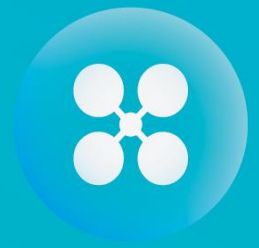


sindri

PROSPERITY PARTNERSHIP

EDF

University of BRISTOL

MANCHESTER 1824
The University of Manchester

UKRI Science and Technology Facilities Council

Imperial College London

Synergistic utilisation of INformatics and Data centRic Integrity engineering

Mahmoud Mostafavi

(on behalf of David Knowles)

Nuclear Academics Meeting
2022

Who?

sindri

High Temperature Centre Est 2006

University of BRISTOL

Imperial College London

EDF

MANCHESTER 1824
The University of Manchester

JACOBS

NATIONAL NUCLEAR LABORATORY

Modelling and Simulation Centre Est 2010

UKRI Science and Technology Facilities Council

UKRI Engineering and Physical Sciences Research Council

UK Atomic Energy Authority

HENRY ROYCE INSTITUTE

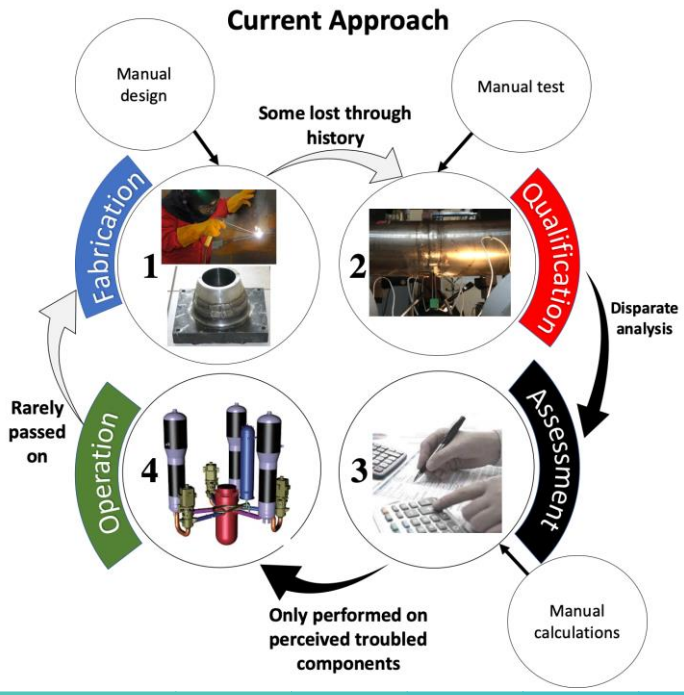
The Alan Turing Institute

ROLLS ROYCE

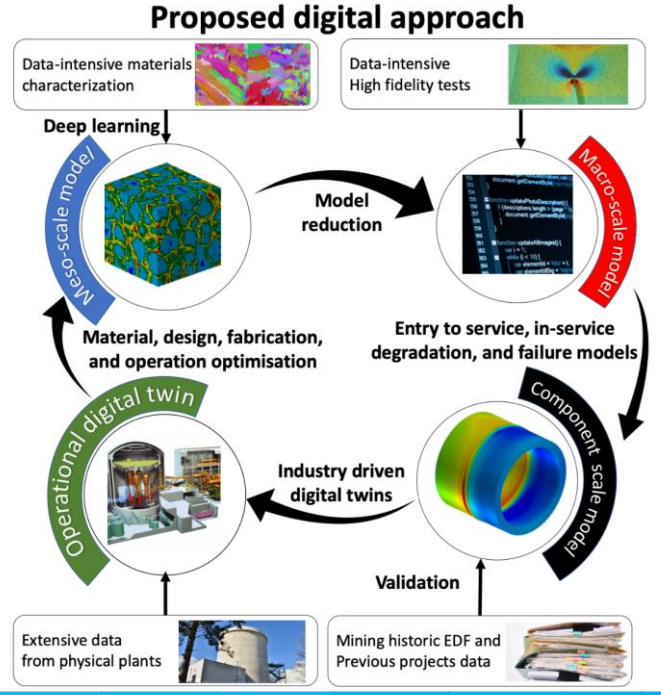
NUCLEAR AMRC

Aim

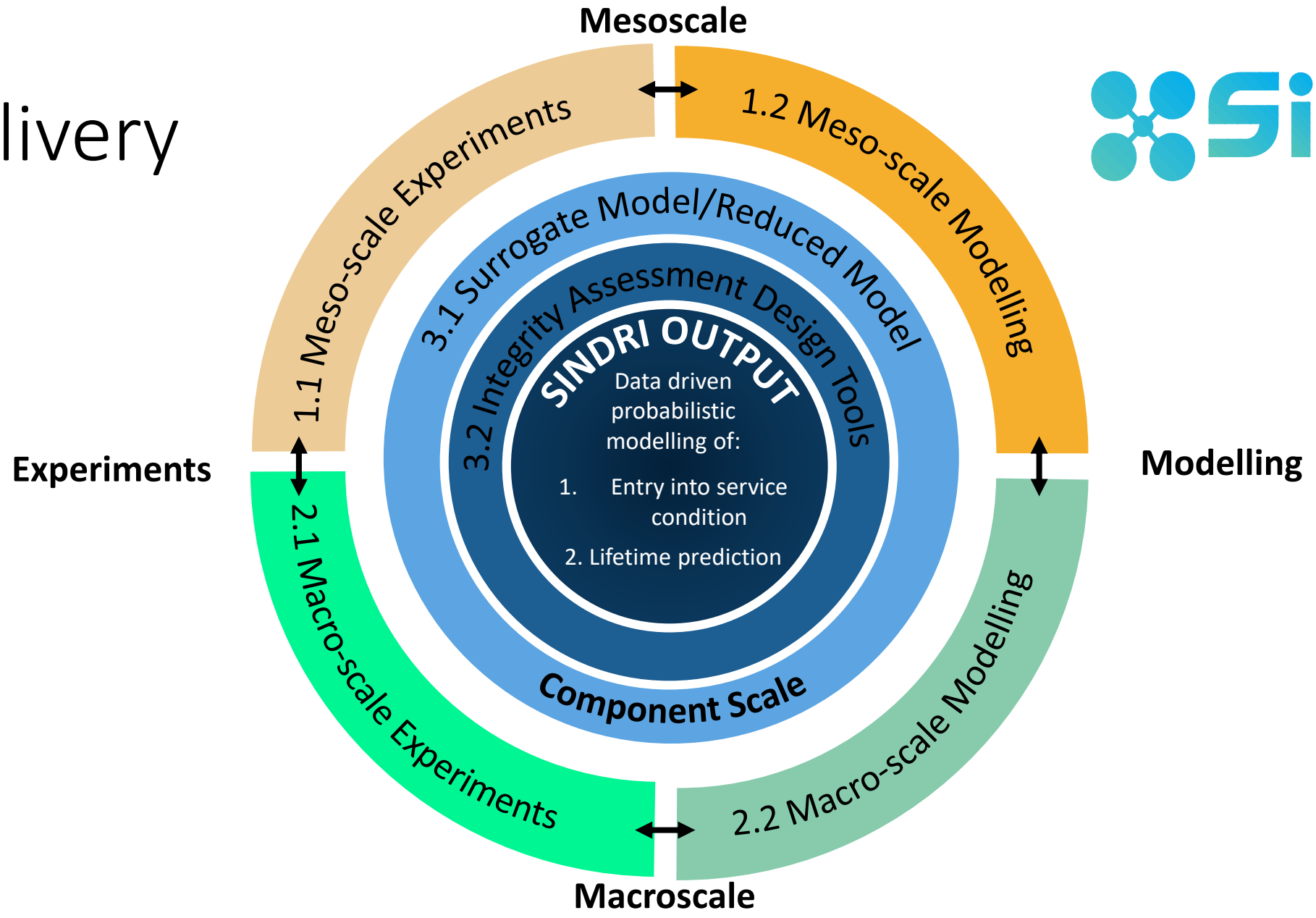
- Create a **coherent digital framework**, populated by **modular** multi-physics, multi-scale models. This will replace time consuming and extensive physical testing associated with traditional approaches; **enhance speed and efficiency**



