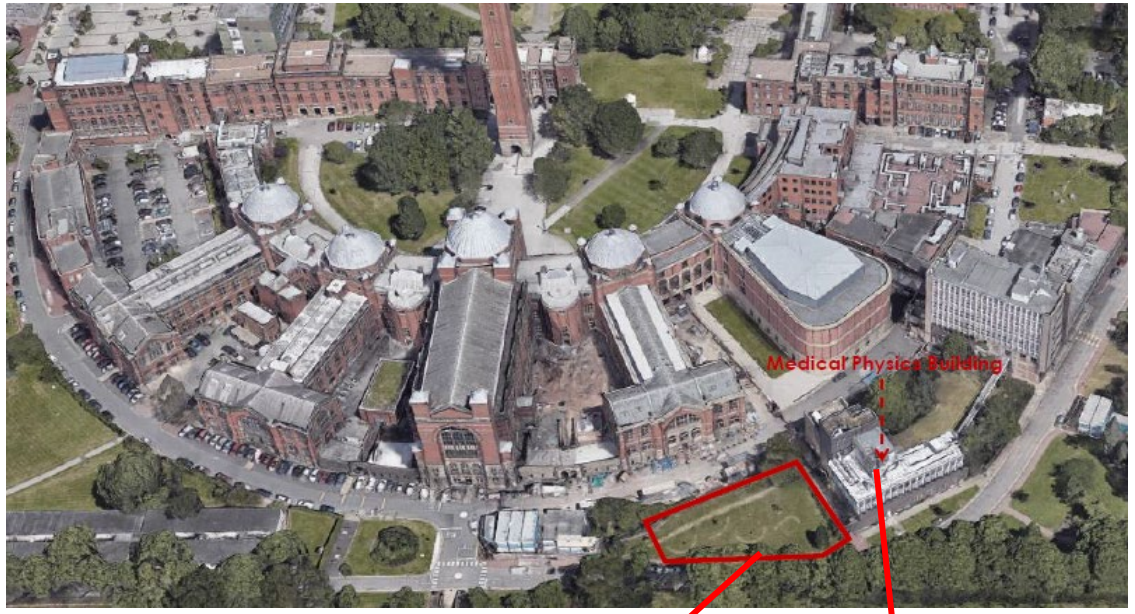
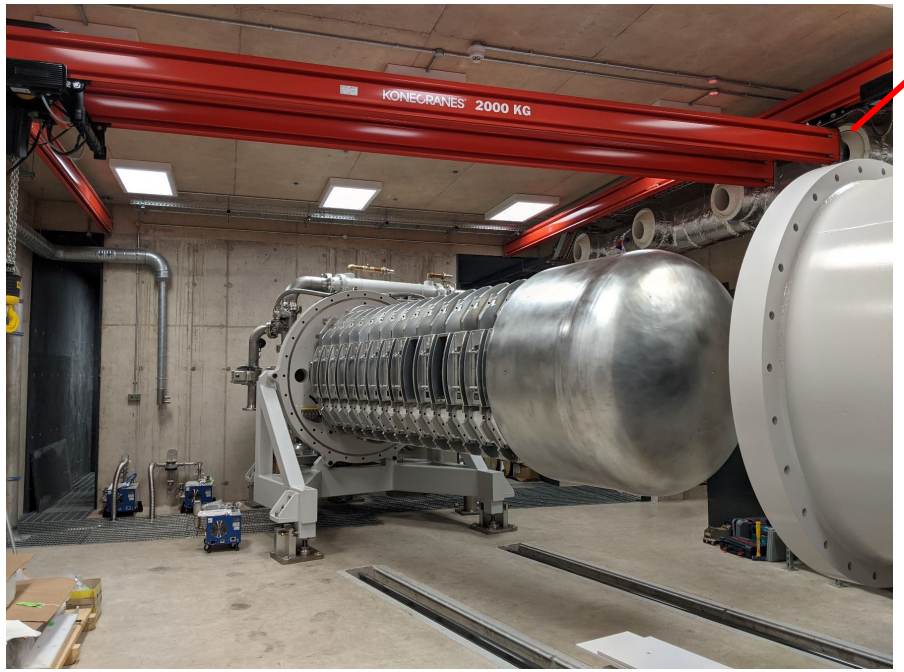
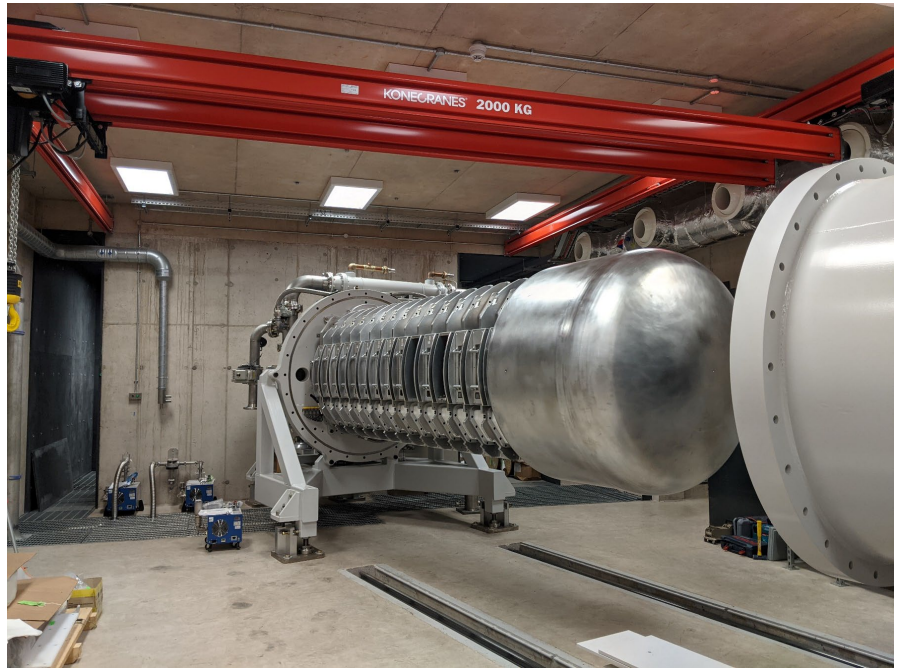
NNUF neutron irradiation facility

