

DHEERAJ

+91 9418267256

dheerajranaut13@gmail.com

Web: [Google scholar](#) [LinkedIn](#) [ORCiD](#)

Professional Experiences

MSCA Physics for Future (P4F) Fellow, 06/2026 – present

Institute of Physics, Czech Academy of Sciences, Prague, Czech Republic

Project: Spin-dimensionality Engineered Rare-Earth MOFs for Efficient Magnetocaloric Cooling (SPINMOF)

Institute Postdoc Fellow, 08/2023 – 03/2026

IISER Thiruvananthapuram, Kerala, India

- Conducted advanced research in quantum magnetism, focusing on quantum criticality, magnetocaloric effect and quantum spin liquids.
- Designed a custom home-built magnetocaloric effect based on adiabatic demagnetization refrigeration to directly measure the adiabatic temperature change.
- Patent on designing a quantum cascade refrigeration (QCR) system based on rare-earth effective spin – $\frac{1}{2}$ quantum magnets.

EDUCATION

Ph.D.: Experimental Condensed Matter Physics, 02/2020 – 07/2023

CGPA – 9/10

Indian Institute of Technology Mandi, Mandi, Himachal Pradesh, India

Thesis Title: “*Exploration of Quantum Magnetism in Rare Earth Orthovanadates*”

My PhD thesis work explored different aspects of quantum magnetism in rare-earth orthovanadates (RVO_4) such as metamagnetic quantum criticality, quantum spin liquid, low dimensional ground state, effective spin – $\frac{1}{2}$ state and higher order moments.

M.Sc.: Physics, 08/2016 – 06/2018

CGPA – 8.35/10, Second rank in university.

Central University of Himachal Pradesh – Dharamshala, Himachal Pradesh, India – Second position in university

B.Sc.: Physics, 08/2013 – 06/2016

CGPA – 8.66/10, Second rank in College (Physics)

MLSM College Sundernagar – Himachal Pradesh University, Shimla, Himachal Pradesh, India

RESEARCH AREAS

Experimental condensed matter physics, Strongly correlated electron systems, Magnetism and magnetic materials, Quantum magnetism, Magnetocaloric effect, Material synthesis and characterizations, Quantum criticality, Low dimensional magnetism, Quantum spin liquids, Electrical and thermal transports, Metal organic frameworks (MOF), Hydrogen sensing and storage, High entropy alloys for magnetic refrigeration and sustainable energy, Electronic structure and magnetic interactions calculation using Density Functional Theory (DFT) formalism.

CONFERENCES/WORKSHOPS

- Attended “Online Workshop on Rietveld Refinement Method”, organized online by UGC-DAE Consortium of Scientific Research Mumbai Centre in association with Indore Centre, 22-24 September, 2020.
- Attended a Short-term Course on “Current Trends in Condensed Matter Physics” organized at Dr. B. R. Ambedkar National Institute of Technology, Jalandhar, 25-29 September, 2020.
- Presented a talk at International Conference on Strongly Correlated Electron System, 2nd – 7th July 2023, Incheon/Seoul, Korea on “*Jahn-Teller driven magnetic phase associated with 5th order susceptibility in rare earth orthovanadate TbVO_4* ”

- Attended “Frontier Symposium Physics 2024” organized by Indian Institute of Science Education and Research, Thiruvananthapuram, Kerala, India, 19-21 Jan, 2024.

PATENT

Quantum Cascade Refrigeration (QCR) System for Efficient Sub-Kelvin Cooling

Dheeraj Ranaut, Sharath Kumar Channarayappa and Deepshikha Jaiswal-Nagar (Filed: Indian patent)

PUBLICATIONS

Total no. of publications: 25 (22 published and 3 submitted)

First author publications: 14; Corresponding author publications: 9

h-index: 9; Total citations: 165

Published:

