SSX Capabilities for INFUSE: experiment and simulation

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In collaboration with 2-3 students (SSX experiment, MHD simulation)

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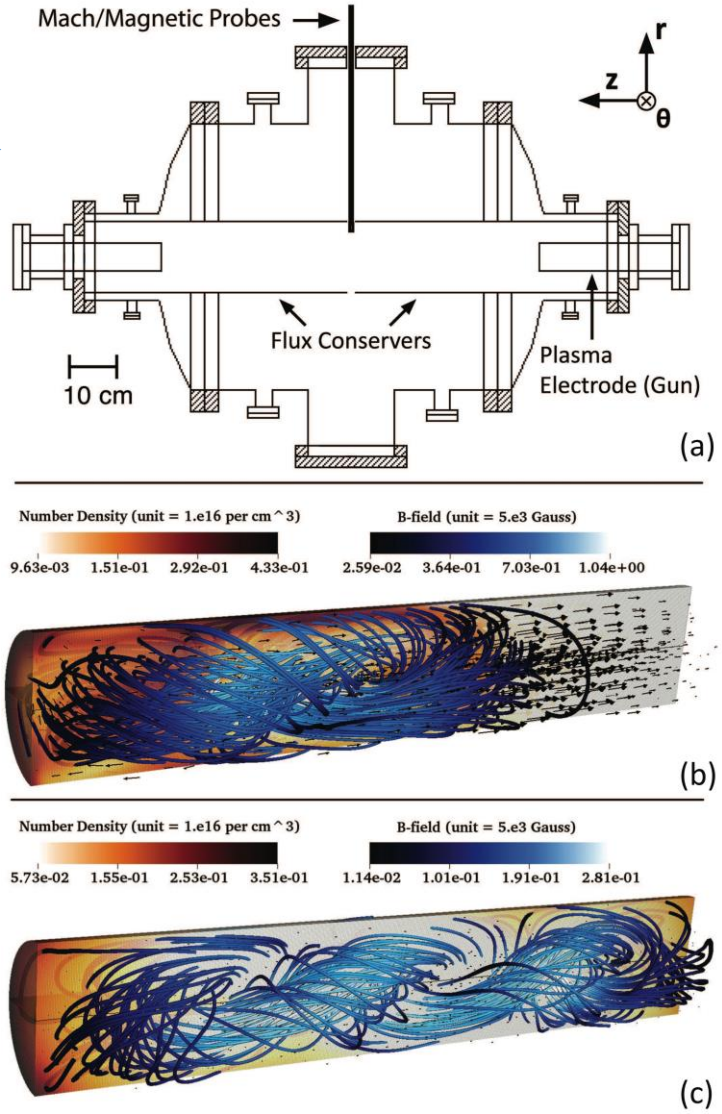
Research supported by NSF XSEDE

The SSX Laboratory

Cylindrical vacuum chamber
(D = 0.5 m, L = 1 m)

Merging plasmas
since 1994



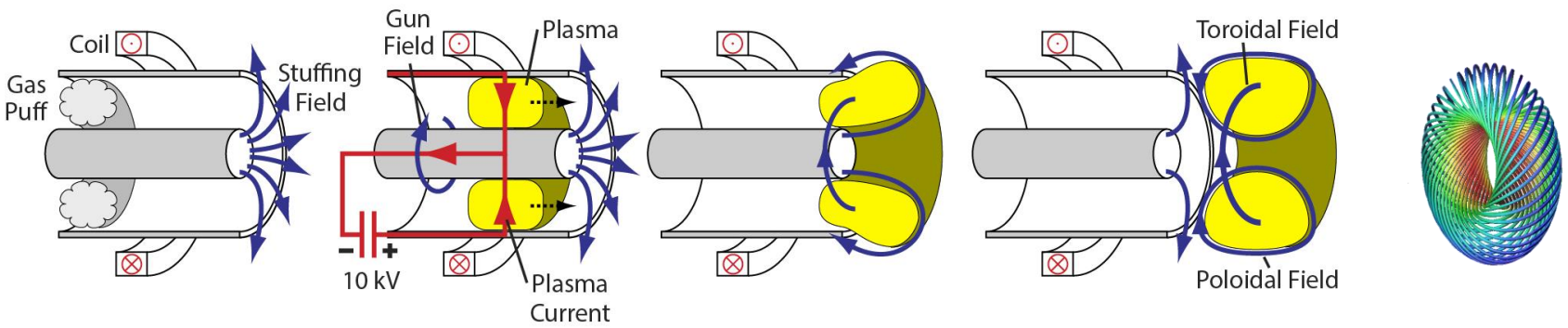
High voltage plasma
guns on each end
inject and merge
high velocity plasma plumes

