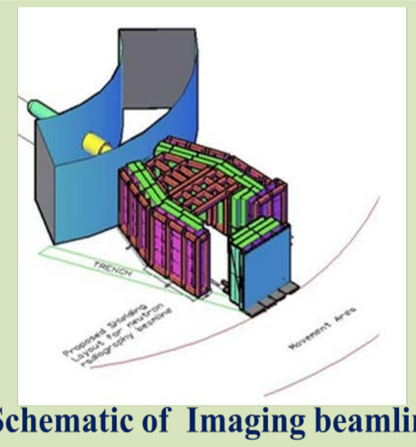
Study of Reactor Structural Materials at Neutron Imaging Beam Line, Dhruva, India

Shefali Shukla, Yogesh Kashyap ,Tushar Roy, Mayank Shukla and S.C.Gadkari*
**shefali@barc.gov.in*

Beam line at Dhruva



Schematic of Imaging beamline

Neutron Imaging Beamline HS-3018

Shielded hutch door

Experimental hutch

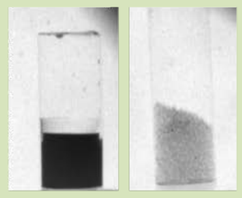
Advanced Imaging Collimator

- Sapphire single crystal as fast neutron filter
- Bismuth single crystal as neutron filter (λ< 0.4nm) and for gamma absorption
- Dual collimator for absorption and phase contrast imaging
- High cadmium ratio pre-dominantly thermal neutron beam

Imaging Techniques Implemented

- Neutron Radiography & Tomography
- Neutron Phase Contrast Imaging
- Real time imaging for transient events

Neutron Radiography for different applications



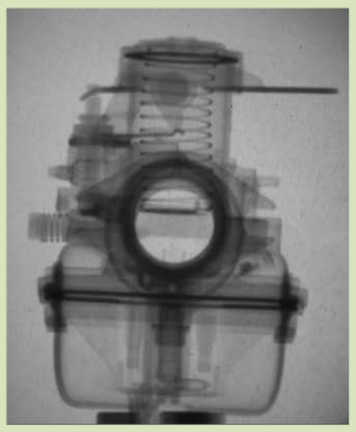
Water and lead balls in aluminium container

Spark plugs and ball bearing

PHWR fuel pin (fresh) and end-cap with inclusions in cladding

Engine Carburettor

Ball bearings – Big and small



Radiography of Carburetor

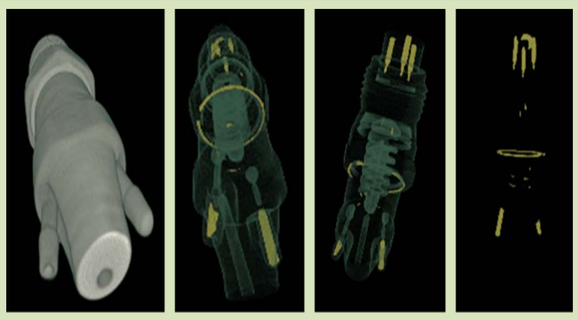
Future Plans

- Neutron Bragg Edge Imaging
- Neutron Laminography

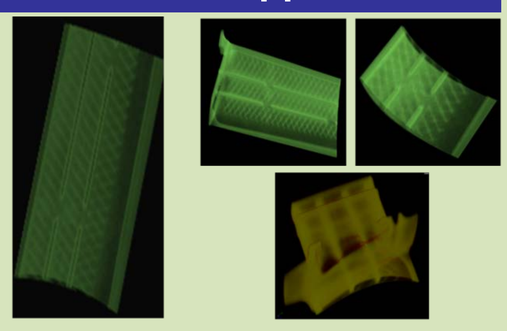
Beam Characteristics

Beam param7eter	Value
Thermal Neutron Flux	$4X10^7$ n/cm^2/sec
L/d (Collimation ratio)	160
Cadmium Ratio	250
Beam Diameter	120 mm