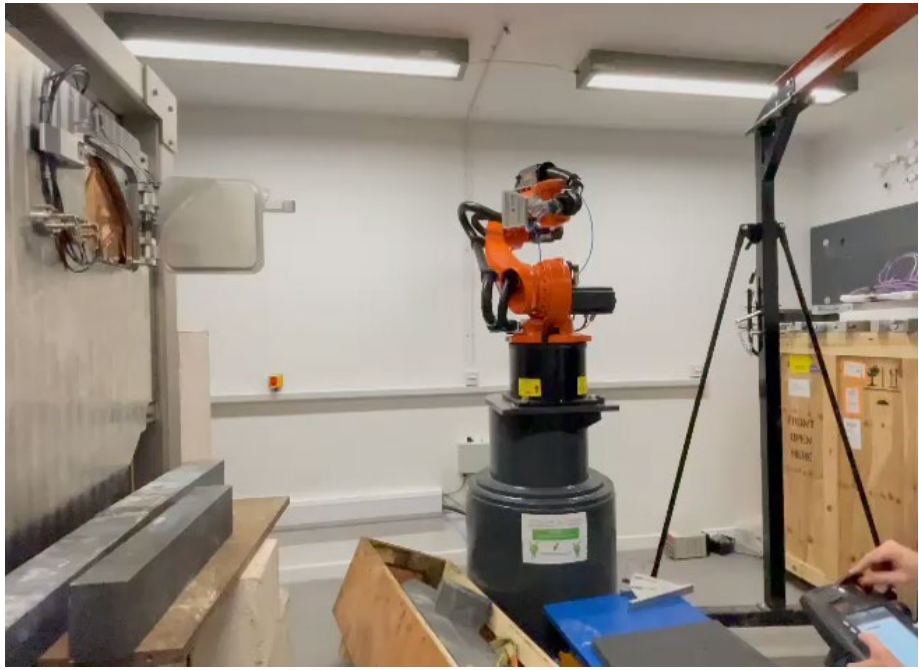
Nuclear Science Facilities at the University of Birmingham

