A Late-type L Dwarf at 11 pc Hiding in the Galactic Plane Characterized Using \textit{Gaia} DR2

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Abstract

We report on the characterization of a nearby \((d = 11.20^{+0.09}_{-0.08} \text{ pc})\) ultracool L dwarf (WISE J192512.78+070038.8; hereafter W1925) identified as a faint \((G = 20.038 \pm 0.009)\) object with high proper motion \((219.834 \pm 1.843 \text{ mas} \text{ yr}^{-1})\) in the \textit{Gaia} Data Releases 1 and 2. A Palomar/ThreeSpec near-infrared spectrum of W1925 confirms a photometric L7 spectral type previously estimated by Scholz & Bell, and its infrared colors and absolute magnitudes are consistent with a single object of this type. We constructed a spectral energy distribution using the \textit{Gaia} parallax, literature photometry, and near-infrared spectrum and find a luminosity \(\log (L_{\text{bol}}/L_{\odot}) = -4.443 \pm 0.008\). Applying evolutionary models, we infer that W1925 is likely a \(53 \pm 18 M_{\text{Jup}}\) brown dwarf with \(T_{\text{eff}} = 1404 \pm 71 \text{ K}\) and \( \log g = 5.1 \pm 0.4 \text{ dex (cgs)}\). While W1925 was detected in both the 2MASS and WISE infrared sky surveys, it was not detected in photographic plate sky surveys. Its combination of extreme optical–infrared colors, high proper motion, and location near the crowded Galactic plane \((b = 4.22)\) likely contributed to its having evaded detection in pre-\textit{Gaia} surveys.

Key words: astrometry – brown dwarfs – parallaxes – solar neighborhood

1. Introduction

Despite decades of dedicated searches, the nearby stellar sample \((d \lesssim 25 \text{ pc})\) remains incomplete, particularly for intrinsically faint low-mass stars and brown dwarfs (e.g., Bihain & Scholz 2016; Henry et al. 2018). Some of the nearest systems to the Sun, such as the binary brown dwarf WISE J104915.57−531906.1AB at 2.0 pc (third closest system to the Sun; hereafter WISE J1049−5319; Luhman 2013) and the Y dwarf WISEA J085510.74−071442.5 at 2.2 pc (fourth closest system to the Sun; Luhman 2014a), were only recently uncovered through multi-epoch infrared imaging surveys (see Luhman 2014b). While these surveys, including the Two Micron All Sky Survey (2MASS; Skrutskie et al. 2006), the Sloan Digital Sky Survey (SDSS; York et al. 2000), the UKIRT Infrared Deep Sky Survey (UKIDSS; Lawrence et al. 2007), and the Wide-field Infrared Survey Explorer (WISE; Wright et al. 2010), have enabled new discoveries in the solar neighborhood, few have been made in or near the Galactic plane (e.g., Kirkpatrick et al. 1999, 2014, 2016; Burgasser et al. 2002; Artigau et al. 2010; Lucas et al. 2010; Gizis et al. 2011; Burningham et al. 2013; Kuchner et al. 2017). Most all-sky searches for nearby, low-temperature dwarfs avoid this region of the sky because of high rates of contamination from heavily reddened background stars with similar colors and astrometric confusion, leading to spurious proper motion measurements.

The nearby stellar sample serves as a benchmark for testing fundamental laws that apply across the Milky Way and beyond. One can extrapolate from the numbers, distributions, and diversity among stars and brown dwarfs in the 20 pc sample to understand overall Galactic demographics (e.g., Clements et al. 2017; Jao et al. 2017; Subasavage et al. 2017). Completing the nearby census remains an important goal in stellar population studies.

In this article, we report the independent discovery and characterization of a nearby \((11.20 \pm 0.08 \text{ pc})\), low-temperature L-type brown dwarf WISE J192512.78+070038.8 (hereafter W1925). In Section 2 we describe the identification of this source in the \textit{Gaia} Data Release 2 (hereafter \textit{Gaia} DR2; Gaia Collaboration et al. 2016)\(^{11}\) and its confirmation as a red source with high proper motion from multi-epoch survey data. In Section 3 we summarize its existing astrometric and photometric observations and report new infrared spectroscopic observations. In Section 4 we analyze these observations, inferring the spectral type, location on diagrams of color and absolute magnitude, kinematics, and fundamental properties of the source. In Section 5 we place this source in context with the nearby stellar sample and the potential for future discoveries in the Galactic plane.