- 1) Crystal field scheme and field induced critical behavior in effective spin – $\frac{1}{2}$ NdVO₄
Dheeraj Ranaut*, D. T. Adroja, Mohamed Aouane, Prashant K. Mukharjee, Philipp Gegenwart and D. Jaiswal-Nagar, [Phys. Rev. B **113**, 144411 \(2026\)](#).
- 2) From order to disorder: Magnetic phase evolution in diluted Ba₃CoNb₂O₉
Akhil N, **Dheeraj Ranaut***, Sharath Kumar Channarayappa, and Deepshikha Jaiswal-Nagar, [J. Phys.: Condens. Matter **37**, 315802 \(2025\)](#).
- 3) Methanol reduced Pd substitution in HKUST-1 MOFs: Enhanced hydrogen storage, sensing and induced magnetization
Sayan Das, **Dheeraj Ranaut***, Akhil N, Somnath Bhopale, Viney Dixit, Debjani Banerjee and Deepshikha Jaiswal-Nagar, [Materials Chemistry and Physics **345**, 131212 \(2025\)](#).
- 4) Low Temperature thermodynamics of metamagnetic quantum criticality in an insulating DyVO₄
Dheeraj Ranaut, Sharath Kumar Channarayappa, Akhil N, G. B. G. Stenning, D. T. Adroja, K. Mukherjee and Deepshikha Jaiswal-Nagar, [Phys. Rev. B **111**, 104409 \(2025\)](#).
- 5) Probing the magnetic ground state of stretched diamond lattices NdTaO₄ and NdNbO₄: Impact of spin-orbit coupling and crystal electric field
Jogendra Kumar, Vinod Kumar Solet, **Dheeraj Ranaut**, S. K. Pandey and K. Mukherjee, [J. Phys.: Condens. Matter **37** 135803 \(2025\)](#).
- 6) Presence of a correlated dynamical ground state in a stretched diamond lattice system YbNbO₄
Jogendra Kumar, **Dheeraj Ranaut**, Jumpei G. Nakamura and K. Mukherjee, [Phys. Rev. B **111**, 014411 \(2025\)](#).
- 7) Enhanced adiabatic demagnetization cooling performance in exchange frustrated GdCrTiO₅
Sharath Kumar Channarayappa, Poorvisha C, **Dheeraj Ranaut**, M. P. Saravanan, and D. Jaiswal-Nagar, [Phys. Rev. Applied **23**, 014041 \(2025\)](#).
- 8) Emergence of magnetic anomaly and development of non-linear susceptibility with magnetic field in rare earth orthovanadate ErVO₄
Dheeraj Ranaut*, Koushik P and K. Mukherjee, [J. Supercond. Nov. Magn. **38**, 11 \(2025\)](#).
- 9) YbTaO₄: A quasi-two-dimensional frustrated magnet possessing spin orbit entangled Kramer’s doublet ground state
Jogendra Kumar, Roumita Roy, **Dheeraj Ranaut**, Jumpei G. Nakamura, Sudipta Kanungo and K. Mukherjee, [Phys. Rev. B **110**, 174420 \(2024\)](#).
- 10) Elucidating correlation-driven insulating state in an effective spin – $\frac{1}{2}$ antiferromagnet NdVO₄
Dheeraj Ranaut*, Antik Sihi, M. P. Saravanan, Deepshikha Jaiswal-Nagar and K. Mukherjee, [J. Phys.: Condens. Matter **36**, 505808 \(2024\)](#).
- 11) Tuning of magnetic frustration and emergence of magneto-structural transition in Mn_{1-x}Cd_xCr₂O₄
Abishek Das, **Dheeraj Ranaut**, P. Pal, R. Pal, S. Moulick, M. Das, D. Topwal, P. Mandal, A. N. Pal, K. Mukherjee, and D. Choudhury, [Phys. Rev. B **108**, 064426 \(2023\)](#).
- 12) Non-equilibrium dynamics and discretization of energy levels in an inverse spinel LiCoVO₄
Dheeraj Ranaut, Manshi Rani and K. Mukherjee, [Phys. Rev. B **107**, 214413 \(2023\)](#).

