

# Astrometric Measurements of 7 Double Stars in Taurus

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## Abstract

This article shows the results of 25 measurements of 7 stars in constellation Taurus from February 2023. During the observations a few new optical components and one possible new physical double star were found.

## 1. Introduction

In February 2023 double stars in constellation Taurus were measured. As in previous years, pairs with large magnitude differences were of most interest.

For the known double stars 61 Tauri, 68 Tauri, 78 Tauri, 97 Tauri some new optical companions were found. For HD 31236 and HD 31539 also new optical companions were found. In case of HD 32561 a possible new physical double star is reported.

All of the measurements of these stars are reported in Table 2.

## 2. Equipment and Methods

Observations were done with a 12-inch Newtonian telescope in combination with a QHY5L II CMOS color camera. Focal length is 1500 mm, reproduction scale is about 0.51'' / pixel. Calibration of the telescope setup was already described in detail in the annual report of 2021 (Schlimmer, 2022).

For each measurement a video with 25 up to 100 frames were recorded. The number of frames depends on the exposure time. The longer the exposure time, the fewer images are taken. Every frame is like a single measurement. Data analyses were done with REDUC software (Losse, 2016). For each frame separation and position angle will be automatically analyzed by the ELI interface. The standard deviation for measurements of the separation is usually smaller than  $\pm 0.15''$ . The standard deviation for measurements of position depends on the separation of both components. For double stars with separation of 5'' the standard deviation for position angle is usually  $\pm 1^\circ$ .

## 3. Results

### 3.1 Two new optical components of WDS04230+1732, BUP 55 AB, (61 Tau)

61 Tauri is part of the Hyades star cluster. In 1909 A.W. Burnham found an optical companion with a brightness of 13.21 magnitudes. Because of the large proper motion of 61 Tauri of +107 mas / yr. in R.A. and -014 mas / yr. in dec he listed this star in his catalog of proper motion stars (Burnham, 1913). Current separation of AB is about 113''. During my observation of 61 Tauri two new optical companions could be found. Separation of the closer one (identified as "New A(1)" in Table 2) is 25.32 arcseconds at position angle of 233.2 degree (see fig. 1). The other one ("New A(2)" in Table 2) has a separation of 78.82 arcseconds at position angle of 311.8 degree. Brightness of both is much fainter than B and is listed in GAIA DR3 as 15.7 and 15.1 magnitudes. Figure 1 shows a stacked image of 25 frames. Exposure time of each frame was 4s.

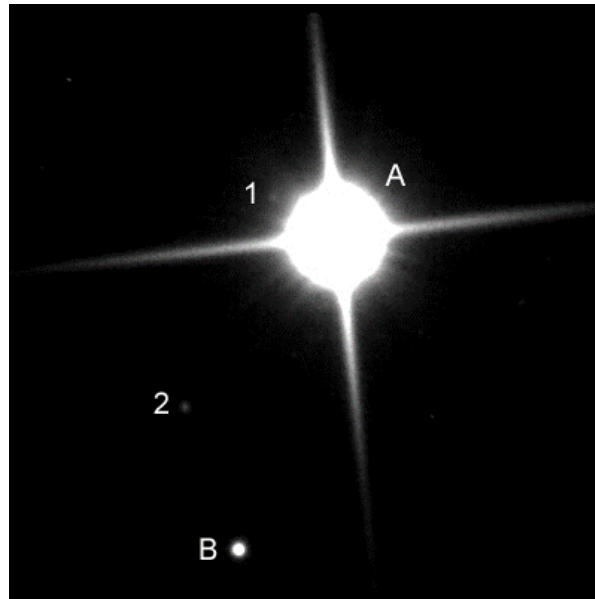


Figure 1 : 61 Tau, (BUP 55AB) with two new companions (1) and (2), stacked image of 25 frames. Exposure time of each frame was 4s.

### 3.2 New optical component of WDS04255+1756, KUI 17AB, H 6 101AC, (68 Tau)

68 Tauri is a common proper motion star. In a separation of only 1.8'' G. P. Kuiper discovered in 1937 a secondary star (KUI 17AB). In larger separations three optical companions are already known since 1782 (H 6 101AC, H 6 101AE) and 1896 (ARN 62AD). Their brightness is between 9 and 11.2 magnitudes.

