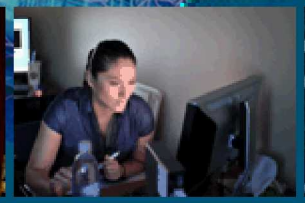
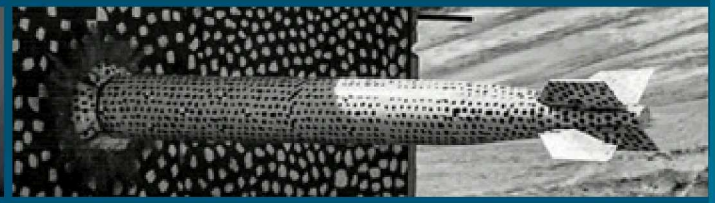
SAND2018-8294C

Plasma Transport Platform Development Summary





PRESENTED BY

Patrick Knapp

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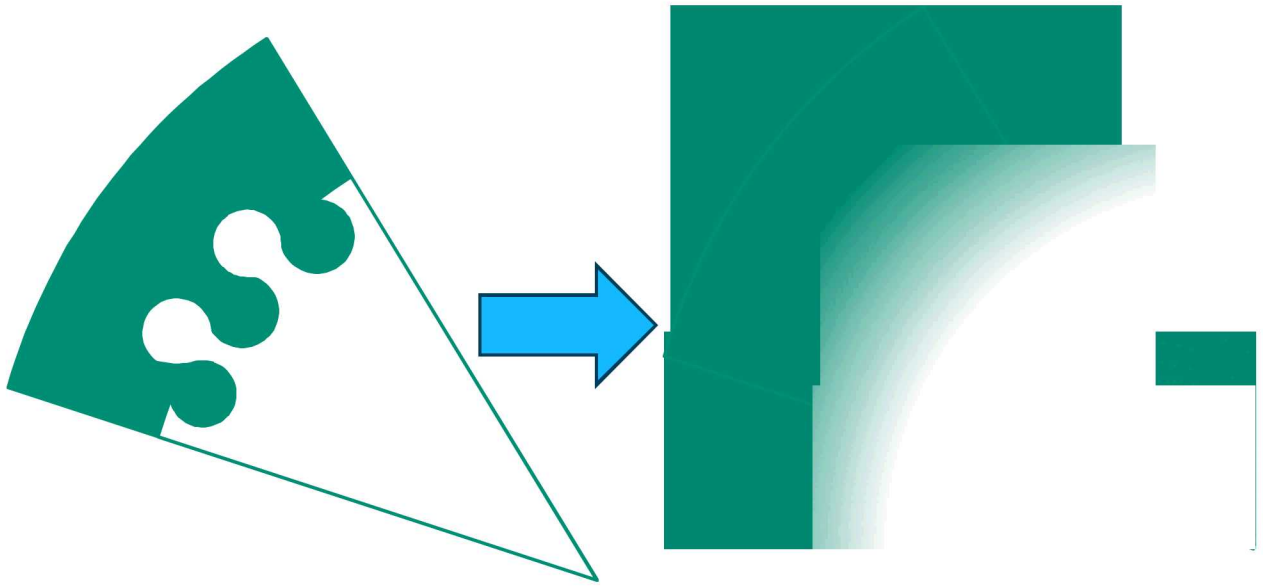
This project has been a large interdisciplinary effort

- Diagnostic Development
  - E.C. Harding, M. Schollmeier, G.P. Loisel, S.B. Hansen
- Sample Development
  - S.B. Hansen, P.J. Christenson, P.F. Knapp
- Target Fabrication
  - Haibo Huang, Reny Paguio, Brian Stahl
  - *General Atomics, La Jolla, CA*
- Modeling and Source Development
  - Roger Vesey, P. J. Christenson, K. Beckwith

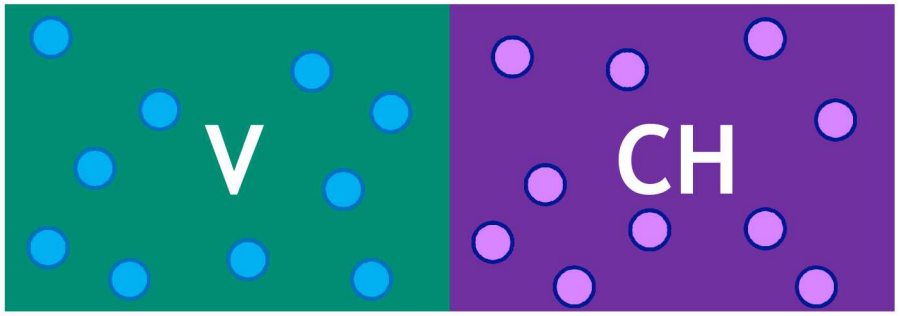
Understanding material transport across an interface is fundamentally tied to our understanding of mix

