

Discovery of variables from University of Athens Observatory

K. Gazeas

Department of Astrophysics, Astronomy and Mechanics, National and Kapodistrian University of Athens, GR 157 84 Zografos, Athens, Greece

Abstract: New variable stars were discovered at the University of Athens Observatory, during data reduction conducted for BVRI CCD observations of eclipsing variable stars between August 2012 and June 2013. The photometric data were used in order to classify the new variables and calculate their principle physical and geometric properties, such as their mass, radius, luminosity, orbital period and amplitude of variation. All new discoveries were classified as contact eclipsing binaries of W UMa-type. Times of minimum light were determined and the astronomical ephemeris is calculated for each individual system.

1 Observing from the University of Athens Observatory

High-precision photometry of variable stars is the main research activity at the University of Athens Observatory with almost 50 new variables having been discovered since the telescopes first light (November 1999). New variables are first observed as faint background stars, close to the main target of interest (a known variable, asteroid etc), and attract attention for further study due to their variability in time. This project presents two newly discovered variables and updated light curves for three known ones which have not been studied thoroughly before. These eclipsing binaries were observed the period between August 2012 and June 2013 with the 0.40 m f/8 Cassegrain reflector at the University of Athens Observatory, Greece, and a SBIG ST10 XME CCD camera, equipped with a set of U, B, V, R, I (Bessell) filters. The CCD chip has 2184×1472 useful pixels of $6.8 \times 6.8 \mu\text{m}$, covering an area of approximately 16×11 arcmin on the sky. A focal reducer f/6.3 additionally attached on the telescope increases the field of view up to 25×17 arcmin, setting the image scale at 1.40 arcsec/pixel in 2×2 binning mode.

All images were reduced and aperture photometry was applied. New times of minima were computed using the AVE program (developed by the research group GEA, 1995). The target star 2MASS 06033762+2735111 was treated in a different way. There are no eclipses covered, as it was observed in patrol mode and the photometric data are very scattered across time, spanning over 101 nights. Therefore, frequency analysis was applied, in order to determine the dominant periodicity. Since the light curves in all filter bands show signs of binarity, the obtained frequency was reduced in half, since a binary configuration has always an orbital period twice as large as the period of its respective pulsating behavior. The new times of minima were combined with all data taken from literature, in order to calculate the linear ephemerides, which are shown for each system on top of their light curve plots.

2 Discussion

Complete multi-color light curves are obtained for five variable stars, two of which are new discoveries. These light curves are essentially by-products of the research activities conducted at the University of Athens Observatory during the period of August 2012 - June 2013, which focus primarily on variable star observations.

GSC 0008:0901 or EX Psc shows relatively deep eclipses, indicating large orbital inclination. The orbital period is very short (0.28945 days) which renders the system one of the contact binaries with

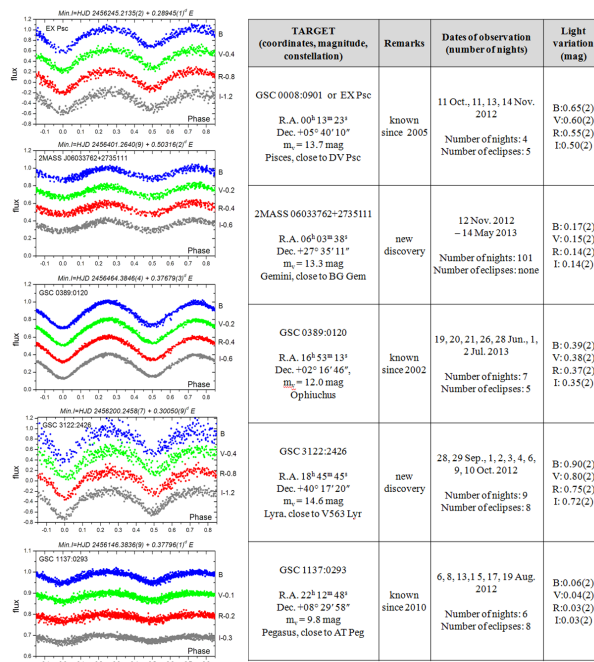


Figure 1: Summarized information for each individual target.

the shortest orbital periods found so far. 2MASS 06033762+2735111 is a newly discovered system with small light variation (0.15 mag in V filter), indicating very shallow eclipses due to low orbital inclination. GSC 0389:0120 was noticed to be variable by the ASAS automated sky survey ([4] and [5]). It has high S/N light curves, allowing the detection of weak magnetic activity (seen as OConnell effect). GSC 3122:2426 is the faintest system among the five in this study. It is a newly discovered system with very large light variation (0.9 mag in B filter), indicating very deep eclipses and/or high orbital inclination. GSC 1137:0293 was discovered in 2010 by [3].

Photometric data suggest that all targets under study are eclipsing binaries in contact configuration. Some of these eclipsing binaries belong to the class of low temperature contact binaries (LTCB), which have been extensively discussed by [2]. These systems are highly evolved contact binaries, as most of their angular momentum and mass have escaped and their orbital period has shrunk to less than 0.3 days (case of GSC 0008:0901 and almost the case of GSC 3122:2426). Although LTCB exhibit magnetic activity, these targets do not show evidence of spotted surfaces - not even GSC 0008:0901. On the other hand, spot activity is visible on GSC 0389:0120, where the secondary maximum at phase 0.75 is lower than the primary one by 0.01 mag. Absolute physical parameters of contact binaries are linked to their orbital period, as a result of their stellar evolution. The absolute physical parameters for these systems are derived by comparing the orbital elements of the targets under study with well studied contact binaries, following the empirical relations given by [1]. It is found that all targets seem to host solar-type components, very similar to all other well known contact binaries.

References

- [1] Gazeas, K., 2009, *CoAst*, 159, 129
- [2] Gazeas, K. & Stepien, K., 2008, *MNRAS*, 390, 1577
- [3] Liakos, A., Niarchos, P., 2011, *PZP*, 11, 2
- [4] Pojmanski, G., 2002, *AcA*, 52, 397
- [5] Pojmanski, G., Pilecki, B., Szczygiel, D., 2005, *AcA*, 55, 275