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A dusty M5 binary in the β Pictoris moving group

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ABSTRACT

We report the identification of a new wide separation binary (LDS 5606) in the ∼20 Myr-old β Pic moving group. This M5+M5 pair has a projected separation of 26″, or ∼1700 AU at a distance of 65 pc. Both stars host warm circumstellar disks and many strong hydrogen and helium emission lines. Spectroscopic observations reveal signatures of youth for both stars and on-going mass accretion in the primary. The properties of LDS 5606 make it an older analog to the ∼8 Myr TWA 30 system, which is also composed of a pair of widely separated mid-M dwarfs, each hosting their own warm circumstellar disks. The binary star LDS 5606 joins a rather exclusive club of only three other known binary systems, far from any molecular cloud, where both members are orbited by detected circumstellar disks.

Key words. binaries: general – open clusters and associations: individual: beta Pictoris – stars: evolution – stars: pre-main sequence

1. Introduction

Over the last few decades, astronomers have identified hundreds of stars in young moving groups near Earth (for reviews see Zuckerman & Song 2004; Torres et al. 2008; Malo et al. 2013). These moving groups have ages of ∼10–100 Myr and provide a sample of stars useful for the study of the planet formation environment. Previous work has relied heavily on the identification of these stars at X-ray wavelengths with the ROSAT All-Sky Survey (RASS). Recent studies have demonstrated that low-mass members can be successfully identified by utilizing the GALEX (Martin et al. 2005) ultraviolet survey (Rodriguez et al. 2011, 2013; Shkolnik et al. 2011).

Among known young low-mass stars within 100 pc of Earth, a modest number stand out with special interest because of the presence of both surrounding dust and gas. The first such star to be recognized was the late-K-type star TW Hya; the first known member of the ∼8 Myr-old TW Hya association (TWA; see Ducourant et al. 2014 and references therein). Relatively recently, Looper et al. (2010a,b) identified a remarkable pair of dusty mid-M-type stars (TWA 30A & B) that are members of TWA and that exhibit surrounding gas that is both accreting and outflowing. As part of the GALEX Nearby Young-Star Survey (GALNYSS; Rodriguez et al. 2013) we identified a pair of mid-M dwarfs that exhibit strong UV emission and excess mid-infrared emission. As we show in Sect. 3, this very dusty binary, LDS 5606, is a likely member of the β Pic moving group. Estimates for the age of β Pic moving group stars range from 10–20 Myr (e.g., Barrado y Navascués et al. 1999; Zuckerman et al. 2001; Jenkins et al. 2012; Binks & Jeffries 2014, and references therein). We adopt an age of ∼20 Myr as derived from the lithium depletion boundary (Binks & Jeffries 2014). As such, LDS 5606 is an older analog of the TWA 30 binary. Dusty low-mass stars such as these serve as excellent laboratories in which to study the planet forming environment of the most abundant stars in the Galaxy.

To date, only a handful of binaries far from molecular clouds or star forming regions are known in which both stars host circumstellar disks. The star LP 876–10, recently recognized as a widely separated companion (158 kAU) to Fomalhaut (Mamajek et al. 2013), has now been shown to host a cold circumstellar disk (Kennedy et al. 2014). The HD 223352 triple system hosts a circumbinary disk around the close binary and a circumstellar disk around the ∼3000 AU companion, HD 223340 (Phillips 2011). Both systems are older than 100 Myr. At the intermediate age range (∼10–100 Myr) of most nearby young moving groups, only TWA 30 is a known binary hosting a pair of disks. The TWA 30 system is comprised of an M4+M5 pair separated by ∼3400 AU (Looper et al. 2010a,b). Among star forming regions, there are many more cases where both stars in a binary system each host disks. Monin et al. (2007) conservatively list 40 multiples with pairs of disks (either accreting or not), but argue that more non-accreting disk pairs remain to be discovered in these regions that are a few Myr old. It is clear that, while binary systems do host disks, these dissipate on faster timescales than around single stars (e.g., Rodriguez & Zuckerman 2012). The presence of two disks within a ≳8 Myr binary is a rare occurrence; LDS 5606 presented here is only the fourth example after Fomalhaut, HD 223352, and TWA30.

The LDS 5606 system is a 26″ binary listed in the Luyten Double Star catalog (Luyten 1997). Other than an entry in the Washington Double Star catalog (Mason et al. 2001), this system has gathered little attention since its discovery. Given that both stars have nearly identical 2MASS magnitudes, spectral types, and similar UV and IR excesses, it is difficult to unambiguously designate one or the other as the brighter primary. Hence, we adopt the notation introduced in the LDS and WDS catalogs that the primary star (A) is the western component of the binary (see Fig. 1). Both stars are detected in GALEX

⋆ Hubble Fellow.

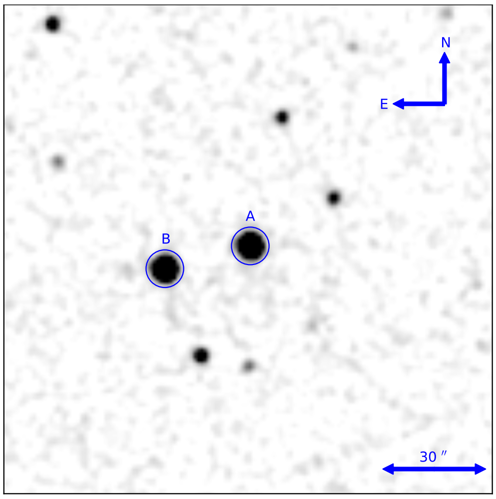

Fig. 1. 2MASS *J*-band finder chart illustrating the location and components of LDS 5606.

