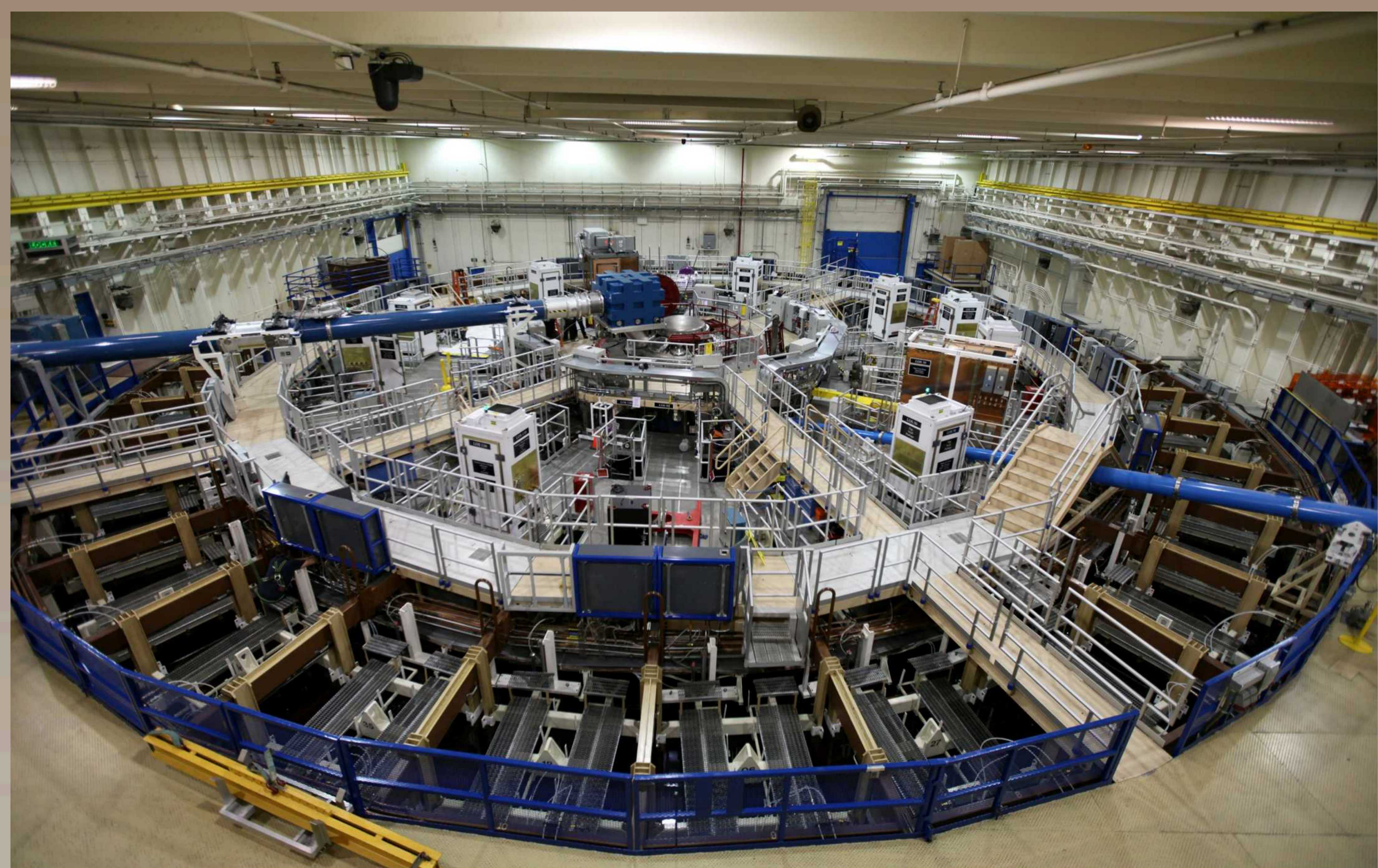
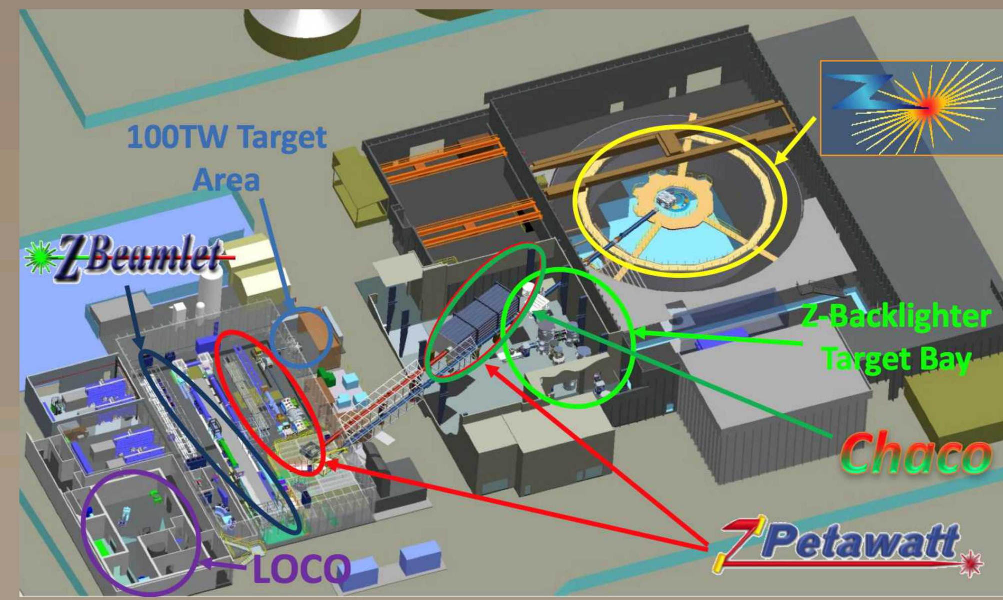
SAND2016-6277C

