New Common Proper Motion Pairs: FMR 18 and FMR 19

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Abstract: In this work I present two new high common proper motion pairs (WDS 22117-2044 = FMR 18 and WDS 20502-0640 = FMR 19) discovered in the 2005 by LIADA Double Stars Section. FMR 19 is composed by stars of 17.02 (M1.5V) and 18.24 (M2.5V) separated by 4.2". FMR 18 is composed of stars of 13.73 (M3.5V) and 15.94 (M4V) magnitudes separated by 12.8". ROSAT X-ray emission and kinematic data were used to obtain an age of about 0.6 Gyr for FMR 18. Several binarity tests were used to determine if the stars for these pairs are gravitationally bound.

Introduction

Several years ago the author read an astrophysical study of 297 new high proper motion stars discovered by Wroblewsky *et al.* (1999). This study showed the astrophysical interest of these stars. In this work I report the discoveries of two common proper motion pairs found in this list of stars. The discovery was made during the observational program of LIADA Double Star Section in 2005 and was published in Rica (2010). In this work I study in detail these objects. FMR 18 is composed of WT2220 and WT2221, proper motion stars discovered and studied by Wroblewsky & Costas (1999) and Riaz *et al.* (2005). Bochanski (2005) only studied the primary component. These pairs were recently added to the WDS catalog as WDS 22117-2044 = FMR 18 and WDS 20502-0640 = FMR 19.

The Astrophysical Study

A detailed astrophysical study for both star components and for the stellar system was performed in this work. The lines of astrophysical study were published in Benavides *et al.* (2010) in sections 3 to 10. In the followed sections I add points to the astrophysical lines.

Determining V magnitude.

Using magnitude r' from *Carlsberg Meridian Catalog Number 14* (CMC 2006, hereafter CMC14) and JHK photometry from Two Micron All Sky Survey (Cutri *et al.* 2000; hereafter 2MASS), I determined the V magnitude using the relation (John Greaves, private communication):

$$V = 0.6\,(J\text{-}K) + r'_{CMT} - 0.03 \qquad (1)$$

Greaves took a large number of V magnitudes from the catalog "*UBVRI photometry of faint field stars*" (Skiff 2007) and matched them against CMC14 plotting V- r'_{CMT} and J-Ks. Expression (1) is only valid for $-0.2 < J\text{-}K < 1.2$ and $9 < r'_{CMT} < 14$. The standard deviation for V calculated in this way is

0.06 magnitudes.

In order to obtain a more accurate estimate for the magnitude V, I also used the photometric data of the UCAC3 catalog (Zacharias *et al*. 2009). From the model fit *fMag* and the aperture photometry *aMag* listed in the UCAC3 catalog and the JHK photometry from 2MASS, the V magnitude was calculated using the followed relations (Pavlov 2009):

$$V = 0.531(J\text{-}K) + 0.9060(mg\_f) + 0.95 \quad (2)$$
$$V = 0.529(J\text{-}K) + 0.9166(mg\_a) + 0.83 \quad (3)$$

Pavlov took a large number of V magnitudes from LONEOS catalog and matched them against UCAC3. For 16,500 stars he then did a linear least squares fit to derive a transformation from UCAC3 magnitudes to LONEOS magnitudes using the J–K as a color index. The standard deviation for V calculated in this way is 0.08 magnitudes.

ugriz photometric bands of Sloan Digital Sky Survey

The optical u, g, r, i and z bands from Sloan Digital Sky Survey (Adelman-McCarthy J.K. *et al.* 2009; hereafter SDSS) were used. Using photometric transformations it is possible to obtain U, B, V and I photometric data of good quality. In this work the following references for transformations were used: Smith *et al.* (2002), Jester *et al.* (2005), Karaali , Bilir, & Tunçel (2005). The errors of the transformation for Jester *et al.* are ±0.045 for U-B color, ±0.035 for B-V color, ±0.015 for V; the other references did not cite their errors.

