



**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

2nd November, 2023

3.30 PM

ONLINE/ FERMION

SPEAKER

**Mr. Sagnick Mukherjee,
Ph. D student, Dept of Astronomy,
The University of California Santa Cruz**

TITLE OF THE TALK

**Constraints on Atmospheric Mixing in Brown Dwarf and
Exoplanet Atmospheres in the *JWST* Era**

ABSTRACT

JWST has brought on a new dawn of discovery and has completely revolutionized our understanding of extrasolar planet atmospheres. We have now finally taken one step further from detecting 5000+ exoplanets to understanding these planets in unprecedented detail. One of the least constrained atmospheric processes in exoplanet atmospheres is atmospheric vertical dynamics, often parametrized with the eddy diffusion parameter K_{zz} . The vertical mixing process significantly impacts atmospheric chemistry and clouds, but it's currently uncertain by 6-8 orders of magnitude. I will briefly introduce atmospheric mixing and show how uncertainty in the K_{zz} parameter leads to uncertainty in our overall understanding of exoplanet atmospheres. I will show how the similarities between brown dwarf and exoplanet atmospheres can help us to constrain and understand the vertical mixing process better. I will present results where, using a new generation of state-of-the-art Sonora Elf Owl atmospheric models and spectroscopic data from JWST, Spitzer, and AKARI telescopes, we have constrained the vigor of atmospheric vertical mixing in the deep atmospheres of brown dwarfs. We find that the observed K_{zz} constraints from our work are several orders of magnitude lower than theoretical predictions. I will present what this theory-observation mismatch teaches us about the deep atmospheres of directly imaged planets and brown dwarfs.

I will discuss the implications of our findings for exoplanet clouds and chemistry. I will also discuss how we are trying to measure K_{zz} in transiting exoplanet atmospheres using the PICASO model and observations from our MANATEE *JWST* collaboration, including the first discovery of Methane in a transiting giant exoplanet (WASP 80b).

HOST FACULTY

Dr. Ramkrishna Das, Associate Professor

Dept. of ASTROPHYSICS AND HIGH ENERGY PHYSICS
