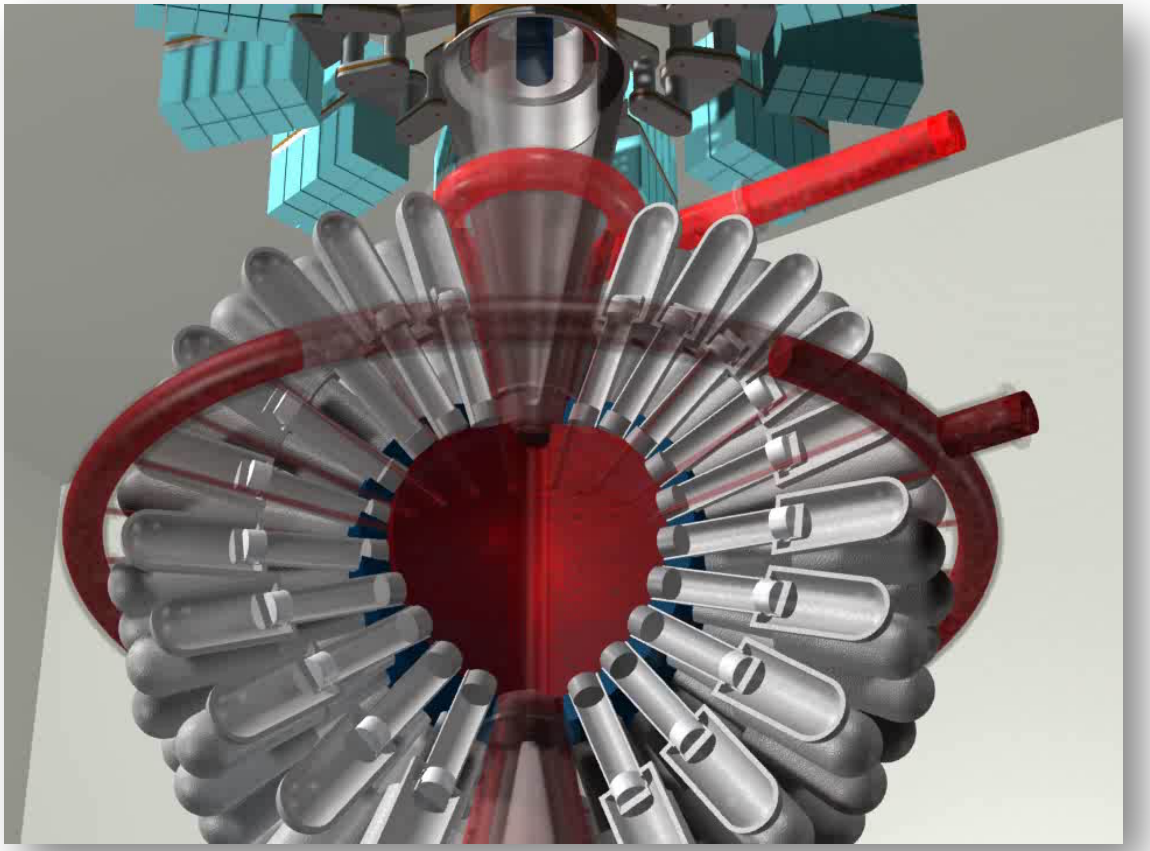

generalfusion
CT workshop 2016
generalfusion

General Fusion's Acoustically Driven MTF

generalfusion



Example Parameters

generalfusion

Initial Conditions

Pistons kinetic energy	120	MJ
Initial plasma density	1.25×10^{17}	cm^{-3}
Initial plasma temperature	100	eV
Initial magnetic field	7	Tesla
Initial plasma radius	20	cm

Compression

Radial compression	10	
Maximum fluid-plasma surface velocity	-2600	m/s
Energy transfer to plasma	14	MJ

Ignition

Peak plasma density	1.16×10^{20}	cm^{-3}
Peak plasma temperature	25	keV
Peak plasma pressure	5	Mbar
Peak magnetic field	670	Tesla
Confinement time (FWHM of plasma density):	7	μs

Energy Output

Fusion energy produced	700	MJ
Energy gain	6	

Plasma Injector

5×10^{16} cm^{-3}

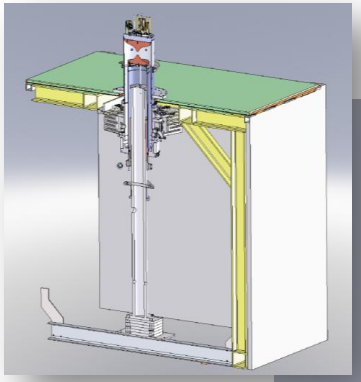
300 eV

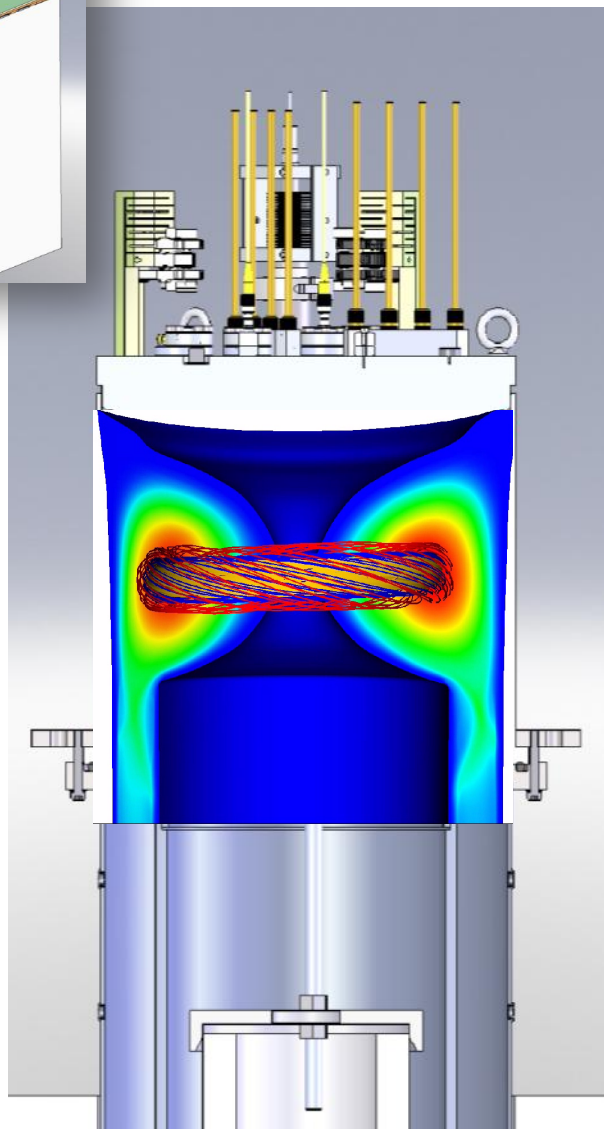
20 μs

3 T

Accelerator current damages plasma magnetic structure

Small Plasma Injector





Direct formation: no acceleration stage.