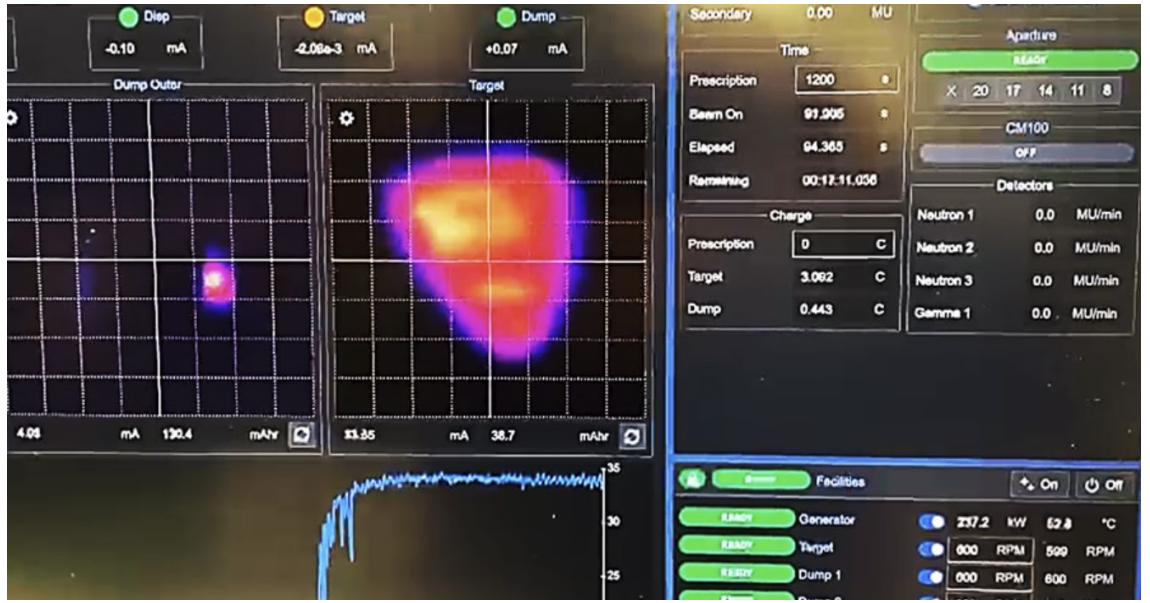


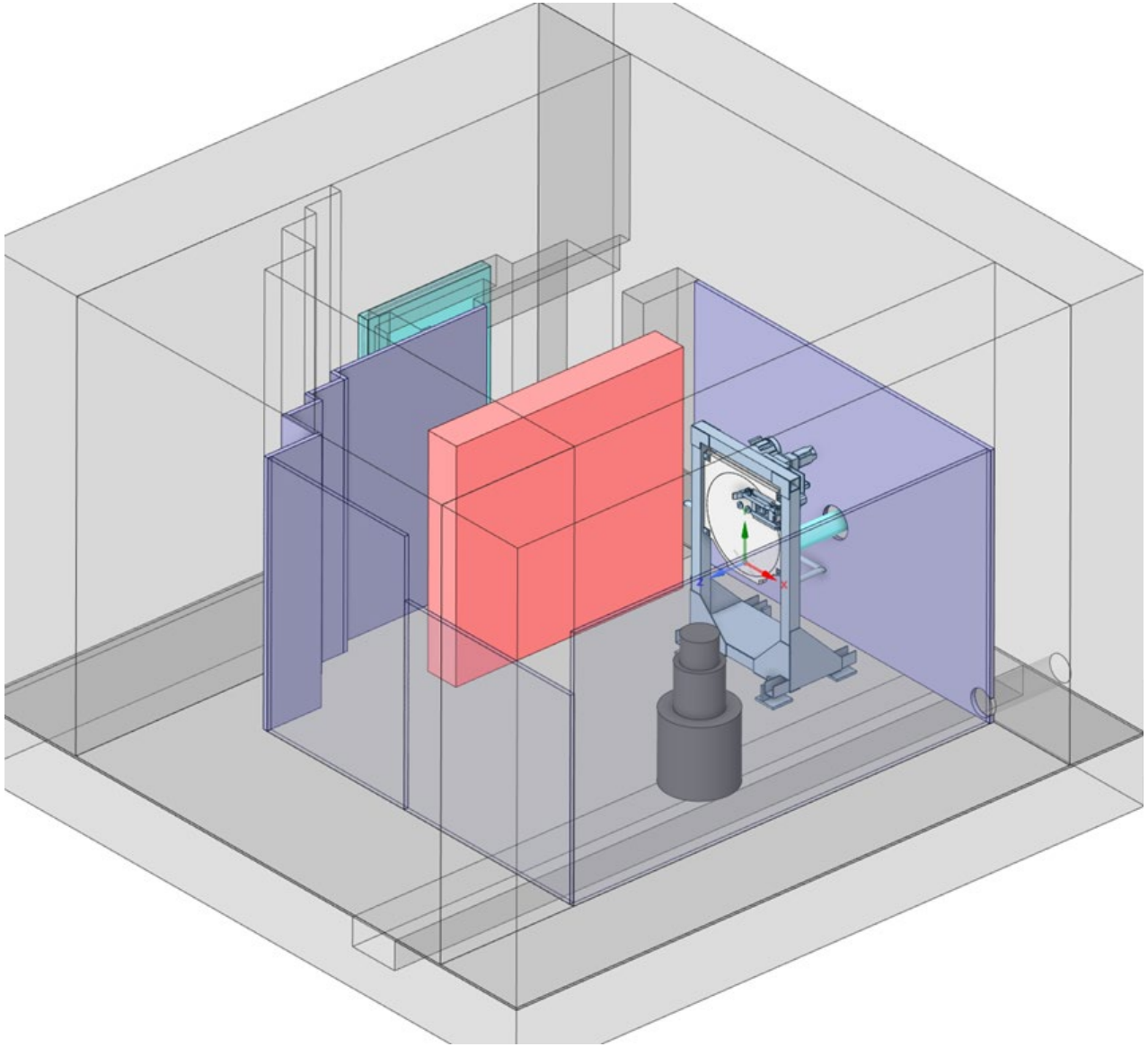


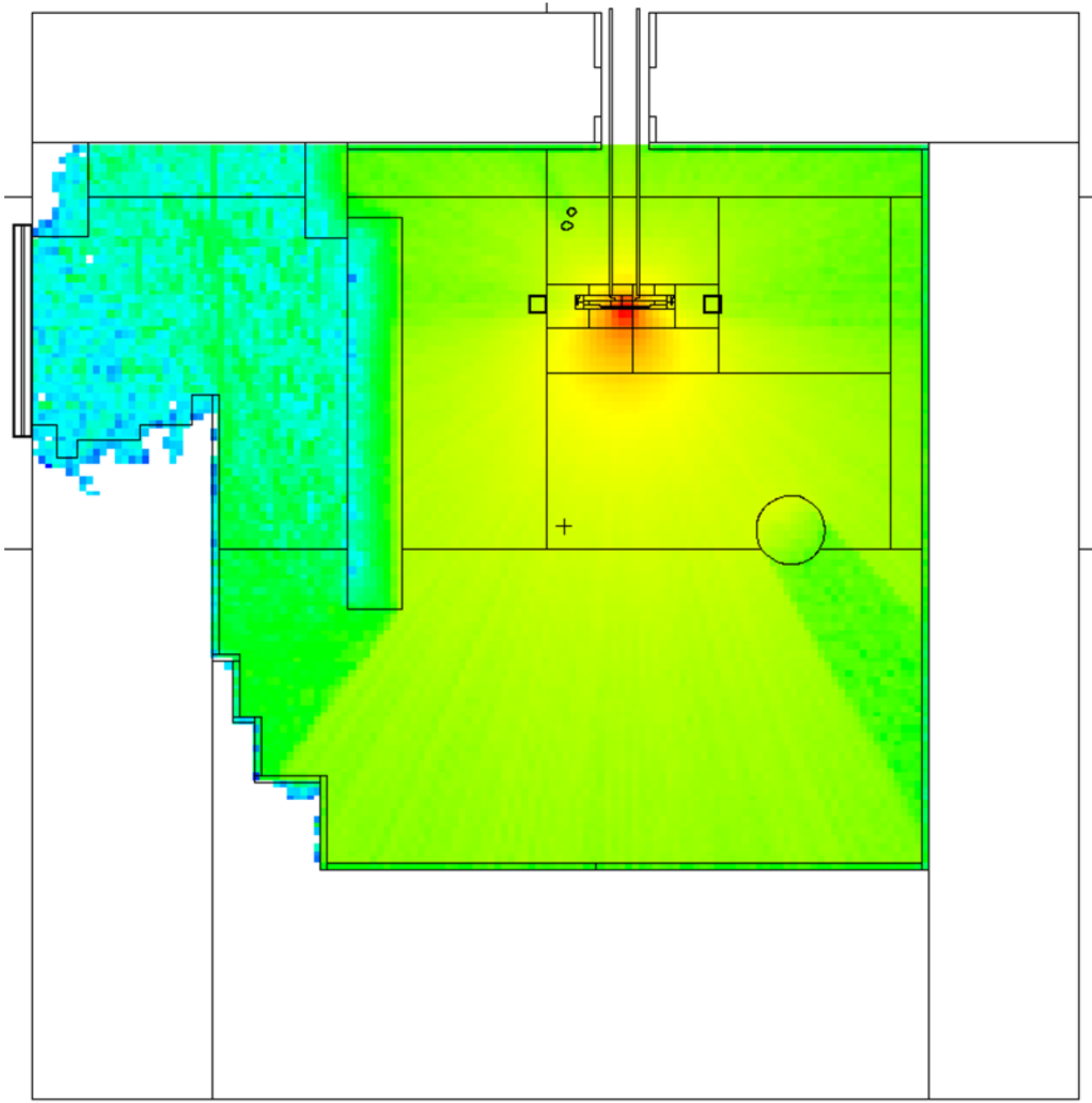
Accelerator Driven Neutron Facility at Birmingham and Neutron Attenuation Measurements

