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Recent progress of laser-driven spherically convergent plasma fusion neutron source

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Neutron sources are widely used in scientific research, industrial measurement and medical diagnostic and treatment. A proposal of producing stable high flux thermonuclear fusion neutron with laser ablated spherical convergent plasmas had been presented, and the physical processes involved have been studied and some optimizing measures have been proposed. The laser irradiates fuel layer lined inside a spherical hohlraum, the ablated fuel plasma expands and eventually converges at the sphere center, and converts most of their kinetic energy to the ion's thermal energy and triggers thermonuclear fusion. Demonstrational experiments had been done on the SGIII-prototype laser, consequent scaling experiments have been done on the ShenGuang series lasers. The fusion neutron yields generally agree with our theoretical scaling of spherically convergent plasma fusion (SCPF) at different laser energy, and scale less efficiently with longer laser laser durations due to ion-electron relaxations. Through our investigations, the SCPF scheme has shown advantages of high energy coupling efficiency, strong features of non-local-thermodynamic-equilibrium with much higher ion temperatures. Its utility as stable high flux neutron sources are under development.

References

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