69th DAE Solid State Physics Symposium

December 19-23, 2025

Souvenir

Venue

Indian Institute of Technology Roorkee,
Uttarakhand

Organized by

Bhabha Atomic Research Centre, Mumbai

Sponsored by

Board of Research in Nuclear Sciences
Department of Atomic Energy
Government of India

डॉ. अजित कुमार मोहान्ती
Dr. Ajit Kumar Mohanty

भारत सरकार
Government of India

अध्यक्ष, परमाणु ऊर्जा आयोग
व
सचिव, परमाणु ऊर्जा विभाग
Chairman, Atomic Energy Commission
&
Secretary, Department of Atomic Energy

MESSAGE

I am happy to note that the 69th DAE Solid State Physics symposium is being organised by Bhabha Atomic Research Centre at the Indian Institute of Technology, Roorkee, Uttarakhand, India during December 19-23, 2025. This symposium over the years has kept its high scientific standard as well as has maintained its popularity in the condensed matter physics community of the country, particularly among the PhD students and young researchers. The interest can be judged by submission of a large number of papers in this symposium by researchers from across the various institutes and universities of the country, among which 680 papers selected by peer reviewing will be presented in the symposium in the form of poster and oral presentations.

The platform provided by this symposium is used not only to present the latest experimental and theoretical scientific findings but also to facilitate scientific interactions and foster discussions between young researchers and eminent senior scientists and it is also nice to see that this year over 40 eminent scientists from India and abroad will attend this symposium to deliver plenary talks, special evening lectures and invited talks.

I send my best wishes to all the delegates of this symposium for fruitful scientific interactions over this five day event and a grand success to the symposium.

Ajit Kumar Mohanty

(Ajit Kumar Mohanty)

राष्ट्र की सेवा में परमाणु
पऊवि DAE
ATOMS IN THE SERVICE OF THE NATION

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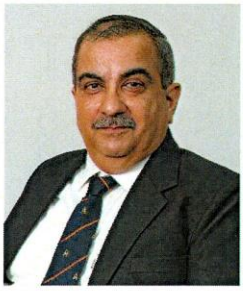
Vivek Bhasin

सत्यमेव जयते
भारत सरकार
Government of India

निदेशक, भाभा परमाणु अनुसंधान केंद्र
Director, Bhabha Atomic Research Centre
सदस्य, परमाणु ऊर्जा आयोग
Member, Atomic Energy Commission



MESSAGE

It gives me great pleasure to note that the DAE Solid State Physics Symposium (DAE SSPS) has entered into the glorious 69th year of successful organisation. DAE SSPS is among the oldest scientific events of the country and among the most prestigious in the field of condensed matter physics. Particularly, PhD students and young researchers look forward to attend this symposium every year to present their latest theoretical and experimental results in this field. The symposium is organised by Bhabha Atomic Research Centre every year in different parts of the country and this year it is being held at the Indian Institute of Technology Roorkee, Uttarakhand, India during December 19-23, 2025.

I am happy to see that more than 680 papers will be presented in this symposium by researchers from various DAE institutes, Universities and other premier institutions of the country and will cover a broad range of topics including phase transitions under high pressure and temperature, physics of soft matter including biological systems, nano-materials, novel experimental techniques and devices, physics of surfaces, interfaces and thin films, computational condensed matter physic, physics of functional materials including ferroelectrics, piezoelectrics, semiconductors and topological insulators, spintronic materials, materials for energy and environmental applications and quantum materials. The best thesis and young achiever categories have also received significant response showing the popularity of these events among the young scientific community of the country. It is also nice to see that over 40 eminent scientists from India and abroad will deliver plenary, special evening lectures and invited talks in this symposium and will interact with the young researchers over the five-day event.

I wish a grand success to this event and fruitful scientific deliberations among young researchers and eminent scientists during the symposium.

(Vivek Bhasin)

27.11.2025

राष्ट्र की सेवा में परमाणु
भा प अ कें
BARC
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Prof. K.K. Pant
Director

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Message

It is with great pleasure that I extend a warm welcome to all delegates, participants, distinguished guests, and invitees attending the 69th DAE Solid State Physics Symposium (DAE-SSPS 2025), hosted by the Indian Institute of Technology Roorkee from December 19 to 23, 2025.

The Department of Physics at IIT Roorkee is truly honored to host this prestigious event, organized under the auspices of the Bhabha Atomic Research Centre (BARC) and the Department of Atomic Energy (DAE). This symposium serves as a testament to the ongoing commitment to excellence in solid state physics, bringing together leading scientists, researchers, early-career scholars, and students from across India and beyond. It provides a platform to share groundbreaking advancements in condensed matter science, materials research, and related fields that are crucial for our nation's scientific and technological advancement.

At IIT Roorkee, we are proud to foster an environment that encourages intellectual exchange on diverse topics in condensed matter physics, including quantum materials, nanomaterials, spintronics, topological phases, and emerging technologies in energy and electronics. These areas not only align with our institute's legacy of innovative research and education but also contribute to solving real-world challenges in sustainable development and high-tech industries. IIT Roorkee has a long-standing tradition of close collaboration with BARC as well as DAE institutions, with our researchers extensively using national facilities for neutron, x-ray, high magnetic field, and pulsed-current sources to carry out cutting-edge experiments in condensed matter physics.

We are deeply grateful to BARC and DAE for their steadfast support and for entrusting IIT Roorkee with the responsibility of hosting this landmark symposium. This partnership exemplifies the collaborative spirit that strengthens the condensed matter physics community in India, fostering deeper connections among our faculty members and the esteemed participants.

We are confident that this symposium will serve as a fertile ground for intellectual exchange, sparking new ideas, forging innovative partnerships, and making meaningful contributions to the field. On behalf of the entire IIT Roorkee community, I wish you a productive, inspiring, and memorable experience that will leave a lasting impact.

(K K Pant)

Dr. T. Sakuntala
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BHABHA ATOMIC RESEARCH CENTRE
भौतिकी वर्ग
PHYSICS GROUP

It gives me immense pleasure to greet the organizers and welcome all the participants of 69th Symposium organized by the Department of Atomic Energy. Popularly known as the DAE-Solid State Physics Symposium, SSPS is a flagship national symposium organized by the Physics Group of Bhabha Atomic Research Centre. This symposium holds a special place for the solid-state research community of India, especially young students and researchers. With a view of recognizing and nurturing talented scientists, it has been a practice to hold this symposium in different part of the country. This year it is organized at IIT-Roorkee, which has a very rich history as a premier institute for engineering & technology.

I am very much hopeful that, as in the past, the 69th DAE SSPS 2025 would give a scientifically enriching experience to all the participants, serve to motivate several new discoveries, and also bring about networking among research groups. I would like to thank and acknowledge the team at IIT Roorkee and my colleagues from Physics Group of BARC, who have worked hard to bring out an excellent scientific program along with all the hospitality arrangements for the participants. I also take this opportunity to thank the Director IIT-Roorkee and Director, BARC for their encouragement and strong support. My best wishes for the grand success of DAE-SSPS 2025.

Sakuntala

(T. Sakuntala)

भारत सरकार
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भाभा परमाणु अनुसंधान केन्द्र
BHABHA ATOMIC RESEARCH CENTRE
अनुप्रयुक्त वर्णक्रमदर्शिकि प्रभाग
ATOMIC & MOLECULAR PHYSICS DIVISION

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Dr. D. Bhattacharyya
Outstanding Scientist &
Head, Atomic & Molecular Physics Division
Bhabha Atomic Research Centre
Mumbai – 400 085, INDIA
& Professor, Homi Bhabha National Institute
Anushaktinagar, Mumbai – 400 094, INDIA
Editor, Journal of Synchrotron Radiation (IUCr)

Message

This is the 69th glorious year of the Department of Atomic Energy - Solid State Physics Symposium (DAE SSPS), one of the most prestigious scientific conferences in the field of condensed matter physics and this year it is being held at the Indian Institute of Technology Roorkee, Uttarakhand, India during December 19-23, 2025. It is a matter of great privilege and also of big responsibility to serve as a convener of the 69th DAE SSPS 2025.