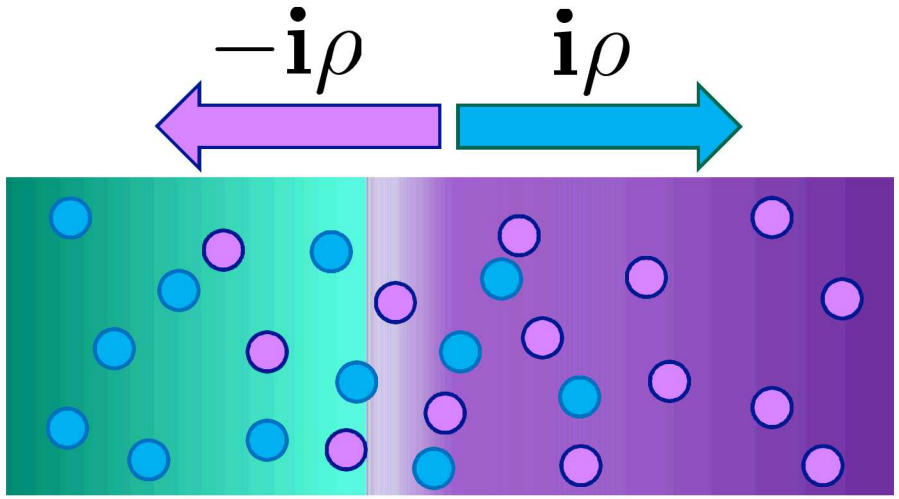


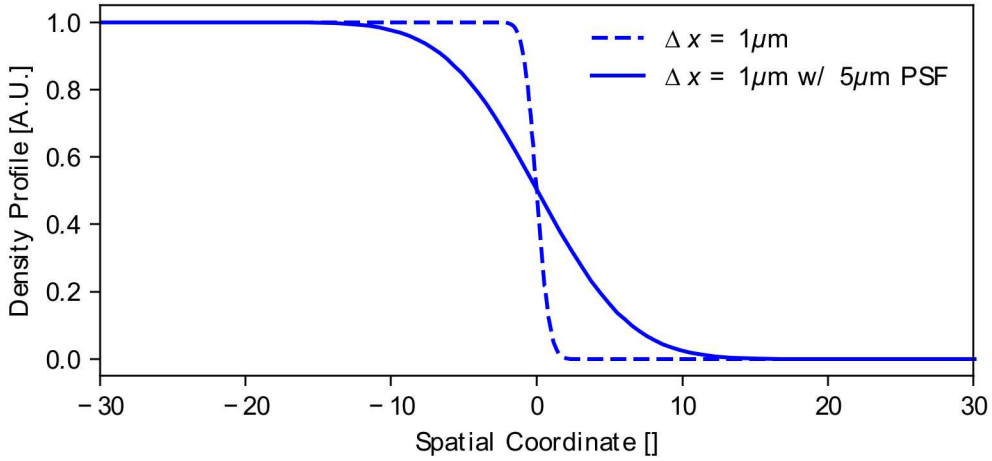
- How does an interface go from perturbed to mixed
- Is it just hydrodynamic stirring/turbulence?
- What role does diffusion play?

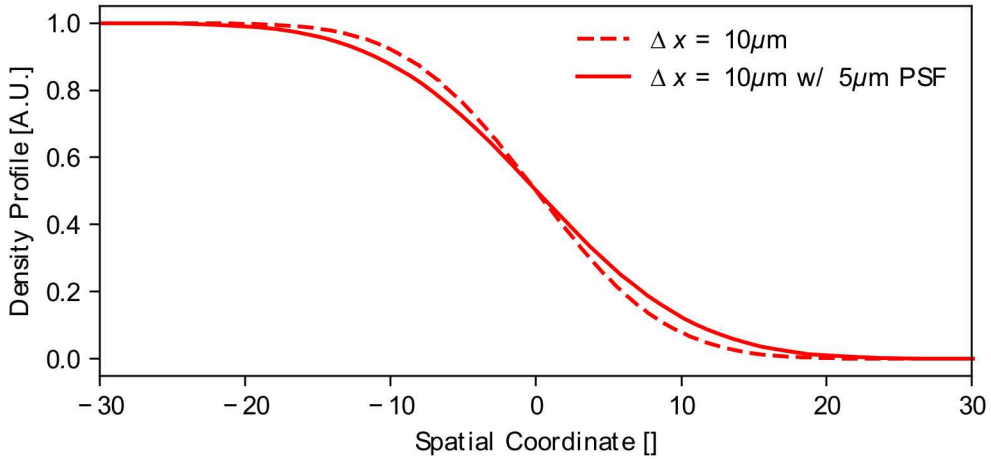
- In addition to distorting the hotspot shape and introducing vorticity, perturbations will
  - increase the surface area available for transport processes
  - decrease the scale length over which transport needs to operate to mix a volume
- Unfortunately fluid models don't account for transport processes well, particularly in strongly coupled plasmas