SINDRI

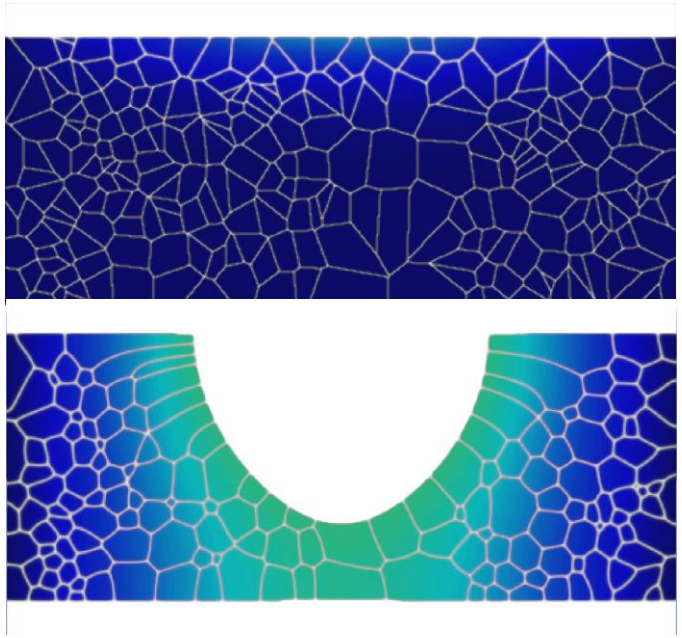


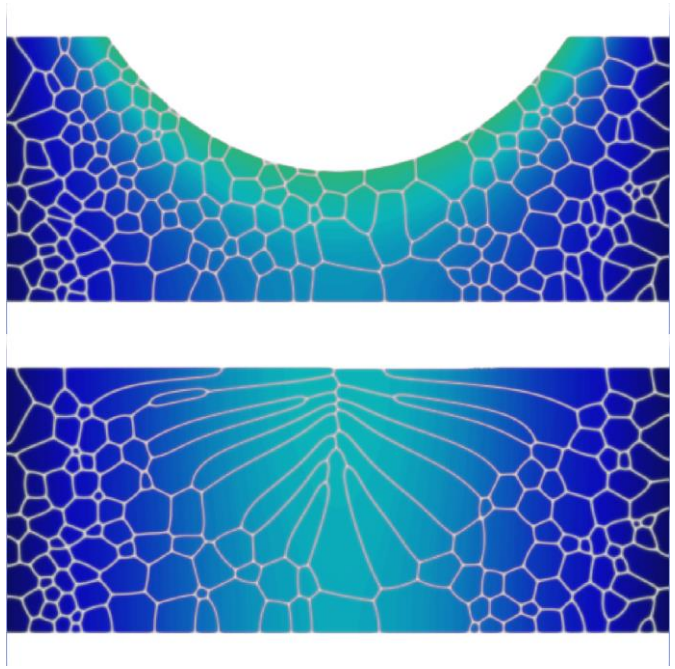
Delivery


Mesoscale
1.1 Meso-scale Experiments
1.2 Meso-scale Modelling
3.1 Surrogate Model/Reduced Model
3.2 Integrity Assessment Design Tools
SINDRI OUTPUT
Data driven probabilistic modelling of:
1. Entry into service condition
2. Lifetime prediction
Component Scale
Experiments
Modelling
2.1 Macro-scale Experiments
2.2 Macro-scale Modelling
Macroscale

