List of Facilities built and operated by Solid State Physics Division, Physics Group, BARC to be offered for collaboration with UGC-DAE CSR

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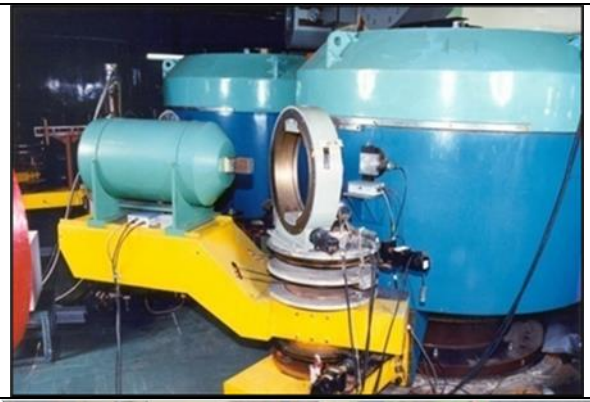
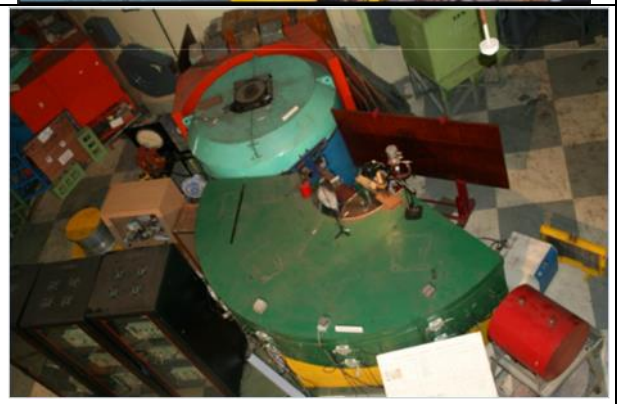
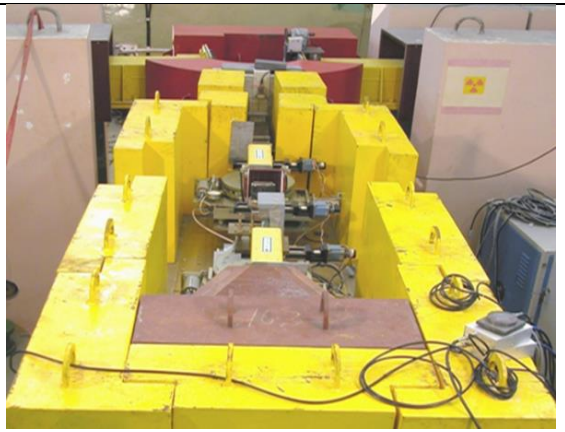
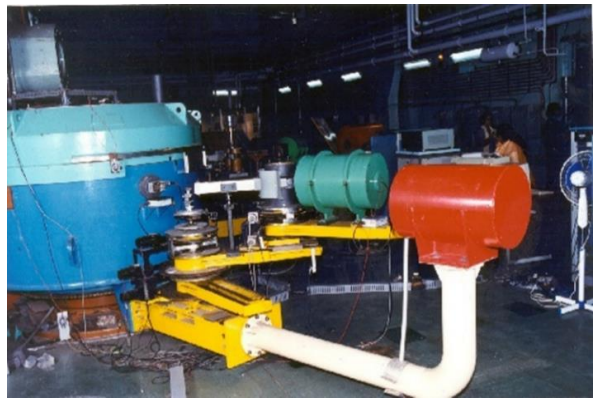
Sr. No.	Facility (Name, Status, Parameters)	Research Area	Representative publications	Photograph of the facility
1.	**Single Crystal Diffractometer** *Working* **Wavelength: 0.995 Å** **Optimum sample size: 3 mm x 3 mm x 3 mm** **$(\sin\theta/\lambda)_{max}$: 0.71 $Å^{-1}$** **Average time per sample: Three months for highly symmetric crystal system**	Study of high precision 3D structure of materials	1. "Deterioration of hydrogen-bonded superprotonic conductors belonging to $CsHSO_4$–CsH_2PO_4–H_2O salt system: a single-crystal neutron diffraction Investigation", R. R. Choudhury, R. Chitra, I. P. Makarova, E. V. Selezneva and V. A. Komornikov, Bull. Mater. Sci. 44 (2021) 108. 2. "L-Histidine with nitric acid: A comparison of crystal structures and Hirshfeld surfaces analysis", R. Chitra, R.R. Choudhury, Rejeena V. Rajan, D. Sajan, Mukesh Kumar, J. Mol. Str. 1267 (2022) 133550.	