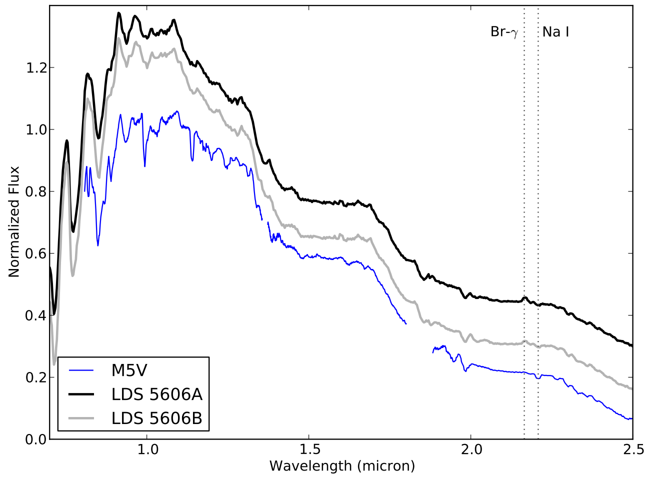

Fig. 2. IRTF-SpeX prism spectra of LDS 5606 compared to an M5 standard. Both stars show weak Na I absorption at 2.2 μm and some possible Br-γ emission.

yet, curiously, the secondary component (B) was not identified as part of GALNYSS given that its near-ultraviolet (NUV) emission is stronger than the selection criteria (see Rodriguez et al. 2013), a situation similar to that of the actively-accreting TW Hya. In this paper, we demonstrate that LDS 5606 is a new member of the β Pic moving group. In a related paper (Zuckerman et al. 2014), we discuss in more detail the disk and accretion signatures of both stars.

2. Observations

2.1. Magellan-MagE

On 2013 January 31 (UT) we used the 6.5 m *Clay Magellan* telescope and *Magellan* Echellette Spectrograph (MagE; Marshall et al. 2008) to obtain optical spectra of LDS 5606A. The MagE spectrograph is a cross-dispersed optical spectrograph covering from 3000 Å to 10 000 Å at medium resolution. Our observations employed a 0.7″ slit aligned at the parallactic angle (resolution $\lambda/\Delta\lambda \sim 4000$). Observations were made under clear conditions with an average seeing of ~0.6″. At the time, we had not identified LDS 5606B so no spectrum was acquired for that star. A 300 s integration was obtained for LDS 5606A followed immediately by a 3 s ThAr lamp spectrum for wavelength calibration. The spectrophotometric standard GD 108 was observed for flux calibration (120 s). Ten Xe-flash and Quartz lamp flats as well as twilight flats were taken at the start of the evening for pixel response calibration. The data were reduced using the MagE Spectral Extractor pipeline (MASE; Bochanski et al. 2009) which incorporates flat fielding, sky subtraction, and flux calibration IDL routines.

2.2. IRTF-SpeX

We obtained low-resolution near-infrared spectra of both components using the SpeX spectrograph (Rayner et al. 2003) mounted on the 3 m NASA Infrared Telescope Facility (IRTF). On 2013 February 28 (UT), we used the spectrograph in prism mode with the 0.8″ slit aligned to the parallactic angle. This resulted in $\lambda/\Delta\lambda \approx 100$ spectral data over the wavelength range of 0.8–2.4 μm. Conditions included light cirrus and the seeing was 0.8″ at *K*. We observed LDS 5606A followed by LDS 5606B. Our strategy employed four individual exposures of 90 s in an ABBA dither pattern along the slit.

Immediately after the science observation we observed the A0V star HD 35036 at a similar airmass for telluric corrections and flux calibration. Internal flat-field and Ar arc lamp exposures were acquired for pixel response and wavelength calibration, respectively. All data were reduced with the SpeXtool package version 3.4 using standard settings (Cushing et al. 2004; Vacca et al. 2003). Figure 2 shows the spectra compared to an M5 standard.

2.3. Keck-HIRES

We used the HIRES echelle spectrometer (Vogt et al. 1994) on the Keck I telescope at Mauna Kea Observatory in Hawaii. Spectra were obtained during observing runs in 2013 October and November. The red cross disperser was combined with a 1.15″ slit aligned at the parallactic angle and the wavelength range between 4370 Å and 9000 Å was covered with a resolution of ~40 000. Spectra were reduced using the IRAF and MAKEE software packages.

The source LDS 5606A was observed on October 17 and November 16. The echelle grating settings were not the same in October and November so the wavelength coverage differed at the extreme wavelengths. Clouds were present during both nights and hampered the integrations (which were terminated early). Integration times were 1900 and 1713 s on October 17 and November 16, respectively. The source LDS 5606B was observed on 2013 October 21 for 2300 s. Some thin clouds were present on this night.

By measurement of centroids of absorption lines we determine radial velocities (RVs) of 14.2 ± 0.9 km s^{-1} and 14.6 ± 0.3 for LDS 5606A and B, respectively. To establish the RV scale, two of the three RV standards HIP 26689, 47690, and 117473 (Nidever et al. 2002) were observed on each of the three nights of HIRES observations. We also cross-correlated the spectra against the radial velocity standard HIP 117473 of M2 spectral type with IRAF's *fxcor* task to measure 15.3 ± 0.7 and 15.6 ± 0.7 km s^{-1} for LDS 5606A and B, respectively.

