

# Archisman Panigrahi

Graduate Student · Physics

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## Education

### Ph.D. in Physics

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

- C.G.P.A - 5.0/5.0

Cambridge, MA, USA

August 2022 - Ongoing

### Master of Science in Physics

INDIAN INSTITUTE OF SCIENCE

- C.G.P.A - 9.8/10.0

Bangalore, India

Aug. 2021 - Jun. 2022

### Bachelor of Science (Research) in Physics

INDIAN INSTITUTE OF SCIENCE

- C.G.P.A - 9.8/10.0

Bangalore, India

Aug. 2017 - Jun. 2021

## Academic Achievements

2023	Qualified among the top 16 participants in MIT Integration Bee	MIT
2022	<b>1st Rank in India</b> in CSIR-NET (JRF) in Physics (score 186/200)	India
2022	<b>1st Rank in India</b> in Graduate Aptitude Test in Engineering (G.A.T.E.) in Physics	India
2017-22	<b>C.G.P.A 9.8/10</b> in B.S. (Research) and M.S., highest GPA in batch	IISc, Bangalore
2017	<b>1st rank (99.2 %) in Board</b> in Higher Secondary Examination, among about 0.7 million candidates	West Bengal, India
2017	10th rank in National Entrance Screening Test (NEST)	India
2017	Qualified for JEE Mains (All India Rank - 381) - an all India Engineering entrance	
2017	Qualified for JEE Advanced examination (All India Rank- 543), Entrance examination of Indian Institute(s) of Technology (IIT)	
2017	Qualified for Indian Statistical Institute, Kolkata and Chennai Mathematical Institute	
2015	Qualified for K.V.P.Y. (All India Rank - 128)	
2015	<b>2nd rank (97.57 %) in Board</b> in Secondary Examination, among about 1 million candidates	West Bengal, India

## Research Articles

- A. Panigrahi**, L. Levitov; *Signatures of electronic ordering in transport in graphene flat bands* [Phys. Rev. B \*\*110\*\*, 035122 \(2024\)](#)
- M. Masseroni, M. Gull, **A. Panigrahi**, N. Jacobsen, F. Fischer, C. Tong, J. D. Gerber, M. Niese, T. Taniguchi, K. Watanabe, L. Levitov, T. Ihn, K. Ensslin, H. Duprez; *Spin-orbit proximity in MoS<sub>2</sub>/bilayer graphene heterostructures* [arxiv:2403.17120](#) (Under review in Nature Communications)
- A. Panigrahi**, S. Mukerjee; *Energy magnetization and transport in systems with a non-zero Berry curvature in a magnetic field* [SciPost Phys. Core 6, 052 \(2023\)](#)
- A. Panigrahi**, V. Juričić, B. Roy; *Projected Topological Branes* [Commun Phys \*\*5\*\*, 230 \(2022\)](#)
- A. Panigrahi**, R. Moessner, B. Roy; *Non-Hermitian dislocation modes: Stability and melting across exceptional points* [PRB \*\*106\*\*, L041302 \(2022\)](#)

## Research Interests

### Broadly interested in theoretical Condensed Matter Physics

- Electronic transport in two-dimensional systems
- Computational methods in quantum condensed matter physics
- Topological phases of matter and Quantum Phase transitions
- Thermo-electric transport and the effects of Berry curvature
- Thermalization of quantum systems and Many body localization

## Skills

**Programming skills** Julia, MATLAB/Octave, Mathematica, Python

**Advanced Physics Courses** Strongly Correlated Systems, Advanced Statistical Physics, Quantum Field Theory I, General Relativity

**Languages** Fluent in English, Bengali, Hindi

## Transport Signatures of Electronic Ordering in Graphene Flat Bands

Indian Institute of Science,  
Bangalore, India  
January 2024

CLICK [HERE](#) TO DOWNLOAD THE PRESENTATION

## Topological phases in quasicrystals: A general principle of construction

APS March Meeting (virtually)  
March 2022

CLICK [HERE](#) TO DOWNLOAD THE PRESENTATION

## Dislocation as a bulk probe of non-Hermitian topology

MPIPKS, Dresden, Germany  
(remotely)  
July 6, 2021

CLICK [HERE](#) TO DOWNLOAD THE PRESENTATION

# Research Experience

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## Transport in momentum-polarized ordered phases in graphene bilayer

