Study of a New CPM Pair 2Mass 01300483-2705191

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Abstract: In this paper I present the results of a study of 2MASS 01300583-2705191 as components of a common proper motion pair. I used the PPMXL catalog's proper motion data to select this system, which has a high declination proper motion but low aright ascension proper motion with large errors in this case. I also determined the proper motions independently, obtaining similar proper motions for both components, however I used the PPMXL values in this study. On the other hand, with the absolute visual magnitude of both components, I obtained distance moduli 7.95 and 7.92 Which put the components of the system at a distance of 389.0 and 383.7 parsecs. Taking into account errors in determining the magnitudes, this means that the probability that both components are situated at the same distance is near 100%. I suggest that this pair be included in the WDS catalog

Introduction

The main purpose is to determine some important astrophysical features of 2Mass J01300483-2705191 (Figure 1), such as distance, spectral type of the components, etc. It was achieved by an astrophysical evaluation using kinematic, photometric spectral and astrometrical data, obtaining enough information to determine if there is a gravitational tie between both components and its nature. In this study I used Francisco Rica Romero's spreadsheets [1] that makes many astrophysics calculation.

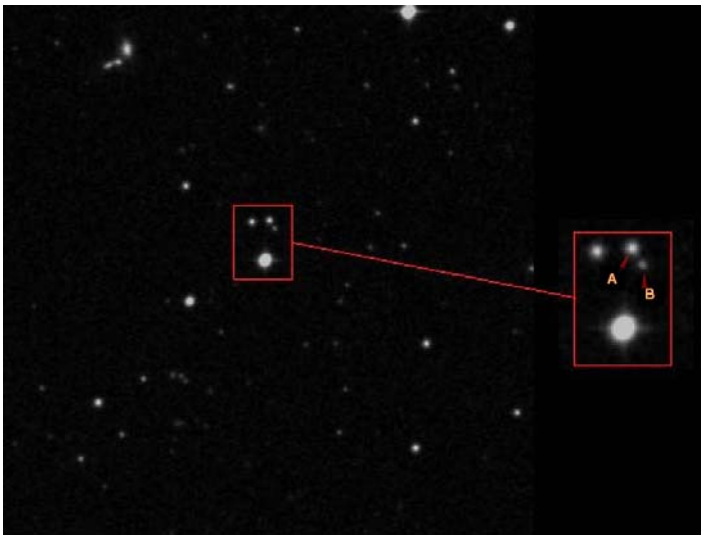

Figure 1: Picture based on POSS plate that shows the system under study. Inset identifies the components.

Methodology

Proper motion / kinematics

I obtained the proper motions for the pair from the PPMXL catalog (a catalog that provides positions and proper motions), which are shown in Table 1. I also calculated the resulting tangential velocity (Table 2).

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Table 1: Proper motion of the pair described in this study

Component	Proper Motion RA	Proper Motion DEC
A	-2.1 ± 4.0	-31.6 ± 4.0
B	-0.5 ± 4.0	-28.6 ± 4.0

Table 2: Tangential velocity calculation based on PPMXL proper motions

Tangential Velocity Calculation	A	B
Mu (alpha) =	-0.002	-0.016
Mu (delta) =	-0.032	-0.029
Pi (“) =	0.0026	0.0026
Ta (km/s)	-4	-29
Td (km/s)	-58	-52
Vt (Km/s)	58	59

I made an independent study of the proper motions of this system, where I calculated component's positions from differently dated plates that I obtained using Aladin Sky Atlas with a timeline difference of 41.7402 years. I made the measurements using Astrometrica software, the stars were not saturated at any plate, obtaining easy measurements. These results are shown in Tables 3 and 4. That study revealed that the proper motions are similar and suggest that this system could be a CPM pair. These results are the reason I decided to study this system.

Relative Astrometry

Relative astrometry measurements were based on plates with different dates obtained from Aladin software and with resolution 1.1”. I used Astrometrica software to obtain angle deviation and applied that value on Reduc software calibration parameters for each plate. I also obtained position angle (theta) and separation (rho) values for each plate using Reduc (see Table 5) .

Table 5:Theta / Rho measurements obtained with Reduc Software

Besselian Date	Theta (deg)	Rho (as)
1955.9391	216.51	8.65
1986.5699	211.34	8.368
1996.6125	212.05	8.32
1997.6793	213.14	8.484

Table 6: Photometric magnitudes pulled from 2MASS (infrared) and USNO B1.0 catalogs

	J	H	K	B2	R2
A	13.55	12.933	12.692	18.53	15.56
B	14.838	14.275	13.919	20.11	17.07

Photometry / Spectral Type of the Components

I retrieved all plates with plate resolution around 1 arcsecond/pixel and catalog data of the image field from USNO B1.0 and 2MASS (Table 6).

Using Francisco Rica Romero's astrophysics spreadsheet “SDSS-2MASS-Johnson conversions” [1], I obtained the results shown in Table 7.

With this set of photometry in bands J,H,K, the deduced B,V,I and using the Rica Romero's “Astrophysics” spreadsheet, I determined the spectral

Table 4: Proper motions deduced using coordinates from Besselian date plates (Besselian date vs coordinates) not used in this study.