We want to measure the "blurring" of an interface between a strongly coupled mid-Z element and a low Z material



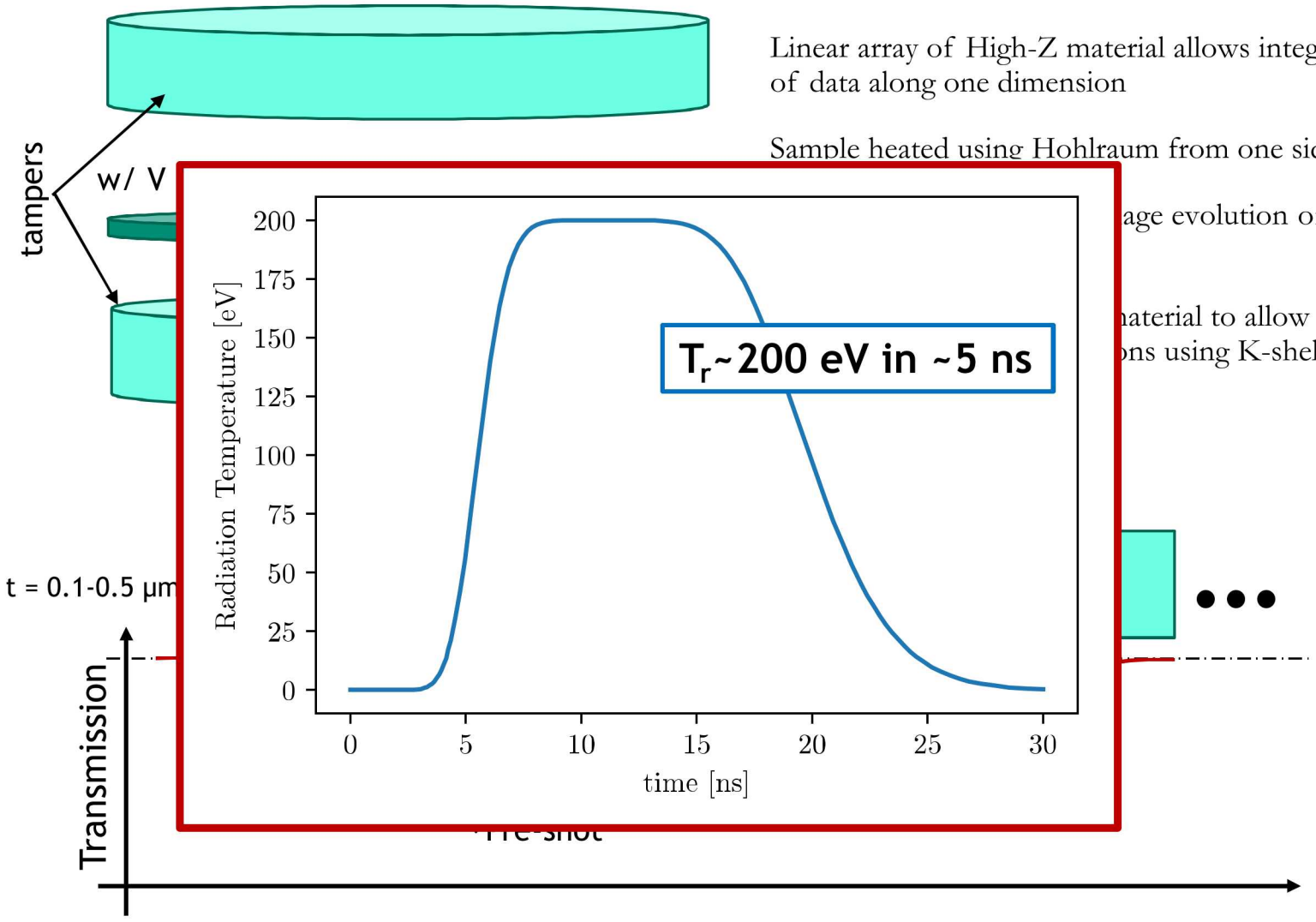






Plasma Transport Sample and Diagnostic Concept

