A NEW EB ECLIPSING BINARY STAR IN LEO

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Abstract: We report the discovery of a new variable star in the Leo constellation, observed by the (IAU station 565) Astronomical Observatory in Bassano Bresciano on 9th March 2014. The star is catalogued as GSC 01443-01140 (11h 51m 40.90s +21° 01' 55.1"). From the light curve, the star should be an EB eclipsing type variable. We computed the epoch HJD 2456726.36730 and the period P = 0.409824 days. Mean magnitude is 14.02 (in Johnson V filter from APASS Cat.) with an amplitude of about 0.22 mag (clear). We registered this star in VSX (Variable Star Index, AAVSO), its UID is 000-BLH-467.

1. Introduction

We observed the new variable star by the Astronomical Observatory in Bassano Bresciano, that is a little town in Lombardy, a region in the north of Italy (Lat. 45°19'03" N   Long. 10°08'04" E). The Observatory is 63 meters above the sea level, in the Po valley.

We discovered this variable star on 9th March 2014 with our Schmidt telescope during the CCD session (with a clear filter) of the minor planet 891 Gunhild for a light curve grabbing, while crossing the Leo constellation. During the photometric analysis with MPO Canopus, Variable Star Search tool, this software detected a possible light change on the GSC 01443-01140 star (VMag. ~ 14) at position R.A 11 51 40.90 Dec .+21 01 55.1 (J2000). In order to determine the typology, the epoch, the amplitude of light variations and the period, we made 7 observing sessions during the following clear nights. The data collected are useful to determine the fundamental parameters of the variable star and to register it in the Variable Star Index (VSX - AAVSO).
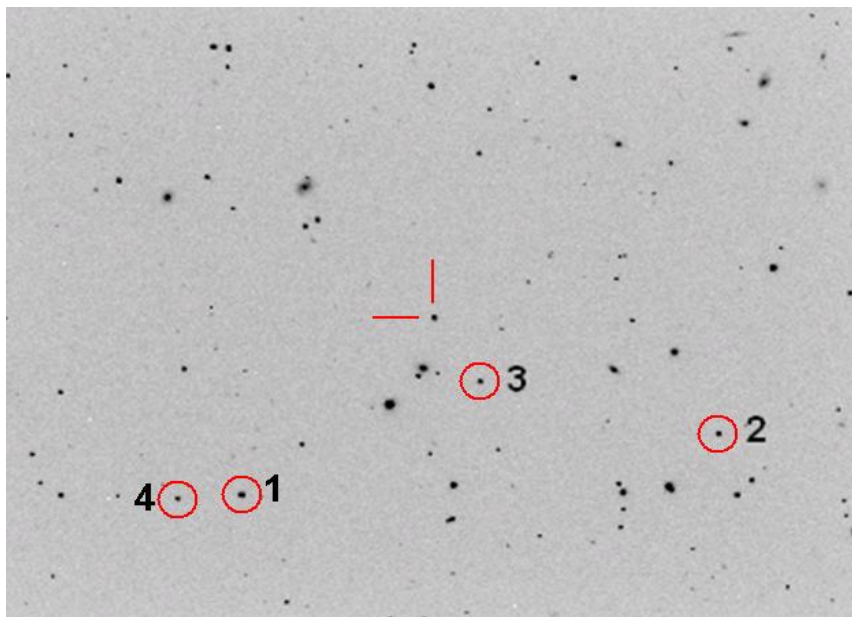
New variable star GSC 01443-01140 and comparison stars

2. Instrumentation and methodology

All observations were obtained using a 320/400/1000mm Schmidt telescope of (IAU station 565) Bassano Bresciano Observatory, equipped with Starlight Xpress MX916 CCD camera, with a sensor area of 752 x 580 pixels (Pixel size: 11.6 x 11.2uM). This configuration results in a FOV (field of view) of 30' x 22' (2.4 x 2.3 arcsec/pix). We configured the camera in a 2x2 binning mode with angular resolution of 4.8 x 4.6 arcsec/pix.

We used Polypus software release 1.9 (Bassano Bresciano Observatory, 2013) to control the robotic observations. We took exposures when the target's altitude was more than 30°, unfiltered, unguided with 120s exposure times. Raw images were processed with flat field and dark frames. MPO Canopus ver. 10.4.0.20 (Bdw Publishing, 2010) was used to perform differential photometry on the reduced images; Peranso software ver.2.51 (CBA Belgium Observatory) was used to determine the epoch and the amplitude.

