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Target Formation and Integrated Experiments for Plasma-Jet-Driven Magneto-Inertial Fusion

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P-4 Thermonuclear Plasma Physics

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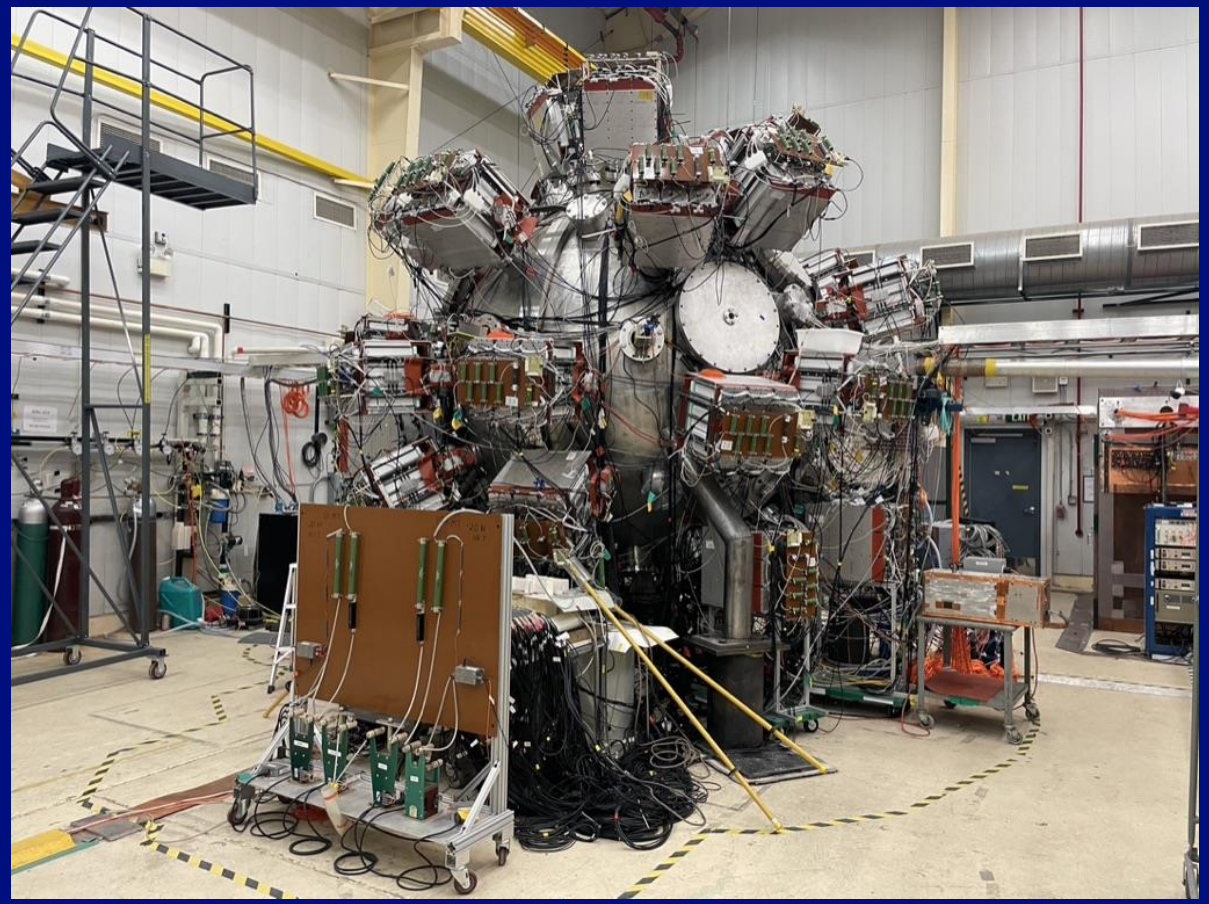
LA-UR-24-25691