2. Identification of W1925

\textit{Gaia} DR2 was released on 2018 April 25 (Gaia Collaboration et al. 2018; Lindegren et al. 2018) and contains...
1,692,919,135 point sources, of which 1,331,909,727 have a five-parameter astrometric solution (position, parallax, and proper motions) and 7,224,631 have a five-parameter solution plus a radial velocity measurement.

We promptly began searching for the very reddest, new sources with robust parallax measurements. We downloaded the 20 pc ($\varpi > 50$ mas) sample from the Gaia archive, which includes 5400 point sources. The vast majority of these sources align with the southern Galactic plane as shown in Figure 1, indicating that they are largely false detections. Nevertheless, as nearly all previous searches for brown dwarfs avoided the Galactic plane due to crowding, we did not immediately reject any source. Instead, we calculated absolute Gaia G-band magnitudes and examined only sources with $M_G > 17.0$ (2859 sources) to focus on the lowest-mass stars and brown dwarfs ($SpT >$ mid to late-type L dwarfs within 20 pc).

The Gaia DR2 catalog comes with quality indicators that allow vetting of targets with poor astrometric solutions (e.g., the contaminants in the Galactic plane). For instance, VISIBILITY.PERIODS.USED indicates the number of distinct observation epochs, ASTROMETRIC_EXCESS_NOISE is the excess source noise, and the ASTROMETRIC_5DSIGMA_MAX parameter is a five-dimensional equivalent to the semimajor axis of the position error ellipse. We examined all of these quality indicators to ascertain whether they might help vet nearby targets in dense regions. In the case of the Galactic plane we find many objects have <10 visibility periods used. However, we also find that Proxima Centauri, the closest star to the Sun, has only eight visibility periods used. Therefore we decided not to apply rejection criteria based on quality indicators alone. We list the most relevant Gaia DR2 quality indicators for W1925 in Table 1.

Instead, we filtered out contaminants by projecting all Gaia epoch 2015 coordinates within 20 pc backward to epoch 2000.0, and searched for a genuine detection in 2MASS within 2″ of the new position. Our goal was to observe new 20 pc candidates with upcoming spectroscopic time, so we limited our search to 331 sources observable in 2018 April–May. We visually examined images from the Digital Sky Survey (DSS), Pan-STARRS (where available; Kaiser et al. 2002), 2MASS, and WISE using the Aladin tool (see also Figure 2). Among these sources, we identified 41 known L and T dwarfs. Aside from W1925, all other objects turned out to be spurious.

We identified W1925 (source ID Gaia DR2 429552482143 (1807232) as a faint, red object, with detections in the 2MASS (2MASS J19251275+0700362), Pan-STARRS (J192512.79 +070039.0), WISE (WISE J192512.78+070038.8) and AllWISE (WISEA J192512.77+070038.6) catalogs based on its proper motion. The source had previously been reported by Scholz & Bell (2018) as a potential nearby candidate L dwarf in Gaia DR1, but without spectroscopic confirmation. Figure 2 shows images of the sky around this source in DSS, UKIDSS, 2MASS, and WISE, with the last two revealing a clearly moving source. The faint absolute magnitude ($M_G = 19.79 \pm 0.02$) and red optical–infrared color ($G - K_s = 7.10 \pm 0.04$) of W1925 indicate it to be a low-luminosity, low-temperature source.

### 3. Observations

#### 3.1. Astrometry and Photometry

Table 1 lists all published photometry and Gaia DR2 astrometry for W1925. While it is detectable in the red optical bands of Pan-STARRS, there are no entries for this source in GSC 2.2 or USNO-B1.0 catalogs, and it does not appear in any of the DSS photographic plates scanned by SuperCOSMOS (Hambly et al. 2001; see the first three panels of Figure 2).

The exceptional optical–infrared color is likely responsible for the absence of this source in early optical images despite its relative brightness in the infrared ($K_s = 12.94 \pm 0.04$).
### Table 1
Parameters for W1925

| Parameter | Value | Units | References |
|-----------|-------|-------|------------|
| \( \alpha \) | 291.3035823223 \( \pm 0.7 \) mas | deg | 1 |
| \( \delta \) | +0.071011136280 \( \pm 0.6 \) mas | deg | 1 |
| \( \ell^a \) | 43.0438 deg | | 1 |
| \( b^a \) | 43.0438 deg | | 1 |
| \( \varpi \) | 89.3 \( \pm 0.7 \) mas | | 1 |
| \( \mu_\alpha \) | 44.9 \( \pm 1.4 \) mas yr\(^{-1} \) | | 1 |
| \( \mu_\delta \) | 215.2 \( \pm 1.2 \) mas yr\(^{-1} \) | | 1 |