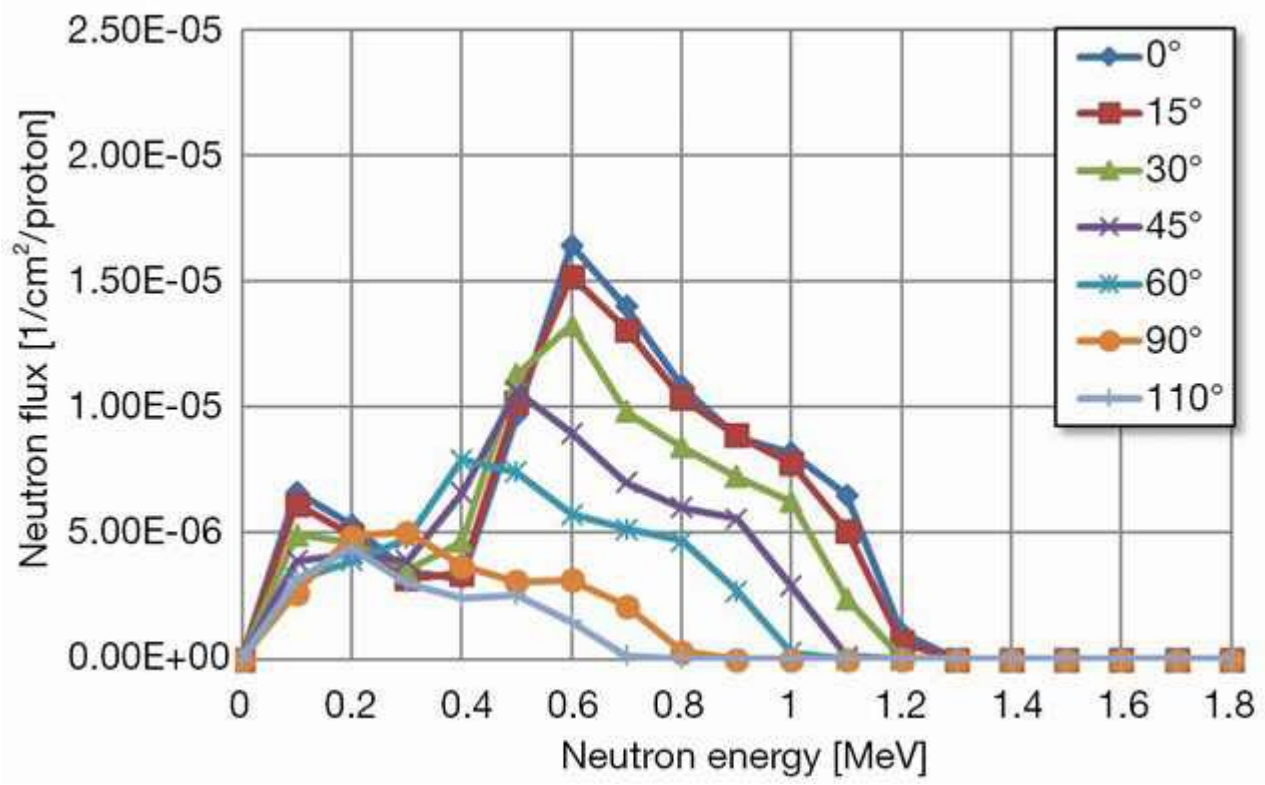


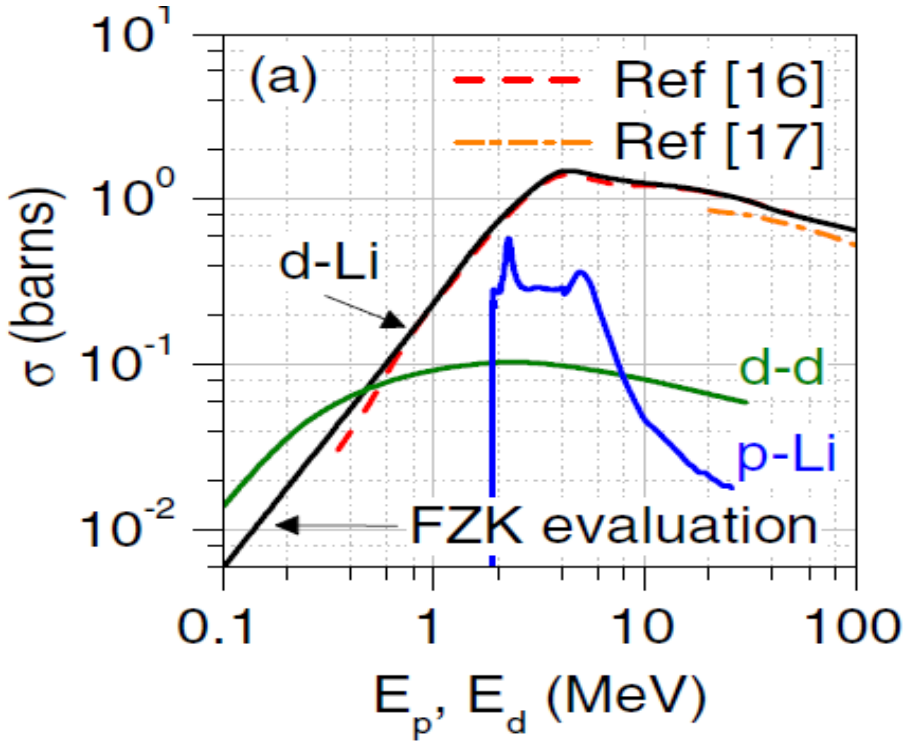


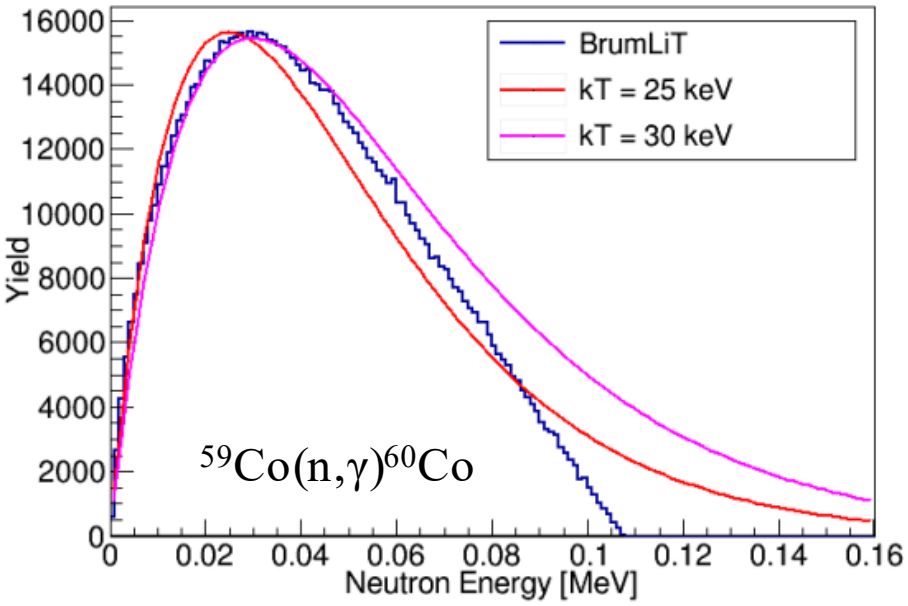












Neutron energy spectra at various emission angles for the p-Li reaction at a proton energy of 2.8 MeV.
Accelerator-based neutron source for boron neutron capture therapy [Yoshiaki Kiyanagi]