Plasma Liner Experiment (PLX) at LANL

Our research is supported by

ARPA-E™

ALPHA & BETHE Program



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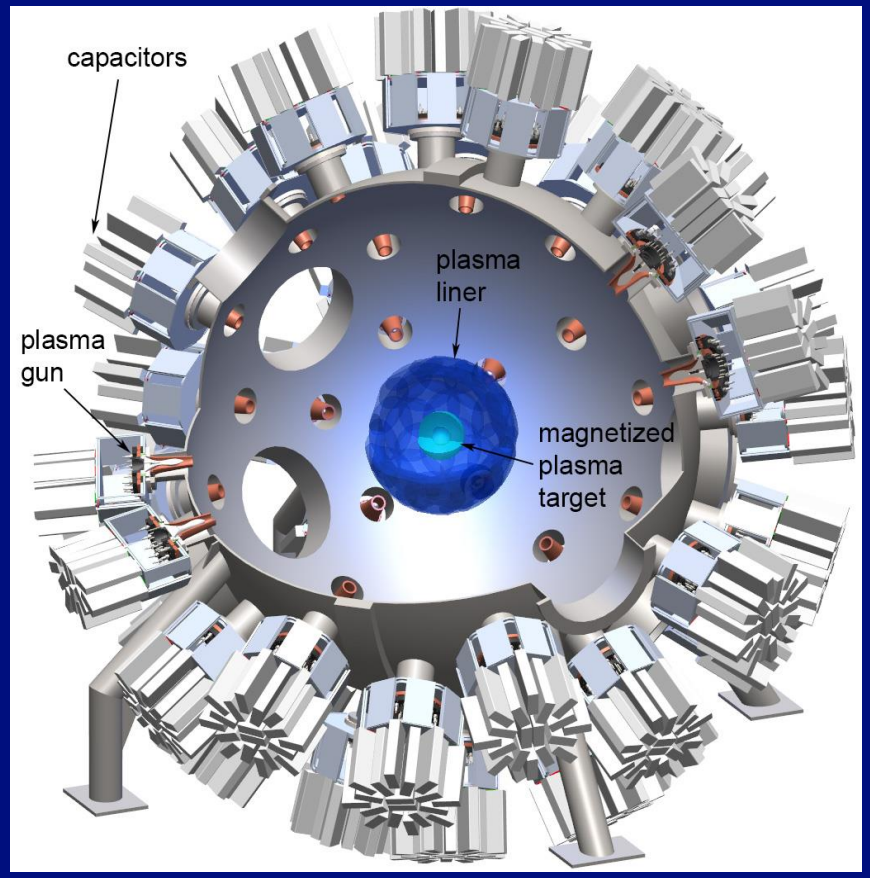
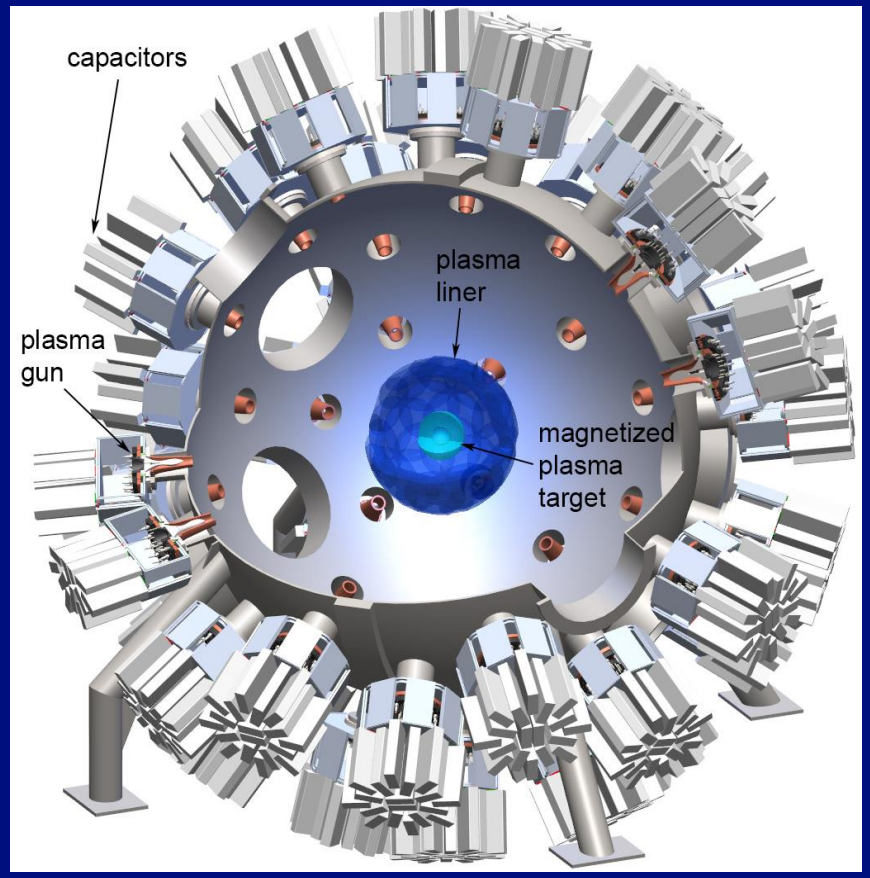
PLX Investigates a “Reactor-Friendly” Alternative Approach to Fusion Energy



