RESOLVED NEAR-INFRARED SPECTROSCOPY OF WISE J104915.57−531906.1AB: A FLUX-REVERSAL BINARY AT THE L DWARF/T DWARF TRANSITION

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ABSTRACT
We report resolved near-infrared spectroscopy and photometry of the recently identified brown dwarf binary WISE J104915.57−531906.1AB, located 2.02 ± 0.15 pc from the Sun. Low-resolution spectral data from Magellan/FIRE and IRTF/Spex reveal strong H2O and CO absorption features in the spectra of both components, while the secondary also exhibits weak CH4 absorption at 1.6 μm and 2.2 μm. Spectral indices and comparison to low-resolution spectral standards indicate component types of L7.5 and T0.5 ± 1, the former consistent with the optical classification of the primary. Both sources also have unusually red spectral energy distributions for their spectral types, which we attribute to enhanced condensate opacity (thick clouds). Relative photometry reveals a flux reversal between the J and K bands, with the T dwarf component being brighter in the 0.95–1.3 μm region (ΔJ = −0.31 ± 0.05). As with other L/T transition binaries, this reversal likely reflects the depletion of condensate opacity in the T dwarf, with the contrast enhanced by the thick clouds present in the photosphere of the L dwarf primary. The 1 μm flux from the T dwarf most likely emerges from gaps in its cloud layer, as suggested by the significant optical variability detected from this source by Gillon et al. Component mass measurements of the WISE J1049−5319AB system through astrometric and component radial velocity monitoring may resolve the current debate as to whether the loss of photospheric condensate clouds at the L dwarf/T dwarf boundary is a slow or rapid process, a conceivable endeavor given its proximity, brightness, small separation (3.1 ± 0.3 AU), and reasonable orbital period (20–30 yr).

Key words: binaries: visual – brown dwarfs – stars: individual (WISE J104915.57−531906.1) – stars: low-mass

Online-only material: color figures

1. INTRODUCTION
The low temperatures and luminosities of brown dwarfs near the Sun are a consequence of their age and inability to sustain core hydrogen fusion (Kumar 1962; Hayashi & Nakano 1963). As these objects evolve down the spectral sequence (through the M, L, T, and Y spectral classes; Kirkpatrick 2005), their spectral energy distributions become increasingly complex as molecular compounds come to dominate photospheric opacity. These compounds include condensed species: minerals and metals in late-M and L dwarf atmospheres (Lunine et al. 1989; Tsuji et al. 1996), and sulfide and alkali salts in late-T and Y dwarf atmospheres (Burgasser et al. 2010b; Morley et al. 2012). Grain scattering and absorption causes significant redistribution of flux, veiling of molecular bands, changes in the gas chemistry, modification of cooling rates, and even variability if the condensates are not uniformly distributed in the photosphere (Allard et al. 2001; Ackerman & Marley 2001; Burrows & Sharp 1999; Saumon & Marley 2008; Radigan et al. 2012). Models of cool atmospheres parameterizing “cloudiness” are now used in fits of brown dwarf spectra (Stephens et al. 2009), and condensate clouds are also seen as playing a major role in shaping the spectra of directly imaged giant exoplanets (Currie et al. 2011; Barman et al. 2011; Skemer et al. 2012; Marley et al. 2012).

