DEPARTMENT OF PHYSICS
INDIAN INSTITUTE OF TECHNOLOGY KANPUR

PHYSICS COLLOQUIUM

Exoplanet Atmospheres: From Atmospheric Escape to Habitability

Abstract

Recent observations have revealed that close-in exoplanets are undergoing significant atmospheric evaporation, which could lead to complete erosion of their atmosphere and make the planet inhabitable. In this talk, I will explain different physical processes (e.g., Jeans escape, hydrodynamic escape) by which an exoplanet can lose its atmosphere. One major process that leads to significant loss of exoplanetary atmosphere is the stellar radiation-driven atmospheric outflow. Once planetary outflow is initiated from the planet by stellar radiation, it further interacts with the stellar wind, shaping the exoplanetary atmosphere (sometimes producing a comet-like structure) and its atmospheric mass-loss rate. In addition, stellar flares and coronal mass ejections (CMEs) also have a great impact on planetary evaporation and mass loss. I will present our newly developed 1D and 3D radiation magnetohydrodynamics model, in which we have implemented a self-consistent radiative transfer of incident stellar radiation to simulate planetary outflow and its interaction with the stellar wind, CMEs, and flares. I will show that radiation-driven planetary outflow alone cannot explain the observed transit signatures & corresponding mass-loss rate, but the interaction with the stellar wind/coronal mass ejections can explain the observed mass-loss rate and transit for many exoplanets. Hence, incorporating stellar transients' effects is very important for planetary habitability study. I will also discuss briefly the effect of stellar and planetary magnetic fields on the atmospheric mass-loss rate and corresponding observational signatures.

Speaker

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5:15 PM , Refreshment starts at 5:00 PM

FB 382 (Prof. Amal Kumar Raychaudhuri Seminar Room)