- Magneto-inertial fusion (MIF) or magnetized target fusion (MTF) – blend of magnetic and inertial confinement concepts
- A magnetized plasma target is injected into the target chamber, and then compressed and heated by a heavy high-velocity plasma liner, assembled from discrete jets

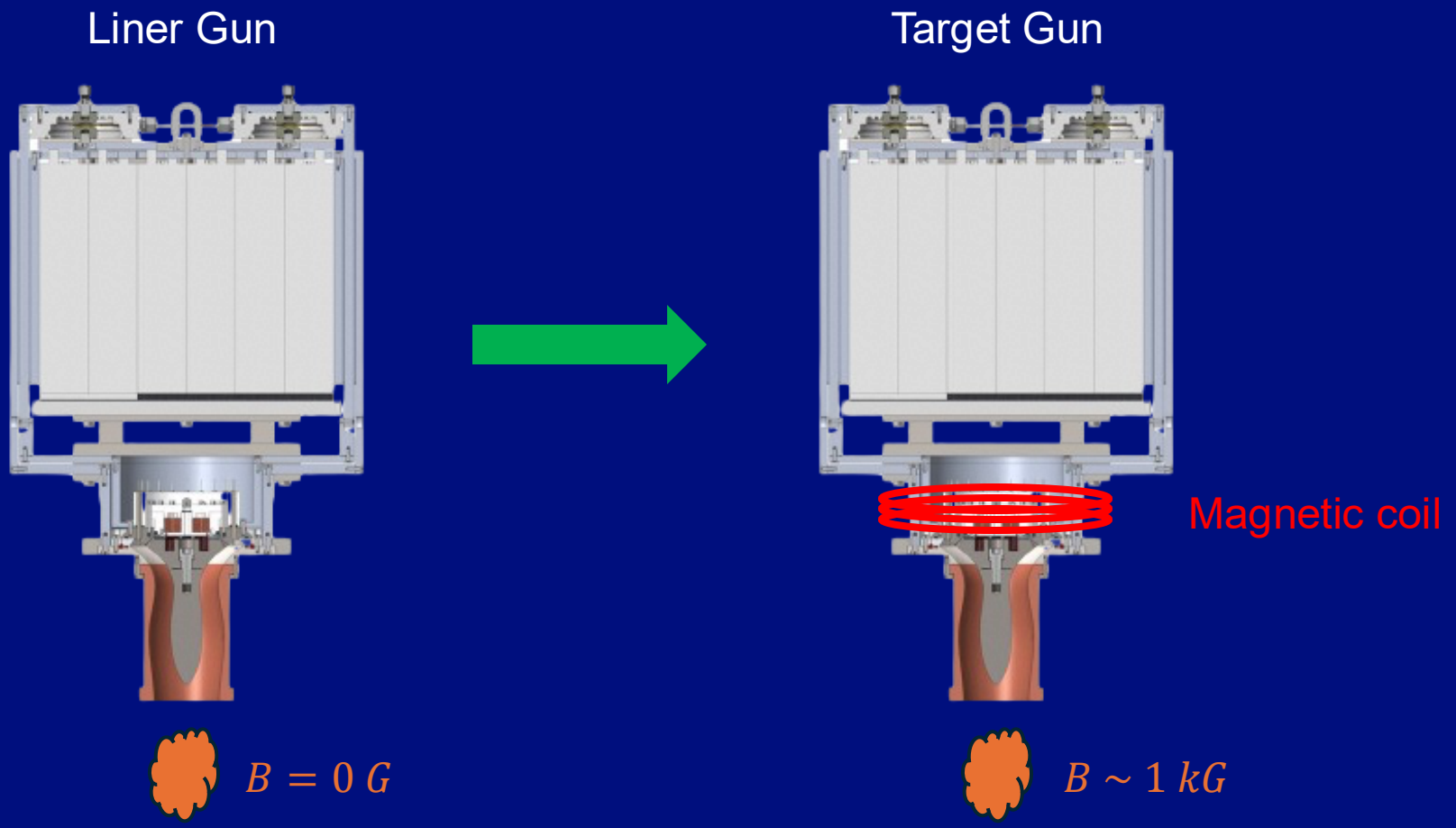
PLX Investigates a “Reactor-Friendly” Alternative Approach to Fusion Energy



