

Study of 17 New Stellar Pairs in the Constellation Aurigae with Three Possible New Common Proper Motion Pairs

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Abstract: During observation in the constellation Auriga, 17 new stellar pairs were found by the author. The separations are between 3 and 10 arc seconds, the brightness's are between 10 and 14 magnitudes. The difference in brightness of the components of each pair is less than or equal to 1 magnitude. Except for USNO-B1.0 1257-0104496 and USNO-B1.0 1257-0104504, all other stars are listed as single stars. With Halbwachs' third criterion, possible new common proper motion pairs were found.

Report

A 12-inch Newtonian telescope with focal length of 1500 mm was used for the observations. Images of sky fields were taken with a Canon 1100 D Digital Single Lens Reflex Camera (DSLR). The camera was sited at the primary focus of the telescope. The field of view was about 0.9 x 0.6 degrees. To make the camera more sensitive to red light, the blocking filter for red light was removed. Therefore, stars with K and M spectra and also HII regions could be better imaged. The scale of the optical setup was about 0.77 arc seconds per pixel. The telescope was connected to a laptop. The software package Redshift 7 was used to aim the telescope. The DSLR camera was also connected to the laptop and could be controlled remotely.

For these observations in the constellation Auriga, single shots of 4 interesting star fields were taken on 2013.168. Exposure time was 30 seconds. The minimum brightness of the stars is about 16 magnitudes. The four interesting fields are around the star clusters M36, M37, M38, and around ϵ Aurigae.

During the analysis of the images, 17 new double stars were found. These double stars are located outside the star clusters, and are not listed in the WDS catalog.

These double stars are listed in Table 1. The first

column lists the catalog name of the star, second and third columns are coordinates for R.A. and declination, fourth column gives the brightness, fifth and sixth columns give the proper motion if known, seventh column is the estimated difference in brightness, eighth column gives a short note about the color if the component has a K or M spectra, ninth and tenth columns give the calculated individual magnitudes, column eleven and twelve give the position angle in degrees and separation between the components in arc seconds, the thirteenth column shows the calculated Aitken limit p max in arc seconds, the fourteenth column gives the time in years for the pair to move the distance of its own separation if the proper motion is known, the fifteenth column gives a short note about the image field in the neighborhood. Except for USNO-B1.0 1257-0104496 and USNO-B1.0 1257-0104504, all other stars are listed as single stars in the Redshift database.

The difference in brightness of the components of each pair is less than or equal to one magnitude. The given value can be interpreted as a combined magnitude (except USNO-B1.0 1257-0104496 and USNO-B1.0 1257-0104504). For each component a new individual brightness and also the Aitken criteria p max can be calculated. For calculation the formula in Francisco

Study of 17 New Stellar Pairs in the Constellation Aurigae with Three Possible New ...

Table 1: 17 new stellar pairs in constellation Aurigae, observing date: 2013,168

Name	RA (h m s)	Dek (deg)	Mag	PM R.A. (mas/ yr)	PM Dec. (mas/ yr)	Est. Mag	spec- tra note	Mag A	Mag B	θ (deg)	ρ (as)	Ait- ken limit ρ max (as)	T= ρ /PM (yr)	Notes
TYC 2907-00308-1	05 00 01.4	43 42 11.1	12.45	0	0	0		13.20	13.20	304.0	5.90	2.04		ϵ Aur
USNO-B1.0 1340-0125220	05 00 35.4	44 02 03.3	11.50	0	0	1	A red	11.86	12.86	61.6	6.20	3.17		ϵ Aur
USNO-B1.0 1341-0125973	05 01 01.7	44 06 07.0	13.30	-6	-4	0.5		13.83	14.33	122.3	4.20	1.38	582	ϵ Aur
USNO-B1.0 1258-0101998	05 27 54.6	35 51 48.1	12.5	0	0	0.5		13.03	13.53	91.9	3.28	2.00		near M38
USNO-B1.0 1259-0104506	05 28 26.0	35 57 46.8	12.10	0	0	0		12.85	12.85	224.4	5.95	2.40		near M38
USNO-B1.0 1260-0103923	05 28 31.8	36 02 11.9	13.10	0	0	1		13.46	14.46	302.7	5.66	1.52		near M38
USNO-B1.0 1260-0104160	05 28 52.7	36 02 15.8	12.40	0	0	0		13.15	13.15	151.9	4.90	2.09		near M38
USNO-B1.0 1257-0104337	05 30 25.6	35 43 47.1	12.50	0	0	1		12.86	13.86	75.6	5.70	2.0		near M38
USNO-B1.0 1257-0104496	05 30 37.1	35 44 38.0	11.20	106	-312	0.1	A red	11.10	11.20	129.2	6.26	5.26	19	near M38
USNO-B1.0 1257-0104504	05 30 37.5	35 44 36.5	11.10	0	0									
USNO-B1.0 1259-0106575	05 30 44.9	35 57 19.2	12.60	0	0	0		13.35	13.35	217.0	5.18	1.91		near M38
USNO-B1.0 1244-0101791	05 35 12.5	34 26 19.4	13.0	0	0	1		13.36	14.36	97.8	5.28	1.59		near M36
USNO-B1.0 1243-0101852	05 35 31.0	34 19 32.2	13.1	0	0	0.5		13.63	14.13	179.0	5.84	1.51		near M36
USNO-B1.0 1243-0102624	05 36 45.1	34 18 23.0	13.5	0	0	0		14.25	14.25	267.1	5.57	1.26		near M36
USNO-B1.0 1243-0102678	05 36 49.2	34 20 15.4	11.10	0	0	0	A red	11.85	11.85	128.0	6.25	3.81		near M36
USNO-B1.0 1243-0102718	05 36 53.0	34 20 12.1	13.30	0	0	0.5		13.83	14.33	321.6	6.04	1.38		near M36
USNO-B1.0 1244-0102740	05 36 56.7	34 25 09.1	12.8	0	0	0.5	B red	13.33	13.83	115.6	5.17	1.74		near M36
USNO-B1.0 1240-0105442	05 38 25.0	34 01 28.2	11.30	-66	8	0	A red	12.05	12.05	4.5	9.80	3.47	27	near M36

Rica Romero's paper was used (Romero, 2006). In all cases the measured separation ρ is greater than the calculated Aitken criteria ρ max (see Table 1). As result of these calculations, it can be expected that these 17 analyzed pairs are not physical double stars.

