Physics Dept Seminar

December 3, Tuesday (** SPECIAL DATE **)  

Star-Terrestrial Planet Interactions in Our Solar System and Beyond: Magnetic Fields, Atmospheric Loss, and Prebiotic Chemistry

Dr. Chuanfei Dong, Princeton Univ.  
(Solar Physics, Host: Bin Chen)

Time: 11:45 am - 12:45 pm with 11:30 am tea time  
Room: ECE 202

In the last two decades, the field of exoplanets has witnessed a tremendous creative surge. Research in exoplanets now encompasses a wide spectrum of fields ranging from astrophysics to heliophysics and climate science. One of the primary objectives of studying exoplanets is to determine the criteria for habitability, and whether certain exoplanets meet these requirements. The classical definition of the Habitable Zone (HZ) is the region around a star where a planetary surface can support liquid water, but this definition largely ignores the impact of the stellar wind and stellar magnetic activity on the erosion of an exoplanet's atmosphere. Amongst the many factors that determine habitability, understanding the atmospheric loss is of paramount importance. Most of the recent attention has been centered around the study of exoplanets orbiting M-dwarfs since the latter are highly numerous in our Galaxy (and in the Universe). The study of these exoplanets has also received a major boost from the discovery of Proxima b (Pb) and seven Earth-sized planets in the TRAPPIST-1 system.

In this presentation, I will begin with NASA’s Mars Atmosphere and Volatile EvolutionN (MAVEN) mission and delineate my recent study concerning the Martian response (with a focus on the atmospheric loss) to a solar storm by using a sophisticated multifluid magnetohydrodynamic (MHD) code. The concomitant role of solar energetic particles (associated with solar storms) in facilitating prebiotic chemistry on early Mars will also be discussed. Then I will discuss the impact of exoplanetary space weather (i.e., stellar winds and stellar magnetic activity) on exoplanetary climate and habitability, which offers fresh insights into potentially habitable exoplanets orbiting M-dwarfs. I will focus on the recently discovered Pb and the TRAPPIST-1 system as two examples to demonstrate the importance of the exoplanetary space weather on the atmospheric loss.