Archisman Panigrahi

Graduate Student · Physics

Massachusetts Institute of Technology, Cambridge, MA, USA

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Education

Ph.D. in Physics

Cambridge, MA, USA

Massachusetts Institute of Technology

August 2022 - Ongoing

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

Master of Science in Physics

Bangalore, India

Indian Institute of Science

Aug. 2021 - Jun. 2022

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

Bachelor of Science (Research) in Physics

Bangalore, India

Indian Institute of Science

Aug. 2017 - Jun. 2021

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

Academic Achievements

2023	Qualified among the top 16 participants in MIT Integration Bee	*MIT*
2022	**1st Rank in India** in CSIR-NET (JRF) in Physics (score 186/200)	*India*
2022	**1st Rank in India** in Graduate Aptitude Test in Engineering (G.A.T.E.) in Physics	*India*
2017-22	**C.G.P.A** 9.8/10 in B.S. (Research) and M.S., highest GPA in batch	*IISc, Bangalore*
2017	**1st rank (99.2 %) in Board** 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	**2nd rank (97.57 %) in Board** 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* arxiv:2403.18817 (accepted in PRB)
- **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**
- **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

Talks

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

Transport in momentum-polarized ordered phases in graphene bilayer

IISc, Bangalore, India (Master's thesis)

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)

September 2021 - April 2022

With Prof. Subroto Mukerjee

- 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)

June 2021 - September 2021

Jointly with Prof. Bitan Roy and Prof. Vladimir Juričić

- 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)

October 2020 - June 2021

With Prof. Subroto Mukerjee

- 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)

May 2020 - September 2020

With Prof. Bitan Roy

- 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 2nd 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

- 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