

## **New Variable Stars in Camelopardalis and Monoceros**

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### **Riassunto**

7 nuove stelle variabili sono state individuate nella costellazioni della Giraffa e dell'Unicorno (Camelopardalis e Monoceros). In due stagioni osservative sono state realizzate più di 50.000 immagini presso l'osservatorio Calina di Carona (CH). Le 7 stelle appartengono a varie classi: cinque ad eclisse, una RR Lyr e una rotazionale. Per alcune di queste si rendono necessarie ulteriori osservazioni

### **Summary**

7 new variable stars have been individuated in the constellations Camelopardalis and Monoceros. More than 50000 images have been taken in two observational seasons at Calina Observatory in Carona (CH). The 7 new variable stars belong to various classes; five of them are eclipsing variables ; one is an RR Lyr pulsating variable and another one is a rotational variable star. Further observations are required for many of these stars.

### **Résumé**

7 nouvelles étoiles variables ont été identifiées dans Camelopardalis et Monoceros. Plus de 50.000 images ont été réalisées pendant deux saisons à l'Observatoire Calina de Carona (CH). Les 7 nouvelles variables appartiennent à des classes différentes; cinq sont des éclipsantes, une est une pulsante RR Lyr et la 7<sup>ème</sup> une variable en rotation. Il est nécessaire de poursuivre les observations de certaines de ces étoiles.

### **Resumen**

7 nuevas estrellas variables han sido identificadas en Camelopardalis y Monoceros. Más de 50.000 imágenes han sido realizadas durante dos temporadas desde el Observatorio Calina en Carona (CH). Las 7 nuevas variables pertenecen a clases diferentes; cinco son eclipsantes, una es pulsante RR Lyr y la última una variable en rotación. Son necesarias más observaciones de algunas de estas estrellas.

## **Introduction**

The authors worked in Calina Observatory (CH) carrying out systematic observations during the years 2009 and 2010 on BL Cam, UU Cam and a new variable star discovered by the CoRoT space telescope in Monoceros.

Results on BL Cam obtained with observations carried out in the past years were published (Rodriguez et al. 2007, Fauvaud et al. 2010), while publications on the latter star are in progress.

The magnitudes shown are instrumental, because the CCD images were taken in white light. The telescopes used for these observations were:

- an apochromatic refractor Ø 140 mm F:1000 mm with a CCD Camera (FOV 49'x 33')
- a Newton Reflector Ø 310 mm F:1500 mm with a CCD Camera (FOV 32'x 21')
- a Wright-Newton reflector Ø 410 mm F:1200 mm with a CCD Camera (FOV 45'x 30')

Those telescopes are remote controlled and are installed at Calina Observatory in Carona, a very nice village 700 m high close to Lugano (CH).

On the whole we discovered 7 new variable stars. Among them, the eclipsing binary USNO 1534-0125213 in the field of BL Cam is at the limits of our observational capabilities, and we could identify it only thanks to the power of the Muniwin software that we used to analyse our results.

The period search was performed by means of a least-squares, iterative sine-wave fitting.

### **1. Field of UU Cam**

3542 images have been exposed on 7 nights of observations, starting from 2009 January 28 until 2009 February 24. The rms standard deviation we obtained between the magnitude of the comparison star and the one of the check star was 0.02 mag. The analysis of the field showed the unpredicted variability of three stars.

The first of them, GSC 4339-250, was already discovered as a new variable star in 2004 (Otero et al. IBVS 5570 Oct. 2004).

It is an eclipsing variable of Algol type with a period of 0.83198 days according to our observations (0.84040 days according to Otero) and a range of variation of 0.6 mag.