Discerning the parameters relevant to condensate formation and evolution in cool atmospheres is partly hindered by uncertainties in the characteristics of individual brown dwarfs, which for a given spectral type can span a broad range of age, mass, and composition. Resolved brown dwarf binaries have proven to be useful in this regard, as their common distance and genesis eliminates many of the uncertainties in their (relative) physical and spatial characteristics. Such systems are also amenable to direct mass measurement (e.g., Lane et al. 2001; Dupuy et al. 2009; Konopacky et al. 2010), allowing direct comparison to and tests of evolutionary models. Binaries with L dwarf and T dwarf components have been particularly valuable in probing the disappearance of mineral clouds at this spectral transition. A handful are found to be “flux-reversal” pairs, in which the later-type secondary is brighter in the 1.0–1.3 μm region than its earlier-type (and overall more luminous) primary (Burgasser et al. 2006b; Liu et al. 2006; Looper et al. 2008a). These binaries indicate that the 1 μm brightening first identified in near-infrared color magnitude diagrams of field L and T dwarfs (the “J-band bump”; Tinney et al. 2003) is a general feature of brown dwarf evolution, rather than sample variation (Burrows et al. 2006). Physical interpretation of this brightening remains under debate, however. It may be evidence of a rapid disruption of the condensate cloud layer (Burgasser et al. 2002; Knapp et al. 2004) or a slow evolutionary process of heat release (Saumon & Marley 2008), and the degree of brightening may be modulated by variations in other parameters, such as rotation, viewing angle, or cloud thickness (Burrows et al. 2006; Burgasser et al. 2010a). Unfortunately, binaries straddling the L dwarf/T dwarf transition are relatively rare, and the compact separations typical of brown dwarf pairs (1–10 AU; Burgasser et al. 2007) mean that they must be very near to the Sun to be resolved.

The recent discovery of the brown dwarf binary WISE J104915.57−531906.1AB (hereafter WISE J1049−5319AB; Luhman 2013), at a distance of only 2.02 ± 0.15 pc from the Sun, therefore represents an outstanding opportunity to study the L/T transition in considerable detail. Luhman (2013) presented
an optical spectrum of WISE J1049–5319A\(^5\) consistent with a spectral type of L8 ± 1 and revealing the presence of strong Li i absorption, implying that this component has a mass below 0.065 \(M_\odot\) (Rebolo et al. 1992; Magazzu et al. 1993). The observation that the secondary is fainter in the red optical (\(\Delta V = 0.45\)) indicates that this component could be a late-L or T dwarf.

In this article, we report resolved near-infrared photometry and spectroscopy of the WISE J1049–5319AB system using the Folded-Port Infrared Echellette (FIRE; Simcoe et al. 2008, 2010) on the Magellan 6.5 m Baade Telescope at Las Campanas Observatory, and the SpeX spectrometer (Rayner et al. 2003) on the 3.0 m NASA Infrared Telescope Facility (IRTF). In Section 2 we describe our observations and reduction procedures; in Section 3 we analyze the data, determining component spectral types and magnitudes, and identify the “flux reversal” nature of the system. We discuss our results in Section 4, placing the components of WISE J1049–5319AB in context with other late-L and T dwarfs, examining the role of cloud thickness in the flux-reversal and variable nature of this system, and motivating mass measurements to empirically test L/T transition theories. We note that contemporaneous studies of this system have been reported in Kniazev et al. (2013) and Gillon et al. (2013), which will be referred to in the discussion.

2. OBSERVATIONS

2.1. Magellan/FIRE Prism Spectroscopy and Imaging

WISE J1049–5319 was observed with Magellan/FIRE on 2013 March 12 (UT) in photometric conditions with seeing of 0′′.8 at \(J\) band. We deployed both the cross-dispersed echelle mode (\(\lambda/\Delta\lambda \approx 6000\)) and the prism-dispersed mode (\(\lambda/\Delta\lambda \approx 300\)) with the 0′′6 wide slit aligned to the parallactic angle. However, due to a slit motor error, only the prism-dispersed data were usable. Each component was placed separately in the slit, and a series of 1 s exposures (10 for the southeastern component, 8 for the southwestern component) were obtained for each in an ABBA dither pattern, nodding 9′′ along the 30′′ slit. We also observed the A0 V star HD 99338 (\(V = 8.26\)) in six 1 s nodded exposures. NeAr and quartz lamp exposures, reflected off the Baade secondary screen, were obtained with the target and A0 V stellar observations for wavelength and pixel response calibration, respectively. Data were reduced using the FIREHOSE low-dispersion reduction package (firehose_kd), which produces a two-dimensional (2D) estimate of the sky spectrum to remove the background in each exposure (Kelson 2003), determines a 2D wavelength mapping from the NeAr spectrum to remove the background in each exposure (Kelson et al. 2003), and extracts one-dimensional source and A0 V spectrum to remove the background in each exposure (Kelson 2010), determines a 2D wavelength mapping from the NeAr spectrum to remove the background in each exposure (Kelson et al. 2003), and extracts one-dimensional source and A0 V spectrum to remove the background in each exposure (Kelson et al. 2003). Signal-to-noise ratio (S/N) for both components peaked at \(\approx 400\) in the \(K\)-band region.

