Discovery of Small Companions of γ Comae and TYC 1989-00307-1 in Constellation Coma Berenices and a Possible New Common Proper Motion Pair in the Constellation Canes Venatici

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Abstract: In the constellation Coma Berenices a new companion of the bright star γ Comae was found. Comparison with historical sky images shows that the companion is joined with the much brighter star. A companion of TYC 1989-00307-1 was also found. In the constellation Canes Venatici a possible common proper motion star was found.

Report

During observations in spring 2013 in the constellations Coma Berenices and Canes Venatici, a new possible binary star and some possible new common proper motion pairs were found. Observations were made with a 12 inch Newtonian telescope in combination with a Canon digital single lens reflex camera (DSLR) 1100D. A 15 second exposure time was used to make the observations. The planetary software, Redshift 7, was used for telescope control. Data analysis was done with the software program REDUC [Losse].

The Tycho catalog and the USNO catalog list these new double stars as single stars. To obtain more information about the possible physical structure of these double stars the Aitken criterion and also Halbwach's criterion were checked. The Aitken criterion can be calculated if the brightness of both components is known. The given brightness can be interpreted as combined brightness. The difference in brightness of both components can be estimated. With this assumption the Aitken criterion can be calculated. The Aitken criterion gives a maximum separation (ρ_{max}) for both components. If the measured separation ρ is smaller than ρ_{max} both components may be physically linked as binary star. The Aitken criterion is not a physical criterion, it is only an indication of possible binaries [Romero, 2006]. Halbwach's criterion is helpful for searching possible common proper motion pairs. To calculate Halbwach's criterion, only proper motion and separation has to be known. If the ratio between measured separation and proper motion is less than 1000 years, the possibility for a common proper motion pair is nearly 99%. T is also the time which the star needs for moving the measured distance [Halbwach, 1986].

Discovery of Small Companions of TYC 1989-00307-1 and γ Comae

TYC 1989-00307-1 is listed in WDS catalog as ARN 6AD and is assigned to 12 Comae. It is near the center of the Coma Berenices star cluster. Separation between TYC 1989-00307-1 and 12 Comae is about 213 arc seconds. Proper motions of 12 Comae and TYC 1989-00307-1 are very different and therefore it has to be expected that both stars are not physically connected. At a distance of only 13.5 arc seconds from TYC 1989-00307-1, another possible component can be found. TYC 1989-00307-1 complies with Halbwach's criterion. Because of the difference in brightness of about 3 magnitudes between both components, TYC 1989-00307-1 doesn't look like a common proper motion pair.

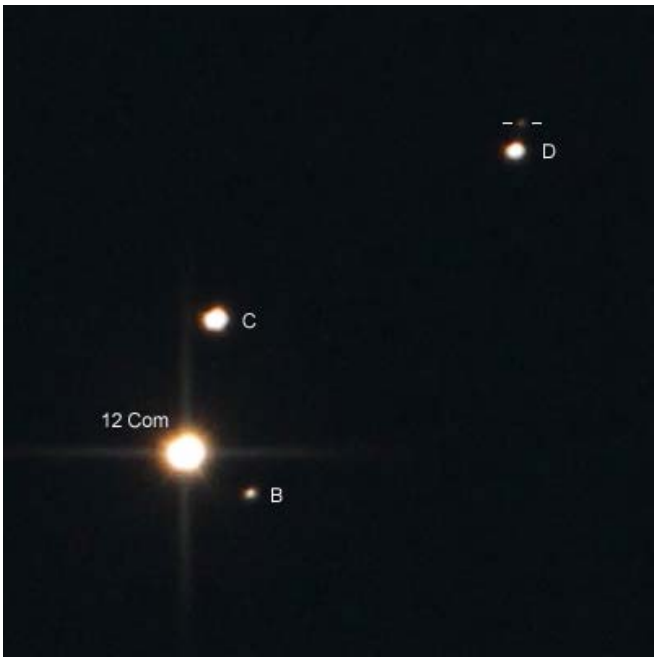

Figure 1: Image of 12 Comae and TYC 1989-00307-1. The new component is marked with lines. The companion is not yet listed in WDS catalog. Image made by the author in 2013.431.

