Scientists Discover an extreme Massive Giant and Most Dense Exoplanet

May 26, 2023

A new Jupiter size exoplanet with highest density of ~14 g/cm^3 known till this date, and mass 13 times that of Jupiter has been discovered by an international team of scientists led by Prof. Abhijit Chakraborty at the Exoplanet Research Group of the Physical Research Laboratory (PRL), Ahmedabad. The team includes scientists from India, Germany, Switzerland and the USA. The discovery of this massive exoplanet was made using the indigenously made PRL Advanced Radial-velocity Abu-sky Search spectrograph (PARAS) at the 1.2 m telescope of PRL at its Gurushikhar Observatory in Mt. Abu by measuring the mass of the planet precisely.

The newly discovered exoplanet is found around the star called TOI4603 or HD 245134. NASA's The Transiting Exoplanet Survey Satellite (TESS) initially declared TOI4603 as a possible candidate to host a secondary body of unknown nature. Using PARAS, scientists discovered it as a planet by measuring the mass of the secondary body and hence the planet is called TOI 4603b or HD 245134b. It is located 731 light years away. It orbits a sub-giant F-type star TOI4603 every 7.24 days. What sets this discovery apart is that the planet falls into the transition mass range of massive giant planets and low-mass brown dwarfs with masses ranging from 11 to 16 times the mass of Jupiter. Only fewer than five exoplanets are currently known in this mass range so far.

Massive giant exoplanets are those having mass greater than four times that of Jupiter. The newly discovered exoplanet TOI 4603b is one of the most massive and densest giant planets that orbits very close to its host star at a distance less than 1/10th the distance between our Sun and Earth. The exoplanet with a surface temperature of 1670 K is likely undergoing high-eccentricity tidal migration with an eccentricity value of approximately 0.3 The detection of such systems provides valuable insights into the formation, migration, and evolution mechanisms of massive exoplanets.

This discovery marks the third exoplanet discovery by India, and by the PRL scientists using PARAS spectrograph and the PRL 1.2m telescope, following the discoveries in 2018 (K2-236b) and 2021 (TOI-1789b).

The findings of this study is published in the journal Astronomy & Astrophysics Letters. The publication titled "Discovery of a massive giant planet with extreme density around the sub-giant star TOI-4603." provides details of the discovery and a comprehensive account of exoplanet's characteristics.Click here to access the publication.

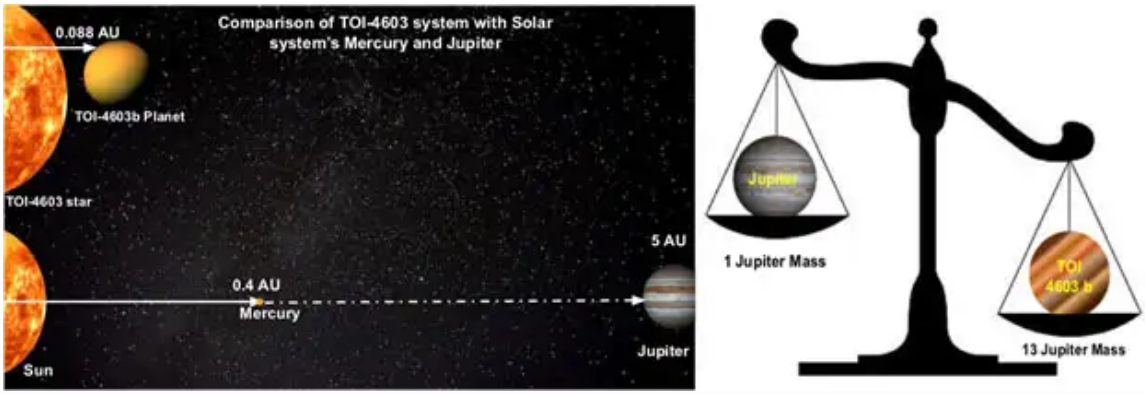

Figure 1. *The figure on the left shows an artistic impression comparing the distances between the TOI-4603 star-planet system and the Sun-Mercury and Sun-Jupiter systems. It is noteworthy that the TOI-4603b planet, which has the same size as Jupiter, is situated more than 50 times closer to its star than Jupiter is to the Sun.* ***On the right*** *is a comparison between the TOI-4603b planet and Jupiter, which is 13 times more massive than Jupiter.*