Neutron Tomography for Material Science Applications

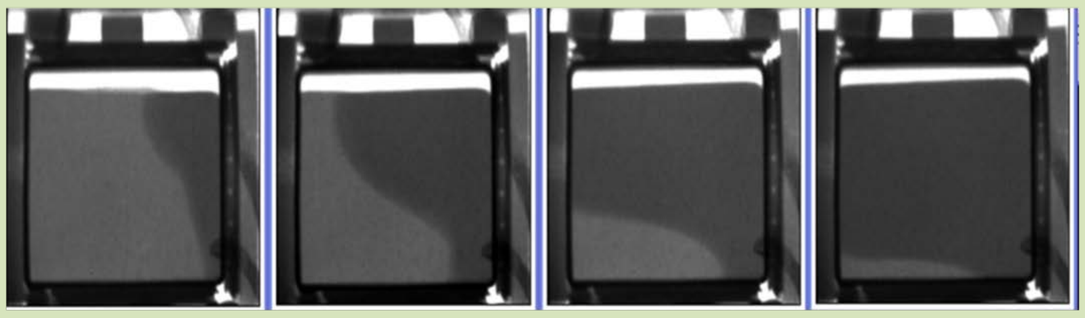


Tomography of fuel injector of automobile

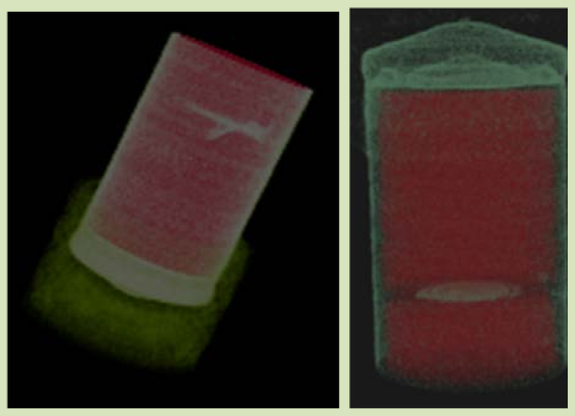


Tomography of turbine blade

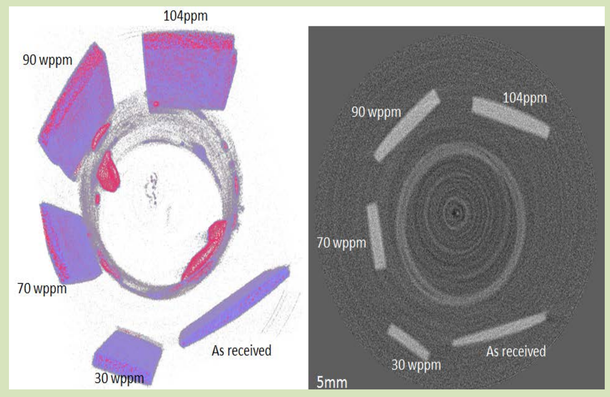
Real Time Imaging of Lead Melting



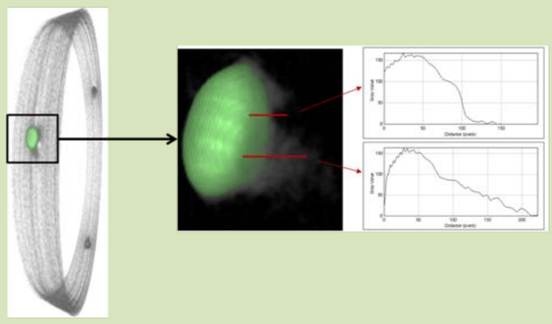
Neutron Tomography for Reactor Applications



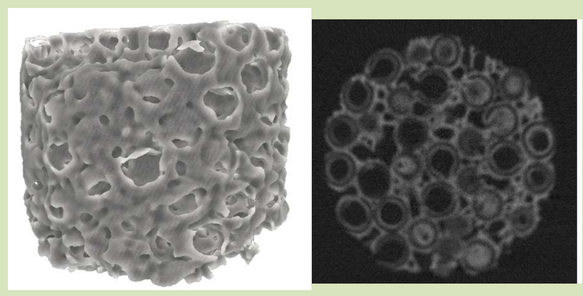
3D tomography of PHWR fuel rod and end cap showing a crack



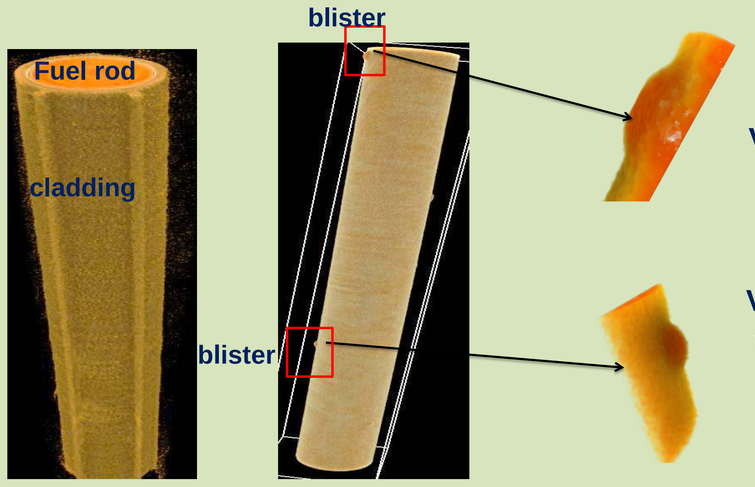
Tomography reconstruction of hydrogen charged Zr-alloy coupons



3D tomography hydride blister in Zircaloy Tube



3D tomography of aluminum foam



Volume rendering of top blister

Volume rendering of bottom blister