

Tushar Kanti Bhowmik

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Research Interests:

Experimental and Computational Condensed Matter Physics and Material Science; Material Synthesis; Crystal and Magnetic Structure; Complex Magnetism; Electrical behaviour; Quantum Spin Liquid; Perovskites; Density Functional Theory and Monte-Carlo simulations.

Technical Skills:

Experimental Techniques:

- **Synthesis of materials:** Solid State synthesis and Sol-Gel Citrate method.
- **Experimental Characterization:** X-ray crystallography and Rietveld refinement (structural confirmation); SEM for microstructure imaging; XPS for elemental oxidation state analysis; Impedance spectroscopy for ac electric properties; Spectrophotometry (UV-Visible absorption) for optical band transitions; Raman Spectroscopy for phonon and thermal properties. Magnetic measurements and Specific heat analysis; Neutron diffraction and magnetic structure determination; Muon spin relaxation and Inelastic neutron scattering.

Computational Skills:

- **Density Functional Theory:** Quantum Espresso, WIEN2k for structural modelling, electronic band structure; Magnetic structures and moments; Optical functions; Boltz-Trap for thermoelectric properties.
- **Classical Monte-Carlo simulations:** Ising Model; Heisenberg Model; Temperature-dependent magnetization, Specific heat, Susceptibility, Magneto-caloric Effect.

Research and Analysis:

- Origin, GNU-Plot, Microsoft Office, MATLAB, Mathematica and Python (Preliminary), Fortran and C++ language, Fullprof-suite (Rietveld Refinement), VESTA and XCRYSDEN (Structure Visualization), Operating Systems (Linux, Windows and Mac OS).

Transferable Skills:

- Resource Management; Collaboration and Team leadership (supervision of early PhD and Masters' students); Scientific Writing (Publications; Research Proposal for Experiment; Research Funding).

Educational Experiences:

PhD in Physics (Experimental)

Bose Institute, University of Calcutta. India, 2017-2023.

Thesis title: “**Physical and microscopic properties of rare-earth based strongly correlated electron systems**”

Supervisor: Prof. Tripurari Prasad Sinha.

Key Deliverables:

- Encountered with some of strongly correlated electronic systems like Perovskites, Double Perovskites, Honeycomb-layered Oxides and some Intermetallics.

- Understanding the crystal structure and physical properties driven short-range and long-range ordering, phase-transitions, conductivity, spin fluctuations, double-exchange and super-exchange mechanism, strong crystal-field effect, John-Teller effect etc.
- Determining the spin-spin correlations through Ising, Heisenberg model with Mean-field and Monte-Carlo simulations. Temperature dependent magnetism and the Magnetocaloric effect are thoroughly investigated.
- Performing the detailed electronic and microscopic properties probing neutron and muon to the materials and Density functional theory.
- Ability in the project management, collaborations and scientific writing include articles, research proposals and grant writing for funding within the scheduled time frames.
- Communication and dissemination of research findings to a wider network of researchers and audiences through oral and poster presentations. Mentoring the early PhD and Masters' students. Organizing member of a national conference on the Recent Trends in Condensed Matter Physics (**RTCMP-2017**).

Master in Science (MSc.) in Physics

Visva-Bharati, Santiniketan, India, 2013 – 2015.

Masters' dissertation: “**Quantum Mechanics on The Noncommutative Space**”

Supervisor: Prof. Pijush Kanti Ghosh.

Skills Development: Fortran, C++ language and Mathematica for programming and simulation, LaTeX and Microsoft office, Linux and Windows OS.

Bachelor in Science (BSc.) in Physics

Department of Physics, Midnapore College, Vidyasagar University, India, 2010-2013.

Undergraduate Project: “**Construction of Digital to Analog (D/A) Converter and to take illumination by LED**”

Publications:

1. **T. K. Bhowmik**, S. Halder, T. P. Sinha, Tailoring the magnetic landscape in Al-doped LaMnO₃: An experimental and computational perspective, **Physica Scripta** **98**, 025806 (2023).
2. Md. S. Sheikh, **T. K. Bhowmik**, A. Dutta, S. Saha, Chhatra R. Joshi, T. P. Sinha, Triclinic BiFeO₃: A new magnetic phase with enhanced magnetism and resistivity, **Under review (Physical Review B)**(Arxiv doi: **10.48550/arXiv.2211.03123**).
3. M. R. Basunia, Md. S. Sheikh, **T. K. Bhowmik**, S. K. Roy, A. Dutta, S. Banerjee, T. P. Sinha, Sol-gel synthesis and opto-electrical properties study of double perovskite oxide Dy₂NiMnO₆ thin film, **Under review (Thin Solid Films)**.
4. H. S. Tripathi, R. Karmakar, **T. K. Bhowmik**, S. Halder, A. Dutta, T. P. Sinha, RCoO₃ {R=Pr, Nd and Sm} electrode-based for efficient solid-state symmetric supercapacitor, **Solid State Sciences**, **134**, 107065 (2022).
5. **T. K. Bhowmik**, T. P. Sinha, The magnetic peculiarity and the optoelectronic properties of Pr₂CrMnO₆ from DFT and Monte Carlo simulation, **Journal of Superconductivity and Novel Magnetism** **35**, 777-786 (2022).
6. **T. K. Bhowmik**, Observation of the magnetic criticality and the magnetocaloric effect in LaMn₂Si₂ in the vicinity of the phase transition around the room temperature, **Physics Letter A**, **419**, 127724 (2021).