Nevertheless since their discoveries only a few observations have been made. Because of similar proper motions, radial velocities and parallaxes as 61 Tau (GAIA DR3), the components H 6 101AC are also members of the Hyades (Melotte 25) star cluster.

Next to the primary in 19.72 arcseconds at position angle of 168.7 degree a small companion could also be found (described as "New A(1)" in Table 2). Brightness is 14.0 magnitudes (GAIA DR3). Due to different proper motion and parallax compared to the primary there is no physical relationship between them.

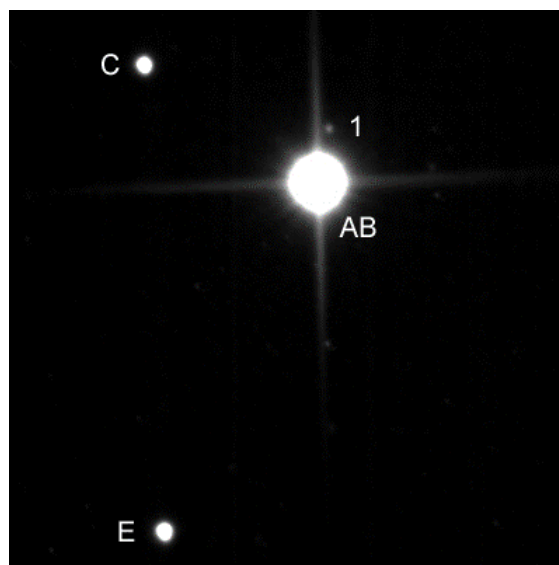
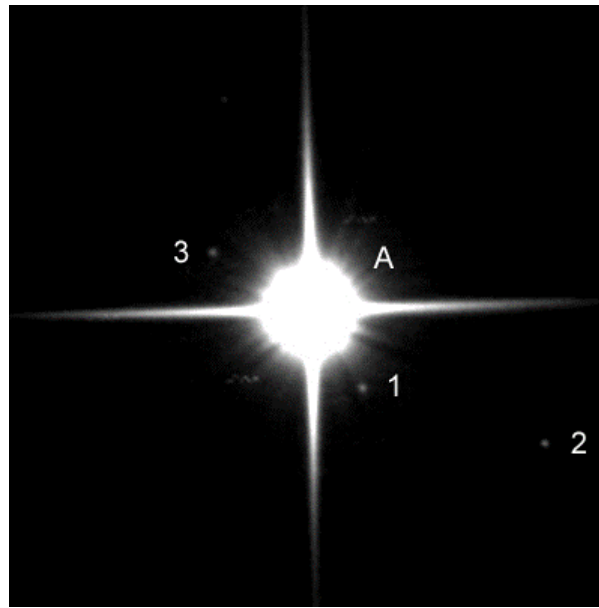


Figure 2 : 68 Tau, (H 6 101AC, H 6 101AE) with optical companion (1), stacked image of 50 frames. Exposure time was 2s. Component D with separation of 413'' is outside the image.

### 3.3 Three new optical components of WDS04287+1552, STFA 10AB, (78 Tau)

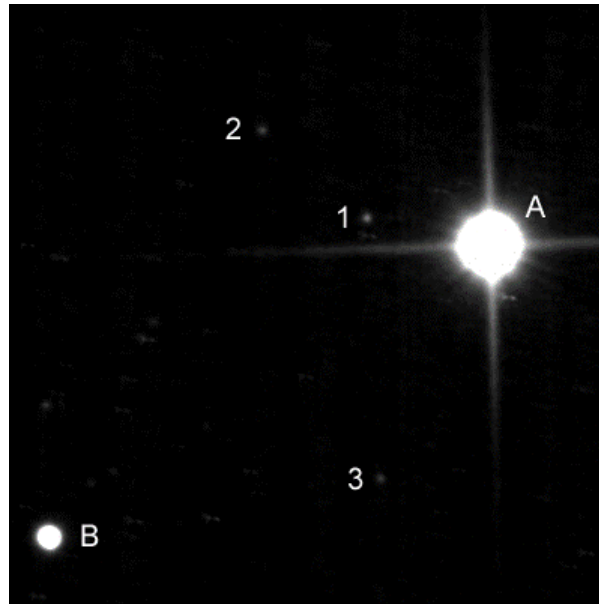
78 Tau is also member of the Hyades (Melotte 25) star cluster. In a separation of about  $337''$  a companion can be found (B is not shown in fig. 3). It was discovered in 1800 by Struve. Because of different proper motions between A and B there is no physical relationship between them. During my observations I found 3 further optical companions which are described as “New A(1)”, “New A(2)” and “New A(3)” in Table 2 : first one in a separation of 32.02 arcseconds at angle of 32 degree (15.4 mag), second one in a separation of 91.96 arcseconds at angle of  $58.9^\circ$  (15.2 mag) and finally a new companion in a separation of 38.66 arcseconds at angle of  $238.4^\circ$  (15.5 mag). All of them have different values for proper motion (GAIA DR3).



