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Author: Ms. Sarah Cader
Connectomix, India, sarah.cader11@gmail.com

AN ANALYSIS AND CHARACTERIZATION OF TERRESTRIAL EXOPLANETS: A DENSITY-BASED APPROACH AND COMPARISON WITH THE SOLAR SYSTEM

Abstract

Exoplanets have been the subject of several investigations, and more exoplanets are discovered and confirmed every day. Out of these, terrestrial or rocky exoplanets have a solid surface which can potentially support liquid water and even sustain life. And these exoplanets might be our answer to the decades-long search for habitable planets. This is why exoplanets that even, slightly resemble Earth are considered very significant. This study focuses on such Earthlike or terrestrial exoplanets, within the Circumstellar Habitable Zone (CHZ) of the host star and takes into consideration the Earth Similarity Index (ESI). Out of almost 5300 confirmed exoplanets discovered so far, only 195 exoplanets are considered to be terrestrial. This is a very small percentage of the confirmed exoplanets. Even though approximately 1600 exoplanets are considered to be Super-Earths, the term merely refers to the size of the discovered exoplanet and it is unclear how much of them have a rocky surface. So, considering the density of the planet would be a viable way of determining if the exoplanet is terrestrial in nature. This study focuses on the rocky exoplanets around different stars but especially Sun-like G spectral-type stars. The lower density level of the planets studied here is taken as $3.93 g/cm^3$ (Density of Mars). This paper studies these particular types of exoplanets with an extensive literature review and the exoplanet data is collected from the NASA Exoplanet Archive. Of almost 5300 confirmed exoplanets, we only know the density of about 769 planets. This number goes down to only about 161 exoplanets when we consider the lower limit density to be $3.93 g/cm^3$. This study investigates if there are any correlations between parameters such as mass, radius, semi-major axis, orbital period, etc of these exoplanets, via plots and graphical representations. Similarities and differences between exoplanetary systems and our own solar system are also studied. The exoplanetary system around a G-type star, TOI -561 has 4 confirmed planets around it, with 3 of them having densities, larger than $3 g/cm^3$. An analysis, comparing this exoplanetary system and the inner solar system, in terms of planet mass, semi-major axis and orbital period is performed. The results of this paper highlight the features of prominent terrestrial exoplanets that may hold the key to our search for other livable worlds and brings into focus, the potentially habitable exoplanet candidates to foster further scientific research on this front.