Comparable to CTX and SSPX designs

Lower maximum plasma density than large injectors

5e14 cm^{-3}, 300 eV

800 μs magnetic life,

80 μs energy confinement time

1.0 T

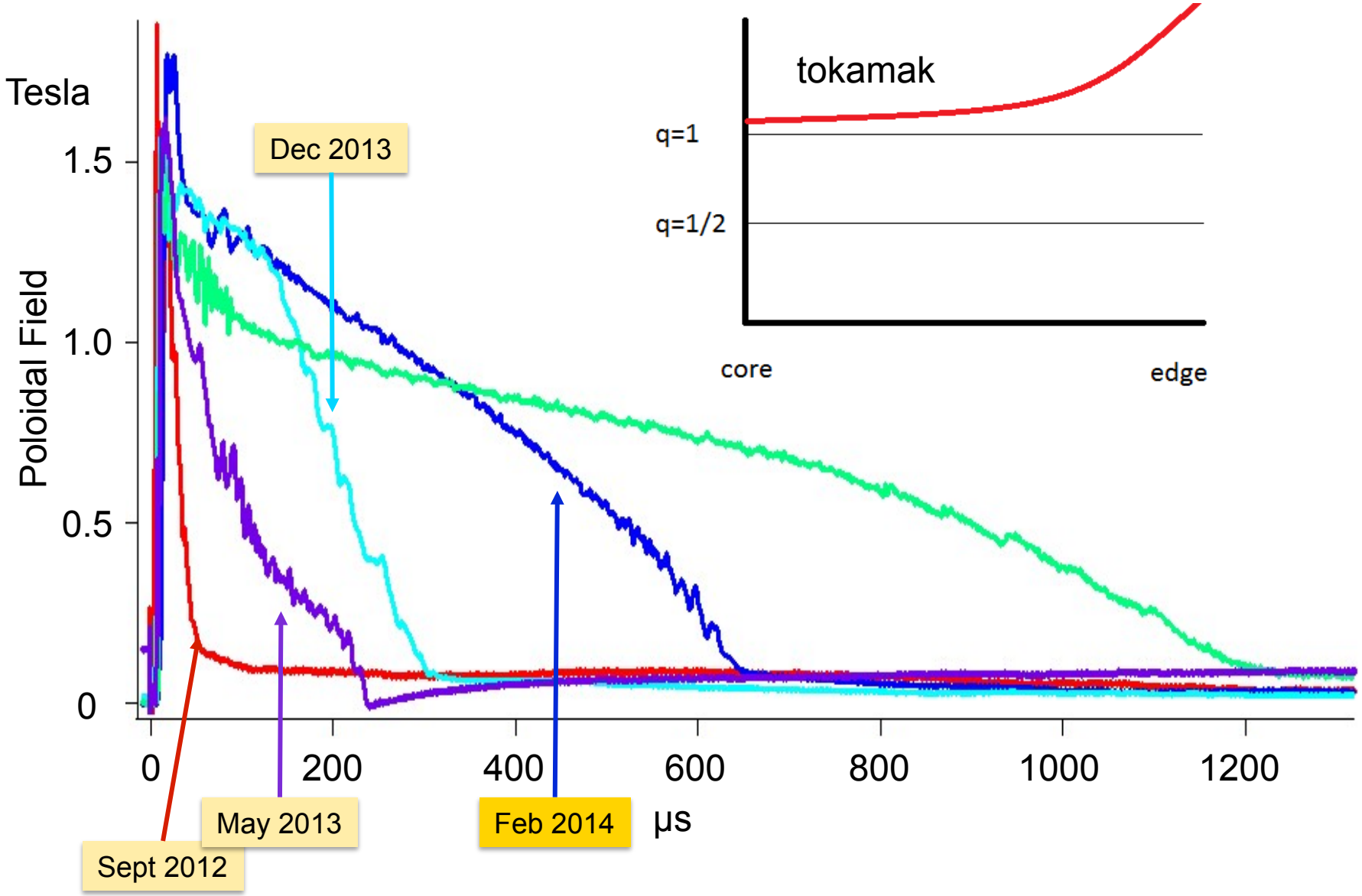
Faster design iteration

Designed for use in plasma compression experiments

Plasma Lifetime Progress

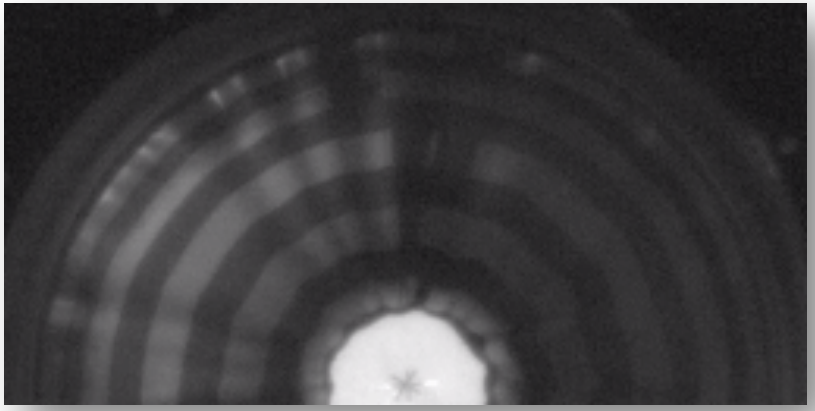
generalfusion

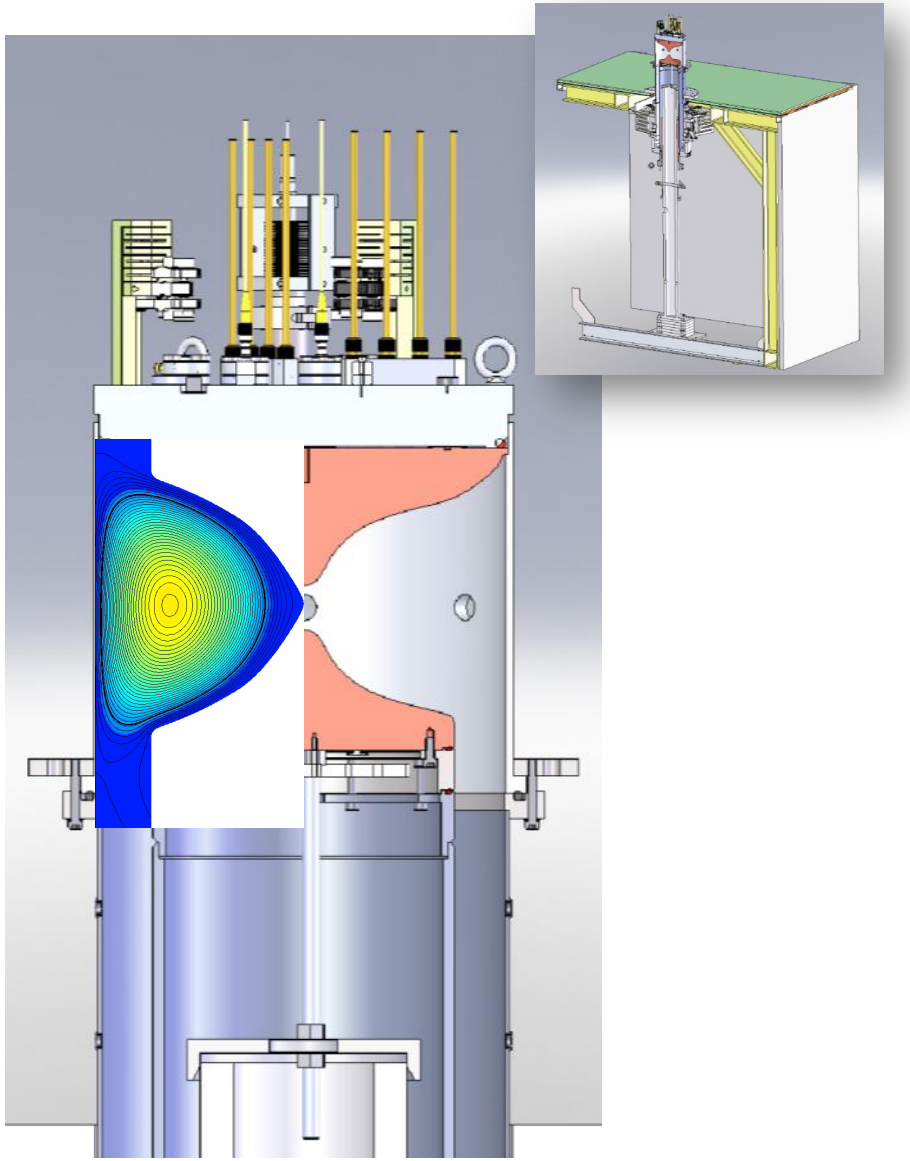
GF has created a long-lived plasma that we believe is good enough to compress.