This year, we had received nearly 800 manuscripts from various DAE institutes, Universities and other premier institutions across the length and breadth of the country under the 11 categories covering almost all important topics of current importance viz., phase transitions under high pressure and temperature, physics of soft matter including biological systems, nano-materials, physics of surfaces, interfaces and thin films, computational condensed matter physic, physics of functional materials including ferroelectrics, piezoelectrics, semiconductors and topological insulators, spintronic materials, materials for energy and environmental applications and quantum materials. Nearly 33 coordinators and around 431 reviewers from across the country helped us to review these manuscripts and finally around 680 manuscripts have been selected for presentation in this symposium. The best thesis and young achiever categories have also received significant response manifesting the impact of these events among the young scientific community of the country. Over 40 eminent scientists from India and abroad have accepted our invitation to deliver plenary, special evening lectures and invited talks in this symposium. We urge all young researchers and PhD students to use this opportunity to interact with the experts to scientifically enlighten themselves further and to initiate possible collaborations.

I would like to acknowledge the efforts of Dr. Himal Bhatt and Dr. Niranjan S. Ramgir, the scientific secretaries of the symposium who have worked very hard to chalk out the well-planned scientific program spreaded over the 5 days. I sincerely thank the local convener Prof. V.K. Malik of IIT Roorkee and his colleagues for their tireless effort in making all the arrangements for hosting the symposium successfully and making the stay of the delegates comfortable.

I look forward to see the 69th DAE SSPS 2025 a great success with enriching scientific deliberations and fruitful interactions among the delegates during the symposium.

Yours sincerely,

Date: 09th December, 2025

(D. Bhattacharyya)
Convener, 69th DAE SSPS 2025

Patrons

Name	Affiliation
A.K. Mohanty	DAE, Mumbai
Vivek Bhasin	BARC, Mumbai

Advisory Committee

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V. K. Malik (Local Convener)	IIT Rookee, Roorkee
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V. Sathe	UGC-DAE-CSR, Indore

SUBJECT CATEGORIES

A. Phase transitions and dynamics

B. Soft matter including biological systems

C. Nano-materials

D. Experimental techniques and devices

E. Surfaces, interfaces and thin films

F. Computational, AI and ML methods in condensed matter physics

G. Dielectric, ferroelectric and piezoelectric materials

H. Transport properties and semiconductor physics

I. Magnetism and superconductivity

J. Energy and environmental materials

K. 1-D, 2-D and quantum materials

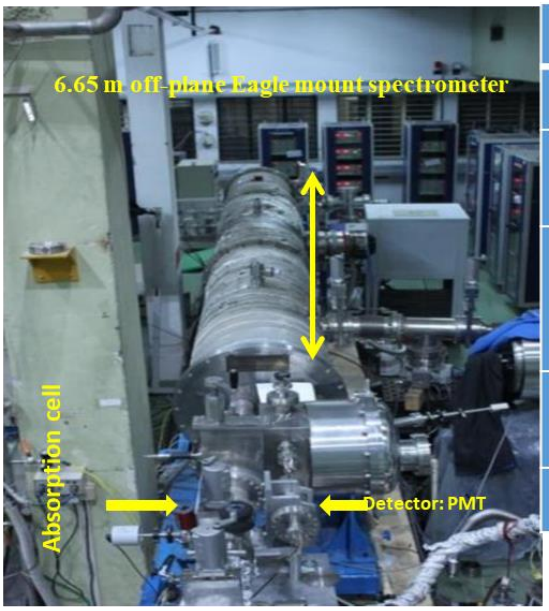
Award Categories

- Ph. D thesis
- Young Achiever
- Best Poster

Large facilities available with Bhabha Atomic Research Centre for condensed matter research

BARC Beamlines at Indus-1 Synchrotron Source

High Resolution Vacuum Ultraviolet (HRVUV) Beamline (BL-01)

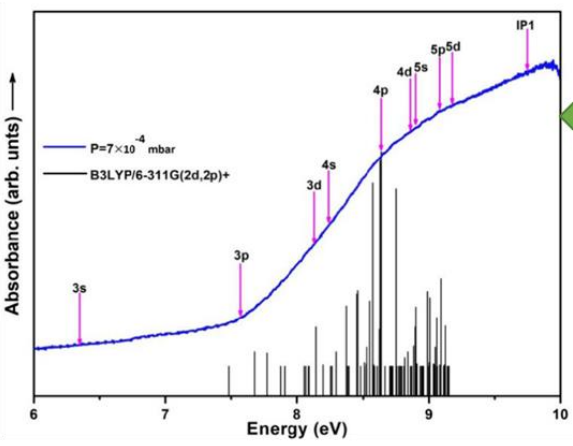


Photograph

Specifications	
Source:	Bending magnet (1.5T)
Wavelength (Energy) Range:	1200–3000 Å (3.5-10.3 eV)
Spectrometer:	6.65 m eagle mount indigenously developed spectrometer with a 1200 lines/mm grating
Wavelength resolution:	~0.1 Å
Detector:	Solar blind photomultiplier tube

Scopes & capabilities	
Sample environment available:	Gas phase absorption cells with sample introduction manifolds
Experiments possible:	Gas phase photo-absorption studies of atoms and molecules for both ground and excited states

Research highlights



Experimental VUV absorption spectrum of n-dodecane ($C_{12}H_{26}$)

N-dodacane is used as
- Diluent for tributyl phosphate in nuclear waste re-processing
- Possible surrogate for kerosene-based fuels such as Jet-A

VUV spectroscopy provides detail information about the ground and excited state structure of the molecule .

Journal of Quantitative Spectroscopy & Radiative Transfer 236 (2019) 106582

Angle Resolved Photoelectron Spectroscopy (ARPES) beamline (BL-03)

Photograph

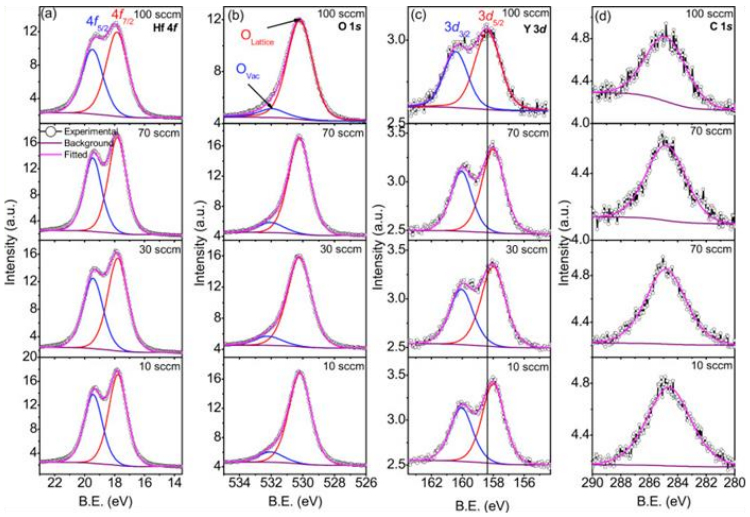
Specifications	
Source:	Bending magnet (1.5T)
Energy Range:	12-300 eV
Monochromator:	Toroidal grating monochromator
Wavelength resolution:	Overall resolution with beamline of 140 meV-400 meV

Scopes & capabilities

Sample environment available:	➢ Electron Analyser : Phoibos 150 ➢ Measurement temperature: Room temperature to 6 K ➢ Base vacuum in measurement chamber: < $5x10^{-11}$ mbar. ➢ Alternate source: He discharge lamp & Twin anode (Al/Mg) X-ray lab sources ➢ Prior to the measurements, samples can be scrapped, cleaved, sputtered or annealed up to 800ºC.
Experiments possible:	➢ ARPES measurements on thin films, single crystals and sintered pellets ➢ Band offsets in hetro-junctions ➢ Sspectroscopy of buried interfaces with depth profiling ➢ Elemental composition and cchemical state information ➢ Phase transition studies as a function of temperature

Research highlights

Narrow scan XPS core level spectra recorded on a series of $Hf_{0.90}Y_{0.10}O_2$ thin films deposited function of oxygen partial pressure



The change observed in Y 3d core level for the film deposited at 100 sccm O_2 pressure is due to structural phase change of the sample from orthorhombic to cubic phase.

