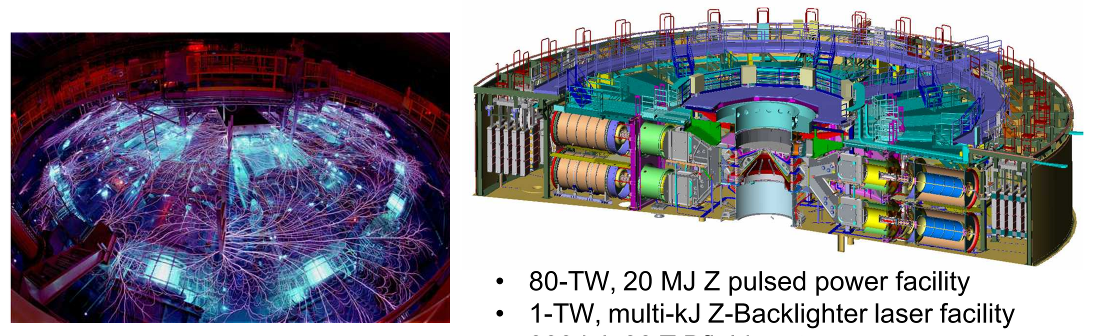
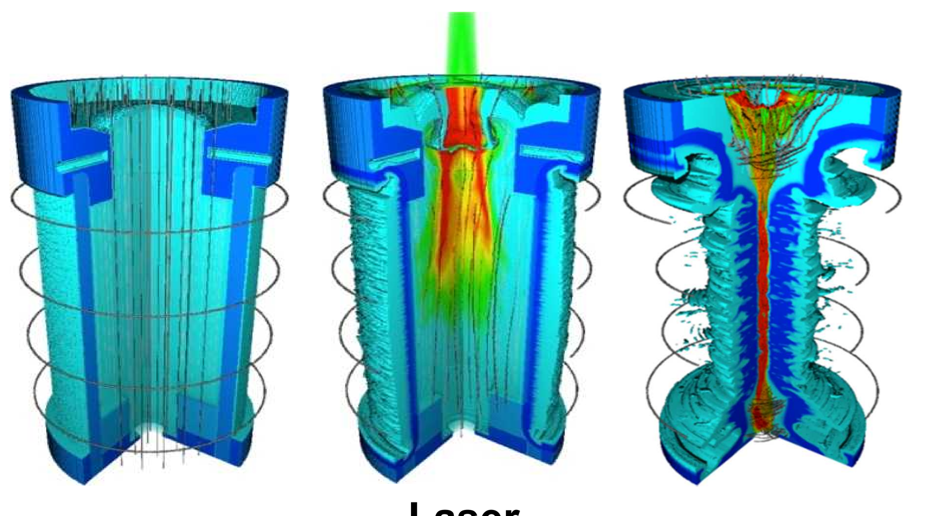
Exceptional service in the national interest

Demonstrating Fuel Magnetization and Laser Heating Tools for Low-Cost Fusion Energy

