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Dr. Harkirat Singh, Assistant Professor

Date of Birth: April 26, 1984

RESEARCH INTEREST

Experimental Condensed Matter Physics

Atomistic simulations and ab-initio calculations. Superconductivity in disordered single crystals and thin films, Entanglement estimation in low dimensional quantum systems, Low temperatures, Magnetic thin films and Nanoparticles

RESEARCH PROJECTS

2023-2026	Multiscale model for simulation of magnetic and superconducting properties of transition metal-based bulk and nanomaterials, DST-SERB in EEQ scheme.
2022-2025	Modelling of oscillations in superconducting transition temperatures in superconductor/Ferromagnet hybrid structure, funded by DST-SERB in MATRICS scheme
2022-2055	2D superconductivity in transition metal dichalcogenides, UGC-DAE CSR

PROFESSIONAL POSITIONS

11, 2018 -	Assistant Professor, National Institute of Technology Srinagar, J&K
06, 2017 – 11, 2018	Assistant Professor, I. K. Gujral Punjab Technical University, Kapurthala
02, 2017 – 04, 2017	Visiting Scientist, Tata Institute of Fundamental Research Mumbai
01, 2014 – 01, 2017	Postdoctoral fellow, Tata Institute of Fundamental Research Mumbai

EDUCATION

2007 – 2014	PhD from Indian Institute of Science Education and Research (IISER) Kolkata
2005 – 2007	M. Sc. from Lyallpur Khalsa College Jalandhar, Punjab
2002 – 2005	B. Sc. from Khalsa College Gardhiwala, Hoshiarpur, Punjab

AWARDS

2022	Womanium Quantum Scholarship, Womanium Team, Washington DC
2015	International Travel Grant, DST-SERB, Govt. of India

COURSES TAUGHT

1. Thermodynamics and Statistical Mechanics (PG Course)
2. Classical Mechanics (PG Course)
3. Computational Methods in Physics (PG Course)
4. Modern Optics Laboratory (PG Course)
5. Computational Physics Laboratory (PG Course)
6. Synthesis and Characterization Laboratory (PG Course)
7. Engineering Physics (UG Course)
8. Engineering Physics Laboratory (UG Course)

EXPERIMENTAL SKILLS

1. Ultra high vacuum 248nm pulsed laser deposition (UHV PLD)
2. DC/Magnetron Sputtering
3. High magnetic field (11T) He3 cryostat for transport and susceptibility measurements
4. Physical (heat capacity) and magnetic property measurement systems
5. Optical photolithography
6. E- Beam milling, thermal evaporator
7. X-Ray Diffraction (XRD)

PROFESSIONAL MEMBERSHIP

1. Material Research Society of India (lifetime member)

COMMUNITY SERVICE	1. Student counsellor to school. 2. Hold Public Seminar for general awareness.
TECHNICAL SKILLS	LabView 2010, AutoCAD 2008, Python, Office 2017, Windows 11
INTERNATIONAL / NATIONAL VISITS	**1.** Georg-August-Universität Göttingen, Germany under DAAD project (2 months). (2009) **2.** Georg-August-Universität Göttingen, Germany under G-KOSS scheme (2 months). (2011) **3.** IIT-Roorkee, India to perform experimental studies (2 weeks). (2012) **4.** UGC-DAE Consortium Indore, India to perform experimental studies (2 weeks). (2008) **5.** Nuclear Science Centre New Delhi, India for ion beam irradiation studies (2 weeks). (2008)
CONFERENCE/ SCHOOLS ATTENDED	1. M2S Geneva, Switzerland (Poster Presentation). (2015) 2. SSPS-DAE national symposium 2013 at Thapar University Patiala. (Poster Presentation). (2013) 3. Magma-2013 at IIT Guwahati (Poster Presentation). (2013) 4. International Conference on Highly Frustrated Systems at McMaster University, Hamilton, Canada (Poster Presentation). (2012) 5. IEEE summer school on Magnetic Materials at SRM University, Chennai, India (Poster Presentation). (2012) 6. International School on Functional Materials at HRI Allahabad, India. (2011) 7. School on Advanced Characterization Techniques at Jadavpur University, Kolkata, India. (2007) 8. National conference on LASERS at Khalsa College Jalandhar, Punjab, India. (2007)
ACHIEVEMENTS	1. Graduate Aptitude Test Examination (GATE) qualified. (2007) 2. First in science exhibition. (2005) 3. Math's Olympiad merit certificate. (2001) 4. Regional-level football. (2000)
JOURNAL PUBLICATIONS	1. Varnika Chaudhary and **Harkirat Singh**, "Atomsitic simulation of magnetic nanoparticles to investigate its effect in alternating magnetic field", Appl. Phys. A, 129 (2023) 689. (SCI, 2.7) 2. Junaid Ul Ahsan and **Harkirat Singh**, "Magnetic features of hybrid transition metal-rare earth nanoparticles: Monte Carlo simulations", Physica B 668 (2023) 415223. (SCI, 2.988). 3. Junaid Ul Ashan, Asif Majeed and **Harkirat Singh**, "Atomistic simulation of Stoner–Wohlfarth (SW) particle", Int. J. Mat. Res., accepted., MAR, 2023. (SCI, 0.678) 4. Asif Majeed and **Harkirat Singh**, "Triplet Proximity Effects in Superconductor/Ferromagnet hybrid structures Exhibiting Intrinsic Spin-