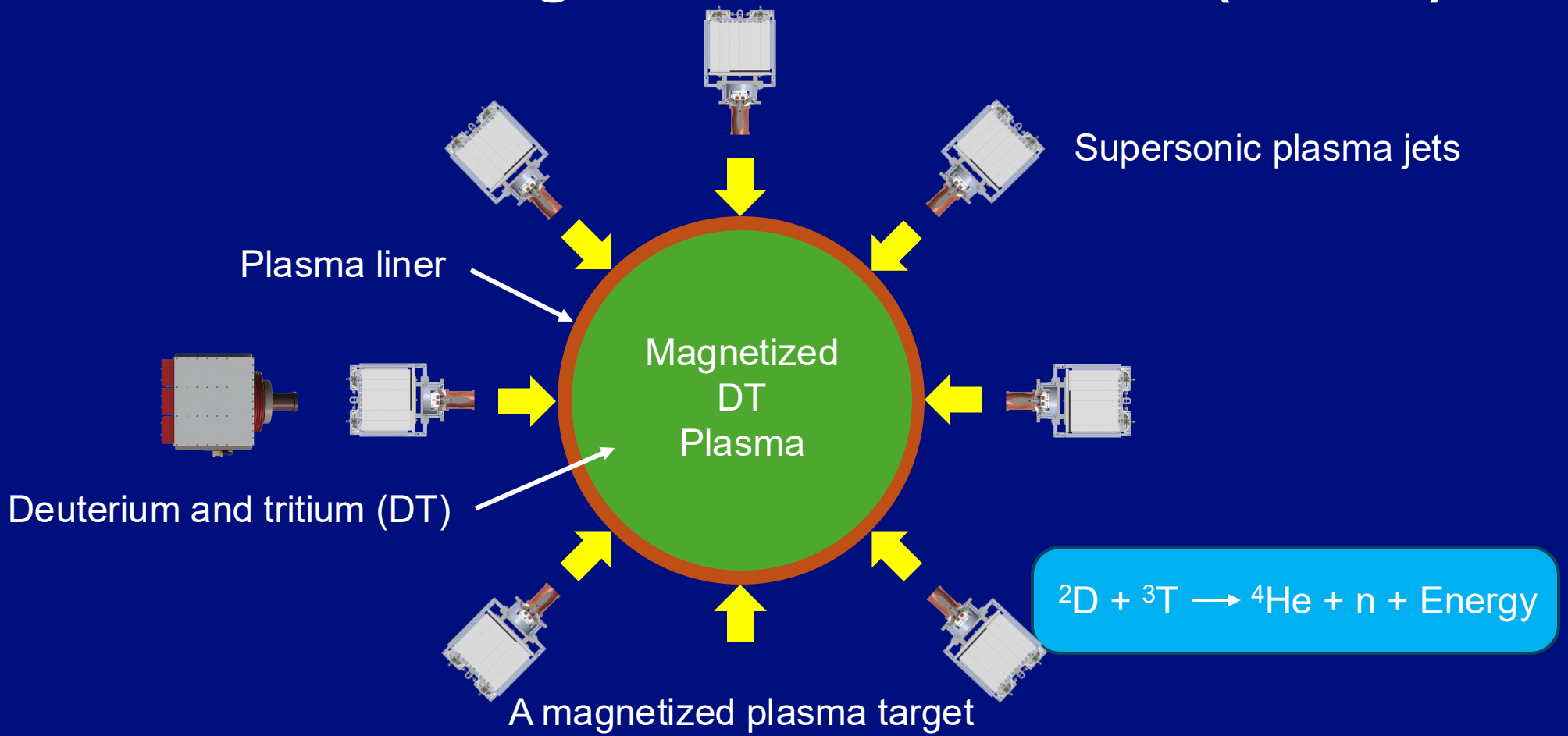
Experimental Scale:

- 3 m diameter spherical chamber
- 36 independent plasma jet drivers, “guns”
- Total stored energy = 0.25 MJ
- Pulsed operation, ~10 μs shots
- Plasma densities up to 10^{17} cm^{-3}

