# MAINTAIN

### What does it stand for:

Multi-scAle INTegrity assessment for Advanced hightemperature Nuclear systems

## What do we actually do:

Main theme: Creep deformation Why: UKAEA, EDF AGRs, and Gen IV How nuclear: Include radiation damage How: Small scale experiment, dislocation dynamics, crystal plasticity Who: Bristol, Oxford, Liverpool, and a tiny bit of

Manchester

What have we done so far ...



# Crystal plasticity including creep and validation



$$\dot{\gamma}^{\alpha} = \left[\gamma_{0,1}^{\cdot} \left(\frac{|\tau^{\alpha} - X^{\alpha}|}{g^{\alpha}}\right)^{n_{1}} + \gamma_{0,2}^{\cdot} \left(\frac{|\tau^{\alpha} - X^{\alpha}|}{g^{\alpha}}\right)^{n_{2}}\right] sgn(\tau^{\alpha})$$





## Dislocation Dynamics Modelling of the Creep Behaviour of Particle-Strengthened Steel (single crystal)



#### Modeling the creep behavior of Fe micropillar during compression

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# **Measuring Microstructure Changes in Ion-Irradiated 316LN Stainless Steel**

Investigate the effects of irradiation damage on the dislocation creep behaviour

#### Material

Stainless steel 316LN

### Irradiation

Heavy lons in the Dalton Cumbria Facility (DCF) 15SDH-4 DAFNE

1, 2, 3 MeV self-ion irradiation at room temperature to different doses: 0.4 dpa, 4 dpa, 40 dpa

3 MeV self-ion irradiation to 4 dpa at different temperatures: 25 °C, 325 °C, 550 °C Used SRIM to estimate damage depth and amount, used to convert fluence to dpa

#### **Post Irradiation Examination**

FEI Helios NanoLab 600i FIB-SEM with EDS-EBSD

JEOL 2100 TEM (200 keV) with STEM-EDS

Samples prepared by FIB

Use TEM to examine dislocation loop and void formation caused by displacement damage

•Atomic resolution

•Electron diffraction patterns

Scanning transmission electron microscopy (STEM)

- •Bright field imaging (indication of sample thickness),
- •Dark field imaging (indication of atomic mass number)
- •Energy Dispersive X-ray (EDX), Electron Energy Loss Spectroscopy (EELS)
- -Chemical analysis in mapping and line scans



15SDH-4 (DAFNE) in the DCF



