Development of a Compact, Fusion Device based on the Flow Z-Pinch

Univ Washington (Seattle, WA), Lawrence Livermore Natl Lab (Livermore, CA)

Project Overview

PI: U. Shumlak (UW), H. McLean (LLNL)
Co-PI: B. Nelson (UW), A. Schmidt & D. Higginson (LLNL)
UW: E. Claveau, E. Forbes, R. Golingo, A. Stepanov, T. Weber, Y. Zhang; LLNL: J. Mitrani, K. Tummel

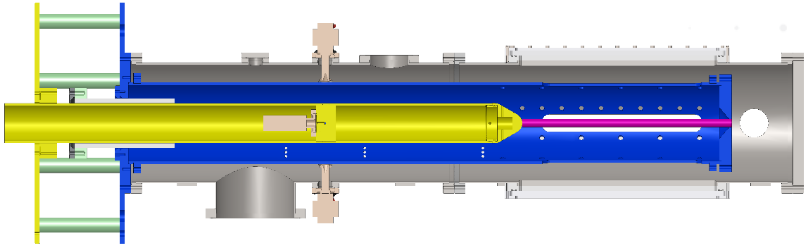
Project Objective: Answer key questions on whether the sheared flow stabilized Z-pinch concept has the potential to scale to a fusion power reactor.

- *Does SFS work at high plasma currents?*
- *Can an SFS Z-pinch be formed?*
- *Do drift/kinetic instabilities appear and limit plasma performance?*

Key Insights and Innovations

A successful SFS Z-pinch fusion device makes a compact reactor core for energy production.

- *No magnetic coils, Amenable to liquid walls, Inherently low-cost*
- *Neutron source and fusion space propulsion*

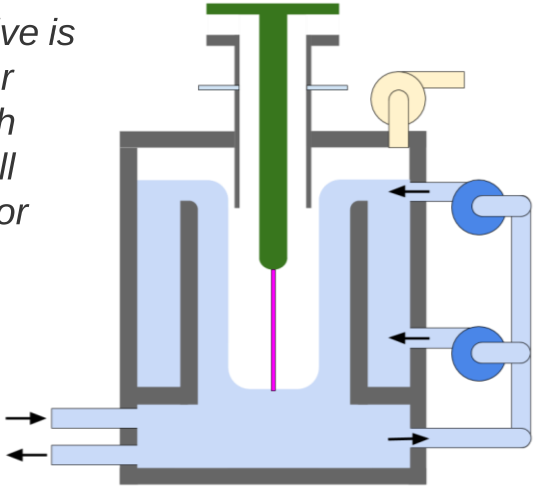


Accomplishments and ARPA-E Impact

- *Increased Z-pinch current from 50 kA to 250 kA, while maintaining stability (15,000 τ_{MHD})*
- *Demonstrated scaling of plasma parameters with increased current: $T_i \approx 2$ keV, $n_e \approx 10^{17}$ cm^{-3}, 0.3 cm (radius) × 50 cm (length)*
- *Sustained neutron production (5000 τ_{MHD}) during quiescent period, counts scale with n_D^2, 30 cm line source → thermonuclear fusion process likely*
- *By ALPHA end, further increase Z-pinch current with tailored waveform*
- *2 patents, 2 publications, 3 invited talks*

Future Plans

The next logical objective is to demonstrate a higher performing SFS Z-pinch fusion device, which will serve as a fusion reactor core.



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