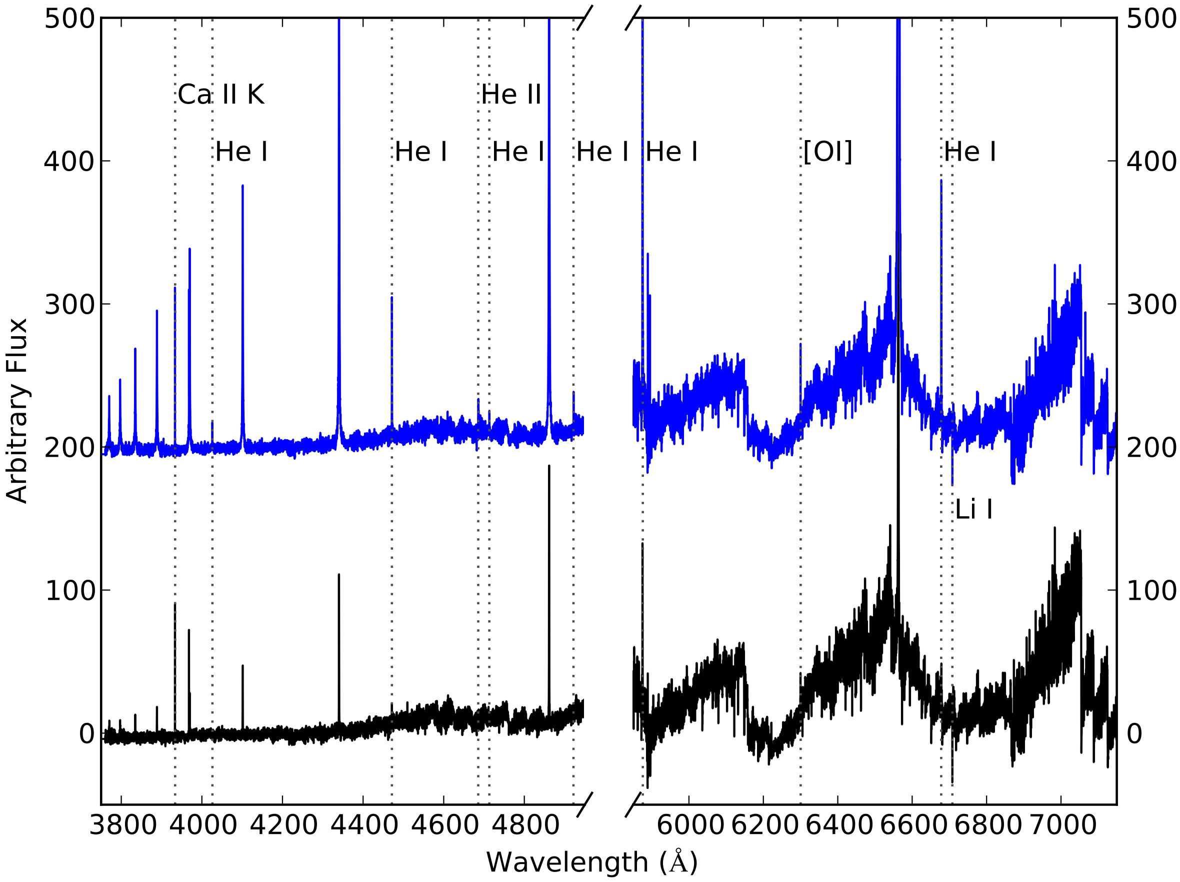

Fig. 3. VLT-UVES spectra for LDS 5606A (top) and LDS 5606B (bottom), smoothed and arbitrarily scaled for clarity. Many prominent emission lines are evident, particularly for LDS 5606A. Emission from the core of the Na-D double at 5890 Å and 5896 Å, and Ca II H at 3968Å (blended with Hϵ at 3970 Å) is not labeled. All other strong, unlabeled emission lines are from the Hydrogen Balmer series, which can be seen to extend from $n = 3$ (Hα) to $n = 11$. Expanded portions of this spectrum highlighting a variety of spectral features, including comparison with portions of the HIRES spectra, appear in Zuckerman et al. (2014).

2.4. VLT-UVES

Both components of LDS 5606 were observed on 2013 December 3 (UT) with the UVES spectrograph (Dekker et al. 2000) on the Very Large Telescope (VLT). Observations were carried out with the standard DICHROIC2 setup with CD#2 and CD#4 set at 4370 Å and 7600 Å. This provides coverage from 3730 Å to 5000 Å and 5650 Å to 9460 Å at a resolution of $R \sim 20\,000$ with a 2.1″ slit aligned at the parallactic angle (Fig. 3). The integration time was 900 s. Data were reduced with the ESO Reflex pipeline.

To determine radial velocities, standards (HIP103039 and HIP5643) from Nidever et al. (2002) were observed. We cross-correlated our observations of LDS 5606 against the standards using IRAF's *fxcor* task to measure radial velocities of 15.1 ± 1.2 km s^{-1} for LDS 5606A and 15.9 ± 0.7 km s^{-1} for LDS 5606B. Although the standards were taken on separate nights (2013 Oct. 9 and 23), comparison against each other reveal close agreement (within ~0.1 km s^{-1}) with the literature value.