2.	**High Q Diffractometer** *Under upgradation*	Study of short and intermediate range order in glasses, liquids and disordered crystals, e.g., Molecular Liquids, Disordered crystals (local structure), High pressure structural phase transitions	1."Structures of Iron-Lithium-Calcium-Silicate Glass and its Devitrified State", Manjunath T. Nayak, J. A. E. Desa, P.S.R. Krishna, A.B. Shinde, Margit Fabian, C. Nayak, D. Bhattacharya and S.N. Jha, Silicon, https://doi.org/10.1007/s12633-022-01789-2 (2022). 2. "Structure of copper tellurite and borotellurite glasses by neutron diffraction, Raman, ^{11}B MAS NMR and FTIR spectroscopy", A. Kaur, Atul Khanna, P. S. R. Krishna, A. B. Shinde, Marina González-Barriuso, Fernando González and Banghao Chen, Phys. Chem. Glasses: Eur. J. Glass Sci. Technol. B 61 (2020) 27. 3. "Structure of lead tellurite glasses and its relationship with stress-optic properties", A. Kaur, Hirdesh, Atul Khanna, Margit Fábián, P.S.R. Krishna and A.B. Shinde, Ma. Res. Bulletin 110 (2019) 239.	

3.	**Powder Diffractometer I** *Working* **Wavelength: 1.094 Å** **Scattering angle: $5^o \leq 2\theta \leq 70^o$** **$(Q)_{max}$: 6.5 $Å^{-1}$** **Resolution (Δd/d): 1 %** **Sample temperature range:** **2 – 300 K** **Sample requirements:** **Powder sample (2-5 g) or pellet of 10 mm diameter and height 6 cm** **Average time per sample: 4-5 hours per diffraction pattern, 5-6 hours at each temperature for temperature variation**	Study of magnetic ordering/phases in technologically important polycrystalline magnetic materials	1."Correlated negative magnetization, exchange-bias, and electrical properties in $La_{1-x}Pr_xCrO_3$", Deepak, A. Kumar, A.K. Bera, and S. M. Yusuf, Physical Review Materials 6 (2022) 074405. 2. "High cubicity of D_2O ice inside spherical nano-pores of MIL-101(Cr) framework: A neutron diffraction study", D. Dutta, A. K. Bera, P. Maheshwari, S. Kolay, S. M. Yusuf, and P. K. Pujari, Physical Chemistry Chemical Physics 24 (2022) 11872. 3. "Mechanism of Na-ionic conduction in the highly efficient layered battery material $Na_2Mn_3O_7$", Bikash Saha, A. K. Bera, and S. M. Yusuf, ACS-Applied Energy Materials 4 (2021) 6040.	
4.	**Powder Diffractometer II** *Working* **Wavelength: 1.2443 Å** **Scattering angle: $4^o < 2\theta < 140^o$** **Q range: 0.4 – 9.4 $Å^{-1}$** **Resolution (Δd/d): 0.8%** **Sample temperature range:** **2 – 1400 K** **Sample requirements:** **Powder sample (8-10 g) or pellet of 6-8 mm diameter and height 4.5 cm** **Average time per sample:4-5 hours per diffraction pattern, 7-8 hours at each temperature for temperature variation**	Delineation of chemical and magnetic structure phase diagrams of poly-crystalline materials	1."Role of correlated disorder on structural stability and functional properties in (Na,Ba)(Nb, Ti)O_3", Sourabh Wajhal, S.K. Mishra, A.B. Shinde, P.S.R. Krishna and R. Mittal, Journal of Alloys and Compounds 866 (2021) 158982. 2. "Spin reorientation behaviour and dielectric properties of Fe-doped h-$HoMnO_3$" Pulkit Prakash, S. K. Mishra, C. L. Prajapat and A. Das, J. Phys.: Condens. Matter 33 (2021) 155801. 3."Mixed ionic-electronic conduction and magnetoelectric coupling in $Li_{0.5}Fe_{2.5-x}Cr_xO_4$ (x= 1.0, 1.1, 1.3, 1.5, and 1.6) involving magnetization compensation phenomenon", Madhu Ghanathe, A. K. Bera, Amit Kumar and S. M. Yusuf, ACS-Applied Electronic Materials 4 (2022) 394.	