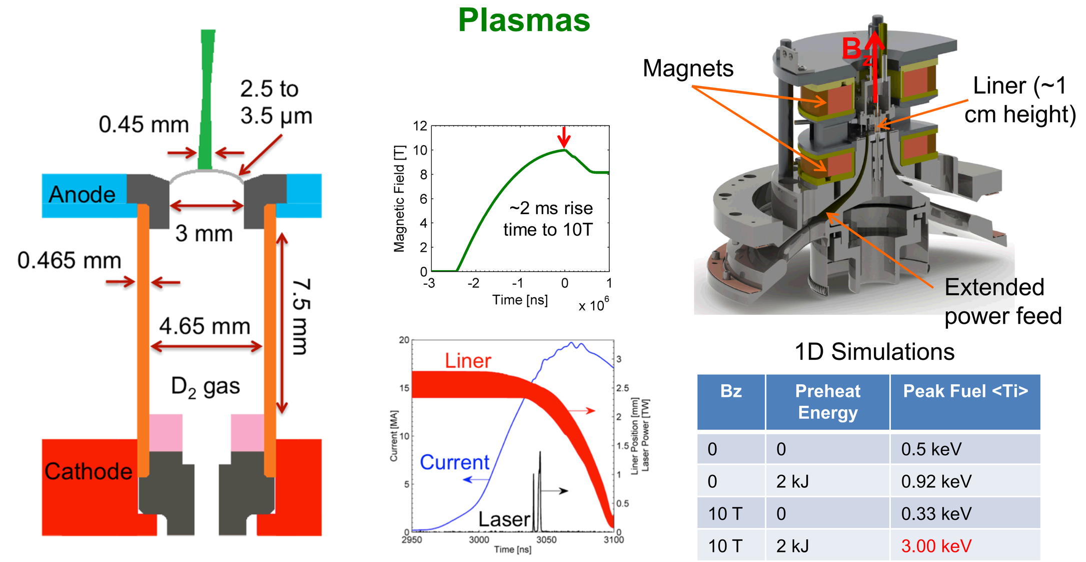
MagLIF on Z



- 80-TW, 20 MJ Z pulsed power facility
- 1-TW, multi-kJ Z-Backlighter laser facility
- 900 kJ, 30 T Bfield system