We observed the minima reported here with heliocentric correction:

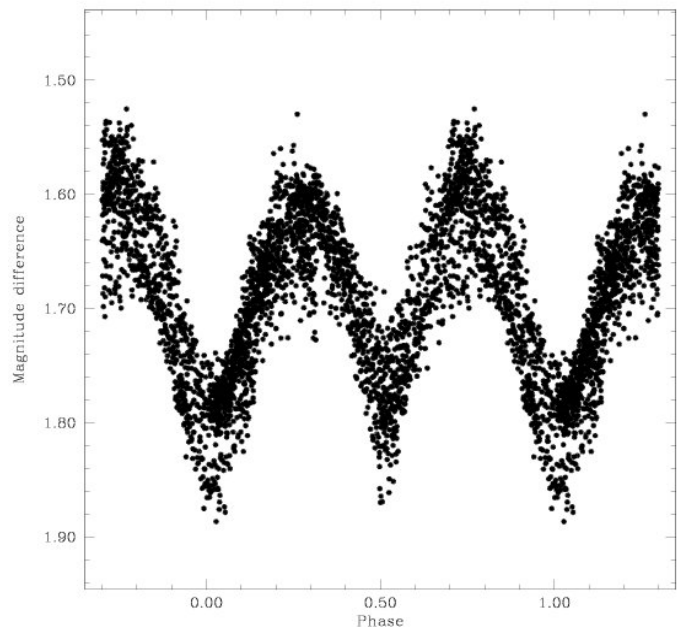
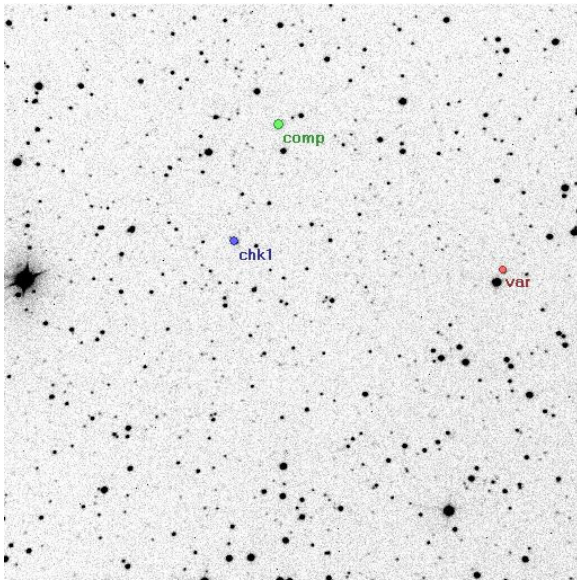
J.D..	2454885.4550	± .0034
	2454886.2972	± .0041
	2454887.5559	± .0038
	2455498.3595	± .0029

The stars used as comparison and check are

GSC 4339-2245	Mg 11.7	$\alpha$ 03 <sup>h</sup> 51 <sup>m</sup> 38 <sup>s</sup>	$\delta$ +74° 32' 29"
GSC 4339-2101	Mg 12.7	$\alpha$ 03 <sup>h</sup> 51 <sup>m</sup> 54 <sup>s</sup>	$\delta$ +74° 37' 18"

**GSC 4339-1166**      Variation: M. instr. 13.25-13.58    Min I = HJD 2454877.5690 + 0.580135 x E  
Contact binary (EW variable) or rotational variable

$\alpha$  03<sup>h</sup> 49<sup>m</sup> 13<sup>s</sup>  
 $\delta$  +74° 36' 51"

