

Shinjan Mandal

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Summary

I am a doctoral candidate at the Indian Institute of Science, Bangalore, studying the transport properties of quantum materials using a combination of atomistic modelling and first-principles calculations.

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).

Submitted

- [8] R. Dutta, A. Ghosh, **Shinjan Mandal**, K. Watanabe, T. Taniguchi, S. Banerjee, H. R. Krishnamurthy, M. Jain, and A. Das. “**Electric field tunable superconductivity in near magic angle twisted bilayer graphene**”. In: *arXiv:2402.11649* (2024).
- [9] S. Kumbhakar, T. K. Maji, B. Tongbram, **Shinjan Mandal**, S. H. Soundaraj, B. Debnath, T. P. Sai, M. Jain, H. R. Krishnamurthy, A. Pandey, and A. Ghosh. “**Engineering ultra-strong electron-phonon coupling and nonclassical electron transport in crystalline gold with nanoscale interfaces**”. In: *arXiv:2405.14684* (2024).
- [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 Au-Ag nano-structures**”. In: *arXiv:2408.15820* (2024).

- [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).

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

TA for PH203: Quantum Mechanics I Nov 20 - Feb 21, Aug 21 - Dec 21
 TA for 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

General Computational Proficiency FORTRAN, Python, Matlab, Mathematica
 Extensive experience in MPI and OpenMP parallelization

Specialized Softwares LAMMPS, Quantum Espresso, Wannier90, EPW

Academic Highlights

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

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

Prof. Manish Jain	Prof H R Krishnamurthy	Prof. Anindya Das
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