

Shinjan Mandal

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Postdoctoral fellow, studying the transport properties of quantum materials using a combination of atomistic modelling and first-principles calculations.

Experience

2025 - present Postdoctoral Fellow at University of Michigan, Ann Arbor [Advisor: Emmanouil Kioupakis]

Education

2018 - 24 **PhD** at Indian Institute of Science (IISc), Bangalore [Advisor: Manish Jain]
Thesis title: Interplay of Electrons and Phonons in 2D Materials, ([Link to thesis](#))
2017 - 18 **MSc in Physics** at IISc, Bangalore
2013 - 17 **BSc(Research) with major in Physics** at IISc, Bangalore

Research Works

Publications

- [1] P. S. Mahapatra, B. Ghawri, M. Garg, **Shinjan Mandal**, K. Watanabe, T. Taniguchi, M. Jain, S. Mukerjee, and A. Ghosh. “**Misorientation-controlled cross-plane thermoelectricity in twisted bilayer graphene**”. In: *Physical Review Letters* 125.22 (2020), p. 226802. DOI: [10.1103/PhysRevLett.125.226802](https://doi.org/10.1103/PhysRevLett.125.226802).
- [2] B. Ghawri, P. S. Mahapatra, M. Garg, **Shinjan Mandal**, S. Bhowmik, A. Jayaraman, R. Soni, K. Watanabe, T. Taniguchi, H. R. Krishnamurthy, M. Jain, S. Banerjee, U. Chandni, and A. Ghosh. “**Breakdown of semi-classical description of thermoelectricity in near-magic angle twisted bilayer graphene**”. In: *Nature communications* 13.1 (2022), p. 1522. DOI: [10.1038/s41467-022-29198-4](https://doi.org/10.1038/s41467-022-29198-4).
- [3] B. Ghawri, P. S. Mahapatra, M. Garg, **Shinjan Mandal**, A. Jayaraman, K. Watanabe, T. Taniguchi, M. Jain, U. Chandni, and A. Ghosh. “**Non-Boltzmann thermoelectric transport in minimally twisted bilayer graphene**”. In: *Physical Review B* 109.4 (2024), p. 045436. DOI: [10.1103/PhysRevB.109.045436](https://doi.org/10.1103/PhysRevB.109.045436).
- [4] M. K. Jat, P. Tiwari, R. Bajaj, I. Shitut, **Shinjan Mandal**, K. Watanabe, T. Taniguchi, H. R. Krishnamurthy, M. Jain, and A. Bid. “**Higher-order Bragg gaps in the electronic band structure of bilayer graphene renormalized by recursive supermoiré potential**”. In: *Nature communications* 15.1 (2024), p. 2335. DOI: [10.1038/s41467-024-46672-3](https://doi.org/10.1038/s41467-024-46672-3).
- [5] S. Sett, R. Debnath, A. Singha, **Shinjan Mandal**, Jyotsna KM, V. Raghunathan, M. Bhakar, G. Sheet, M. Jain, and A. Ghosh. “**Emergent inhomogeneity and non-locality in a graphene field-effect transistor on a near-parallel moiré superlattice of transition metal dichalcogenides**”. In: *Nano Letters* (2024). DOI: [10.1021/acs.nanolett.4c01755](https://doi.org/10.1021/acs.nanolett.4c01755).
- [6] K. P. Bera[†], D. Solanki[†], **Shinjan Mandal**[†], R. Biswas, T. Taniguchi, K. Watanabe, V. Raghunathan, M. Jain, A. Sood, and A. Das. “**Twist Angle Dependent Phonon Hybridization in WSe₂/WSe₂ Homobilayer**”. In: *ACS Nano* (2024). ([†]equal contribution). DOI: [10.1021/acsnano.4c06767](https://doi.org/10.1021/acsnano.4c06767).
- [7] **Shinjan Mandal**, I. Maity, H. R. Krishnamurthy, and M. Jain. “**Phonon linewidths in twisted bilayer graphene near the magic angle**”. In: *Physical Review B* 110.12 (2024), p. 125421. DOI: [10.1103/PhysRevB.110.125421](https://doi.org/10.1103/PhysRevB.110.125421).
- [8] S. Kumbhakar, T. K. Maji, B. Tongbram, **Shinjan Mandal**, S. H. Soundararaj, B. Debnath, M. Jain, H. Krishnamurthy, A. Pandey, and A. Ghosh. “**Engineering ultra-strong electron-phonon coupling and nonclassical electron transport in crystalline gold with nanoscale interfaces**”. In: *Nature Communications* 16.1 (2025), p. 61. DOI: <https://doi.org/10.1038/s41467-024-55435-z>.
- [9] R. Dutta, A. Ghosh, **Shinjan Mandal**, K. Watanabe, T. Taniguchi, H. Krishnamurthy, S. Banerjee, M. Jain, and A. Das. “Electric Field-Tunable Superconductivity with Competing Orders in Twisted Bilayer Graphene near the Magic Angle”. In: *ACS nano* (2025). DOI: <https://doi.org/10.1021/acsnano.4c12770>.
- [10] **Shinjan Mandal**, S. H. Soundararaj, M. Jain, and H. R. Krishnamurthy. “**Possibilities for enhanced electron-phonon interactions and high- T_c superconductivity in engineered bimetallic nanostructured superlattices**”. In: *Phys. Rev. B* 111.18 (2025), p. 184507. DOI: [10.1103/PhysRevB.111.184507](https://doi.org/10.1103/PhysRevB.111.184507).