10kV/100kA
Pulsed power

SSX parameters

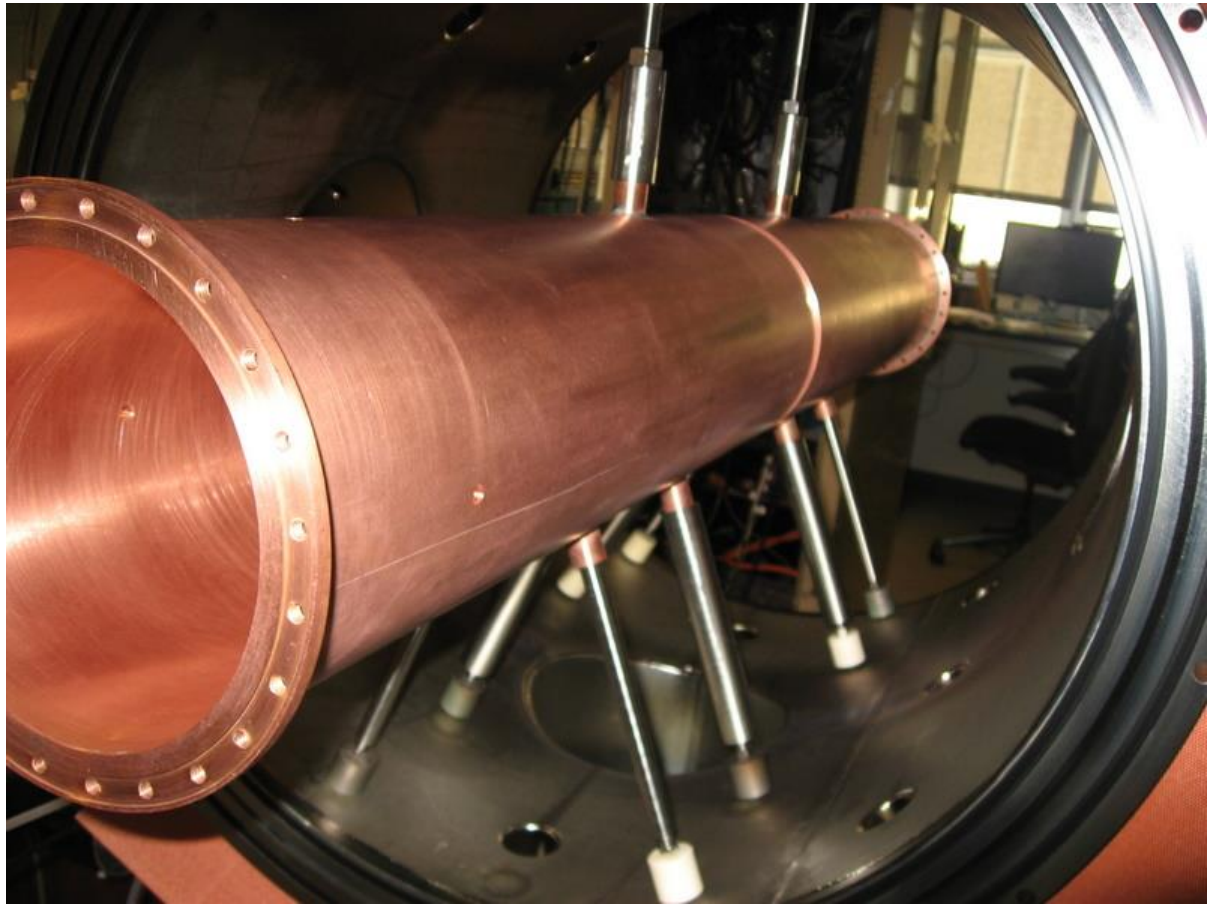
Ion Density (protons)	10^{14} -10^{16} cm^{-3}
Temperature (T_e,T_i)	20 - 60 eV
Magnetic Field	> 0.1 Tesla
Ion gyroradius	< 0.5 cm
Alfvén speed	100 km/s
S (Lundquist number)	> 1000
Plasma b	0.1-1