X-Ray Activity

The X-ray emission is related to the age of stars and is inversely proportional to stellar age. While young stars are strong X-ray emitters, old stars are weak X-ray emitters. There are several diagrams published that show the relation of X-ray emission with stellar age. When an M dwarf emits X-rays it indicates an important coronal activity.

X-radiation is absorbed by the Earth's atmosphere, so instruments to detect X-rays must be taken to high altitude. **ROSAT** was an X-ray satellite telescope designed by Germany. It was launched in 1990 and operated until 1999. The ROSAT All-Sky Survey (RASS) was the first imaging X-ray survey of the entire sky. X-ray digital images show X-ray sources with very large FWHM of about 2 arcminutes and accurate calculation of centroids is difficult. So AR and DEC for the X-ray source are known with an error of tens of arcseconds. Optical counterparts for the X-ray sources are not easy to identify when the astrophysical search for optical counterparts is at angular distance that ranges from 16 to 40 arcseconds.

The flux conversion (CF) of Schmitt *et al.* (1995) was used to convert the count rate to energy flux. This CF is a function of hardness ratio HR:

$$CF = (5.30HR + 8.31) \times 10^{-12} \text{ [ergs cm}^{-2}\text{ count}^{-1}] \quad (4)$$

The X-ray energy flux was calculated as ergs cm^{-2} s^{-1}:

$$Fx = CF * CR \quad (5)$$

The HR and count rate values were taken from ROSAT catalog. If the distance to the source is known then the X-ray luminosity (Lx, units: ergs s^{-1}) can be calculated using the followed expression:

$$Lx = 1.2 \times 10^{38} (\pi^{-2})(Fx) \quad \text{[ergs s}^{-1}] \quad (6)$$

Several relations Lx – Age (Damiani *et al.* (1995), Stern *et al.* (1995) and Catalán *et al.* (2008)) were used to estimate the age of the stars.

WDS 22117-2044 = FMR 18

This new common proper motion pair is composed of two M3.5V and M4V red dwarfs of V magnitudes 13.74 and 15.91 (Figure 1). From the 2MASS catalog, I measured an angular separation of 12.79" in direction 304.4° (1998.504). The values of this measure correct the mistaken measure published in Rica (2010).

Astronomical Literature

Recently the stars of this stellar system have been study by Bochanski (2005) and Riaz (2006). Bochanski used 3 telescopes with diameters that range from 2.5 to 5 meters. He obtained spectra determining the spectral type and the spectroscopic distances using the TiO_5 molecular index. Riaz (2006) used a 1.5 meter telescope and also obtained spectra to determine the spectral type and distances using TiO_5 molecular index.

Photometric Data

The J, H and K photometry came from 2MASS. DENIS catalog was consulted to obtain the magnitudes in I band of 11.03 ± 0.04 and 13.06 ± 0.04.

The V magnitude was determined from CMC14,

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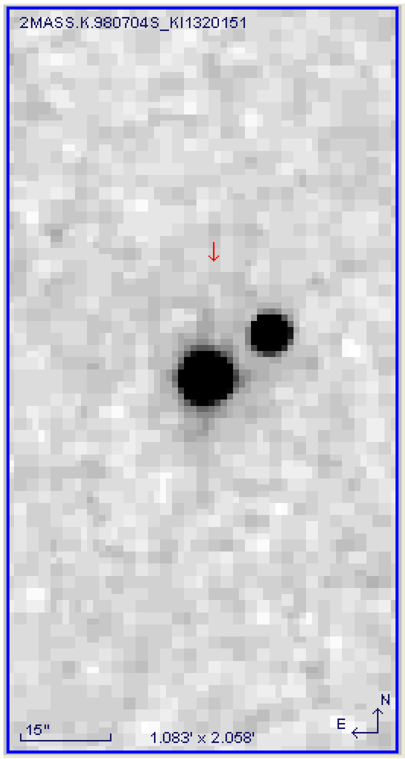

Figure 1: Image from 2MASS in K band of the new binary FMR 18.

