Shinjan Mandal

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Summary

I am a doctoral candidate at Indian Institute of Science, Bangalore, studying the transport properties of quantum materials using a combination of atomstic 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

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

Publications

[1] Phanibhusan S Mahapatra, Bhaskar Ghawri, Manjari Garg, **Shinjan Mandal**, K Watanabe, T Taniguchi, Manish Jain, Subroto Mukerjee, and Arindam 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] Bhaskar Ghawri, Phanibhusan S Mahapatra, Manjari Garg, **Shinjan Mandal**, Saisab Bhowmik, Aditya Jayaraman, Radhika Soni, Kenji Watanabe, Takashi Taniguchi, HR Krishnamurthy, Manish Jain, Sumilan Banerjee, U. Chandni, and Arindam 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.

Preprints and Under preparation

[1] Mohit Kumar Jat, Priya Tiwari, Robin Bajaj, Ishita Shitut, **Shinjan Mandal**, Kenji Watanabe, Takashi Taniguchi, HR Krishnamurthy, Manish Jain, and Aveek 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).

[2] Krishna Prasad Bera†, Darshit Solanki†, **Shinjan Mandal**†, Rabindra Biswas, Takashi Taniguchi, Kenji Watanabe, Varun Raghunathan, Manish Jain, Ajay Sood, and Anindya Das. "**Twist Angle Dependent Phonon Hybridization in WSe2/WSe2 Homobilayer**". In: *(Under Review)* (2023). (†These authors contributed equally).

[3] Bhaskar Ghawri, Phanibhusan S. Mahapatra, Manjari Garg, **Shinjan Mandal**, Sujay Ray, Aditya Jayaraman, Kenji Watanabe, Takashi Taniguchi, Tanmoy Das, Manish Jain, Usha Chandni, and Arindam Ghosh. "**Non-Boltzmann thermoelectric transport in minimally twisted bilayer graphene**". In: *(Under Review)* (2023).

[4] Ranit Dutta, Ayan Ghosh, **Shinjan Mandal**, Kenji Watanabe, Takashi Taniguchi, Sumilan Banerjee, HR Krishnamurthy, Manish Jain, and Anindya Das. "**Electric field tunable superconductivity in near magic angle twisted bilayer graphene**". In: *Under Preparation* (2023).

[5] Darshit Solanki, Krishna Prasad Bera, **Shinjan Mandal**, Manish Jain, Ajay Sood, and Anindya Das. "**Evolution of G and 2D Raman Modes in Twisted Bilayer Graphene with Twist Angle**". In: *Under Preparation* (2023).

[6] **Shinjan Mandal**, Indrajit Maity, HR Krishnamurthy, and Manish Jain. "**PARPHOM: PARallel PHOnon calculator for Moiré systems**". In: *Under Preparation* (2023).

[7] **Shinjan Mandal**, Indrajit Maity, HR Krishnamurthy, and Manish Jain. "**Phonon Linewidth in twisted bilayer graphene**". In: *Under Preparation* (2023).

[8] Shri Hari Soundararaj[†], **Shinjan Mandal**[†], Manish Jain, and HR Krishnamurthy. "**Unconventional electronic transport in AuAg nanocluster**". In: *Under Preparation* (2023). ([†]These authors contributed equally).

[9] Kemal Atalar, **Shinjan Mandal**, Manish Jain, Arash Mostofi, and Johannes 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

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: ELectron 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 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

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

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 $\sim$ top 250 students across India)	2013-18
MP Birla Award (for securing a rank of 9 among $\sim$ 600,000 students in WBCHSE)	2013

Conferences and Talks

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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