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Research Article

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The Discovery of the Variability of Alpha Sextantis, A Non-Eclipsing Binary Star

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Abstract

This paper presents the discovery of the variability of the main star of the Sextans constellation. The discovery was made using data from the TESS space telescope, and the analysis was done in Peranso.

Keywords: Discoveries, Light Curve Periodicity, Photometry, Stars, Variable

1. Introduction

1.1 Ellipsoidal Variable Stars

Non eclipsing binary stars can be detected using the photometry by three methods. One method is to observe ellipsoidal light variations caused by the deformation of the stellar shape by the companion. Other possibility is to observe the light from a star reflecting on the companion's surface. It is also possible to observe the effect of relativistic beaming on the apparent magnitude of the stars. Those methods require having very accurate photometry of the stars. The light amplitude of ELL-type stars usually is not bigger than 0.1 V, but sometimes reaches 0.3 V. Those stars have a wide range of possible periods.

1.2 Naked Eye Variable Stars Discovered in the Last Two Years

In the past, because of the accuracy of the instruments, detecting these low amplitude objects was impossible, but now, thanks to the TESS instrument, it is possible to detect variabilities even for the most well-known, naked eye stars. Some examples are presented in the following table (1).

VSX Name	Discoverers	Amplitude	Period (d)	Type
alf APS	G.C.Neagu,D.M. Manole	0.007 TESS	-	VAR
bet Dra	G. C. Neagu	0.014 V	-	
ome Eri	G. C. Neagu	0.1V/0.005TES S	0.274957/0.158759	

Table 1: Other discoveries made using a similar method

2. Methodology

Spectroscopic binaries brighter than magnitude 6 were selected for further analysis using data from the TESS mission. By using Peranso, the most recent data was analyzed in search for periodicity, using the FALC method [1, 2]. The amplitude was calculated using the Kwe-Van Woerden fit and the epoch of the minima was determined using the same method [3].

3. Results and Discussion

3.1 Alpha Sextantis

Alf Sex is a B9.5III spectral type with the average magnitude of 4.49 V and an amplitude of 0.001 as observed by TESS. The magnitude vs JD plot indicates an ELL-type star [4, 5]. The period resulting from the FALC analysis is 0.7592+/-0.0002 days and the epoch given in the magnitude vs Phase plot is 2459527.338 (HJD).The Gaia EDR3 parallax is equal to 7.6582 +/- 0.3736 mas, putting the star at a distance of 130.57 +/- 8.03 pc also Ra= 10^{h} 07^{m} 56.29556^{s} De= −0° 22′ 17.8621. The star is 214.63 times more luminous than the sun, having an absolute magnitude of -1.09. The fact that multiple spectral observations yielded different results with the star being an A-type or a B-type shows that spectral follow up is encouraged. Alpha Sextantis is proposed as a new ELL-type variable star. This statement comes as a result of querying available variable star catalogues, where the star is unknown as variable. The parameters presented above indicate to the object being an ellipsoidal variable star. AMH-V1 is the brightest star in the constellation of Sextans, visually located 7 arcminutes north of the equator. The star is visible to the naked eye in dark sky. The variability is showing ELL-type variability. These are rotating ellipsoidal variable stars: close binary systems with ellipsoidal components that change combined brightnesses with the period being equal to the orbital period of

the stars. The variability doesn't show eclipses. Alpha Sextantis (α Sex, α Sextantis) is the brightest star in the equatorial constellation of Sextans [6].

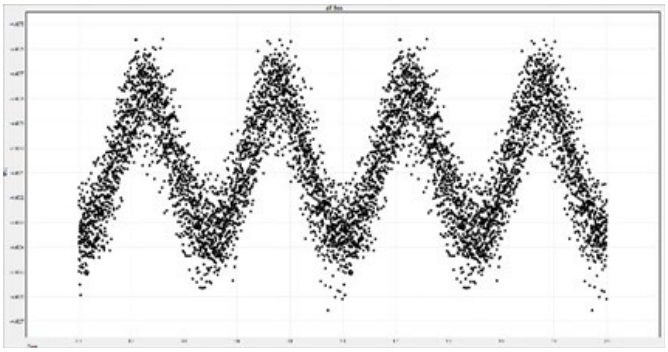

Figure 1: The Phase plot of Alpha Sextantis using TESS data

3.2 Other Results from the Literature

The analysis of naked eye stars using data from TESS and Kepler is useful in confirming new naked eye variable stars. This is useful because using the high precision these instruments provide, we can detect new or rare behaviors of certain variable star types, or even use timing variations for the search of other bodies in the system (other stars or exoplanets). When analyzing these bright stars that have very precise spectral data is even possible to discover a new variable star type. One interesting example is bet Dra, discovered in 2020 by Gabriel Cristian Neagu, it is a star of G2Ib-IIa with the amplitude of 0.014 V (as seen by Hipparcos). Recent data from TESS indicate an amplitude of around 0.003. This could come as a cause of chromaticity, the star probably being a pulsating one

Another such example of microvariable is Alpha Apodis, confirmed by Gabriel Cristian Neagu and Diana Maria Manole (2020). This is a K3III CN0.5 spectral type star with the mean magnitude of 3.83 V with an amplitude of 0.007 as seen by TESS. Looking at the light curve it is showing small amplitude pulsations usually observed in this kind of stars.

One more interesting object is Omega Eridani, discovered by Gabriel Cristian Neagu (2021), being a non-eclipsing binary where each component is a pulsating variable of different type. There is a GDOR star with P= 0.274957 d and amplitude of 0.1 V. The second component is a DSCT-type star with P= 0.158759 d and amplitude of 0.005 TESS. Omega Eridani is known as a spectroscopic binary with P= 3057 days, making it a very good target for O-C studies. The star is even more useful because there are two very stable pulsating stars.

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