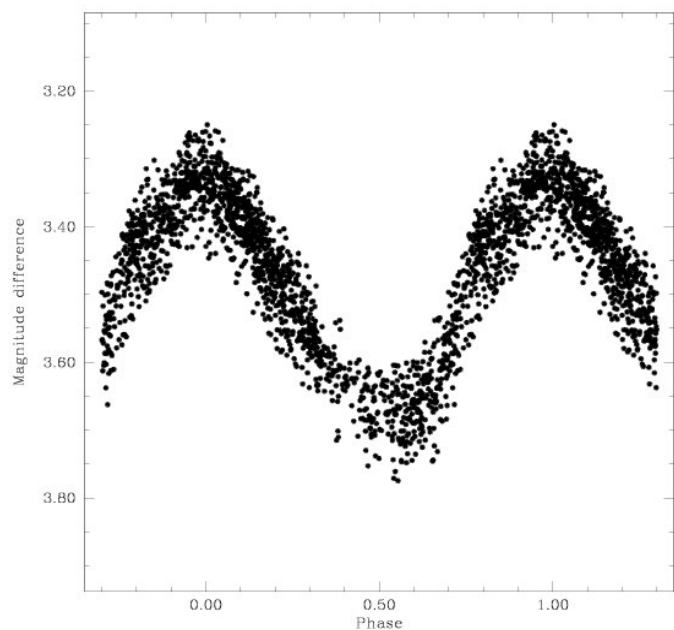
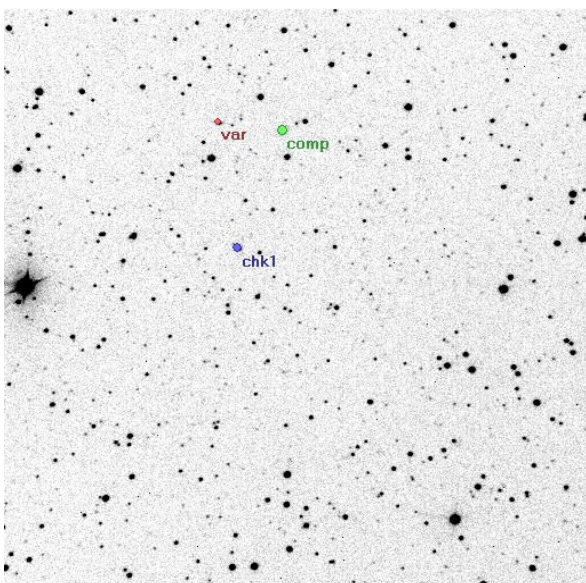


We collected 2886 usable data points after removing obvious outliers (spurious pixels, cosmic rays,...) and measurements with too low counts. The period ( $0.580135 \pm 0.00034$  d) and the shape of the light curve suggest a contact binary, i.e. a W UMa variable. The scatter at both maxima and minima do not rule out the possibility of a rotational variable. The rms residual after a fit by means of a Fourier series is 0.033 mag. The amplitude value of 0.20 mag (white light) has been obtained from a least-squares fit. An O'Connell effect probably causes the difference in magnitude of the maxima

**GSC 4339-2181**      Variation: M instr. 14.98-15.45      Max = HJD 2454877.4434 + 0.271983 x E  
Class RR Lyr

$\alpha$  03h 52m 17s

$\delta$  +74° 32' 32"



Though the star is quite faint in the CCD images yet we could collect 1555 useful data points. The asymmetry of the light curve clearly suggests pulsation. The dispersion visible just before the maximum light could be due to a standstill or to a double maximum, typical of RRc variables. The period of 0.27 d is definitely too long to be ascribed to a Delta Scuti variable. The rms residual after the fit is 0.040 mag.

## 2. Field of BL Cam

In the 2008-2009 observational campaign we collected 5888 images in 12 nights from 2008 December 26 to 2009 January 20.

In the 2010-2011 observational campaign we collected 15970 images in 20 nights from 2010 October 20 to 2011 January 31. The measurements rms standard deviation is 0.02 mag.

We identified two new variable stars and two suspected variables.