Conceptual Sample



Half moon sample allows transmission to be obtained from the attenuation

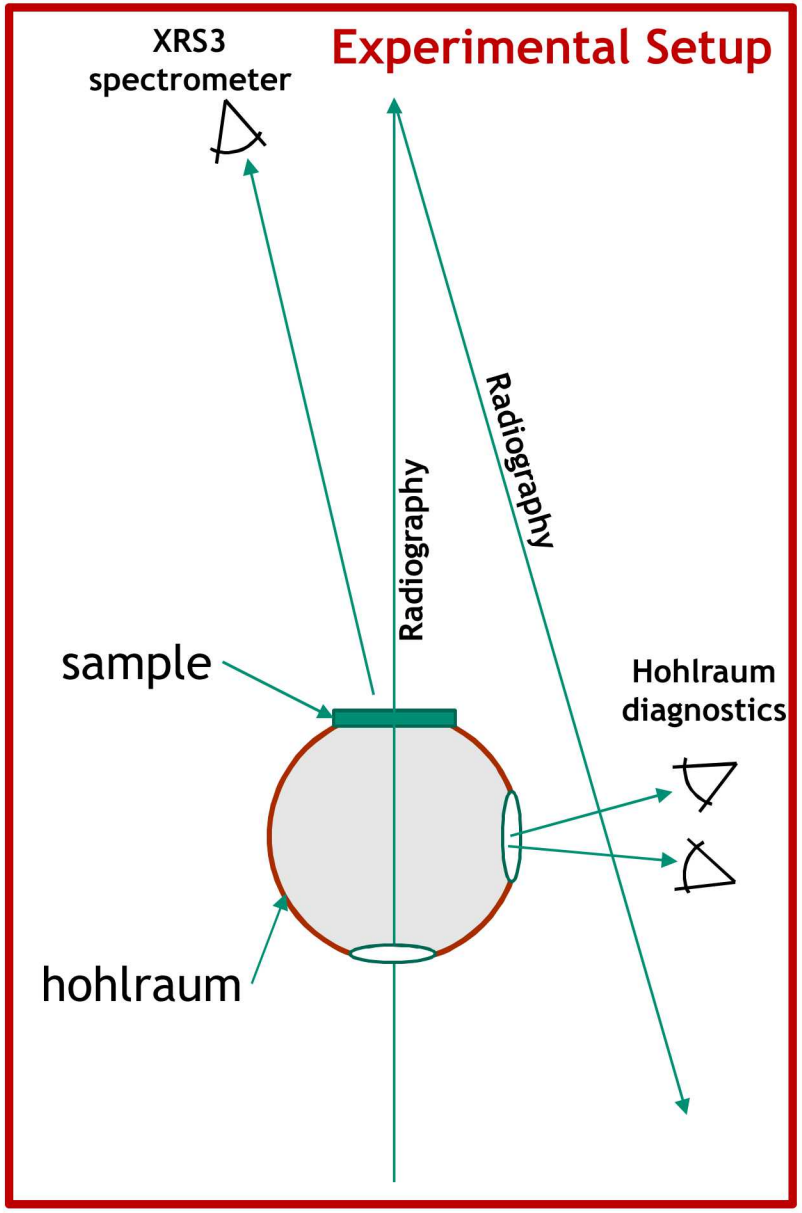
Linear array of High-Z material allows integration of data along one dimension