Plasma Compression Testing

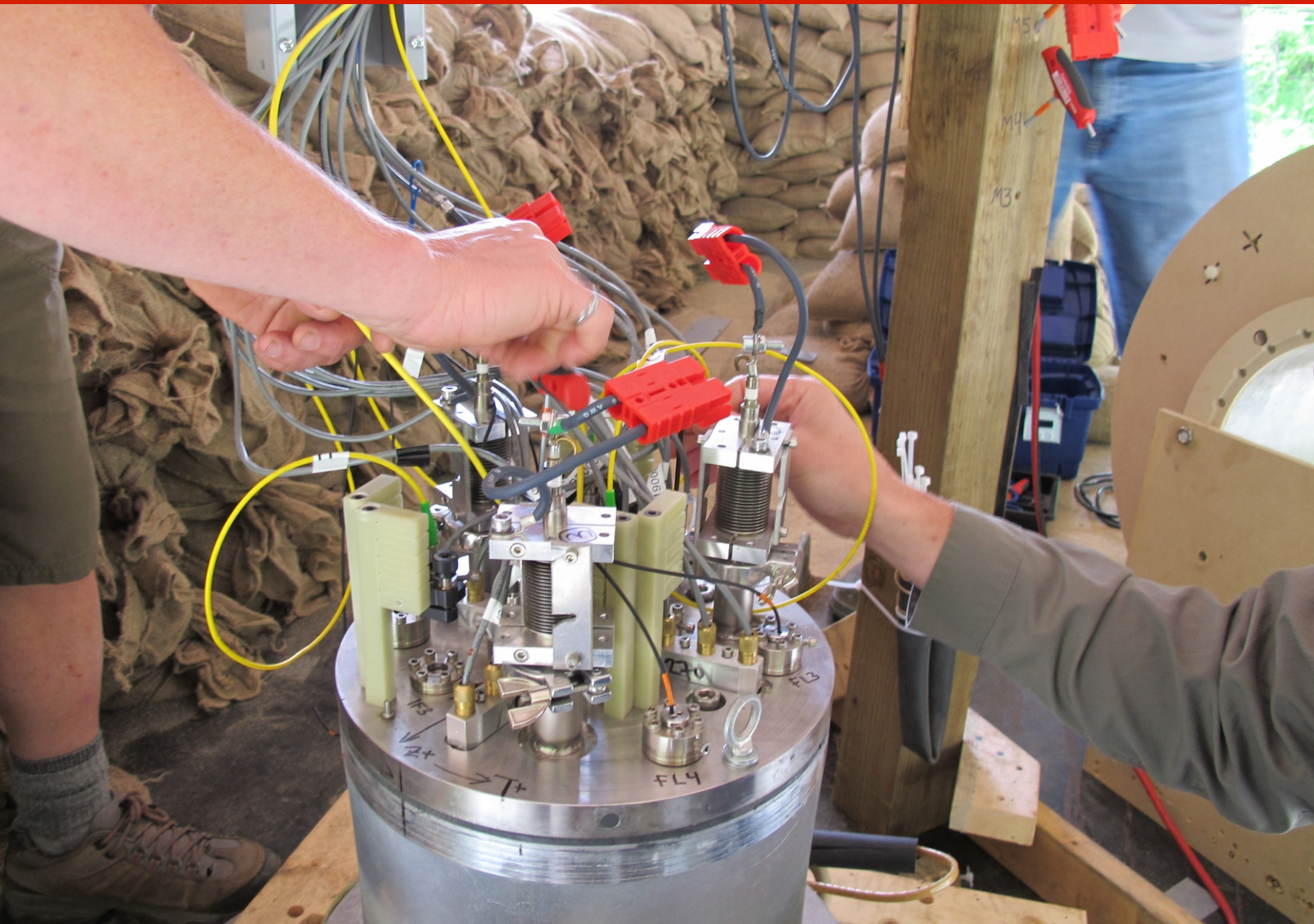
generalfusion





Diagnostics

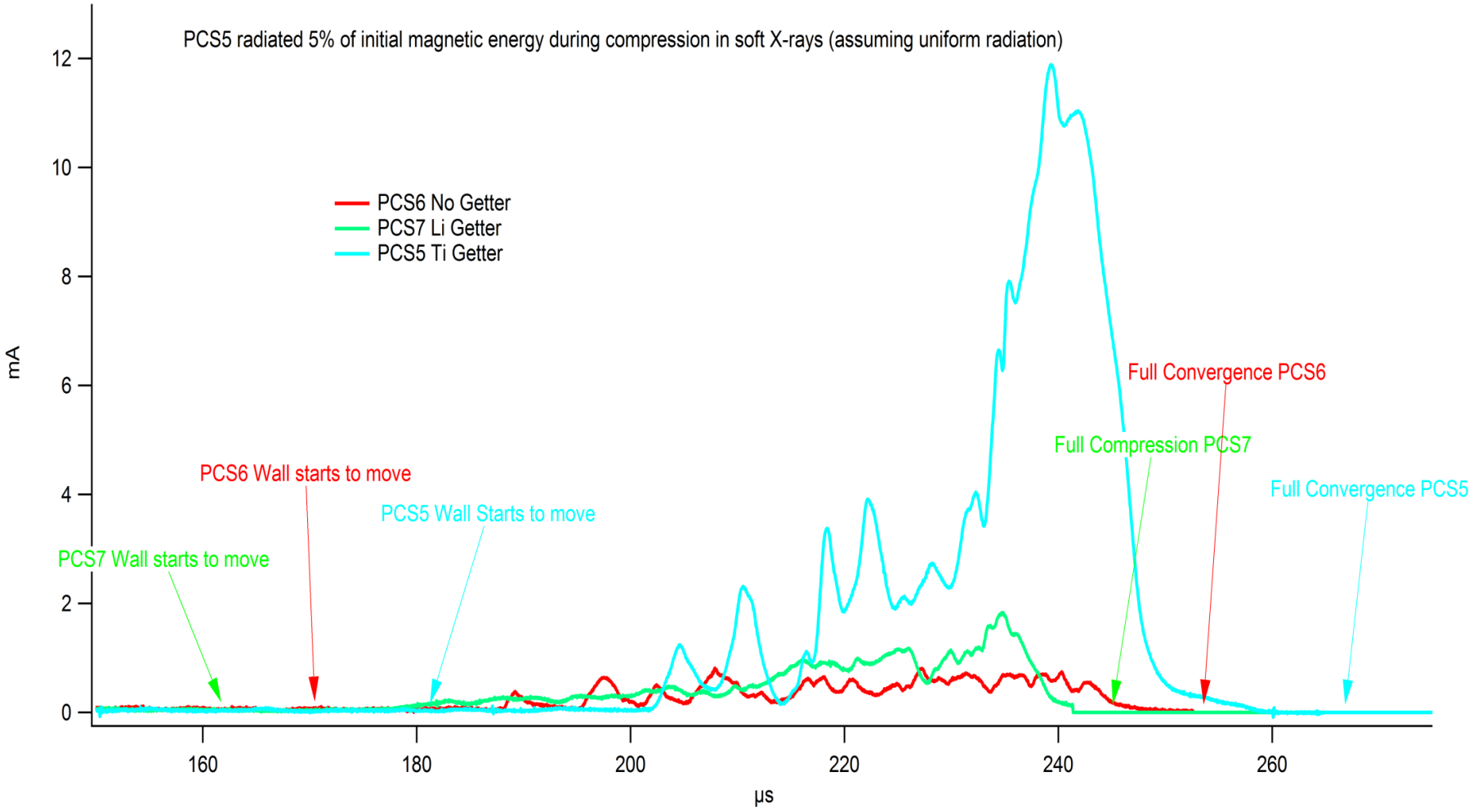
generalfusion



Fix impurity injection and radiation death

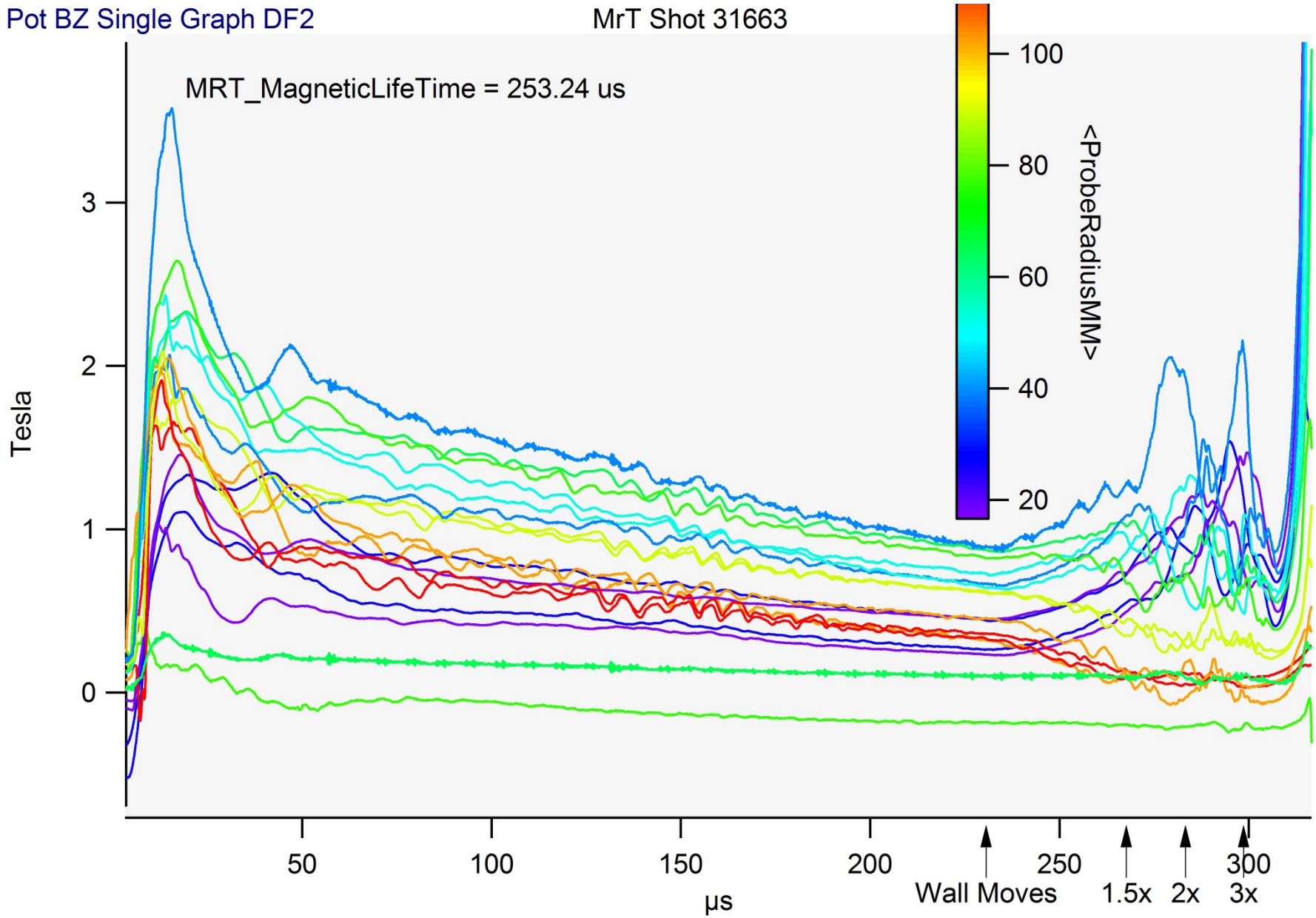
generalfusion

- Changed from Ti coating to Li coating. Lower Z. Less brittle coating
- Put a vacuum gap between the explosive and the liner. Shockless acceleration of the liner



