



35th Mid-Year Meeting, 28-29 June 2024

Venue: Auditorium of Biological Sciences Building, Indian Institute of Science, Bengaluru

Symposium on “Twistronics” (Friday 28 June 2024: 14:30–16:30)



Symposium Convener: Manish Jain, Indian Institute of Science, Bengaluru.

Manish Jain received PhD in 2002 in materials science and engineering from the University of Minnesota. Since December 2012 he is a faculty member at the Department of Physics, Indian Institute of Science, Bengaluru. At IISc, he established the Quantum Theory of Materials group with graduate students, postdoctoral fellows and research assistants, with whom he conducts research on developing methods and understanding electronic, optical, structural and dynamical properties of materials. His research interests are in density functional theory, many-body perturbation theory, twistronics. He was elected Fellow of Indian Academy of Sciences in 2023.

Friday 28 June 2024: 14:30-14:55



Speaker: Priya Mahadevan, SN Bose National Centre for Basic Sciences, Kolkata
Title: When and why do we have unconventional behaviour in van der Waals bilayers?

There has been a lot of recent interest in hetero structures of van der Waals materials, with the easy exfoliation of each layer allowing for novel structures to be constructed. In the hierarchy of interactions, the van der Waals interactions are the weakest, so finding unconventional phenomena merely by changing small details of how these materials are stacked seems puzzling. A family of materials will be considered, and how rotating one layer with respect to the other leads to unconventional behaviour will be shown.

Speaker Profile: Priya Mahadevan is a Professor at SN Bose National Centre for Basic Sciences, Kolkata. She completed her PhD from Indian Institute of Science in Bengaluru in 1998. Her research interests range from understanding and predicting magnetism, complex ordering phenomena of correlated electrons manifesting as charge and orbital ordering, size-dependent elastic properties in semiconductors, structure evolution at the nanoscale, etc. She was elected Fellow of Indian Academy of Sciences in 2014

Friday 28 June 2024: 15:00–15:25



Speaker: Sankalpa Ghosh, Indian Institute of Technology, Delhi
Title: Moiré fractals in twistronics

The field of twistronics and Moiré patterns will be introduced. A broad theoretical framework by considering the behaviour of charge carriers in an effective super-lattice potential to understand the single-particle physics in a host of van der Waals hetero-structures (a common acronym for layered materials) which is frontier research area electronic materials will be explained (more popularly dubbed as "quantum materials" in modern day literature). The basic physics of Moiré patterns in twisted bilayer graphene will be explained in this framework. Subsequently the recently introduced concept of "Moiré fractals" that provides quantitative information about band structures of large class of super- moiré systems that consists of two or more moiré structures under certain specific conditions will be described. How such structures can be observed in experiments will also be explained.

Speaker Profile: Sankalpa Ghosh is an assistant professor at Indian Institute of Technology, Delhi. He completed his PhD from Jawaharlal Nehru University, Delhi. His research interests are quantum hall systems, ultra-cold atoms and Bose-Einstein condensation, electron transport in Dirac materials (graphene, topological Insulators etc.)

Friday 28 June 2024: 15:30–15:55



Speaker: Aveek Bid, Indian Institute of Science, Bengaluru
Title: Graphene on hBN: bands with a twist

The relationship between energy (E) and wave vector (k , the inverse of wavelength) is a key characteristic of quantum systems. In metals, the energy of electrons varies quadratically with k , whereas for photons, the relationship between E and k is linear. This means that electrons in metals are non-relativistic, while photons adhere to Einstein's theory of relativity. Graphene presents a condensed matter system that allows the study of relativistic effects in a laboratory setting. In this talk, how the dispersion relation in bilayer graphene can be transformed from non-relativistic to relativistic by creating moiré superlattices will be explained. This is done by placing graphene on an insulator, boron nitride (hBN), which has a slight lattice mismatch with graphene. The effect is further enhanced by introducing a small twist between the graphene and the hBN lattice. How this alteration in the electronic dispersion relation of graphene influences its electronic properties will be discussed.

Speaker Profile: Aveek Bid is an associate professor at Indian Institute of Science, Bengaluru. He completed PhD from the Department of Physics, Indian Institute of Science. His research interests are Electrical transport in two-dimensional materials, graphene, and low-dimensional superconductors.

Friday 28 June 2024: 16:00–16:25



Speaker: Anindya Das, Indian Institute of Science, Bengaluru
Title: Twisted bilayer graphene—A magic platform

The recent discovery of twisted bilayer graphene with flat band has led to many unprecedented emerging phenomena in the condensed matter of physics. In this presentation, an overview of the field of twisted bilayer graphene and its significance in the current scientific landscape will be provided, and recent experiments exploring emergent properties of these systems will be discussed.

Speaker Profile: Anindya Das is an associate professor from Indian Institute of Science, Bengaluru. His research interest are transport properties of mesoscopic structures in reduced dimensions: one-dimensional carbon nanotube (CNT), semiconductor nanowires; zero-dimensional quantum dots; two-dimensional graphene, 2D and 3D topological insulators.