We also obtained a resolved image of the binary using FIRE’s acquisition camera, which has a 50′′ × 50′′ field of view (FOV), a pixel scale of 0′′.147, and a fixed MKO\(^6\) \(J\)-band filter. Several 1 s exposures were obtained with the binary on and off slit; these were median-combined to produce an overall sky frame

\[\text{Figure 1. FIRE (upper left frame) and SpeX slit viewer images of the WISE J1049–5319AB pair in MKO } J, H, \text{ and } K \text{ bands (labeled). All three images are oriented with north at the top and east to the left, and display 9′′7 × 9′′7 fields of view. Contours are indicated at 50%, 75%, and 95% peak flux in the FIRE image, and 50%, 70%, and 90% peak flux in the SpeX images. The individual components are labeled in the FIRE image.} \]

that was subtracted from all images. We extracted a 9′′7 × 9′′7 (49 × 49 pixels) subframe from a single image in which the binary is well separated from the slit, shown in Figure 1 and analyzed below.

2.2. IRTF/SpeX Spectroscopy and Imaging

WISE J1049–5319 was observed with IRTF/SpeX on 2013 March 15 (UT) in cloudy and windy conditions with poor and variable seeing (1′.5–2′.0 at \(J\) band). We deployed the 0′′5 slit and prism-dispersed mode to obtain \(\lambda/\Delta\lambda \approx 120\) spectra covering 0.7–2.5 \(\mu\)m. In this case, the slit was aligned along the binary axis (position angle of 315°, 50′ off parallactic) to obtain concurrent spectra, and six 90 s exposures were obtained in an ABBA dither pattern at an airmass of 3.3–3.4. We also observed the A0 V star HD 92518 (\(V = 6.87\)) at an airmass of 3.3 with the slit aligned to the same position angle. Internal flat field and Ar arc lamp exposures were obtained for pixel response and wavelength calibration. Data were reduced using SpeXtool, applying standard settings. Due to the poor seeing, we did not attempt to extract component spectra; rather, we extracted the combined-light spectrum of the binary using a wide aperture. Average S/N was roughly 400 in the \(J, H,\) and \(K\)-band peaks, respectively. While combining the individual spectral frames, we verified that the variable cloud extinction during the observation was gray and had minimal impact on the observed spectral shape; however, differential color refraction and associated wavelength-dependent slit loss appears to be present, and is addressed below.

We obtained images of the binary on the same night using the SpeX slit-viewing camera (60′′ × 60′′ FOV, pixel scale 0′′.12) in each of the MKO \(J, H,\) and \(K\) filters, with the instrument oriented at a position angle of 0°. Four exposures were obtained in each filter using a two-point dither pattern with a 7′′ nod,
features are labeled, as well as regions of strong telluric absorption (WISE J1049-5319A with total integrations of 32 s, 56 s, and 84 s, respectively. We interleaved these with observations of a nearby red star 2MASS J10490107−5317252 (J = 10.75, J − Ks = 1.16) for point-spread function (PSF) calibration. Frames were pair-wise subtracted to remove sky background, mirror-flipped along the y-axis to reproduce sky orientation, and 9.7 × 9.7 (81 × 81 pixels) subframes were excised for analysis. The frames with the best seeing in each of the filters are shown in Figure 1.

