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. My PhD thesis focuses on studying the role of electron-phonon interactions on the transport properties of moiré materials.

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

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.

[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), pp. 1–7. DOI: 10.1038/s41467-022-29198-4.

[3] 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: *Physical Review B* (Accepted 2023).

Submitted

[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: *(Under Review) arXiv:2304.01720* (2023).

[5] 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: *(Under Review)* (2023). (†These authors contributed equally).

[6] 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: *(Under Review)* (2023).

Under Preparation

[7] 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: *Under Preparation* (2023).

[8] 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**". In: *Under Preparation* (2023).

[9] **Shinjan Mandal**, I. Maity, H. R. Krishnamurthy, and M. Jain. "**PARPHOM: PARallel PHOnon calculator for Moiré systems**". In: *Under Preparation* (2023).

[10] **Shinjan Mandal**, I. Maity, H. R. Krishnamurthy, and M. Jain. "**Phonon Linewidth in twisted bilayer graphene near Magic Angle**". In: *Under Preparation* (2023).

[11] S. H. Soundararaj[†], **Shinjan Mandal**[†], M. Jain, and H. R. Krishnamurthy. "**Possibilities for enhanced electron-phonon interactions and high-T_c superconductivity in engineered Au-Ag nano-structures** ". In: *Under Preparation* (2023). ([†]These authors contributed equally).

[12] 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

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

Academic Highlights

Senior Research Fellowship, Department of Science and Technology, India	2020-23
Junior Research Fellowship, Department of Science and Technology, India	2018-20
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

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 Satellite Meeting, ICTS, Bangalore, India [Poster]	April, 2022
APS March Meeting, 2022 (online) [Talk]	March, 2022
Novel Phases of Quantum Matter, ICTS, Bangalore, India [Poster]	Dec, 2019

References

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