A New Binary System in Orion's Shield

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Abstract: This paper highlights a new double star in Orion, previously not listed in the WDS catalog. On observed photometric and proper motion characteristics, calibration of distances, and other assumptions, it is concluded that the components comprise a wide gravitationally-bound visual binary system.

Introduction

A binary system was identified using the search method and selection criteria described in earlier papers, and I later communicated my discovery to Dr William Hartkopf at the USNO [1]. He concurred that this was indeed a CPM pair and provided matches, stating that the proper motions of both stars were similar even in the Astrographic Catalog dating back to 1910.

The double is located in the shield of Orion, at J2000 ICRS: 04 52 16.70, +09 35 05.2, as shown in Figure 1. The components bear the designations HD 287241 / TYC 688-1236-1 and are of V mags 11.08 and 11.58, respectively.

Observations and Analysis

I visually observed and sketched this pair, as shown in Figure 2. Astrometric measurements on FITS images obtained from SIMBAD spanning 44 years between the POSS1 and 2MASS surveys of the 1950s and 1990s, respectively, revealed a lack of relative motion between components, as shown in Table 1.

Figure 1. Sky location of the new double. (Source: Stellarium)

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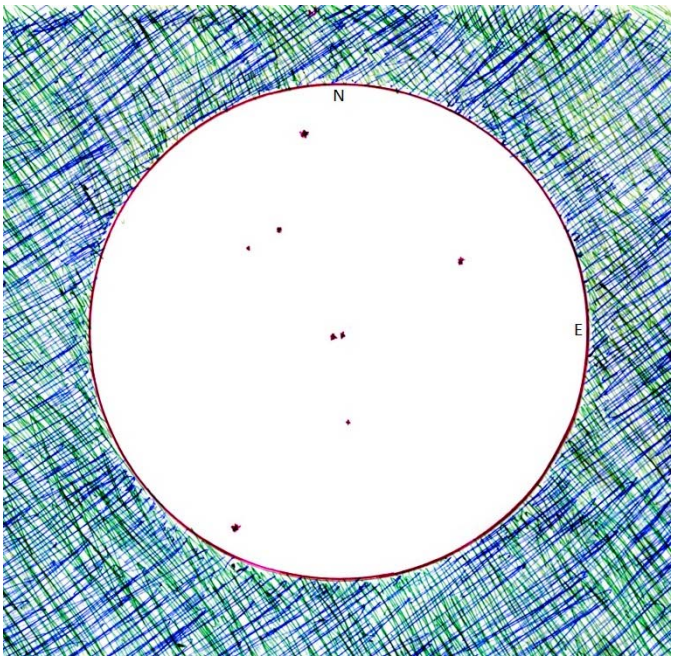

Figure 2. Field drawing made by the author using his 4.75" f/8.33 refractor at a magnification of 159X.

Matches were found in the following ten catalogs: the Tycho-2 Catalog, the FON Astrographic Catalog, All-sky Compiled Catalog of 2.5 million stars, the USNO-B1.0 Catalog, UCAC2 Catalog, NOMAD Catalog, PPMX Catalog of positions and proper motions, the PPMXL Catalog, UCAC4 Catalog, and URAT1 Catalog.

Each of these showed a consistent similarity in the measured proper motions of both stars, as can be seen in the UCAC4 [2] extracts presented in Table 2. An average proper motion, μ, of components A and B was computed to be:

$$\mu = [(A\mu_\alpha{}^2 + A\mu_\delta{}^2)^{1/2} + (B\mu_\alpha{}^2 + B\mu_\delta{}^2)^{1/2}]/2$$
$$= 27.78 \text{ mas yr}^{-1}.$$

Referring to the negative exponential I had previously determined in reference [3]:

$$y = 17941x^{-1.11}$$

Table 1. Positional Astrometry

Epoch:	P.A.(θ)	Sep (ρ)
1955.961	79.7°	23.76″
1999.953	80.3°	23.84″

Table 2. Proper Motion of Components in the UCAC4 Catalog

	μ_α mas yr^{-1}	Error mas yr^{-1}	μ_δ mas yr^{-1}	Error mas yr^{-1}
Primary	-20.1	±0.7	+18.9	±1.2
Companion	-21.4	±1.4	+18.0	±1.5

This proper motion of 27.78 mas yr^{-1} indicates the binary is placed at a probable distance in the region of 340 ly (104 pc) from Earth.

From the UCAC4 and 2MASS [4] catalogs we find B, V, J and K magnitudes, color indices, and likely spectral types for the components, shown in Table 3.

The K2V classification for the B-component in Table 3 has been inferred from its (B – V) color index, disregarding the over-reddened (J - K) color index in this particular instance. This increased reddening in the near-infrared J and K magnitudes of the secondary in this pair (an '*infrared excess*') is very likely due to the presence of circumstellar dust surrounding the star. By way of comparatives, both Epsilon Eridani and Tau Ceti are Solar neighborhood stars which have been better studied, and they have been observed to be surrounded by circumstellar dust, which give rise to similar infrared excesses in their (J – K) color indices compared to their (B – V)'s.

Consequently, it follows that components A and B in this new Orion binary would be of absolute magnitudes in the region of 5.9 and 6.4, respectively [5]. Projecting spectral distances of each on their apparent visu-

Table 3. Photometry, Color Indices, and Spectral Types.

	B	V	J	K	Color Index (B-V)	Color Index (J-K)	Spec Type
Primary	11.831	11.082	9.822	9.439	+0.75	+0.38	G9V
Companion	12.422	11.584	10.185	9.731	+0.84	+0.45	K2V

al magnitudes of 11.08 and 11.58 places both stars at an identical distance of 355 ly away from the Earth. This distance bears a close resemblance to the proper motion distance of 340 ly derived earlier, all of which independently suggest a true binary system.

Conclusions

On the basis of the common proper motions stated within an overwhelming number of independently compiled catalogs, and the analytical findings in this paper, we conclude that this is a visual binary system with gravitationally-connected components.

References

1. Private communication, dated 2015 September 23

2. "The Fourth US Naval Observatory CCD Astrograph Catalog (UCAC4)", Zacharias, N. et al, *AJ*, **145**, 44, 2013.

3. Ahad, A., "A New Visual Binary System in Auriga", *Journal of Double Star Observations*, **11**, 70-72, 2015.

4. The Two Micron All-Sky Catalog of Point Sources, Cutri, et al, 2003, website: http://pegasus.phast.umass.edu/

5. *Allen's Astrophysical Quantities,* 4th edition, Cox, Arthur N. (editor), Springer, New York, 2000.