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Generating an imploding rotating plasma in MagLIF targets

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Axially rotating plasmas implode very differently than non-rotating ones since the kinetic energy delivered by the implosion is now shared between pressure and rotation, rather than pressure alone. We propose to study this approach numerically inside a MagLIF target using a cryo-DT fiber rather than a gas pre-fill. An external pulsed-power generator is used to turn the fiber into a plasma. When the plasma has filled completely the liner, it is imploded by a much larger driver, such as the Z-machine. The rotation is initiated via $J \times B$ forces when a vertical magnetic field is present. Analytically, one can illustrate that for a given uniform B_z, and $B_\phi(r, z)$, a nontrivial J_r and J_z will be retrieved via Ampere's law. As a result, the MHD equations in 2D cylindrical geometry yield a rotational velocity dependent on both B_z and $B_\phi(r, z)$. Starting from the analytical solution, we assess how much rotation is expected in a MagLIF-like target. Then we complete our analysis by using the FLASH, a fully explicit adaptive mesh refinement code, that studies the viability of this new approach to magnetized target fusion. FLASH was developed in part by the DOE NNSA ASC and DOE Office of Science ASCR-supported Flash Center at the University of Chicago.

Author: ADAMS, Marissa (University of Rochester)

Co-authors: WEIDE, Klaus (University of Chicago); Dr TZEFERACOS, Petros (University of Chicago); GOURDAIN, Pierre (University of Rochester)

Presenter: ADAMS, Marissa (University of Rochester)

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