Magnetized plasma production



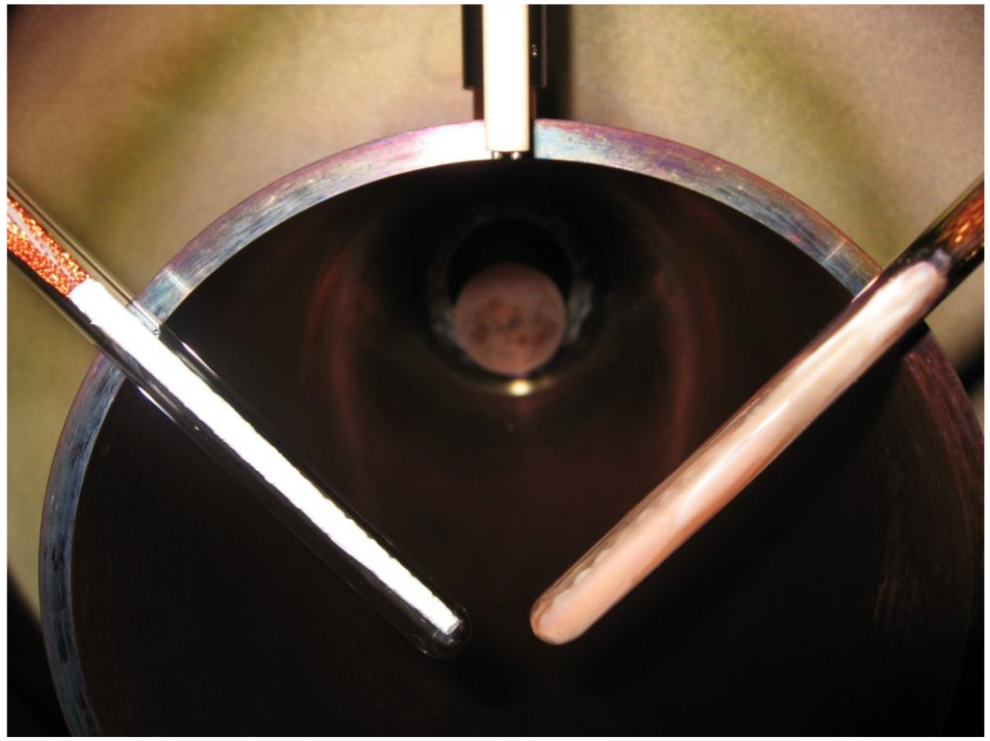
SSX MHD wind tunnel
50 km/s, magnetic and fluid turbulence

Current configuration 2022: several aspect ratios have been implemented up to 0.5 meter diameter



