Transiting brown dwarfs from the TESS mission

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November 22, 2022

Abstract

Traditionally, astronomers have separated giant planets from brown dwarfs based on the object's mass. Objects more massive than 13 Jupiter masses but less massive than 80 Jupiter masses are considered to be brown dwarfs. However, in detail, the lower mass threshold is 11 to 16 Jupiter masses depending on the metallicity of the object. This betrays how arbitrary a purely mass-based distinction between planets and brown dwarfs is. Instead, we take a critical look at the population of brown dwarfs for which we have the most fundamental information: transiting brown dwarfs. Transiting brown dwarfs provide us their mass, radius, and sometimes age, which makes them useful for directly testing substellar evolutionary models. Through a better understanding of how well these models describe the population of transiting brown dwarfs, we will develop a better definition of what makes a brown dwarf different than a giant planet: its formation mechanism. It is certainly true that in the mass range spanning between giant planets and low-mass stars that the dominant formation mechanism must change in a significant way. If we can determine which mass or distribution of masses that this change occurs at, then we will have a more physical way to distinguish planets from brown dwarfs. This poster provides an overview of the substellar mass-radius diagram and highlights several of the recent discoveries facilitated by the TESS mission.

Using transiting brown dwarfs from the TESS mission to explore the substellar mass-radius diagram

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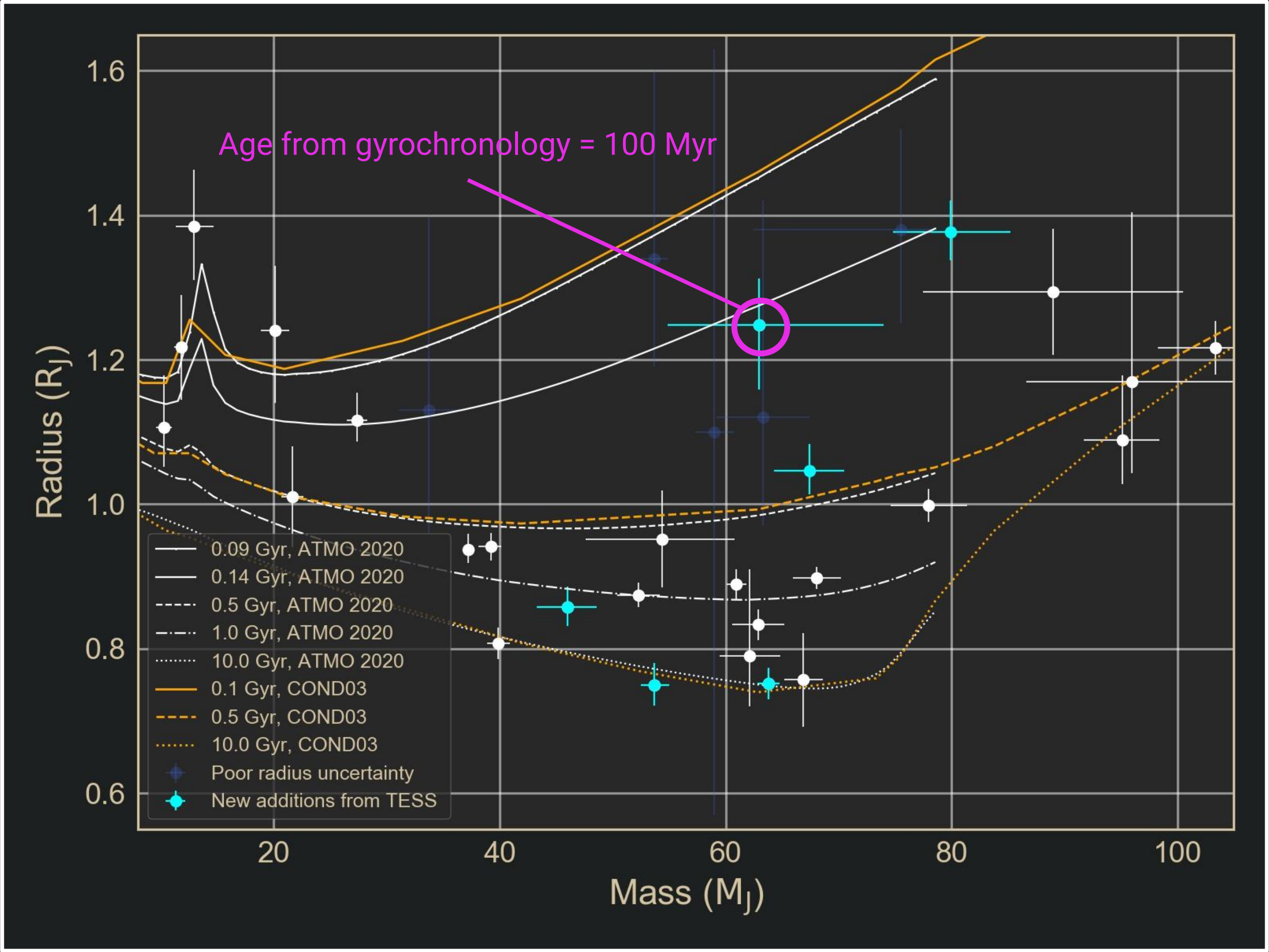

We have made use of TESS, Gaia DR2, and precise radial velocity follow up to measure the mass, radius, and sometimes the age of **6 new transiting brown dwarfs**. The mass, radius, and age of each transiting brown dwarf are used to benchmark substellar evolutionary models. Transiting brown dwarfs with poor radius constraints are not useful in these benchmarks, but useful in the overall census of these objects. The oldest transiting brown dwarfs trace out the oldest substellar isochrones, but we have very few young brown dwarfs to test younger substellar isochrones.

<u>Host star stats</u>: 4 A-type, 11 F-type, 10 G-dwarfs, 2 K-dwarfs, 6 M-dwarfs

<u>Orbital period range</u>: 0.6 - 167 days

<u>Important pursuits</u>: 1) Apply age-dating techniques like gyrochronology to host stars (paper on TOI-811 coming soon) 2) Examine orbital properties and evolution of brown dwarf systems 3) Find more transiting brown dwarfs around M and K dwarfs (compare to hot Jupiter population) 4) Examine the role of metallicity, assuming it matches the host star

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