Vacuum 221 (2024) 112882

Photophysics Beamline (BL-05)

Photograph

Specifications	
Source:	Bending magnet (1.5T)
Wavelength Range	1050 – 3000 Å
Energy Range	~ 3.9 – 11.8 eV
Resolving Power	~1500
Detector:	solar blind VUV photomultiplier tube

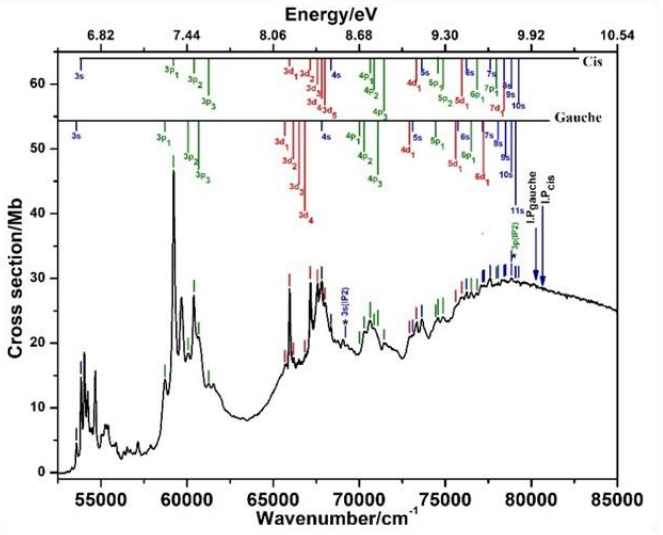
Scopes & capabilities

Sample environment available:	Gas phase absorption cells with sample introduction manifolds Stainless steel absorption cells of various lengths and designs are connected after the post-optics section.
Experiments possible:	Gas phase photo-absorption studies, Solid phase transmission/ fluorescence Useful for photo-absorption studies of polyatomic molecules of importance in atmospheric physics, astrophysics, biology, nuclear fuel cycle and various industries.

Research highlights

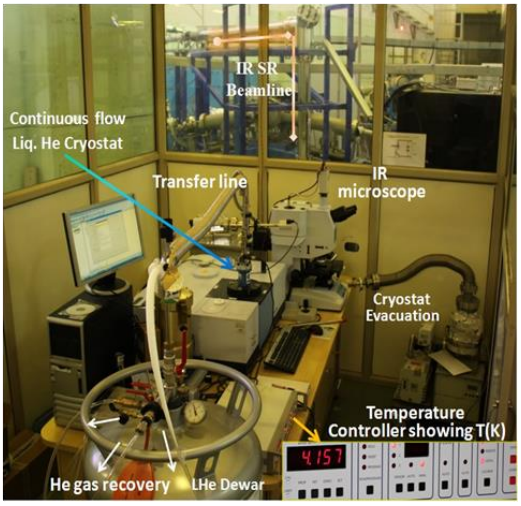
VUV absorption spectrum of propionaldehyde showing Rydberg series converging to the first Ionisation Potentials of its cis and gauche conformers

Propionaldehyde is a molecule of interest in atmospheric physics and astrochemistry, and interesting conformational effects in its the electronic excited states were observed



J. Chem. Phys. 159 (2023) 144301

Infrared (IR) beamline (BL-06)



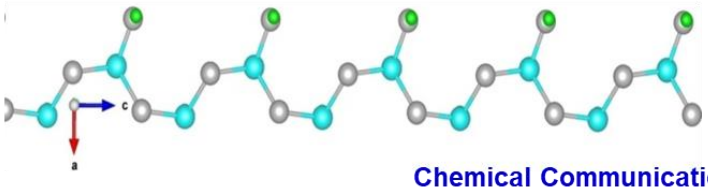
Photograph

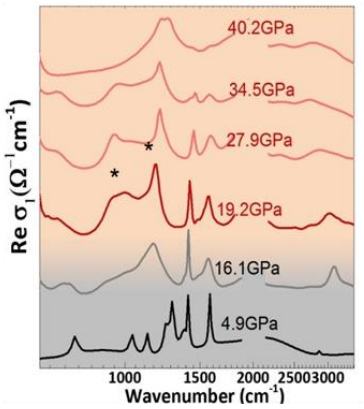
Specifications	
Source:	Bending magnet (1.5T)
Spectral range:	600–6000cm^{-1} (Mid-IR: 0.07 – 0.7eV)
Energy Resolution (E/ ΔE):	0.07 cm^{-1} (max.)
Beam size at the sample:	200μm x 200μm

Scopes & capabilities	
Sample environment available:	➢ Microscope: Hyperion2000 with 4X, 15x, 36x objective ➢ High Pressure: Type-IIa Diamond anvil cell 40 GPa ➢ Low Temp.: 4.2 - 500K continuous flow Liq. He
Experiments:	➢ ATR, Diffuse, Specular (11°, 30°) ➢ IR microscopy ➢ In-situ high pressure studies ➢ In-situ variable temp. studies ➢ Polarization dependent studies ➢ Absorption, reflections modes

Research highlights

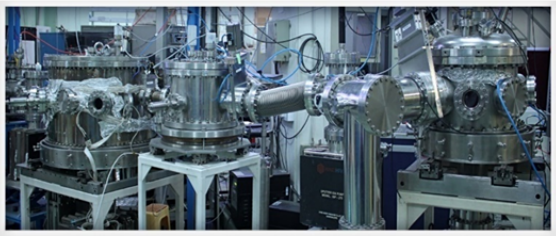
A new polymer (ether) phase of formic acid (the simplest acid) discovered under high pressure :





Chemical Communications 59 (2023) 9888

Photo Absorption Spectroscopic Studies (PASS) beamline (BL-07)



Photograph

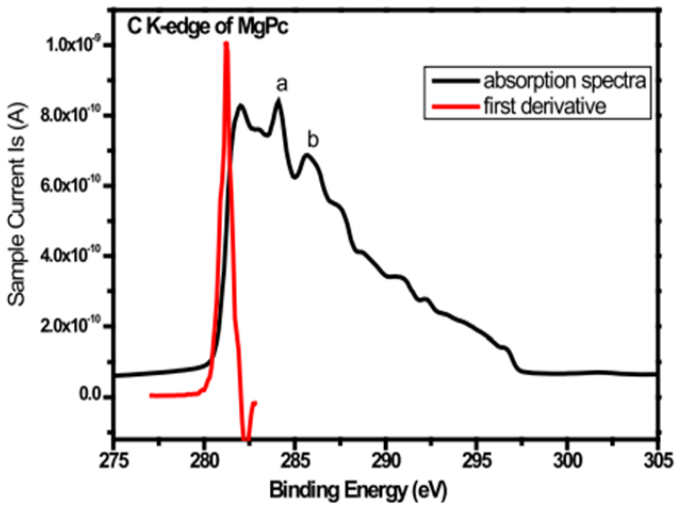
Source:	Bending magnet (1.5T)
Energy Range:	55 eV – 840 eV
Monochromator:	Plane Grating Monochromator
Energy Resolution (E/ ΔE):	~1.5 eV at 284 eV
Beam size at the sample:	1 mm (V)x 2 mm(H);
Detection method:	Total electron yield by measuring sample current

Scopes & capabilities

Experiments possible:

- Absorption spectra of solid samples both in thin film as well as bulk form.
- XANES & EXAFS measurements at K edges of low Z-elements like C, N, O etc. and at L and M threshold of 3d elements such as Ti, V, Fe, Cr etc.

Research highlights



Rev. Sci. Instrum. 92 (2021) 90151106

First result from the beamline:

C K-edge of Magnesium Phthalocyanine thin film

Metal phthalocyanine have emerged as an alternative to inorganic counterparts for their use in opto-electronic devices

BARC Beamlines at Indus-2 Synchrotron Source

X-ray imaging beamline (BL-04)

Photograph

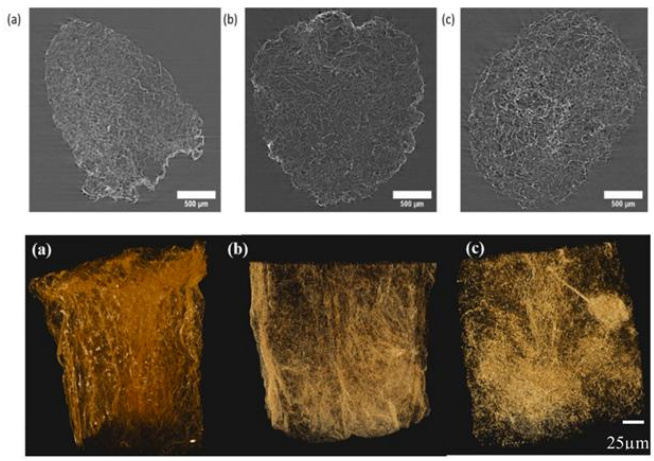
Specifications	
Synchrotron source	Bending magnet (1.5 T)
Operational modes	Monochromatic and White beam
Energy range	8-35 keV Monochromatic
Monochromator	Si(111) DCM
Energy resolution ($\Delta E/E$)	3.2×10^{-4} @ 12keV
Photon flux at sample (calculated)	~ 1.74×10^{8} ph/s/mm^2 at 12keV
Highest spatial resolution:	1 µm 2D & 3 µm 3D
Highest temporal resolution:	10 ms for 2D & 5s in 3D

