

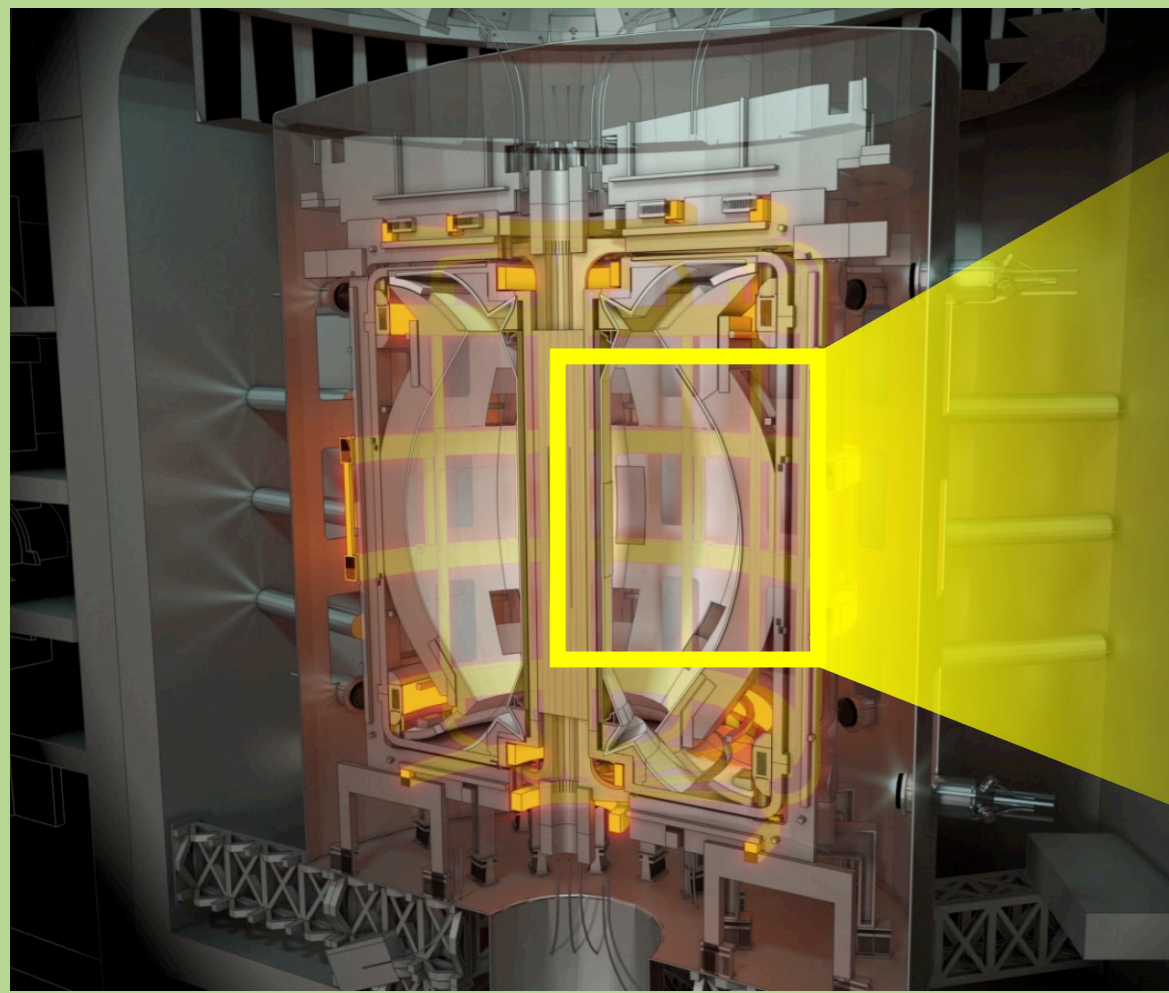
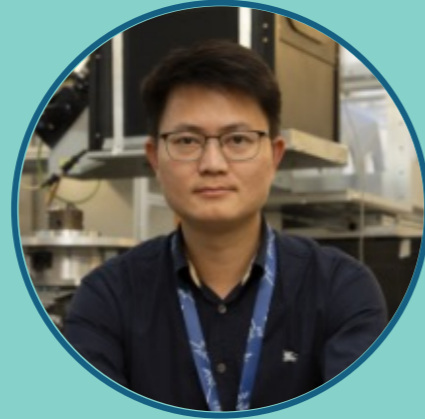
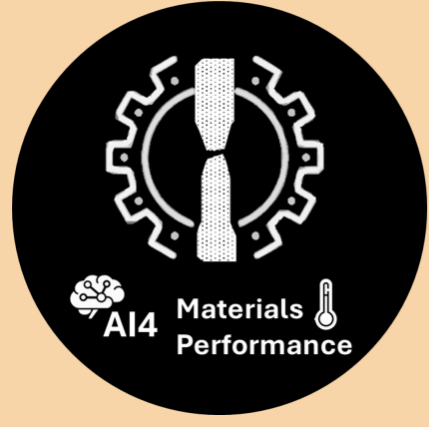
Machine Learning Enabled 3D Inspection of Complex Joints for Improved Structural Integrity

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