**Gaia DR2 Astrometry**

| Parameter | Value | Units | References |
|-----------|-------|-------|------------|
| \( G_{BP} \) | 21.0 \( \pm 0.6 \) mag | | 1 |
| \( G \) | 20.038 \( \pm 0.009 \) mag | | 1 |
| \( G_{RP} \) | 18.20 \( \pm 0.04 \) mag | | 1 |

**Other Photometry**

| Parameter | Value | Units | References |
|-----------|-------|-------|------------|
| \( r \) | 22.03 \( \pm 0.15 \) mag | | 2 |
| \( i \) | 20.149 \( \pm 0.015 \) mag | | 2 |
| \( z \) | 17.859 \( \pm 0.012 \) mag | | 2 |
| \( y \) | 16.868 \( \pm 0.010 \) mag | | 2 |
| \( J \) | 14.76 \( \pm 0.05 \) mag | | 3 |
| \( H \) | 13.69 \( \pm 0.03 \) mag | | 3 |
| \( K_s \) | 12.94 \( \pm 0.04 \) mag | | 3 |
| \( W_1^b \) | 12.005 \( \pm 0.023 \) mag | | 4 |
| \( W_2^b \) | 11.638 \( \pm 0.021 \) mag | | 4 |
| \( W_3^b \) | 10.93 \( \pm 0.11 \) mag | | 4 |
| \( W_4^b \) | <9.102 mag | | 4 |

**Spectroscopy**

| Parameter | Value | Units | References |
|-----------|-------|-------|------------|
| Spectral type (IR) | L7 \( \pm 1 \) | | 5 |
| Radial velocity | \( -9 \) \( \pm 7 \) km s\(^{-1} \) | | 5 |

**Fundamental Parameters**

| Parameter | Value | Units | References |
|-----------|-------|-------|------------|
| \( \log(L_{bol}/L_\odot) \) | \( -4.443 \pm 0.008 \) | | 5 |
| \( T_{eff} \) | 1404 \( \pm 71 \) K | | 5 |
| Radius | 0.99 \( \pm 0.10 \) \( R_\odot \) | | 5 |
| Mass | 53 \( \pm 19 \) \( M_\odot \) | | 5 |
| \( \log g \) | 5.1 \( \pm 0.4 \) | | 5 |

**Calculated Kinematics**

| Parameter | Value | Units | References |
|-----------|-------|-------|------------|
| Distance | 11.20 \( \pm 0.09 \) \( \pm 0.08 \) pc | | 5 |
| \( \nu_{tan} \) | 11.67 \( \pm 0.13 \) km s\(^{-1} \) | | 5 |
| \( X \) | 8.16 \( \pm 0.06 \) pc | | 5 |
| \( Y \) | 7.62 \( \pm 0.06 \) pc | | 5 |
| \( Z \) | 0.83 \( \pm 0.01 \) pc | | 5 |
| \( U \) | 0.14.1 \( \pm 5.1 \) km s\(^{-1} \) | | 5 |
| \( V \) | +2.2 \( \pm 4.8 \) km s\(^{-1} \) | | 5 |
| \( W \) | +3.93 \( \pm 0.53 \) km s\(^{-1} \) | | 5 |

**Absolute Magnitudes**

| Parameter | Value | Units | References |
|-----------|-------|-------|------------|
| \( M_J \) | 14.52 \( \pm 0.06 \) mag | | 5 |
| \( M_H \) | 13.45 \( \pm 0.05 \) mag | | 5 |
| \( M_K \) | 12.69 \( \pm 0.05 \) mag | | 5 |
| \( M_{W1} \) | 11.80 \( \pm 0.04 \) mag | | 5 |
4. We observed W1925 starting at 11:27 UT at an airmass of 1.183, and obtained eight frames of 180 s each in an ABBA nodding pattern for a total integration time of 1440 s. The slit was aligned with the parallactic angle. Data were reduced using a modified version of SpeXtool (Cushing et al. 2004), following standard procedures for imaging processing where the A and B images are subtracted for sky removal, order identification, and spectral extraction; and wavelength calibration was determined using OH airglow lines (rms scatter = 5 km s$^{-1}$). Correction for telluric absorption and flux calibration were determined from observations of the A0 V star HD 183324 ($V = 5.783$) immediately after the W1925 observation, following the procedures of Vacca et al. (2003).