Scopes & capabilities

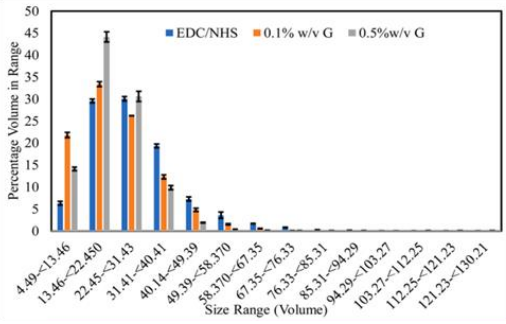
Targeted Information:	X-ray imaging techniques available:
Density mapping, micro-structure, morphology	Absorption and Phase contrast imaging, tomography
Dynamics	Real time imaging tomography
Effect of morphology and porosity on the deformation behaviour	*In-situ* Imaging and tomography under compression and tensile loads
Elemental mapping, composition	K-edge subtraction imaging/CT Fluorescence microscopy (under progress)
Crystal defects and Grain boundary mapping	Diffraction contrast imaging, topography (Future development)

Research highlights

Role of graphene concentration on the porosity of collagen cryogels



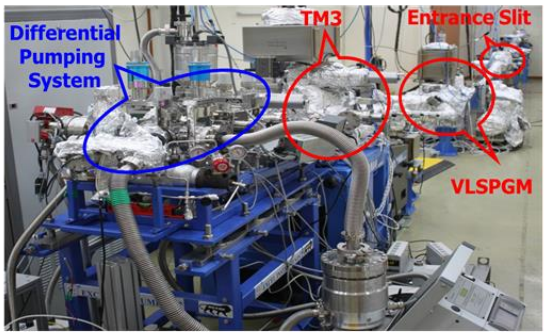
a) Control b) 0.1% w/v graphene c) 0.5% w/v graphene *((top) slices images & (bottom) full 3D images of cryogels)*



Graphene promotes uniform pore size, wall thickness and connectivity for cellular proliferation and tissue regeneration

Micron 150 (2021) 103127

Atomic Molecular and Optical Science (AMOS) Beamline (BL-05)



Photograph

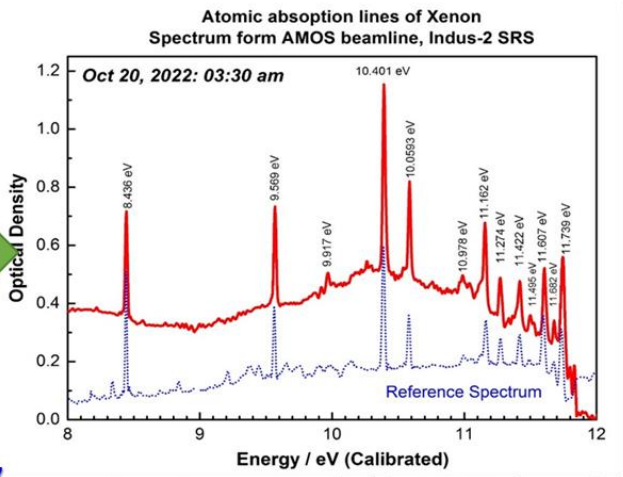
Specifications	
Synchrotron source	Undulator (planar permanent magnet type)
Energy (Wavelength) range	6-800 eV 20000-15 Å
Monochromator	Variable Line Spacing Plane Grating Monochromator (4 gratings)
Resolving Power (EΔ/E) (theoretical)	10000
Photon flux at sample (theoretical)	10^{12} photons/sec
Detector	Total electron yield, PMT, Photodiode

`Scopes & capabilities

Sample environment available:	Gas absorption cell with differential pumping facility Sample mount for solid sample
Experiments possible:	➢ VUV-soft X-ray spectroscopy of molecules of interest in atmospheric physics, astro-chemistry, plasmas, photobiology and various industries ➢ Photoionization and photo-fragmentation dynamics of molecules using velocity map imaging and coincidence techniques (under development). ➢ Soft X-ray XAS on samples with low Z elements like O,C,N etc. and L edges of magnetic elements like Fe, Co. Ni.

Research highlights

First Result



Rev. Sci. Instrum. 95 (2024)123307

Xe Spectrum recorded in AMOS beamline

Energy Dispersive EXAFS Beamline (BL-08)

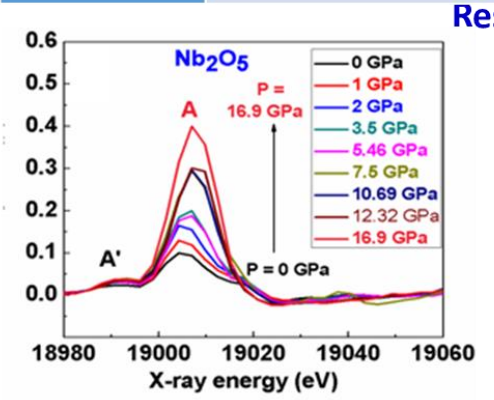
Photograph

Specifications	
Synchrotron source	Bending Magnet (1.5 T)
Energy range	5-20 keV
Monochromator	Elliptically bent crystal polychromator
Energy resolution (ΔE/E)	1×10^{-4} @10 keV
Spot size at sample	0.1 mm (horizontal) x 0.5 mm (vertical) @10 keV
Experimental stage	19-axix goniometer
Detector	CCD

Scopes & capabilities

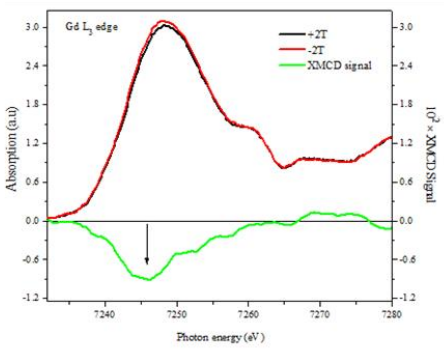
Sample environment available:	Heating Cell upto 1000 K under vacuum & various gaseous ambience
	Cell for simultaneous measurements of XAS & UV-Vis transmission
	Peristaltic pump based flow cell Magnetic field: 2T High pressure Diamond Anvil Cell (uopto 50 GPa) with nano polycrystalline diamond
Experiments possible:	Time-resolved XAS studies at 300 msec time scale on systems like heterogeneous catalysis
	In-situ growth of nanoparticles from solution phase during one-pot synthesis and flow-cell configuration
	X-ray Magnetic Circular Dichroism (XMCD) under 2T magnetic field
	High pressure studies

Research highlights



Nb K-edge XANES spectra for Nb_2O_5 under high pressure

J. Synchrotron Rad. 27 (2020) 988



XMCD signal of the Gd foil taken at 2T magnetic field

J. Synch. Rad. 26 (2019) 445-449

Energy Dispersive EXAFS Beamline (BL-09)

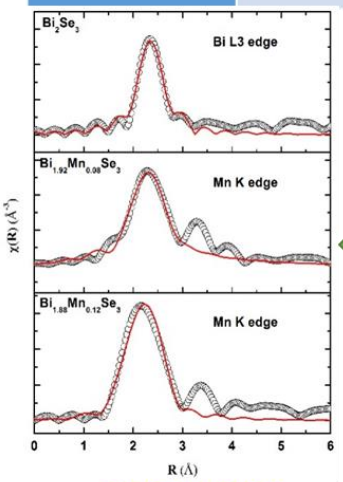
Photograph

Specifications	
Synchrotron source	Bending Magnet (1.5 T)
Energy range	5-25 keV
Monochromator	Double Crystal monochronmator
Energy resolution (ΔE/E)	1×10^{-4}
Spot size at sample	5 mm x 5 mm (typically) Horizontal focussing can be controlled by sagittal bending of 2nd crystal
Detectors	Ionisation Chamber, single channel & 4 channel Si drift detector

Scopes & capabilities

Sample environment available:	Low temperature cryostat (down to 5.4 K)
	High temperature SS cells with Be windows for XAS measurements under vacuum and various gaseous ambience (upto 1000 K in transmission mode) & 800 K in fluorescence mode
	SS Cell with quartz window at 45 deg and Kapton windows for X-ray beam in- and out for photocatalysis
	Specially designed electrochemical cell with Kapton window for operando studies on Li ion batteries
	Teflon cell for electrocatalysis with provision for measurements with three electrodes
	Ultra-thin quartz capillary based chemical reactor bead with blower heater for catalysis study under various gaseous ambience
Experiments possible:	XAS measurements all forms of samples including bulk, thin film, solution, powders, pellets, dilute samples (upto 0.1 % concentration) *In-situ* operando studies on Heterogeneous catalysts, Electro-catalysts, Photo-catalysts, Single atom catalysts & Li ion batteries