Z/ZBL Facility Overview





Z-Beamlet Laser Facility

- 1-4 kJ Deliverable energy with Z-Beamlet
- 0.5 kJ in Z Petawatt
- Can serve as stand-alone facility or be integrated with Z experiments

The Z facility combines the MJ-class Z pulsed-power driver with the TW-class Z Beamlet Laser

Z Machine Pulsed Power Facility

- >22 MJ Stored energy
- >3 MJ Delivered to the load
- >26 MA Peak current
- ~100-1,000 ns pulse length

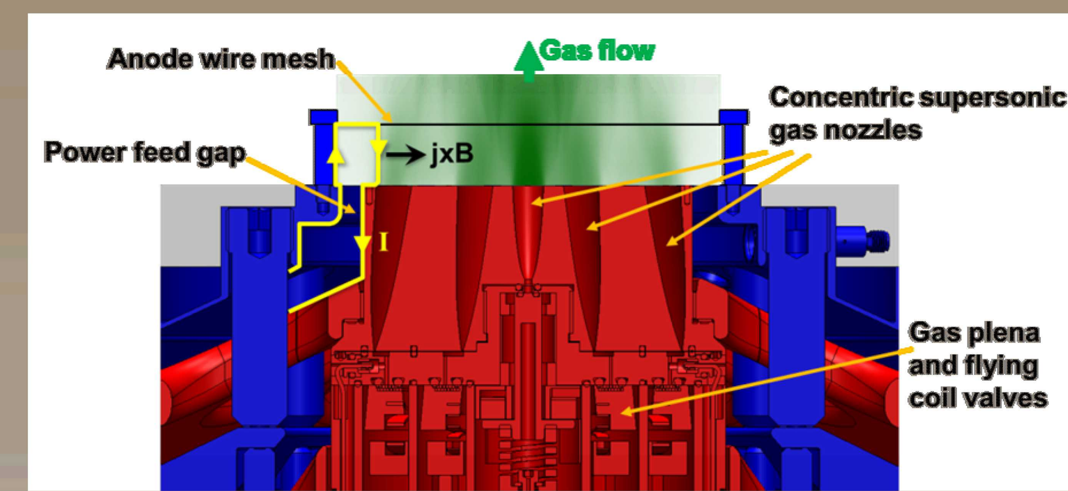
Diagnostics

- X-Ray power & energy
- X-Ray & visible spectrometers
- Imaging (x-ray, visible, neutron)
- Axial and radial locations