Phase 1 (years 1 and 2) Complete

- Building alteration and hardware procurement
- Accelerator delivery and installation

Phase 2 (year 3) Sept 2022

- Work-up to 30 mA protons [Q1-Q2 2022]
- Fast neutron fluence rate of 1.8×10^{11} n/cm^2/s
- Thermal fluence rate of 6×10^{9} n/cm^2/s
- Develop modified target system for closer location of samples
- Develop associated fast neutron reflector configuration

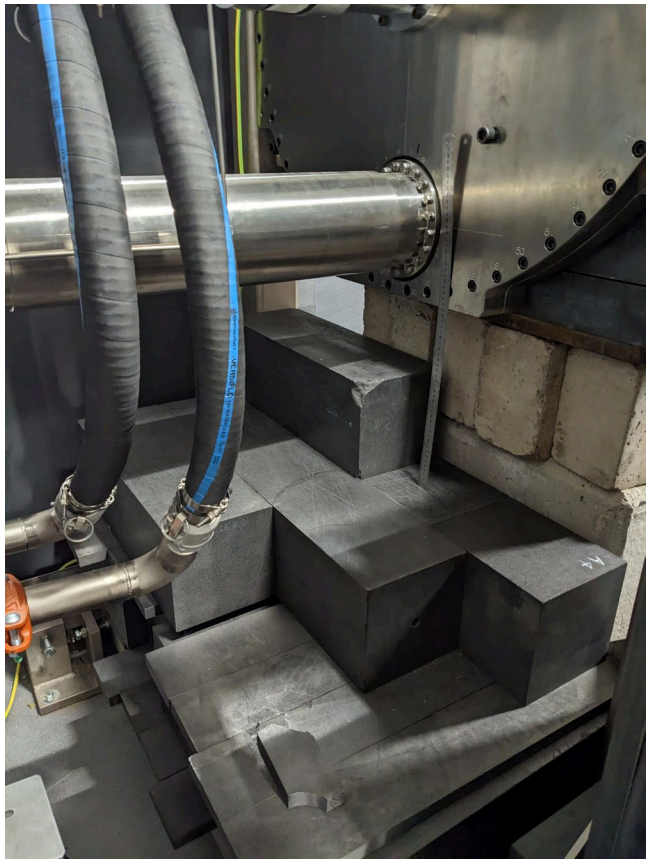
Phase 2 (year 4)

- Fast neutron fluence of 1×10^{12} n/cm^2/s
- Achieving a 10^{18} integrated neutron fluence required operation for 11.5 days

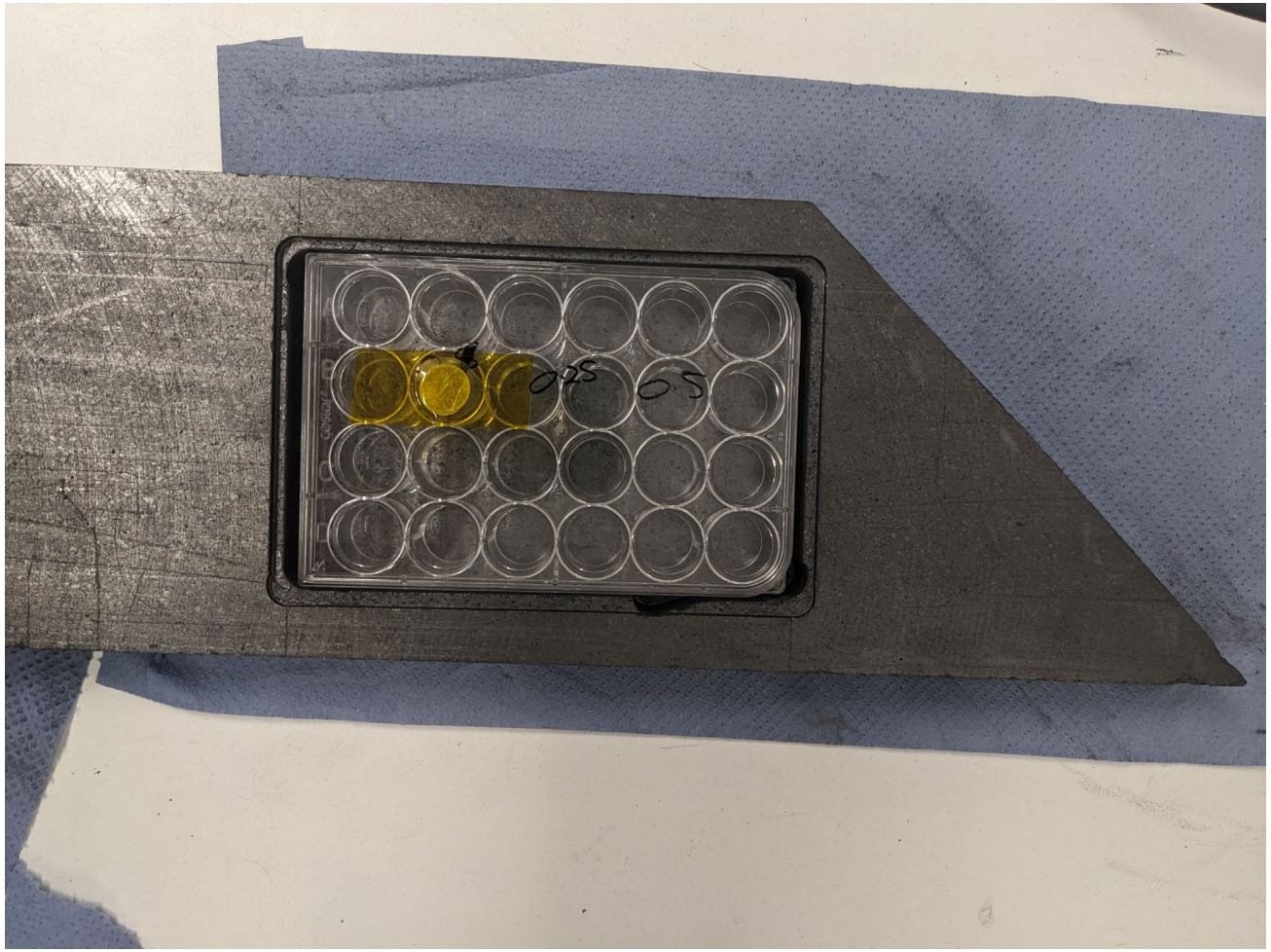
Phase 3 (years 4+)