UCAC3 and 2MASS. Using CMC14 a V magnitude of 13.73 and 15.92 was determined for A and B while using UCAC3, a V magnitude of 13.75 for the primary was obtained. For the secondary depending on whether the “a” or “f” photometry is used, values of 15.81 and 15.99 were obtained. The weighted mean for V magnitude was 13.73 ± 0.05 and 15.94 ± 0.05.

From the V magnitudes determined in this work and DENIS I band, a V-I color of +2.7 and +2.85 were calculated for A and B members. An independent value of V-I can be calculated using the TiO_5 molecular index of the spectra determined by Bochanski (2005) and Riaz (2006). Using the followed expression:

$$V - Ic = 6.3657 - 14.6706 \times TiO_5 + 17.6957 \times (TiO_5)^2 - 8.0934 \times (TiO_5)^3$$

Bochanski only studied the primary component of this system and obtained a TiO_5 = 0.46. Riaz (2006) obtained a TiO_5 of 0.45 and 0.48 for A and B. Using the mathematical expression I obtained V-Ic color of +2.59 and +2.51. This color V-Ic is an excellent temperature indicator for cool objects like red dwarf stars. Surprisingly component B has smaller V-Ic color than A component while the V-K color are +4.96 and +5.22 indicating that B component is redder tan A component.

The galactic latitude is -53 degrees and the reddening calculated in this work was of E(B-V) = +0.01 so their influence on the astrophysical parameters is negligible.

Relative Astrometry

Photograhic plates from the Digitized Sky Survey and 2MASS catalog were used to obtain relative astrometry (θ and ρ measures). Astrometrica 4.4 software was used to perform the measures. The results are listed in Table 1. Column (1) lists the epoch of the measures in Besselian years; column (2) and (3) give the position angle (θ, in degrees from North to East) and angular separation (ρ, in arcseconds); the last column lists the source were the relative astrometry was obtained (DSS: Digitized Sky Survery; 2MASS: 2MASS catalog).

A small relative motion of B with respect to A (Δx = +1.9 ± 7.6 mas/yr and Δy = -8.7 ± 6.3 mas/yr) is calculated, confirming the common proper motion nature of this pair.

Proper motions, spectral types, absolute magnitude, and photometric distances.

UCAC2 and UCAC3 were consulted to obtain the proper motions for the components. In this work I used the proper motion data from UCAC2. This catalog lists a very similar proper motion for A and B component (see Table III) so this pair is a common proper motion pair (within the error margins).

From photometric data (bands VJHK) and kinematic data (proper motions from UCAC2), I could estimate spectral types and luminosity classes of M3.5V and M4.0V for primary and secondary component of FMR 18.

Bochanski (2005) and Riaz (2006) also determined spectral types information with a precision of 0.5

Table 1: Relative Astrometry for WDS 22117-2044 = FMR 18

Epoch (1)	Theta (deg) (2)	Rho (arcsec) (3)	Source (4)
1977.546	304.0	13.02	DSS
1984.774	305.6	12.75	DSS
1991.753	302.6	12.87	DSS
1994.774	302.8	12.93	DSS
1998.504	304.4	12.79	2MASS

spectral subclass. For the primary component both works estimated a M3.5V spectral type in total agree with the result obtained in this work. For the secondary member only Riaz (2006) estimated its spectral type (obtained a M3V spectral type). It is 1 subclass hotter than my result.

The difference of 1 spectral subclass is small and it is within the error margins. But for red dwarfs, this small error corresponds to important change in absolute magnitude of more than 1 magnitude. This difference is important when we calculate photometric distances.

The absolute magnitudes calculated from the V-J, V-H and V-K colors are 12.09 and 12.65 for primary and secondary respectively. These are the typical absolute magnitudes for M3.5V and M4V stars confirming our results. I also could calculate the K absolute magnitude and the photometric distances (see Table 2).