Sample heated using Hohlraum from one side

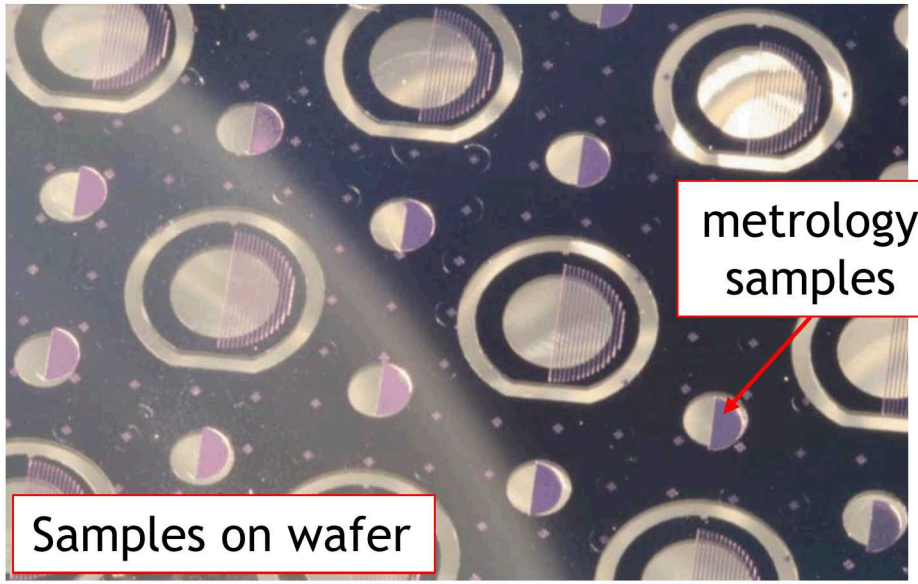
age evolution of high

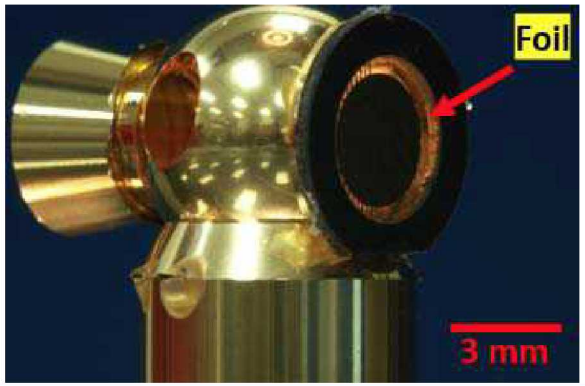
aterial to allow
ons using K-shell

Experimental Setup

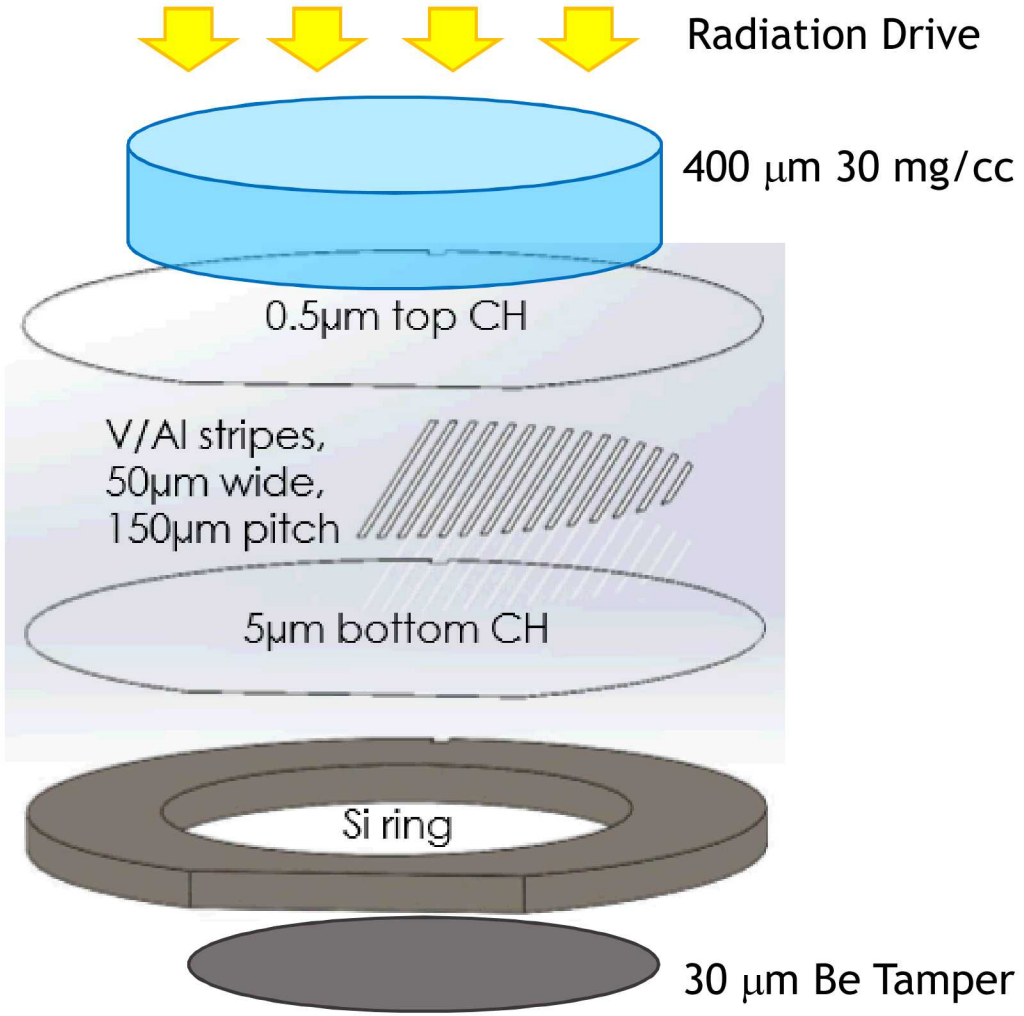


Fabrication of the sample required significant R&D by general atomics





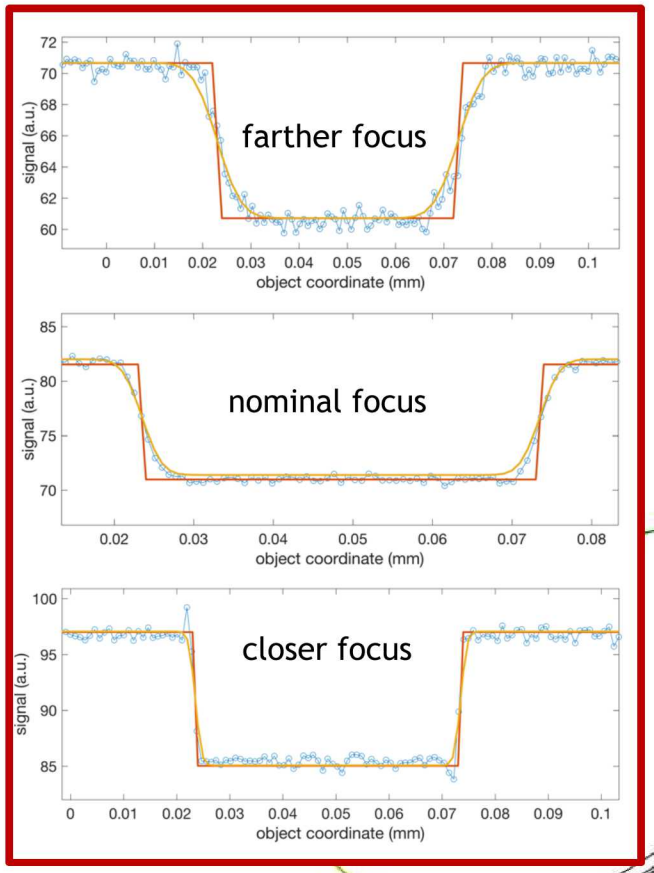
Sample on hohlraum w/ Be tamper attached

