MONDAY

COLLOQUIUM

Superconducting van der Waals devices for science and technology

Mandar M Deshmukh (TIFR, Mumbai)

28 Apr 2025 (Monday) | 16:00 Hrs (Tea / Coffee 15:45 Hrs) | Venue: TIFRH Auditorium

2D van der Waals materials-based heterostructures have led to new devices for fundamental science and applications. Superconducting Josephson devices based on 2D materials offer unique opportunities to engineer new functionality for quantum technology. I will present results from two classes of materials. First, proximitized graphene-based Josephson junctions lead to a quantum noise-limited parametric amplifier with performance comparable to best discrete amplifiers in this class [1]. Gate tunability of the center frequency of the amplifier, rather than flux, offers key advantages. An extension of graphene Josephson architecture to make state-of-the-art bolometers leveraging graphene's low specific heat, and I will present initial results. Second, twisted van der Waals heterostructures based on high Tc superconductor $Bi_2Sr_2CaCu_2O_{8+\delta}$ lead to the realization of a high-temperature Josephson diode [2] for the first time. Such Josephson diodes offer an opportunity to engineer the current phase relationship and the resulting inductive response for many applications close to liquid nitrogen temperature.

References:

1. Quantum-noise-limited microwave amplification using a graphene Josephson junction" Joydip Sarkar et al., Nature Nanotechnology 17, 1147 (2022)
2. High-temperature Josephson diode," Sanat Ghosh et al. Nature Materials 23, 612 (2024)

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