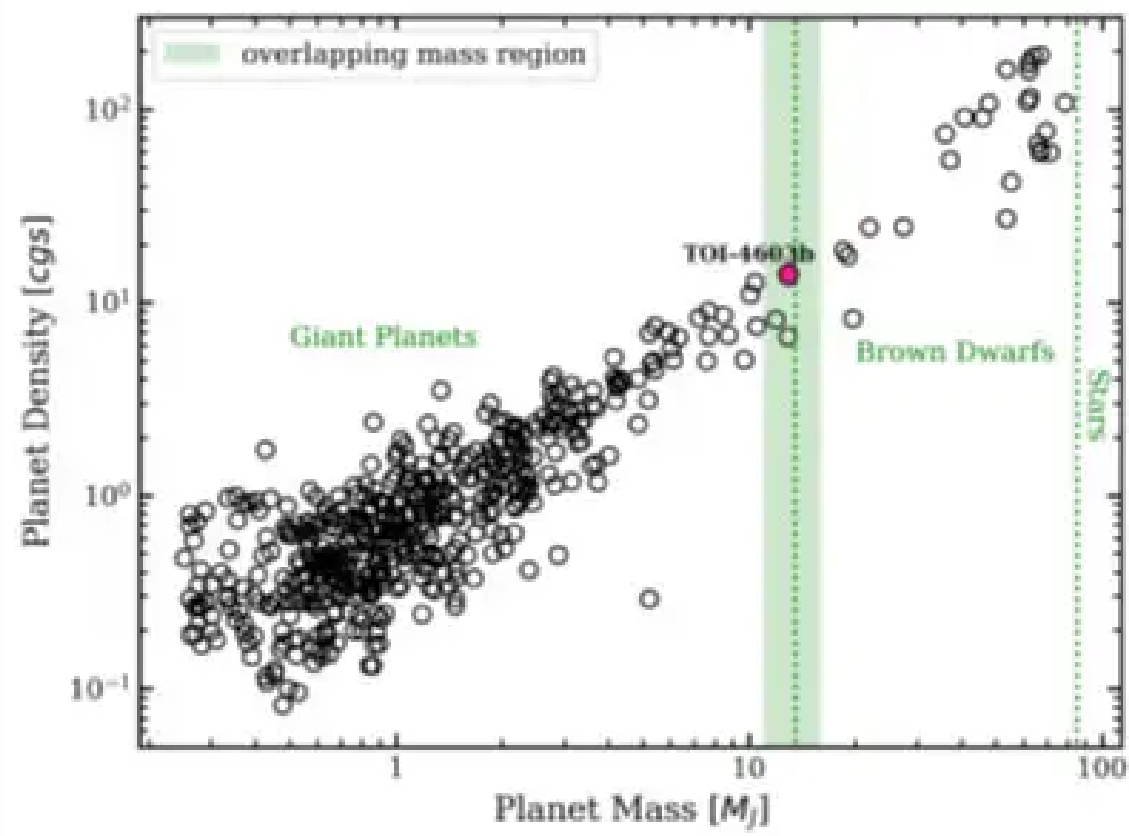

Figure 2. *Planetary density as a function of planetary mass for transiting giant planets and Brown Dwarfs (0.25–85 Jupiter Mass, M_J) is plotted. The shaded area represents the overlapping mass region of massive giant planets and Brown Dwarfs based on the deuterium burning limit, and the dotted lines are at Planet Mass = 13 M_J and 85 M_J. The position of discovered exoplanet (TOI-4603 b) is denoted by the red filled circle clearly showing that it is the densest exoplanet seen till today.*

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