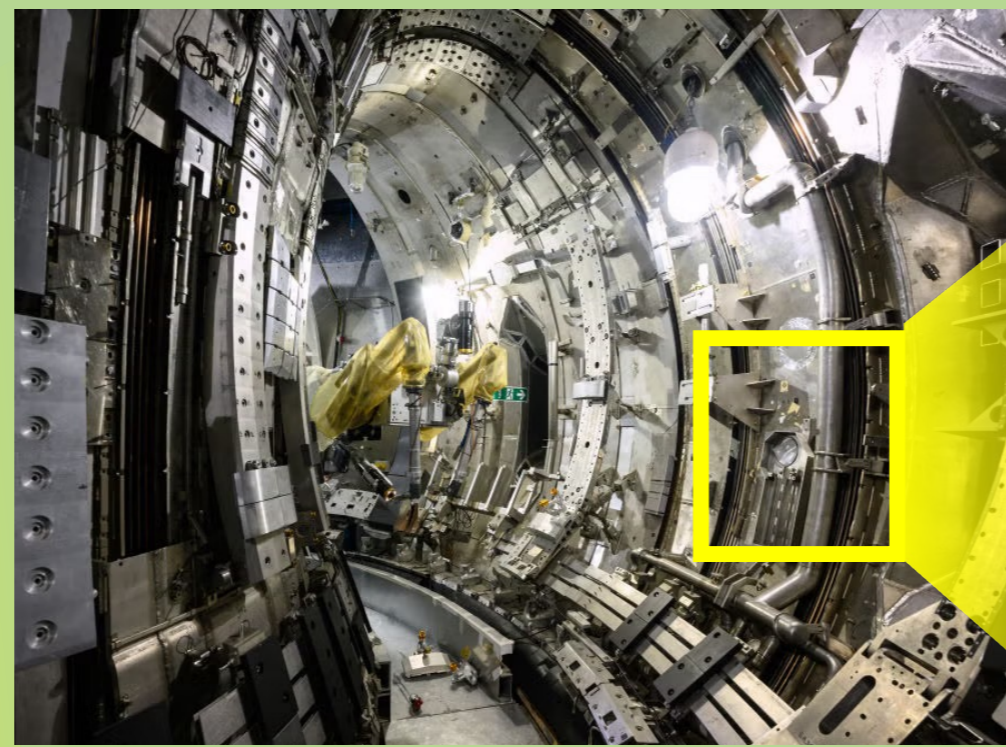
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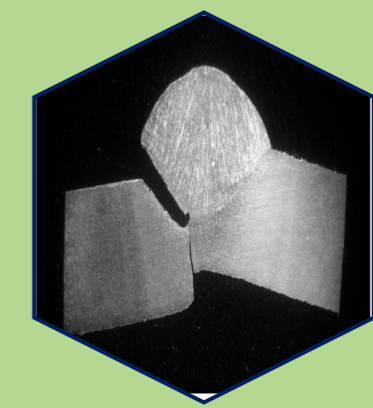
Fusion tokamaks have been developed in realisation of the UK's first fusion reactor, Spherical Tokamak for Energy Production (STEP).