3. Results

The LDS 5606 system was identified as part of GALNYSS (Rodriguez et al. 2013) and immediately flagged as an interesting system; Table 1 summarizes its parameters. The secondary component had such blue NUV–*W1* colors that it was not picked up as part of the survey, but was recovered because of its common motion to LDS 5606A (see finding chart in Fig. 1). Both stars show evidence of WISE IR excess by their red *W1*–*W3* and *W1*–*W4* colors (Fig. 4). Their proper motions, as we describe below, place them as candidate members for the β Pic moving group.

Utilizing the convergent point tool in Rodriguez et al. (2013) and the BANYAN tool in Malo et al. (2013), we find β Pic membership probabilities of 66% and 79%, respectively. These kinematic tools also predict radial velocities of ~14.5 km s^{-1} and distances of ~65 pc. At a distance of 65 pc, both components would have M_K ~6.6. With *V*-band magnitudes from UCAC4 and NOMAD, we find $V - K$ is ~6, consistent with an M5 spectral type. An M5 star with this M_K matches well the empirical β Pic isochrone in Zuckerman & Song (2004). For a spectral type of M5, an old field dwarf would have $M_J \sim 9.6$ ($M_K \sim 8.6$; Cruz & Reid 2002), which, at a distance of 65 pc, would suggest an apparent magnitude of $J \sim 13.7$ ($K \sim 12.7$). The components of LDS 5606 are more luminous than these estimates, consistent with a young age (see Sect. 3.1). In consideration of group membership, we implicitly assumed that both members of the visual binary are single stars. Should both stars actually be as yet unresolved (and thus unrecognized) roughly equal luminosity binaries, then M_K would be inconsistent with β Pic membership. Our high-resolution UVES and HIRES spectra show no evidence of binarity.

Figure 5 shows a color–magnitude diagram of β Pic moving group members (from Malo et al. 2013; Binks & Jeffries 2014;

Table 1. Properties of LDS 5606.

Parameter	LDS 5606A	LDS 5606B	Ref.
WISE Designation	J044800.86+143957.7	J044802.59+143951.1	1
μ_α (mas/yr)[a]	24.6 ± 5	24.3 ± 5	2, 3
μ_δ (mas/yr)[a]	−42.3 ± 4	−41.5 ± 4	2, 3
RV (km s^{-1})[b]	14.9 ± 0.8	14.9 ± 0.4	4
Distance (pc)[c]	65 ± 6	65 ± 6	4
Spectral Type	M5±1	M5±1	4
U (km s^{-1})	−12.4 ± 0.9	−12.4 ± 0.6	4
V (km s^{-1})	−16.0 ± 1.9	−15.7 ± 1.9	4
W (km s^{-1})	−6.3 ± 1.4	−6.3 ± 1.4	4
X (pc)	−61.2		4
Y (pc)	−4.7		4
Z (pc)	−21.2		4
GALEX FUV (mag)	19.98 ± 0.17	19.97 ± 0.17	5
GALEX NUV (mag)	19.97 ± 0.13	19.26 ± 0.08	5
V (mag)[d]	16.7	16.6	2,6
2MASS J (mag)	11.68 ± 0.02	11.68 ± 0.02	7
2MASS H (mag)	11.06 ± 0.02	11.07 ± 0.02	7
2MASS K (mag)	10.73 ± 0.02	10.68 ± 0.02	7
WISE 3.4 μm ($W1$ mag)	10.22 ± 0.02	10.52 ± 0.02	1
WISE 4.6 μm ($W2$ mag)	9.77 ± 0.02	10.16 ± 0.02	1
WISE 12 μm ($W3$ mag)	7.98 ± 0.02	8.11 ± 0.02	1
WISE 22 μm ($W4$ mag)	6.18 ± 0.06	6.09 ± 0.05	1
$m_{\rm bol}$ (mag)	13.64 ± 0.02	13.62 ± 0.02	4
log $L_{\rm bol}/L_\odot$	−1.93 ± 0.09	−1.93 ± 0.09	4

Notes. [a] Average of proper motions given in PPMXL and UCAC4. [b] The listed radial velocity is the weighted average of all measurements. [c] The listed distance is from the BANYAN kinematic analysis (Malo et al. 2013). At 65 pc, the projected sky separation of the two stars is ~1700 AU. [d] We assume V-band magnitude uncertainties of ~0.3 mag.

References. (1) WISE (Wright et al. 2010); (2) UCAC4 (Zacharias et al. 2012); (3) PPMXL (Roeser et al. 2010); (4) this work; (5) GALEX GR6/7 (Martin et al. 2005); (6) NOMAD (Zacharias et al. 2004); (7) 2MASS (Cutri et al. 2003).