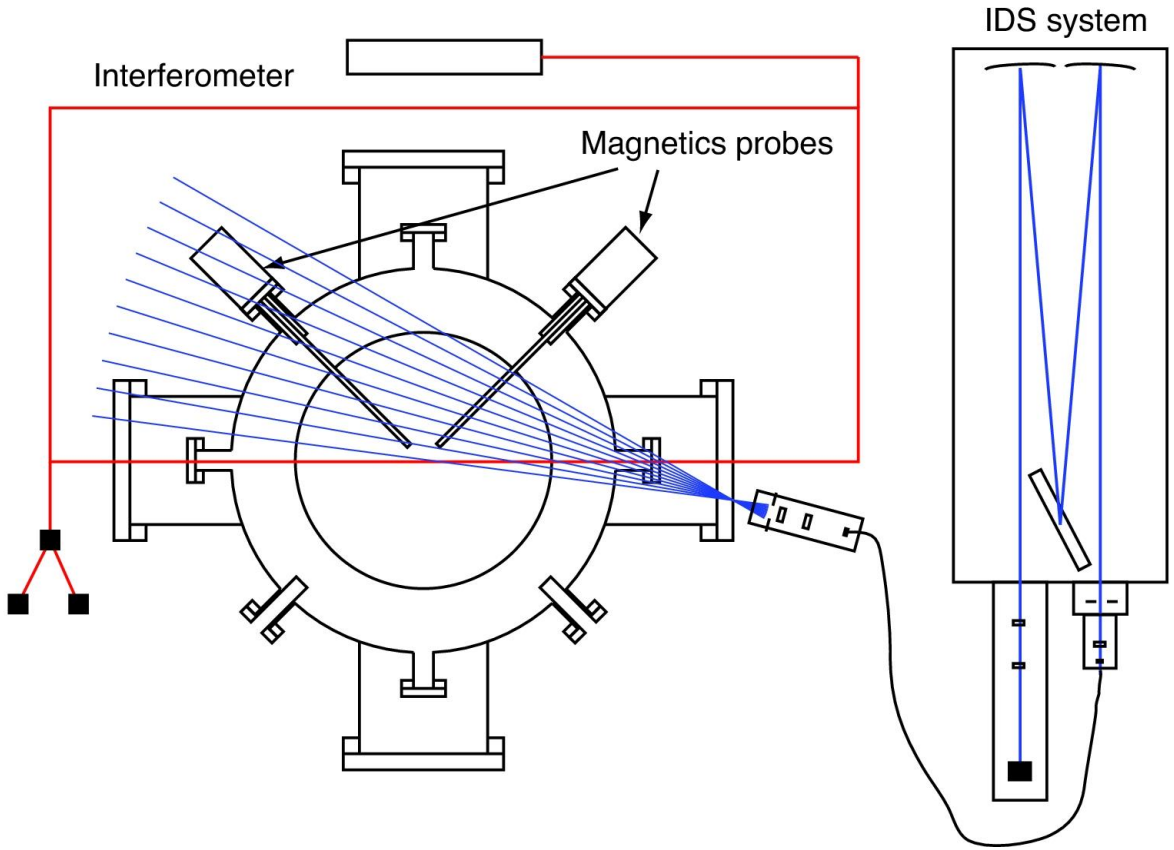
Diagnose with arrays of magnetic and velocity probes

Diagnostics at midplane (B and n_e)