Spheromak compression

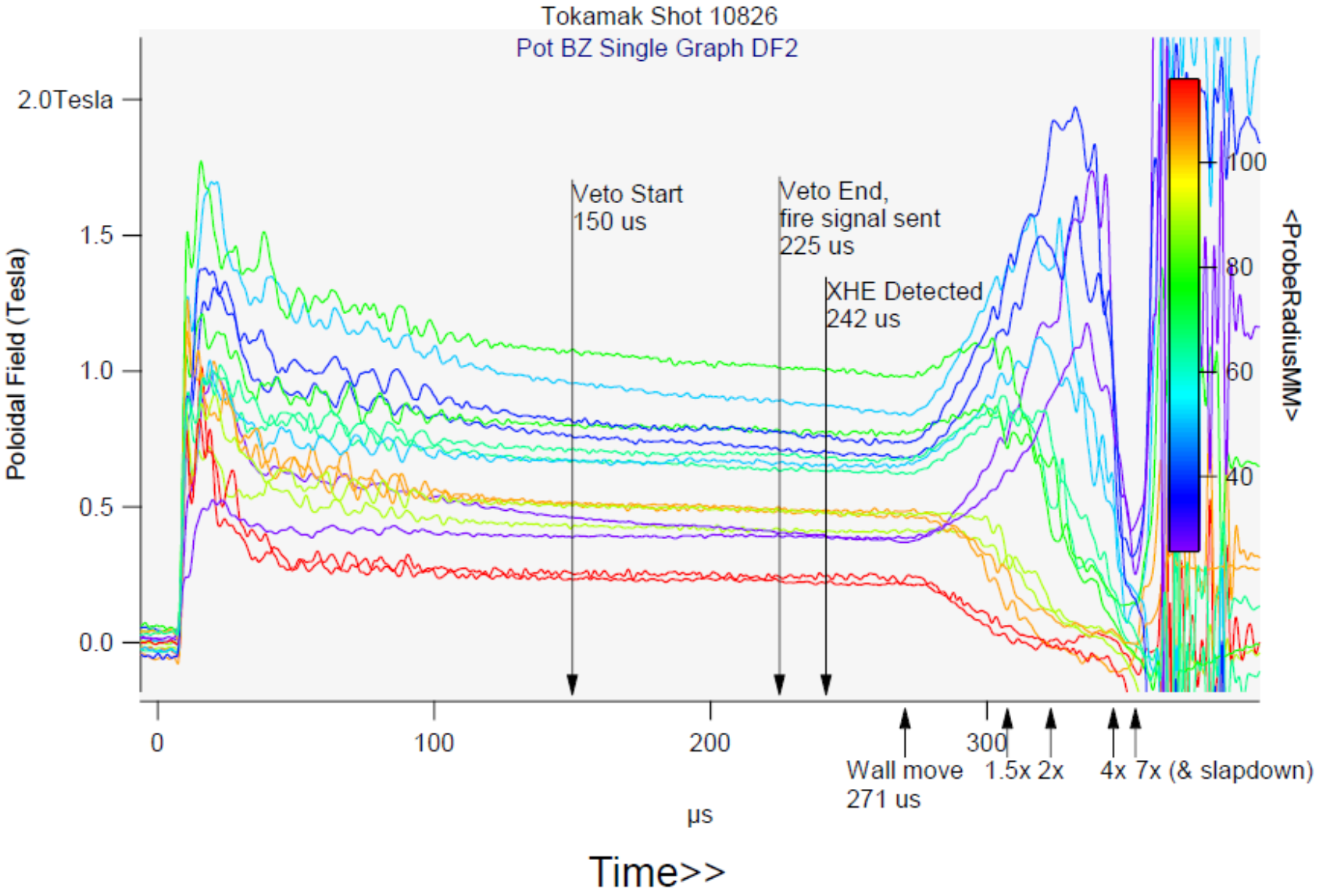
generalfusion



Poloidal Field Compression: Field Test #12

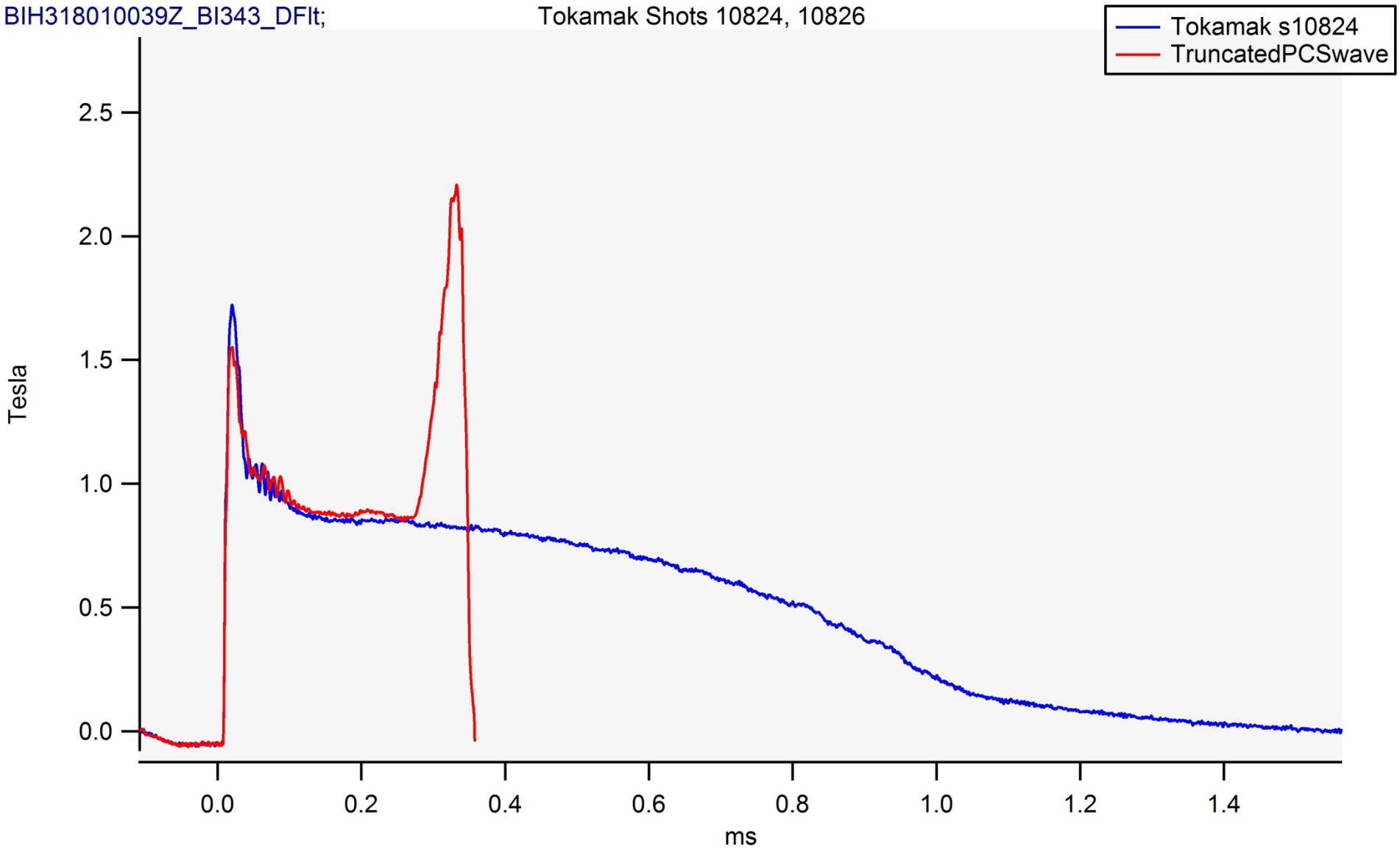
generalfusion

Chart of increase in magnetic field during compression…for field test #12



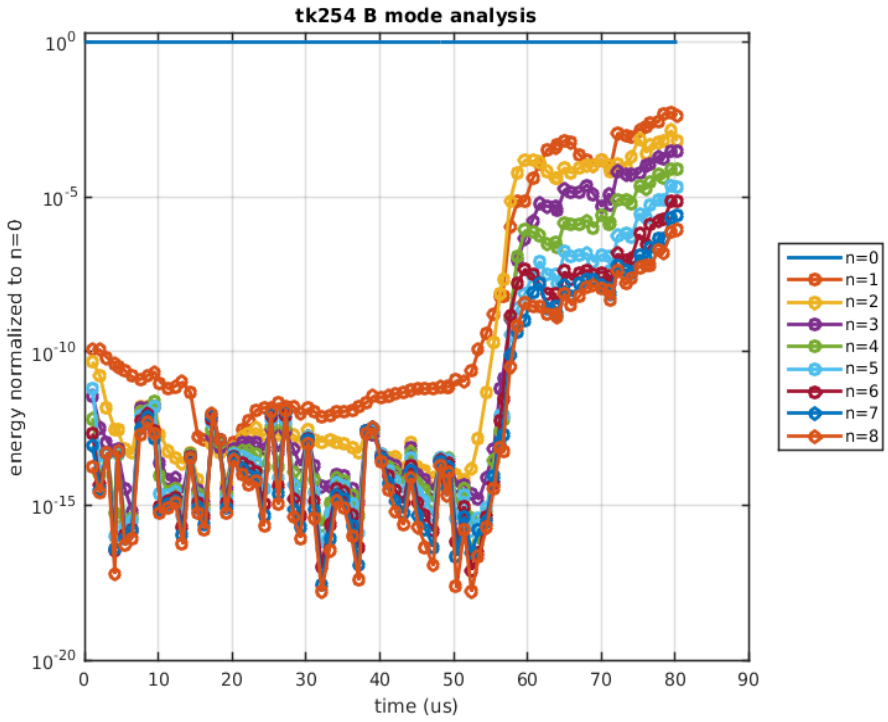
Uncompressed (blue) compared to compressed (red)

