



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

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

DEPARTMENTAL SEMINAR

Department of Astrophysics and High Energy Physics

24th August, 2026

3.00 pm

FERMION / ONLINE

SPEAKER



**Dr. Nirupam Roy, Associate Professor,
Department of Physics, Indian Institute of Science (IISc), Bangalore**

TITLE OF THE TALK

**Magnetizing the Large-Scale Universe:
From Gravitational Seed Fields to Cluster Turbulence**

ABSTRACT

Magnetic fields permeate the universe across almost all physical scales, from stars and galaxies to the megaparsec-scale intra-cluster medium. Yet two fundamental questions persist: where do these magnetic fields originate, and how does turbulence structure them on cosmic scales? In this talk, I will focus on phenomenological approaches in bridging plasma mechanisms and radio astronomical observations in understanding the astrophysical magnetic field. We will first revisit global gravitational-electric polarization in self-gravitating astrophysical plasmas. I will show that, accounting for dark matter halos (or considering modified gravity paradigms), the charge imbalance is capable of producing rotationally coupled seed fields coherent over galaxy and cluster scales prior to dynamo amplification. Next, I will consider observational diagnostics of the magnetohydrodynamic turbulence in the intra-cluster medium, where turbulent cascade and particle re-acceleration shape diffuse radio halos. Using power spectrum estimators to low-frequency radio observations, we demonstrate how synchrotron intensity fluctuations probe underlying magnetized turbulence. These complementary approaches highlight how large-scale magnetic fields serve not only as dynamic drivers of cosmic structures, but also as unique probes of dark matter, modified gravity, and plasma turbulence in the era of next-generation observatories like the Square Kilometre Array.

HOST FACULTY

**Dr. Parijat Dey, Assistant Professor
Dept. of ASTROPHYSICS AND HIGH ENERGY PHYSICS**
