Sandia National Laboratories

# Mining magnetized liner inertial fusion data: trends in stagnation morphology

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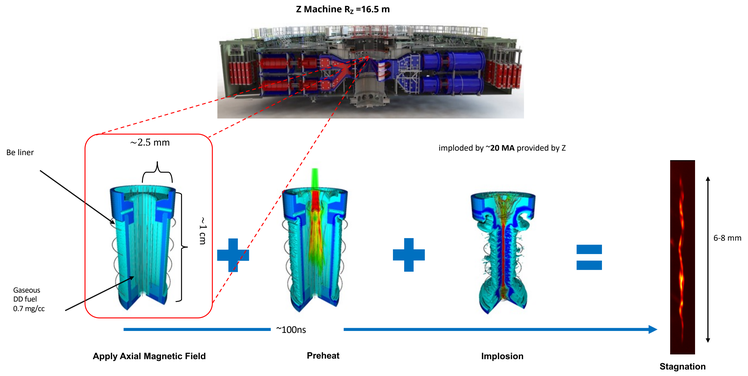
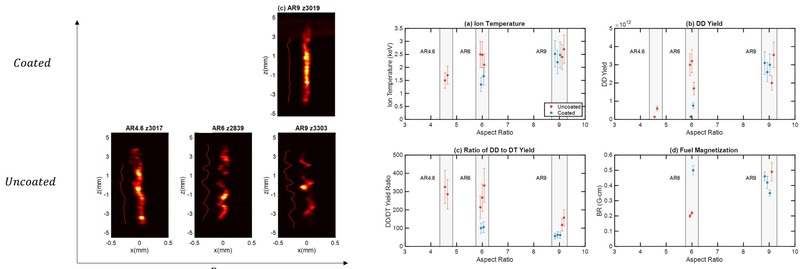
## Introduction:

Magnetized liner inertial fusion (MagLIF) is a magneto-inertial fusion platform fielded at Sandia's Z Pulsed Power Facility. The concept relies on three key stages to harness electrical energy from Z to compress a premagnetized and laser preheated fusion fuel. In fully integrated experiments, the fuel is diagnosed primarily through x-ray and neutron emission.




## Observation:

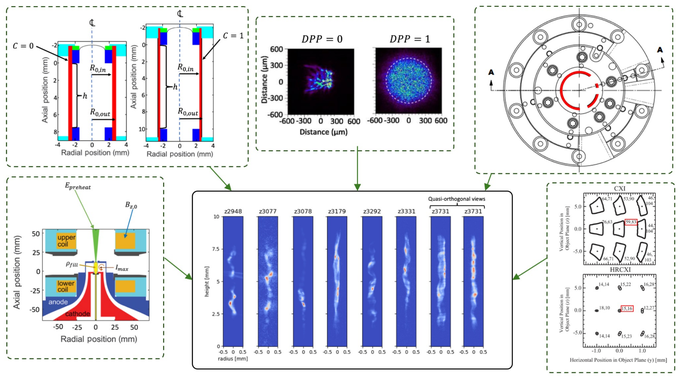
Self-emission x-ray images of the MagLIF stagnation column as well as neutron yield appear to exhibit systematic variation versus liner aspect ratio (*i.e.* thickness) and application of dielectric coating. Observed variation is qualitatively consistent with theoretical expectations of sources of instability growth that reduces compression and confinement of the fusion plasma.




$$AR = \frac{R_{0,in}}{R_{0,out} - R_{0,in}}$$

## Question:

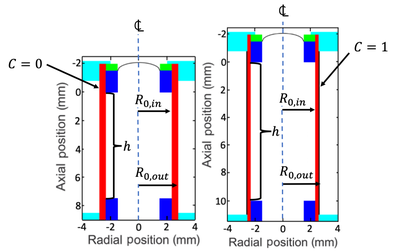
What other sources of variation in morphology may be evident upon exploring the entire MagLIF experimental database?



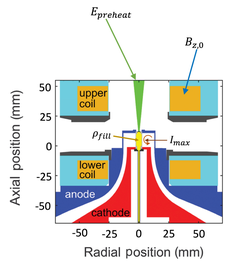
## Input data:

We select a wide variety of data sources characterizing experimental inputs and diagnostic configurations to explore additional sources of morphological variation.