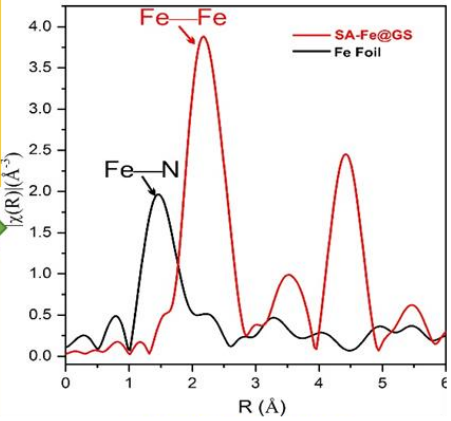
Research highlights



Phys Rev. Mater. 6 (2022) 114201

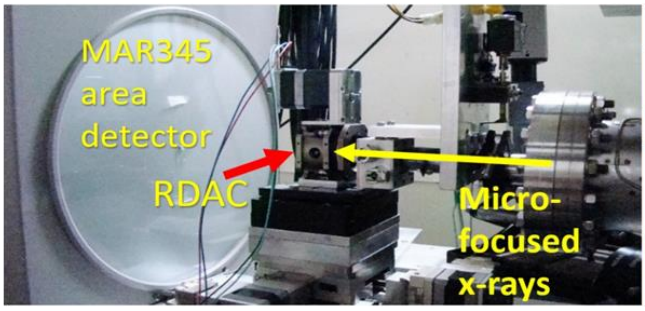
Fourier Transformed EXAFS data taken on Mn doped Bi_2Se_3 crystals at Bi L_3 and Mn K edges showing substitutional doping at Bi edge upto 6% Mn doping

Fourier-transformed Fe K edge EXAFS spectra of a Fe based single atom catalyst (SAC) vis-à-vis that of Fe foil clearly showing the monoatomic dispersion of the SAC



Adv. Funct. Mater. 31 (2021) 2010916

Extreme Condition X-ray Diffraction (ECXRD) beamline (BL-11)



Photograph

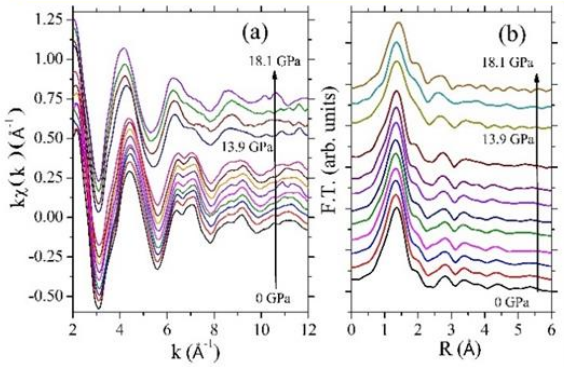
Specifications	
Synchrotron source	Bending Magnet (1.5T)
Energy range	10-30 keV
Spot size at sample	30 µm X 30 µm (focused) to 2x2mm (unfocused)
Detectors	MAR345 image plate detector for angle dispersive XRD, HPGe detector for energy dispersive XRD, Mini ionization chamber for HP-EXAFS studies

Scopes & capabilities

Sample environment available:	High-pressure Diamond Anvil Cell (~ 1Mbar)
	Rotational Diamond Anvil Cell (unlimited torsion up to 50 GPa)
	Resistive heated Diamond Anvil Cell (800K)
	High-temperature capillary furnace (1500 K)
Experiments possible:	X-ray Diffraction X-ray Absorption Spectroscopy (EXAFS, XANES) Grazing Incidence X-ray Diffraction of thin films Radial X-ray Diffraction

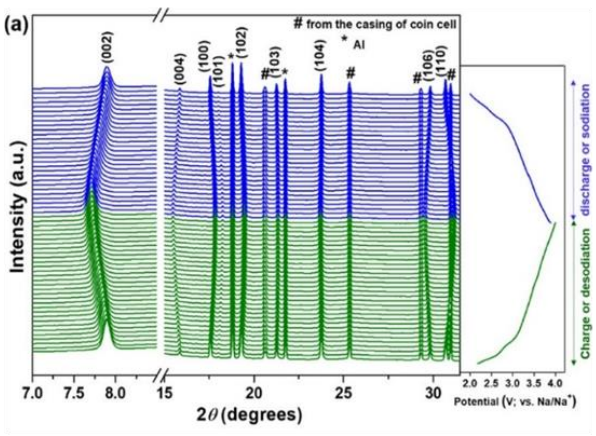
Research highlights

High-pressure short and long range structural investigations on $Y_2Ge_2O_7$ using XRD and EXAFS



Phys. Rev. B 108 (2023) 174108

***Operando* XRD studies on new sodium based ion battery materials**



Chem. Mater. 34 (2022) 10470

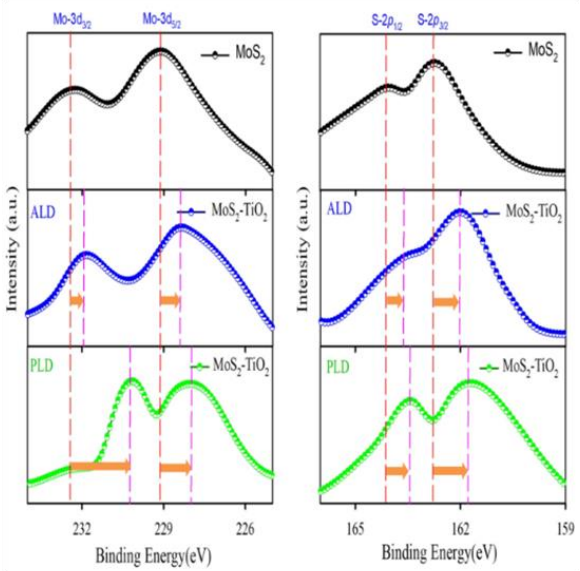
Hard X-ray Photo-Electron Spectroscopy Beamline (BL-14)

Photograph

Specifications	
Synchrotron source:	Bending Magnet (1.5T)
Monochromator :	Double Crystal Monochromator
Energy range :	3-15 keV
Energy Resolution:	~ 10^{-4}
Spot size @sample	1.0 mm (H) x 2.0 mm (V)

Scopes & capabilities

Sample environment available:	➢ Specs Make Phoibos 225 hemispherical analyser ➢ High resolution 2D imaging system using Micro-channel Plate with phosphor and CCD ➢ Argon gun for in-situ ion itching of sample surface
Experiments possible:	➢ Hard X-ray Photoemission Spectroscopy ➢ Elemental identification in solid samples upto a depth of 15-20 nm in non-destructive mode ➢ Oxidation state and chemical shift determination in samples ➢ Quantification of elements ➢ Both destructive and non-destructive depth profiling ➢ Band alignment study at interfaces between different materials



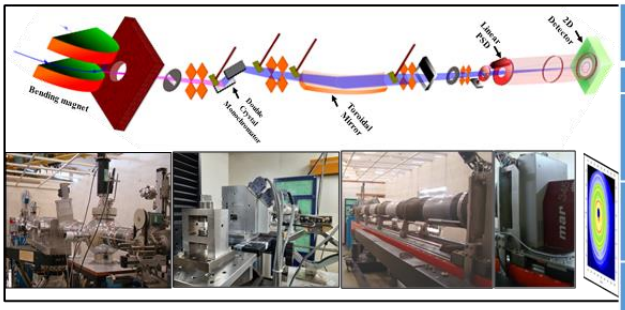
Research highlights

Studies of combinatorial Large-Area MoS_2/Anatase–TiO_2 Interface: A Pathway to Emergent Optical and Optoelectronic Functionalities

Shifts of both Mo-3d and S-2p levels towards lower binding energies confirm p type doping of MoS_2 due to TiO_2 deposition

ACS Applied Materials & Interfaces 12 (2020) 44345

Small and Wide-Angle X-ray Scattering (SWAXS) beamline (BL-18)



Photograph

Specifications	
Source	Bending Magnet (1.5T)
Operational mode	Monochromatic (wavelength tunable by Double Crystal Monochromator)
Energy range	5KeV–20KeV (Preferred 12 KeV)
Detectors	2-Dimension online image plate (For SAXS measurements) Linear position sensitive gas detector (For WAXS measurements)
q-range	0.03 – 3.7 nm^{-1} (SAXS with 2-Dimension image-plate detector) >2 nm^{-1} (WAXS with 1D detector)