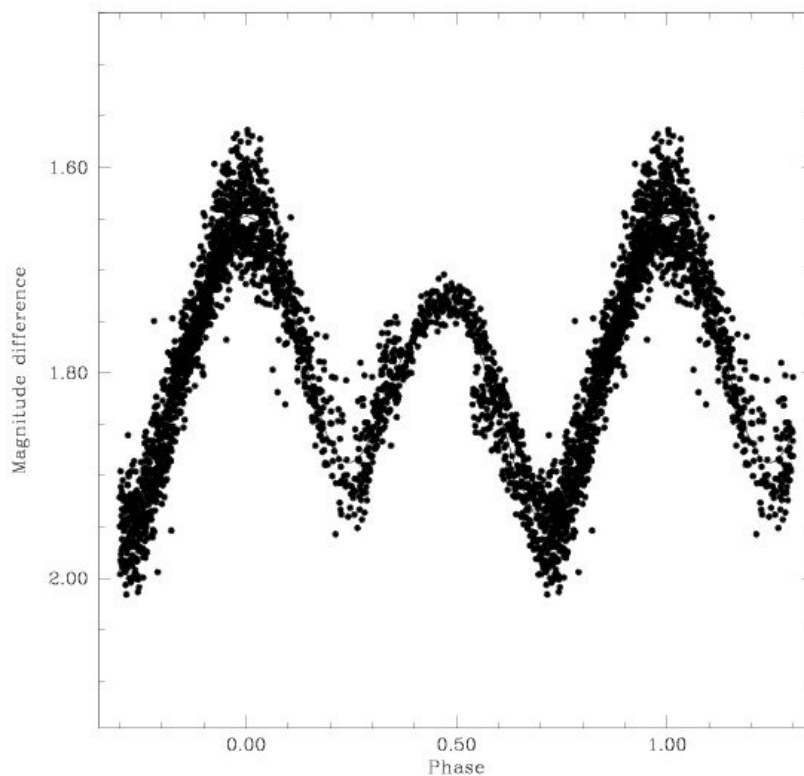
The stars used as comparison and check are

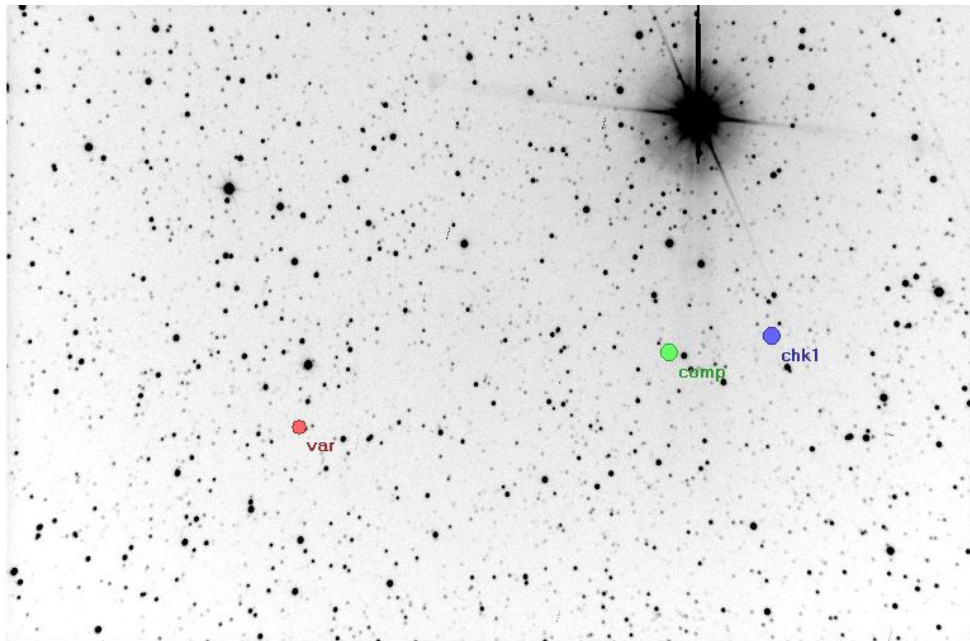
GSC 4067-0077	Mg 12.07	$\alpha$ 03 <sup>h</sup> 47 <sup>m</sup> 13 <sup>s</sup>	$\delta$ +63° 20' 50"
USNO 1534-0125526	Mg 12.01	$\alpha$ 03 <sup>h</sup> 47 <sup>m</sup> 05 <sup>s</sup>	$\delta$ +63° 24' 10"

**USNO 1531-0149458** Variation: M Instr.13.78-14.18 Max I = 2454535.0675 + 0.254647 x E  
Class: Rotational Variable

$\alpha$  03<sup>h</sup> 47<sup>m</sup> 49.6s

$\delta$  +63° 08' 52"



