High-yield and high-angular-fluence neutron generation from deuterons accelerated by laser-driven collisionless shock

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Compact and bright collimated neutron sources have several applications in global security and fundamental scientific research. We study a concept of laser-driven neutron source based on the collisionless shock acceleration of deuterons in a deuterated target and the use of a Beryllium converter in a pitcher-catcher setup. This neutron source concept [1] features small neutron-source size and predominantly forward high energy neutrons that allow penetrability in shielded material. High neutron yield per Joule can be achieved in a short duration with synchronization of the optical driver providing the advantage of spatial and time precision. We discuss the characteristics of the neutron break-up reaction which motivate the choice of the acceleration mechanism, the consideration for the optimization of the laser plasma interactions and the overall scaling of the neutron yield and flux of such concept. In addition, distinction and possible control of the target normal sheath field acceleration will be discussed. The development of such laser-driven neutron sources may enable the design of next generation high precision radiography and global security applications.

References
[1] C.-K. Huang, D.P. Broughton, S. Palaniyappan, et al., 2022, “High-yield and high-angular-fluence neutron generation from deuterons accelerated by laser-driven collisionless shock,” Appl. Phys. Lett., vol. 120, no. 2, p. 024102.

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