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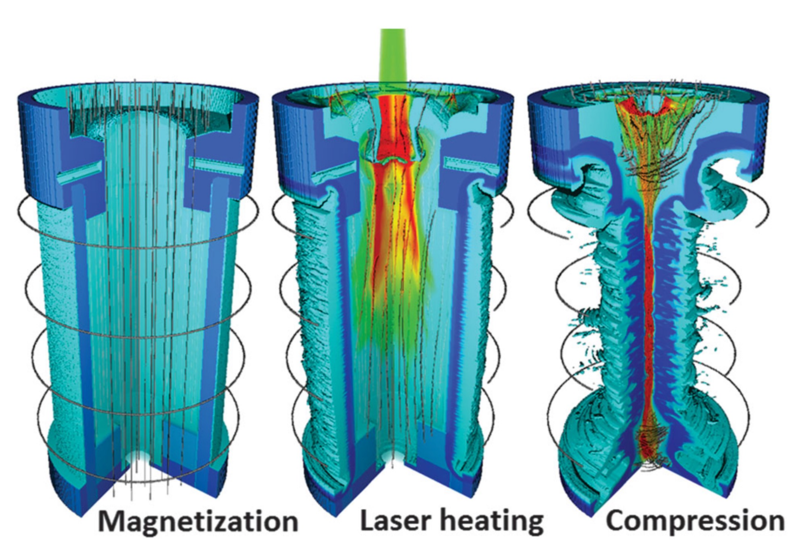
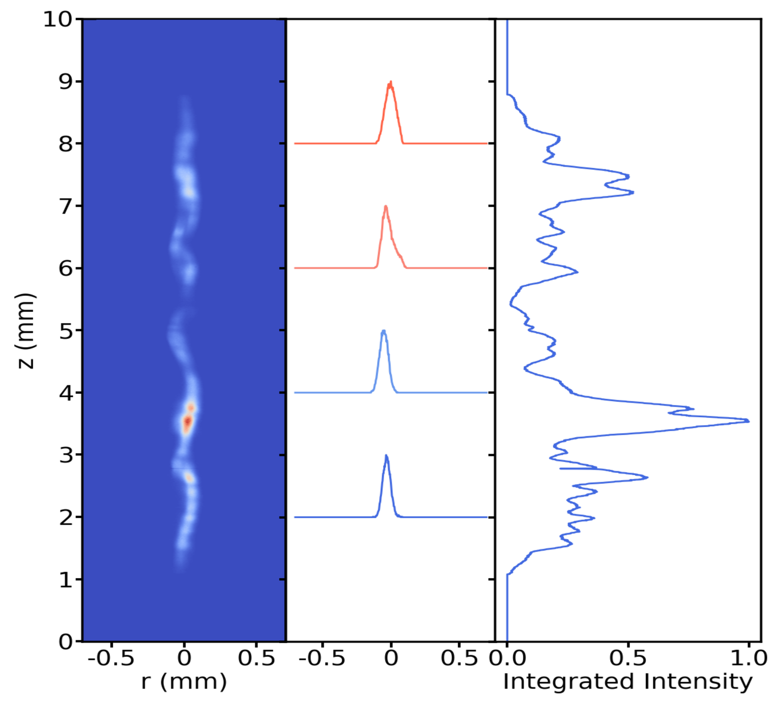
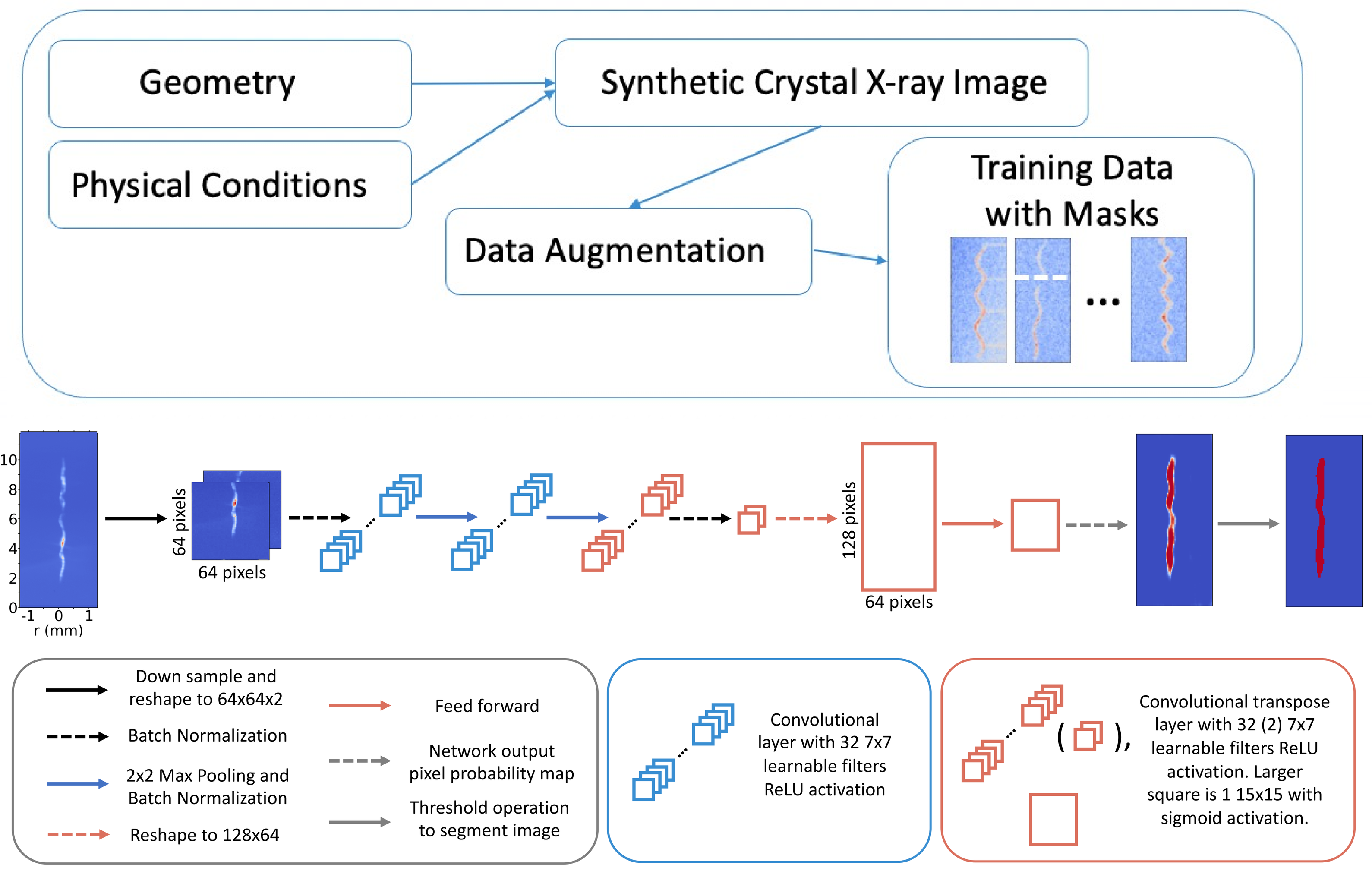
The many faces of Magnetized Liner Inertial