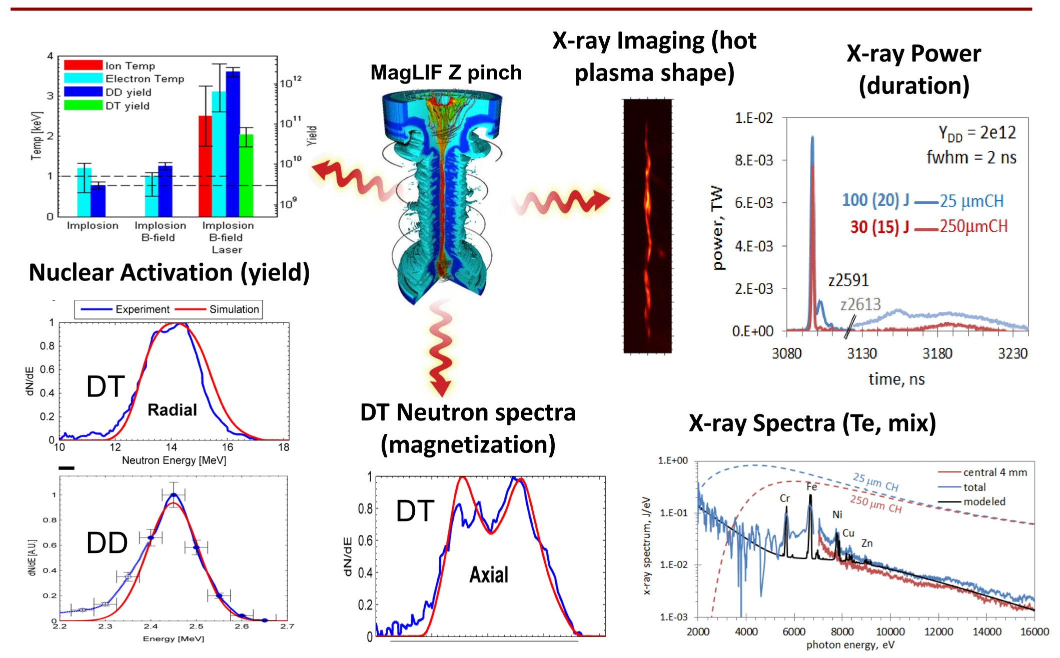


Demonstration of Magnetized Thermonuclear Plasmas



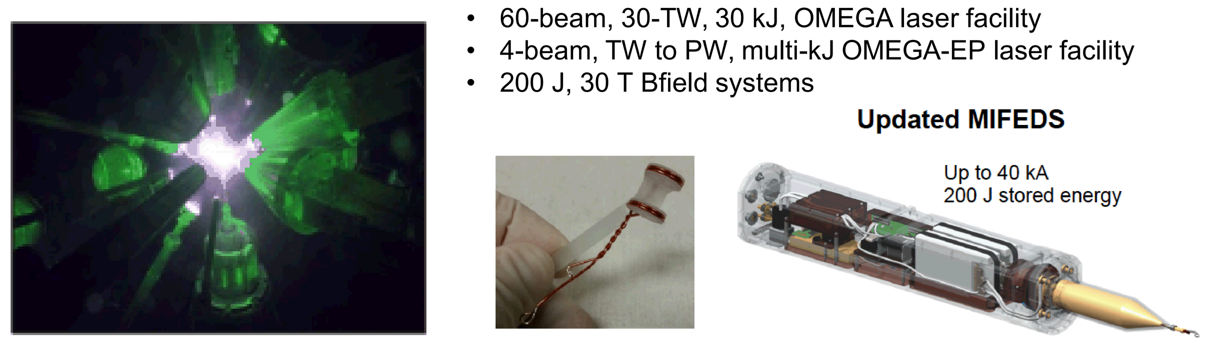
1D Simulations

Bz	Preheat Energy	Peak Fuel <Ti>
0	0	0.5 keV
0	2 kJ	0.92 keV
10 T	0	0.33 keV
10 T	2 kJ	3.00 keV



Fuel ρ: 0.2-0.4 g/cm³ Fuel ρR: ~1.5 mg/cm² Fuel