### 3. ANALYSIS

#### 3.1. Spectral Characteristics of WISE J1049−5319

The reduced FIRE spectra of the WISE J1049−5319AB components are shown in Figure 2, scaled to their inferred absolute flux densities as described below. Strong absorption features typical of late L-type brown dwarfs are present in both spectra, notably deep H2O bands at 1.4 and 1.9 μm; strong CO absorption at 2.3 μm; marginally resolved NaI and KI doublets at 1.14, 1.17, and 1.25 μm; and a steep 0.8–1.1 μm spectral slope, shaped primarily by the pressure-broadened red wing of the 0.77 μm KI doublet (Burrows et al. 2000). WISE J1049−5319A also exhibits weak absorption from CH4 at 1.6 μm and 2.2 μm, characteristic of an early-type T dwarf (Burgasser et al. 2006a); enhanced absorption at 1.15 μm in the spectrum of this source can also be attributed to CH3 absorption. Near-infrared KI lines are stronger in the spectrum of WISE J1049−5319B, and a hint of FeH can be seen at 0.99 μm (the Wing–Ford band) in this spectrum. The overall near-infrared spectral energy distribution of WISE J1049−5319B is bluer than that of WISE J1049−5319A.

Spectral classifications were determined through spectral indices and comparison to spectral standards. We used the indices and spectral type/index relations defined by Geballe et al. (2002), Burgasser et al. (2006a), and Burgasser (2007); values are listed in Table 1. We find mean classifications of L7.5 ± 0.9 and T0.5 ± 0.7, consistent with the characteristics described above; the former is also consistent with the L8 ± 1 optical classification of WISE J1049−5319A reported in Luhman (2013).

We then compared the 0.9–1.4 μm spectra to low-resolution spectral standards defined in Kirkpatrick et al. (2010), following the prescription for near-infrared classification outlined in that work. The best-match standards (minimum χ^2) for WISE J1049−5319A and B are the L8 2MASSW J1632291+190441 (Kirkpatrick et al. 1999) and the T1 SDSSp J083717.22−000018.3 (Leggett et al. 2000), respectively (Figure 3); these are consistent with the index types. Note that both components have significantly redder spectral energy distributions than their corresponding standards. Spectral flux ratios are a relatively smooth and roughly linear with wavelength, suggesting a continuum opacity source is responsible. We rule out differential color refraction or slit losses in the FIRE data, as we verify that J − K spectrophotometric colors are consistent with both the photometry reported here (below) and that reported in Kniazev et al. (2013). We can also rule out interstellar

### Table 1

| Index      | Value (erg cm/s cm^2 μm) | SpT | Value (erg cm/s cm^2 μm) | SpT | Ref. |
|------------|--------------------------|-----|--------------------------|-----|------|
| H2O-O      | 0.672 ± 0.010            | L8  | 0.588 ± 0.010            | T0.5| 1    |
| CH4-J      | 0.870 ± 0.010            | ... | 0.734 ± 0.010            | ... | 1    |
| H2O-O-H    | 0.681 ± 0.010            | L8  | 0.574 ± 0.010            | T0.5| 1    |
| CH4-H      | 1.093 ± 0.010            | ... | 1.073 ± 0.010            | T1  | 1    |
| H2O-O-K    | 0.716 ± 0.010            | L7  | 0.643 ± 0.010            | T1  | 1    |
| CH4-K      | 0.936 ± 0.010            | ... | 0.845 ± 0.010            | ... | 1    |
| H2O-1.2    | 1.519 ± 0.010            | ... | 1.734 ± 0.010            | T1  | 2    |
| H2O-1.5    | 1.751 ± 0.010            | L8  | 2.213 ± 0.010            | T1  | 2    |
| CH4-1.6    | 1.073 ± 0.010            | ... | 1.093 ± 0.010            | T1  | 2    |
| CH4-2.2    | 1.068 ± 0.010            | L6  | 1.183 ± 0.010            | L9  | 2    |
| K/J        | 0.903 ± 0.010            | ... | 0.578 ± 0.010            | ... | 1    |