Example 1: From Melt pool to creep

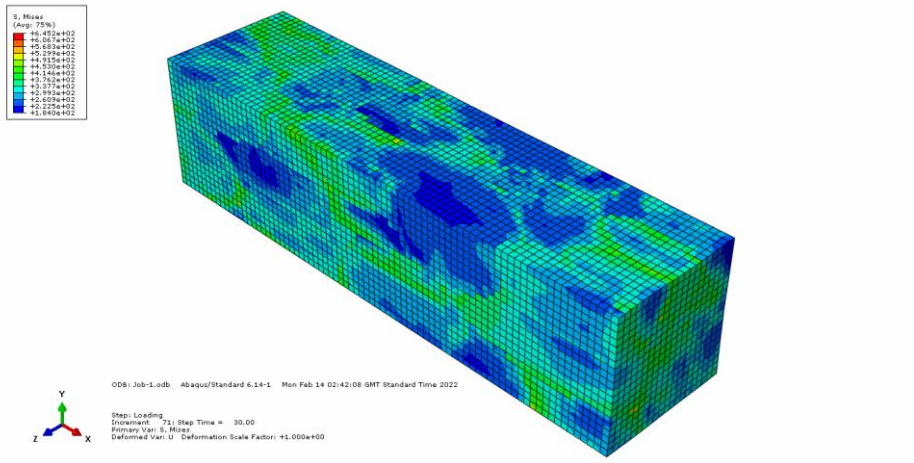
- Solidification

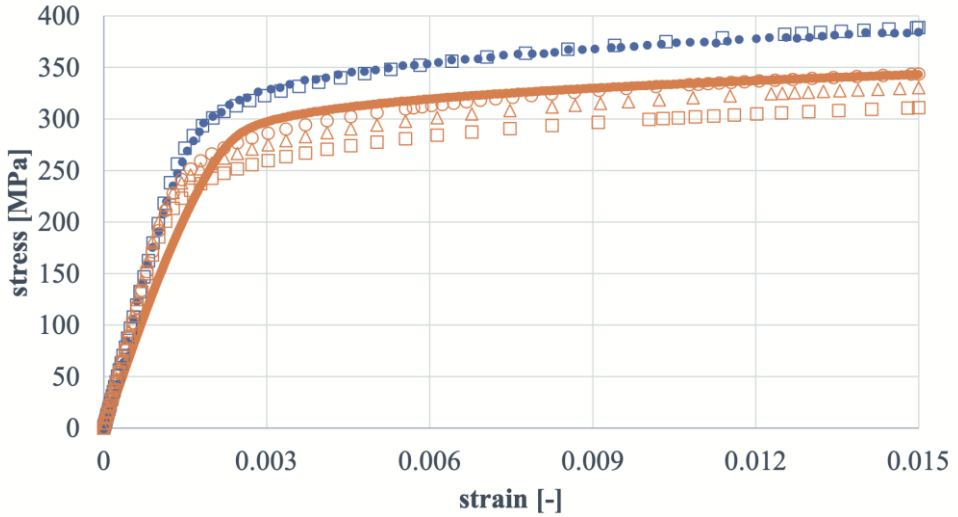


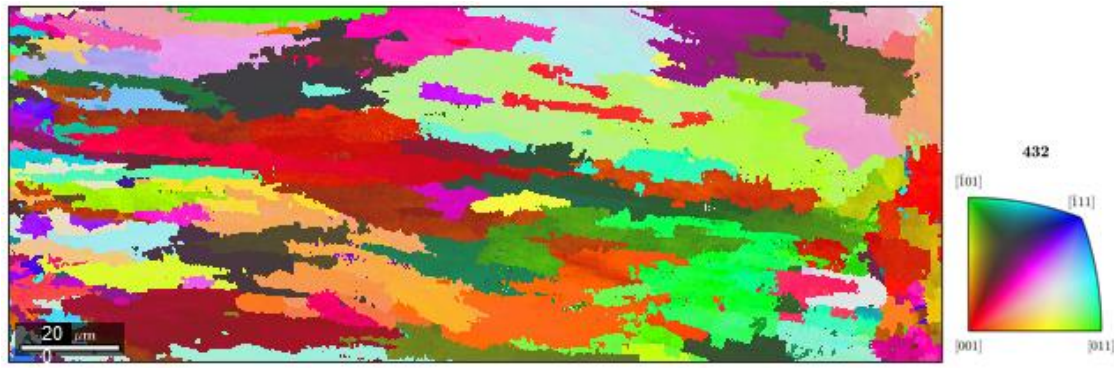


Physics-based model

- Mechanical response

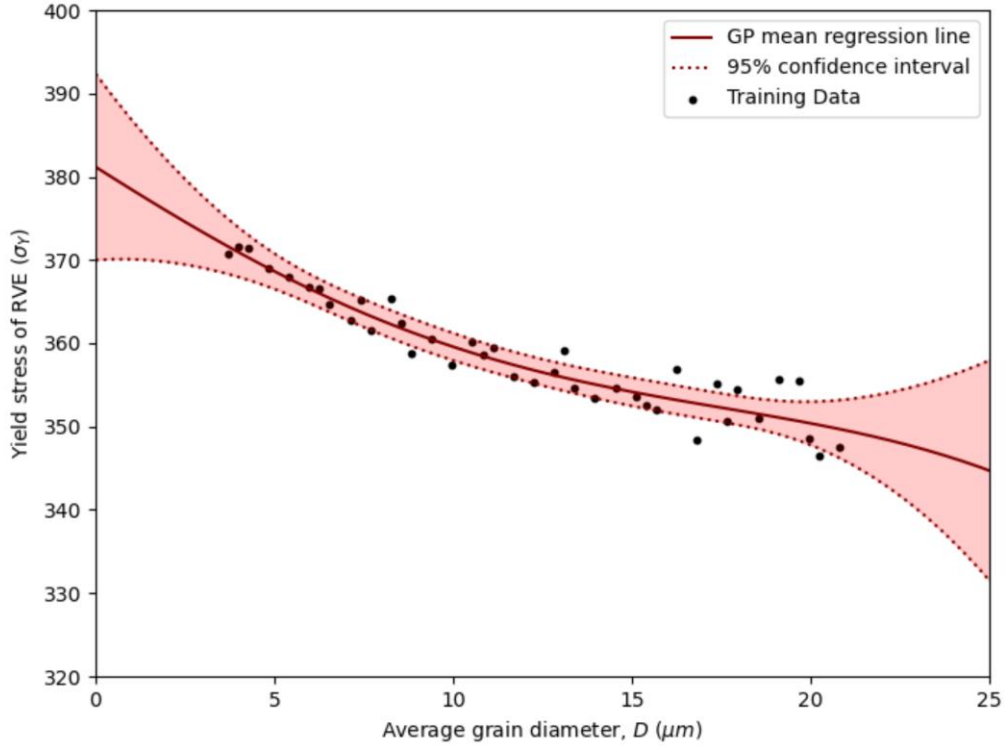






Engineering model

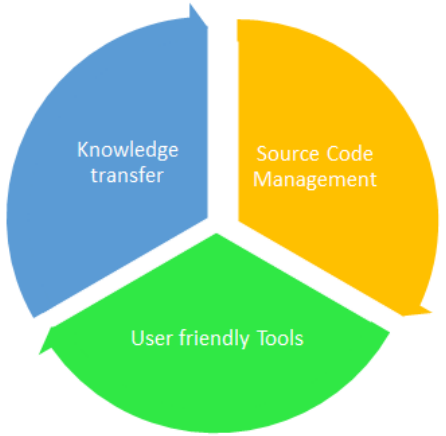
- Mechanical properties from microstructure
  - Ageing behaviour prediction
  - Irradiation damage behaviour prediction
  - New materials behaviour prediction
  - Forecasting future behaviour

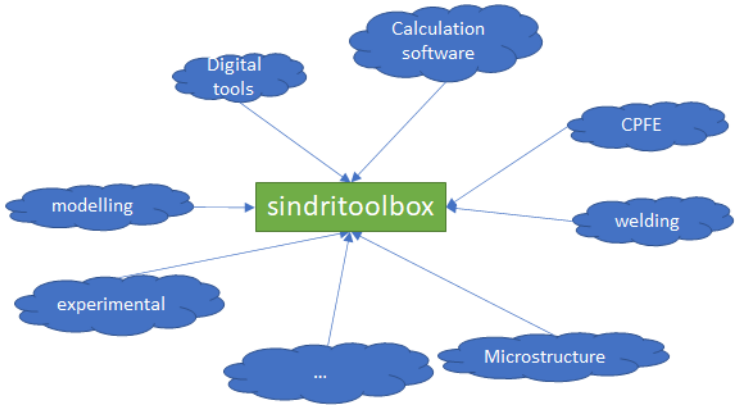


Gaussian Process

Enduring impact

- SindriToolbox
  - Knowledge transfer
    - Shared best practice, training tools and tutorials
    - Tools usage for all researcher
  - Source code Management
    - Git hosted, clear verification/validation, release control, harmonized architecture
  - User friendly tools
    - Simple software environment
    - Easy implementation for test of cross-comparison





Future work

- PWR specific potential issues
- Translating AGR knowledge to an AMR asset
- Move towards in-silico qualification of new process (e.g. repair)
- Reduce the cost of mitigating damage mechanisms (creep, creep – fatigue, fracture, stress corrosion cracking)

Priorities

- Bring on the regulator with us
- Leverage UK investment in data science (e.g. through Alan Turing)
- Identify opportunities outside EDF (e.g. in fusion and AMR)
- Plan for adapting to a changing landscape