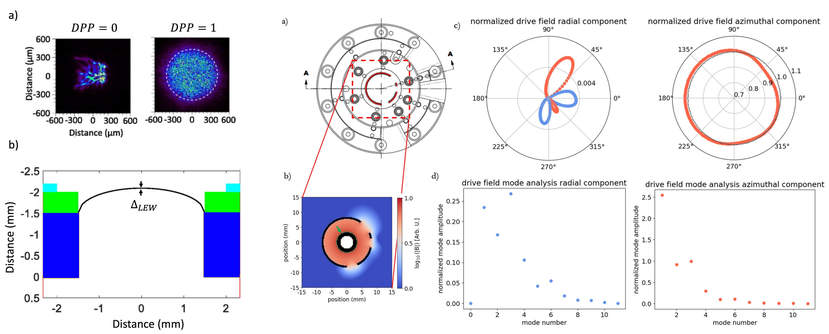
Liner parameters



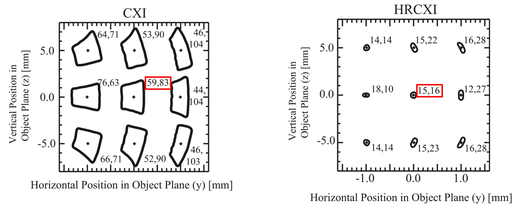

Integration parameters




Laser preheat protocol and magnetic drive protocol parameters

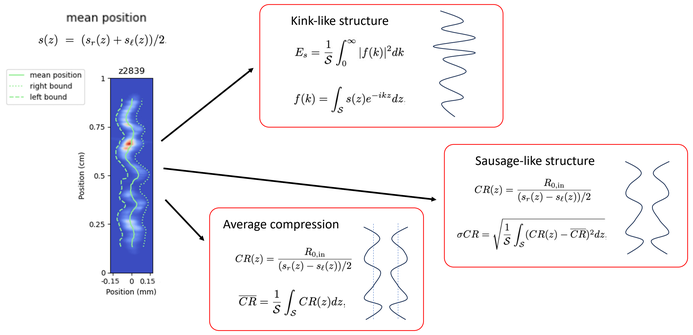



Diagnostic parameters



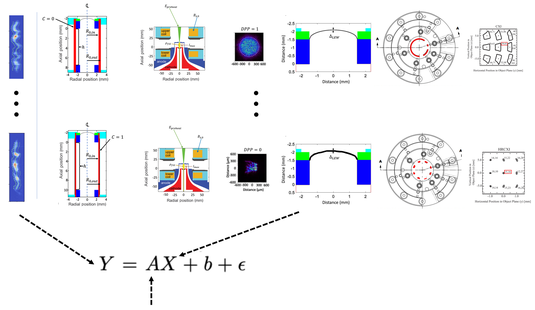

## Output data:

We characterize stagnation morphology by three distinct parameters describing kink-like structure, overall compression, and sausage-like structure.




## Data exploration:

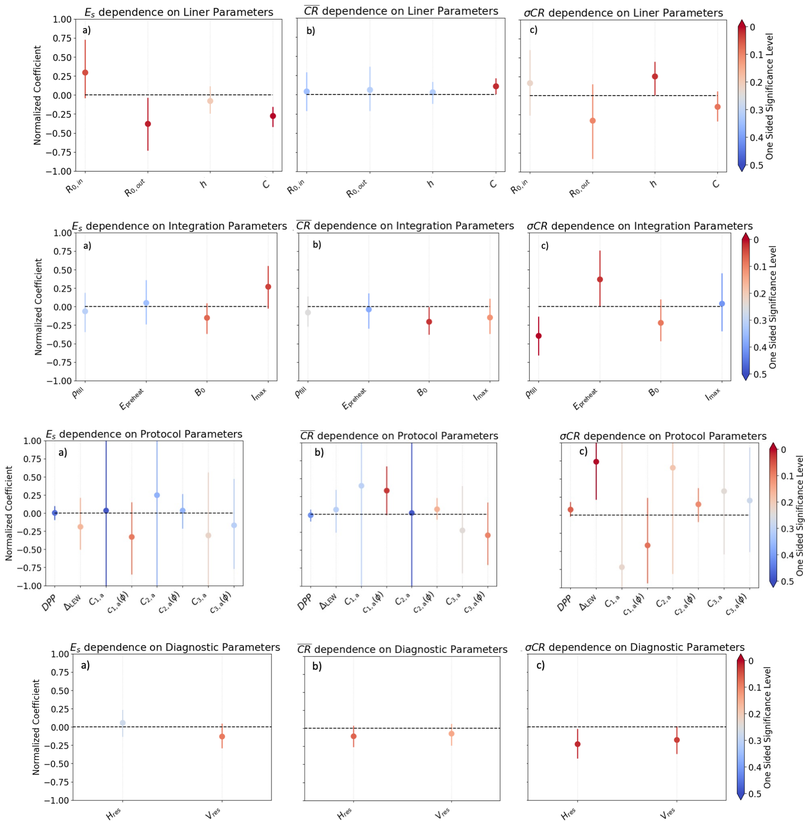
We utilize linear regression to assess correlations between inputs and morphology.




Coefficients measure the linear correlation between an input and the morphology parameter under consideration.

## Results:

Correlation coefficients may be explored revealing consistency with a variety of effects. For example, correlations are consistent with original motivating observations. We also see first ever indication that magnetic field strength appears to measurably stabilize against kink-structure in *integrated* MagLIF experiments. Average compression does not appear to be impacted by inner and outer radii, which may hint at dominance of 3D effects. Return can structure and laser preheat protocol exhibit a variety of interesting correlations, while diagnostic resolution behaves as expected.

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