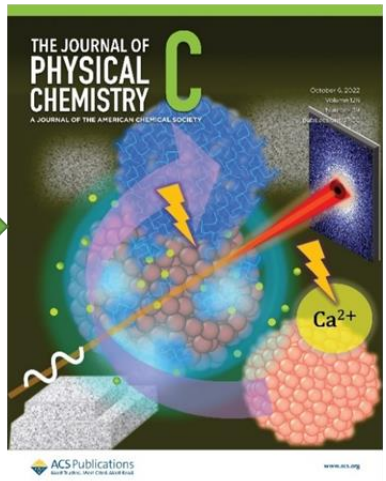
`Scopes & capabilities

Sample environment available:	➢ Capability to handle powder, gel or liquid samples ➢ Automated multiple sample stage for high throughput experiment ➢ Heating stage (up to 200°C) ➢ Flow experiments ➢ Magnetic stage (0.2T)
Experiments possible:	➢ Probing of structure in nanometer length scale (1-100 nm) in condensed matter covering a wide range of fields, including alloys, polymers, macromolecules, emulsions, porous materials, nanoparticles and soft-matter. ➢ Time dependent measurements

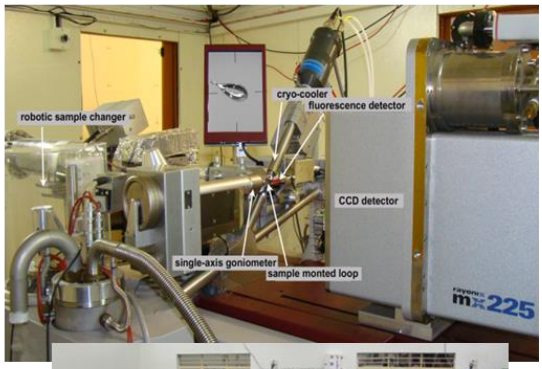
Research highlights

Time-resolved small-angle X-ray scattering and computer simulation quantify the structural evolution during such pozzolanic gelling in spray-dried silica microgranules

J. Phys. Chem. C 126 (2022) 16785



Protein crystallography beamline (BL-21)



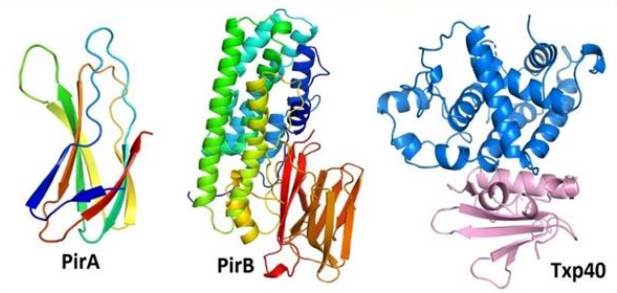
Photograph

Specifications	
Synchrotron source	Bending Magnet (1.5T)
Energy range (in wavelength)	5 –17 keV (2.0–0.73 Å)
Maximum resolution (d spacing)	< 1.0 Å
Energy resolution (ΔE/E)	~2 × 10^{-4} for Si (111) and ~ 5.5× 10^{-5} for Si (220)
Spot size at sample	0.4 mm (horizontal) x 0.4 mm (vertical)
Experimental stage	MARdtb
Detectors	MARCCD 225 (Rayonix), 225mm x 225mm (active area)
	AMPTEK XR 100 SDD Fluorescence detector

Scopes & capabilities

Sample environment available:	➢ Oxford Cryostream - 700 series Cryo sample cooler
	➢ MAR research Cryogenic Robotic sample changer with Carousel of 19 samples
	➢ HP Z800 (12-core Xeon 2.67 GHz, 24 GB RAM) on-site data processing server with Automar, XDS, Mosflm, CCP4, PHENIX, Coot, Pymol softwares
	➢ A well-equipped biochemical laboratory and cold rooms with all the necessary infrastructure and facility for protein expression, purification and crystallization
Experiments possible:	➢ Macromolecular crystallography i.e., diffraction studies on single crystals of protein, DNA and their complexes.
	➢ Single and multi- wavelength anomalous dispersion experiments (SAD, MAD)

Research highlights



Crystal structures of a novel insecticidal proteins from *Xenorhabdus nematophila* bacteria at high resolutions (1.6, 2.1, 2.1 Å),
Prashar et. al., Insect Biochem. Mol. Bio., 162 (2023) 104014.
Kinkar et. al., Insect Biochem. Mol. Bio., 164 (2023) 104045.

Neutron Beam Research Facility at Dhruva

Solid State Physics Division, Bhabha Atomic Research Centre, Mumbai 400085, India

(Email: sspd@barc.gov.in)

National Facility for Neutron Beam Research (NFNBR) has been created to cater to the needs of the Indian scientific community in the field of neutron beam research. Scientists from BARC, other DAE units, universities and national laboratories use NFNBR through collaborative research projects. Many of these collaborations are being supported by UGC-DAE Consortium for Scientific Research, Board of Research in Nuclear Sciences (BRNS) and other agencies.

Neutron scattering is an essential tool for characterization of structure and dynamics in condensed matter and it encompasses a wide spectrum of multidisciplinary research. Penetrating power inside materials, simultaneous sensing capabilities of both light and heavy atoms, comparable wavelength (/energy) to the atomic length scale (/basic excitations) in materials, magnetic responsiveness etc. have made thermal neutron a unique probe for characterization of materials. A variety of materials including ceramics, biological, soft matter, nuclear, pharmaceuticals, engineering, etc. are being routinely investigated by neutrons, aiming to design novel materials for societal applications in the domains including spintronics/electronics, quantum technology, energy harvesting and storage, pharmaceuticals, drug delivery and cosmetics, water treatment, nuclear waste management. In this article a few recent research highlights based on the neutron scattering facilities in Dhruva is provided.

Unlike x-ray photons with a similar wavelength, that interacts with the electron-cloud surrounding the nucleus, neutrons interact primarily with the nucleus. This makes neutron very sensitive to light atoms like hydrogen, which are difficult to detect using x-rays. Neutrons can also distinguish between the neighboring atoms of the periodic table like iron, cobalt, and nickel. Scattering and absorption cross sections of neutron vary widely among the isotopes of an element and thus neutron can distinguish between the isotopes. Neutrons have a magnetic moment, which allows them to interact with the atomic magnetic moments through dipole–dipole interaction. Therefore, neutrons can be used to investigate magnetic structures in a microscopic manner.

Today, the neutron scattering activity in India (https://nssi.org.in/pdfs-files/NFNBR-Brochure-2024.pdf) is mainly centered around the indigenously built Dhruva reactor (a medium flux, natural Uranium, heavy water moderated, heavy water-cooled reactor; maximum thermal power 100 MW, maximum core thermal neutron flux $\sim 1.8 \times 10^{14}$ neutrons/cm^2/s) and it serves as the National Facility for Neutron Beam Research (NFNBR).

NFNBR, Dhruva contains twelve beamlines: i) Triple Axis Spectrometer ii) Polarized Neutron Spectrometer, iii) Single Crystal Diffractometer, iv) Powder Diffractometer I, v) Powder Diffractometer II, vi) Powder Diffractometer III, vii) Time of Flight Spectrometer, viii) High-Q Diffractometer, ix) Double Crystal Based Medium-resolution Small-Angle Neutron

Scattering (MSANS) Facility, x) Polarized Neutron Reflectometer, xi) Small Angle Neutron Scattering (SANS) Instrument and xii) Multipurpose Test Facility, and

These facilities attract a strong national user base of over 200 groups from universities and other academic institutions. At present this is one of a kind of facility in the entire country. Some details of the facilities, particularly the sample requirements, and the research areas they cater to, are given herein.

Fig. 1. Panoramic view of the neutron instruments at Dhruva.

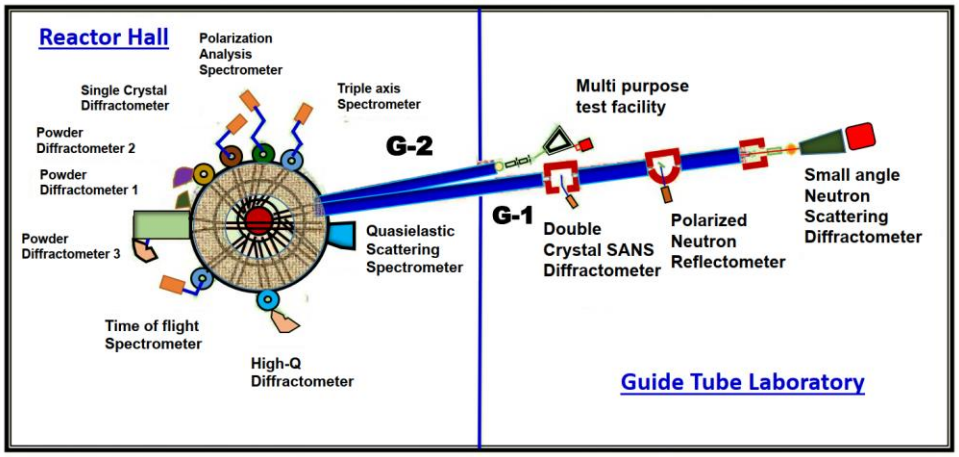


Fig. 2. Layout of the neutron scattering facilities at Dhruva reactor, and attached guide tube laboratory.

