Multi-shell targets and current pulse shaping techniques in inertial fusion with magnetically driven liners.

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We present the results of a design study which explores the use of multi-shell targets in magnetically driven liner implosions and their potential benefits for inertial fusion. The use of nested shells of differing initial densities provides a mechanism for shock acceleration during implosion due to the discontinuity in shock impedance. This allows for relatively low velocity implosions to be used with relatively low convergence ratios. The shock accelerates as it propagates through the final shell into the DT fusion fuel. The fuel accelerates further due to convergence as it approaches the axis, producing a high temperature fuel which is then heated further as it compressed and confined by the heavy inertia of the imploding shells. This concept has been refined in recent designs for spherical direct drive targets [1], but has also been considered previously for cylindrical implosions with magnetically driven liners.

We present results from simulations using the Chimera [2] radiation MHD code of multi-shell liner implosion designs driven by the ‘Z’ generator at Sandia National Laboratory. The use of controlled current pulse shaping is explored to provide a means of generating a cylindrical ramp wave which compresses the outer shell during implosion in order to minimize the shell adiabat and control the density contrast at the point of collision with the inner shell. Other methods to sharpen the rate of pressure transfer between shells and the effective rate of current rise time using magnetic flux compression are also examined.

References

[1] K. Molvig et. al., PRL **116**, 255003 (2016).
[2] J. Chittenden *et al*, Phys. Plasmas **23**, 052708 (2016).