

# A New Visual Binary in Pisces with a Possible Brown Dwarf Third Component

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**Abstract:** A new visual binary system is reported in Pisces, the components of which share a common proper motion. Since discovery, this new pair has been added to the WDS catalog as AHD22. A 19<sup>th</sup> magnitude substellar C component has also been identified in this system which shares the same proper motion as the AB pair.

## Introduction

First identified in DSS images on April 27<sup>th</sup> 2014, the system lies in the constellation of Pisces in the night sky, some 2.3° NNE of 4<sup>th</sup> magnitude  $\eta$  Piscium at ICRS: 01h 33m 26.8s, +17° 34' 29". The AB pair is made up of two main-sequence orange dwarves (Figure 1). The primary has a 2MASS designation 01332682+1734287 and USNO catalog designation USNO-A2 1050-00426539.

## Measurements and Astrophysical Properties

Astrometric measurements of the AB pair on J-band imagery from 2MASS [1] confirmed PA 154.6° and Sep 22.70" (epoch 1998.717).

Two days following the discovery of this binary, it became apparent from catalog queries that there was yet another unseen third component in this system which shares exactly the same PPMXL [2] proper motion as the AB pair, as shown in Table 1.

With respect to the primary, the C-component lies at a measured PA of 273.1° and a separation of 9.17" (2000.0).

A total PM of 37.4 mas yr<sup>-1</sup> suggests that the system is located somewhere around 200 to 400 ly (60 to 120 pc) away in distance [3] with a midpoint estimate of about 300 ly (90 pc).

It is often the case that 2MASS (J – K) color indices would have a small amount of uncertainty built into the stated values. This could be due to any number of

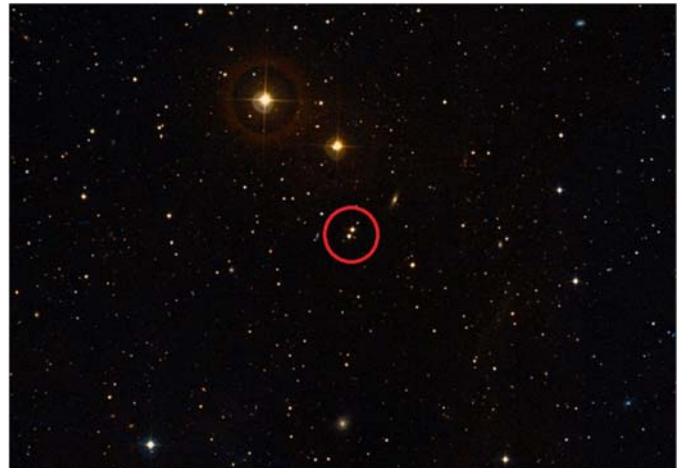


Figure 1. SDSS image of the new pair in Pisces. The double star immediately to the north is Couteau 35 (WDS 01335+1739).

reasons, such as instrument error, interstellar reddening, etc. The values for this Pisces system indicate that the primary would have a spectral type in the range G9V to K3V on the H-R diagram [4]. It is likely to be at the upper (redder) end of this range, however, as that fits more closely with the distance modulus and the proper motion consistency described in earlier papers.

## A Brown Dwarf C-Component?

If it can be properly verified, the prospect of a 19<sup>th</sup> magnitude third component adds an additional dimension of astrophysical interest to this Pisces binary. Giv-

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*Table 1: Proper Motion and Astrophysical Data*

Comp	$\mu_{\alpha}$ mas yr <sup>-1</sup>	$\mu_{\delta}$ mas yr <sup>-1</sup>	PPMXL r1-mag	J-mag	K-mag	Color Index (J - K)	Likely Spec Type
A	-8.3	-36.8	11.88	10.918	10.541	+0.38	~K3V
B	-8.0	-36.2	12.56	11.407	10.985	+0.42	~K5V
C	-8.4	-36.2	19.42				Brown Dwarf

en its observed visual brightness and its likely distance inferred from proper motion, this object is most likely to be a brown dwarf. A “brown dwarf” is defined as a substellar object that is too low in mass to sustain hydrogen fusion at its core for it to be a star, yet it is too heavy in mass to be classed as a giant planet.

