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Neutron yield enhancement and suppression by magnetization in laser-driven cylindrical implosions[1]

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An externally applied, axial magnetic field can increase neutron yield in inertial confinement fusion by reducing heat losses from the compressing fuel. On the other hand, magnetic pressure is detrimental to achieving a high fuel pressure, so it must remain negligible for magnetization to be beneficial. Experiments and three-dimensional magneto-hydrodynamic simulations of cylindrical implosions on the OMEGA laser show yield enhancement of up to 60% and then yield degradation as an applied axial magnetic field is increased from 0 to nearly 30 T. The results demonstrate that maximizing the benefit of magnetization in cylindrical implosions requires the fuel convergence ratio to be limited, which requires the fuel to be preheated. The results also show that it is possible to produce a plasma with an ion temperature greater than 1 keV and a density of order 1 g/cm^3 with a magnetic pressure comparable to the thermal pressure, a new regime for laser-produced plasmas on OMEGA.

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