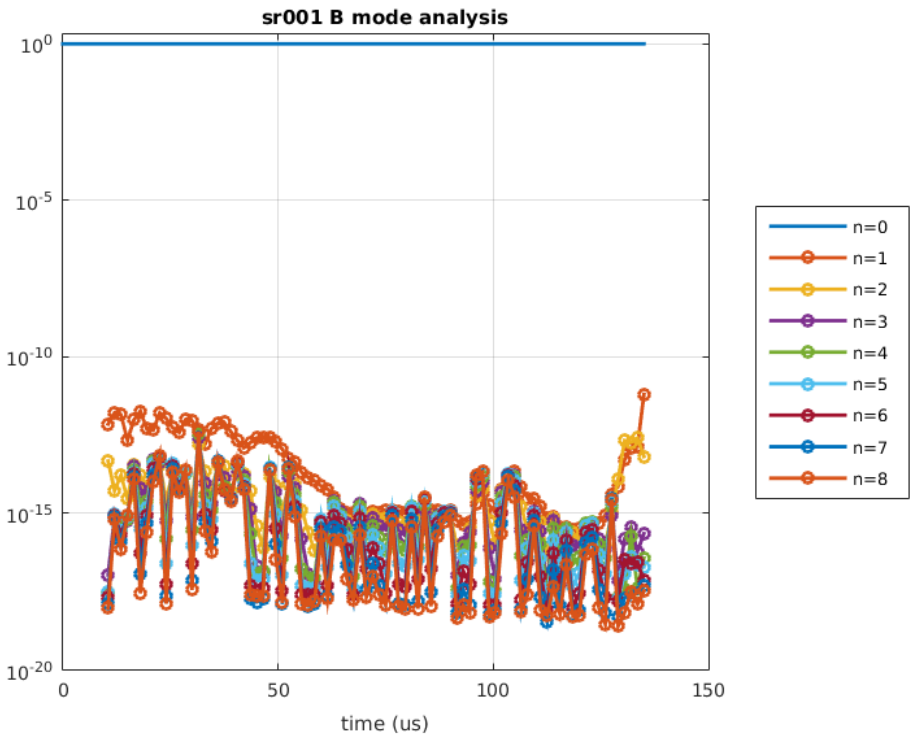
generalfusion

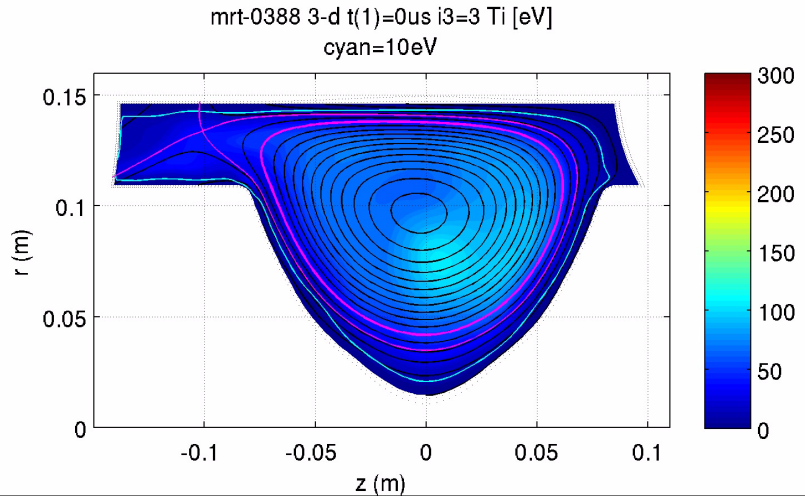


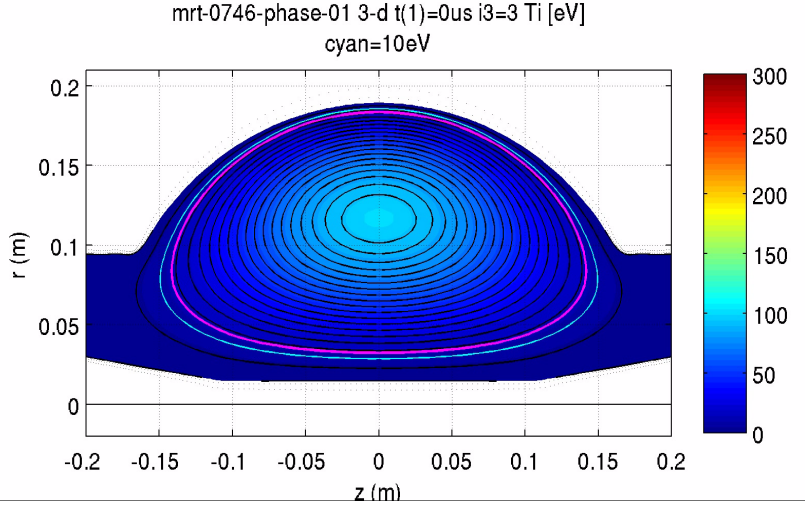
Change in compression geometry

generalfusion





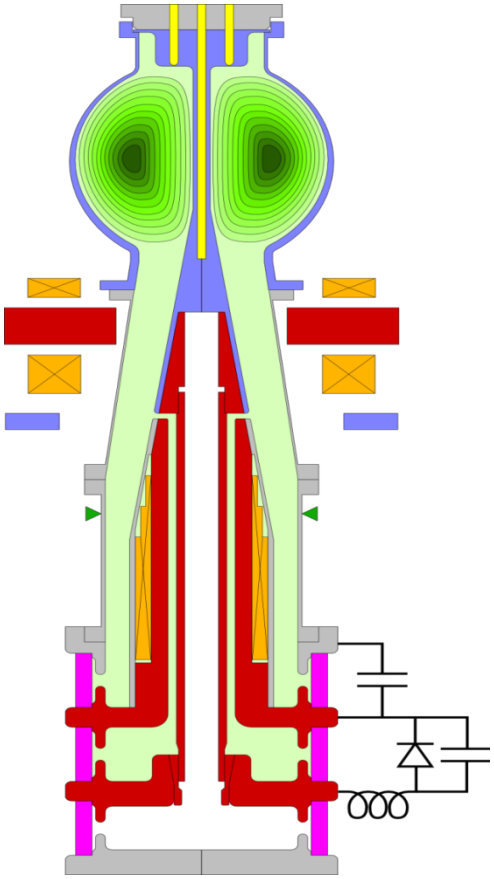




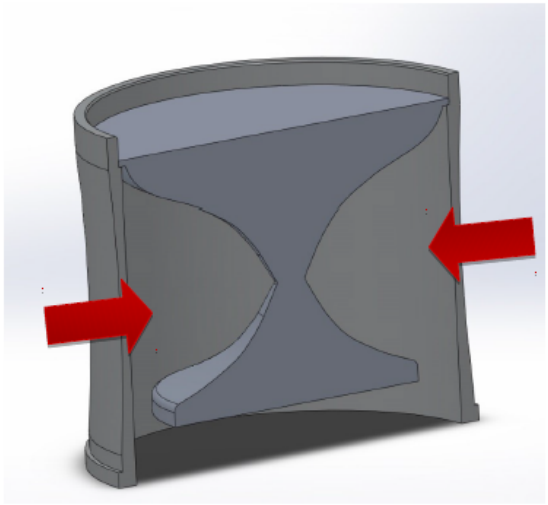
New more spherical plasma

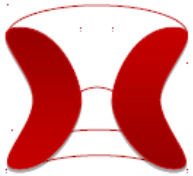
generalfusion

- Commissioning and lab tests of advanced shape, variable-q device: *SPECTOR*
  - "3D" compression tests of **SP**h**E**rical **C**ompact **TOR**oid



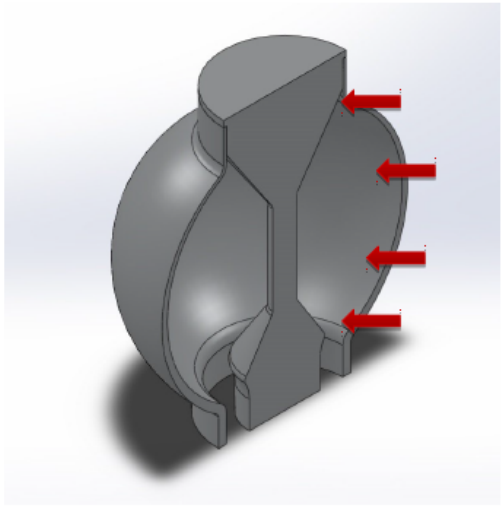
Current Geometry
Cylindrical Compression

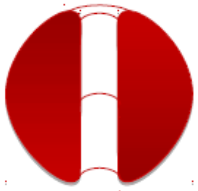




Compressed plasma shape is reverse-D, quite unstable; technique was easier to implement