### 3.2. Spectroscopy

W1925 was observed with the TripleSpec near-IR spectrograph (Wilson et al. 2004; Herter et al. 2008) on the Palomar 200′′ telescope on 2018 April 28 UT. TripleSpec covers 1.0–2.4 μm at a resolution $R \sim 2600$ with a fixed 1″ × 30″ slit. The sampling of the spectrograph is ~2.7 pixels per resolution element with an array size of 1000 × 2000. Conditions during the observation were clear and dry, with seeing around 1″0–1″4. We observed W1925 starting at 11:27 UT at an airmass of 1.183, and obtained eight frames of 180 s each in an ABBA nodding pattern for a total integration time of 1440 s. The slit was aligned with the parallactic angle. Data were reduced using a modified version of SpeXtool (Cushing et al. 2004), following standard procedures for imaging processing where the A and B images are subtracted for sky removal, order identification, and spectral extraction; and wavelength calibration was determined using OH airglow lines (rms scatter = 5 km s$^{-1}$). Correction for telluric absorption and flux calibration were determined from observations of the A0 V star HD 183324 ($V = 5.783$) immediately after the W1925 observation, following the procedures of Vacca et al. (2003).

### 4. Analysis

#### 4.1. Spectra

Figure 3 shows the reduced near-infrared spectrum for W1925. We used the SpeX Prism Library Analysis Toolkit (SPLAT; Burgasser & the SPLAT Development Team 2017) to compare with low-resolution near-infrared spectral standards for M, L, and T dwarfs, and found the best overall fit to the L7 standard 2MASS J0103320+193536 (Kirkpatrick et al. 2010). In Figure 3(a), we compare W1925 to similar data from the Folded-port Infrared Echellette spectograph (FIRE; Simcoe et al. 2013) of WISE J1049−5319 A (Faherty et al. 2014), which has a similar L7.5 infrared spectral type (Burgasser et al. 2013). There are subtle differences in the spectra, including CH$_4$ in the H-band and the redder shape of the 2.2 μm peak; however, overall the spectra are very similar.

The spectra of L dwarfs are known to have a variety of gravity-sensitive features, including VO and metal hydride molecular bands, alkali lines, and the H-band peak shape (Lucas et al. 2001; McGovern et al. 2004; Cruz et al. 2009; Allers & Liu 2013).

#### 4.2. Color and Absolute Magnitudes

Figure 4 shows the average and spread of near- and mid-infrared colors for L6, L7, and L8 brown dwarfs from Faherty et al. (2016), compared to the measurements for W1925. All 2MASS and WISE colors are consistent with the L7 spectral type. The bottom panel of Figure 4 shows the residuals of each color against the distribution for L7 dwarfs. The ($J - W1$), ($H - W1$), and ($K_s - W1$) colors for W1925 are all within $1\sigma$ but at the red end of these distributions, which may be due to its atmosphere being slightly more cloudy than that of other L7 dwarfs or due to contamination from a nearby star.

Using the Gaia DR2 parallax, we computed the absolute magnitudes of W1925 in 2MASS $J$, $H$, and $K_s$ bands, and WISE $W1$, $W2$, and $W3$ bands. Figure 4 compares these absolute magnitudes to those of L6, L7, and L8 dwarfs calculated using the polynomial relations in Faherty et al. (2016). Again, we find that W1925 aligns well with the late L dwarf field sequence, Allers & Liu (2013) define a spectral index approach for estimating surface gravity in late M and L dwarfs; however, the method is not well calibrated for L7 objects. Nevertheless, applying their methodology we find a near-infrared spectral type of L7.1 (consistent with our analysis) and gravity indices of $n_{00}$ implying a FLD-G (field gravity) designation. From visual inspection, we see that W1925 has strong K1 absorption (equivalent widths of 7.1 ± 0.9 Å, 8.9 ± 1.0 Å for the 1.168, 1.177 μm doublet and 4.9 ± 0.6 Å, 6.0 ± 0.7 Å for the 1.243, 1.254 μm doublet), which places it in line with other field L dwarfs (Martin et al. 2017). It also has a flattened H-band peak and no evidence of VO absorption at 1.05 μm. These features consistently indicate that W1925 has a surface gravity similar to field brown dwarfs, log $g \approx 5.0$–5.5 dex (cgs; see Section 4.4).