Seven unfiltered sessions were taken in total, with 120 second of exposure, for every available night time. All sessions were measured using the same 4 comparison stars. The comparison stars were chosen as the most appropriate ones in the field according to their photometric indices (see Table 3).

Tab 1. Summary of the observations:
Session, Date of sessions, number of images/session, Time span, exposure times

Session number	Date of the observations	N. of images	Time span	exp. time sec.
S1	March 09th	68 points	2:20 hours	120
S2	March 10th	53 points	1:00 hours	120
S3	Match 11th	178 points	6:50 hours	120
S4	March 12th	141 points	5:40 hours	120
S5	March 19th	99 points	4:40 hours	120
S6	March 20th	45 points	2:10 hours	120
S7	March 24th	96 points	3:30 hours	120

Tab 2. Cross identification of variable star

GSC 01443-01140 = UCAC4 556-050656 = 2MASS J11514091+2101550 = USNO-B1.0 1110-0204664

Tab 3. Variable and Comparing stars
Session, UCAC4 name, RA(J2000)Dec, UCAC4(APASS)VMag, Colour indexes

Num	UCAC4	RA J2000	DE J2000	UCAC4 VMag	B-V	V-R	R-I
Var	556-050656	177.9204250	21.0319781	14.02	1.02	0.26	0.30
C1	555-049617	178.0374612	20.9289314	13.24	0.67	0.18	0.20
C2	555-049593	177.7474621	20.9642984	14.10	0.62	0.17	0.17
C3	555-049602	177.8925000	20.9948389	14.47	0.63	0.18	0.14
C4	555-049619	178.0763242	20.9266737	14.59	0.66	0.19	0.11

3. Period analysis

We used the software Peranso 2.51 to determinate the approximate values. The period has been determined from periodogram analysis using the ANOVA algorithm (Schwarzenberg - Czerny, 1996) implemented in Peranso 2.51.
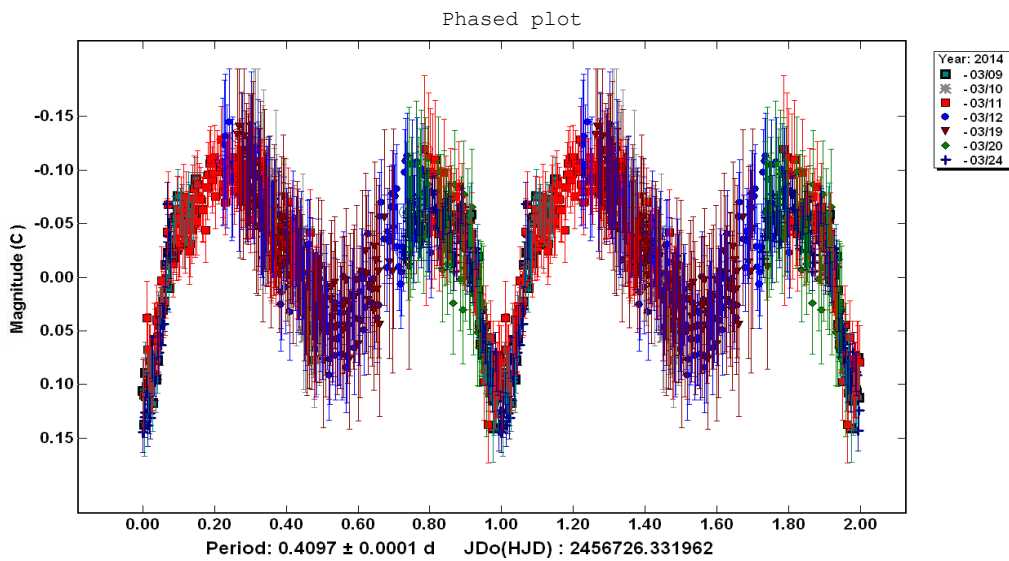
The periodogram is shown on the following figure:
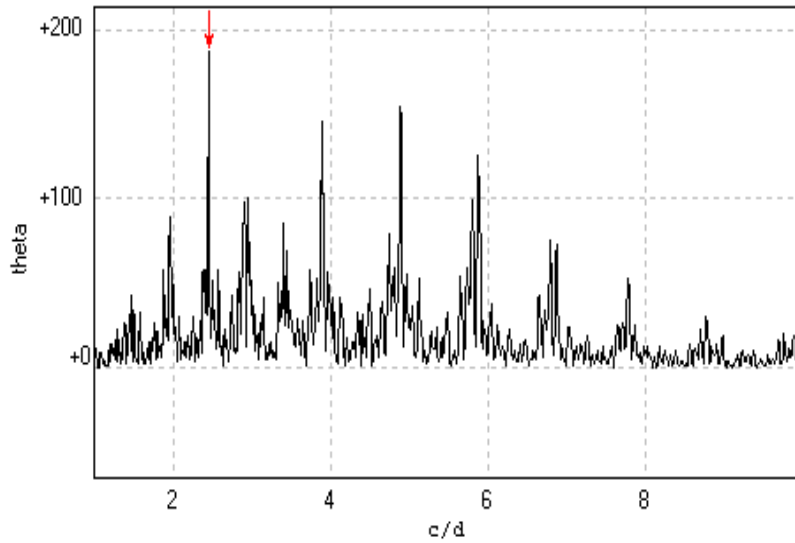
Periodogram given by ANOVA period analysis.