From Legget (1992) we can calculate the absolute magnitude in K band for young ("y"), old ("o"), and halo population stars. This absolute magnitude is not the same for different stellar populations (based on the age and/or the kinematics). Table 2 lists distances that range from about 20 to 25 pc for the primary and 44 to 54 pc for the secondary depending on the stellar population in which the components belong. But, how can we know if these stars are young or old? In the next section I will detail how.

Bochanski (2005) studied only the primary component. He obtained an absolute magnitude in R band from TiO_5 index. This relation has a sigma of ±0.4 magnitudes. His result was a distance of 20 pc, in excellent agreement with our result. Riaz used the same method to determine the distance, but he used a different mathematical expression, with an error of ±0.8 magnitudes. These distances were 39 pc and 101 pc for primary and secondary component.

The photometric distances calculated in this work use the V-J, V-H and V-K colors. The distances obtained in this way have a mean error of about 20 percent (if they are compared to Hipparcos distances). There are no trigonometric parallaxes in the literature for these stars. So to know accurate distances, we must wait until the GAIA satellite obtains accurate trigonometric parallaxes (2012).

Stellar population and stellar age

In this work we determine for the first time that primary component is surely a young disc star about 600 million years old.

Photometry

The two color diagram of Leggett (1992) presents different regions where stars of different stellar populations are located. In Figure 2, the members of FMR 18 are plotted as red filled circles. They are in a region typical for young disk stars or young/old disk stars.

The primary component has a width in the Hα line of 4.9 Å and this is a clear indicator of the existence of cromospheric activity and so of a stellar youth.

Galactocentric Velocity

Another age indicator is stellar kinematics. The galactocentric velocity is the space velocity of the stars around the Milky Way's center. Young stars have a motion linked to the thin galactic disk, older stars also move in the galactic disk but in a wider region. Finally, the halo stars have motions not linked to the galactic disk and so their motions with respect to our solar system are very large and often similar to the galactic disk rotation (about 215 km/s). For a more detailed information consult Benavides *et al.* (2010).

Bochanski (2005) calculated a galactocentric velocity of (U, V, W) = (+3, +4, +9) km/s. This value is very different to that calculated in this work using the same data ((U, V, W) = (-14, -9, -4) km/s). In this work we, used the method of Johnson & Soderblom (1987), the same that was used by Bochanski. I confirmed the good results of our computer program using a star in the list published in Johnson & Soderblom (1987) so possibly the value of Bohanski is not correct.

From galactocentric velocity and using several diagrams (see Benavides *et al.* (2010)), FMR 18 A belongs to the young disk population. The Grenon's parameter, fG, is 0.06 - 0.07 corresponding to stars belonging to a young - medium age thin disk with an

Table 2: Absolute Magnitudes and Photometric Distances

References	Absolute Magnitudes	Distances	Using
Henry *et al.* (1997)	Mv: 12.09±0.15 for A 12.65±0.10 for B	21.4±1.4 pc for A 44.9±2.0 pc for B	V-J, V-H and V-K
Henry *et al.* (2004)	Mk: 7.09±0.05 for A 7.44±0.04 for B	21.7±0.4 pc and 45.1±0.8 pc	V-J, V-H and V-K
Leggett (1992)	For A: Mk: 6.75 (y) – 7.24 (o) For B: Mk: 7.08 (y) – 7.52 (o)	For A: 25.4 pc (y) – 20.3 pc (o) For B: 54.0 pc (y) – 44.0 pc (o)	V-K