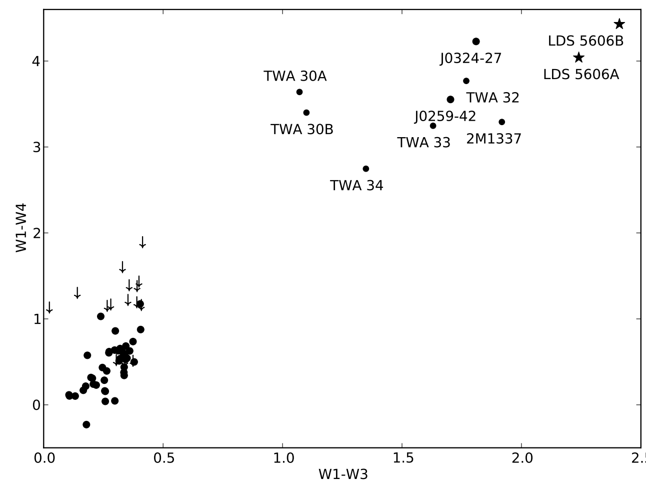

Fig. 4. $W1$–$W3$ and $W1$–$W4$ colors for early to mid M-dwarfs from Rodriguez et al. (2013) as well as labeled dusty M-dwarfs (Looper et al. 2010a,b; Schneider et al. 2012a,b). The colors of TWA 30B have been modified as described in Schneider et al. (2012a). Both components of LDS 5606 exhibit very red colors comparable to those of stars known to host warm circumstellar dust disks.

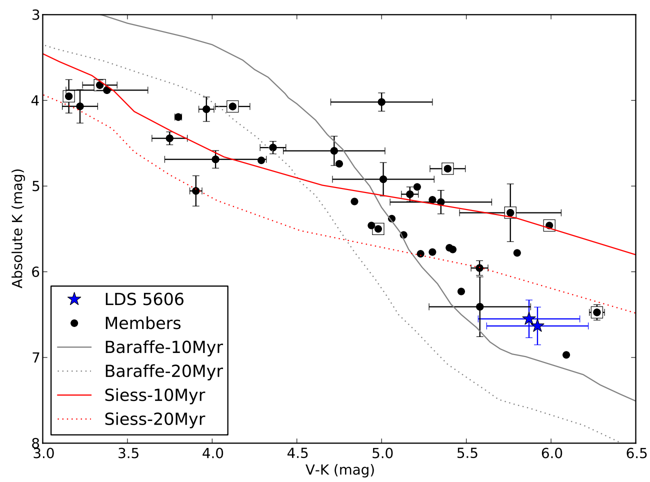

Fig. 5. Color–magnitude diagram of β Pic moving group members (as drawn from Malo et al. 2013; Binks & Jeffries 2014; Riedel et al. 2014) and the LDS 5606 binary system. Unresolved binaries are indicated with squares. For the sample from Riedel et al. (2014), we used their deblended magnitudes without uncertainties (see their Table 5). V-band magnitudes for LDS 5606 are drawn from UCAC4 and NOMAD; we assume an uncertainty of 0.3 magnitudes for these faint stars. Theoretical isochrones from Baraffe et al. (1998) and Siess et al. (2000) are shown for comparison.

Riedel et al. 2014) and the LDS 5606 system along with theoretical 10 and 20 Myr isochrones (Baraffe et al. 1998; Siess et al. 2000). The two models differ substantially at these late spectral types, which makes identification of additional late-type members of moving groups invaluable to better constrain stellar evolution models.

With our UVES spectra, we measured the TiO5 index (Reid et al. 1995) to estimate the spectral type of both stars, accurate to 0.5 spectral types. We measure M4.7 and M5.4 for LDS 5606A and B, respectively. For the HIRES data, a gap between orders falls at the TiO5 wavelengths rendering this index unusable.

Table 2. Optical spectroscopic measurements of LDS 5606.

Object	Instr.	UT date	Hα *EW* (Å)	Li *EW* (Å)	Na I Index
LDS 5606A	MagE	2013-Jan.-03	-73.6 ± 3.1	0.389 ± 0.055	1.16
	HIRES	2013-Oct.-17	-99.4 ± 7.9	0.382 ± 0.041	
	HIRES	2013-Nov.-16	-135.3 ± 10.2	0.380 ± 0.042	
	UVES	2013-Dec.-03	-84.9 ± 7.8	0.383 ± 0.054	1.16
LDS 5606B	HIRES	2013-Oct.-21	-25.1 ± 2.8	0.501 ± 0.047	
	UVES	2013-Dec.-03	-16.0 ± 2.0	0.489 ± 0.053	1.18

Notes. The Na I index is the ratio of the average flux on and off the doublet (see Lawson et al. 2009).

Table 3. IRTF-SpeX measurements for LDS 5606.

	Spectral type indices			Gravity indices		
Object	H_2O	H_2O–1	H_2O–2	FeH_z	KI_J	*H*-cont
LDS 5606A	5.1	4.2	5.0	1.020 ± 0.007	1.006 ± 0.004	1.011 ± 0.006
LDS 5606B	5.3	4.4	5.0	1.031 ± 0.006	1.008 ± 0.003	1.011 ± 0.006

Notes. Spectral type and gravity indices as listed in Allers & Liu (2013).

A by-eye comparison of the MagE, HIRES, and UVES spectra with active M-dwarf templates from Bochanski et al. (2007) suggests that a spectral type of ~M5 is appropriate. In the near-infrared, both stars appear to be M5 either by eye or by utilizing some of the spectral type indices summarized in Table 3 of Allers & Liu (2013). We thus adopt spectral types of M5±1 for both components of LDS 5606. Pecaut & Mamajek (2013) suggest a $T_{\rm eff}$ of 2880 K for young (5–30 Myr) M5 dwarfs. With the bolometric corrections listed in Pecaut & Mamajek (2013) and the 2MASS magnitudes, we estimate a bolometric luminosity of 0.012 $L_\odot$ for each component. The Baraffe et al. (1998) models suggest a ~20 Myr-old object with that luminosity would have a mass of 0.13 $M_\odot$ (0.09 $M_\odot$ if ~10 Myr-old). The Siess et al. (2000) models suggest similar masses. However, the temperatures these models predict is warmer (3170 K) than suggested for young M5 dwarfs. Matching a cooler temperature, however, suggests a mass of ~0.06 $M_\odot$ for each component of LDS 5606 regardless of whether we use the 10 Myr or 20 Myr model. This temperature (and color) discrepancy has been noted before (e.g., see Pecaut & Mamajek 2013). Hence, we adopt a mass of ~0.1 $M_\odot$ for both components.