Fig. 3. Different facilities at Dhruva for structure and dynamics studies.

The neutron scattering activities can be divided into three sub categories, namely i) structure in advanced functional and magnetic materials, including thin films and multilayers, ii) Mesoscopic structure and interaction in soft matter and nanostructured materials, and iii) Periodic dynamics in materials.

i). Structure in advanced functional and magnetic materials

Neutron scattering is an invaluable tool to provide information about the atomic-scale structure of materials. Neutron diffraction can be used for the investigation of crystalline, hybrid nanostructured materials, and to determine the static structure factor of gases, liquids or amorphous materials. The available facilities for carrying out Neutron diffraction are:

Sr. No.	Facility (Name and sample requirements)	Research Area
1.	Single Crystal Diffractometer Optimum sample size: 3 mm x 3 mm x 3 mm	Study of high precision 3D structure of materials
2.	High Q Diffractometer Sample requirements: Powder sample 1- 2.5 cc (Volume) or pellet of 6-8 mm diameter and height 4.5 cm	Study of short and intermediate range order in glasses, liquids and disordered crystals
3.	Powder Diffractometer I	Study of magnetic ordering/phases in

	Sample requirements: Powder sample (2-5 g) or pellet of 10 mm diameter and height 6 cm	polycrystalline magnetic materials
4.	Powder Diffractometer II Sample requirements: Powder sample 1- 2.5 cc (Volume) or pellet of 6-8 mm diameter and height 4.5 cm	Delineation of chemical and magnetic structure phase diagrams of poly-crystalline materials
5.	Powder Diffractometer-III Sample requirements: Powder sample 1- 2.5 cc (Volume) Beam size: 15x25 mm^2	Chemical and magnetic structure phase diagrams of poly-crystalline materials
6.	Polarized Neutron Spectrometer Sample requirements: Powder sample (2 g) or pellet of 5-6 mm diameter and height 15 mm	Study of 1.Size/magnetization of magnetic domains or clusters at mesoscopic length scales 2. Magnetic correlations

ii). Mesoscopic structure and interaction in soft matter and nanostructured materials

Soft matter and nanostructured materials possess structures at the mesoscopic level (1-100 nm), which is between the microscopic and macroscopic scales. Small Angle Neutron Scattering (SANS) is a powerful technique for studying the shape, size distribution of mesoscopic structure, interactions between structures, and morphology of their complexes in soft matter and nanomaterials. The facilities for carrying out SANS are:

Sr. No.	**Facility (Name and sample requirements)**	**Research Area**
1.	Small Angle Neutron Scattering (SANS) Instrument Sample size: Larger than 15 mm (H) x 10 mm (W) x 1 mm (T) (Approximately 2 ml in volume for liquids and 1 g for solids)	Determination of the structure and interactions at nanometer length scales in systems
2.	Double Crystal Based Small- Angle Neutron Scattering (SANS) instrument Minimum required sample size: Larger than 15 mm (H) × 15 mm (W) × 2 mm (T)	Mesoscopic structure in synthesized and naturally occurring materials

3.	Polarised Neutron Reflectometer Sample size: More than 20 mm x 20 mm	Structural and magnetic characterization of thin film and multilayer samples

iii). Periodic dynamics in materials

Neutrons can gain or lose energy as they interact with the material, providing information about the energy levels of atomic vibrations and molecular motions. Inelastic neutron scattering (INS) studies the energy exchanged between the neutron and the material, revealing information about the vibrations and other dynamic processes. Neutron spectrometers are used to measure the energy and momentum transferred during neutron scattering, providing detailed information about the material's dynamics. The facilities for INS are:

Sr. No.	Facility (Name and sample requirements)	Research Area
1.	Triple Axis neutron Spectrometer Sample requirements: Powder sample (10-15 g) or pellet of 20 mm diameter and height 3-4 cm, single crystal 8-10 cc volume	Measurements of phonon dispersion curves, phonon density of states, and crystal field excitations
2.	Time of flight neutron Spectrometer Sample requirements: Powder sample (10-15 g) or pellet of 20 mm diameter and height 3-4 cm	Allows measurement of the scattering function in (Q, E) space

In brief, the neutron scattering facility, NFNBR, at Dhruva reactor, BARC, Mumbai, caters to a large number of users from different regions of the country as well as in-house, for research activities on structural and dynamical investigations in condensed matter physics. Further, several state-of-the-art neutron scattering facilities are envisaged at the upcoming High Flux Research Reactor (HFRR), Visakhapatnam (Vizag), which will take advantage of the significantly higher flux of HFRR.

Indian Physics Association (IPA)

- **Indian Physics Association (IPA)** was founded in 1970.

Aims and Objectives of IPA :

1. To help the advancement, dissemination and application of the knowledge of Physics.

2. To promote active interaction among all persons, bodies, institutions (private and/or state owned) and industries interested in achieving the advancement, dissemination and application of the knowledge of physics.

3. To disseminate information in the field of physics by publication of bulletins, reports, newsletters, journals incorporating research and teaching ideas, reviews, new developments, announcements regarding meetings, seminars, etc., and also by arranging special programmes for students or establishing student cadres.

4. To arrange seminars, lectures, debates, panel discussions, conferences and film shows on current research topics and other topics of national and local interest pertaining to research and teaching in physics.

5 To undertake and execute all other acts as mentioned in the constitution of IPA.

Membership

IPA has over 3500 members under 45 chapters in India and some foreign countries.

Publications

Physics News, the IPA bulletin is published quarterly and mailed free to all members
IPA has published several books and monographs on a wide range of topics in physics

Awards

a. **R. D. Birla Memorial Award in Physics**
(Rs. 50,000/- cash, citation and a medallion)

b. **Murli M. Chugani Award for Excellence in Applied Physics**
(Rs. 1,00,000/- cash, citation and a medallion)

c. **Buti Foundation Memorial Award for Excellence in Theoretical Physics, Astrophysics and Biophysics**

(Rs. 25,000/- cash, citation and a medallion)

d. **P. K. Iyengar Memorial Award for Excellence in Experimental Physics**
(Rs. 1,00,000/- cash and citation)

e. **S. N. Seshadhri Instrumentation Award in Physical Sciences**
(Rs. 20,000/- cash and citation)

f. **N. S. Satyamurthy Award in Physics for Young Scientists**
(Rs. 20,000/- cash and citation)

g. **Aswini Kumar Rath Memorial Award in Nuclear Physics**
(Rs. 10,000/- cash, citation and a medallion)

h. **Best Thesis Award in the following fields**

- Prof. C. V. K. Baba Award for the Best Thesis Presentation in Nuclear Physics
- Anil K. and Bharati Bhatnagar for Best Thesis Presentation in Solid State Physics
- Rahul Basu Memorial Award for Best Thesis in any area of High Energy Physics

i. **C L Bhat Memorial Award for the Best Student at the Indian Astronomy Olympiad Camp**
It is given at both Junior and Senior levels each year.

j. **Indian Physics Association Award at the International physics Olympiad Camp :**
At the International physics Olympiad Camp two awards are given for:
(a) Best Solution to a Challenging Problem
(b) Best Performance in Experimental programme

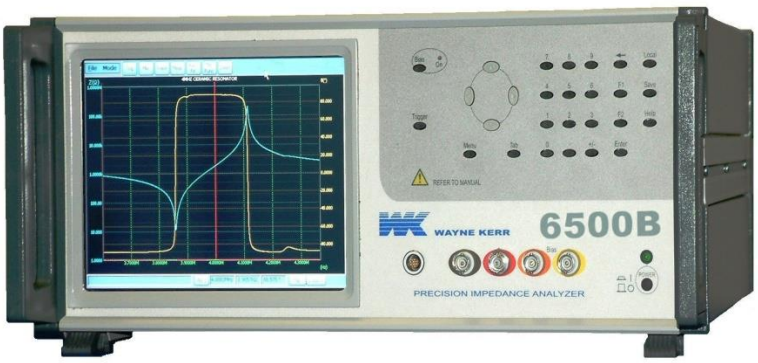
Source: http://www.ipa1970.org.in/index.php

Wayne Kerr Electronics

Wayne Kerr Electronics is acknowledged worldwide for the quality, accuracy and the capability of its component Measurement products

Model	6505B	6510B	6515B	6520B	6530B	6550B	65120B
Max. Frequency	5MHz	10MHz	15MHz	20MHz	30MHz	50MHz	120MHz

PRECISION IMPEDANCE ANALYZER



The 6500B range of Precision Impedance Analyzers provide users a comprehensive set of functions for characterizations /research/ analysis etc. The color user-friendly touch screen allows easy representation of the graphical results. Basic accuracy of 0.05% enables measurements to be made with confidence.