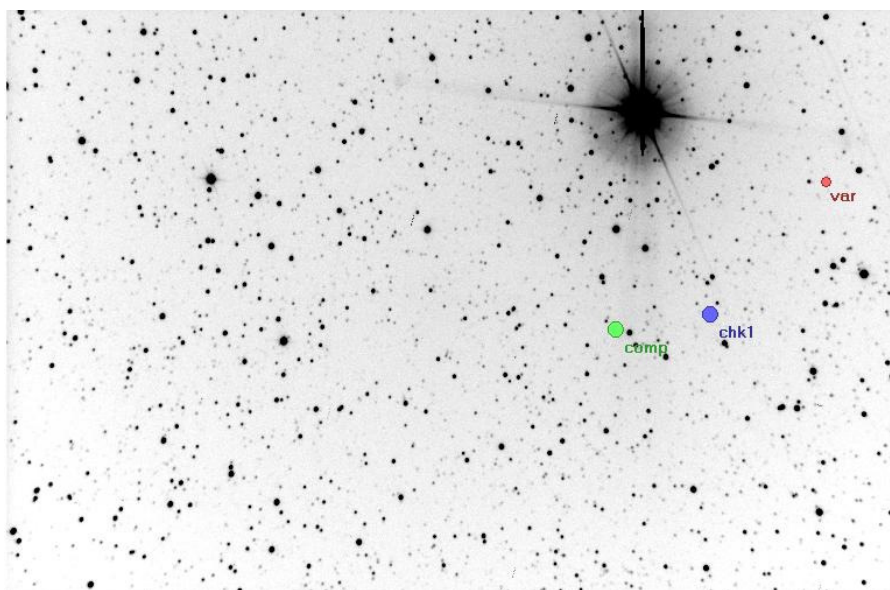


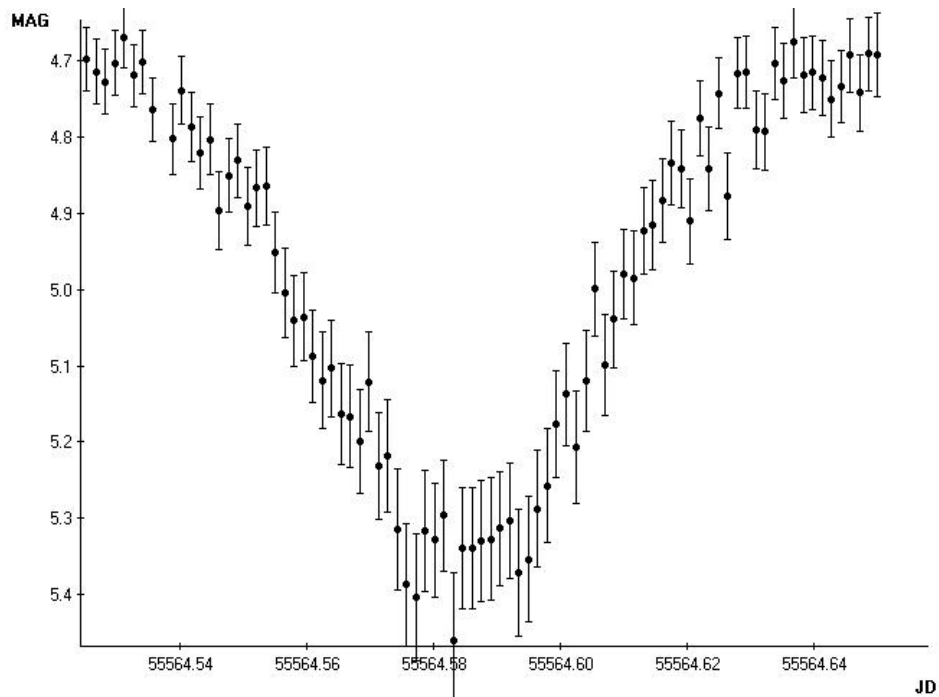
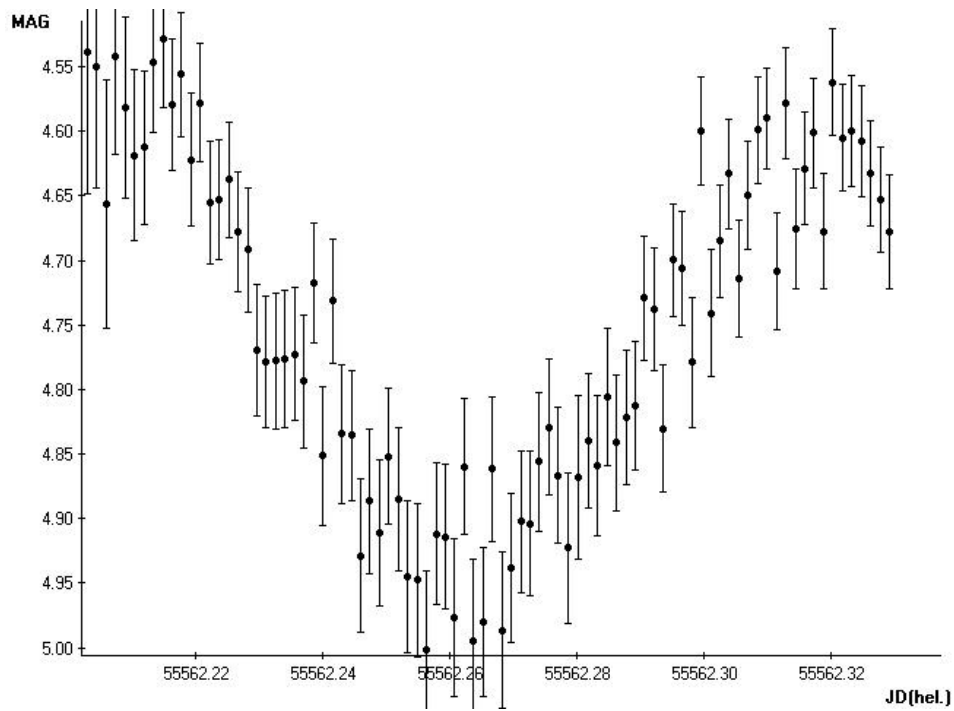
We collected 2486 data points. The light curve analysis revealed a strong difference in both maxima and minima. This clearly points out a rotational effect. The amplitude is remarkable, around 0.30 mag. Variability due to a contact system is less probable, since in this case the two stars should be very similar and then it would be more difficult to explain the differences in the height of the maxima and in the depth of the minima. The short period (0.255 d) suggests binarity and USNO 1531-0149458 is probably a binary system composed of two active stars, not undergoing eclipses. The least-squares fit leaves a rms residual of 0.029 mag.