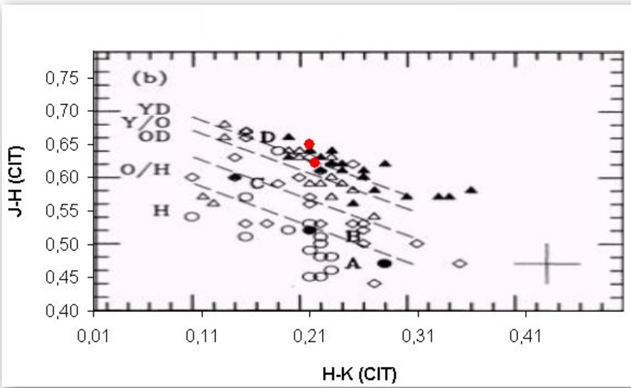

Figure 2: The J-H and H-K two color diagram shows the different locations for different stellar populations. The members of FMR 18 are plotted as red filled circles. They are in a region typical for young disk stars or young/old disk stars.

approximate age of 3-4 Gyrs.

X-ray activity

The ROSAT satellite found an X-ray source at an angular distance of 14 arcsecond from FMR 18 A and at 17 arcseconds of FMR 18 B. This source is cataloged as 1RXS J221142.4-204406. The positional error for the X-ray source is of 17 arcseconds, so it is difficult to be sure which optical counterpart is emitting in the X-band. According to the *ROSAT All-Sky Bright Source Catalog (Voges 1999)* the best candidate is FMR 18 A.

In this work the flux Fx was calculated. From Fx and distance for FMR 18 A, I calculated the absolute luminosity, log Lx, in erg * s^{-1}. For this X-ray source, ROSAT lists a count rate of 0.0804 ct/s and a HR1 = -0.37 ± 0.19. A log Lx = 28.60 (+0.15 / -0.19) erg s^{-1} was obtained.

If I consult the diagram used in Catalán *et al.* (2008) the age for the primary is 600 (+100 / - 150) million years. A similar age to that of Hyades cluster (about 625 million years) was determined using the diagrams of Damiani *et al.* (1995) and Stern *et al.* (1995).

Nature of the pair.

Although the large common proper motion (probability of 97.6 percent) is an important binarity indicator, it is desirable to confirm its nature using other tests.

To be a true binary the members of the pair must be at the same distance. At first sight it seems clearly that both components are at different distances to us. But if we take into account the 20 percent error in the distances, then A and B components have a small (5-10 percent) but not negligible probability to be at the same distance, so it can not assured that both stars have different distances.

The criterion of Grocheva & Kiselev (1998) calculate the stars that have the same proper motion (within the errors margins) that the components of the pair, around the position of the pair. This criterion determines that if $P < 0.01$ then the pair is true. For FMR 18 I obtained a P = 0.002, searching in a region of 1 deg of radius around FMR 18. If I extend this region to 5 degrees, then P = 0.0001. So FMR 18 is a true binary according to this criterion.

Several criteria based in celestial mechanics were used (those of Dommanget (1954), van de Kamp (1961) and Sinachopoulos & Mouzourakis (1992)). These criteria from astrophysical data determine if a pair of stars orbits each other around their center of mass. They are described in detail in Benavides *et al.* (2010). The criterion of Dommanget (1954) determined that the minimum parallax to consider this pair as gravitationally bound is about 0.036" which corresponds to a maximum distance of 27.6 pc. The primary component is at 21 - 25 pc, but the distance for the secondary is larger. At the average distance for the stellar system (~40 ± 15 pc), A and B are not bound stars, but if I use the distance for the main component (25.4 pc for a young star) then FMR 18 would be a binary with component gravitationally bound.

For the criterion of van de Kamp, I need the stellar mass, the projected separation and the annual variation of theta. Using the average distance for the system, this criterion shows that the true critical value for a parabolic orbit is 45 $AU^3\ yr^{-2}$ while the observed projected critical value is of 62.8 $AU^3\ yr^{-2}$, larger than the true value, so B is not bound to A. But if I use the distance for the main member, then this test says the stars in this pair are gravitationally bound.