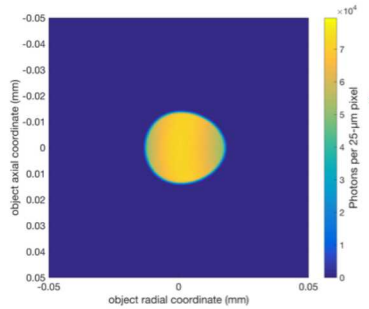


- Requirement of sharp interface led to use of lithographic technique
- Significant effort in metrology for areal density, mixture properties, and edge widths

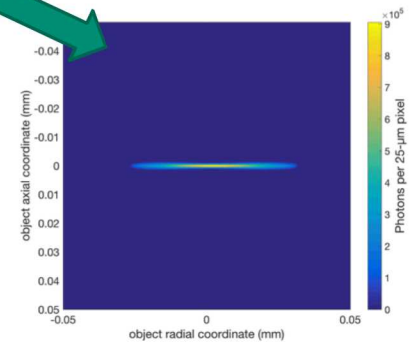
Material provided by Haibo Huang, General Atomics

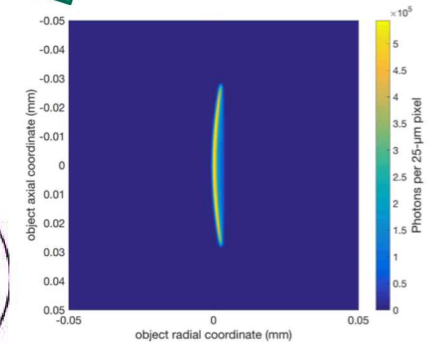
The Spherical Crystal Backlighter on Z is the primary diagnostic for these experiments