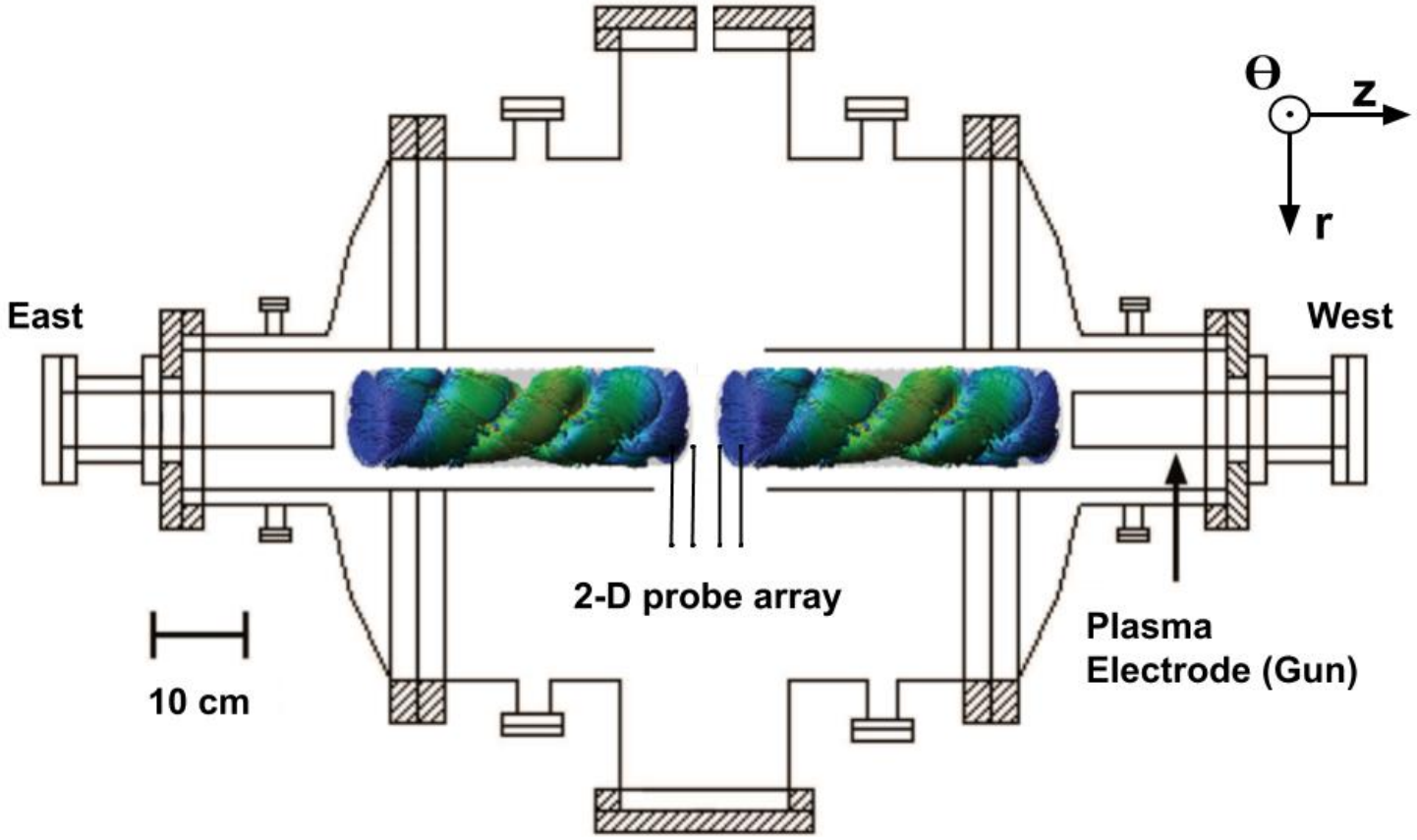
Line-averaged density with He-Ne, temperature from IDS