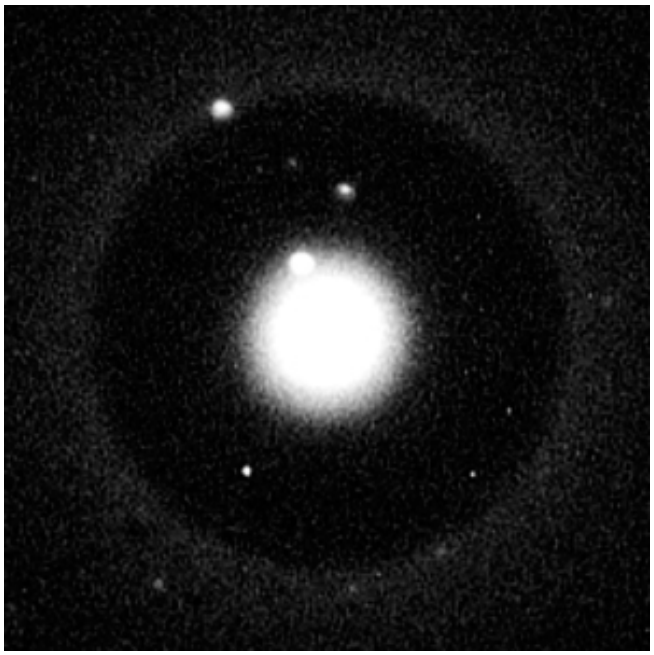

Figure 2: Image of γ Comae, made by Max Wolf (1863-1932) in 1901 with the Bruce telescope on Königstuhl observatory in Heidelberg, exposure time was 102 minutes [HDAP, B123a 1901-01-18],

Gamma Comae is the brightest star in the open star cluster Coma Berenices. At a separation of only 16.2 arc seconds, a possible companion with a brightness of about 12 magnitudes can be found. This faint companion can also be found on images made with the Bruce telescope at Königstuhl observatory in Heidelberg/ Germany in 1901 (see also Schlimmer 2012). Proper motion of γ Comae is about 117 mas/yr. In the time of 112 years, γ Comae changed its position of about 13.1 arc seconds. The relative position of the companion to γ Comae appears unchanged. Therefore, it can be expected that the companion has the same proper motion and is joined to γ Comae. Because of its brightness and its the proper motion γ Comae complies with Aitken criterion and also with Halbwach's criterion. On POSS 2 images this companion is outshined by the much brighter star [CDS].

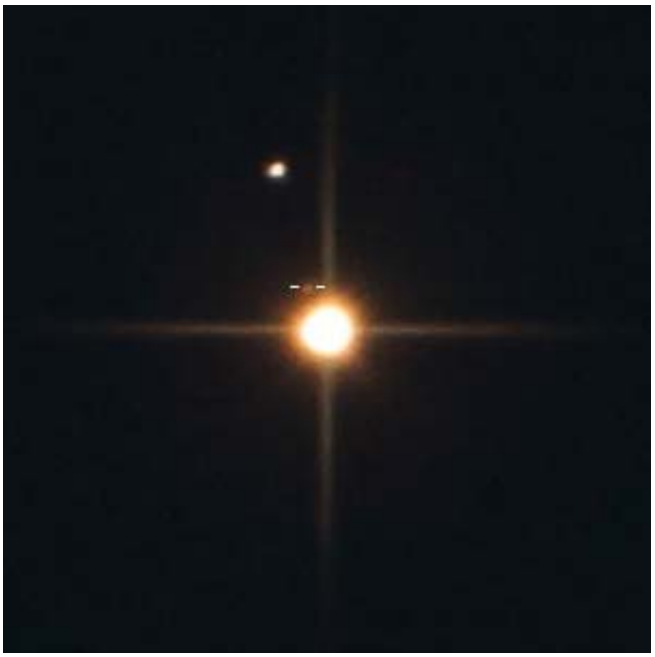

Figure 3: Image of γ Comae with new companion made by the author in 2013.431. The companion is marked with lines and is not yet listed in WDS catalog