Other Products :

- HF LCR meter up to 120MHz
- LCR meter up to 1MHz
- Component Analyzers
- Magnetic &Inductance Analyzer
- DC Insulation Tester
- High Speed DC resistance Bridge
- Lockin Amplifier

Features:

- **Precise high frequency impedance measurements up to 120MHz**
- **0.05% basic measurement accuracy**
- **Frequency resolution is ≤ 1mHz**
- **Measurement parameters: C, L, R, X, G, B, D, Q, Z, Y, Ø , Permittivity, Permeability**
- **Five equivalent circuit Analysis models suit complex 3 element / 4 element models**
- **Polar and complex plot**
- **DC bias ± 40V / 0-40V&0-100mA**
- **AC Drive Level 1Vrms**
- **Source Impedance 50 ohm**
- **Easy to use, with large TFT touch screen, built-in micro-controller computer**
- **Traditional LCR Meter mode for single and repetitive measurements**
- **Fully programmable over GPIB and LAN**
- **VGA output allows screen to be displayed using a TV / projector**
- **Keyboard and mouse control with Pen drive option for data storage**

Accessories / options available:

High & Low Temperature Setup: LN2 to ambient / 500degC, Ambient to 250degC, Ambient to 500degC, Ambient to 1000degC and above, (custom built furnaces also available)
Cryo Industries of America, U.S Products: CCR's, Cryostats, Cryocooler, Electromagnets and Microscopy Workstations for temperature ranges 2K ~ 325K / 800K, 4K ~ 325K / 800K, 10K ~ 325K / 800K
Zero Point Cryogenics Canada: Dilution Refrigerator (<10mK)
Sample holders suitable for use with temperature controller furnaces: Solids & Liquids Sample holders, Di-electric Sample holder, Low temperature sample holders for LN2 to Ambient etc.
Software: For control, view, recording in tabular / excel form, graphical representation; Plot of Parameters vs Frequency / DC bias / AC level / Temperature and Data-Fitting software,

Wayne Kerr Electronics

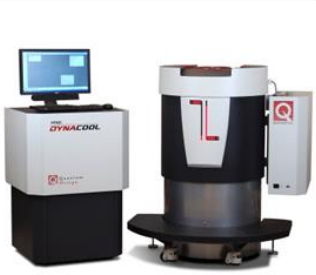
Wayne Kerr Electronics Pvt. Ltd.,

410, KM Trade Tower, Hotel Radisson Building
Sector - 14, Kaushambi, Ghaziabad, UP - 201010
Phone : 0120 2642612 • Telefax : 0120 2641113
Mob. No: 8800544566/9910339018 E-mail : sales@waynekerr.co.in

CIA CRYO INDUSTRIES

Quantum Design
INDIA

Quantum Design: MPMS 3 Squid Magnetometer
Temperature Range: 1.8K - 400K
Magnetic Field: ±7T



Quantum Design: PPMS DynaCool (Cryogen Free)
Temperature Range: 1.8K - 400K
Magnetic Field: ±14T

Single Quantum SNSPD systems: 12/24-channels cryostat. Low jitter, high efficiency and low dark count.

FusionScope (AFM with SEM and EDS) !
Innovative correlative microscope that combines the power of AFM with the benefits of SEM imaging. Switch between a sub-nanometer resolution AFM and SEM imaging with a simple click of a button to extract your desired data

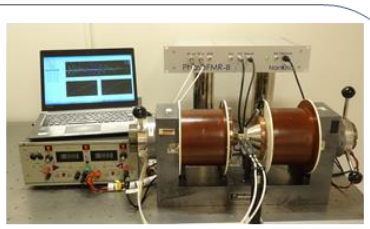
Durham Magneto Optics, Ltd: MicroWriter ML
Direct Write Lithography Machines
(0.4, 0.6, & 1 µ resolution)
Up to 180mm²/minute (resolution dependent)
Compact Size

Quantum Design: OptiCool
Low Vibration: <10nm peak to peak
Temperature Range: 1.7K to 350K
7T Split-Coil Conical Magnet (4-1-1 Vector)
Automated Temperature & Magnet Control

Laboratory XAFS and XES
Hard x-ray spectrometers
(Synchrotron-quality spectra from 4.5-25+ keV in your lab)
Tender x-ray emission spectrometer
(2-5 keV).

Lake Shore CRYOTRONICS
ADVANCING SCIENCE

Cryogenic probe stations
Cryostats
Cryogenic sensors, monitors, and controllers.
Vibrating sample magnetometers (VSMs)
Magnetic test/measurement instruments and sensors
Hall effect analysis systems
FastHall measurement in PPMS



Broadband FMR /ST-FMR Spectrometers (Ambient and Cryogenic)
CryoFMR operates in all Quantum Design PPMS
Calculates the effective magnetization, anisotropy, gyromagnetic ratio, damping and inhomogeneous broadening
Extraction of exchange stiffness and inverse spin Hall effect ISHE

Quantum Design India Pvt Ltd.
Tel: +91-22-27781011/12/13
Email: info@qd-india.com

ants
MATERIALS | EQUIPMENT | PROJECTS

2005-2025: A Manufacturing Start-up Journey from "Lab to Leading Player"

"20 Years of Service to the Nation: An IP-driven

Advanced Ceramic Materials & Thermal Process Equipment Company"

Starting as a small R&D-focused team, Ants has evolved into a globally trusted name, combining academic innovation with rugged industrial execution

With your blessings, Ants Group continues to expand its footprint across both research and advanced manufacturing

Manufacturing Facilities: 2

Location 1: Vasai (Furnace System, 20,000 sq feet)

Location 2: Pune (Advanced Ceramics, 12,000 sq feet)

International Office: 2

Location 1: Shenzhen, China

Location 2: Copenhagen, Denmark

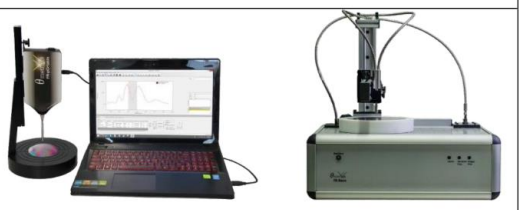
Global R&D: ASPIRE, IIT Powai

aspire
IITB Research Park
Foundation

Contact us: 8600033151 Email: sales@antsglobal.in
Website: www.antsglobal.in

EdgeTech Scientific Pvt. Ltd.

DEALS IN:

SEMILAB Spectroscopic Ellipsometry, Deep Level Transient Spectroscopy, Scanning Probe Microscope, Nanoindentation, Hall Measurement System, Four point Resistivity measurement, Mercury CV Profiling, Non-Contact Mobility (Microwave reflectance), Non-Contact Sheet Resistance (Eddy Current), Minority Carrier Diffusion Length Measurement, Minority Carrier Lifetime Measurement, Non-Contact CV Profiling, Spreading Resistance Profiling.	
CRESTEC **CRESTEC CORPORATION:** State of art dedicated stand-alone electron beamlithography systems – 50kVA series, 130kVA series Systems for R&D & for production too!	
FEMTO SCIENCE Plasma Surface Treatment System, Atmospheric Plasma, Plasma Etching System, Parylene Coating System, Hand-Held Atmospheric Plasma (Plasma Pipette)	
MPI CORPORATION MPI's four main product markets include state-of-the-art Probe Cards, Production LED Equipment, Advanced Semiconductor Test Equipment's: Manual Probe station, Semi-Automatic, Automated, High Power probe station RF & MW.	
θ metrisis Film Metrology & More **Non-destructive characterization of coatings in the nano- and micro- scale.** Optical metrology tools for the characterization of single layer and multi-layer coatings for a wide range of diverse applications. ***Film Characterization*** **(thickness, optical properties), Absorbance, Fluorescence, Reflectance, Transmittance**	

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