

A New Common Proper Motion Double Star in Cetus

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Abstract: In this paper, I report a new visual binary star in the Constellation of Cetus that is not in the current edition of the WDS catalog, the components of which share a common proper motion. On a number of different binarity tests, the two stars seem likely a gravitationally connected pair, showing evidence of orbital motion between the 1950's and 1990's Palomar Observatory Sky Surveys.

Introduction

This pair first came to my attention on May 15th 2012, whilst studying DSS images from the Palomar Observatory Sky Survey (POSS). The primary has the Henry Draper designation of HD10327 and is of visual magnitude 9.94. The secondary appears at least 3 magnitudes fainter, at V magnitude ~13.5. The primary is at ICRS coordinates: 01 40 29.1, -24 12 39 (Epoch 2000.0).

Distance and Proper Motion

From the UCAC3 catalog[5], we find the two stars share very similar proper motions in both RA and Dec, in both magnitude and in sign, see Table 1.

The pair as a whole, has a total proper motion of: $([(63.7)^2 + (68.8)^2]^{1/2} + [(66.3)^2 + (68.0)^2]^{1/2}) / 2 = \sim 94.3$ milliarcseconds per year.

In my report in the Webb Society DSSC 19[1], I showed for purposes of illustration the distances and proper motions of a number of binary systems, and the basic correlation that exists between these two parameters. Referring to that scale, this figure of 94.3 mas/year suggests the pair is located in the region of about a 100 light-years away from the Earth. For example, the star η Herculis has a total proper

Table 1: Proper Motions of the Studied Stars

Component	RA Proper Motion	Dec. Proper Motion
A	+63.7 mas/year	+68.8 mas/year
B	+66.3 mas/year	+68.0 mas/year

motion of 92 mas/year and it lies at a distance of ~112 light-years away, measured on Hipparcos parallax.

Since both stars in this double star have virtually identical proper motions in both RA and Dec and are also positioned within a mere 15" from each other in the sky, on a balance of probabilities it seems more than likely that they are physically connected.

Photometry

In the "spectral distance" method of binarity testing that I had applied in previous papers[2] if two stars genuinely reside within a bounded binary system, then we expect them to display particular kinds of photometric attributes in relation to one another. The Two Micron All-Sky Survey (2MASS) gives reliable J and K-filter magnitudes for all point sources and I have found it to be an excellent resource for gauging the individual colors and spectral classifica-

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Table 2: Approximate Relationships Between 2MASS (J - K) Color Indices and Spectral Classifications for Main Sequence Stars

2MASS(J - K)	Spectral type	Example star
-0.04	B3 V	Eta Ursae Majoris
0.00	A1 V	Sirius
+0.21	A7 V	Altair
+0.23	F2 V	Sigma Bootis
+0.31	G0 V	Beta Comae
+0.43	K5 V	61 Cygni A
+0.86	M2 V	Lalande 21185

tions of visual double stars. Based on an average taken over a small sample, I have derived Table 2 to be a basic fit of J and K magnitudes, the color index (J - K) and spectral classifications for seven stars scattered across the visible spectrum.

Photometry in the 2MASS All-Sky Catalog of Point Sources [4] (Cutri+ 2003), queried via VizieR, gives values for the two components in this Cetus double star presented in Table 3.

From these we deduce color indices of (J - K) = +0.49 for the primary component and (J - K) = +0.90 for the secondary component in this double star. Interstellar reddening in the J and K magnitudes can sometimes be a factor that distorts the apparent color of a star from its true (intrinsic) color. In the case of this particular double star, such reddening will be negligible, since the pair is located at a high galactic

Table 3: Photometry of the component stars.

	J-magnitude	K-magnitude
A-component	8.566	8.076
B-component	11.199	10.301

latitude of -78 degrees, and far removed from the obscuring gas and dust clouds typically found along the band of the Milky Way in the night sky.