New Geometry
Spherical Compression



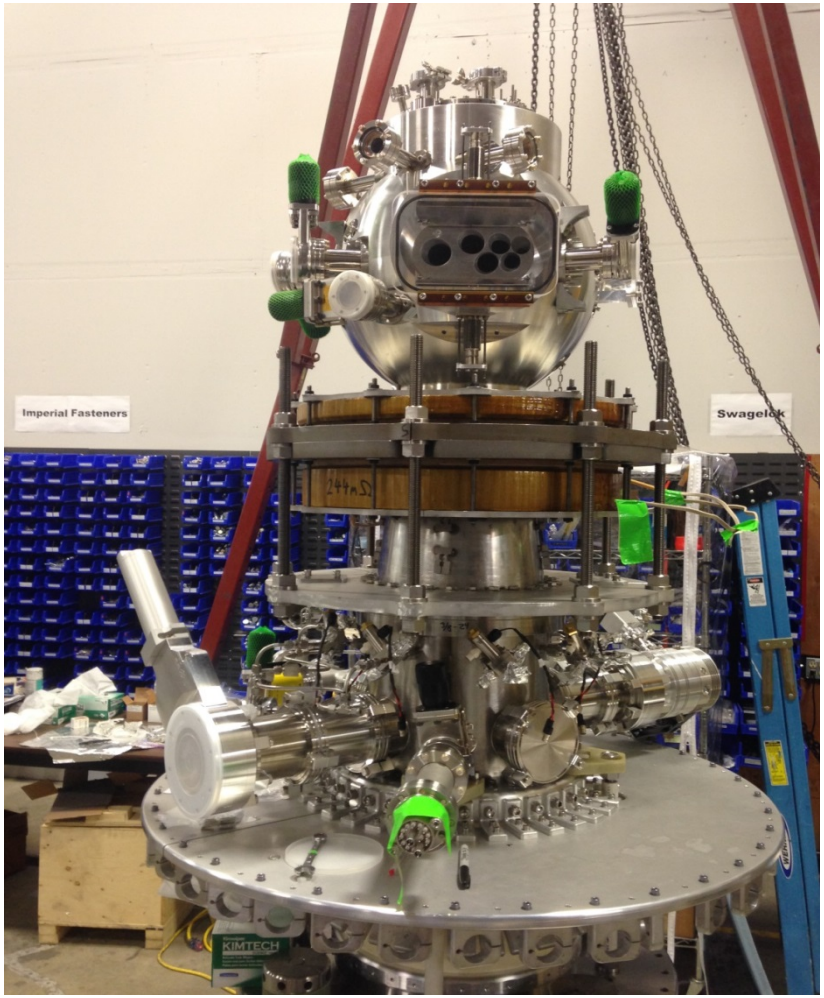


Compression maintains D-shape of plasma.