ρz: ~150 mg/cm²	Pressure: ~1 Gbar Temperature: ~3 keV	Burn: 1-2 ns Radius: 30-70 μm Height: 5-7 mm

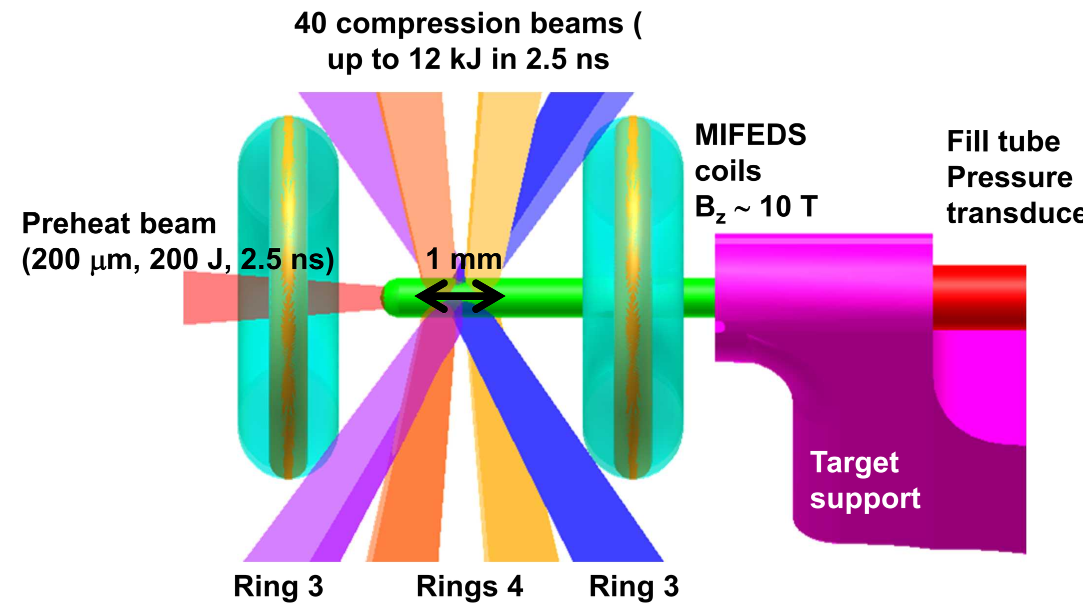
Integrated MagLIF on OMEGA



- 60-beam, 30-TW, 30 kJ, OMEGA laser facility
- 4-beam, TW to PW, multi-kJ OMEGA-EP laser facility
- 200 J, 30 T Bfield systems