*Figure 3: WDS04287+1552, (STFA 10) with three optical companions (1-3), stacked image of 50 frames. Exposure time was 2s. Component B with separation of  $337''$  is outside the image.*

### 3.4 Three new optical components of WDS04514+1850, BUP 70, (97 Tau)

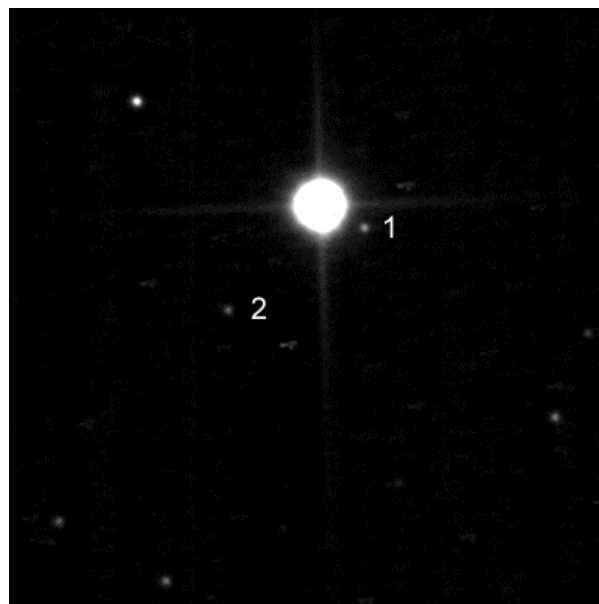
In 1897 a companion of 97 Tau in a separation of about  $181''$  was discovered by Burnham (BUP 70). Values for proper motion and parallax are different for AB, so it can be assumed that the secondary component B is only an optical companion. A little bit closer at a separation of 43.05 arcseconds at angle of  $255.8^\circ$  another companion with a brightness of 14.9 mag can be found (described as “New A(1)” in Table 2). Two further companions can be found in separation of 87.09 arcseconds at position angle of  $241.5^\circ$  (15.5 mag) and in a separation of 88.07 arcseconds at position angle of  $333.0^\circ$  (15.7 mag). Both are described as “New A(2)” and “New A(3)” in Table 2. The components aren’t listed in the WDS catalog. According to GAIA DR3 data for parallaxes and proper motions there is no physical relationship between the components.



*Figure 4 : WDS04514+1850, BUP 70 with three further optical companions (1-3), stacked image of 50 frames. Exposure time was 2s*

### **3.5 Two new optical components of HD 31236, coordinates : 04 52 01.8 + 19 29 07.4**

HD 31236 can be found  $1^\circ$  in north-east of 97 Tauri. Its exact coordinates are 04 52 01.8 + 19 29 07.4. SIMBAD database described HD 31236 as high proper motion star, but with proper motion of 62.7 mas / yr. in R.A. and -29.0 mas / yr. in declination, its proper motion isn't higher than the listed stars above. Its brightness is 6.3 magnitudes. Some faint optical companions can be found in the neighborhood, two examples (described as “New A(1)” and “New A(2)” in Table 2) in 16.70 arcseconds and 47.71 arcseconds separation have brightness of 15.1 and 15.4 magnitudes (see fig. 5). Proper motions, parallaxes and radial velocities so far known are different, so there is no relationship between them.