- 13) Anti-site disorder driven short-range order and canted antiferromagnetism in inverse spinel LiNiVO_4
Dheeraj Ranaut*, Jogendra Kumar and K. Mukherjee [J. Magn. Magn. Mater. 578, 170833 \(2023\)](#).
- 14) Origin of long-range ferrimagnetic ordering in cubic $\text{Mn}(\text{Co})\text{Cr}_2\text{O}_4$ spinels
 Abhishek Das, P. Pal, **Dheeraj Ranaut**, K. P. Islam, G. Bhattacharya, S. Mehta, A. Mondal, V. Adyam, K. Mukherjee, A. Das and D. Choudhury [Phys. Rev. B 107, L100414 \(2023\)](#).
- 15) Van Vleck paramagnetism and enhancement of effective moment with magnetic field in rare earth orthovanadate EuVO_4
Dheeraj Ranaut and K. Mukherjee [Phys. Letts. A. 465, 128710 \(2023\)](#).
- 16) A plausible investigation of low dimensional magnetism in rare earth orthovanadate PrVO_4
Dheeraj Ranaut and K. Mukherjee [Phys. Chem. Chem. Phys. 25, 4302 \(2023\)](#).
- 17) Evolution of field induced magnetic phase attributed to higher order magnetic moments in TbVO_4
Dheeraj Ranaut* and K. Mukherjee [Sci. Rep. 13, 487 \(2023\)](#).
- 18) Possible realization of three-dimensional quantum spin liquid behavior in HoVO_4
Dheeraj Ranaut, S. S. Shastri, S. K. Pandey and K. Mukherjee [J. Phys.: Condens. Matter 34, 485803 \(2022\)](#).
- 19) Melting of spin ice state and development of fifth order susceptibility with magnetic field in pyrochlore $\text{Tb}_2\text{Sn}_2\text{O}_7$
 K. Singh, **Dheeraj Ranaut**, G. Sharma and K. Mukherjee [New. J. Phys. 24, 073037 \(2022\)](#).
- 20) Unravelling the signatures of effective spin $\frac{1}{2}$ moments in CeVO_4 : Magnetization and Heat Capacity study
Dheeraj Ranaut* and K Mukherjee, [J. Phys.: Condens. Matter 34, 315802 \(2022\)](#).
- 21) Entropic topography associated with field-induced quantum criticality in a magnetic insulator DyVO_4
Dheeraj Ranaut and K Mukherjee, [Sci. Rep. 12, 56 \(2022\)](#).
- 22) Unconventional critical behavior in weak ferromagnets $\text{Fe}_{2-x}\text{Mn}_x\text{CrAl}$ ($x = 0$ to 1)
 K. Yadav, **Dheeraj Ranaut** and K. Mukherjee, [Sci. Rep. 11, 18742 \(2021\)](#).

Manuscript under review:

- 23) Quantum Cascade Refrigeration system: A Design Strategy for Efficient Adiabatic Demagnetization Refrigeration
Dheeraj Ranaut*, Sharath Kumar Channarayappa, and D. Jaiswal-Nagar (revision submitted).
- 24) Unravelling Field-Induced Magnetism in a Frustrated Garnet $\text{Gd}_3\text{Te}_2\text{Li}_3\text{O}_{12}$ with Enhanced Adiabatic Demagnetization Refrigeration
Dheeraj Ranaut*, Govind Unnikrishnan, Samraj M Viswanathan, Sharath Kumar Channarayappa, Prashanta K. Mukharjee, M. P. Saravanan, Philipp Gegenwart and D. Jaiswal-Nagar (under review).
- 25) Crystal electric field driven magnetic ground state in frustrated triangular antiferromagnet $\text{NdZnAl}_{11}\text{O}_{19}$
 Manshi Rani, **Dheeraj Ranaut**, Manh Duc Le, Mohamed Aouane and K. Mukherjee (under review).

Teaching/mentor experience

Teaching assistance (TA):

Course: Magnetism and Magnetic materials, Electronics, Physics lab for Engineering students, Physics practicum.

Mentorship:

- 1) Jogendra Kumar (IPhD, IIT Mandi)
 Project: Low dimensional magnetism in rare-earth orthovanadate PrVO_4 (Feb – June 2021).
- 2) Manshi Rani (MSc, IIT Mandi)
 Project: Critical analysis of Heusler alloy Fe_2MnCrAl (July – Dec 2021).
 Project: Effective spin – $\frac{1}{2}$ state in CeVO_4 (Jan – June 2022).
- 3) Robin (MSc, IIT Mandi)
 Project: Anti-site disorder in inverse spinel LiNiVO_4 (July 2022 – June 2023).
- 4) Akhil N (PhD, IISER Thiruvananthapuram)
 Project: Impact of intrinsic and external disorder on magnetic ground state of transition-metal oxides (Dec 2023 – present).
- 5) Sayan Das (IPhD, IISER Thiruvananthapuram)
 Project: magnetism and hydrogen sensing/storage in Pd nanoparticles substituted metal-organic frameworks (MOFs) (Feb 2025 – July 2025).
- 6) Samraj M (Junior Research Fellow, IISER Thiruvananthapuram)
 Project: Quantum criticality in metamagnetic materials and their ADR performances (Nov 2024 – present).

