

TYC 2738-1322-1: An Optical Triple Star and Potential Binary System

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Abstract: In 2017, the author stumbled upon a group of three stars that gave the impression of a possible triple star system based on their colors and their similar proper motion. Based on Gaia DR2 data however, it seems more likely that only two nearest stars are gravitationally bound, while the other lies much further away.

During a hunt for previously unknown deep sky objects in SDSS images, I noticed an interesting group of three stars in Pegasus. A first glance at their color and relative brightness suggested they might be triple star system (see image). No mention of this system could be found in SIMBAD, VizieR or the WDS.

A search through SIMBAD and VizieR found the stars to be designated TYC 2738-1322-1, UCAC4 612-124267 and SDSS J222230.00+321814.6. These stars will now be referred to as A, B and C respectively throughout the rest of this work.

The Visual magnitude and B-V index for component A was extracted from the APASS catalog (Henden et al, 2016). For components B and C, the B-V indexes were derived from 2MASS (Cutri et al, 2003). Using the Blue magnitude measurements from the GSC2.3 catalog (STScI, 2006) I was able to derive the Visual magnitude for these two components using the previously calculated B-V indexes. The values are given in Table.

The UCAC5 (Zacharias et al, 2017) catalog shows A and B to have a very similar proper motion. The URAT1 catalog (Zacharias et al, 2015) shows all three stars to have similar proper motions. The values are summarized in Table 1. The UCAC5 proper motion is



Figure 1. Discovery SDSS image showing the trinary nature of the TYC 2738-1322-1 system. The image was extracted from Aladin Lite. Image taken B2009.8710.

used to represent A and B, while URAT1 is used for C.

The parallax measured by Gaia (Gaia Collaboration, 2016) shows A to have a distance of 701 ly. If these three stars are indeed a true binary system, and if we assume that A, B and C are all located at the same distance as A, then B and C should be separated by on-

Table 1. Summary Data

Star	RA+Dec	PM (RA)	PM (Dec)	PA	Sep	B-V	Mag
A	335.620+32.306	12.5	-11.2	--	--	0.60	11.0
B	335.623+32.305	11.3	-12.6	124°	0.18'	1.35	14.9
C	335.625+32.304	12.2	-5.8	115°	0.27'	1.48	16.7

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ly 0.55 ly and 0.82 ly respectively from A (based on their apparent separation). These distances are sufficiently small for C and B to be gravitationally bound to A.

However, despite giving the impression of a possible triple star system at first glance, Gaia DR2 (Gaia Collaboration, 2018) astrometry shows that only A and B are likely to form a gravitationally bound system. Indeed, C appears to lie much further away (about 1600 ly more distant than A and B). Furthermore, unlike URAT1 and UCAC5 data, Gaia DR2 data shows a significant difference in the proper motion of C according to A and B. Gaia DR2 values are summarized in Table 2.

To conclude, despite the appearance of a CPM triary star system at first glance, Gaia DR2 demonstrates that only TYC 2738-1322-1 and UCAC4 612-124267 are likely to form a true gravitationally bound star system. Based on Gaia astrometry, we can estimate TYC 2738-1322-1 and its companion to be separated by about 0.55 ly. SDSS J222230.00+321814.6 is likely to lie about 1600 ly further from the system.

Acknowledgments

I wish to thank Sebastian Otero (AAVSO) for having provided me with the tools allowing the magnitude conversions.

This work makes use of data products from the Two Micron All Sky Survey, which is a joint project of the University of Massachusetts and the Infrared Processing and Analysis Center/California Institute of Technology, funded by the National Aeronautics and Space Administration and the National Science Foundation.

This work has also 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.

Table 2. Gaia DR2 Astrometry

Star	PM (RA)	PM (Dec)	Plx (mas)
A	13.08	-10.53	5.09
B	14.50	-13.22	4.79
C	8.49	-4.95	1.45

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