The tangential velocity corresponding to the observed relative proper motion for B with respect to A ranges from 1.3 to 2.0 km s^{-1}, depending on the distance used (that of the primary or that of the secondary component). Using the criterion of Sinachopoulos & Mouzou, a maximum orbital velocity of 1.05 km s^{-1} was calculated so B is not bound to A.

To summarize, it is not possible to reliably determine the nature of this pair. It is important to improve the distance values for A and B and determine if they are at the same distance from us. However this common proper motion pair could be a true binary with components gravitationally bound if it was at the distance of the main component (about 25.4 pc). A monte carlo simulation was designed to determine

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Table 3: Astrophysical Data for Components of FMR 18.

	Primary (WT 2221)	Secondary (WT 2220)
α_{2000} c)	22h 11m 4.08s	22h 11m 41.33s
δ_{2000} c)	-20° 44' 18.1″	-20° 44' 10.9″
V a)	13.74	15.94
K c)	8.78	10.71
J – H c)	+0.66	+0.63
H – K c)	+0.24	+0.25
J – K c)	+0.90	+0.88
$\mu(\alpha)$ [mas/yr] b)	+127.3 ± 8.0	+121.8 ± 8.0
$\mu(\delta)$ [mas/yr] b)	-58.1 ± 8.0	-59.0 ± 8.1
Spectral type d)	M3.5V	M4 V
Distance [pc] d)	21.4	44.9
Distance moduli K- M_K d)	+2.03	+3.63
Mv d)	12.09	12.65
Bolometric correction d)	-2.27	-2.50
Mass [in solar unit] d)	0.31	0.26

a) inferred from photometric data of CMC14, UCAC3 and 2MASS catalogs; b) UCAC3 catalog; c) 2MASS catalog; d)This work

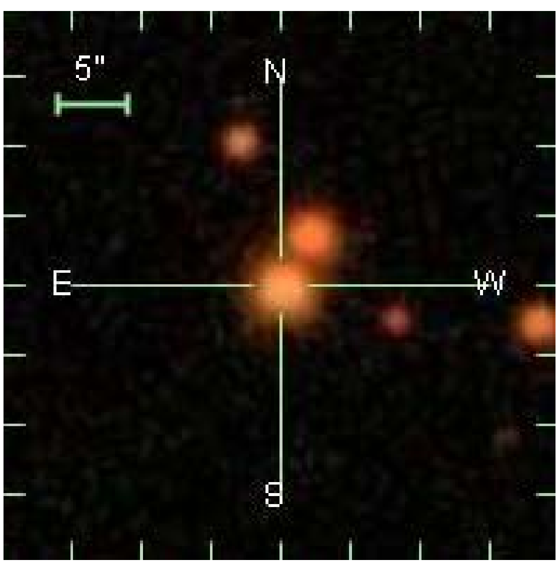

Figure 3: Image from Sloan Digital Sky Survey (SDSS) of the new binary FMR 19. The image was taken in 2000.673

the probability that FMR 18 A and B be gravitationally bound. The input parameters (proper motions, distances, stellar masses, etc.) with their errors, were considered as Gaussian distributions. Relative radial velocity was considered zero. About 25,000 iterations were executed that concluded there is a maximum of 30% probability that the components of FMR 18 be gravitationally bound, assuming that both stars are at the same distance. The probability that both stars be at the same distance is about 8 - 9%. If this information is taken into account, the final probability that FMR 18 A and B are gravitationally bound is only of about 3%. But, that we must wait to GAIA obtain accurate parallaxes for these stars.