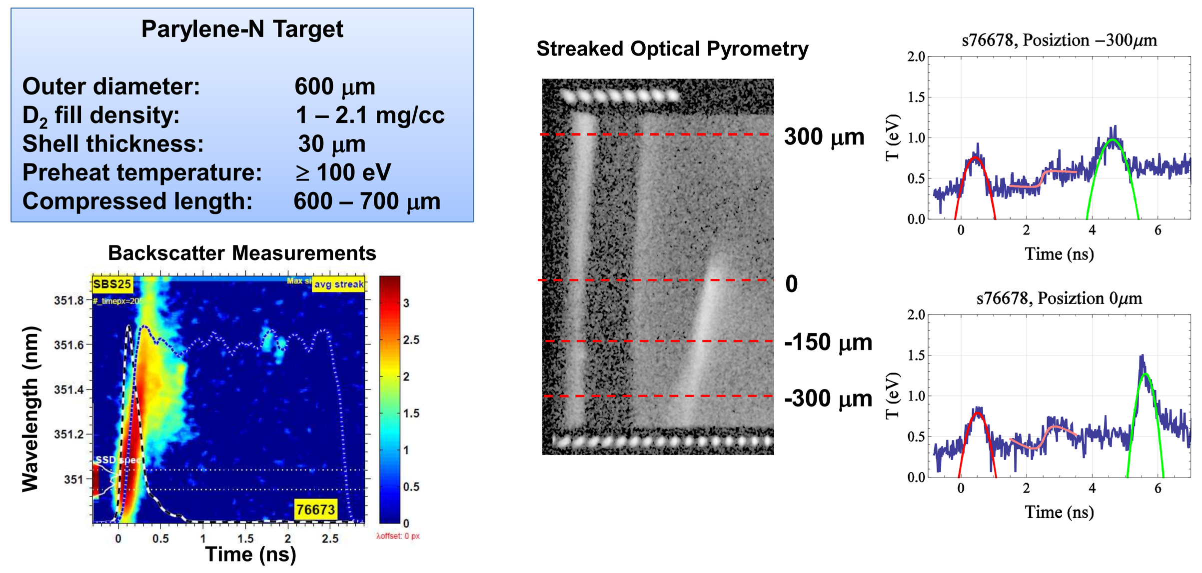
Updated MIFEDS

Up to 40 kA
200 J stored energy

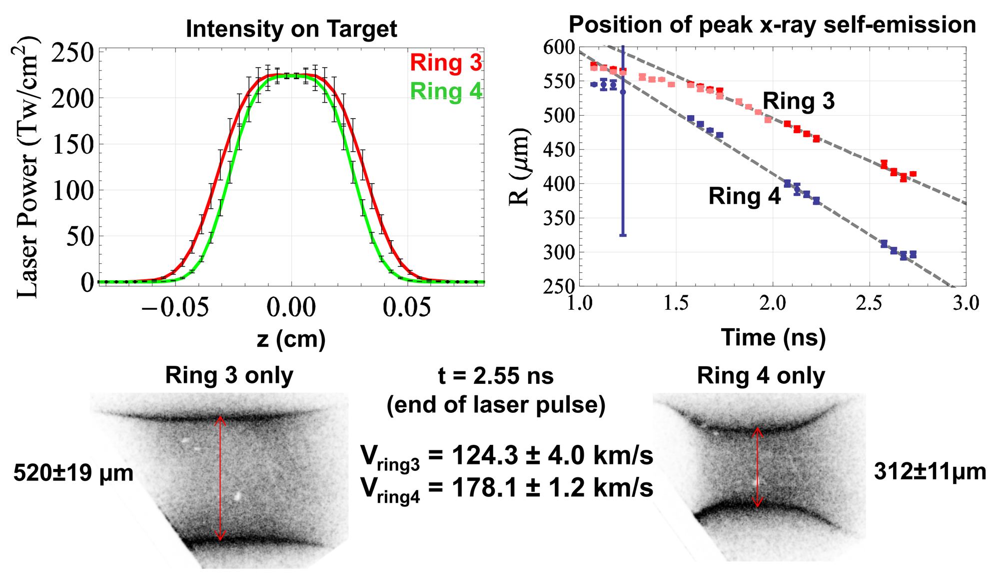


Parylene-N Target

Outer diameter:	600 μm
D_2 fill density:	1 – 2.1 mg/cc
Shell thickness:	30 μm
Preheat temperature:	≥ 100 eV
Compressed length:	600 – 700 μm