Fusion: A data-driven approach to model-free characterization of image metric sensitivities for stagnation imaging applications

Magnetized Liner Inertial Fusion produces a hot (multi-keV) dense (~1 g/cc) cylindrical D_2 plasma. Imaging of self-emission x-rays from the fuel with different photon energy ranges provides diagnostic access to the spatial distribution of plasma properties (e.g. T_e) and characterizes plasma morphology. [1,2,3]

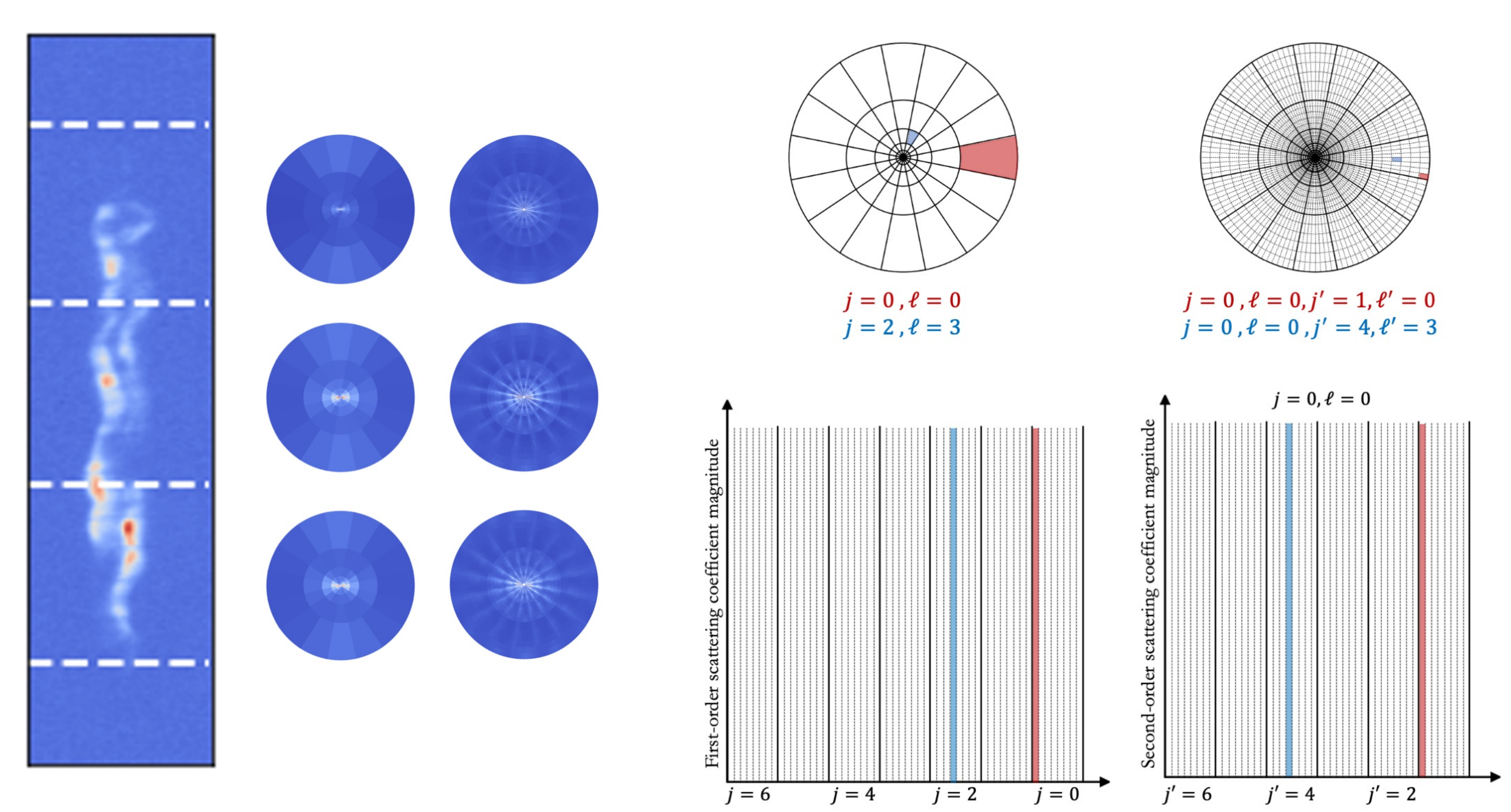




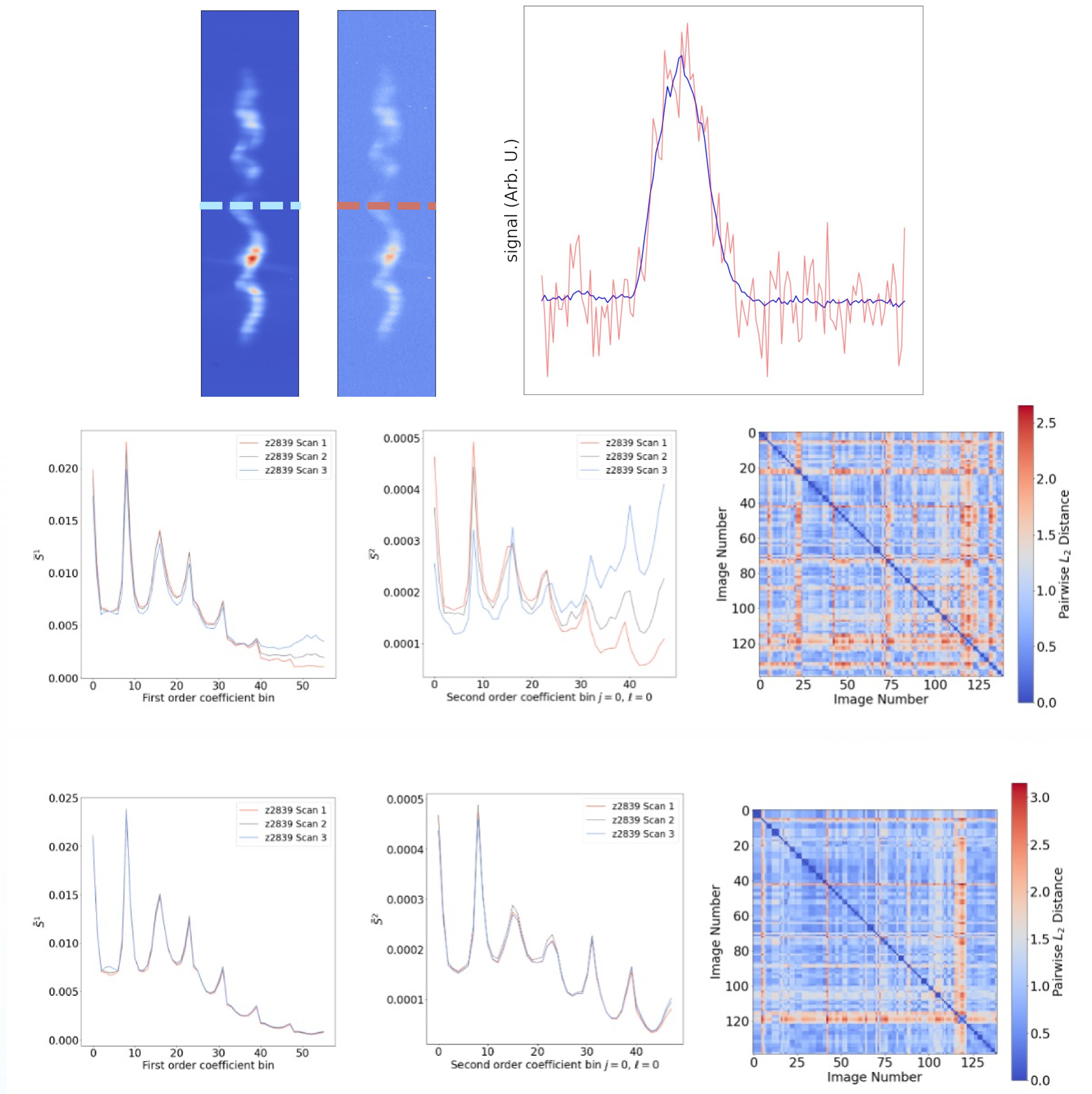
Convolutional neural networks can be leveraged to introduce automated reproducible workflows and enable accurate UQ in background removal.