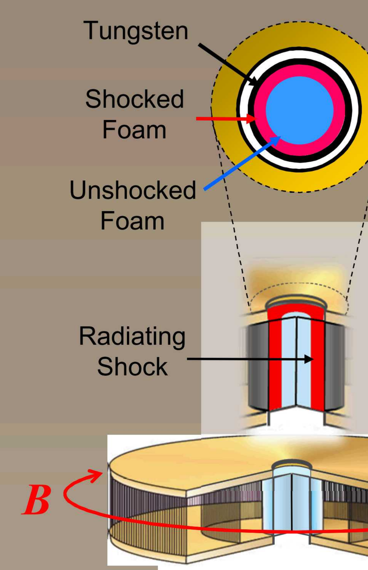
Integrated Performance

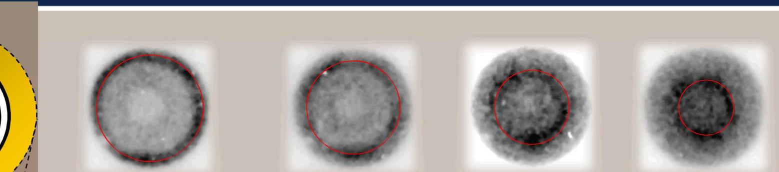
- 1-100 Megabar in planar geometry
- >100 Megabar in cylindrical geometry
- 330 TW, 2.5 MJ X-ray output
- $>10^{13}$ DD Neutrons

X-Ray Sources and Applications



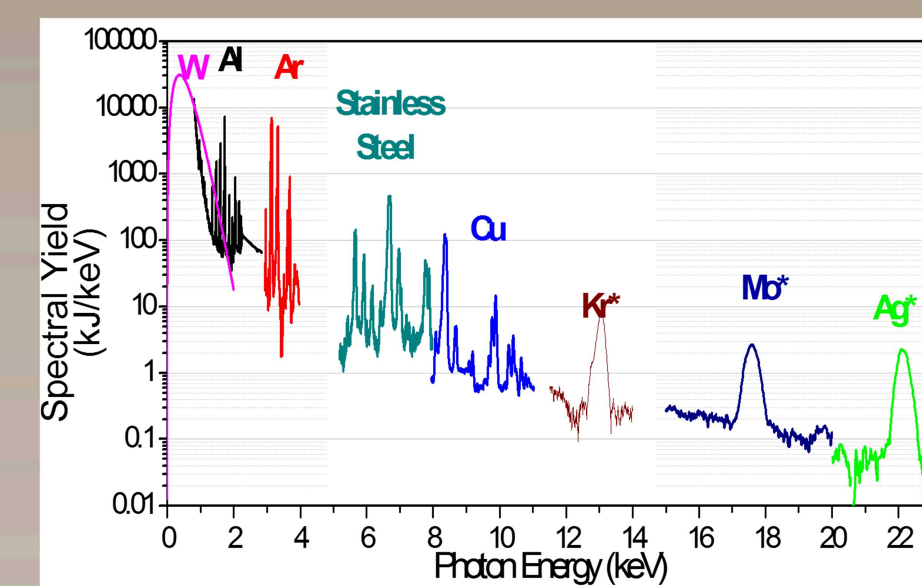
Argon gas puff experiments have demonstrated great reproducibility