MIT, Cambridge, MA, USA  
March 2023 –

WITH PROF. LEONID LEVITOV

- Predicted that momentum-polarized nematic phases in biased bilayer graphene can lead to resistance decreasing with rising temperature
- Demonstrated hysteresis-like switching behavior under the action of a strong electric field

## Many Body Localization (MBL) and thermalization of interacting quantum spin chain

IISc, Bangalore, India  
(Master's thesis)

WITH PROF. SUBROTO MUKERJEE

September 2021 - April 2022

- Studied how the Out-of-Time Ordered Correlator (OTOC) behaves for MBL and thermal systems
- Studied behavior of OTOC in MBL systems with random and incommensurate potential, with and without interaction

## Topological phases in projected lower dimensional branes

MPIPKS, Dresden, Germany  
(remotely)

JOINTLY WITH PROF. BITAN ROY AND PROF. VLADIMIR JURIČIĆ

June 2021 - September 2021

- Numerically studied how topological properties of parent systems emerge in projected crystals and Fibonacci quasicrystals
- Verified the existence of dislocation modes, Weyl points, and Landau levels in projected crystals and quasicrystals
- Proposed how this method can be utilized to study higher dimensional (>3D) topological phases within 3D systems

## Berry curvature effects on thermoelectric transport

IISc, Bangalore, India  
(Bachelor's thesis)

WITH PROF. SUBROTO MUKERJEE

October 2020 - June 2021

- Studied how Berry curvature can alter thermoelectric transport, leading to anomalous Hall and anomalous Nernst effects
- Studied the Boltzmann transport formalism
- Studied how the Onsager relation can be demonstrated from microscopic theories for a system with a non-trivial Berry curvature
- Found a condition on the energy magnetization such that the Einstein relation holds for the transport energy current in these systems
- Showcased a physical interpretation of this condition, and obtained a closed expression for energy magnetization
- Analytically solved the Boltzmann transport equation (including Berry curvature effects) for two-dimensional systems

## Non-Hermitian Topological Insulators and Dislocations

MPIPKS, Dresden, Germany  
(remotely)

WITH PROF. BITAN ROY

May 2020 - September 2020

- Studied and numerically implemented SSH Model, Chern Insulators, Quantum Spin Hall Insulators
- Studied the effects of dislocation in Hermitian and Non-Hermitian Chern Insulators
- Obtained phase diagrams for regimes where topological states get pinned at dislocation centers
- Proposed how dislocations can be used to probe topological phases in non-Hermitian systems, where the non-Hermitian skin effect masks the traditional bulk-boundary correspondence

## Nano Heat Engines beyond the Carnot Efficiency

IISc, Bangalore, India  
May 2019 - July 2019

WITH PROF. H. R. KRISHNAMURTHY

- Studied how harmonic oscillators and two state systems can be used as efficient heat engines
- Read articles claiming Carnot efficiency can be surpassed with "squeezed" thermal baths
- Figured out the sense in which Carnot efficiency is surpassed without violating 2<sup>nd</sup> law of thermodynamics
- Studied about Brownian Motion and Langevin equation
- Solved the Langevin equation for a special kind of stochastic force, for which a classical harmonic oscillator behaves like a squeezed state
- Created a computer simulation to verify the nature of this solution

## References

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- Prof. **Leonid Levitov**, Dept. of Physics, Massachusetts Institute of Technology, Cambridge, MA 02139, USA.  
Email Address - levitov@mit.edu
- Prof. **Subroto Mukerjee**, Dept. of Physics, Indian Institute of Science, Bangalore, India.  
Email Address - smukerjee@iisc.ac.in
- Prof. **Bitan Roy**, Dept. of Physics, Lehigh University, Bethlehem, PA 18015, USA.  
Email Address - bitan.roy@lehigh.edu