

Mapping the Abyss: A Breakthrough in Mass Determinations for Stars and Brown Dwarfs using HST and RECONS Astrometry

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We present astrometric results for seven close binary systems from the ongoing RECONS (REsearch Consortium On Nearby Stars, www.recons.org) astrometry program on the CTIO/SMARTS 0.9m telescope. The systems consist of red and brown dwarf components with masses of 0.05–0.30 M_{\odot} that straddle the transition region between stars and substellar objects. We report trigonometric parallaxes with errors less than 3 milliarcseconds that place the objects at distances between 10 and 33 parsecs.

Measurements of the long-term perturbations in the systems' photocenters over 5–13 years allows us to derive orbital periods that are on the order of a decade for all seven systems. Followup analysis is underway using measurements from HST-WFC3 to measure the optical fluxes, separations, and position angles of the individual components in these systems. These new resolved astrometric data, coupled with the long-term ground-based work, will be used to convert the photocentric orbits into relative orbits to provide critical mass ratios and mass measurements for both components in each system. The 14 carefully characterized objects will comprise a fundamental set of standards that will stress-test theoretical models of the smallest stars and brown dwarfs for years to come. The results will be combined with our previous mass-luminosity relation work for stars with masses 0.08–0.60 M_{\odot} to extend our understanding into the realm of brown dwarfs. We will then have a detailed map covering a factor of more than 10 in mass for the most common objects in the Galaxy.

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