

# Shinjan Mandal

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## Summary

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I am a doctoral candidate at Indian Institute of Science, Bangalore, studying the transport properties of quantum materials using a combination of atomistic modelling and first principles calculations. My PhD thesis focuses on the study of electron-phonon interactions in twisted bilayer graphene systems and how the transport properties are affected due to this interaction.

## Education

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- 2018 - present**    **PhD** at Indian Institute of Science (IISc), Bangalore  
Advisor: Manish Jain  
Thesis title: Interplay of Electrons and Phonons in twisted 2D Materials
- 2017 - 18**        **MSc in Physics** at IISc, Bangalore  
Advisor: H R Krishnamurthy  
Thesis title: Interlayer conductance in Bilayer Graphene
- 2013 - 17**        **BSc(Research) with major in Physics** at IISc, Bangalore  
Advisor: H R Krishnamurthy  
Thesis title: A study on the properties of twisted bilayer graphene

## Research Works

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### 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.
- [2] B. Ghawri, P. S. Mahapatra, M. Garg, **Shinjan Mandal**, S. Bhowmik, A. Jayaraman, R. Soni, K. Watanabe, T. Taniguchi, H. Krishnamurthy, M. Jain, S. Banerjee, U. Chandni, and A. Ghosh. “**Breakdown of semiclassical description of thermoelectricity in near-magic angle twisted bilayer graphene**”. In: *Nature communications* 13.1 (2022), pp. 1–7. DOI: 10.1038/s41467-022-29198-4.

### Submitted

- [3] M. K. Jat, P. Tiwari, R. Bajaj, I. Shitut, **Shinjan Mandal**, K. Watanabe, T. Taniguchi, H. Krishnamurthy, M. Jain, and A. Bid. “**Higher-order Bragg gaps in the electronic band structure of bilayer graphene renormalized by recursive supermoiré potential**”. In: *(Under Review) arXiv:2304.01720* (2023).
- [4] K. P. Bera<sup>†</sup>, D. Solanki<sup>†</sup>, **Shinjan Mandal**<sup>†</sup>, R. Biswas, T. Taniguchi, K. Watanabe, V. Raghunathan, M. Jain, A. Sood, and A. Das. “**Twist Angle Dependent Phonon Hybridization in WSe<sub>2</sub>/WSe<sub>2</sub> Homobilayer**”. In: *(Under Review)* (2023). (<sup>†</sup>These authors contributed equally).
- [5] B. Ghawri, P. S. Mahapatra, M. Garg, **Shinjan Mandal**, S. Ray, A. Jayaraman, K. Watanabe, T. Taniguchi, T. Das, M. Jain, U. Chandni, and A. Ghosh. “**Non-Boltzmann thermoelectric transport in minimally twisted bilayer graphene**”. In: *(Under Review)* (2023).

### Under Preparation

- [6] R. Dutta, A. Ghosh, **Shinjan Mandal**, K. Watanabe, T. Taniguchi, S. Banerjee, H. Krishnamurthy, M. Jain, and A. Das. “**Electric field tunable superconductivity in near magic angle twisted bilayer graphene**”. In: *Under Preparation* (2023).
- [7] D. Solanki, K. P. Bera, **Shinjan Mandal**, M. Jain, A. Sood, and A. Das. “**Evolution of G and 2D Raman Modes in Twisted Bilayer Graphene with Twist Angle**”. In: *Under Preparation* (2023).
- [8] **Shinjan Mandal**, I. Maity, H. Krishnamurthy, and M. Jain. “**PARPHOM: PARallel PHOnon calculator for Moiré systems**”. In: *Under Preparation* (2023).
- [9] **Shinjan Mandal**, I. Maity, H. Krishnamurthy, and M. Jain. “**Phonon Linewidth in twisted bilayer graphene**”. In: *Under Preparation* (2023).

- [10] S. H. Soundararaj<sup>†</sup>, **Shinjan Mandal**<sup>†</sup>, M. Jain, and H. Krishnamurthy. “**Unconventional electronic transport in AuAg nanocluster**”. In: *Under Preparation* (2023). (<sup>†</sup>These authors contributed equally).
- [11] K. Atalar, **Shinjan Mandal**, M. Jain, A. Mostofi, and J. Lischner. “**Electron-phonon coupling in twisted bilayer transition metal dichalcogenides using a hybrid classical/quantum mechanical approach**”. In: *Under Preparation* (2023). (Link to APS talk).

## Softwares Developed

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### 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

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TA for PH203: Quantum Mechanics I	Nov 2020 - Feb 2021
TA for PH203: Quantum Mechanics I	Aug 2021 - Dec 2021
TA for PH320: Condensed Matter Physics II	Aug 2022 - Dec 2022
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
Miscellaneous	1) Performed the role of system administrator for three 128 core clusters in Prof. Manish Jain's group during my PhD tenure. 2) Was part of the team of people involved in setting up and benchmarking Param Pravega, a 3.3 PF supercomputer at IISc, Bangalore.

## Academic Highlights

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Senior Research Fellowship, Department of Science and Technology, India	2020-23
Junior Research Fellowship, Department of Science and Technology, India	2018-20
National Graduate Physics Examination National Topper (top 1%)	2015
KVPY Scholarship, Department of Science and Technology (Awarded to ~ top 250 students across India)	2013-18
MP Birla Award (for securing a rank of 9 among ~ 600,000 students in WBCHSE)	2013

## Conferences and Talks

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NAMMA Psi-K, JNCASR & IISc, Bangalore, India	July, 2023
Indo-Israel Meeting, Weizmann Institute of Science, Rehovot, Israel	July, 2023
APS Satellite Meeting, ICTS, Bangalore, India	April, 2022
APS March Meeting, 2022 (online)	March, 2022
Novel Phases of Quantum Matter, ICTS, Bangalore, India	Dec, 2019

## References

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Prof. Manish Jain Department of Physics Indian Institute of Science mjain@iisc.ac.in	Prof H R Krishnamurthy Department of Physics Indian Institute of Science hrkrish@iisc.ac.in	Prof. Anindya Das Department of Physics Indian Institute of Science anindya@iisc.ac.in
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