*Figure 5 : HD 31236 with 2 new optical components (1-2), image of 50 stacked frames*

### 3.6 New optical components of HD 31539, coordinates : 04 57 22.3 +17 09 13.2

HD 31539 can be found in the middle of the line between 97 Tau and 11 Ori. Its brightness is 5.1 magnitudes, coordinates are 04 57 22.3 +17 09 13.2. It isn't listed as double star in WDS catalog. However, in a separation of about 46.46'' an optical companion (described as "New A(1)" in Table 2) with brightness of 14.1 magnitudes can be found. Position angle is 21.3 degree. A further optical companion ("New A(2)") with brightness of 14.8 magnitudes can be found in a separation of 38.90 arcseconds at position angle of 249.4 degree. Proper motions, radial velocities and parallaxes in GAIA DR3 are different, so there is no relationship between them.

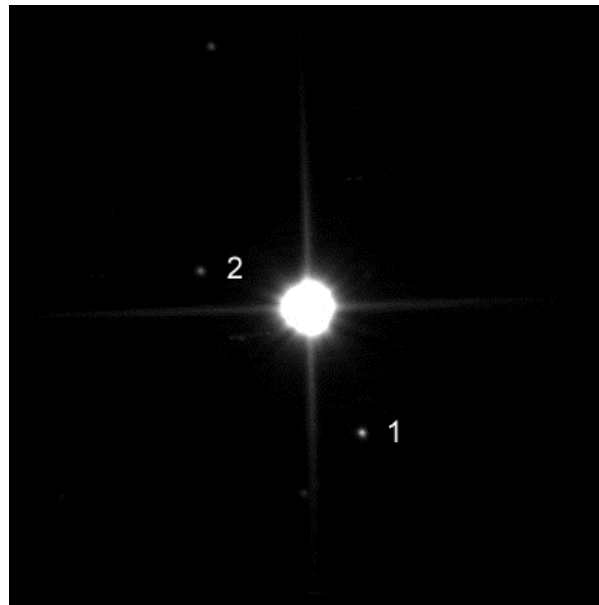


Figure 6 : HD 31539 with 2 new components (1-2). Image is stacked of 50 frames.

### 3.7 New physical component of HD 32561, OCC 27, WDS05048+1815

HD 32561 can be found 45' north-east of 104 Tauri. Its brightness is 7.6 magnitudes. A close companion in 0.1'' separation is already listed as OCC 27 in the WDS catalog.

In a separation of 11.8 arcseconds at angle of 191.8 degree a new faint component (described as "New A(1)" in Table 2) could be found (see fig. 7). Its brightness is 16.0 magnitudes. Parallax and proper motion are similar to the primary, radial velocity isn't known for the companion. Because of good agreement for parallax and proper motion it can be assumed that there is a physical relationship between them. A further companion ("New A(2)") with same brightness of 16 magnitudes can be found in a separation of 15.99 arcseconds at angle of 123.7 degree. Parallax indicates this component as a background star. Also proper motion is different from primary. Table 1 shows the GAIA DR3 data for the primary and the new possible physical companion "New A(1)" :

Table 1: shows the astrometric Data from GAIA DR3 for the primary and the possible physical secondary "New A(1)"

	Magnitude	Parallax mas	Pmra mas/yr	Pmdec mas/yr
Primary HD 32561	8.7	8.60	-2.73	-15.30
Secondary "New A(1)"	16.0	8.67	-3.65	-15.44

