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Magnetized Liner Inertial Fusion[1]

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The natural geometry for magnetically driven implosions is cylindrical, but cylindrical implosions require more radial convergence than spherical implosions due to reduced volume convergence. Fuel magnetization and preheat can ameliorate this problem by reducing conduction losses and the required compressive heating. Assuming a deuterium-tritium fuel preheated to 200-500 eV and magnetized with a 10T field, numerical simulations indicate that fusion conditions could be obtained by cylindrical liner implosions driven by the Z accelerator. According to the simulations the initial axial magnetic field is compressed to more than 100 MG, which inhibits thermal conduction and the escape of alpha particles. The inhibited thermal transport allows the fuel to reach temperatures exceeding 5 keV despite an implosion velocity of only 10 cm/μs. The final fuel density is about 1 g/cc, which is high enough to axially trap alpha particles for cylinders less than 1 cm long with a purely axial magnetic field. Analytic and numeric calculations indicate that the fuel can be heated to 200-500 eV with 3-10 kJ of green laser light, which could be provided by the Z-Beamlet laser. The Magneto-Rayleigh-Taylor instability poses the greatest threat to this approach to fusion. 2D numerical simulations indicate that the liner walls must have a substantial initial thickness (15-30% of the radius) to maintain integrity throughout the implosion. Z and Z Beamlet experiments are underway to test the various components of this concept.

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