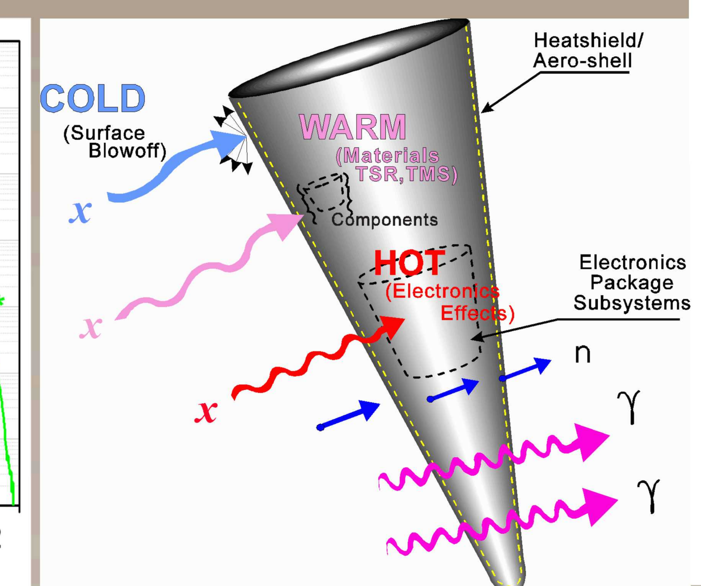




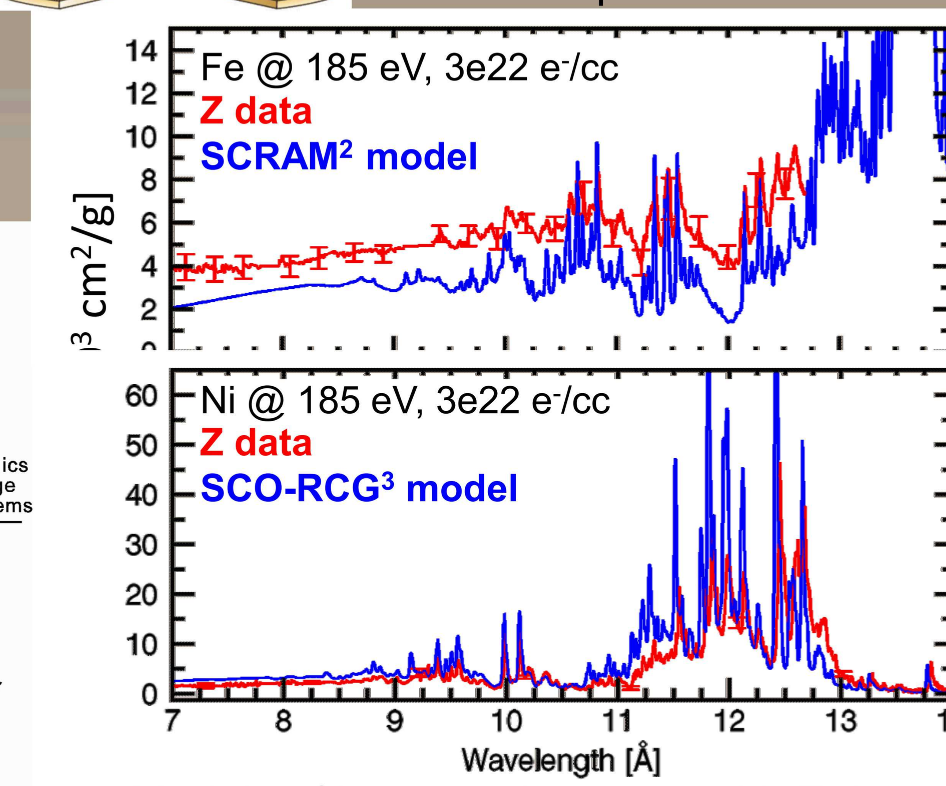
Framing Pinhole Camera Images

The Z-Pinch Dynamic Hohlraum provides a bright x-ray source to heat and backlight opacity samples.





