Dr. Sumit Ghosh

P4F Fellow
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Employment

2024-Present **P4F Fellow**, The Institute of Physics of the Czech Academy of Sciences, Prague, Czech Republic.

2024-2024 **Postdoc**, Max-Born-Institute for Nonlinear Optics and Short Pulse Spectroscopy, Berlin, Germany.

2021-2023 **Postdoc**, Institute of Physics, Johannes Gutenberg-University, Mainz, Germany.

2019-2023 **Postdoc**, PGI-1 and IAS-1, Forschungszentrum Jülich, Germany.

Academic Experience

2013-2019 **PhD Student**, *KAUST*, Thuwal, Saudi Arabia.
Thesis Title: Non-equilibrium transport in topologically non-trivial systems.

2011-2013 **Senior Research Fellow**, *SNBNCBS*, India, Working on Mesoscopic Physics.

2009-2011 **Junior Research Fellow**, *SNBNCBS*, India, Working on Black Hole Thermodynamics.

2007-2009 **M.Sc.**, *University of North Bengal*, India, (First class with distinction).

2004-2007 **B.Sc.**, *Raiganj College*, India, (First class with Hons. in Physics).

Awards and Achievements

1. Physics for Future (P4F), MSCA COFUND Fellowship, Prague Czech Republic, (2024).
2. Best Poster award by American Physical Society in Graphene 2016, Genova, Italy (2016).
3. PhD scholarship, King Abdullah University of Science and Technology [KAUST], Saudi Arabia (2013).
4. Senior Research Fellowship - Council of Scientific and Industrial Research [CSIR], India (2011).
5. Junior Research Fellowship and Lecturership qualification - Council of Scientific and Industrial Research [CSIR], India (2009).
6. Qualified in the Graduate Aptitude Test in Engineering (GATE), in Physics, with 97.58 percentile (all India Rank 130) (2009).
7. Qualified in Joint Entrance Screening Test (JEST), with 93.03 percentile (all India rank 66) (2009).

Teaching experience

1. Teaching Assistant,Computational electronic structure, 2024, Freie Universität, Berlin.
2. Teaching Assistant, Advanced Mathematics for Engineers, 2018, KAUST, Saudi Arabia.
3. Co-supervisor of Guilhem Manchon, 2018, KAUST (Thesis: Tight-binding modelling of spin orbit torque).
4. Co-supervisor of Ahmed Hajr, 2018, KAUST (Thesis: Tight-binding modelling of Dzyaloshinskii-Moriya interaction).

Research Interests

1. Topological properties of matter
2. Nonequilibrium spin transport
3. Atomistic simulation
4. Density functional theory
5. Light-matter interaction
6. Ultrafast spin dynamics
7. Magnetic texture
8. Machine learning

Computational Skill

Language: Fortran, Wolfram, Python, Bash, LaTex.
Software: Mathematica, KWANT, Spirit,
Quantum Espresso, VASP, Quantum ATK.

Languages

Bengali (Mother Tongue), Hindi (Fluent in speaking),
English (Proficient, IELTS overall score 7 (2012)).

Hobbies

1. Reading.
2. Generative art.
3. Origami.
4. Fountain pens.

Academic Visits

2022 Host: Prof. Johan Mentink, Radboud Universiteit, Nijmegen, Netherlands.

2022 Host: Prof. Stefan Eisebitt, Max Born Institute, Berlin, Germany.

2019 Host: Prof. Ingrid Mertig, Institute of Physics of the Martin Luther University Halle-Wittenberg, Germany.

2019 Host: Prof. Yuriy Mokrousov, Forschungszentrum Jülich, Germany.

2018 Host: Prof. Tomáš Jungwirth, Institute of Physics of Czech Academy of Sciences, Czech Republic.

2018 Host: Prof. Branislav K. Nikolić, University of Delaware, USA.

Recent Conferences and Workshops

2024 822. WE-Heraeus-Seminar "Chirality and Quantum Spin - a Critical Assessment", 02-05 Dec 2024, Bad Honnef, Germany. **Poster:** Chirality induced spin selectivity from charge current.

2023 Topological Metamaterials and Dynamical Phenomena in Magnets, 08-10 Nov 2023, Kalmar, Sweden. **Invited talk:** Manipulating topology with scalar potential.

2023 SPP2137 Skyrmionics, Topological Spin Phenomena in Real-Space for Applications,13-15 Sep 2023, Hamburg, Germany. **Oral Presentation:** Ultrafast optical generation of antiferromagnetic texture with conservation of topological charge.

2023 DPG Spring Meeting (SKM) 2023, 26-31 Mar 2023, Dresden. **Oral Presentation:** Manipulating topological feature of massive Dirac particle with scalar potential

2023 APS March Meeting, (Online) 20-22 Mar 2023. **Oral Presentation:** Ultrafast optical generation of antiferromagnetic texture-antitexture pair.