Frequency = 2.440081 (Period = 0.4097 d)

The following phase plot, shows 0.4097 days period and clear amplitude of 0.22 Mag. We have used the polynomial fit algorithm of fourth degree implemented in Peranso 2.51 to estimate the magnitudes (see table 6).

Catalina (CRTS) data merging

We searched on CRTS web site (http://nesssi.cacr.caltech.edu/DataRelease/) to check if light changing was detecting by this automatic survey.

We have done a search on the coordinates R.A 11 51 40.76 Dec .+21 01 56.0 with radius 0.5 arcsec. Object was found with Catalina ID = 1121060027535. This data was available:
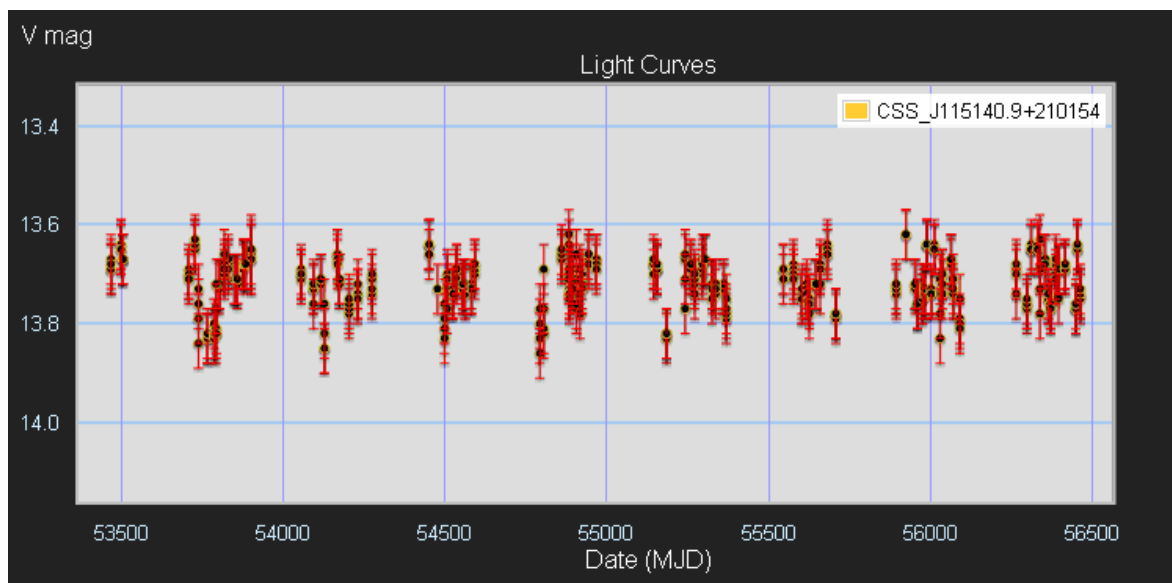

CRTS data of variable star

Searching of the period, the result was this:

Period from CRTS
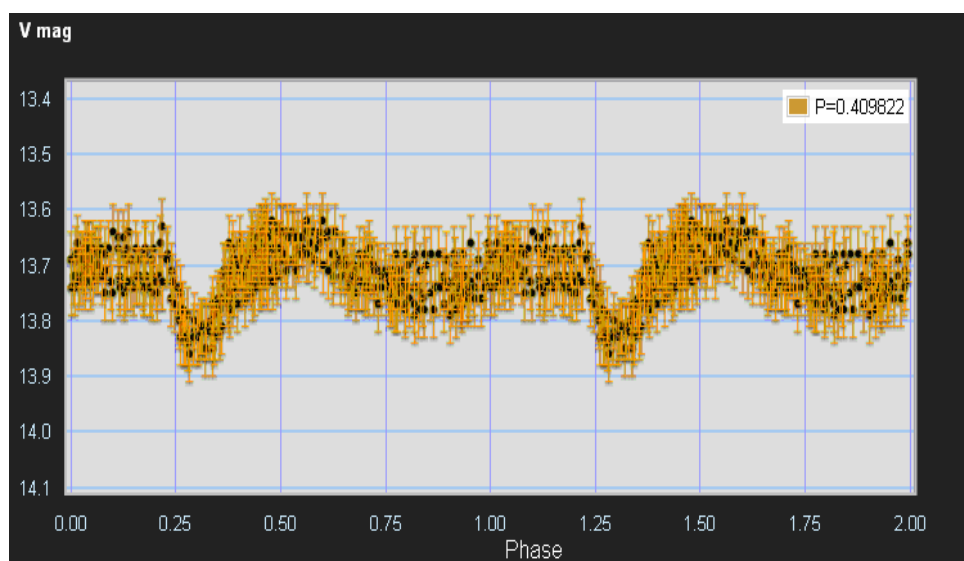
CRTS Period is 0.409822 days, very close to our solution (difference is round about 10 seconds of time). CRTS data are from 09/04/2005 to 19/06/2013.

CRTS data are worse than ours in magnitude noise, but the long time span would be helpful for a better estimation of the orbital period . Combining the CRTS with our data, the resulting period is **0.409824** +/- 0.000001 days.

Combined light curves from CRTS and Bassano Bresciano Obs.
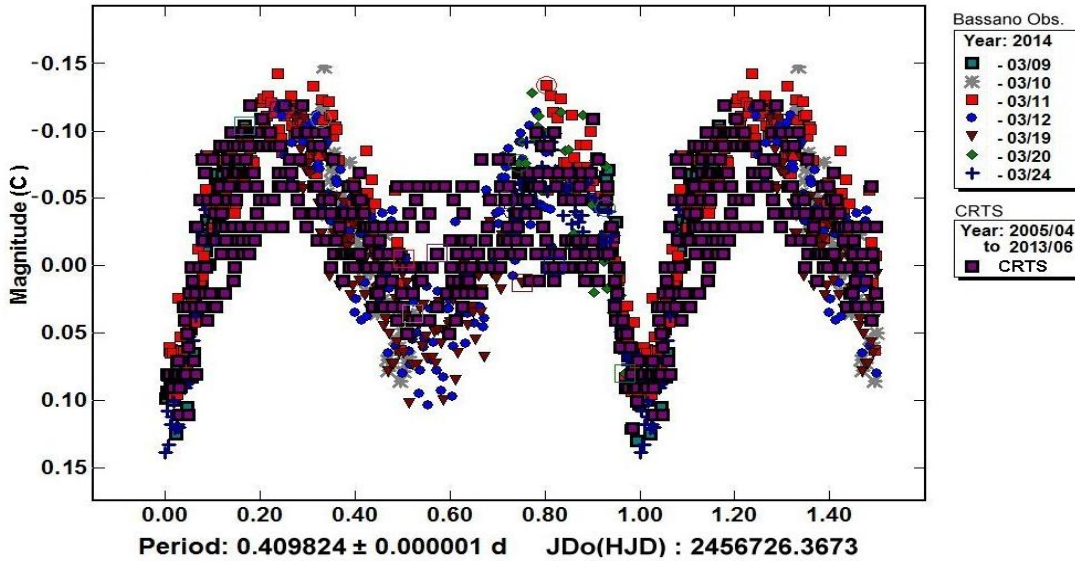
Leaving the CRTS data and forcing the period 0.409824 day, following is the final light curve plot:

Light curve from Bassano Bresciano with period of 0.409824 day.
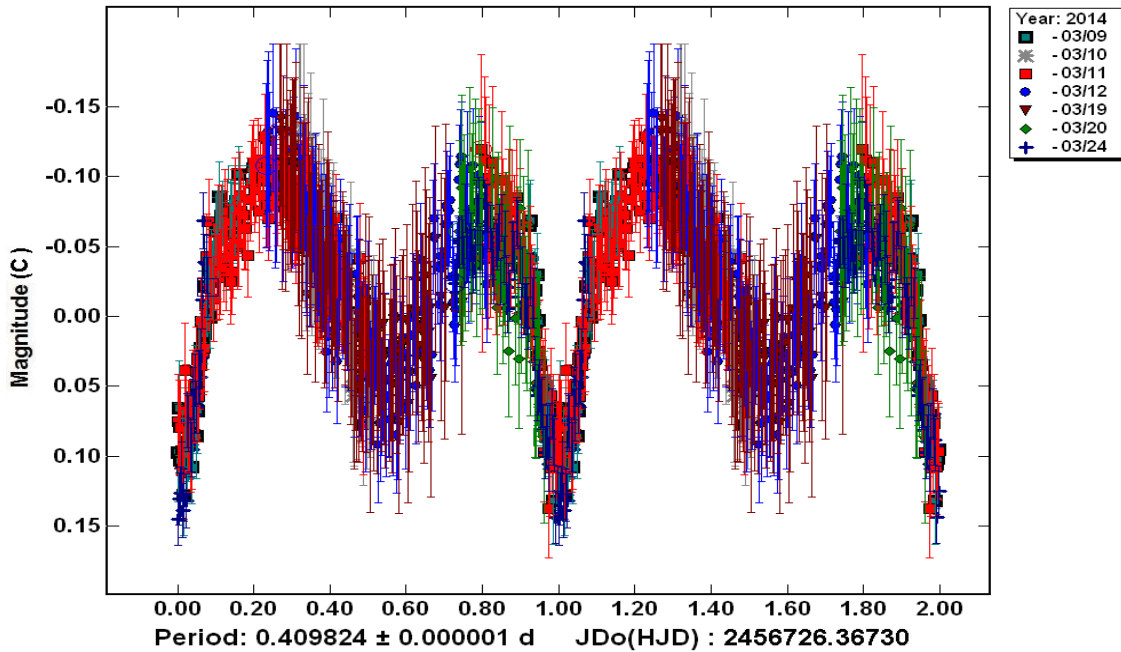
4. Epoch

Using Peranso software (through a polynomial fitting routine of order 3), we were able to compute the primary minimum epoch as HJD 2456726.36730 +/- 0.0032 and the secondary minimum epoch as HJD 2456726.5752 +/- 0.0097 (see Table 6 for details).

3 primary minima (I) and 2 secondary minima (II) were observed during March 2012 . First primary minimum is marked as initial epoch (see table 5) .

Tab 5. Timing and type of minima

EPOCH(HJD)	Error	Type	Filter
2456726.36730	0.00334	I	Clear
2456728.41395	0.00458	I	Clear
2456729.46339	0.01076	II	Clear
2456736.42029	0.00970	II	Clear
2456741.53113	0.00313	I	Clear

Due to long time span, is not possible to determine any minimum in the CRTS data.

5. Conclusion

This star shows a periodic light change with a bimodal curve, where maximums are at least same level and a minimum have a more appreciable difference. Period spectrum analysis doesn't show other possible period than P = 0.409824 days, with amplitude A = 0.22 Mag (Clear) . Epoch HJD 2456726.36730. Light curve seems be from a binary eclipse star EB type (see table 6).

Tab 6. Main characteristics of discovered star

Name	Type	Period (d)	Iitial epoch (HJD)	Mean Johnson V Mag.	Amplitudes Mag(Clear)		
					Max	Min I	Min II
GSC 01443-01140	EB	0.409824 +/- 0.000001	2456726.36730 +/- 0.0032	14.02	-0.09	+0.13	+0.07

6. Acknowledgments

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- Thanks to Sebastian Otero (AAVSO-VSX) for helpful discussion and classification of this new variable star.

- AAVSO, http://www.aavso.org

- VSX, http://vsx.aavso.org/

- Simbad Astronomical Database, 2007, http://simbad.u-strasbg.fr/simbad/

- VizieR, 2010, http://vizier.u-strasbg.fr/viz-bin/VizieR

- Warner, B.D. (2009b). MPO Software, Canopus version 9.5.0.3. Bdw Publishing, http://minorplanetobserver.com/

- Vanmunster T., 2007, PERANSO, PERiod ANalysis SOftware, http://www.cbabelgium.com

- Catalina Survey http://nesssi.cacr.caltech.edu/DataRelease/

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