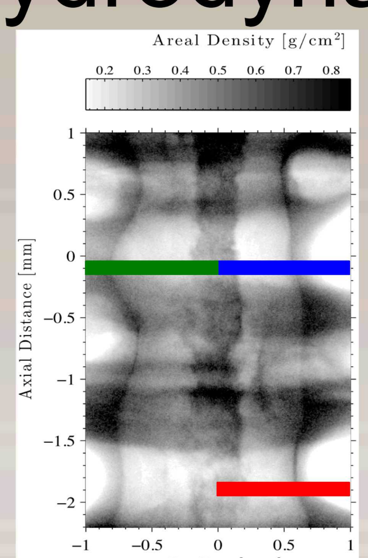
Z provides intense x-ray sources at different energies for nuclear survivability studies

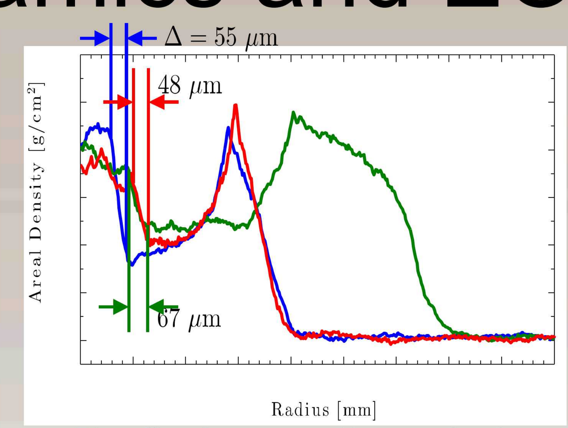


Models of iron opacity agree with Z data at some conditions, but show disturbing disagreement at increased Te and ne.