For 3 stars, the proper motion is given in the USNO-B1.0 catalog. With Halbwachs' criteria (Halbwachs, 1986) it can be determined if these stars are possible common proper motion pairs. If time T is less than 1000 years, the probability for a common proper motion pair is nearly 99% (Halbwachs, 1986). T is the ratio of separation and proper motion ($T = \rho/PM$).

USNO-B1.0 1341-0125973 has the smallest proper motion of these 3 stars. Proper motion is -6 mas per year in R.A. and 4 mas per year in declination. The given error for proper motion in USNO-B1.0 catalog is for R.A. 1 mas per year and 5 mas per year in declination. Separation is 4.2 arc seconds, $T = 582$ years.

USNO-B1.0 1257-0104496 and USNO-B1.0 1257-0104504 are both single stars but the separation is only 6.26 arc seconds. The proper motion for USNO-B1.0 1257-0104496 is about 330 mas per year. The proper motion for USNO-B1.0 1257-0104504 is not known. Relative position between both stars has not significantly changed since the POSS-1 survey. Therefore it can be expected that both stars have same proper motion and are common proper motion stars. $T = 19$ years.

USNO-B1.0 1240-0105442 is the widest pair in this study of 17 new stellar pairs. The separation is 9.8 arc seconds. $T = 27$ years.

Because USNO-B1.0 1341-0125973, USNO-B1.0 1257-0104496/USNO-B1.0 1257-0104504 and USNO-B1.0 1240-0105442 satisfy Halbwachs' criteria these 3 pairs could be possible new common proper motion pairs.

(Continued on page 266)

Study of 17 New Stellar Pairs in the Constellation Aurigae with Three Possible New ...



Figure 1: TYC 2907-00308-1



Figure 4: USNO-B1.0 1258-0101998



Figure 2: USNO-B1.0 1340-0125220



Figure 5: USNO-B1.0 1259-0104506



Figure 3: USNO-B1.0 1341-0125973 could be a possible common proper motion pair



Figure 6: USNO-B1.0 1260-0103923

Study of 17 New Stellar Pairs in the Constellation Aurigae with Three Possible New ...



Figure 7: USNO-B1.0 1260-0104160

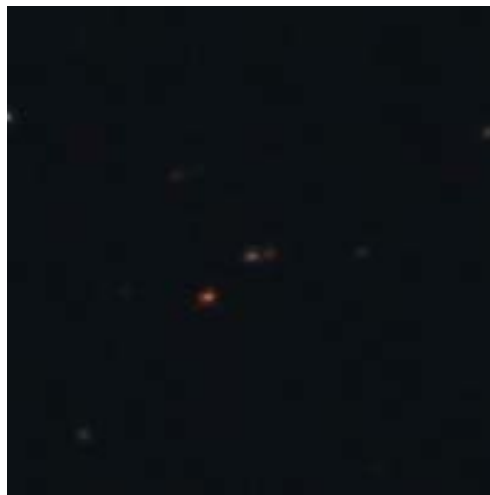


Figure 10: USNO-B1.0 1244-0101791



Figure 8: USNO-B1.0 1257-0104337, USNO-B1.0 1257-0104496 and USNO-B1.0 1257-0104504 could be a possible common proper motion pair



Figure 11: USNO-B1.0 1243-0101852

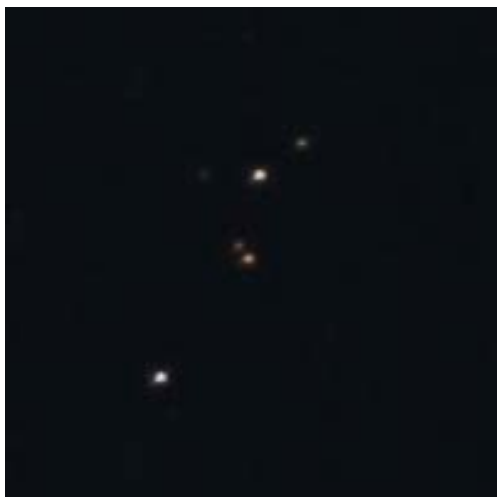


Figure 9: USNO-B1.0 1259-0106575



Figure 12: USNO-B1.0 1243-0102624

Study of 17 New Stellar Pairs in the Constellation Aurigae with Three Possible New ...



Figure 13: USNO-B1.0 1243-0102678 on left hand side, USNO-B1.0 1243-0102718 on right hand side



Figure 15: USNO-B1.0 1240-0105442 could be a possible common proper motion pair



Figure 14: USNO-B1.0 1244-0102740

Romero, Francisco Rica, 2006, "R.G. Aitken's Criterion to Detect Physical Pairs", *Journal of Double Star Observations*, **2**, 36-41.

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(Continued from page 263)

Acknowledgements

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This research made use of the Washington Double Star Catalog maintained at the U.S. Naval Observatory.

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