In the case that FMR 18 is a bound system then, the expected semimajor axis, E(a), would be 16.11" (= 408 AU), if the system is located at 25.4 pc. Using Kepler's Third Law the orbital period (assuming a face-on and circular orbit) would be about 11000 years. The value for 25.4 pc for the distance was calculated using the expressions listed in Legget (1992) for young population disk stars. Our X-ray analysis determined the young age for this system so this

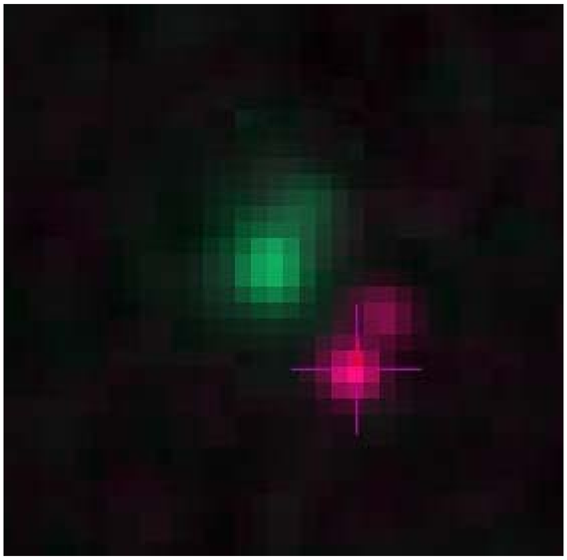

Figure 4: Color composition image for FMR 19 using a POSS I (O emulsion) photographic plate taken in 1953.629 and a 2MASS image taken in 1998.804. The position of the FMR 19 members is showed in green for epoch 1953.629 and in red for 1998.804. The common proper motion for both components is clear.

value for the distance can be a suitable one.

Another wide companion?

At 7 arcminutes north of FMR 18, in position 22h 11m 37.78s -20º 36' 56.2", is located a star cataloged as WT 2219 in Wroblewski & Costa (1999) catalog. This star moves with a similar proper motion to that of the FMR 18 members. Is it physically bound to FMR 18 AB? From VJHK photometry (J = 11.64; H = 10.98; K = 10.81) and the USNO-B1.0 proper motion ($\mu(\alpha)$ = +0.134"/yr *and* $\mu(\delta)$ = -0.028"/yr) a spectral type of M1.5V was determined. From CMC14 and UCAC3 photometric data, a V = 14.80 ± 0.08 was determined. This star is located at a distance of 100-132 pc (depending if it is a young or an old star), so it is more distant than the FMR 18 members and it is not bound to FMR 18.

The astrophysical data for FMR 18 are summarized in Table 3.

WDS20502-0640 = FMR 19

This binary is located at RA = 20h50m13.44s and dec = -6º 39' 56.4" in the constellation Aquarius and is composed of two M1.5V and M2.5V red dwarfs of V magnitudes 17.02 and 18.24. They are separated by 4.2" in direction 333 degrees. See Figure 3.

The primary is cataloged as WT 2195 in the Wroblesky list. In the study for this pair, I used also the photometric and astrometric data from Sloan Digital Sky Survey (SDSS). I obtained the reddening using several extinction maps. From BVIJHK photometric and proper motion data, I determined the stellar population where this system belongs and the absolute magnitudes.

Measure of the relative astrometry

Using Surface and QuadPx tools of REDUC software, I measured an old photographic plate from Palomar Observatory Sky Survey taken on 1953.629 by the 48 inch Palomar telescope. The result was: 343.9º and 4.28" (with a delta_mag = 1.3 mag.; the image was taken with a blue filter).

Relative astrometry (θ and ρ) were obtained from astrometric information of 2MASS and SDSS catalogs. To transform RA and DEC into θ and ρ, I used software included in the CD-ROM of the book "Observing and Measuring Visual Double Stars" by Bob Argyle. The result was θ = 331.7º and ρ = 4.09" (1998.804); θ = 332.5º and ρ = 4.16" (2000.673) from 2MASS and SDSS respectively.

Spectral types and luminosity class

Spectral types and luminosity class for the components were determined using broad photometric information and proper motions. The optical u, g, r, i and z bands came from SDSS and the J, H and K infrared bands came from 2MASS catalog. SDSS photometry was transformed to U, B, V, I photometric data of good quality.