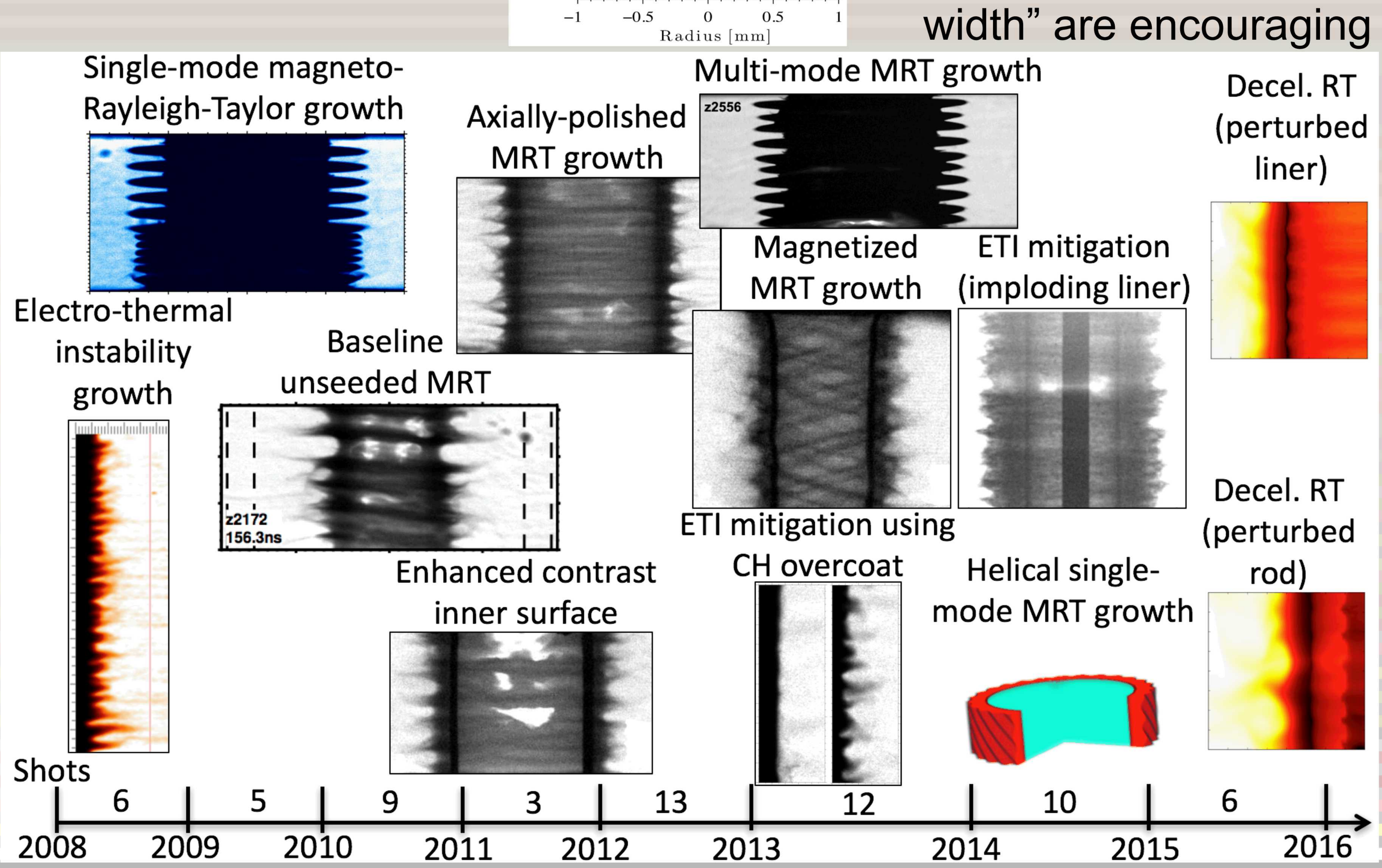
Complex Hydrodynamics and EOS

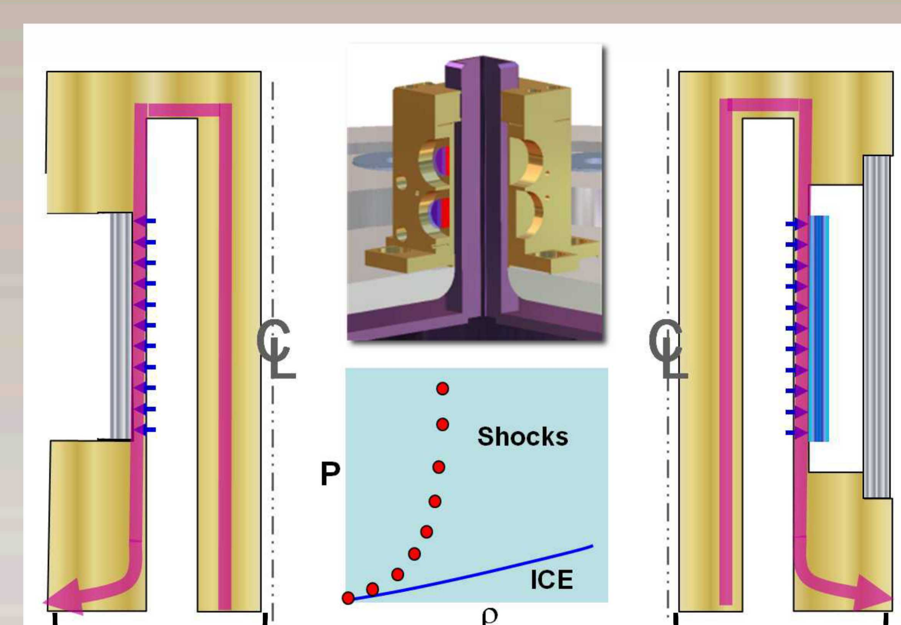
Rapid progress has been made in our ability to study, modify, and mitigate MHD instabilities





