A New Visual Binary Star in Scorpius

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Abstract: Presented in this paper is a new visual binary star in the constellation of Scorpius that is not in the current edition of the WDS catalog, the components of which share similar proper motions. Given their tight angular separation and near-identical photometric and proper motion characteristics, it seems likely that this is a physically related pair.

Introduction

I first identified this pair in January 2012 in DSS images, though it wasn't until four months later that I was able to obtain my own discovery image using the remotely operable 61-centimeter Cassegrain telescope of the Sierra Stars Observatory Network (SSON) in California [1] (Figure 1). A low resolution image was obtained on May 14th 2012 at 08:37 UTC. I was moderately happy with this image at the time even though it lacked the processing precisions I would have liked, ending with only a partial resolution of the components.

This Scorpius double star resides at ICRS coordinates: 16 03 22.2, -14 53 35 (Epoch 2000.0). Much to my surprise, I found that neither component appears to have formal designations in the catalogs. Using the PPMXL Catalog's 'r1 mag' as a guide, I have estimated the apparent visual brightness of the pair at V mags ~11.0, ~11.1, with the southernmost of the two stars appearing marginally the brighter one in the pair. I have hence assigned it as the 'A' component.

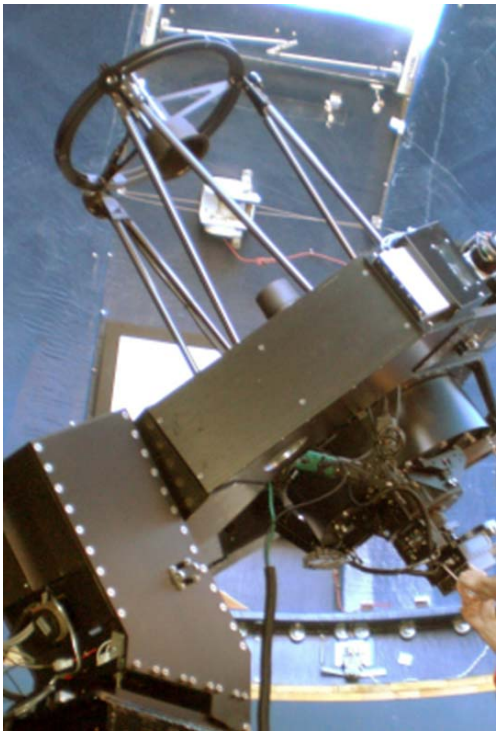

Figure 1: The 61-centimeter Cassegrain telescope of the SSON in California, housed within its observatory dome.

Latest Measurements

My preliminary discovery image of this pair, de-

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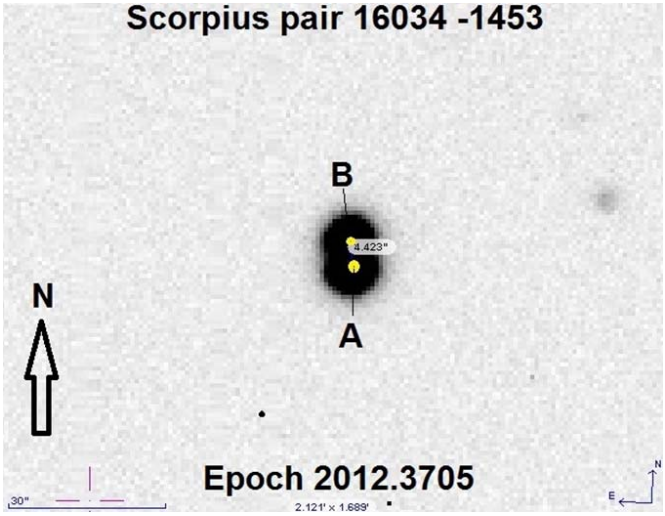

Figure 2: Image of the new CPM pair

scribed earlier, is shown in Figure 2. Measurements from the above image yield:

Position Angle (θ): 5.8° (Epoch 2012.3705)
Separation (ρ): 4.42" (Epoch 2012.3705)

Even though the two stars were only partially resolved, with their Airy discs overlapping, the center of disc of each star could be isolated by eye in the FITS image in the Aladin viewer, enabling approximate measurements to be taken. Due to the tight separation and partial resolution of the components, the margins of error were thus expected to be quite high. Following several sets of measurements, it was found that the Position Angle was oscillating by up to ±2.5° and the Separation by up to ±1.5" around the stated mean values.