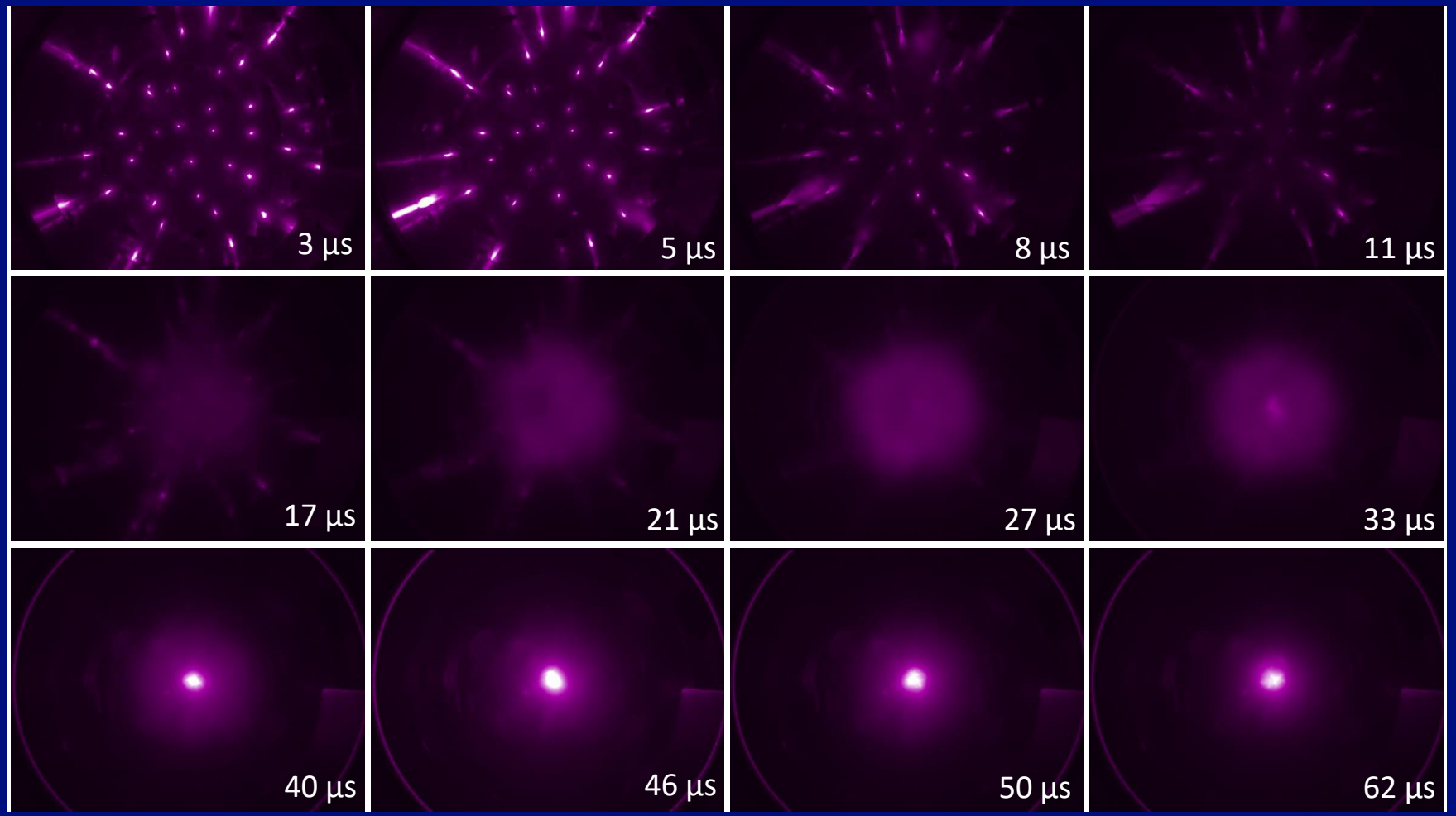
PLX Liner Gun vs. Target Gun



Plasma-Jet-Driven Magneto-Inertial Fusion (PJMIF)