5.	**<u>Polarized Neutron Spectrometer</u>** *Working* **Wavelength: 1.201 Å** **Scattering angle: Up to 120º** **Sample temperature range: 1.5 – 400 K** **Magnetic field range: ≤ 1.2 kGauss** **Electric field range: Up to 100 KV/cm (typically for 10 mm dia, 1mm thick pellet)** **Sample requirements: Powder sample (2 g) or pellet of 5-6 mm diameter and height 15 mm** **Average time per sample: 2-3 days per temperature/ magnetic field**	Study of 1.Size/magnetizat-ion of magnetic domains or clusters at mesoscopic length scales 2. Magnetic correlations	1. "Correlated negative magnetization, exchange bias, and electrical properties in $La_{1-x}Pr_xCrO_3$, Deepak, A. Kumar, A. K. Bera, and S. M. Yusuf, Phys. Rev. Materials 6 (2022) 074405. 2. "Intertwined magnetization and exchange bias reversals across compensation temperature in $YbCrO_3$ compound" Deepak, Amit Kumar, S. M. Yusuf, Phys. Rev. Materials 5 (2021) 124402. 3. "Investigation of magnetic ordering and origin of exchange-bias effect in doped manganite, $Sm_{0.4}Ca_{0.6}MnO_3$", Amit Kumar, S. K. Giri, T. K. Nath, C. Ritter, S. M. Yusuf, Journal of Applied Physics 128 (2020) 203901.	
6.	**<u>Small Angle Neutron Scattering (SANS) Instrument</u>** *Working* **Wavelength (average): 4 - 10 Å** **Sample size: Larger than 15 mm (H) x 10 mm (W) x 1 mm (T)** **Resolution (Δλ/λ): 10 – 20 %** **Sample Temperature Range: 15 – 80º C** **Q range: 0.01 – 0.4 $Å^{-1}$** **Average time per sample: 4 hours or more, for each run**	Determination of the structure and interactions at nanometre length scales	1. "Small-angle neutron scattering studies suggest the mechanism of BinAB protein internalization", M. Sharma, V.K. Aswal, V. Kumar and R. Chidambaram, IUCrJ 7 (2020) 166. 2. "Unusual stability of protein molecules in the presence of multivalent counterions", Sugam Kumar, D. Saha, D. Ray, S. Abbas and V.K. Aswal, Phys. Rev. E (Letters) 104 (2021) L012603. 3. "Modifications in surfactant-dependent phase behavior of colloidal nanoparticles under charge reversal", D. Ray, Sugam Kumar, D. Saha and V.K. Aswal, Chem. Phys. Lett. 79 (2022) 139635.	

7.	**Double Crystal Based Medium - resolution Small- Angle Neutron Scattering (MSANS) facility** *Working* **Wavelength: 0.312 nm** **Minimum required sample size: >15 mm diameter** **Thickness~2 mm** **Accessible q range: 0.003 – 0.173 nm^{-1}** **Resolution (Δλ/λ): 1%** **Sample temperature range: RT – 100° C** **Average time per sample: 24 hours for each run**	Mesoscopic structure in synthesized and naturally occurring samples including porous and granular materials	1. "A novel approach to identify accessible and inaccessible pores in gas shales using combined low-pressure sorption and SAXS/SANS analysis", D. Chandra, V. Vishal, J. Bahadur, D. Sen, Int. J. Coal Geology 228 (2020) 103556. 2. "Unravelling the structural hierarchy in microemulsion droplet templated dendritic fibrous nano silica", D. Sen, A. Maity, J. Bahadur, A. Das, V. Polshettiwar, Microporous and Mesoporous Materials 323 (2021) 111234 3. "Jamming of Nano-Ellipsoids in a Microsphere: A Quantitative Analysis of Packing Fraction by Small-Angle Scattering", A. Das, R. Mondal, D. Sen, J. Bahadur, D. K. Satapathy, M. G. Basavaraj, Langmuir 38 (2022) 3832.	