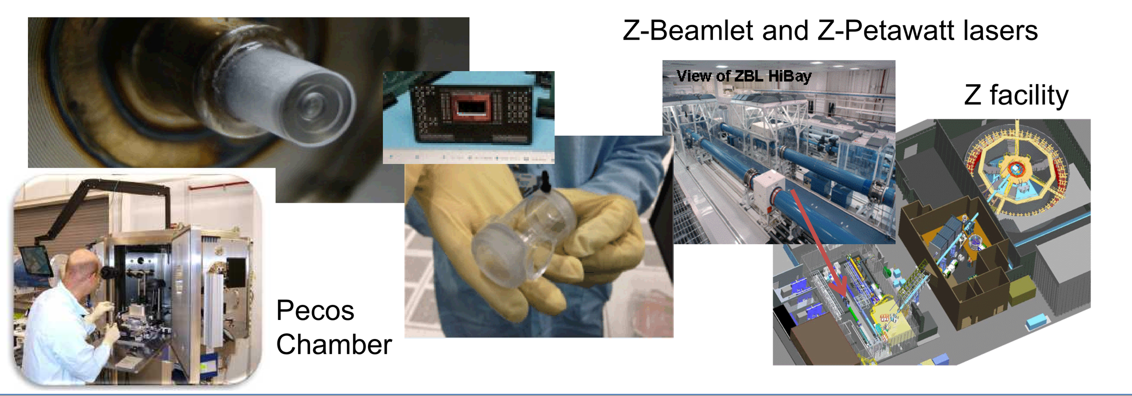


Initial Implosion Uniformity Tests

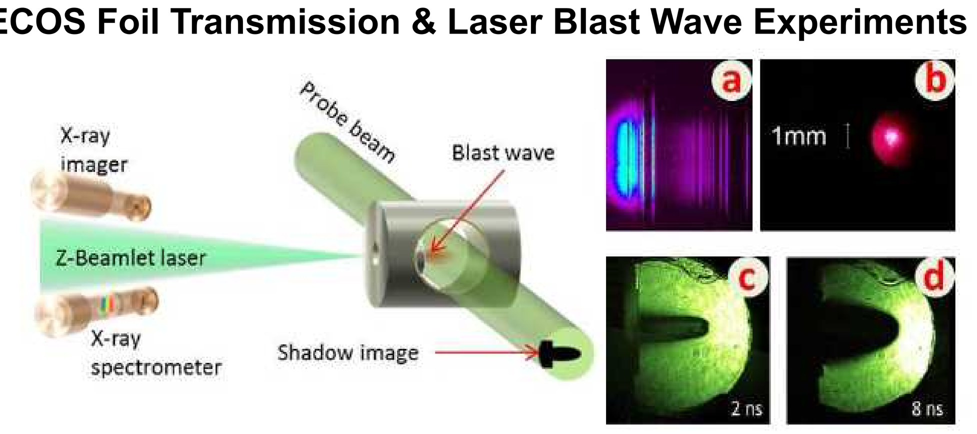


Overlap rings 3 at the center and drive the ends with rings 4

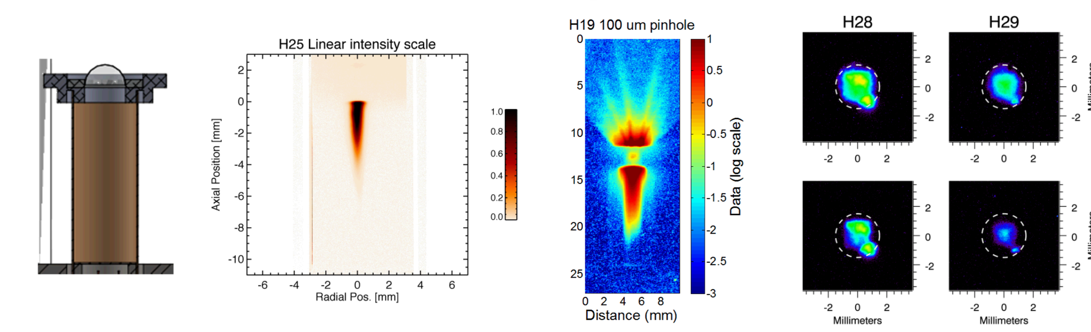
Target Preconditioning



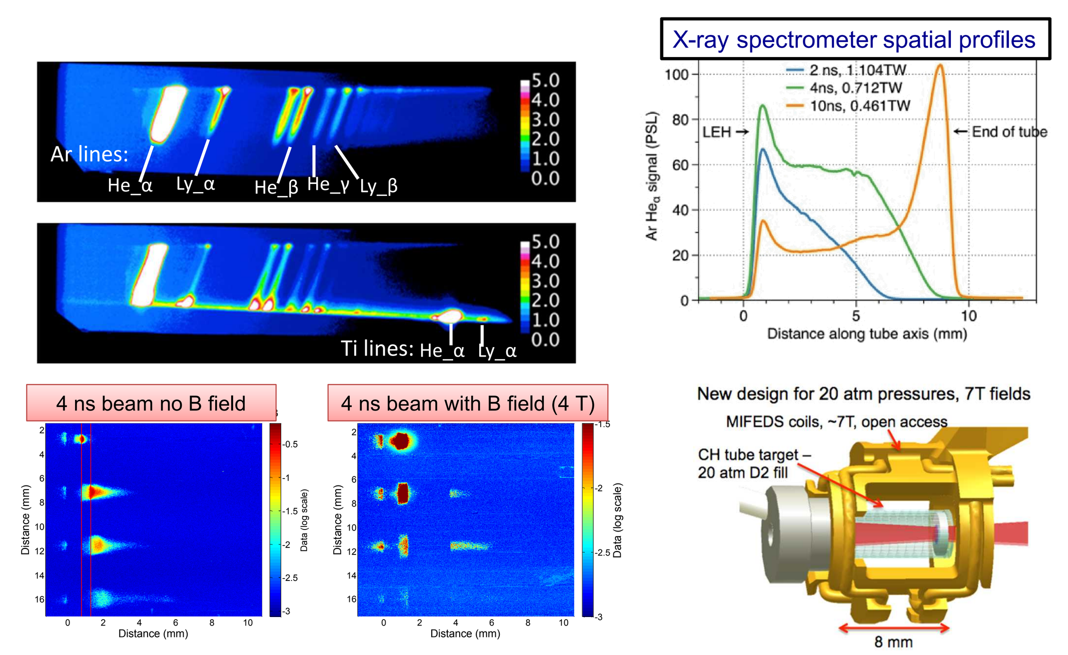
PECOS Foil Transmission & Laser Blast Wave Experiments