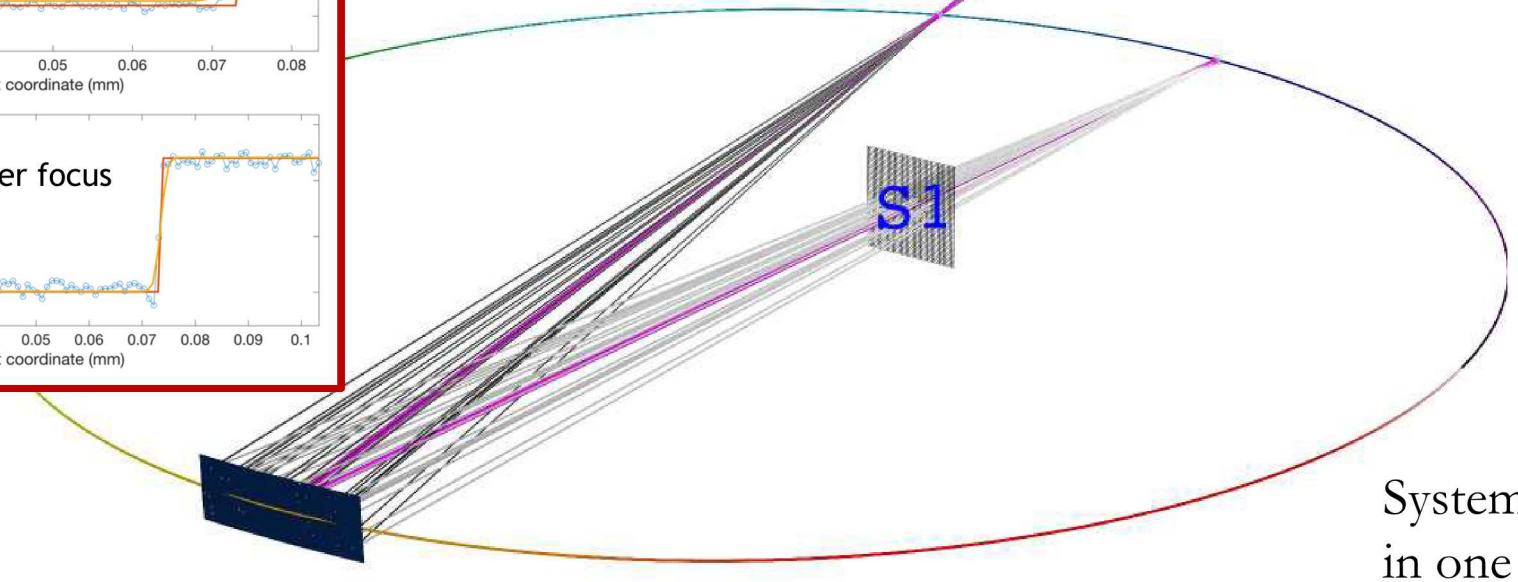


nominal focus





closer focus

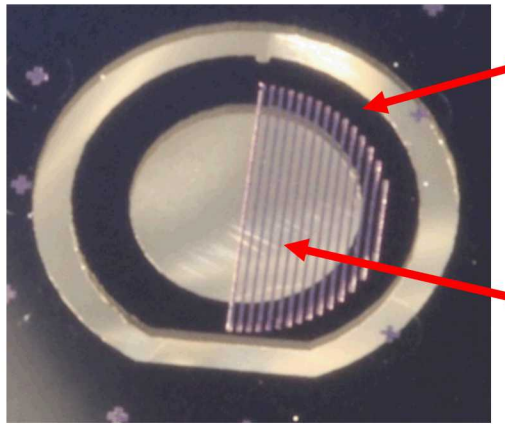


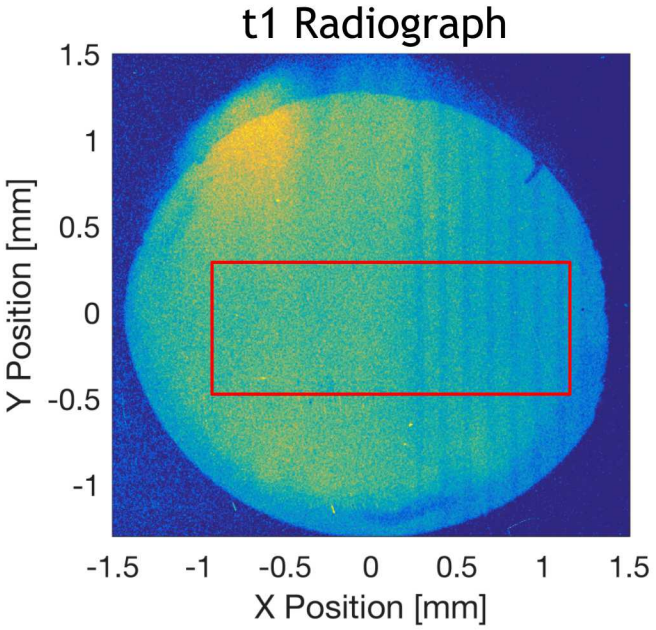
System can be optimized for resolution in one dimension, exploiting the 1D nature of the sample

