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Discovery of new variables from the University of Athens Observatory

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Abstract: New variable stars have been discovered at the University of Athens Observatory. Two of these new discoveries are classified as pulsating variable stars, while two others are eclipsing binaries of Algol type. The rest discoveries are classified as eclipsing binaries of W UMa type. Their absolute parameters were calculated by comparing their physical properties with a wider sample of similar systems. Their components lie close to ZAMS and TAMS region, sharing the same evolution properties among solar type MS stars. In all cases, the astronomical ephemeris is calculated and times of maximum or minimum light are determined.

1 Introduction

The University of Athens (UoA) Observatory is mostly used for collecting high-precision photometric data of celestial objects with variable brightness. The discovery of new variable stars using the most modern photometric techniques is not a rare incident [3]. This study presents nine new variable stars, discovered during a routine photometric data reduction of already known variable stars during the period of 2014-2015.

2 Observations and data reduction

The new variable stars are listed in Table1 and they were observed with the 40cm f/8 telescope at the UoA Observatory and an SBIG ST10 XME CCD camera, equipped with a set of B,V,R,I (Bessell) filters. The CCD chip covers an area of approximately 16×11 arcmin on the sky, which is increased up to 26×17 arcmin with an f/6.3 focal reducer. This results in an image scale of 1.40 arcsec/pixel under 2×2 binning mode. All images were processed using the AIP4WIN software [1] and new times of minima/maxima were computed using the method of [6]. For the orbital or pulsational period the photometric data were analyzed with the use of Period04 software [7], which utilizes FFT analysis. The panels below summarize the basic information of all new variables in this study. In the field of view of KIC 2835289 there are five eclipsing binaries of W UMa-type. They all show primary and secondary eclipses of very similar depth. Following the empirical relations given by [2] for W UMa-type variables, the physical parameters of contact binaries are linked to their orbital period, as a result of their stellar evolution (Fig.1). It is shown that the secondary components on W UMa-type binaries are over-luminous for their actual radius and mass, as they appear to be more evolved than the primary ones. Statistically, eclipsing binaries of W UMa-type are very frequently discovered from the University of Athens Observatory. The histogram below is a comparison among a sum of 68 new variables which have been discovered between 2003 and 2015. It can be seen that 50% of the new discoveries are contact binaries (EW) and 25% are eclipsing variables of other type (EA and EB), while only 20% are pulsating variables. The unclassified group contains either cataclysmic variables or stars with peculiar behavior (flares, or non periodic variations).

Table 1: New variables presented in this study together with their location and apparent magnitude.

Target and Location	Coordinates (RA/Dec)	VT_{mag}	type
GSC 0104-0634 (close to 1SWASP J052036.84+030402.1)	$05^h21^m08.24^s/+03^d02'51.9"$	11.3	EA
GSC 5991-1106 (close to TY Pup)	$07^h33^m35.77^s/-20^d44'37.2"$	12.2	EA
GSC 5991-1727 (close to TY Pup)	$07^h32^m38.99^s/-20^d46'52.1"$	11.1	DSCT
GSC 5991-1865 (close to TY Pup)	$07^h32^m44.65^s/-20^d43'11.7"$	11.5	DSCT
USNO-A2.0 1275-10813091 (close to KIC 2835289)	$19^h08^m03.88^s/+37^d53'59.2"$	15.0	EW
USNO-A2.0 1275-10811543 (close to KIC 2835289)	$19^h08^m00.31^s/+38^d01'57.2"$	15.4	EW
USNO-A2.0 1275-10794124 (close to KIC 2835289)	$19^h07^m19.58^s/+37^d55'15.7"$	16.0	EW
USNO-A2.0 1275-10788218 (close to KIC 2835289)	$19^h07^m05.80^s/+37^d54'34.8"$	16.4	EW
USNO-A2.0 1275-10815489 (close to KIC 2835289)	$19^h08^m09.64^s/+37^d56'16.9"$	16.1	EW

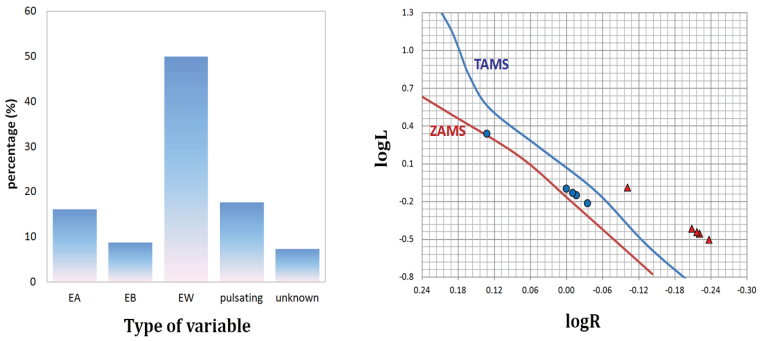

Figure 1: Statistical study of new discoveries from the University of Athens Observatory (left) and the R-L diagram for the contact binaries presented in this study.

3 Discussion

In this study nine newly discovered variable stars are presented, as by-products of the photometric study on eclipsing systems TY Pup, 1SWASP J05236.84+030402.1 and KIC 2835289. These new discoveries have been announced on the IBVS No.6200 [4] and [5]. Four out of five newly discovered contact binary systems contain components with remarkable similarities to our Sun. It is interesting to observe that the orbital period of all systems are very similar to each other (approx. 0.3 days). This comes as a confirmation that the majority of contact binaries follow certain empirical relations, which, in turn, are used for calculating their absolute parameters. Eclipsing binaries of W UMa-type (EW) are discovered frequently as they are very common in our Galaxy and their light variation is very fast and continuous, so they can be detected within just a few hours of observation. On the contrary, detached and semi-detached systems (EA and EB) have longer orbital periods and they are difficult to detect. Pulsating variables can also be detected easily due to their fast light variability. However, their population is not very rich and light variation amplitude is much smaller and filter dependent.

References

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