- Develop deuteron beam with enhancement of fluence to $>3 \times 10^{12}$ n/cm^2/s
- Achieving a 10^{18} integrated neutron fluence required operation for 4 days

Graphite stack for thermal neutron irradiations



Graphite stack for thermal neutron irradiations



Thermal flux of ~1.5×10^9 n/cm^2/sec with almost no fast contamination

At 50ppm boron, ~0.25 Gy/min dose rate

Uniform to approx. ± 5% over the cell plate

Programme

Completed

- Neutron Radiation Induced Attenuation in Optical Fibers for Fusion Magnet Protection –Bart Ludbrook, VUW New Zealand/ Gerard Fernando/ Madhav Ramesh Birmingham
- Assessing the Neutronic Shielding Performance of Materials for Nuclear Fusion - Max Rigby-Bell, UKAEA
- The impact of radiation damage on deuterium retention of CVD diamond - James Pittar, Bristol
- Direct activation measurements of the Co-60m metastable state - Patrick Galvin, Jack Bishop, Birmingham

Ongoing

- Radiobiological effects of BPA and novel boron containing drugs to optimise the response of head and neck cancer to BNCT. - Leah Punshon, Jason Parsons Birmingham

Upcoming

- Proof of principle test of new beam shaping assembly for BNCT - Igancio Porras, UGR Spain
- Tests of new detector array for gamma ray detection in fusion environments - Igancio Porras, UGR Spain
- Tests of detectors for boron capture gamma imaging in neutron fields - Zamir Ghani, UKAEA

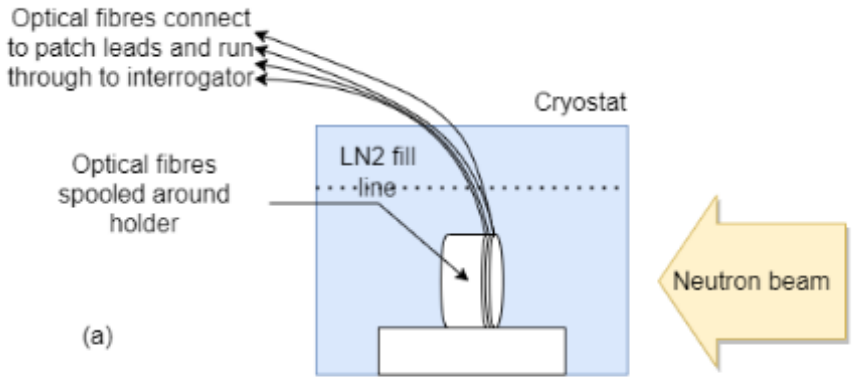
Potential

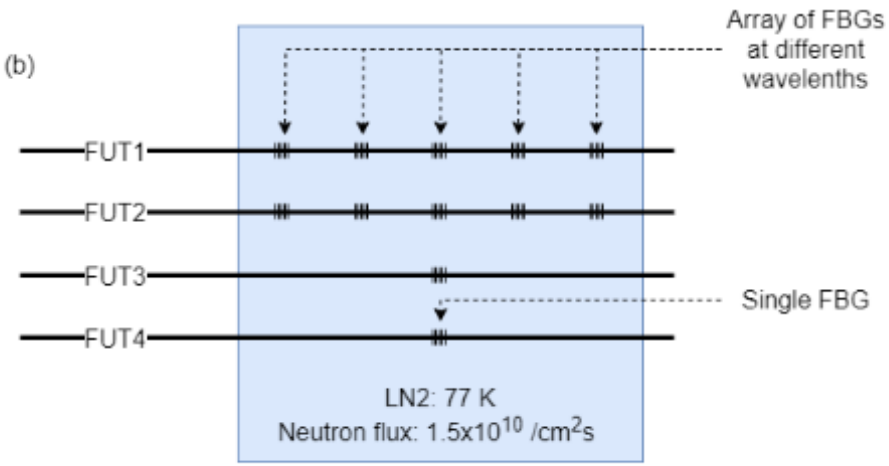
- High dose(~100 days of beam time) irradiation of superconducting magnet material for fusion applications
- Tests of liquid lithium loop previously installed at SARAF

Photobleaching of Neutron Radiation Induced Attenuation of Optical Fibers at Cryogenic Temperatures

F Solis Fernandez[1], B Ludbrook[1], B. Phoenix[2], M. Ramesh[2], J. Schuyt[1], D. Moseley[1], G. Fernando[2], and R. Badcock[1]

[1]Paihau - Robinson Research Institute, Aotearoa - New Zealand
[2]University of Birmingham, United Kingdom





Resilience of optical senors under cryogenic neutron irradiation

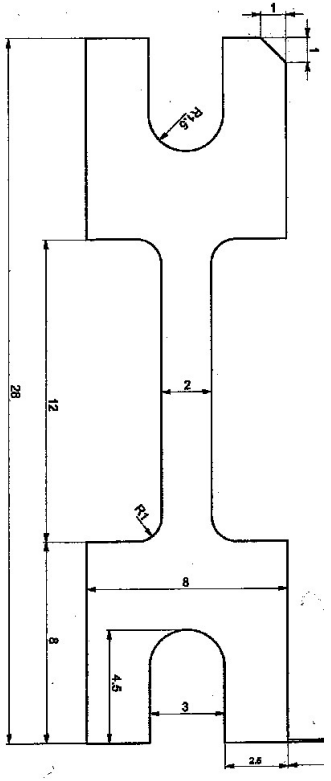
Bartholomew M. Ludbrook, Fernando S. Fernandez, Madhav Ramesh, Ben Phoenix, Dominic A. Moseley, Joe J. Schuyt, Gerard Fernando, Rod A. Badcock

