



**S N BOSE NATIONAL CENTRE
FOR BASIC SCIENCES**

Block JD, Sector III, Salt Lake, Kolkata 700 106

DEPARTMENTAL SEMINAR

Condensed Matter and Materials Physics

16th December, 2022

12.00 Noon

ONLINE/ FERMION

SPEAKER

Dr. Tamaghna Hazra,
Postdoctoral Researcher,
Rutgers University: State University of New Jersey

TITLE OF THE TALK

**TRIPLET PAIRING MECHANISMS FROM HUND'S-KONDO MODELS - APPLICATIONS TO
HEAVY FERMION SUPERCONDUCTORS**

ABSTRACT

The family of heavy fermion materials, with active f-electrons, hosts a large variety of candidate-triplet superconductors, with upper critical fields often exceeding the Pauli limit by an order of magnitude. Some, like UTe₂, remain superconducting in fields over 60T indicating tightly bound pairs with coherence lengths shorter than 2nm. Notably, almost every triplet heavy fermion superconductor shares a common structural motif – two or more f-shell atoms in the primitive unit cell related to each other by inversion, with only two exceptions UAu₂ and YbRh₂Si₂. I will present a triplet pairing mechanism driven by Hund's and Kondo coupling and enabled by this structural motif. In essence, Hund's coupling leads to pre-formed triplet pairs between the electrons trapped inside local moments. In heavy fermion superconductors as diverse as UPt₃, UBe₁₃, UTe₂, CeRh₂As₂, UGe₂, U(Co,Rh)Ge, CeSb₂ as well as PrTi₂Al₂₀ and analogues, the moments are situated away from the inversion center, so that their pre-formed triplet pairs can be odd under inversion. As they delocalize via Kondo hybridization, these heavy fermion pairs then have finite overlap with odd-parity triplet pairs on the same Fermi surface, leading to a triplet pairing instability. This pairing mechanism is demonstrated by a two-channel Kondo model, in which Hund's coupling modifies the Kondo interaction into a triplet super exchange between local moment and conduction spins. This unifies the triplet superconductivity and the local moment physics in a coherent framework, and we discuss experimental consequences and existing support for this pairing mechanism. The near-universal correlation with the structural motif suggests a common origin of heavy fermion triplet superconductivity in Hund's-coupled local moments.

HOST FACULTY

Prof. Manoranjan Kumar, Professor