New Possible Common Proper Motion Pairs in Constellation Canes Venatici

USNO B1.0 1374-0287544 can be found in the neighborhood of the well known galaxy M51. In the USNO catalog B1.0, 1374-0287544 is listed as single star, but Figure 4 shows that it consists of two components with equal brightness. Proper motion is 25.6 mas/ yr. With a separation of 7.2 arc seconds, the time T is

Figure 4: Possible common proper motion pair USNO B1.0 1374-0287544, image made by the author in 2013.431.

Figure 5: Image of USNO B1.0 1372-0290876 made by the author in 2013.431.

only 281 years. Because T is smaller than 1000 years, Halbwach's criterion for a possible common proper motion pair is satisfied.

USNO B1.0 1372-0290876 can also be found in the neighborhood of the galaxy M51. At a separation of 3.7 arc seconds another star can be found. The difference in brightness is about 0.5 magnitude. Aitken's criterion is not satisfied, so we can expect that this not a physical binary star. Proper motion is not known and therefore Halbwach's criterion cannot be calculated.

The double stars are listed in table 1. The first column lists the catalog name of the star, while the second and third columns are coordinates for R.A. and declination, the fourth column gives the brightness, the fifth and sixth columns give the proper motion in mas/yr if known, in the seventh column is the estimated difference in brightness, the eighth and ninth columns give the calculated individual magnitudes, columns ten and eleven give the angle in degrees and separation between the components in arc seconds, the twelfth column shows the calculated Aitken limit p max in arc seconds, and the thirteenth column gives the time in years that the pair needs to move the distance of its own separation if proper motion is known. Finally, column fourteen gives a short note on the image field neighborhood.

Acknowledgements

This research has made use of the SIMBAD data-

Table 1: New stellar pairs in constellation Coma Berenices and Canes Venatici.

Name	RA	Dek	Mag	PM R.A.	PM Dec.	Mag A	Mag B	Theta	p	Aitken limit	T=p/PM	Notes
TYC 1989-00307-1 = ARN 6AD	12 22 42.0	+25 48 22.56	10.07	42.80	-17.20	10.13	13.13	166.8	12.835	6.13	278.3	member of Melotte 111 near 12 Comae
γ Comae	12 26 56.3	+28 16 06.3	4.34	-83.95	-81.13	4.34	12	203.8	16.2	85.5	138.8	member of Melotte 111
USNO B1.0 1374-0287544	13 31 28.5	47 26 12.1	12.6	-16	-20	13.35	13.35	121.7	7.18	1.91	281.1	near M51
USNO B1.0 1372-0290876	13 32 25.5	47 17 02.6	12.0	0	0	12.53	13.03	248.6	3.70	2.51		near M51

base, operated at CDS, Strasbourg, France. This work made use of the HDAP which was produced at Landessternwarte Heidelberg-Königstuhl under grant No. 00.071.2005 of the Klaus-Tschira-Foundation. This research has made use of the USNO Image and Catalogue Archive operated by the United States Naval Observatory, Flagstaff Station, (http://www.nofs.navy.mil/data/fchpix/). Finally, this research made use of the Washington Double Star Catalog maintained at the U.S. Naval Observatory.

References

CDS, Centre de Données astronomiques de Strasbourg, SIMBAD Astronomical Database, http://simbad.u-strasbg.fr/simbad/

Halbwachs, J.L., 1986, Common Proper Motion stars in the AGK 3, Astronomy & Astrophysics Supplement Series 66, pages 131-148

HDAP, Heidelberg Digitized Astronomical Plates, http://dc.zah.uni-heidelberg.de/lswscans/res/positions/q/form

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