At a statistically de-projected separation of $1.26 \times 1700 \approx 2140$ AU (Fischer & Marcy 1992) and mass of 0.1 $M_\odot$, the binding energy of this wide binary is $E = GM_1M_2/a = 0.8{\times}10^{41}$ erg. This binding energy is comparable to some of the other $\gtrsim$8 Myr disk binary systems, notably TWA 30AB (0.9×10^{41}; Looper et al. 2010b) and Fomalhaut A–C (0.4×10^{41}; Mamajek et al. 2013). The HD 223352/40 A0+K1 system is more tightly bound (115×10^{41}; Phillips 2011). Additional binaries with comparable (low) binding energies can be seen in Fig. 8 of Faherty et al. (2011).

Assuming a circular orbit, the two components of LDS 5606 would orbit each other with a period of ~221 000 years and orbital velocity ~0.3 km s^{-1}. At a distance of 65 pc, this amounts to a motion of ~0.9 mas/yr. While small, this motion can be detected by the *Gaia* satellite. With the $V-Ic$ color typical of young M5 dwarfs (3.31; Pecaut & Mamajek 2013) and the $G-V$ relationship in Jordi et al. (2010), we estimate a G magnitude of ~15 for LDS 5606. For a $G \sim 15$ star, *Gaia* is expected to reach a parallax error of ~27 μas and a proper motion error of ~14 μas/yr (de Bruijne 2012)[1]. However, while 900 μas/yr motion should be easily detectable with *Gaia*, the baseline will likely be insufficient to characterize the orbit or estimate dynamical masses.

3.1. Youth features

The MagE, UVES, and HIRES spectra cover several indicators of youth for mid-M dwarfs. For this paper, we have measured Li absorption, Hα emission, and the Na I index in both stars. The results are summarized in Table 2. We note that both components show very strong Li absorption (>380 mÅ) and Hα emission. The presence of strong Li absorption is in agreement with other β Pic moving group members of similar spectral types (see Binks & Jeffries 2014). The smaller equivalent width for LDS 5606A compared to B suggests that it may be close to the Li depletion boundary and that the age of the system cannot be significantly older than ~20 Myr. As further indication of a young age, numerous emission lines are evident in the spectra (see Fig. 3), including forbidden OI emission at 6300 Å (air). These are suggestive of ongoing accretion onto the central stars along with OH photodissociation in the disk and are discussed in more detail in Zuckerman et al. (2014). Although neither the MagE or UVES spectra could be telluric corrected, the Na I index, a measure of surface gravity (Lawson et al. 2009), has values in the range 1.16–1.18 and agrees well with those of other β Pic members (see, e.g., Fig. 5 in Riedel et al. 2014). The numerous emission lines, strong Li absorption, and weak Na I index all suggest a young age for this system.

At near-infrared wavelengths, we measured the FeH_z, KI_J, and *H*-cont gravity indices from Allers & Liu (2013) and summarize our measurements in Table 3. Unfortunately, the gravity scores in Table 9 of Allers & Liu (2013) only start at M6 and both components of LDS 5606 are M5. Nevertheless, extrapolating to M5 suggests that both components have very low surface gravity, consistent with the features indicating a young age observed in the optical spectra.

In addition to spectroscopic features of youth, both systems exhibit strong UV emission which led to their initial selection. The star LDS 5606B, in particular, had such strong UV emission that its NUV–*W1* color fell outside the standard GALNYSS selection criteria and would not have been identified had LDS 5606A not been recovered. Both systems also show WISE infrared excesses similar to those identified around TWA 30AB, 31, 32, 33, and 34 (Schneider et al. 2012a,b; see

[1] See *Gaia*'s Science Performance at `http://www.cosmos.esa.int/web/gaia/science-performance`