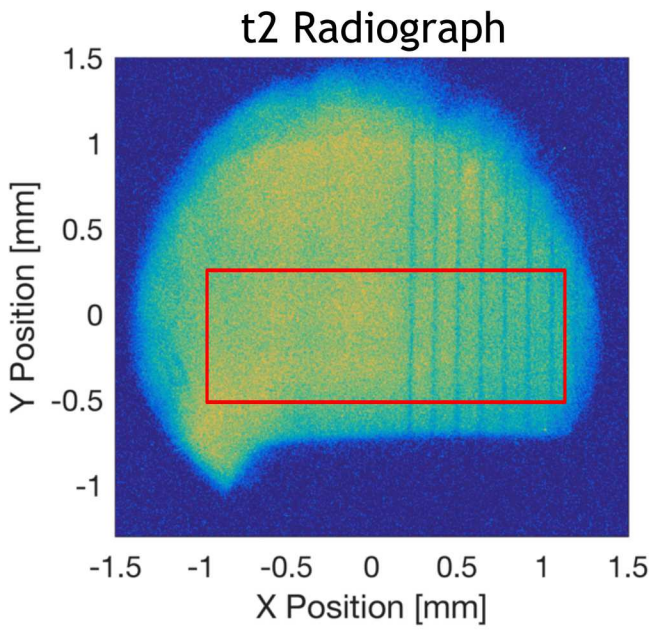
Ray tracing performed by Marius Schollmeier

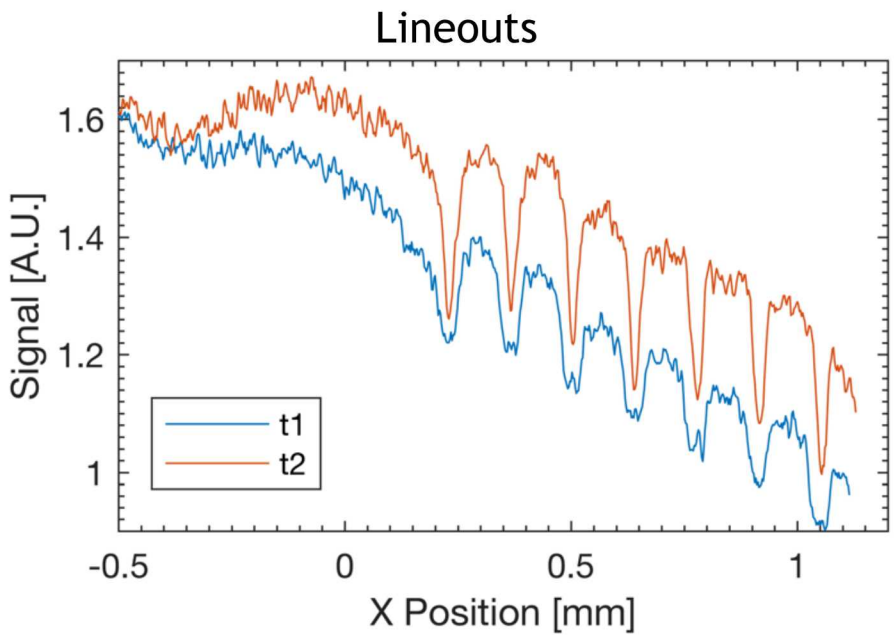
Shot z3220 was the first ever plasma transport experiments have been executed on Z demonstrating the feasibility of the proposed measurement

- Executed two experiments in March testing x-ray heating and diagnostics performance
- Demonstrated good contrast of the sample in the radiographs on shot z3220 (6.1 keV backlighter with detector placed at closer focal position)









Future Work

- We are pursuing alternate heating mechanisms to achieve higher heating rates (more impulse-like) and a more isochoric heating profile with less hydro-motion
- We are also pursuing alternate sample configurations that could allow new diagnostics to be used that don't have such stringent spatial resolution requirements
  - X-ray scattering techniques (Diffraction, SAXS, Thomson Scattering, etc.)
  - Fluorescence measurements (x-ray or e^- induced)
- This platform is well suited to development on other facilities to help bring the diagnostics and physics to a more mature state