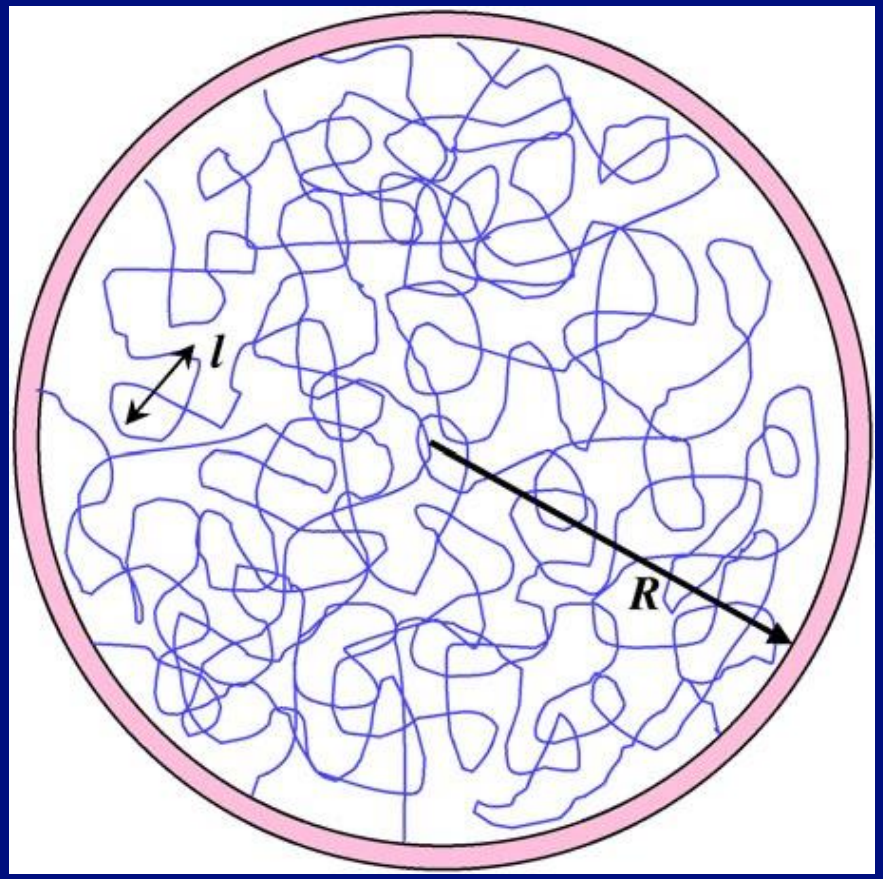


PLX Liner Formation (Argon Liner)



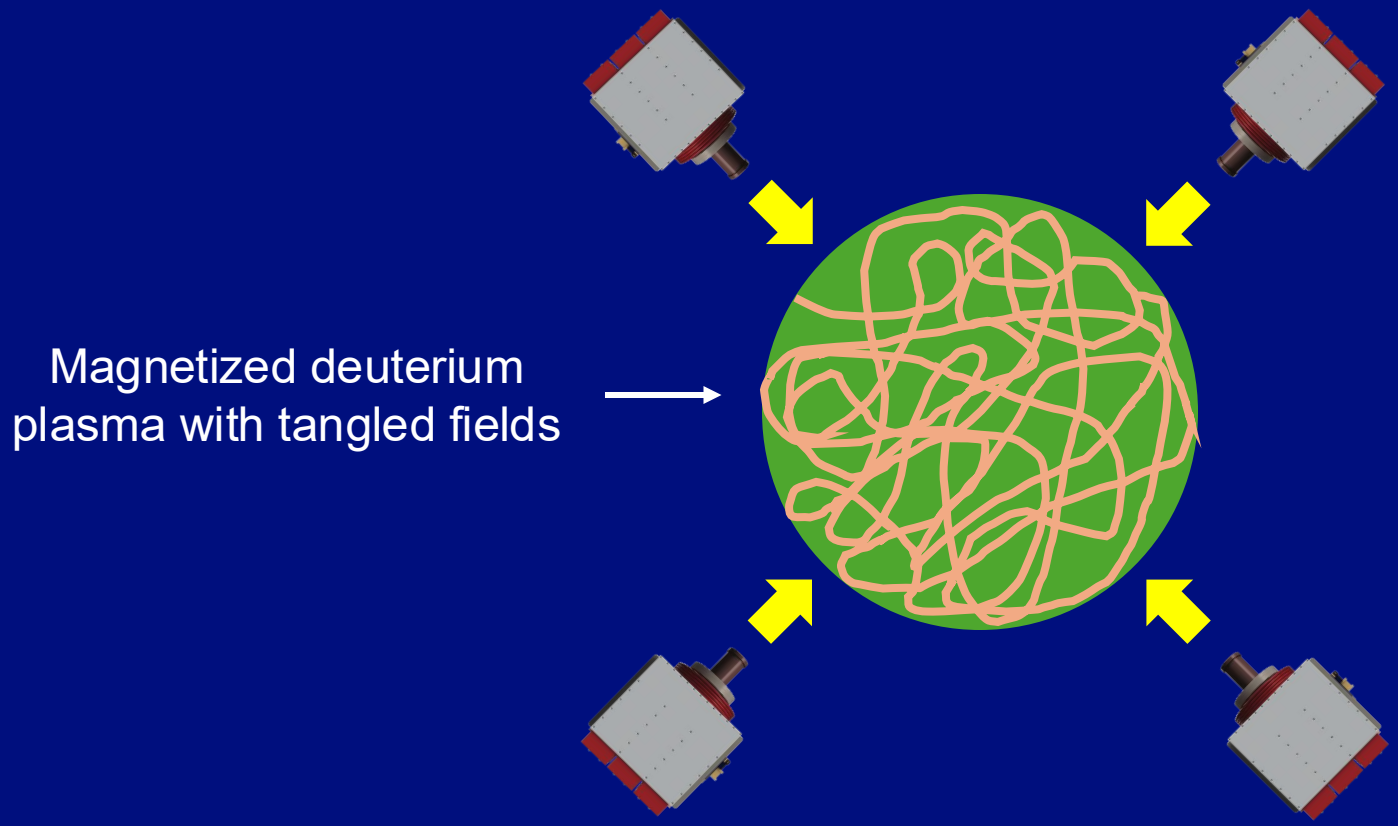
LaJoie et al, Phys. Plasmas **31**, 102701 (2024)