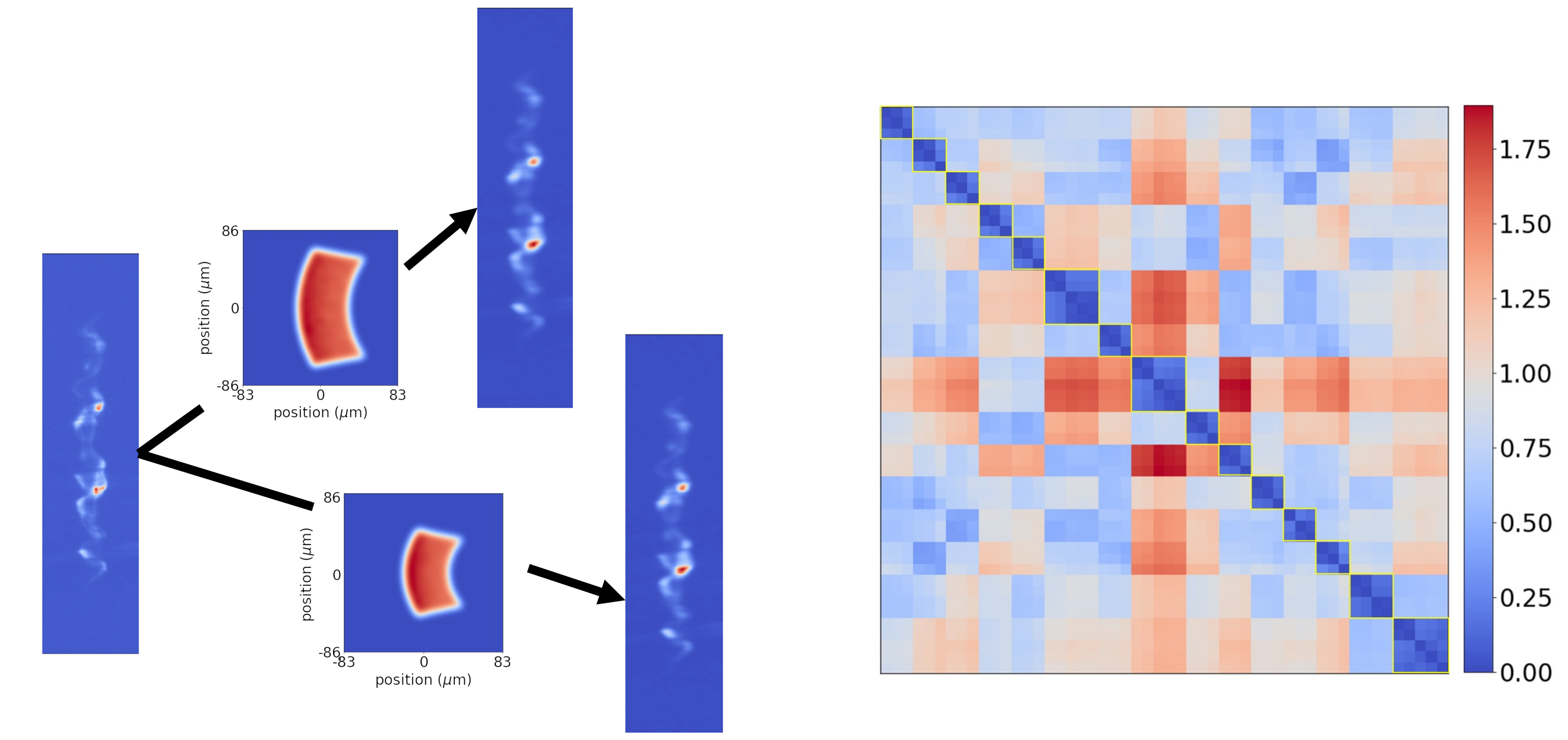
Fixed weight convolutional networks such as the Mallat Scattering Transform (MST)[3,4] provide a route to image comparison.