8.	**Polarised Neutron Reflectometer** *Working* **Wavelength: 2.9 Å** **Magnetic field (fixed): 2 kGauss** **Sample size: More than 20 mm x 20 mm** **Resolution (ΔQ/Q): 0.141 –0.411** **Reflectivity range: 1 – 10^{-4}** **Average time per sample: 24 hours per run**	Structural and magnetic characterization of thin film and multilayer samples, using specular and off-specular (diffuse) reflectivity techniques, with vertical sample geometry	1."Interface-driven static and dynamic magnetic properties of ultrathin Fe/Ge multilayers", Surendra Singh, H. Bhatt, Y. Kumar, C.L. Prajapat, A. Mishra and S. Bedanta, S. Basu, Applied Surface Science 570 (2021) 151193. 2. "Formation of an intermetallic $GdCo_2$ alloy on controlled annealing of a Gd/Co multilayer", M.A. Basha, H. Bhatt, Y. Kumar, C.L. Prajapat, M. Gupta, S. Basu, and Surendra Singh, Materials Letters 283 (2021) 128879. 3. "Evolution of structure and magnetic properties of FePtCu alloy films on annealing of FePt/Cu multilayers", M A. Basha, H. Bhatt, Y. Kumar, C.L. Prajapat, M. Gupta, V. Karki, S.K. Ghosh, S. Basu and Surendra Singh, Physical Chemistry Chemical Physics 22 (2020) 16107.	

9.	**Triple Axis neutron Spectrometer** *Working* **Energy transfer range: Up to 100 meV** **Momentum transfer range: 1 – 10 Å^{-1}** **Elastic energy resolution: 15%** **Sample temperature range: 10 – 300 K** **Sample requirements: Powder sample (10-15 g) or pellet of 20 mm diameter and height 3-4 cm, single crystal 8-10 cc volume** **Average time per sample: 1 week at each temperature for powder samples, 3-4 months for single crystal samples**	Inelastic neutron scattering experiments from single crystals/ polycrystalline samples for measurements of phonon dispersion curves, phonon density of states, crystal field excitations, and quasielastic scattering	"Lattice dynamics in kesterite-type Cu_2ZnSnS_4: Inelastic neutron scattering studies and thermoelectric properties", S.P. Kandare, Mala N. Rao, S.S. Dahiwale, Rekha Rao, S.D. Dhole, S.L. Chaplot, Journal of Physics and Chemistry of Solids 150 (2021) 109819.	
10.	**Quasi Elastic Neutron Spectrometer** *Working* **Wavelength range: 1.3 – 4.7 Å** **Scattering angle: 2θ < 80º** **ΔE range (for E_i=4 meV): 2.3 meV** **Resolution (ΔE/E): 4%** **Q range: 0.6 – 1.8 Å^{-1}** **Sample temperature range: RT – 70º C** **Sample requirements: Powder/ liquid samples (6 g) (~ 5 cc volume)** **Average time per sample: 24 hours per momentum transfer (Q) value at each temperature**	Study of stochastic molecular motion in pico second time scales along with geometry of motion	1. "Diffusion of Confined Fluids in Microporous Zeolites and Clay Materials", S. Mitra, V. K. Sharma and R. Mukhopadhyay, Reports on Progress in Physics 84 (2021) 066501. 2. "Can the microscopic and macroscopic transport phenomena in deep eutectic solvents be reconciled?", H Srinivasan, V. K. Sharma, S. Mitra, Physical Chemistry Chemical Physics 23 (2021) 22854. 3. "An investigation of morphological, microscopic dynamics, fluidity, and physicochemical variations in Cu-decorated metallosomes with cholesterol", Baljinder Kaur, Gurpreet Kaur, Ganga Ram Chaudhary, Veerendra K. Sharma, H. Srinivasan, S. Mitra, Ankur Sharma, Santosh L. Gawali, P. A. Hassan, J. Mol. Liq. 318 (2020) 114034.	

11.	**<u>Time of flight neutron Spectrometer</u>** *Under commissioning*	Inelastic neutron scattering experiments from polycrystalline samples, for measurements of phonon density of states, crystal field excitations, and quasielastic scattering, allows measurement of the scattering function in (Q, E) space	"Design and commissioning of neutron time-of-flight spectrometer at Dhruva reactor", Mala N. Rao, Shraddha S. Desai, Rohit Chandak, S. S. Naik, V. Kulkarni, S. K. Mishra, Santosh Kumar, S. Mitra, P. Goel, R. Mittal, Somesh Rai, R. Mukhopadhyay, and S. L. Chaplot, Proc. Solid State Phys. Symposium 55 (2021) 358.