2023 776. WE-Heraeus-Seminar, Re-thinking Spintronics: From Unconventional Materials to Novel Technologies. 04-06 Jan 2023, Bad Honnef, Germany. **Oral Presentation:** Manipulating topology of massive Dirac Fermion with scalar potential.

2022 UMC 2022 : 5th Ultrafast Magnetic Conference, 12-16 Sept 2022. Nancy, France. **Poster Presentation:** Ultrafast optical generation of texture-antitexture pairs.

2022 The 2022 AtC-AtG Magnetic Conference (IEEE) (online), 31st Aug 2022. **Oral Presentation:** Ultrafast optical generation of magnetic texture pairs.

2022 DPG Spring Meeting (SKM) 2022, 04-09 Sept. 2022, Regensburg, Germany. **Oral Presentation:** Ultrafast optical generation of antiferromagnetic spin texture.

2022 7th IWMP, Recent trends in Magnetism and Superconductivity, 31 Aug-2nd Sept 2022, NIMP, Romania. **Invited Talk:** Ultrafast optical generation of magnetic texture in antiferromagnets.

2022 META 2022, 19-22 Jul, 2022, Torremolinos - Spain. **Invited Talk:** Emergent chiral interaction and ultrafast optical generation of antiferromagnetic texture.

2022 SPICE-Workshop Ultrafast Antiferromagnetic Writing, 09–10 May, 2022, Ingelheim, Germany. **Poster:** Ultrafast laser induced chirality in collinear magnets.

2022 APS 2022 (online), 14–18 Mar, 2022, Chicago, USA. **Oral Presentation:** Emergent chiral interaction and ultrafast optical generation of antiferromagnetic spin spirals.

2022 MMM 2022 (online), 10-14 Jan 2022, New Orleans, USA. **Oral Presentation:** Imprinting chirality in collinear magnet with ultrafast laser.

2022 757.WE-Heraeus-Seminar, Non-Linear Magnetism, 5-7 Jan, 2022, Bad-Honnef, Germany. **Poster Presentation:** Optical generation of antiferromagnetic spin-spiral and underlying emergent interactions.

2021 "Advanced Parallel Programming with MPI and OpenMP @ JSC" (online course), 29 Nov - 01 Dec, 2021, JSC, Jülich.

2021 Joint School on Spin Physics, 25-28 Oct, 2021, Apolda, Germany. **Poster :** Ultrafast optical generation of antiferromagnetic spin spirals and underlying electronic interactions.

2021 84. Annual Meeting of DPG and DPG-Tagung of the Condensed Matter Section (SKM) (online), 27 Sep -01 Oct, 2021, Germany. **Poster:** Imprinting chirality in an antiferromagnetic spin chain with ultrafast laser.

2021 The 2021 AtC-AtG Magnetic Conference (IEEE) (online), 24th Aug 2021. **Oral Presentation:** Ultrafast optical generation of antiferromagnetic spin spiral.

2021 INTERMAG 2021 (online), 26-30 April 2021, Lyon, France. **Oral Presentation:** Ultrafast electronic manipulation of antiferromagnetic spin spiral states.

2021 3D MAGiC Workshop on magnons (online),1st Feb 2021, Germany. **Oral Presentation:** Magnetisation dynamics from electronic point of view.

2021 736. WE-Heraeus Seminar on Magnetism at the Nanoscale: Imaging - Fabrication – Physics (online), 06-08 Jan 2021, Bad Honnef, Germany. **Poster:** Ultrafast electronic generation of antiferromagnetic spin spiral states.