Proper Motion, Photometry and Distance

The PPMXL Catalog [2] indicates that the two stars share similar proper motions in both RA and Dec, in both magnitude and in sign. These are given in Table 1.

The pair as a whole has a total proper motion of: $\{ [(12.5)^2 + (-10.0)^2]^{1/2} + [(13.9)^2 + (-8.1)^2]^{1/2} \} / 2 =$ ~16.0 milliarcseconds per year.

A total proper motion of 16.0 mas/year implies a distance for the pair in the region of something like 650 light-years, though this figure will be hugely dependent upon the quality of the proper motion measures themselves.

The 2MASS catalog [3] gives the J and K-band magnitudes for this Scorpius double star shown in Table 2.

Table 1: Proper motion of the components

Scorpius Double Star	Proper Motion in RA	Proper Motion in Dec
A-component	+12.5 mas/year	-10.0 mas/year
B-component	+13.9 mas/year	-8.1 mas/year

Table 2: J and K magnitudes of the components

	J-magnitude	K-magnitude
A-component	9.895	9.486
B-component	9.927	9.445

From these we derive color indices of (J – K) = +0.41 for the primary and (J – K) = +0.48 for the secondary component. However, these values appear way too high (i.e. making the stars seem way too red) when we compare them with the actual visual appearance of the two stars in color DSS images.

At a galactic latitude of +27° on the celestial sphere, this double star is located in a dense region of the summer Milky Way not far from the direction looking toward the center of our galaxy, which lies in Sagittarius (Figure 3). The pair is therefore subjected to high levels of interstellar reddening, which is more pronounced in the infrared end of the spectrum. Indeed, long exposure deep sky survey images show the pair to be visibly eclipsed by a dark and tenuous cloud of intervening gas and dust, giving rise to both increased reddening and some measure of interstellar extinction in their visual brightness as well.

The derived (J - K) color indices from 2MASS stated earlier, therefore, need to be reduced by a factor of some ~0.1-magnitude each, which would take the spectral types of the pair to an early-G on the Hertzsprung-Russell diagram. That is to say, the revised color indices would be (J – K) = +0.31 for the primary and (J – K) = +0.38 for the secondary component. I made the decision to do this and found this classification, based on the corrected (J - K) color indices, to be certainly in closer agreement with the creamy-yellow hues of the two stars we see visually in DSS color images. This then suggests an absolute magnitude (M) of around +4.5 for each star in the pair, fitting the apparent magnitudes (m) of +11 and distance modulus of a pair of G0 V-type main sequence stars placed at 650 light-years

Figure 3: Position in the night sky relative to the Milky Way. [Image courtesy: Stellarium]

away from the Earth.

On the assumption that both stars in this pair are in fact at this same distance of 650 light-years away, if their orbit was projected in the plane of the sky, the two stars would be physically separated by:

Tan (4.42”) x 650 x 63240 = 881 A.U.

They would thus be well within the distance threshold from each other to form an orbital binary pair.

Conclusion

In the various methods of fitting the observed photometric values to physical properties, distances and proper motions of this pair discussed in this paper, it seems that this is a good candidate for being a true binary star.

References

[1] Sierra Stars Observatory Network (SSON) http://www.sierrastars.com

[2] PPMXL Catalog (Roeser+ 2010).

[3] 2MASS All-Sky Catalog of Point Sources (Cutri+ 2003).