Given these (J - K) values, referring to Table 2, spectral types can be readily inferred of late K for the primary and a very low-mass, M-type red dwarf for the secondary. These are roughly consistent with the distance/proper motion fit described earlier, again hinting that the pair is physically connected. The primary star (A component) in this pair is likely to be of comparable in mass/luminosity to the star 61 Cygni A. This can be confirmed by applying the distance mod formulae [3]. 61 Cygni A has an absolute magnitude, M, of +7.5. If 61 Cygni A were hypothetically placed at the same distance of this Cetus double star (~100 light-years), it would shine at an apparent visual magnitude of +9.91, which is virtually the same as the A component. Through a similar set of deductions, we find the B-component in this double star to be of absolute magnitude +11.1, and of comparable mass/luminosity as the nearby red dwarf star, Lalande 21185 (of absolute mag +10.5).

Orbital Motion?

From the POSS1 and POSS2 surveys, historical astrometry on this Cetus binary shows the position angle to be slowly increasing and the separation de-

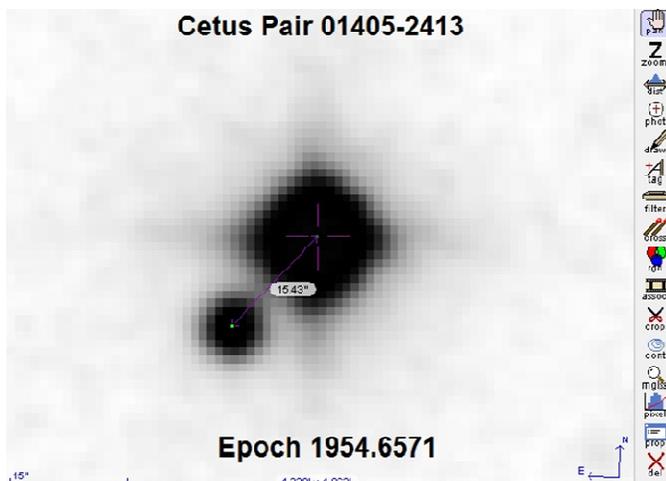


Figure 1 – Image from 1950s POSS 1

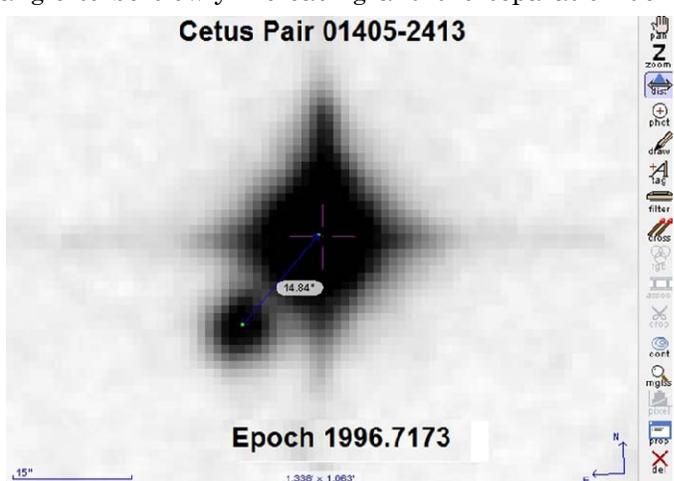


Figure 2 – Image from 1990s POSS 2

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creasing, hinting at likely orbital motion (Figures 1 and 2).

POSS 1 (RED) PA=137.3, Sep = 15.43" (Epoch: 1954-08-28)

POSS 2 (RED) PA=138.6, Sep = 14.84" (Epoch: 1996-09-18)

Conclusion

In the various methods of fitting the observed photometric values to physical properties, distance and proper motions of this pair discussed in this paper, it seems likely that this is an orbital binary. Measurements over an extended time period going into the future will therefore enable the determination of its orbit in 3D space.

References

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2. Ahad, A. 20102 Webb Society Double Star Section Circulars, **20**, 14
3. Ahad, A. 2010 Webb Society Double Star Section Circulars, **18**, 49
4. 2MASS All-Sky Catalog of Point Sources (Cutri+ 2003)
5. UCAC3 Catalog (Zacharias+ 2009)