We used the spectral data to measure the radial velocity of W1925 by cross-correlating regions containing strong features with a high-resolution BT-Settl atmosphere model having $T_{\text{eff}} = 1400$ K and log $g = 5.0$ dex (cgs) (Allard et al. 2012). The comparison regions were 1.16–1.185 μm and 1.235–1.26 μm (K1); 1.32–1.34 μm, 1.46–1.50 μm, and 1.75–1.78 μm (H2O); and 2.03–2.06 μm (NaI and CO). The heliocentric radial velocity was determined to be $-9 \pm 7$ km s$^{-1}$, which includes a barycentric velocity correction of $+25.4$ km s$^{-1}$, and the uncertainty is based on the scatter of measurements from the six comparison regions.

### Table 1

| Parameter | Value | Units | References |
|-----------|-------|-------|------------|
| $M_{W2}$  | 11.41 ± 0.04 | mag | 5 |
| $M_{W3}$  | 10.85 ± 0.15 | mag | 5 |
| $M_{C}$   | 19.79 ± 0.02 | mag | 5 |

Notes. The object does not have entries in GSC 2.2 or USNO-B1.0, and does not appear on any of the photographic sky surveys scanned by SuperCOSMOS.

* Epoch J2015.5, ICRS.
* We chose the original WISE catalog values in the analysis over the AllWISE values so we could compare to the photometry in Faherty et al. (2016).
* Calculated using $D = 1/\pi$, which is a good approximation for parallax known to $\pi/\pi_{\text{true}} = 133$ accuracy.
* Calculated using astrometry of Lindegren et al. (2018).

References: (1) Lindegren et al. (2018), (2) Chambers et al. (2016), (3) Cutri et al. (2003), (4) Wright et al. (2010), (5) this paper.
with no indication of unresolved binarity or other brightness anomalies.

4.3. Kinematics

Gaia DR2 reports a total proper motion of $\mu = 219.8 \pm 1.8$ mas yr$^{-1}$ and a parallax of $\pi = 89.3 \pm 0.7$ mas for W1925, which yield a tangential velocity of $v_{\text{tan}} = 11.67 \pm 0.13$ km s$^{-1}$. The average $v_{\text{tan}}$ value for L7 objects in Faherty et al. (2009) was $30 \pm 9$ km s$^{-1}$, placing W1925 at the low-velocity end of this distribution. Including the measured radial velocity of $-9 \pm 7$ km s$^{-1}$ implies UVW velocities of $(-14.1 \pm 5.1, +2.2 \pm 4.8, 3.93 \pm 0.53)$ km s$^{-1}$ consistent with a field disk star. As a further check, we ran the full kinematics through the BANYAN $\Sigma$ tool (Gagné et al. 2018) and found negligible probability for membership in any known moving group. Using the velocity distributions and population normalizations from Bensby et al. (2003), we find that this velocity vector corresponds to population probabilities of 93.9% (thin disk), 6.1% (thick disk), and 0.027% (halo). We conclude that W1925 is most likely a brown dwarf member of the thin disk.

Figure 2. Finder chart for W1925 centered on the current Gaia reported position (red circle). We show 2.0 arcmin boxes around DSS, UKIDSS, 2MASS, and WISE images and find W1925 clearly detected in the latter three. We have used an arrow to distinguish the position of W1925 in multiple images.

4.4. Fundamental Parameters

Using the technique described in Filippazzo et al. (2015), we used the Gaia parallax, the TripleSpec near-IR spectrum, as well as the 2MASS, WISE, and Pan-STARRS photometry to construct a distance-calibrated spectral energy distribution for W1925 and compute a bolometric luminosity ($\log(L_{\text{bol}}/L_\odot) = -4.43 \pm 0.008$). As discussed in Filippazzo et al. (2015), the spectrum is scaled by the absolute magnitude in each band and appended with a Rayleigh–Jeans tail shortward and longward of data. Using the model-predicted measurements of radii over the broad age range of 500 Myr–10 Gyr from Saumon & Marley (2008), we semi-empirically calculated the effective temperature ($T_{\text{eff}}$), mass, and log $g$. We list all calculated parameters in Table 1. Using the $L_{\text{bol}}$ polynomial relations for field objects in Faherty et al. (2016), an L7 dwarf should have $\log(L_{\text{bol}}/L_\odot) = -4.426 \pm 0.133$ dex, hence W1925 is well within normal. Similarly, $T_{\text{eff}}$ for W1925 fits well within the predicted field L7 value of 1401 $\pm$ 113 K. At an estimated mass of $53 \pm 19 M_\text{Jup}$, W1925 is between the deuterium- and hydrogen-burning minimum masses and should be classified as a brown dwarf.
5. Discussion

Using the current sample of spectroscopically classified L0–L7 dwarfs, we estimate that there are 40 sources known within ∼12 pc of the Sun; 28 had trigonometric parallaxes before Gaia DR2, the remaining 12 have distances estimated from photometry and spectral type. W1925 is the 30th closest L dwarf discovered to date.