The primary, WT 2195, is a weak red dwarf of V = 17.02 and spectral type M1.5V. The secondary, SDSS J205013.29-063952.9, is another red dwarf of V = 18.24 and spectral type M2.5V. The distance moduli differs only by 0.2 magnitudes (distances 217 and 234 pc) and so both stars are surely located at the same distance. Spectral types were corrected by reddening. In this work a E(B-V) = +0.03 was calculated.

Are the stars of FMR 19 gravitationally bound?

The primary component is a weak star with high proper motion ($\mu(\alpha)$ = -0.120"/yr and $\mu(\delta)$ = -0.119"/yr from UCAC3) cataloged as WT 2195 in the Wroblesky & Costa (1999) catalog. There is no data in the literature about the proper motion for the secondary star. The visual inspect and the blink constructed from Digitized Sky Survey (DSS) and the SuperCosmos Sky Survey (SCSS) shows clear evidence that both stars share a common proper motion. The 2MASS catalog shows both stars with very similar offset with respect the older photographic plates confirming the common proper motion nature. See Figure 4.

From the measures presented here, I obtained a preliminary relative motion of B with respect to A of

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Table 4: Astrophysical Data for components of FMR 19

	Primary SDSS J205013.42-0639566	Secondary SDSS J205013.29-063952.9
α_{2000} c)	20h 50m 13.44s	20h 50m 13.31s
δ_{2000} c)	-06° 39' 56.4s	-06° 39' 52.8s
V a)	+17.02	+18.24
B – V a)	+1.66	+1.63
V – I a)	+2.04	+2.30
K c)	+12.99	+13.76
J – H c)	+0.58	+0.55
H – K c)	+0.18	+0.23
J – K c)	+0.76	+0.78
u' e)	+20.41 ± 0.07	+21.55 ± 0.17
u'-g' e)	+2.59 ± 0.07	+2.54 ± 0.18
g'-r' e)	+1.48 ± 0.03	+1.44 ± 0.08
r'-i' e)	+0.84 ± 0.03	+1.14 ± 0.09
i'-z' e)	+0.48 ± 0.03	+0.51 ± 0.13
$\mu(\alpha)$ [mas/yr] b)	-0.120	---
$\mu(\delta)$ [mas/yr] b)	-0.119	---
Spectral Type d)	M1.5 V	M2.5 V
Distance [pc] d)	217 ± 14	234 ± 25
V- Mv d)	+6.63	+6.80
Mv d)	+10.27 ± 0.14	+11.54 ± 0.24
Bolometric correction d)	-1.65	-1.90
Mass [Solar Mass] d)	0.37	0.29

a) Transformation of SDSS photometry to BVRI standard photometry; b) Wroblesky & Costa (1999); c) Two Micron All Sky Survey; d) this work; e) Sloan Digital Sky Survey (SDSS).

Δx = -16.0 ± 0.8 mas/yr and Δy = -10.0±1.8 mas/yr. Then, I can calculate the proper motion of B from the primary proper motion and the relative motion: $\mu(\alpha)$ = -0.136 ± 6 "/yr and $\mu(\delta)$ = -0.129 ± 6 "/yr. UCAC3 does not list errors in proper motion for the primary (the motion was obtained using only 2 observations), so in order to obtain errors for secondary proper motion, I assumed an error for UCAC3 data of about 5 mas/yr.

The distance moduli for the stellar members (+6.6 and +6.8 for primary and secondary) is a good indicative that both stars surely are at the same distance from us.

I used several criteria (those of Dommanget (1954), van de Kamp (1961) and Sinachopoulos & Mouzourakis (1992)) that are based in the astromechanics. They are described in Benavides *et al.* (2010). According to these criteria, and using the very preliminary relative motion for the system, the component of FMR 19 does not orbit around the center of mass. So, I conclude that is a common proper motion binary (the "binary" term is used in a wider sense although this pair of stars seems not to be orbiting around the center of mass).

The astrophysical data for FMR 19 are summa-

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rized in Table 4.

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