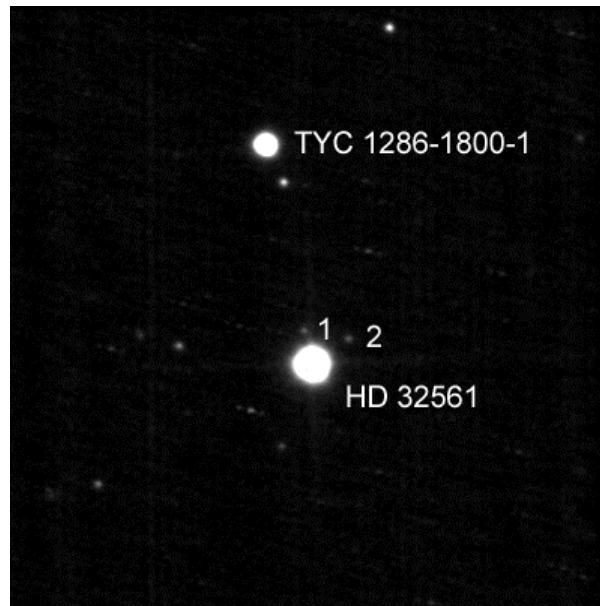


Figure 7: HD 32561 with possible new physical companion (1). Component (2) and TYC 1286-1800-1 on the other hand are only an optical stars. Image is stacked of 50 frames.

#### 4. Observation Data

The following table shows the 25 measurements of separation and position angle. Brightness and coordinates from known double stars were taken from *The Washington Double Star Catalog* (Mason et al., 2020). Brightness for the new components were taken from GAIA DR3. Date is given in Julian years.

Table 2: 25 measurements of 7 stars in constellation Taurus

RA+DEC	Code	MAGS	PA	SEP	Date	Name
04230+1732	BUP 55AB	3.76,13.21	336.9	113.10	2023.104	61 Tau
04230+1732	BUP 55AB	3.76,13.21	336.1	112.59	2023.142	61 Tau
04230+1732	New A(1)	3.76,15.7	233.2	25.32	2023.104	61 Tau
04230+1732	New A(1)	3.76,15.7	231.3	25.64	2023.142	61 Tau, second measurement
04230+1732	New A(2)	3.76,15.1	312.7	78.82	2023.104	61 Tau
04230+1732	New A(2)	3.76,15.1	311.8	78.91	2023.142	61 Tau, second measurement
04255+1756	H 6 101AC	4.26,11.12	234.9	76.81	2023.104	68 Tau
04255+1756	H 6 101AC	4.26,11.12	234.1	76.63	2023.142	68 Tau
04255+1756	New A(1)	4.26,14.0	168.7	19.72	2023.104	68 Tau
04255+1756	New A(1)	4.26,14.0	167.1	19.95	2023.142	68 Tau, second measurement
04255+1756	H 6 101AE	4.26,10.55	335.1	139.3	2023.104	68 Tau
04255+1756	H 6 101AE	4.26,10.55	334.4	139.17	2023.142	68 Tau, second measurement
04287+1552	New A(1)	3.41,15.4	32.2	32.02	2023.142	78 Tau
04287+1552	New A(2)	3.41,15.2	58.9	91.96	2023.142	78 Tau
04287+1552	New A(3)	3.41,15.5	238.4	38.66	2023.142	78 Tau
04514+1850	BUP 70	5.12,10.57	301, 7	180,52	2023.142	97 Tau
04514+1850	New A(1)	14.9, 15.5	255.8	43.05	2023.142	97 Tau
04514+1850	New A(2)	5.12,15.5	241.5	87.09	2023.142	97 Tau
04514+1850	New A(3)	5.12,15.7	333.0	88.07	2023.142	97 Tau

04520+1927	New A(1)	6.3,15.1	61.5	16.70	2023.142	HD 31236
04520+1927	New A(2)	6.3,15.4	316.6	47.71	2023.142	HD 31236
04572+1709	New A(1)	5.1,14.1	21.3	46.46	2023.142	HD 31539
04572+1709	New A(2)	5.1,14.8	249.4	38.90	2023.142	HD 31539
05048+1815	New A(1)	8.7,16.0	191.8	11.81	2023.142	HD 32561, new phys. comp.
05048+1815	New A(2)	8.7,16.0	123.7	14.99	2023.142	HD 32561

### Acknowledgements:

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

This work has made use of data from the European Space Agency (ESA) mission Gaia (<https://www.cosmos.esa.int/gaia>), processed by the Gaia Data Processing and Analysis Consortium (DPAC, <https://www.cosmos.esa.int/web/gaia/dpac/consortium>). Funding for the DPAC has been provided by national institutions, in particular the institutions participating in the Gaia Multilateral Agreement.

This research has made use of the SIMBAD database, operated at CDS, Strasbourg, France

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