Orbit Coupling", Physica B: Condensed Matter 655 (2023) 414749. (SCI, 2.988)

5. Junaid Ul Ahsan and **Harkirat Singh**, "Atomistic study of positive exchange bias in hard/soft ferromagnetic bilayer nanosystem", Phys. Scr. 98 (2023) 025403. (SCI, 3.081)
6. Asif Majeed and **Harkirat Singh**, "Effect of the Interface Transparency and Ferromagnetic Thickness on the Critical Temperature of NbN/Gd/NbN hybrid structure", Physica C 602 (2022) 1354127. (SCI, 1.534)
7. Junaid ul Ahsan and **Harkirat Singh**, "Atomistic simulation study of FeCo alloy nanoparticles", Applied Physics A **128** (2022) 443. (SCI, 2.983)
8. Junaid ul Ahsan and **Harkirat Singh**, Temperature-dependent magnetization in Co@Fe nanoparticles", Physica B: Condensed Matter **627** (2022) 413488. (SCI, 2.988)
9. J. Kumar and **H. Singh**, "Electron-phonon mediated superconductivity in 1T-MoS_2 and effect of pressure on its transition temperature", J. Phys & Chem. of Solids **156** (2021) 110185. (SCI,3.995)
10. Indranil Roy, Rini Ganguly, **Harkirat Singh**, and Pratap Raychaudhuri, "Robust pseudogap across the magnetic field driven superconductor to insulator-like transition in strongly disordered NbN films", Eur. Phys. J. B **92** (2019) 49. (SCI,1.5)
11. Rini Ganguly, Indranil Roy, Anurag Banerjee, **Harkirat Singh**, Amit Ghosal, and Pratap Raychaudhuri, "Magnetic field induced emergent inhomogeneity in a superconducting film with weak and homogeneous disorder", Phys. Rev. B **96** (2017) 054509. (SCI,3.908)
12. T. Chakraborty, **H. Singh**, D. Chaudhuri, H. S. Jeevan, P. Gegenwart, C. Mitra, "Investigation of thermodynamic properties of Cu(NH3)4 SO 4 . H2O, a Heisenberg spin chain compound", JMMM **439** (2017) 101-106. (SCI,2.993)
13. Indranil Roy, Prashant Chauhan, **Harkirat Singh**, Sanjeev Kumar, John Jesudasan, Pradnya Parab, Rajdeep Sensarma, Sangita Bose, Pratap Raychaudhuri, "Dynamic transition from Mott-like to metal-like state of the vortex lattice in a superconducting film with a periodic array of holes", Phys. Rev. B **95** (2017) 054513. (SCI,3.908)
14. Bing Cheng, Liang Wu, N. J. Laurita, **Harkirat Singh**, Madhavi Chand, Pratap Raychaudhuri, N. P. Armitage, "Anomalous gap edge dissipation in disordered superconductors on a brink of localization", Phys. Rev. B **93** (2016) 180511(R). (SCI,3.908)
15. Somesh Chandra Ganguli, **Harkirat Singh**, Indranil Roy, Vivas Bagwe, Dibyendu Bala, Arumugam Thamizhavel, and Pratap Raychaudhuri, "Disorder-induced two-step melting of vortex matter in Co-intercalated $NbSe_2$ single crystals", Phys. Rev. B **93** (2016) 144503. (SCI,3.908)
16. Somesh Chandra Ganguli, **Harkirat Singh**, Rini Ganguly, Vivas Bagwe, Arumugam Thamizhavel and Pratap Raychaudhuri, "Orientational coupling between the vortex lattice and the crystalline lattice in a weakly pinned $Co_{0.0075}NbSe_2$ single crystal", J. Phys.: Cond Matter **28** (2016) 165701. (SCI,2.745)
17. S. C. Ganguli, **H. Singh**, G. Saraswat, R. Ganguly, V. Bagwe, P. Shirage, A. Thamizhavel, P. Raychaudhuri, "Disordering of the vortex lattice through

successive destruction of the positional and orientational order in a weakly pinned $Co_{0.0075}NbSe_2$ single crystal", Scientific Reports **5** (2015) 10613. (SCI,4.996)