7) Samraj M (MSc., IISER Thiruvananthapuram)

Project: ADR performance of effective spin – $\frac{1}{2}$ quantum magnets (Feb 2025 – present).

8) Govind (BS-MS, IISER Thiruvananthapuram)

Project: High entropy alloys for magnetic refrigeration and sustainable energy materials (May 2025 – present).

SKILLS

Software:

FORTRAN 77, MATHEMATICA 9, 'C' and "C ++" Programming, ORIGIN, MANTID, WiMDA

Experiment:

- **Synthesis:** Solid-state synthesis, Arc-melting technique, Centrifuge method, Flux method and Chemical vapor transport (CVT), thin film synthesis using Magneto-sputtering, Solvothermal synthesis.
- **Characterization:** X-ray diffraction (XRD), X-ray photoemission spectroscopy (XPS), Energy-dispersive X-ray spectroscopy (EDX), Raman scattering.
- SQUID-VSM, Magnetic property measurement system (MPMS), Physical property measurement system (PPMS) and He-3 measurements.
- Adiabatic demagnetization refrigeration (ADR), Magnetocaloric effect (MCE) and thermal expansion.
- In-situ preparation of metal organic frameworks (MOFs).
- Hydrogen storage and sensing.
- Neutron scattering and muon spectroscopy.

Computational:

Density functional theory (DFT) using ELK and theoretical modelling for higher order moments.

ACHIEVEMENTS

- Postdoctoral Researcher position on Fe₂P-based magnetocaloric materials at CRISMAT Laboratory (a joint French National Centre for Scientific Research (CNRS) and university research laboratory), France (Declined).
- Postdoctoral Researcher in Structural Analysis and Quantum Materials (HIP-2D-QM project) at the Institute of Physics Belgrade, Serbia (Declined).
- Institute Postdoctoral position at Indian Institute of Technology Kharagpur, India (Declined).
- Fully funded research proposal (among top 5 %) accepted for performing inelastic neutron scattering (INS) experiment to investigate the crystal field excitations in CeVO₄ and NdVO₄ at UKRI Science and Technology Facilities Council (STFC) Neutron & Muon Source, Rutherford Appleton Laboratory, Oxfordshire, UK, from 25th Nov–2nd Dec, 2024.
- International travel grant awarded 150000 INR by Science & Education Research Board (SERB), Department of Science & Technology (DST), Govt. of India to attend "International conference on strongly correlated electron systems", at Seoul, South Korea, from 2nd July to 7th July, 2023.
- Travel grant of INR 100000 from Indian Institute of Technology Mandi to attend "International conference on strongly correlated electron systems", at Seoul, South Korea from 2nd July to 7th July, 2023.
- First prize in oral Presentation on National Science Day celebration at School of Physical Sciences, Indian Institute of Technology Mandi, India, 28th Feb 2023.
- 150 All India Rank (among 30000 students) in Graduate Aptitude Test in Engineering (GATE) Physics 2019.
- Department of Science & Technology (DST) INSPIRE fellowship Provision certificate to pursue Ph.D (Declined).
- DST INSPIRE Fellowship (INR 80000 per annum) from 12th class onwards.
- Cleared Himachal Pradesh State Eligibility Test (HP-SET) Physics Oct, 2018 for the lectureship in state university.
- 2nd Rank in M.Sc. Physics, Central University of Himachal Pradesh, Dharamshala.

REFERENCES

Dr. Kaustav Mukherjee
(PhD Supervisor)

Professor

School of Physical Sciences

Indian Institute of Technology Mandi,
Himachal Pradesh, India – 175075

Email: kaustav@iitmandi.ac.in

Phone: +91-1905-267043

Dr. Deepshikha Jaiswal-Nagar
(Postdoc supervisor)

Associate Professor

School of Physics

IISER Thiruvananthapuram, Kerala, India
– 695551

Email: deepshikha@iisertvm.ac.in

Phone: +91 (0)471-2778141

Dr. D. T. Adroja

Senior Scientist

School of Physics

Rutherford Appleton Laboratory, UK

Email: devashibhai.adroja@stfc.ac.uk