INTRODUCTION TO ASTROPHYSICAL FLUIDS

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Department of Physics

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PRE-REQUISITES : Basic knowledge of vector analysis (algebra and calculus), partial differentiation, fluid dynamics and electromagnetism are required. A notion of Hamiltonian mechanics is preferable.

INTENDED AUDIENCE : Advanced UG and PG (Masters and PhD) students.

COURSE OUTLINE :

The physics of astrofluids is the subject of active research during past seventy years.
Starting from the solar wind and magnetospheric plasmas, the scope of astrophysical fluids expands upto large interstellar clouds. A thorough understanding of astrophysical fluid dydnamics is essential to understand fascinating phenomena like the formation of sunspots, solar flares, accretion disks, stellar winds, explosion of supernovae, the formation of stars etc. This course is structured to offer the students a systematic analytical approach towards various astrophysical concepts along with a research oriented outlook.

ABOUT INSTRUCTOR :

Prof. Supratik Banerjee is Assistant Professor (grade I) at the department of Physics of IIT Kanpur since February 2018. After completing B. Sc. (Hons. In Physics) from Presidency College, Kolkata and securing 1st class 3rd rank in the University of Calcutta, he joined the prestigious Diplome d‚ÄôIngenieur program of Ecole Polytechnique, France. He completed his two Masters (in theoretical physics and in plasma physics) in 2011. In 2014, he completed his thesis from Universite Paris-Sud, France on compressible turbulence in space and astrophysical plasmas and bagged the Best thesis award of his school. Since 2011, he has been engaged in teaching which is already widely accepted and appreciated by the students in France, Germany and India. He has also received DST Inspire faculty research grant for research.

COURSE PLAN :

Week 1: General introduction, phase space, collisionless Boltzmann equation
Week 2: Collisional Boltzmann equation, derivation of moment equations, Oort limit
Week 3: Dynamics and properties of ideal fluids, streamlines and stream function
Week 4: Real fluids, accretion disks, stellar wind
Week 5: Compressible flow, shock waves, Supernova explosion
Week 6: Convective instability, Rayleigh-Benard convection
Week 7: Linear instabilities in two fluid interface, stellar oscillations, Jeans instability
Week 8: Effect of rotation in astrophysical objects
Week 9: Introduction to plasmas , Magnetohydrodynamics (MHD)
Week 10: Properties of MHD fluids and importance in astrophysics
Week 11: Turbulence in astrophysical fluids
Week 12: Dynamos in astrophysics