**References.** (1) Burgasser et al. 2006a; (2) Geballe et al. 2002; (3) Kirkpatrick et al. 2010; (4) Based on comparison to SpeX templates and using near-infrared spectral types as computed in Burgasser (2007).
reddening given the proximity of the system and the absence of such reddening in the optical data reported by Luhman (2013) and Kniazev et al. (2013). As described below, we attribute this reddening to condensate cloud opacity.

Finally, we compared the full 0.9–2.4 μm FIRE spectra to 806 low-resolution templates from the SpeX Prism Spectral Libraries; see Burgasser et al. (2010a) for details on the fitting procedure. We found excellent matches to the L8 SDSSp J085758.45+570851.4 ($J - K_s = 2.08 \pm 0.05$) and the L9.5 SDSSp J083008.12+482847.4 ($J - K_s = 1.77 \pm 0.06$; Geballe et al. 2002) for WISE J1049−5319A and B, respectively (Figure 4). Both of these sources have distinctly red near-infrared colors for their spectral type as well (Faherty et al. 2009; Schmidt et al. 2010). The former has been characterized through spectral fitting as being unusually cloudy ($f_{\text{sed}} = 2$; Marley et al. 2012), while the latter has been inferred to be an older, high surface-gravity source based on $H - K$ color (Knapp et al. 2004). Mean near-infrared classifications from all template fits (weighted by the relative $\chi^2$ of fit) were found to be L7 ± 0.9 and L9.5 ± 0.5, respectively.

Figure 3. Comparison of the FIRE prism spectra of WISE J1049−5319A (left) and B (right, in black) to best-match near-infrared spectral standards 2MASSW J16321904+190441 (L8) and SDSSp J083717.22-000018.3 (T1, in red), following the method of Kirkpatrick et al. (2010). All spectra are normalized. The comparison region of 0.9–1.4 μm is indicated by dotted lines; both sources are notably redder than the standards. Bottom panels show the ratio of fluxes between source and standard, with a linear fit to regions outside the telluric absorption bands. SpeX data for the standards are from Burgasser et al. (2006a) and Burgasser (2007).

(A color version of this figure is available in the online journal.)

Figure 4. Comparison of the FIRE prism spectra of WISE J1049−5319A (left) and B (right, in black) to best-fit spectral templates SDSSp J085758.45+570851.4 (L8) and SDSSp J083008.12+482847.4 (L9.5, in red) drawn from the SpeX Prism Spectral Library. All spectra are normalized. SpeX data for the templates are from Burgasser et al. (2008) and Burgasser et al. (2010a).

(A color version of this figure is available in the online journal.)
Combining these analyses, we assign classifications of L7.5 and T0.5 ± 1 for the two components, which places them squarely on the L dwarf/T dwarf transition.

3.2. Component Photometry: A Flux Reversal Binary

Resolved photometry by Luhman (2013) identified WISE J1049—5319A as the brighter of the two sources at i band, but inspection of the images in Figure 1 indicates that the two components “flip” in relative brightness, with WISE J1049—5319B being brighter at J but fainter at K. WISE J1049—5319B appears to be marginally brighter at H as well.