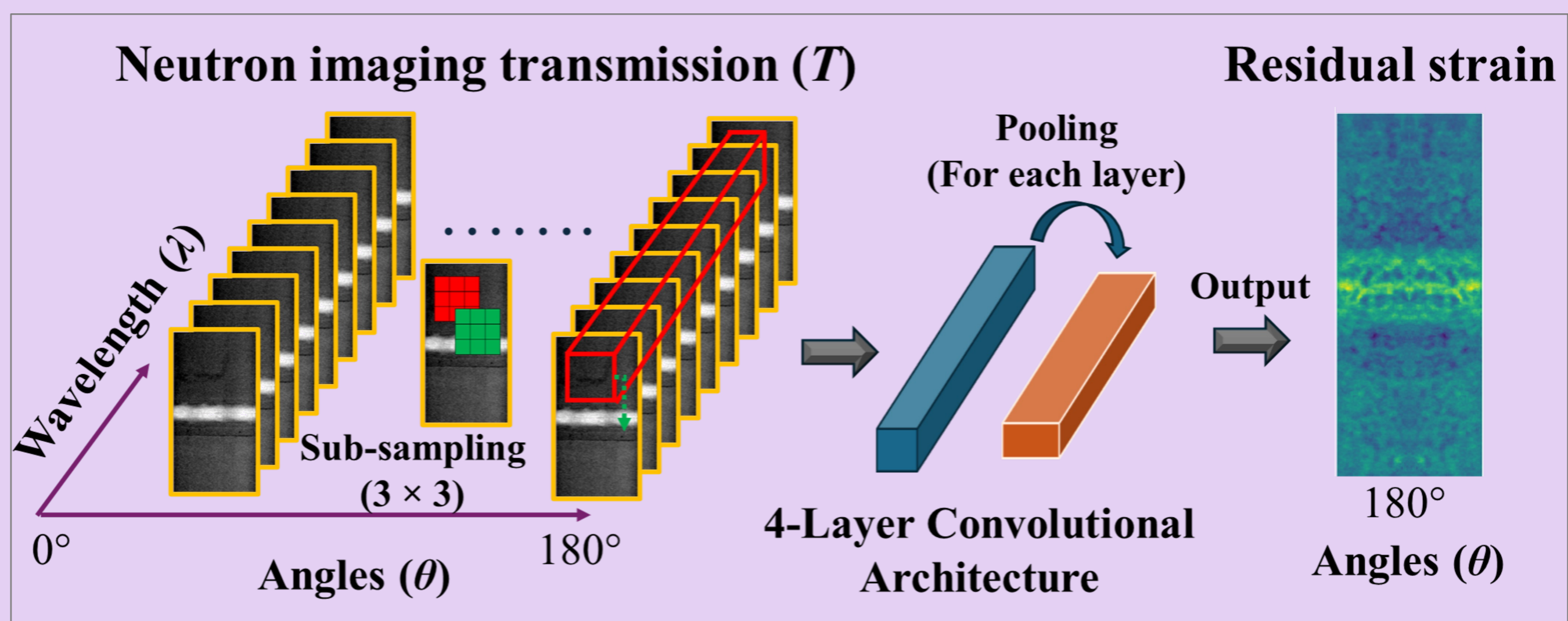
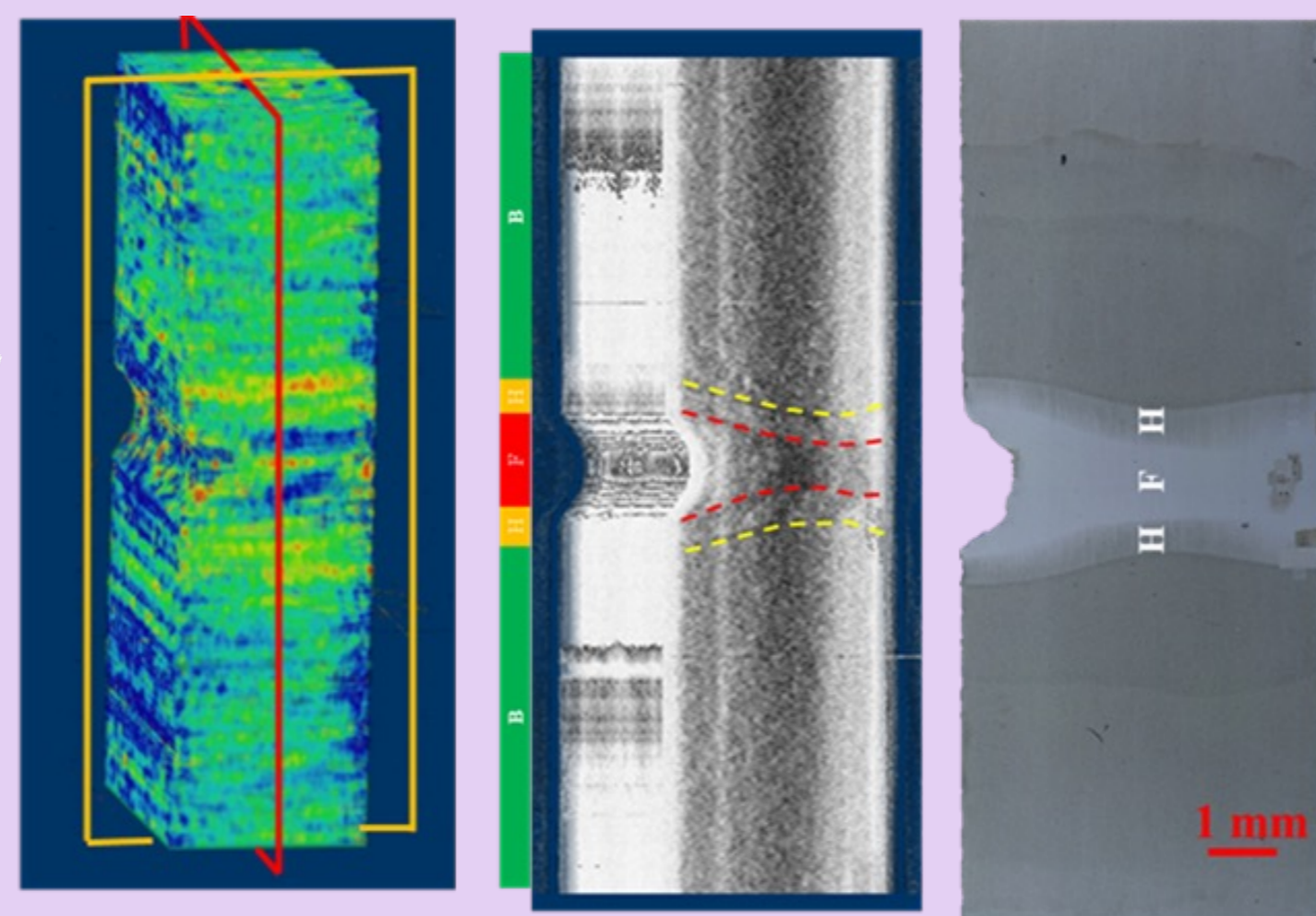
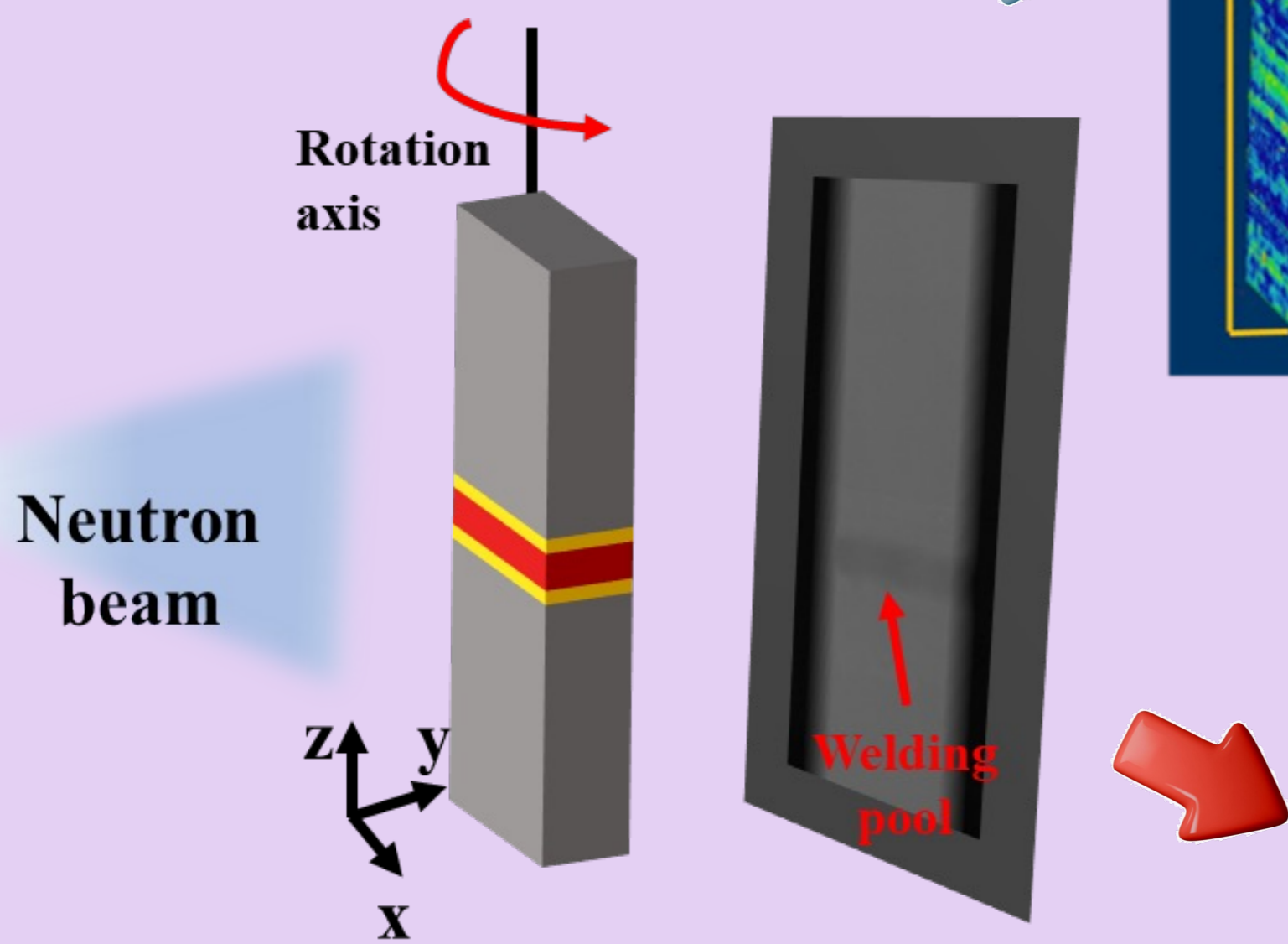
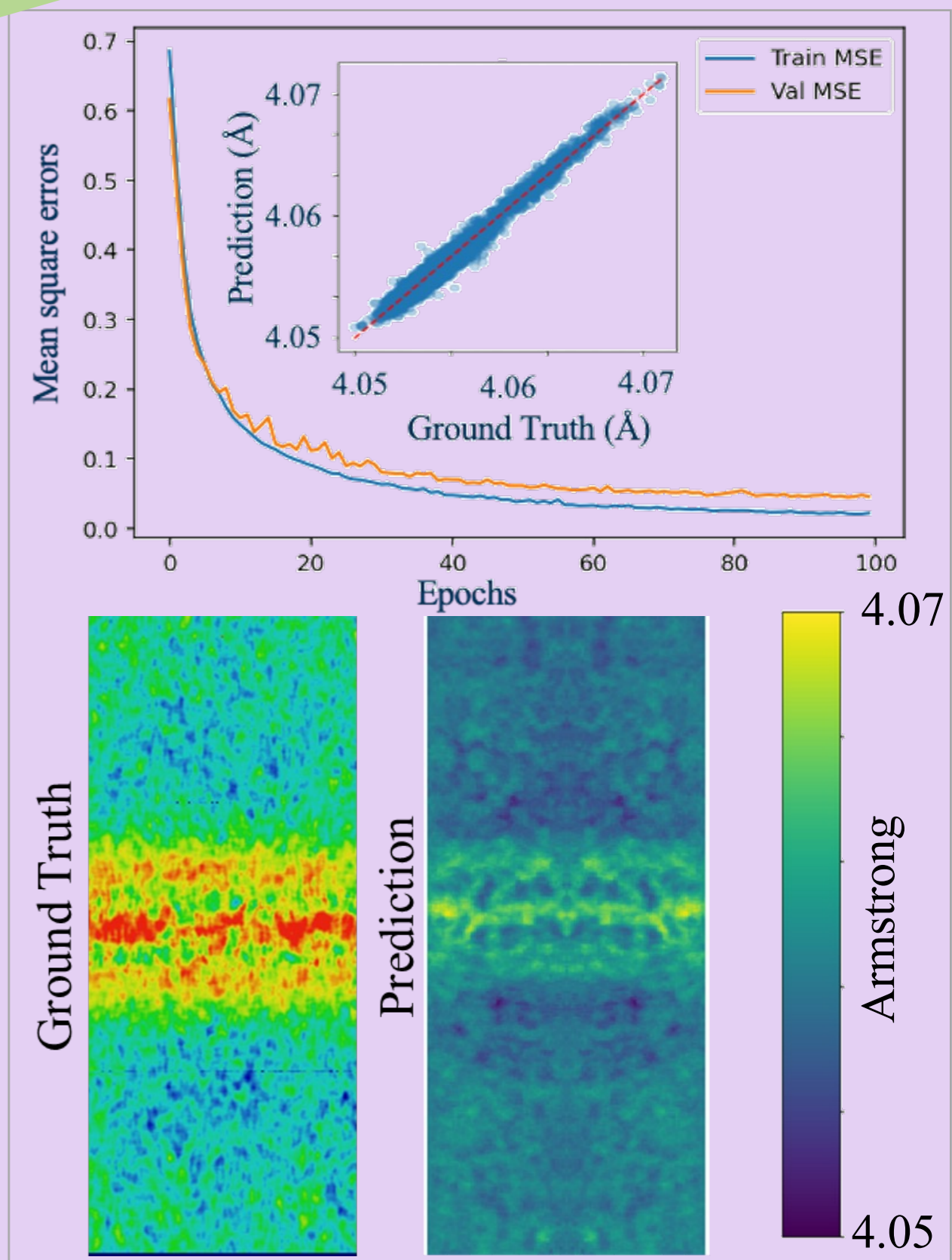
Extreme environments and rapid maintenance require advanced structural integrity assessment.



Laser welding is a promising technique for advanced manufacturing; however, it inherently generates residual stresses.



Robust performance evaluation ensures structural integrity.



Residual strain tomography of laser-welding joints with dimension of $28 \times 10 \times 6 \text{ mm}^3$ is achieved building upon the success of neutron imaging.

Feature enhancement via sub-sampling and derivative ($d(T)/d(\lambda)$) for physics-guided machine learning.
Optimised integral regression convolution neural network (CNN).

Machine learning model enhances residual strain evaluation at **complex conditions led by short acquisition time, harsh environments and multiphase materials**, for every projections.



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