Besselian Date	Primary RA(°)	Primary DEC(°)	Secondary RA(°)	Secondary DEC(°)
1955.9391	22.515500	-27.087861	22.514000	-27.089889
1986.5699	22.515458	-27.088167	22.514000	-27.090083
1996.6125	22.515375	-27.088306	22.513917	-27.090256
1997.6793	22.515292	-27.088194	22.513708	-27.090139

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Table 7: Based at JHK (2MASS) and B2, R2 (USNO B.1) photometric magnitudes and using Francisco Rica Romero's "SDSS-2MASS-Johnson conversions" I obtained color index (B-V), (V-I), Magnitude V and later with "Astrophysics" spreadsheet, Bolometric correction.

	Color B-V	Color V-I	Magnitude V	Bolometric correction
A	1.30	1.38	15.93	-0.752
B	1.35	1.48	17.39	-0.865

Table 8: Reduced Proper Motion

BAND	Mag (A)	H(A)	Mag (B)	H(B)
V	15.93	13.4	17.39	15.0
K	10.2	10.5	13.919	11.5

Table 9: Distance moduli and distances in parsecs, values obtained using Francisco Rica Romero's spreadsheet "Astrophysics"

Component	Distance modulus	Distance parsec
A	7.95	389.0
B	7.92	383.7

type of each component from photometric data and obtained K7V and K9V for the primary and secondary, respectively.

Using the same spreadsheet, I obtained the reduced proper motions for the companions presented in Table 8. The Reduced Proper Motion Diagram (Figure 2) shows that both components are situated in the dwarf/subdwarf region. This suggests that the primary component and its companion are main sequence stars.

The absolute visual magnitude of both components enabled the calculation the distance moduli. Again, I used Rica Romero's spreadsheet "Astrophysics", the results are shown in Table 9.

The distance moduli obtained for each component were similar. Taking into account the errors in determining the magnitudes, I conclude that the probability that components are at the same distance is almost 100%

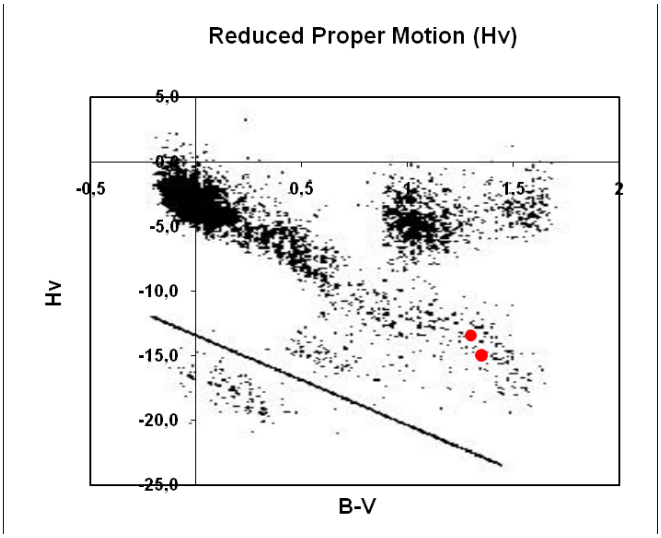

Figure 2: Reduced-Proper diagrams after Luyten's White Dwarf Catalog [4]. This diagram shows that both components are situated in the swarf/subdwarf region.

Conclusions

Using the spectroscopy obtained above, I estimate the sum of the masses to be 1.15 solar masses. Using the above calculated distances, the Wilson and Close criteria [2,3] indicate a physical system.

The distance moduli calculated above, put both components at the same distance 389.0 (primary) and 383.7 (secondary) parsecs Which means that the probability that both components are at the same distance is almost 100%, which is a good indicator about the possible physical relation between the stars.

With respect to kinematics, the RA proper motion of this system is low (as indicated by PPMXL), for this reason, I verified the kinematics through digitized plates from different dates, the difference being 41.7402 years, and obtained similar results on RA proper motions and nearly the same values for DEC.

The latest image available from Aladin software (1997.6793) gives astrometry values: $\theta = 213.14^{o}$ and $\rho = 8.484"$. According to these data and using Rica Romero's spreadsheet, I estimate the parameter (p/μ) representing the time it takes the star to travel a distance equal to their angular separation with its motion μ at T = 266 years. This also indicates that the stars are likely to be physically associated.

In summary, with the present information I think that this pair should be considered a binary and I suggest that this pair be included in the WDS catalog.

Acknowledgements

I used Florent Losse's "Reduc" software for relative astrometry and Herbert Raab's "Astrometrica" software to calculate plate's angle deviation.

I used Francisco Rica Romero's "Astrophysics" and "SDSS-2MASS-Johnson conversions" with many useful formulas and astrophysical concepts.

The data analysis for this paper made use of the Vizier astronomical catalogs service maintained and operated by the Center de Donnès Astronomiques de Strasbourg (http://cdsweb.ustrasbg.fr)

References

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