As to further verification of the object in this new Pisces binary, each of the PPMXL, NOMAD [5] and the USNO B1.0 [6] catalogs were consulted in turn and they have all independently confirmed the existence of a third component in this system that is visually very faint and which shares a broadly similar PM as the AB pair. It was also directly visualised and pinpointed in a sky chart obtained from the USNO Image and Catalog Archive [7] (Figures 2(a) and 2 (b)).

In relation to the 12<sup>th</sup> magnitude AB pair, which can be positively confirmed as main sequence orange dwarves, the third component can only be an extremely low-mass, substellar object of feeble luminosity. Comparing the PPMXL r1 magnitudes of 11.88 for the

A-component and 19.42 for the C-component, the suspected brown dwarf is found to be only about 1/1000<sup>th</sup> as luminous as the orange K-type primary star in this system. At a projected distance of some 300 ly away, the elusive C-component would have an absolute magnitude of 14.6, which amounts to a luminosity of just 0.012% of that of the Sun. This compares with an estimated luminosity of Teide 1 of ~ 0.1% of that of the Sun. Teide 1 was the first brown dwarf to have been positively identified as such in 1995, and which lies at a similar distance as this Pisces object, at a distance of about 400 light-years away inside the Pleiades open cluster in Taurus.

**Conclusions**

This is a confirmed common proper motion binary, with main sequence components that are placed at a distance that is consistent with their visual appearance, physical, and photometric properties. The third component identified in this Pisces system has remained elu-

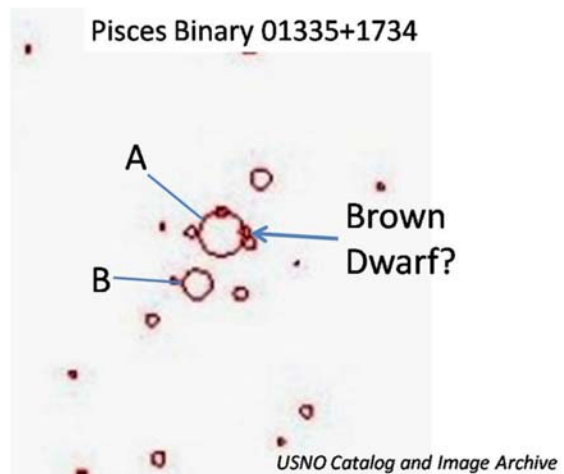
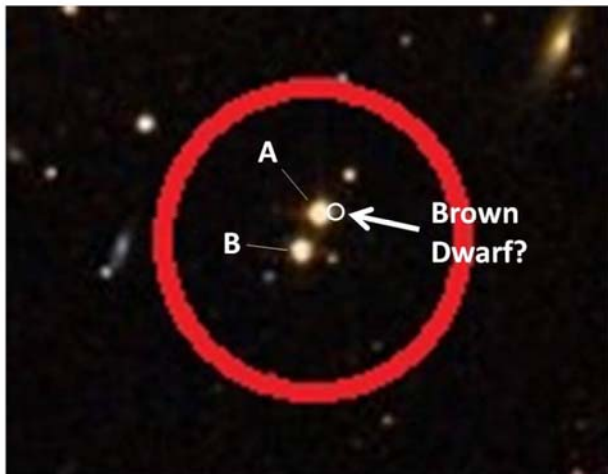


Figure 2: (a) Enlarged image from SDSS, (b) Chart obtained from the USNO Catalog and Image Archive

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sive in its verification up to this point. Its true nature may well be revealed in further advanced studies from such sources as the Keck II telescope's adaptive optics or the Gaia astrometric mission of the European Space Agency, from which the first results have already started to arrive.

### Acknowledgements

I would like to thank Dr William Hartkopf at the USNO for his kind suggestions on improving my paper and pointing out the proper motion errors that exist for the third component, where some caution was advised. I am also grateful to Professor R. Kent Clark for the great editing and for accommodating all the revisions.

### References

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