Spector, working very well now

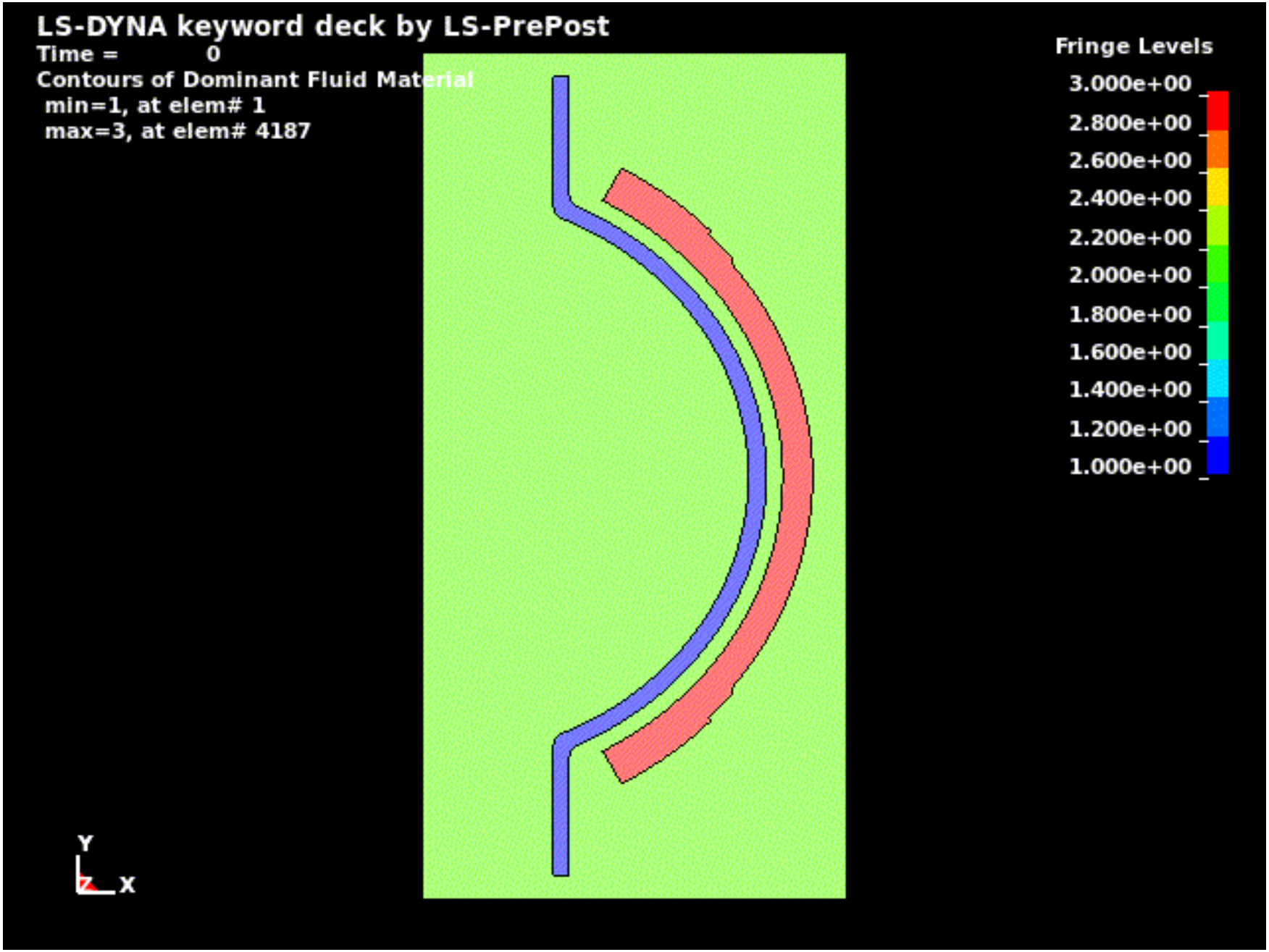
generalfusion

Even better plasma, see Stephen Howard presentation Wednesday 9:30 AM



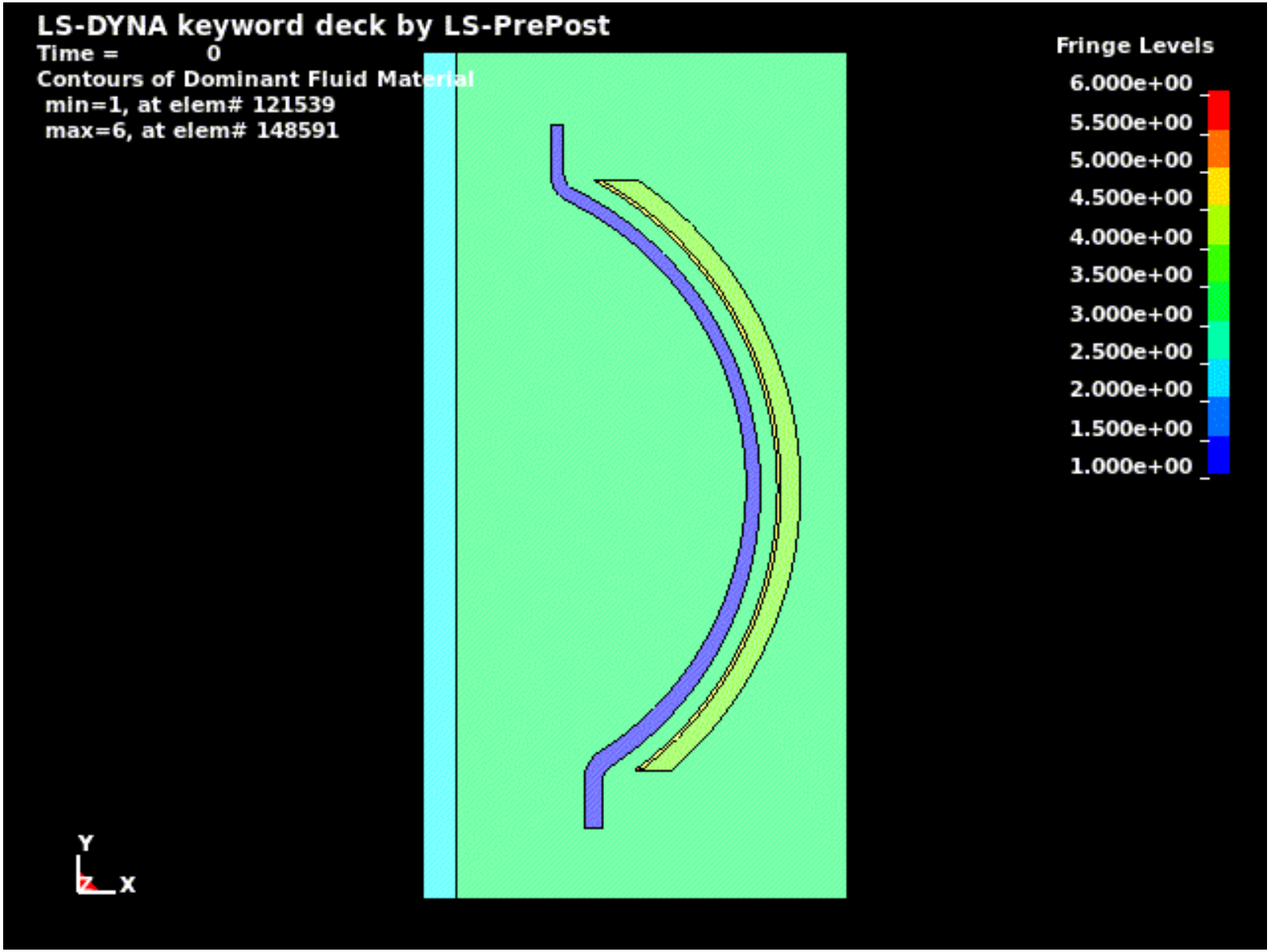
Simultaneous detonation

generalfusion



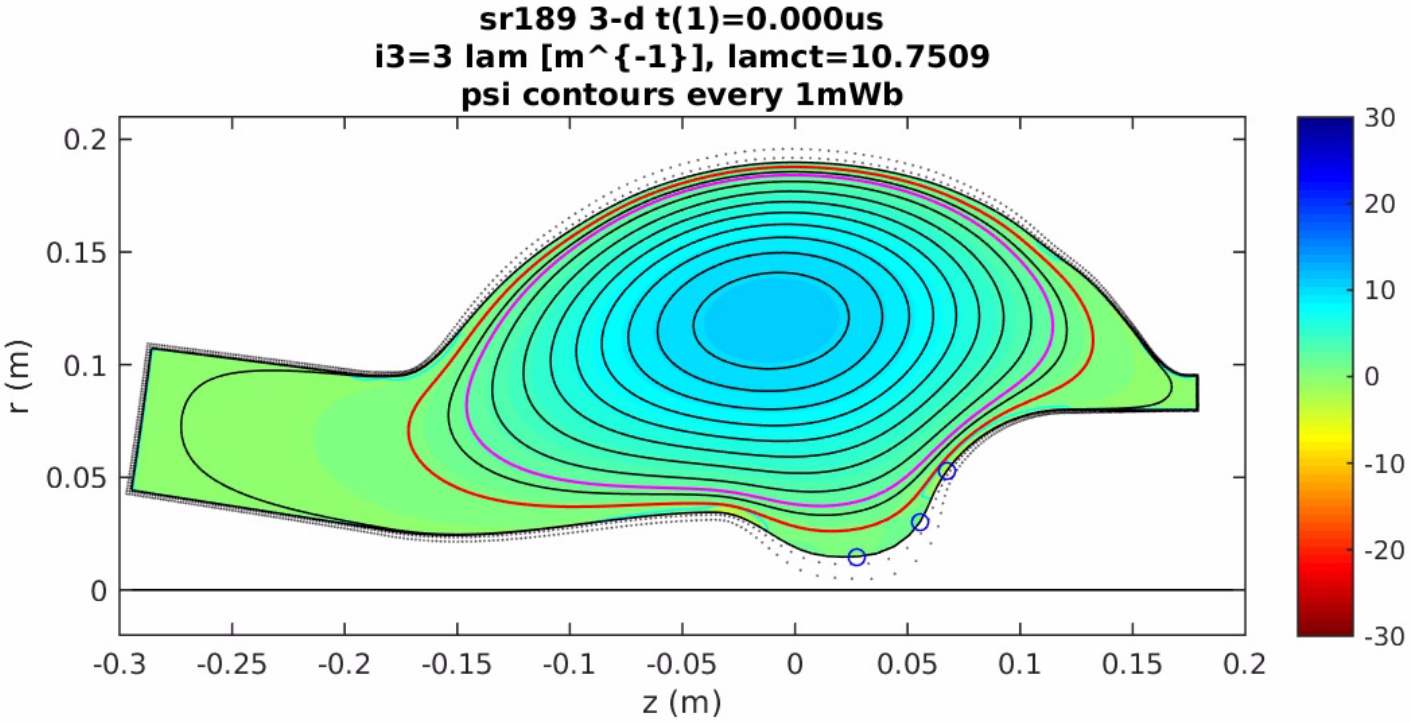
Bottom up detonation

generalfusion



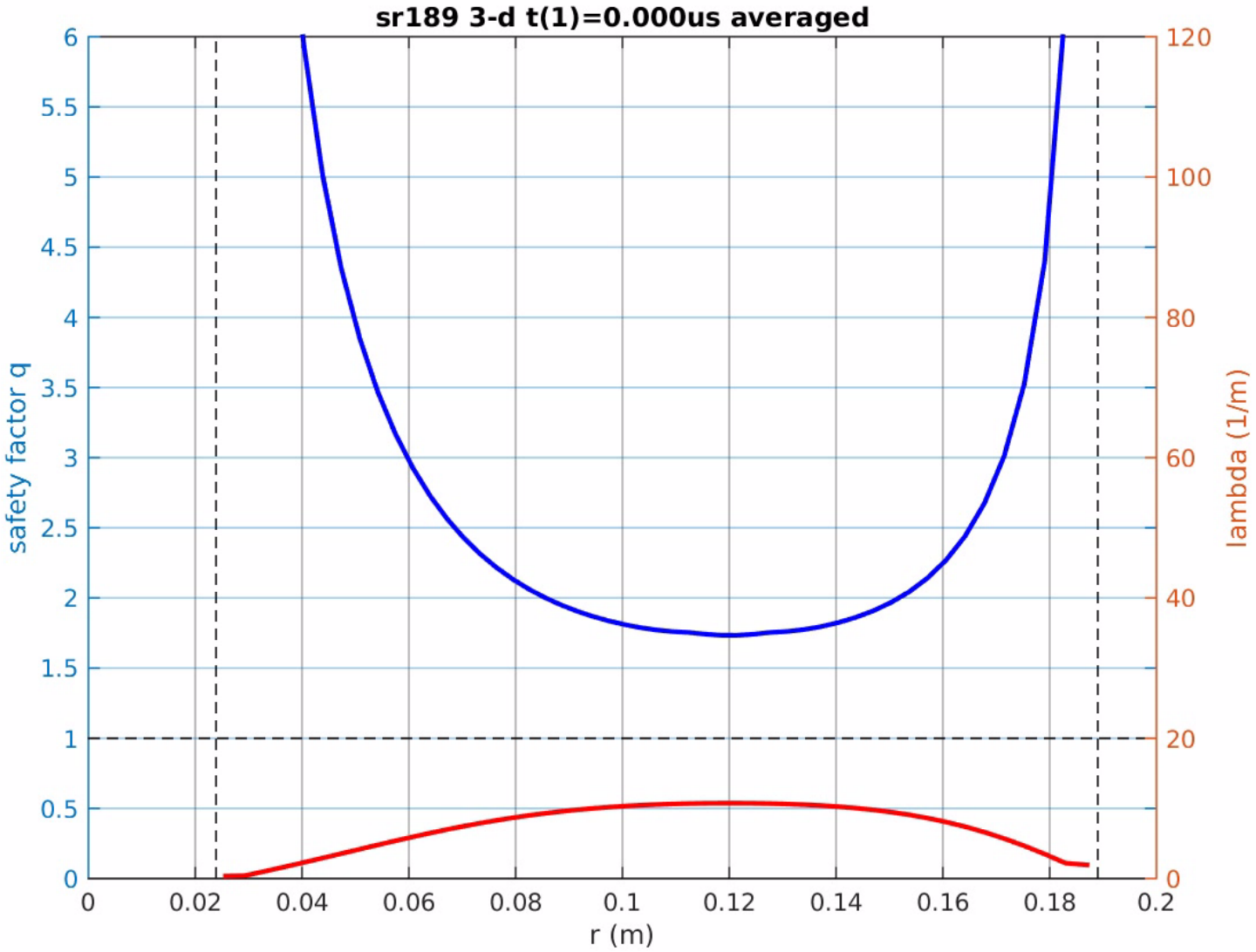
Bottom up detonation, matching shaft, constant shaft current