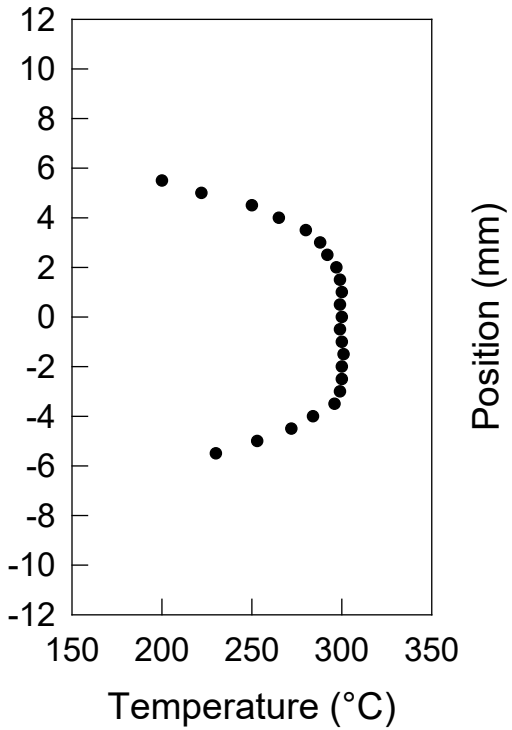
Nuclear Material Facilities: In-situ Irradiation Characterisation

PAUL SCHERRER INSTITUT

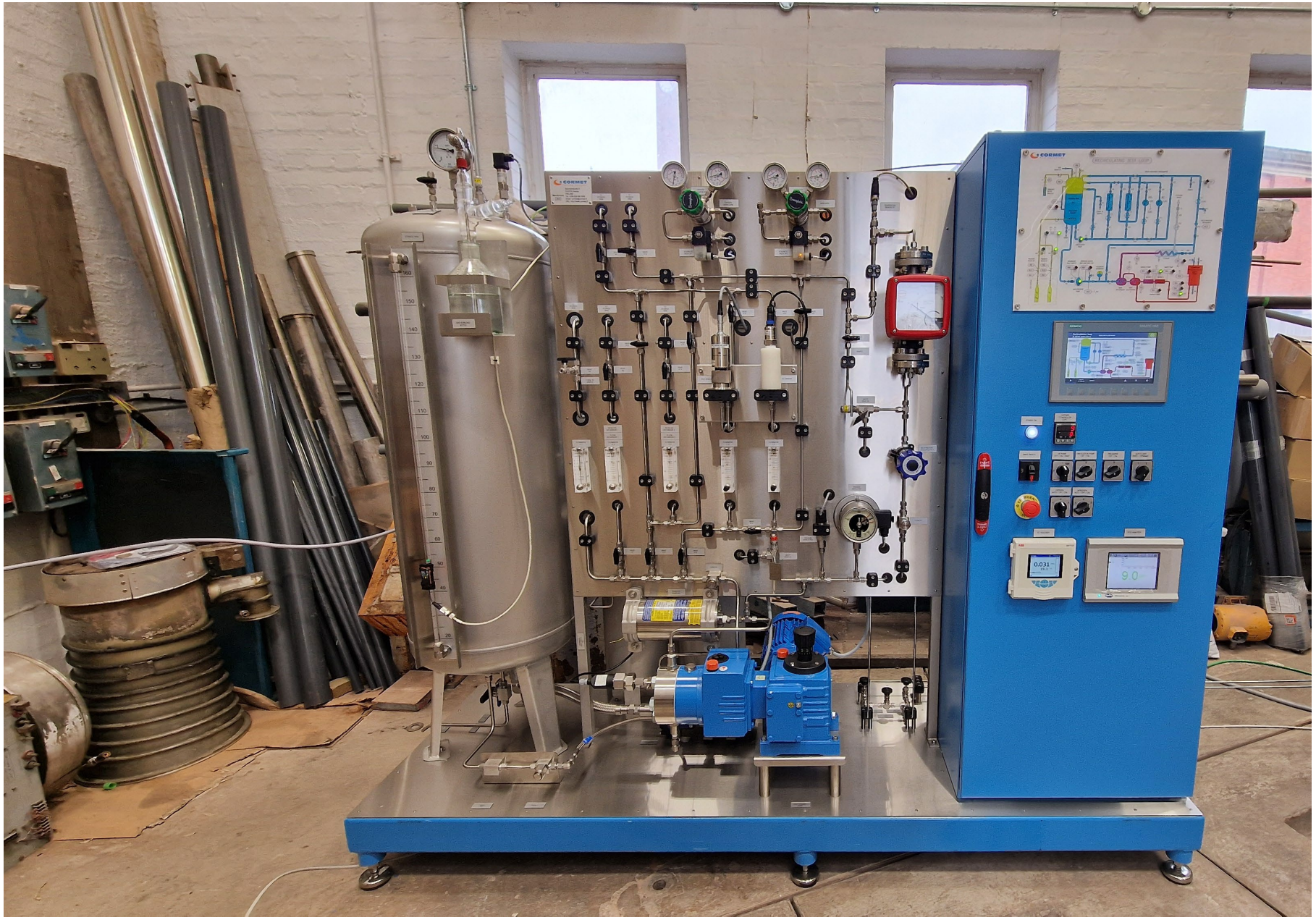
PSI

Sample size	Dispal. Rate	Impl. rate	T (°C)
10x12 mm^2	0.02 dpa/h	100 appm/h	200-1000





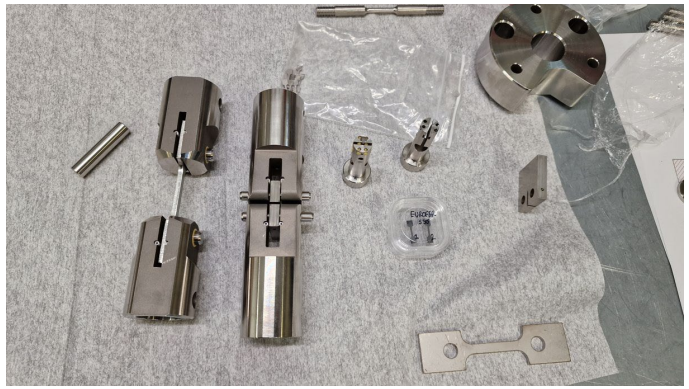
Nuclear Material Facilities: In-situ Irradiation Characterisation