Target Plasmas with Tangled Magnetic Fields



- Stochastic fields provide very long connection lengths between the core and the liner surface, effectively reducing heat loss from the hot fuel plasma to the colder plasma liner
- High β (β > 1) plasmas do not typically suffer from MHD instabilities found in spheromaks or field-reversed configurations (FRC)

Target Formation Experiments will Begin Soon!



Forming a magnetized plasma target with four target guns,
compatible for spherical compression

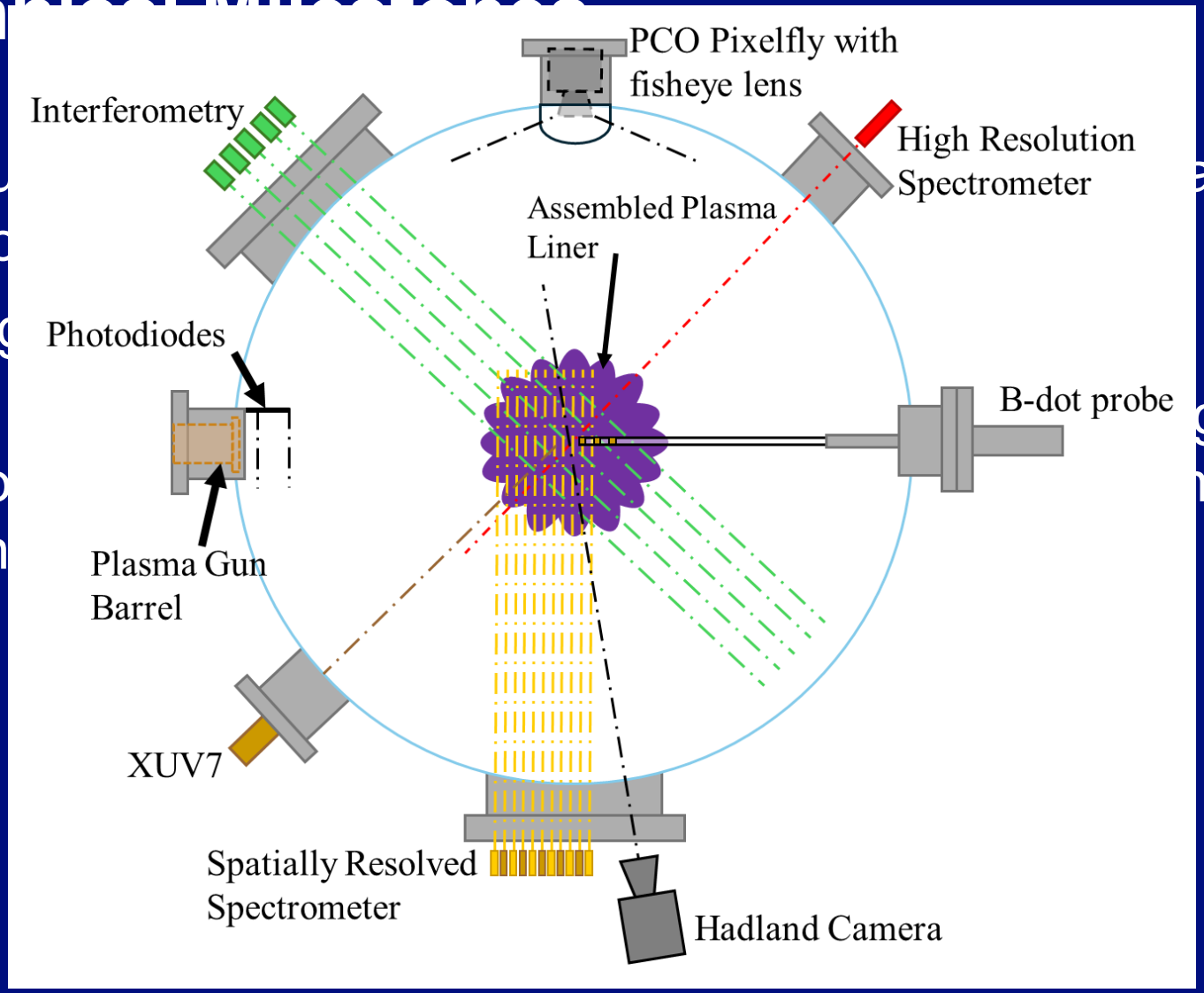
Magnetic Probe Array Recently Installed to Map the Magnetic Field in the Target