generalfusion



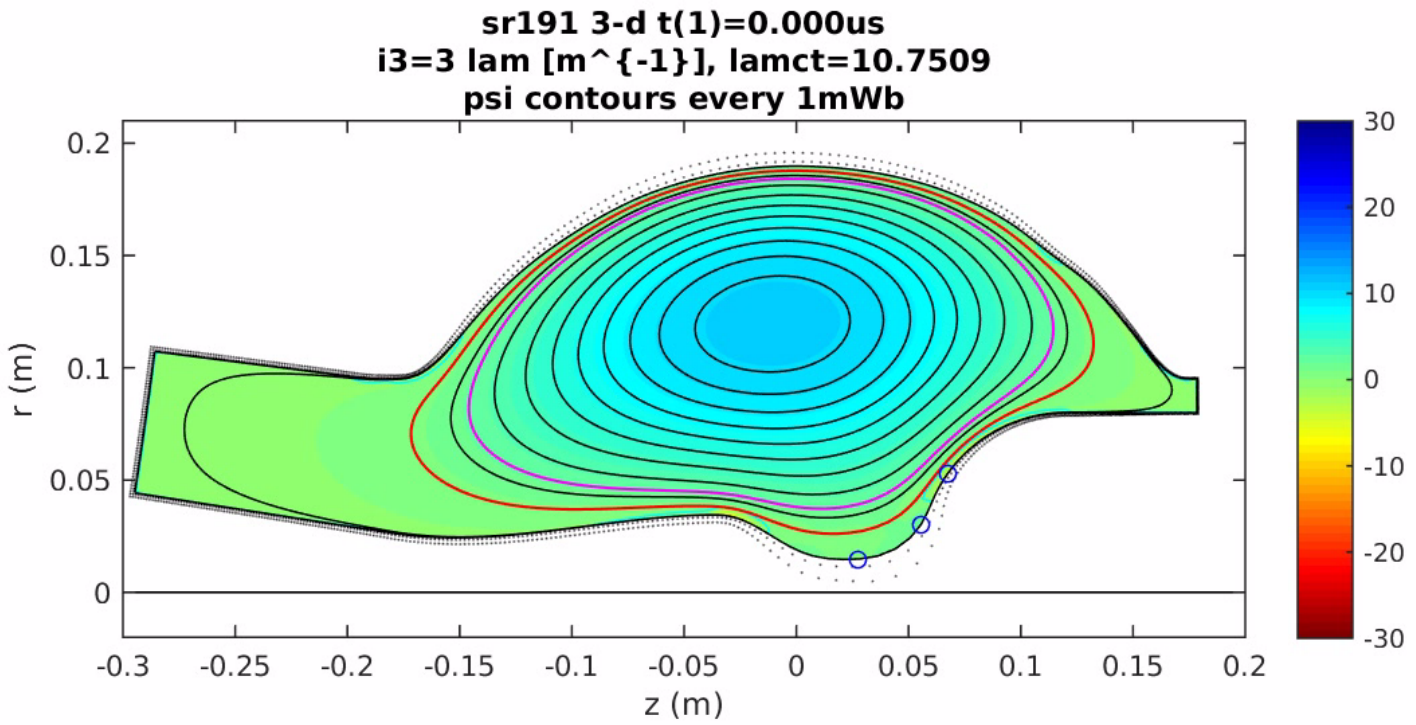
Q and lambda profiles constant shaft current

generalfusion



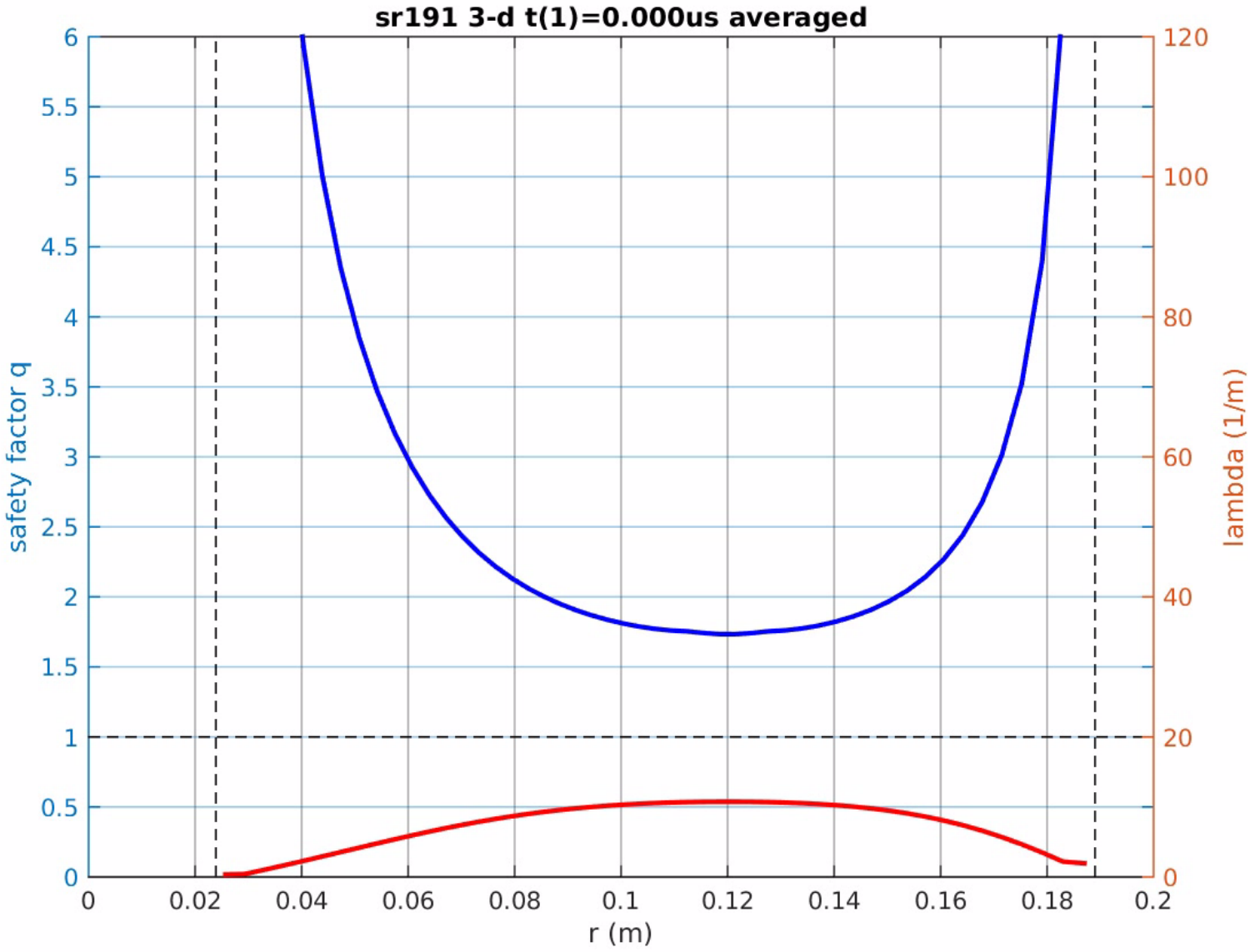
Bottom up detonation, matching shaft, tracking shaft current

generalfusion



Q and lambda profile, tracking shaft current

generalfusion

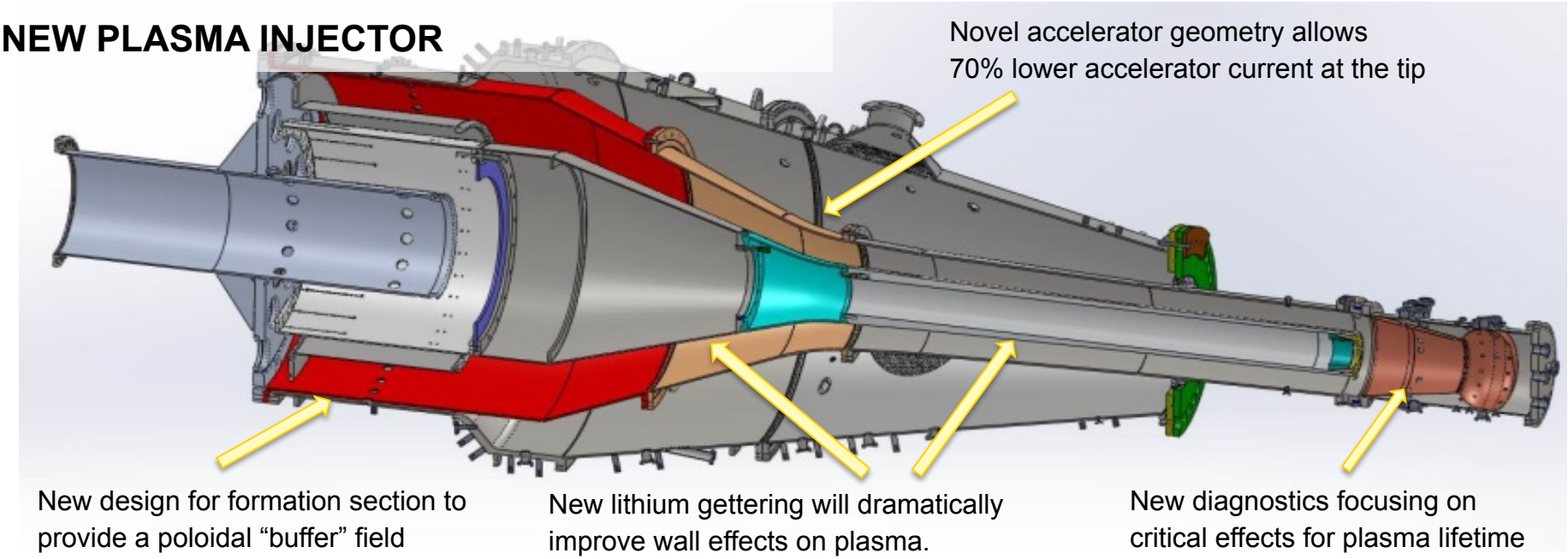


Insufficient density

generalfusion

- Small injectors produce 5e14 cm-3
- If successful will heat to keV range and produce nice flash of neutrons
- But well short of break-even
- Need 1e17 cm-3 starting density to get around break-even
- Now starting building PI3 to achieve these starting condition

NEW PLASMA INJECTOR



Current left in accelerator when CT arrives at the tip will be just the amount required to stabilize the CT

Conclusion

generalfusion

- We can make beautiful tokamak pre-compression plasma with sufficient confinement
- We solved death by radiation from impurities during compression
- We now go MHD unstable under compression both with spheromak and tokamak
- We build a more self similar tokamak plasma
- Will implode with non ideal shape in the next few month
- Difficulty with spherical implosion using chemical driver slowing progress
- Building PI3, more density and magnetic field
- Will implode PI3 with new more self similar compression to high DD yield