A. Stygar, and R. J. Leeper, Phys. Plasmas 18, 056303 (2011)
3. Hawthorne, M. Frederick. "New horizons for therapy based on the boron neutron capture reaction." Molecular medicine today 4.4 (1998): 174-181.
4. Perkins, L. J., et al. "The investigation of high intensity laser driven micro neutron sources for fusion materials research at high fluence." Nuclear Fusion 40.1 (2000).
5. Anderson, Ian S., Robert L. McGreevy, and Hassina Z. Bilheux. "Neutron imaging and applications." Springer Science+ Business Media 200.2209 (2009): 987-0.
6. Sturhahn, Wolfgang. "Nuclear resonant spectroscopy." Journal of Physics: Condensed Matter 16.5 (2004): S497.
7. Hawthorne, M. Frederick. "New horizons for therapy based on the boron neutron capture reaction." Molecular medicine today 4.4 (1998): 174-181.
8. S. R. Mirfayzi, et al. "Calibration of time of flight detectors using laser-driven neutron source." Review of Scientific Instruments 86.7 (2015): 073308.

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