18. **H. Singh**, T. Chakraborty, D. Das, H. S. Jeevan, Y. Tokiwa, P. Gegenwart and C. Mitra* "Experimental quantification of entanglement through heat capacity", New J. Phys. **15** (2013) 113001. (SCI,3.874)
19. D. Das, **H. Singh**, T. Chakraborty, R. K. Singh and C. Mitra*, "Experimental detection of quantum information sharing and its quantification in quantum spin systems", New J. Phys. **15** (2013) 013047. (part of my thesis work) (SCI, 3.874)
20. **H. Singh**, T. Chakraborty, P. K. Panigrahi and C. Mitra*, "Experimental estimation of discord in an antiferromagnetic Heisenberg compound $Cu(NO_3)_2 \cdot 2.5\ H_2O$", Quantum Info. Process **14** (2015) 951–961. (SCI, 1.965)
21. **H. Singh**, T. Ono, T. Chakraborty, K. Srikanth, A. Venimadhav, R. Chandra, C. Mitra, and U. Kumar*, "Study of crossover from 3D ferrimagnetic bulk $NiCr_2O_4$ compound into 2D spin glass like nanophase", J. Nanoparticle Res. **16** (2014) 2354. (SCI, 2.253)
22. T. Chakraborty, **H. Singh** and C. Mitra*, "Signature of quantum entanglement in $NH_4CuPO_4.H_2O$", J. Appl. Phys. **115** (2014) 034909. (SCI, 2.877)
23. T. Chakraborty, **H. Singh**, S. Singh, R. K. Gopal, C. Mitra*, "Probing quantum discord in a Heisenberg dimer compound", J. Phys.: Condens. Matter. **25** (2013) 425601. (SCI, 2.745)
24. **H. Singh**, R. Gupta, T. Chakraborty, A. Gupta, and C. Mitra*,"Study of exchange bias in all ferromagnetic Fe/Co soft/hard bilayer", IEEE Tran. Mag.**50** (2014) 9. (SCI, 2.1)
25. T. Chakraborty, **H. Singh**, and C. Mitra, "Experimental evidence of singlet to triplet transition in a spin cluster compound", JMMM **396** (2015) 247. (SCI, 2.993)
26. T. Chakraborty, T. K. Sen, **H. Singh**, D. Das, S. K. Mondal, C. Mitra*, "Experimental detection of thermal entanglement in a molecular chain", J. Appl. Phys. **114** (2013) 144904. (SCI, 2.877)
27. T. Chakraborty, **H. Singh**, D. Das, T. K. Sen, C. Mitra*, "Quantification of entanglement from magnetic susceptibility for a Heisenberg spin ½ system", Phys. Lett. A **376** (2012) 2967-2971. (SCI, 2.707)
28. T. Chakraborty, T. K. Sen, **H. Singh**, D. Das, S. K. Mandal, C. Mitra*, "Comparative study of magnetic behavior in three classical molecular magnets", Solid State Comm.**152** (2012) 1945-1950. (SCI, 1.804)
29. **H. Singh***, T. Chakraborty, K. Srikanth, R. C. Chandra, C. Mitra and U. Kumar*, "Study of exchange bias in $NiCr_2O_4$ nanoparticles", Physica B **448** (2014) pp. 77-79. (SCI, 2.988)

CONFERENCE PAPERS

1. **H. Singh**, T. Chakraborty and C. Mitra, "Quantification of quantum discord in an antiferromagnet Heisenberg compound", AIP Conf. Proc. **1591** (2014) 1551
2. T. Chakraborty, **H. Singh** and C. Mitra, "Violation of Bells inequality in a spin quantum magnet", AIP Conf. Proc. **1591** (2014) 1569.

	3. Tanmoy Chakraborty, Diptaranjan Das, **Harkirat Singh**, Tamal K. Sen, Swadhin K. Mandal, and Chiranjib Mitra, “Study of entanglement in a quantum antiferromagnet”, AIP Conf. Proc. **1447** (2012) 1145. 4. D. Das, T. Chakraborty, T. K. Sen, **H. Singh**, S. K. Mandal, and C. Mitra, “Experimental quantification of entanglement in quantum spin systems”, AIP Conf. Proc. **1384** (2011) 261
Book Chapter	1. Asif Majeed, Junaid Ul Ahsan and **Harkirat Singh**, Manipulating Superconductivity in Superconductor/ Ferromagnet Hybrid Nanostructures", Book Title: Recent Trends in Nanomaterials, Springer Nature, accepted (2023).