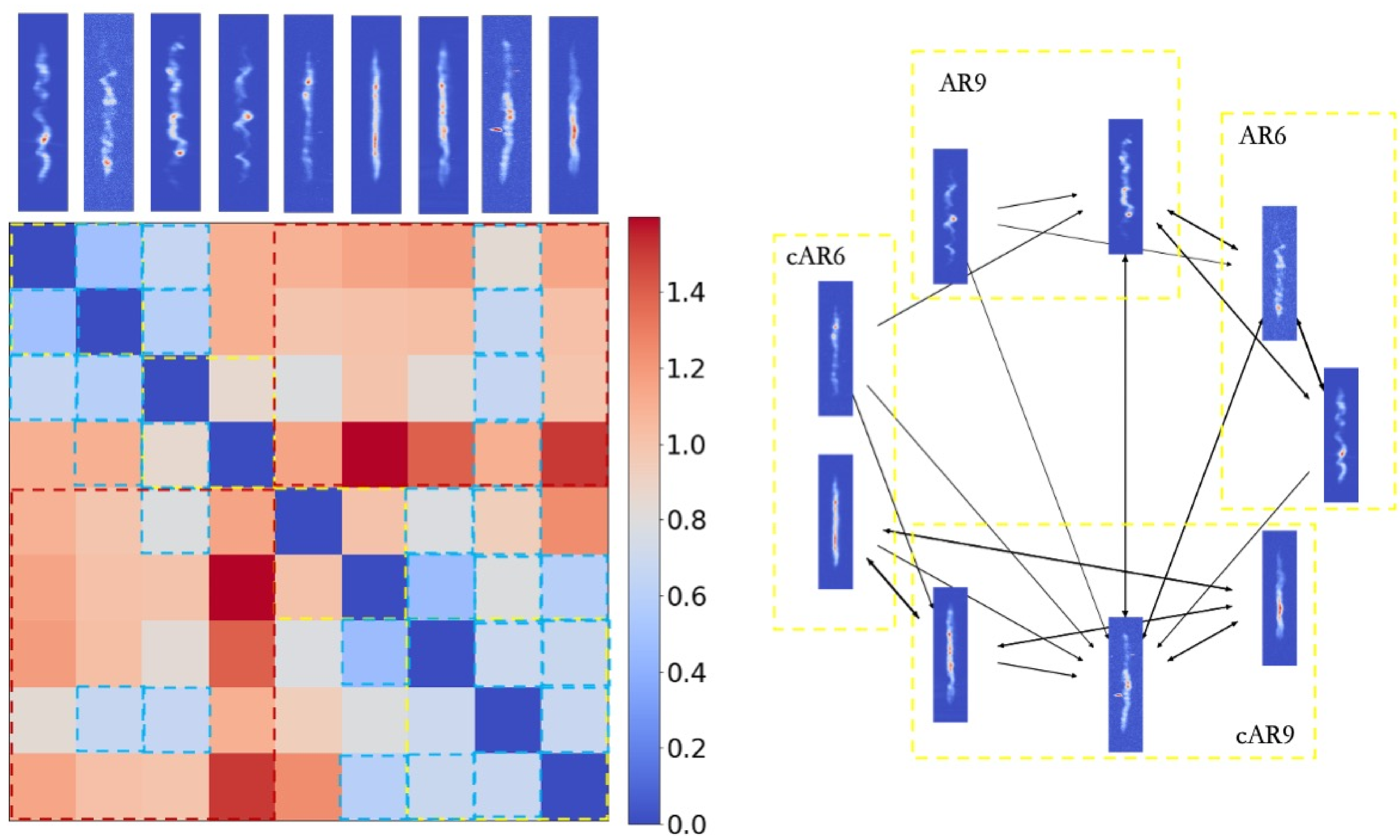
Use of MagLIF stagnation image database allows a simple *model-free* assessment of image metric sensitivities to instrumentation and fielding induced features such as *signal-to-noise ratio*.



Applying point-spread-functions from ray tracing to high-resolution images allows an assessment of imager resolution impact on image metrics.



Appears sensitive to morphological similarity for example effectively distinguishing between visually distinct stagnation structure produced by dielectric coated and uncoated liners described in Ref. [5].



In summary, historical MagLIF data and modern analysis techniques can be used to aid in image metric design and provide insight into when and how different MagLIF spherical crystal x-ray imaging modalities can be quantitatively compared.

References:
[1] E. Harding *et al.* In Preparation.
[2] P. Knapp *et al.* Submitted.
[3] M. Glinsky *et al.* Phys. Plasmas **27**, 112703 (2020).
[4] J. Bruna and S. Mallat IEEE Trans. Pat. Analysis and Mach. Intelligence **35**, 1872 (2013).
[5] D. Ampleford *et al.* In Preparation.

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