List of publications

26. S. Ghosh, Y. Mokrousov and S. Blügel, *"Microscopic origin of scalar potential induced topological transition in massive Dirac fermions and scalar Hall effect"*, *Phys. Rev. B* 110, 125117 (**2024**), [arXiv:2204.06412].
25. F. R. Lux, S. Ghosh, P. Prass, E. Prodan and Y. Mokrousov, *"Unified topological characterization of electronic states in spin textures from noncommutative K-theory"*, *Phys. Rev. Res.* 6, 013102 (**2024**), [arXiv:2103.01047].
24. L. Zhang, H. Li, Y. Jiang, Z. Wang, T. Li and **S. Ghosh**, *"Current-driven magnetoresistance in van der Waals spin-filter antiferromagnetic tunnel junctions with $MnBi_2Te_4$"*, *Phys. Rev. Appl.*, 20, 044056 (**2023**), [arXiv:2310.02830].
23. K. J. B. Ghosh and **S. Ghosh**, *"Exploring exotic configurations with anomalous features with deep learning: Application of classical and quantum-classical hybrid anomaly detection"*, *Phys. Rev. B*, 108, 165408 (**2023**), [arXiv:2304.08616].
22. **S. Ghosh**, P. Rüßmann, Y. Mokrousov, F. Freimuth and A. Kosma, *"Perspective on spin–orbit torque, topology, and reciprocal and real-space spin textures in magnetic materials and heterostructures"*, *J. Appl. Phys.*, 133 (**2023**).
21. **S. Ghosh**, S. Blügel and Y. Mokrousov, *"Ultrafast optical generation of antiferromagnetic meron-antimeron pairs with conservation of topological charge"*, *Phys. Rev. Res. (Lett.)*, 5, L022007 (**2023**), [arXiv:2205.12100].
20. K. J. B. Ghosh and **S. Ghosh**, *"Classical and quantum machine learning applications in spintronics"*, *Digit. Discov.*, 2, 512, (**2023**), [arXiv:2207.12837].
19. **S. Ghosh**, F. Freimuth, O. Gomonay, S. Blügel and Y. Mokrousov, *"Driving spin chirality by electron dynamics in laser-excited antiferromagnets"*, *Commun. Phys.*, 5, 69 (**2022**), [arXiv:2011.01670].
18. A. Hajr, A. Hariri, G. Manchon, **S. Ghosh** and A. Manchon, *"Semirealistic tight-binding model for Dzyaloshinskii-Moriya interaction"*, *Phys. Rev. B*, 102, 224427 (**2020**), [arXiv:2002.05546].
17. **S. Ghosh** and S. Grytsiuk, *"Orbitronics with uniform and nonuniform magnetic structures"*, In *Solid State Phys. - Adv. Res. Appl.*, pages 1–38. (**2020**).
16. S. Laref, **S. Ghosh**, E. Y. Tsymbal and A. Manchon, *"Induced spin textures at 3d transition metal–topological insulator interfaces"*, *Phys. Rev. B*, 101, 220410 (**2020**).
15. G. Manchon, **S. Ghosh**, C. Barreteau and A. Manchon, *"Semirealistic tight-binding model for spin-orbit torques"*, *Phys. Rev. B*, 101, 174423 (**2020**).
14. R. Sokolewicz, **S. Ghosh**, D. Yudin, A. Manchon and M. Titov, *"Spin-orbit torques in a Rashba honeycomb antiferromagnet"*, *Phys. Rev. B*, 100, 214403 (**2019**), [arXiv:1908.11354].
13. **S. Ghosh** and A. Manchon, *"Nonequilibrium spin density and spin-orbit torque in a three-dimensional topological insulator/antiferromagnet heterostructure"*, *Phys. Rev. B*, 100, 014412 (**2019**), [arXiv:1901.08314].
12. **S. Ghosh** and A. Manchon, *"Spin-orbit torque in a three-dimensional topological insulator–ferromagnet heterostructure: Crossover between bulk and surface transport"*, *Phys. Rev. B*, 97, 134402 (**2018**), [arXiv:1711.11016].
11. **S. Ghosh** and A. Manchon, *"Spin-orbit torque in two-dimensional antiferromagnetic topological insulators"*, *Phys. Rev. B*, 95, 035422 (**2017**), [arXiv:1609.01174].
10. **S. Ghosh** and U. Schwingenschlögl, *"Hexagonal graphene quantum dots"*, *Phys. status solidi - Rapid Res. Lett.*, 11, 1600226 (**2017**).
9. **S. Ghosh** and A. Manchon, *"Signature of topological transition in persistent current in a Dirac Ring"*, (**2016**) [arXiv:1607.05052].

8. **S. Ghosh** and A. Manchon, *"Signature of Topological Phases in Zitterbewegung"*, *SPIN*, 06, 1640004 (**2016**), [arXiv:1605.02207].
7. U. Satpathi, **S. Ghosh**, A. K. Ray and P. S. Deo, *"Localization of electrons in internal frame"*, *Int. J. Mod. Phys. B*, 30, 1550266 (**2016**), [arXiv:1306.3781].
6. **S. Ghosh**, U. Schwingenschlögl and A. Manchon, *"Resonant longitudinal Zitterbewegung in zigzag graphene nanoribbons"*, *Phys. Rev. B*, 91, 045409 (**2015**).
5. **S. Ghosh**, *"Generalized Uncertainty Principle, Modified Dispersion Relation and Barrier Penetration by a Dirac Particle"*, *Int. J. Theor. Phys.*, 54, 736 (**2015**), [arXiv:1202.1962].
4. **S. Ghosh** and A. Saha, *"Persistent current of relativistic electrons on a Dirac ring in presence of impurities"*, *Eur. Phys. J. B*, 87, 167 (**2014**), [arXiv:1308.4071].
3. **S. Ghosh**, *"Relativistic Fermion on a Ring: Energy Spectrum and Persistent Current"*, *Adv. Condens. Matter Phys.*, 2013, 1 (**2013**), [arXiv:1206.2170].
2. R. Banerjee, **S. Ghosh** and D. Roychowdhury, *"New type of phase transition in Reissner Nordström–AdS black hole and its thermodynamic geometry"*, *Phys. Lett. B*, 696, 156 (**2011**), [arXiv:1008.2644].
1. R. Banerjee and **S. Ghosh**, *"Generalised uncertainty principle, remnant mass and singularity problem in black hole thermodynamics"*, *Phys. Lett. B*, 688, 224 (**2010**), [arXiv:1002.2302].