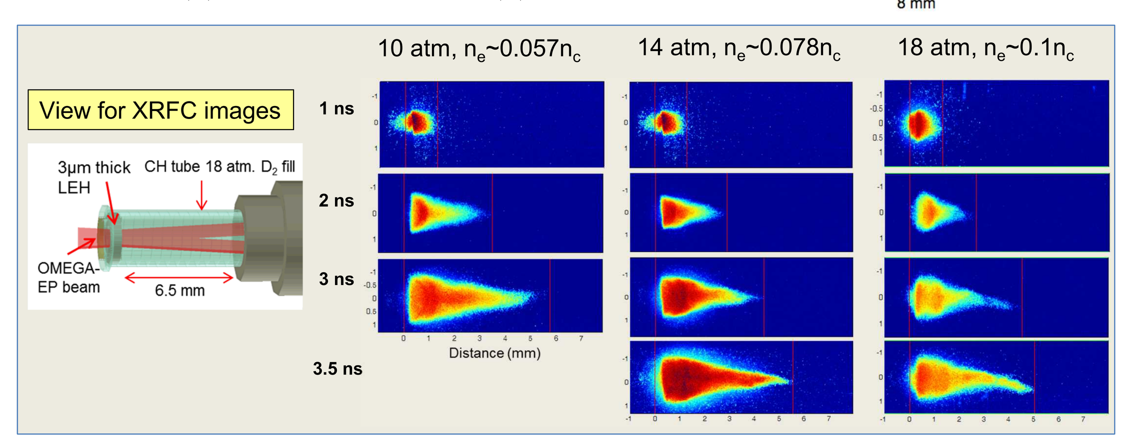


ZBL Laser Coupling Experiments



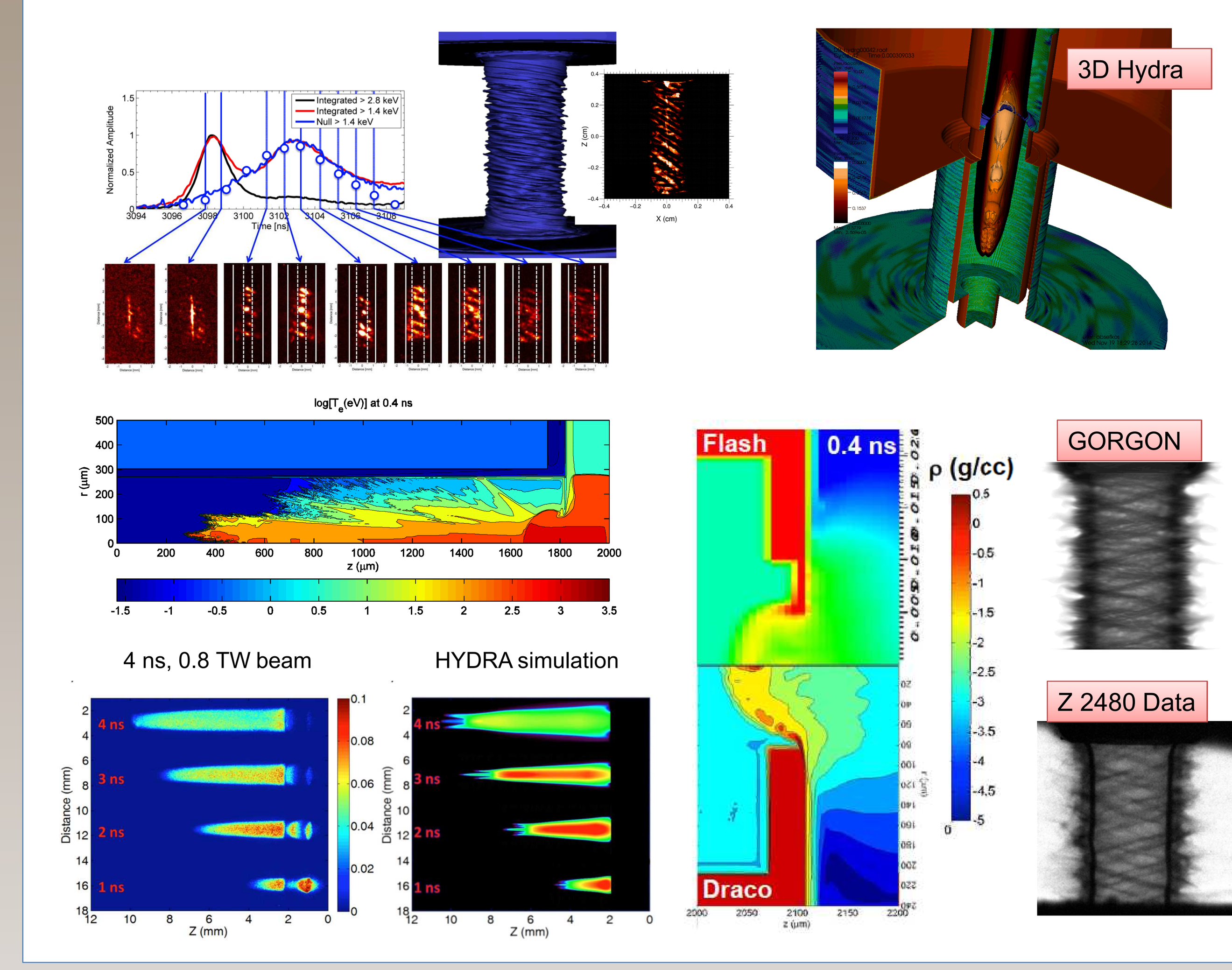
OMEGA-EP Laser Propagation Experiments



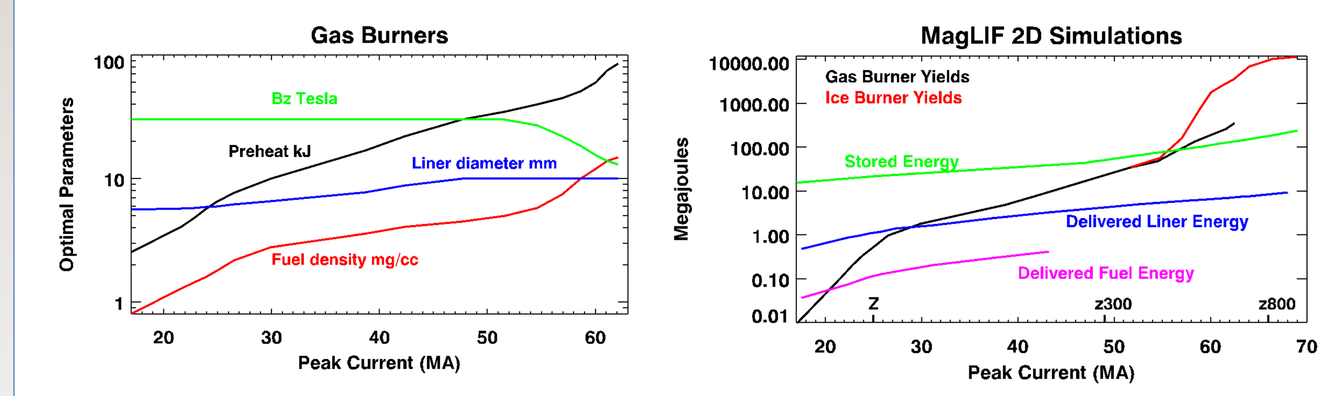


Numerical Simulation & Modeling

Verification & Validation of High Fidelity Simulations



Magnetized Target Fusion Parameter Space Studies



Project Goals & Milestones

Target pre-conditioning experiments (Z, ZBL, OMEGA, OMEGA-EP)

Demonstrate a set of functional laser pre-heating parameters (laser pulse shape, focal spot size, window thickness) to provide >1 kJ of laser heating to the fusion fuel in an integrated MagLIF shot on Z.

Determine the time-dependent Te history in a Z MagLIF experiment

Laser-driven MagLIF experiments (OMEGA)

Confirm effective (>100 eV) and low mix preheat

Symmetrically implode cylindrical target containing preheated fuel with 10 kJ/cm of kinetic energy

Demonstrate >30% increase in Te (as compared to unmagnetized target) in axially symmetric target compression over >0.6 mm length

Numerical Modeling & Theory (Sandia, U. Rochester)

Results for integrated OMEGA experiments agree with Flash and Hydra to within 20% of key observables and 2x in yield

Report on key dependencies across the MIF parameter space for generalized scaling laws, and highlight most promising regimes. Analysis to include both near-term and long-term fusion power cases

- *Provides much needed credibility to MIF concepts and simulation models as alternative to MCF and ICF.*
- *Motivates new investments in MTF and IFE technologies*