Probe assembly

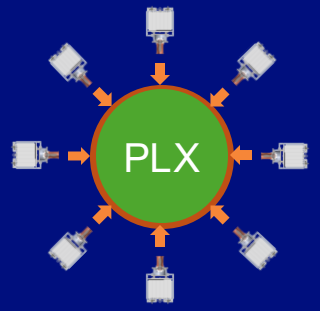
Digitizers and integrators

Future Technical Milestones

- We will continu ace such as various jet velo
- We will investig in the target
- Finally, we will grated experiments to mperatures of 100 eV or high



PLX Commercialization Roadmap



2015

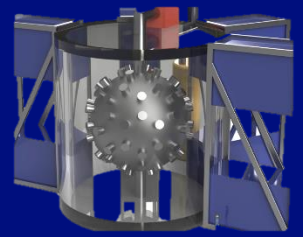
2025

- Explore short term application opportunities
- Investigate liner formation in parameter space such as various jet velocities and densities

- Expand IP portfolio
- Industry day (**July 30**) to outline industry alignment with commercial opportunity
- Investigate plasma target formation and magnetic field in the target

2026

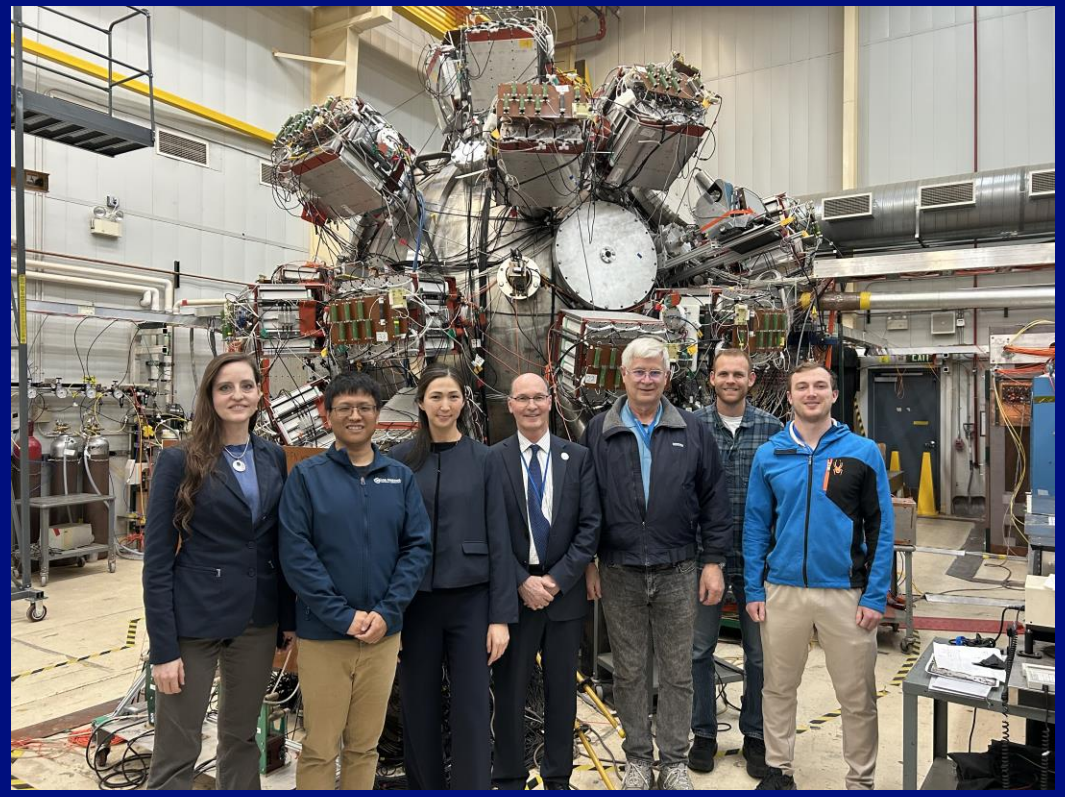
- Formalize partnership(s) for testing & validation of technical milestones and early T&V applications
- Spin out PLX into a commercial venture



2029+

- Perform integrated experiments towards the objective of reaching compressed temperatures of 100 eV or higher

Thank You!



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