To quantify the amplitude of this reversal, we performed PSF-fitting analyses on our FIRE and SpeX images using a Monte Carlo Markov Chain (MCMC) technique. For the FIRE image, our PSF model was a 2D ellipsoidal Gaussian for which the major and minor axes were allowed to vary separately in width and orientation. For the SpeX images, we used the four individual images of the PSF star to make independent fits to the four source images in each filter. Following initial guesses for the pixel positions of both primary and secondary components and their integrated fluxes, our code explored this four-parameter space (plus three Gaussian-shape parameters for the FIRE data) using an MCMC chain, with parameters sequentially updated by drawing randomly from normal distributions. Subpixel shifts for the SpeX PSF model were made using a damped sinc function based on code developed by John Spencer and Mike Ressler. Models and data were compared using the \( \chi^2 \) statistic. We found that MCMC chain lengths of 2000 were sufficient for convergence, and we discarded the first 200 steps of each chain. For the FIRE analysis, we marginalized the distribution of each parameter in the single chain to determine uncertainties, and included a 5% systematic uncertainty to account for the non-Gaussian PSF shape. For the SpeX analysis, we used the mean and standard deviation of the 16 PSF and binary image pairings in each filter as our measurement and uncertainty, respectively. The separation and position angle for WISE J1049—5319AB was determined from all of the images (SpeX and FIRE) using an uncertainty-weighted average.

Results from these fits are listed in Table 2, where we report both relative and component magnitudes; the latter are in excellent agreement with the results of Kniazev et al. (2013). Our relative photometry quantifies the magnitude of the observed flux reversal: WISE J1049—5319B is 0.31 ± 0.05 mag brighter at J (combination of FIRE and SpeX data), 0.02 ± 0.06 mag brighter at H (a marginal detection), and 0.29 ± 0.16 mag fainter at K. The reversal at J is highly significant, although not as extreme as that reported for the T1+T5 binary 2MASS J14044941—3159329AB (Looper et al. 2008a; Dupuy & Liu 2012; \( \Delta J = −0.54 ± 0.08 \)).

![Figure 5](image.png)

Figure 5. Relative flux scaling of the FIRE spectra of WISE J1049—5319A (red) and B (blue) based on the measured photometry (Table 2). The summed spectrum (purple) is a good match to the combined-light SpeX spectrum of the system (black; reddened by \( A_V = 0.6 \) to account for differential color refraction slit loss). Note that the secondary is brighter than the primary between 0.95–1.3 \( \mu m \) and 1.55–1.70 \( \mu m \). The relative spectrophotometric magnitudes (MKO system) of the combination shown are \( \Delta J = −0.25, \Delta H = 0.02, \) and \( \Delta K = 0.26 \).

(A color version of this figure is available in the online journal.)

4. DISCUSSION

Using the distance and component magnitudes of WISE J1049—5319AB, we compare these sources to other L and T dwarfs with distance measurements in near-infrared color–magnitude diagrams in Figure 6. As in our comparison with the spectral standards (Figure 3), we see that both components are relatively red and underluminous at J band for their spectral types. WISE J1049—5319A in particular is one of the reddest L dwarfs known with a well-determined parallax. Unusually red \( J − K \) colors for L dwarfs have been attributed to youth (Kirkpatrick et al. 2006), unusually thick clouds (Looper et al. 2008b), or both (Currie et al. 2011; Faherty et al. 2013). The kinematics of WISE J1049—5319AB appear to rule out membership of any of the known local young associations, including a proposed association with the 40 Myr Argus association (Mamajek 2013; Kniazev et al. 2013). We also see no obvious indicators of low surface gravity in the spectra of either source; i.e., triangular-shaped \( H \)-band peaks, strong VO, and weak alkali absorption (Lacoss et al. 2001; Allers et al. 2007). The presence of Li\( i \) absorption in the optical spectrum of the primary sets a relatively high maximum age for the system of \(~4.5\) Gyr (assuming \( M_1 < 0.065\) \( M_\odot \), \( T_{\text{eff}} \approx 1350\) K, and evolutionary models...
Figure 6. Near-infrared color–magnitude diagrams (top: $M_J$ vs. $J - K$; bottom: $M_K$ vs. $J - K$) for field L and T dwarfs with reported parallax measurements having absolute magnitude and color uncertainties $\leq 0.3$ mag. Subdwarfs and young brown dwarfs are excluded. Components of binary systems (including WISE J1049−5319AB) are indicated by outlined symbols and connected by solid lines. L7-L8 dwarfs are highlighted in the left panels; T0-T1 dwarfs in the right panels. WISE J1049−5319A and B are somewhat redder and fainter (at $J$) than their equivalently classified counterparts. Mean color–magnitude trends from Dupuy & Liu (2012) are delineated by dashed lines.