We can estimate the number of L dwarfs hiding in the Galactic plane by calculating a space density of known sources and applying it to the volume occupied by the plane. Looking at the collection of known objects, the majority of proper motion and photometric surveys have avoided |b| < 15° when targeting candidates. Thus by (1) counting the number of spectroscopically confirmed L dwarfs outside the Galactic plane (129 out to ∼20 pc), (2) calculating the fraction of the total 20 pc volume that is within the Galactic plane (∼26%), (3) constructing a probability density function of the space density to predict the number inside the Galactic plane with Bayes’ theorem based on a Poisson likelihood and a non-informative prior on the space density, (4) counting the number of spectroscopically confirmed L dwarfs inside the Galactic plane (26 including W1925), and (5) subtracting from the number of expected brown dwarfs in the Galactic plane the number that is actually detected (including Poisson error bars on this number), yields a predicted 18 ± 7 L dwarfs within 20 pc that remain to be detected in the Galactic plane at a 68% confidence level. While this number is small, Gaia DR2 is an excellent resource for filling in the missing objects.

W1925 is an L/T transition dwarf, and such sources have been found to show large-amplitude photometric variability in the optical and infrared (e.g., Radigan et al. 2012; Gillon et al. 2013; Metchev et al. 2015). Given that W1925 is located in a dense, crowded area of the sky, it has numerous calibrator stars that can allow the source to be monitored with exceptionally high precision, making it an excellent target for future studies of variability. The density of the field around W1925 also makes it an excellent candidate for (1) adaptive optics imaging to search for faint companions that contributed negligibly to the overall

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12 See https://jgagneastro.wordpress.com/list-of-ultracool-dwarfs/.
5.1, Jup. All values are consistent with those of objects of equivalent

Figure 4. (a) Absolute magnitudes of L6 (blue), L7 (black), and L8 (red) brown dwarfs across 2MASS and WISE photometry from the polynomial relations reported in Faherty et al. (2016). We plot the absolute magnitudes of W1925 and their uncertainties in green. Residuals from just the L7 brown dwarfs are plotted in the bottom panel. W1925 fits within the normal sources across all magnitudes. (b) Average colors and spreads of L6 (blue), L7 (black), and L8 (red) dwarfs across 2MASS and WISE from Faherty et al. (2016). The colors of W1925 and their uncertainties are shown as green stars. Residuals from just the L7 brown dwarfs are plotted along the bottom panel. W1925 fits well within the distribution of L7 dwarfs, although it is slightly red in J − W1, H − W1, and K − W1 colors.

luminosity of the system, and (2) searching for occultations of background stars. All of these benefits also apply to future discoveries of brown dwarfs in the Galactic plane.

6. Conclusions

We have spectroscopically confirmed W1925 to be an L7 brown dwarf at 11.20±0.09 pc. We estimate a radial velocity of −9 ± 7 km s⁻¹ and calculate UVV space velocities of (−14.1 ± 5.1, +2.2 ± 4.8, 3.93 ± 0.53) km s⁻¹ respectively. Using its spectrum, colors, and absolute magnitudes, we confirm that W1925 has the properties of a field brown dwarf, and likely has an age typical of field stars. From the parallax, photometry, and spectral data we create a spectral energy distribution and empirically determine log(Lbol/L⊙) = −4.426 ± 0.133 dex. We translate these data into semi-empirical estimates of T eff = 1404 ± 71 K, log g = 5.1 ± 0.4 dex, and a mass of 53 ± 19 M Jup. All values are consistent with those of objects of equivalent spectral type (L7) in the field.

The discovery of W1925 is a demonstration of the power of Gaia astrometry for mining the solar neighborhood, even in the most crowded regions of the sky near the Galactic plane. We estimate that there are a roughly 18 ± 7 L-type brown dwarfs remaining to be found in this region. Not only will finding such objects complete the nearby stellar census, but they will also serve as key targets for follow-up studies of variability and multiplicity given the dense field of calibration stars.

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Facilities: Gaia, Hale(TripleSpec), WISE, CTIO:2MASS, UKIRT.

Software: Aladin, BANYAN Σ (Gagné et al. 2018).

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