Preliminary attempts to determine a "mix width" are encouraging



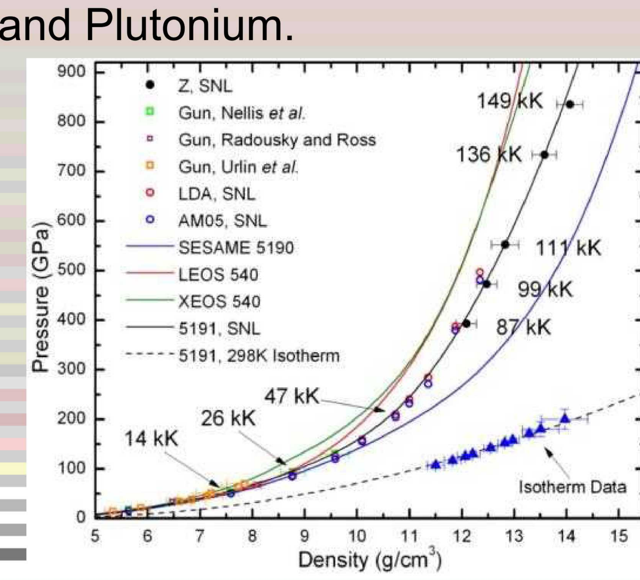


Isentropic compression: gradual pressure rise in the sample

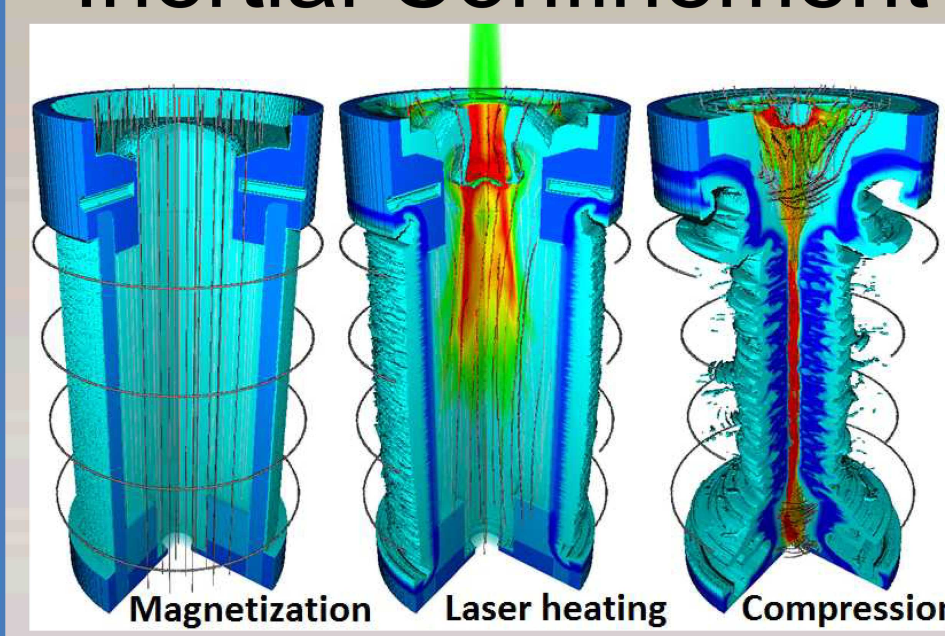
Shock Compression: shock wave launched in sample at impact

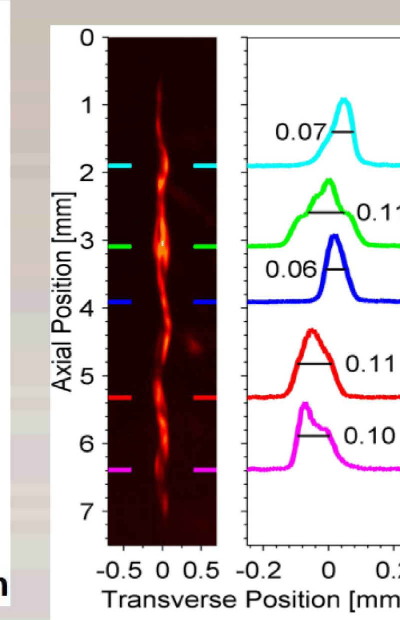
Z isentropic compression and shock wave experiments enable access to key equation of state regions for many weapon relevant materials, including Uranium and Plutonium.