(A color version of this figure is available in the online journal.)

from Buraffe et al. 2003). We therefore conclude that WISE J1049−5319AB is not a young brown dwarf system, and that thick clouds is the more likely explanation for their red colors.

Thick clouds may also explain two unusual features of WISE J1049−5319AB: the prominence of its flux reversal and its observed variability (Gillon et al. 2013). As illustrated in Figure 6, binaries straddling the L/T transition show a broad range of behavior in relative 1 $\mu$m fluxes, from significant excess to no excess in the secondary. A factor that could explain this variation is the degree of condensate opacity in the primary, which primarily affects the 1.05 $\mu$m and 1.25 $\mu$m flux peaks (Ackerman & Marley 2001). Thicker clouds in WISE J1049−5319A can drive up the flux contrast compared to WISE J1049−5319B at these wavelengths, producing a stronger reversal. This effect has been previously proposed to explain brightness differences among candidate L/T transition spectral binaries (Burgasser et al. 2010a). The brightness of WISE J1049−5319B in the 1 $\mu$m region may arise from patchiness in its cloud layer, allowing deeper, warmer thermal emission to emerge in gaps (Ackerman & Marley 2001; Burgasser et al. 2002). A patchy cloud layer would also explain the pronounced variability arising from the combined light system, which Gillon et al. (2013) attributes primarily to WISE J1049−5319B. We note that our observations of WISE J1049−5319AB (Heliocentric Julian Date 2456366.9051) occurred near a minimum of the optical light curve reported in Gillon et al. (2013), suggesting that the flux reversal could be more pronounced at maximum brightness if the primary is unchanging.

What gives rise to the difference in the cloud properties between these coeval brown dwarfs? The most obvious explanation is that the components straddle the evolutionary stage during which mineral clouds are disrupted, a process that has already begun for the secondary. While there is consensus that mineral condensate clouds must be removed from the photosphere as brown dwarfs cool into the T spectral class, debate remains over whether this process occurs rapidly, making the L/T transition a short evolutionary stage (Burgasser 2007), or slowly, as stored entropy is released with the loss of cloud opacity (Saumon & Marley 2008). The mass differential between these components could potentially constrain the timescale over which this evolutionary phase occurs; a large differential would imply a slow evolution, a small differential a rapid evolution.

Fortunately, both its relatively tight separation (3.1 ± 0.3 AU) and its proximity and well-resolved components makes WISE
J0494–5319A B a promising target for individual component mass measurements through astrometric and radial velocity (RV) orbiting mapping. Assuming a true semimajor axis of roughly 4 AU and near-equal component masses of 0.04–0.065 $M_\odot$ (appropriate for $T_{\text{eff}} \approx 1300$–1350 K and ages of 1–4.5 Gyr; Stephens et al. 2009; Baraffe et al. 2003), this system has a likely orbital period of 20–30 yr, implying astrometric orbital motion of up to 0.3 yr$^{-1}$ and differential RV amplitudes of up to 1.6 km s$^{-1}$. Kniazev et al. (2013) have measured an RV difference of 2.5 ± 1.9 km s$^{-1}$ between the components using medium-resolution spectral data, of insufficient precision to measure orbital motion. High-resolution near-infrared spectroscopy deploying absorption gas cells (Bean et al. 2010; Anglada-Escudé et al. 2012) should provide the necessary precision to measure RV variations and individual component masses, which in turn could shed some light on the timescale for cloud disruption at the L dwarf/T dwarf transition.

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**Facilities:** Magellan:Baade (FIRE), IRTF (SpeX)

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