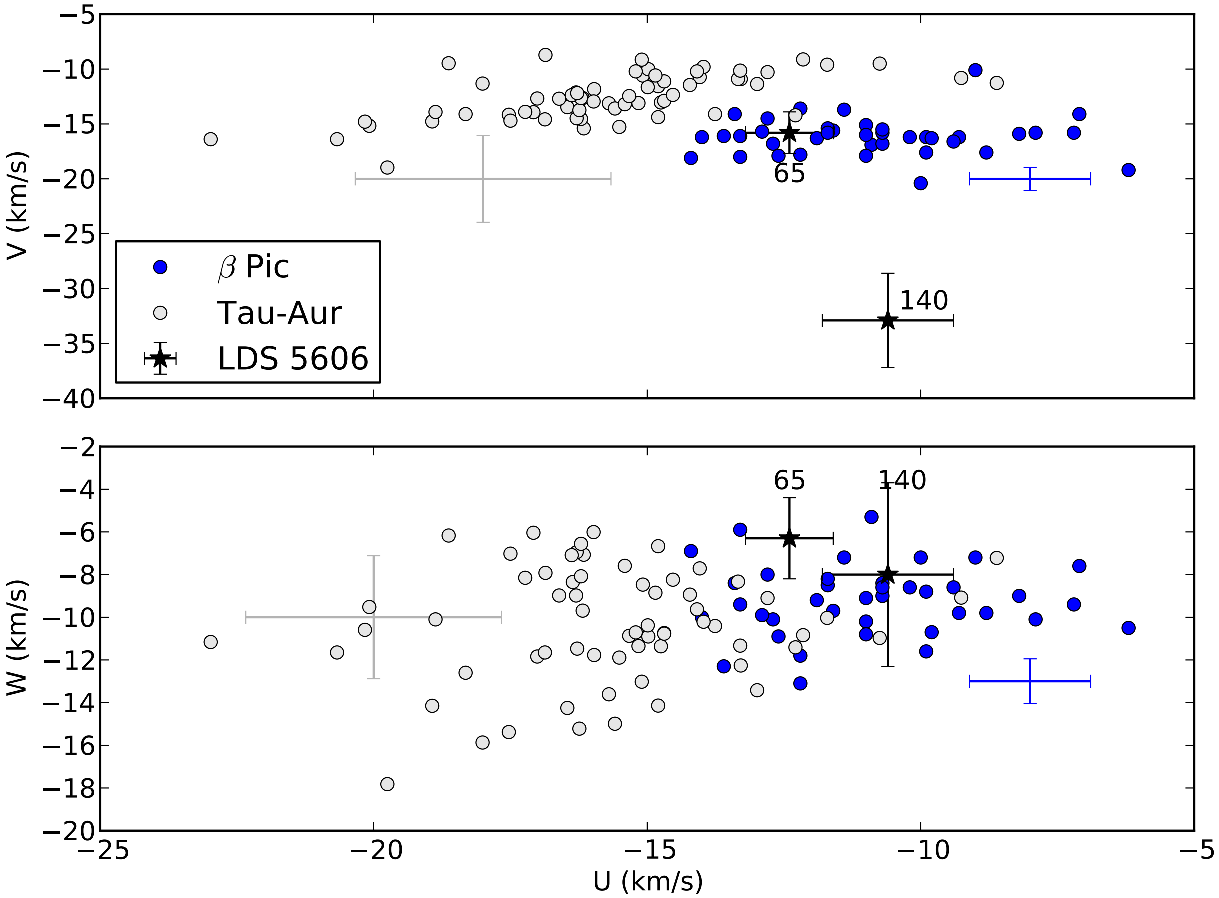

Fig. 6. Average *UVW* velocities of LDS 5606 at two distances (65, 140 pc) compared to β Pic and Tau-Aur members (Malo et al. 2013; Bertout & Genova 2006). Blue and gray error bars show the average uncertainty in the group member's *UVW*.

also Fig. 4). These excesses indicate the presence of warm circumstellar dust surrounding both stars (Zuckerman et al. 2014).

Neither LDS 5606 star is detected in X-rays in the RASS, nor have Chandra or XMM observations been carried out. Assuming a RASS flux limit of 2×10^{-13} erg cm^{-2} s^{-1} (Schmitt et al. 1995), we estimate that each component of LDS 5606 has log $L_X/L_{bol} \lesssim -2.8$. This is just above the saturation limit observed for active M-dwarfs (∼−3; see Fig. 5 in Riaz et al. 2006). We note that TWA 30A was detected in the RASS (log $L_X/L_{bol} = -3.34$; Looper et al. 2010a) and expect that if LDS 5606 had been closer it would likely have been detected by ROSAT.

3.2. Kinematics

As previously mentioned and listed in Table 1, we measure radial velocities and estimate a distance for LDS 5606. The radial velocities are in good agreement with the convergent point and BANYAN estimates. BANYAN can take as input the measured radial velocities to return a revised membership probability of 88% for both components. With the new BANYAN II tool (Gagné et al. 2014), and selecting the option for young objects with priors set to unity, a β Pic membership likelihood of 99% is returned. This is reflected by the system's *UVW* velocities, which we illustrate in Fig. 6 for several distances for LDS 5606 and compare to known β Pic and Tau-Aur members (see below).

To test for possible membership in other groups, we computed *UVW* velocities with a range of distances from 50 pc to 150 pc in 1 pc steps. We find a good match to the β Pic moving group *UVW* velocity at a distance of ∼66 pc, in good agreement with the BANYAN and convergent point results. However, the *UVW* velocities at a distance of ∼90 pc are also a good match to those of the Columba association (Torres et al. 2008). The convergent point (Rodriguez et al. 2013) returns a similar high likelihood of membership in the 30 Myr-old Columba association of ∼70%, with predicted radial velocity of 15.1 km s^{-1} and distance of 95 pc. On the other hand, BANYAN (Malo et al. 2013) returns a Columba membership likelihood of only 5%, with similar radial velocity and distance requirements (14.9 km s^{-1}, 83 pc). Inclusion of the radial velocity only increases the BANYAN Columba likelihood to 11%. If LDS 5606 were to be a Columba member, then at 90 pc, its M_K would place it above various younger β Pic members with similar $V-K$ that are plotted in Fig. 5. Thus, LDS 5606 is unlikely to be a Columba member.