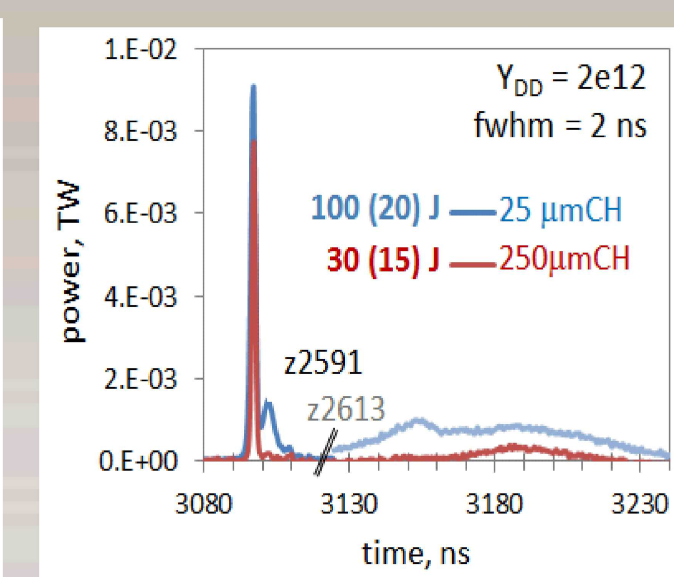
Z acquires data never seen in UGTs and is resolving fundamental EOS differences

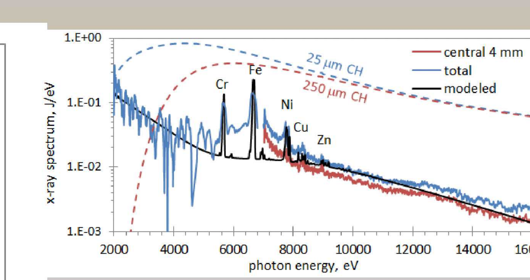


Inertial Confinement Fusion and Burn Physics

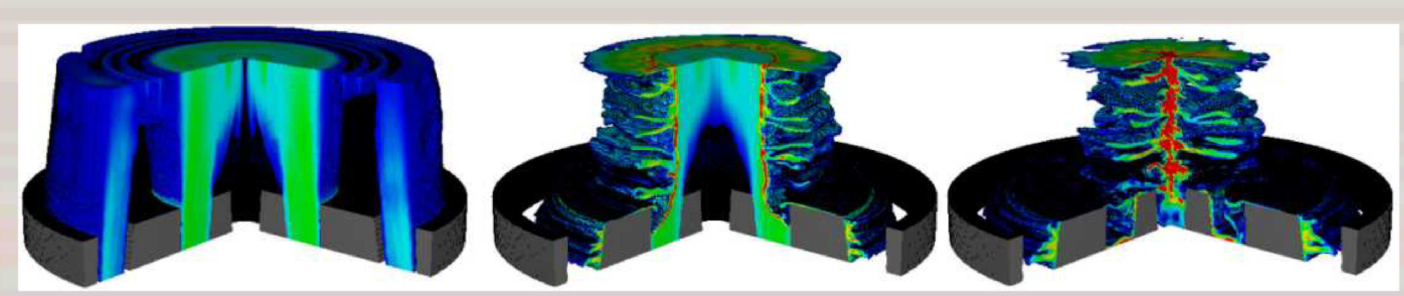








An extensive suite of x-ray diagnostics inform fuel morphology, electron temperature, burn duration, etc.



	Y_n(DD)	Y_n(DT)	T_e (keV)	T_i (keV)	n_i (cm^{-3})	Δt (ns)	Diameter
MagLIF	$3x10^{12}$	$5x10^{10}$	~3	2.5	~ 10^{23}	< 2	~50 μm
D_2 gas puff	$4x10^{13}$	$<4x10^9$	2.2	~10	$2x10^{20}$	~30	6 mm

Z inertial confinement experiments are exploring novel methods to produce thermonuclear neutrons

Several key physics issues could be addressed with DT experiments on Z

		Tritium fuel content		
Physics	Measurement	<0.1%	0.1%	1%
Behavior of tritium in the Z pulsed power environment	Sampling of tritium contamination, migration	■	■	■
Scaling of yield to DT—thermonuclear?	DT yield		■	■
Ion temperature and non-thermal population	Precision nTOF and DT/DD yield ratio		■	■
Liner/fuel mix	DT yield with tritiated gas fill and deuterated liner		■	■
Fuel morphology	Neutron imaging			■
Thermonuclear reaction history	Gamma Ray History/GCD, Thompson parabola			■
Liner/fuel density, non-thermal effects (peak shifts)	Compact/Magnetic Recoil Spectrometer (CRS/MRS), precision nTOF			■

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