

Dynamical mass of the first T-dwarf

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Abstract

GJ 229 B was the first methane dwarf ever discovered, now classified as a peculiar T7, and one of the earliest known brown dwarfs in the Galaxy (Nakajima et al. 1995). It was identified as a proper motion companion, orbiting at 7.7 arcsec around the bright, nearby M1V-type star GJ 229 A ($d=5.7612 \pm 0.0005$ pc, Gaia EDR3). Recent evidence suggests that GJ 229 B is indeed a very peculiar brown dwarf. Brandt et al. (2020, 2021) utilized Keck/HIRES radial velocities (RVs) for the M1V star, high spatial-resolution images from the Subaru Telescope's Adaptive Optics system, and astrometry from the Hubble Space Telescope (HST), Hipparcos, and Gaia to determine a precise dynamical mass of $71.4 \pm 0.6 M_{\text{Jup}}$ for GJ 229 B, independent of any model. This mass is at the boundary between star and brown dwarf for solar metallicity objects ($72\text{--}75 M_{\text{Jup}}$). Our analysis includes additional RV data from ESPRESSO and CARMENES, as well as more recent astrometric measurements with Keck, increasing the time sampling of the orbit with the aim of determining the dynamical masses of the components. The exceptionally high mass of GJ 229 B challenges the predictions of all existing substellar evolutionary models, including the latest models by Chabrier et al. (2023), which were specifically designed to interpret the brown dwarf and planetary domains.

My poster in zenodo.org can be found here