Ion Doppler spectrometer on SSX



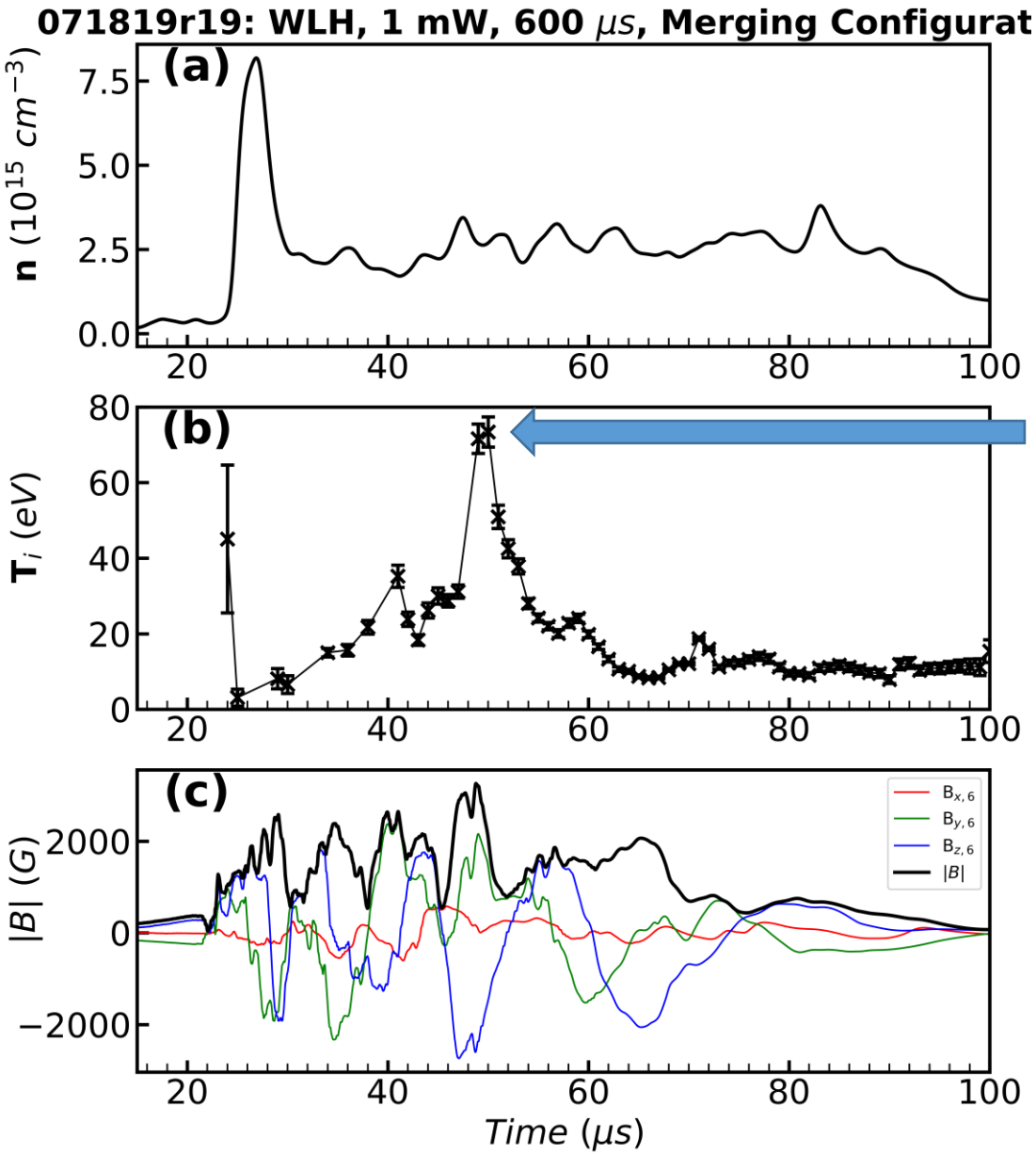
Interferometer chord and two magnetic probes also shown

Merging to generate hot plasma



Relevant for any merging fusion scheme (TAE, Helion, HelicitySpace, PJMIF)