Submitted

- [11] R. Soni, S. Datta, R. Bajaj, S. Bhowmick, **Shinjan Mandal**, K. Watanabe, T. Taniguchi, M. Jain, and U. Chandani. “**Enhanced Phonon-Assisted Tunneling in Metal - Twisted Bilayer Graphene Junctions**”. In: *(Under Review)* (2024).
- [12] **Shinjan Mandal**, I. Maity, H. R. Krishnamurthy, and M. Jain. “**PARPHOM: PARallel PHOnon calculator for Moiré systems**”. In: *arXiv:2410.21075* (2024).
- [13] S. K. Sahu, R. Bajaj, S. U. Ali, A. Bhut, R. J. Mathew, **Shinjan Mandal**, K. Watanabe, T. Taniguchi, M. Jain, and C. Kumar. “**Probing Phonon Modes in Reconstructed twisted Homo and Hetero Bilayer System**”. In: *(Under Review)* (2025).
- [14] S. Kumbhakar, B. Debnath, T. K. Maji, B. Tongbram, **Shinjan Mandal**, T. P. Sai, T. Ramakrishnan, M. Jain, H. R. Krishnamurthy, A. Pandey, and A. Ghosh. “**Giant Rashba spin-orbit coupling in bulk gold with buried network of nanoscale interfaces**”. In: *(Under Review)* (2025).

Softwares Developed

PARPHOM: PARallel PHOnon calculator for Moiré systems

A massively parallel Python/FORTRAN hybrid package interfaced with LAMMPS, that computes the force constants in moiré systems, and uses that information to compute the phonon spectra

ELPHONSO: ELection PHONon SOlver

FORTRAN package with hybrid parallelization (MPI+OpenMP) to compute the electron phonon coupling coefficients in systems with large number of atoms. A tight binding code written exclusively to handle large systems is an accessory to this project.

Teaching Experience

PH203: Quantum Mechanics I Nov 20 - Feb 21, Aug 21 - Dec 21
PH320: Condensed Matter Physics II Aug 22 - Dec 22
TA-ship duties included conducting regular tutorial sessions and grading assignments for a mixed class of undergraduate and graduate students in PH203 and a class of advanced graduate students in PH320.

Skills

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| General Computational Proficiency | FORTRAN, Python, Matlab, Mathematica Extensive experience in MPI and OpenMP parallelization |
| Specialized Softwares | LAMMPS, Quantum Espresso, Wannier90, EPW |

Academic Highlights

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| DCOMP Travel Award APS March Meeting, 2025 | 2025 |
| DCOMP Travel Award APS March Meeting, 2024 | 2024 |
| Senior Research Fellowship, Department of Science and Technology, India | 2020 |
| Junior Research Fellowship, Department of Science and Technology, India | 2018 |
| MP Birla Award (for securing a rank of 9 among ~ 600,000 students in WBCHSE) | 2013 |
| KVPY Scholarship, Department of Science and Technology (Awarded to ~ top 250 students across India) | 2012 |
| National Talent Search Examination Scholarship (NCERT, Govt. of India) | 2009 |

Conferences and Talks

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| APS March Meeting, 2025, Anaheim, USA [Talk] | March, 2025 |
| APS March Meeting, 2024, Minneapolis, USA [Talk] | March, 2024 |
| Workshop on moiré materials, ICTP, Italy [Talk] | Jan, 2024 |
| Recent Progress in Graphene Research, Bangalore, India [Talk] | Nov, 2023 |
| NAMMA Psi-K, JNCASR & IISc, Bangalore, India [Poster] | July, 2023 |
| Indo-Israel Meeting, Weizmann Institute of Science, Rehovot, Israel [Poster] | July, 2023 |
| APS March Meeting, 2022 (online) [Talk] | March, 2022 |
| Novel Phases of Quantum Matter, ICTS, Bangalore, India [Poster] | Dec, 2019 |

References

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