The distance of LDS 5606 (see Table 1) places it somewhat removed from most known β Pic members. However, while the β Pic moving group is currently sparsely sampled at distances >50 pc, recent studies have identified more candidates at similar distances as LDS 5606 (Schlieder et al. 2012; Vican et al. in prep.). Nevertheless, it is worthwhile to consider whether LDS 5606 may instead be younger and more distant. In particular, the Taurus-Auriga (Tau-Aur) star forming region at a distance of 140 pc (Bertout & Genova 2006; Rebull et al. 2011) has members in close proximity in the sky to LDS 5606. Tau-Aur members within 8 degrees of LDS 5606 have average proper motions of 3 ± 9, −15 ± 9 mas/yr and average radial velocities of 17.6 ± 1.3 km s^{-1} (Herbig & Bell 1995; Rebull et al. 2011). The proper motion and radial velocities of these Tau-Aur members differ from the measurements for LDS 5606. Furthermore, the

K-band magnitude of LDS 5606 is ~1–2 mag fainter than Tau-Aur members of similar colors suggesting that if it were at a distance of 140 pc, it would be underluminous compared to other stars of the same spectral type (Rebull et al. 2011). Finally, the *UVW* velocities of LDS 5606 at the average Tau-Aur distance of 140 pc are –11, –33, and –8 km s^{-1}. These are markedly different from the *UVW* velocities listed in Bertout & Genova (2006). Figure 6 compares the *UVW* of LDS 5606 at 65 pc and 140 pc with members of β Pic (Malo et al. 2013) and Tau-Aur (Bertout & Genova 2006). There is no distance for which the *UVW* of LDS 5606 match those of Tau-Aur. Given these considerations, membership of LDS 5606 in Tau-Aur is unlikely.

3.3. Comparison with TWA 30

The LDS 5606 system shows remarkable similarity to TWA 30AB (Looper et al. 2010a,b). Both systems have stars of similar spectral type (~M5) and are widely separated: ~1700 AU for LDS 5606 and ~3400 AU for TWA 30. As a member of the TW Hya association, TWA 30 is younger (~8 Myr) than LDS 5606. Both LDS 5606 and TWA 30 host warm dust disks around each component (Fig. 4). The optical spectra of TWA 30AB and LDS 5606A show numerous emission lines. However, with the exception of some [OI] emission, the emission lines seen in LDS 5606A are permitted transitions (Zuckerman et al. 2014) while forbidden transitions dominate the TWA 30 spectra.

Looper et al. (2010a,b) interpret the TWA 30 spectra as due to a disk seen edge-on in the case of TWA 30B and nearly edge-on in the case of TWA 30A. The many forbidden lines in the optical spectra of both TWA 30 stars are produced in strong outflows nearly in the plane of the sky. The edge-on disks obscure the regions near the base of the accretion flows, which are responsible for the strong permitted lines expected in the magnetospheric model for disk accretion seen in many T Tauri stars. The disks around LDS 5606, in contrast, are likely to be nearly face-on (Zuckerman et al. 2014) thus enabling the optical helium and hydrogen lines to be seen strongly in emission. Furthermore, neither TWA 30A or B are detected in GALEX whereas both components in LDS 5606 are. The edge-on disk may be blocking all UV emission from TWA 30, yet this emission is unobscured in LDS 5606, a scenario probably similar to that of the face-on disk of TW Hya itself (see Rodriguez et al. 2011). In contrast, TWA 30A is detected in X-rays with ROSAT, whereas TWA 30B and both components of LDS 5606 are not. Looper et al. (2010b) attribute the TWA 30B X-ray non-detection to the edge-on disk. The non-detection for LDS 5606 is most likely due to the greater distance of this pair. The general absence of forbidden line emission indicates that any outflows at LDS 5606 are much weaker than at the TWA 30 stars (Zuckerman et al. 2014).

4. Conclusion

The LDS 5606 system is a widely separated (26″) binary consisting of two M5 dwarfs. These stars were identified as part of the ongoing GALNYSS program (Rodriguez et al. 2013), which seeks to identify low-mass members to nearby young moving groups by virtue of their strong ultraviolet emission. Our kinematic and spectroscopic analysis of LDS 5606 place it as a member of the ~20 Myr-old β Pic moving group. We estimate a kinematic distance of 65 pc, implying a projected separation of ~1700 AU. Features of youth are seen in the spectra of both stars. In particular, LDS 5606A shows numerous strong emission lines, especially of hydrogen and helium.

Both components of LDS 5606 have IR excess at WISE wavelengths suggestive of warm circumstellar dusk disks. As such, the properties of this binary are analogous to the younger (~8 Myr) TWA 30 binary (Looper et al. 2010a,b). Both systems exhibit strong emission lines and host circumstellar disks, although the different orientation of these disks may account for the different emission lines observed and for the lack of GALEX detections for TWA 30. To date, only a handful of binary stars located far from molecular clouds are known to host disks around each component. Among stars with ages ~8 Myr or older, LDS 5606 is one of only four binary or multiple systems known to host a pair of disks (TWA 30: Looper et al. 2010a,b; HD 223352: Phillips 2011; Fomalhaut: Kennedy et al. 2014; and LDS 5606). The unusual properties of the disks around the components of LDS 5606 and the accretion and photodissociation signatures in the spectra are discussed in detail in Zuckerman et al. (2014). Identification of systems like LDS 5606 show that additional outstanding members of these young moving groups may yet be found.

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