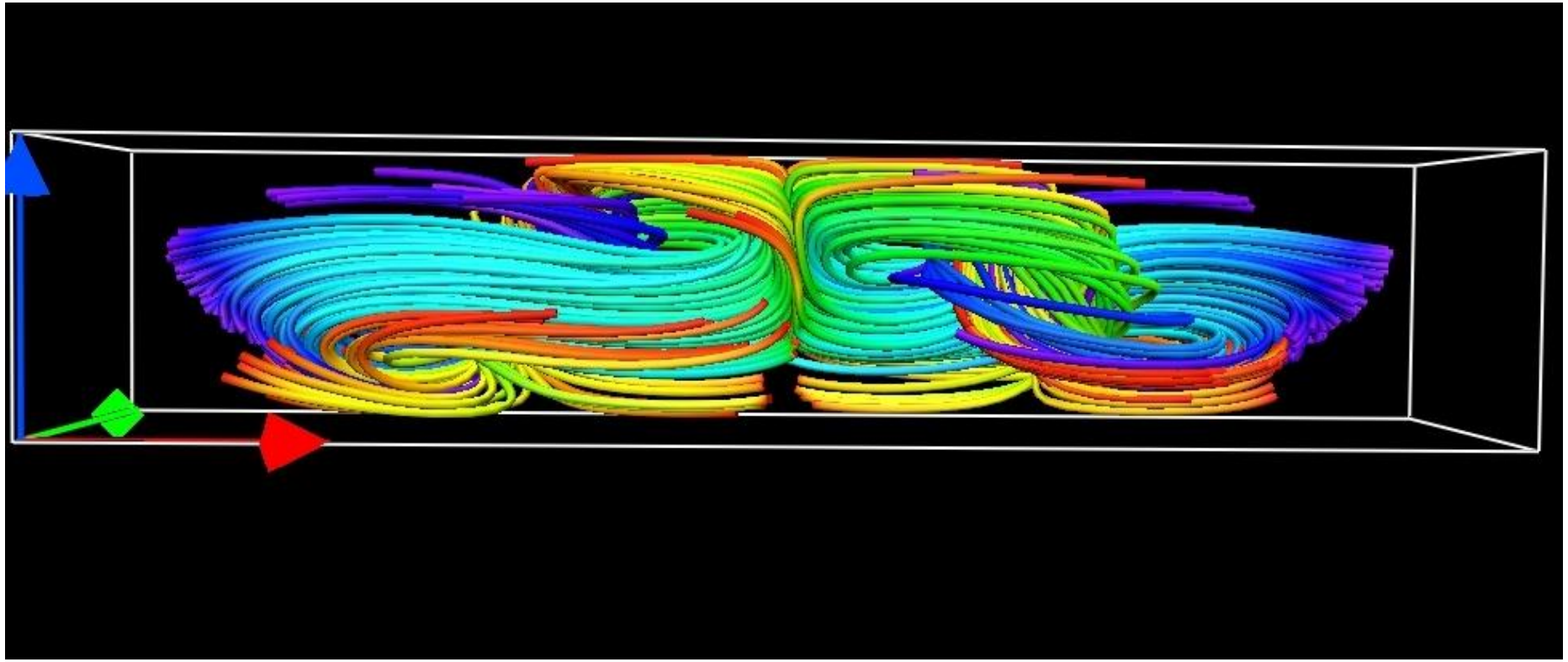
Merging to generate hot plasma



About one million K

Diagnostic capability

Recent simulation run on XSEDE PSC

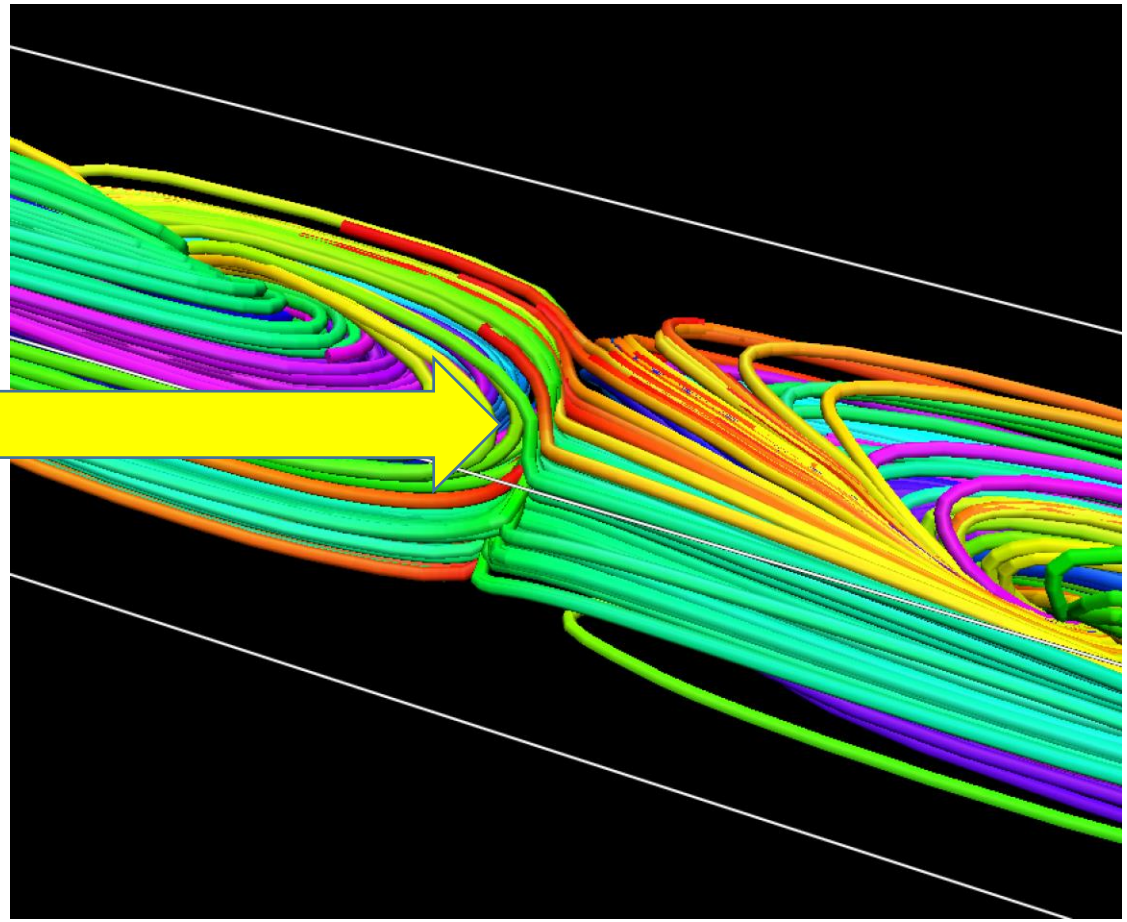


100k CPU hours = 1 Mac quad running for 1000 days

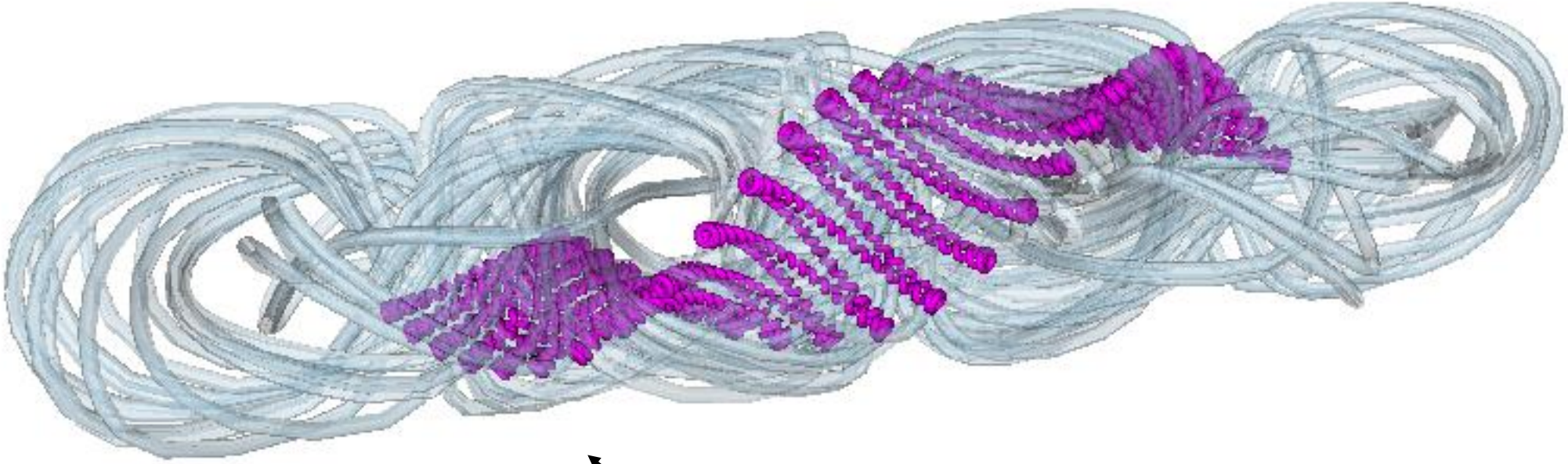
Simulation capability

MHD simulations with Dedalus

Merging layer is the location of large electric fields, plasma heating, and particle acceleration



Recent simulation run on XSEDE PSC



Proton orbit in twisted SSX fields

Possible Projects for Summer 2022

(with two or three Swarthmore students,
$5k per student plus one month for MB plus supplies)

- Supercomputer simulations of your idea using Dedalus and XSEDE:
  2.2M CPU hours to use (recently funded)

- Experimental merging studies on SSX:
  diagnostic development, testbed for new ideas with rapid turnaround

Thank you!
Questions?