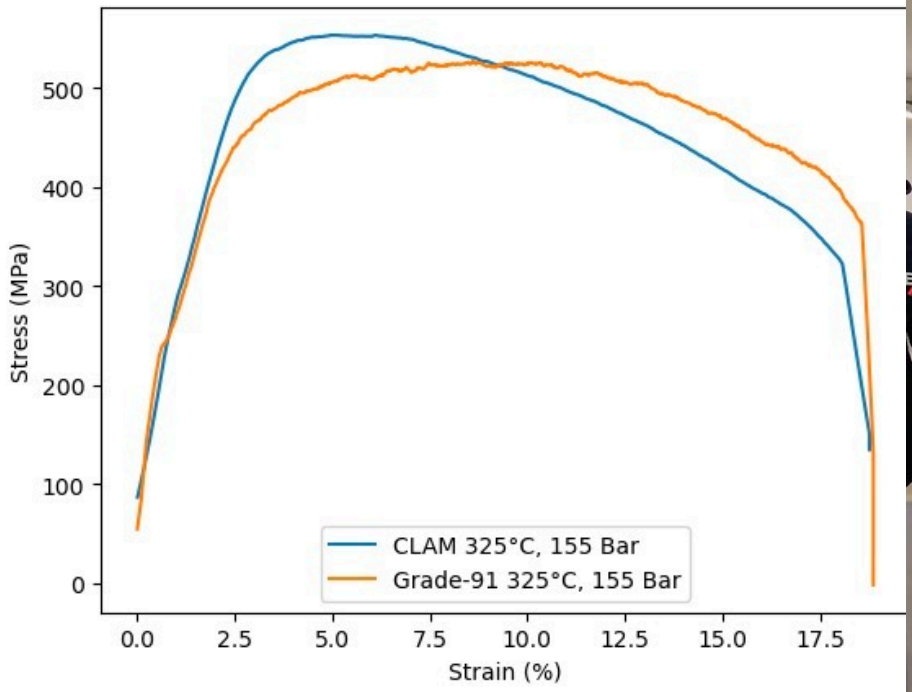
Nuclear Material Facilities: In-situ Irradiation Characterisation

Super-critical water corrosion loop and autoclave for SCC tests:

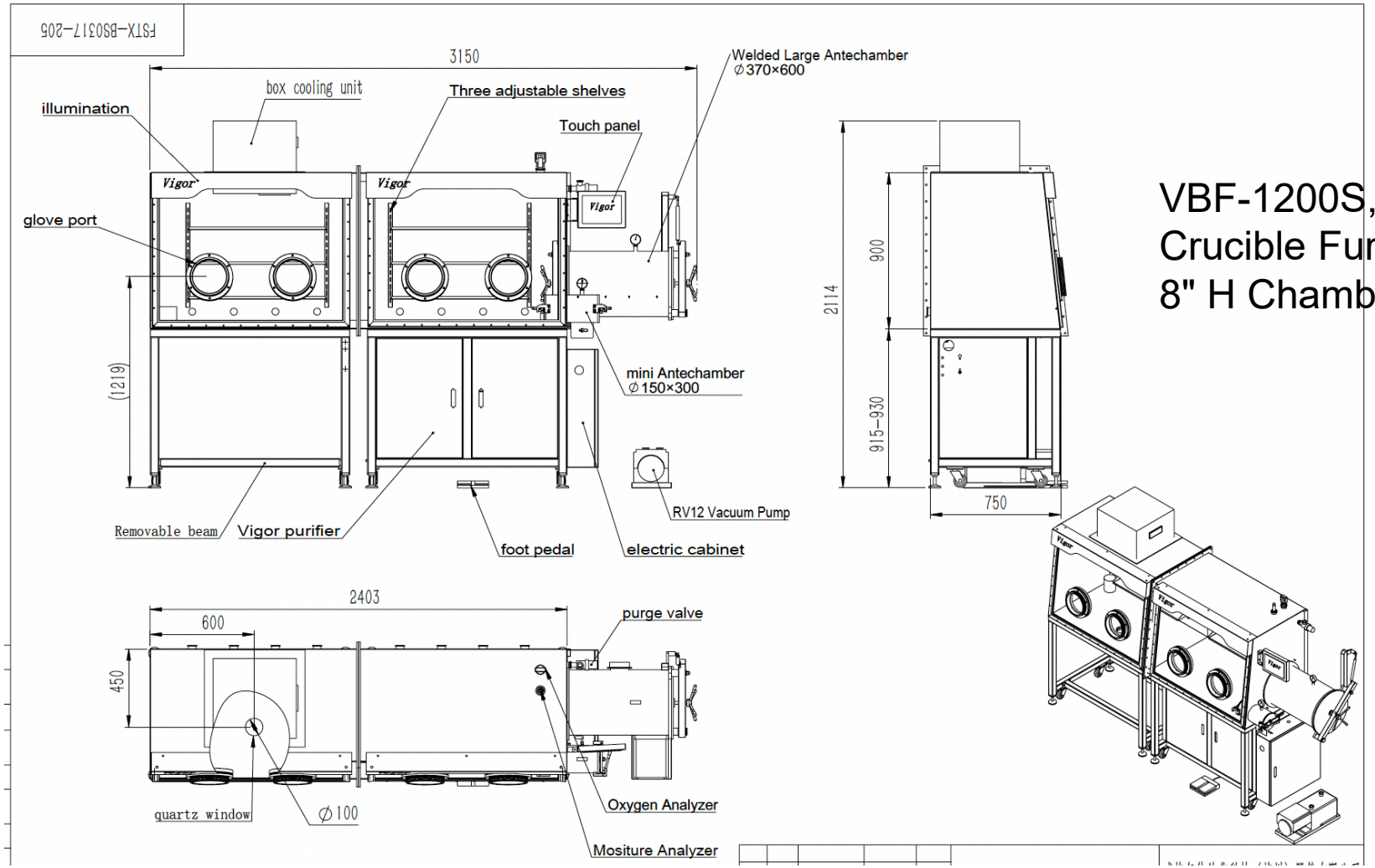
Temp. max.: 650 dC
Pressure: 30 MPa
Oxygen level controllable



Slow Strain Rate Test
Tensile
Mini-CT



Nuclear Material Facilities: In-situ Irradiation Characterisation



VBF-1200S, 1000C Vertical Crucible Furnace with 4.7" Dia x 8" H Chamber & SS316 Case

Molten Salt Processing

NNUF neutron irradiation facility