7. M. Rudra, **T. K. Bhowmik**, H.S. Tripathi, R.A. Kumar, R. Sutradhar, T.P. Sinha, Hopping mechanisms, photoluminescence studies toward highly efficient UV-responsive $\text{Pr}_2\text{MgTiO}_6$ photocatalyst, **Physica B, Condensed Matter**, **619**, 413213 (2021).
8. **T. K. Bhowmik**, T. P. Sinha, Phase driven magnetic and optoelectronic properties of $\text{La}_2\text{CrNiO}_6$: A DFT and Monte Carlo perspective, **Journal of Solid State Chemistry**, **304**, 122570 (2021).
9. **T. K. Bhowmik**, Md. S. Sheikh, A. P. Sakhya, A. Dutta, T. P. Sinha, Synthesis, structural and electrical conductivity of half-metallic perovskite oxide $\text{La}_2\text{CrNiO}_6$, **AIP Conference Proceedings** **2369**, 020080 (2021).
10. A. Bhattacharyya, **T. K. Bhowmik**, D. T. Adroja, B. Rahaman, S. Kar, S. Das, T. Saha-Dasgupta, P. K. Biswas, T. P. Sinha, R. A. Ewings, D. D. Khalyavin, and A. M. Strydom, Dynamic spin fluctuations in the frustrated spin chain compound $\text{Li}_3\text{Cu}_2\text{SbO}_6$, **Physical Review B** **103**, 174423 (2021).
11. **T. K. Bhowmik**, T. P. Sinha, Al-dependent electronic and magnetic properties of YCrO_3 with magnetocaloric application: an ab-initio and Monte Carlo approach, **Physica B: Condensed Matter**, **606**, 412659 (2021).
12. S. Halder, **T. K. Bhowmik**, A. Dutta, T.P. Sinha, The photophysical anisotropy and electronic structure of new narrow band gap perovskites $\text{Ln}_2\text{AlMnO}_6$ (Ln = La, Pr, Nd): An experimental and DFT perspective, **Ceramics International** **46**, 21021 (2020).
13. Md. S. Sheikh, D. Ghosh, **T. K. Bhowmik**, A. Dutta, S. Bhattacharyya, T. P. Sinha, When Multiferroics become Photoelectrochemical Catalysts: A Case Study with $\text{BiFeO}_3/\text{La}_2\text{NiMnO}_6$, **Material Chemistry and Physics**, **244**, 122685 (2020).
14. Md. S. Sheikh, A. Dutta, **T. K. Bhowmik**, S. K. Ghosh, S. K. Rout, T. P. Sinha, Synthesis, structural and photo physical properties of perovskite oxide $(\text{KNbO}_3)_{1-x} + (\text{La}_2\text{NiMnO}_6)_x$ for photovoltaic application, **35th European Photovoltaic Solar Energy Conference and Exhibition, Brussels, Belgium, 2018**, pp. 143-148.

Selected Poster and Oral Presentations:

1. Oral Presentation in the **National Conference on Physics and Chemistry of Materials (NCPCM-2020)** at **Govt. Holkar Science College, Indore, India**, December 14-16, 2020.
2. Oral presentation at the **National Conference on Condensed Matter Physics: Condensed Matter Days-2019 (CMDAY19)** at **Vidyasagar University, Midnapore, India**, August 29-31, 2019.
3. Oral Presentation in the **National Conference on Advances in Spectroscopic Techniques and Materials (ASTM-2018)** at **Indian Institute of Technology (Indian School of Mines), Dhanbad, India**, March 14-16, 2018.
4. Participate in the **International Conference on Condensed Matter Physics** at **Indian Statistical Institute, Kolkata, India**, November 14-16, 2017.
5. Poster Presentation in the **National Conference on Recent Trends in Condensed Matter Physics (RTCMP-2017)** at **Bose Institute, India**, October 31st- November 3rd, 2017.
6. Poster presentation in the **Structural Aspects in Studying Chemistry of Materials (SASChem-2017)** at **Indian Institute of Science and Education and Research, Kolkata, India**, August 29-30, 2017.

Workshop Attended:

1. Participation in the **Neutron and Muon Science Meeting & Workshop on Data Analysis of Neutron Scattering and Muon Spectroscopy** at **Jawaharlal Nehru Centre for Advanced**

Scientific Research, Bangalore, India by the joint collaboration of **STFC, Oxford, UK and DST, Govt. Of India**, February, 2019.

Awards and Achievements:

1. Acceptance of Research proposals for beamline experiments at **ISIS Facility, RAL, UK** in **2018** and **2019**.
 2. Full financial support from **Newton-India Fund** to perform experiments at **ISIS Facility, RAL, UK** in December, 2018.
 3. PhD Fellowship (Registration No: IF160418) from the **Department of Science and Technology (DST), India** named **Innovation in Science Pursuit for Inspired Research (INSPIRE Fellowship)**, (March 2017- March 2022).
 4. Scholarship for Higher Education (Registration No: 99/2010) from the **Department of Science and Technology (DST), India** named **Scholarship for Higher Education (SHE Programme)**, (2010-2015).
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