**USNO 1534-0125216** Variation M.instr.:16.8-17.4 P:?  
Class E?

Epoch: 55562.2559

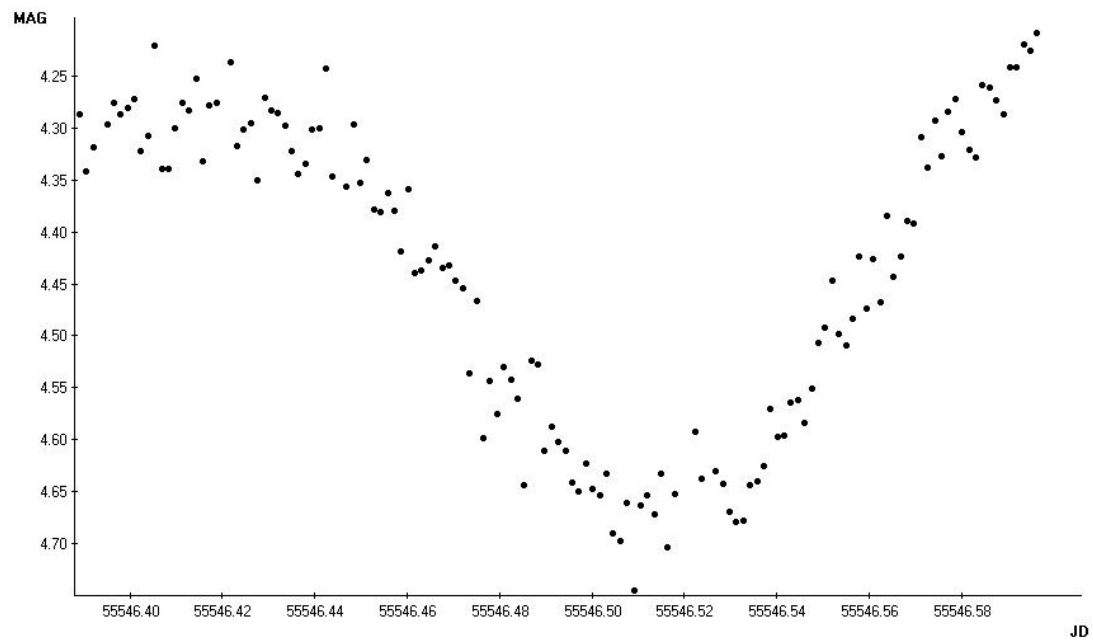
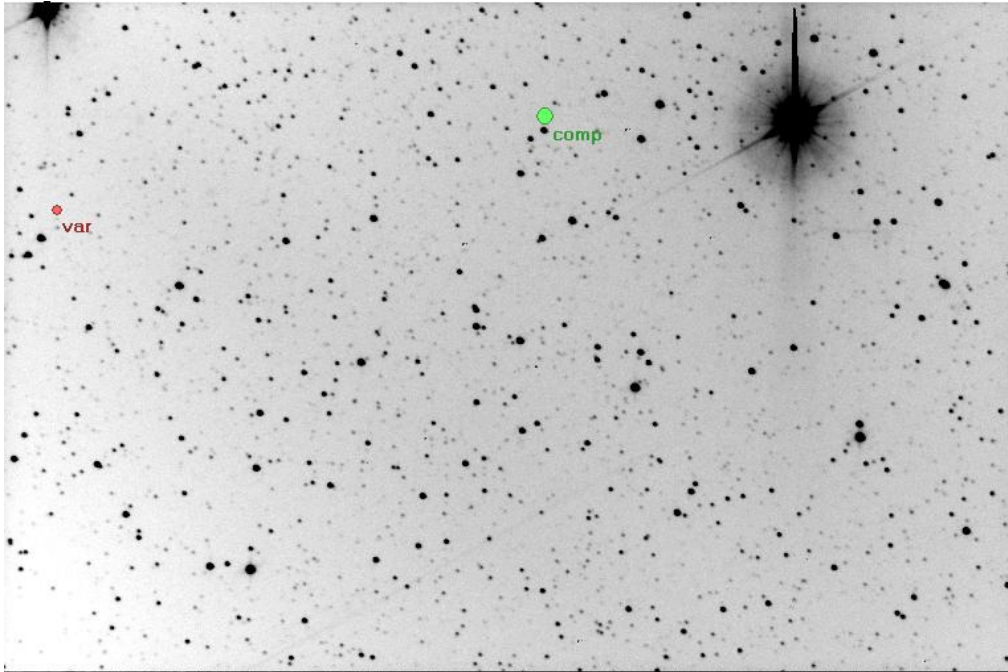
$\alpha$  03h 46m 19.7s  
 $\delta$  +63° 27' 47"





This star is the faintest we observed. We only have four nights of observation, as the star is often beyond instrumental limits; but showed its coherent light variation during two nights. Further observations are necessary to confirm the class of variability.



**USNO 1534-0126575**Variation M.instr.: 16.6-17.0 P:? Epoch: 2455546.517  
Class E? $\alpha$  03h 49m 32s  
 $\delta$  +63° 24' 21"

Also in this case we have a very faint star with only two nights available, and we cannot classify with certitude its variability class. So a further observational effort will be necessary during the next season.

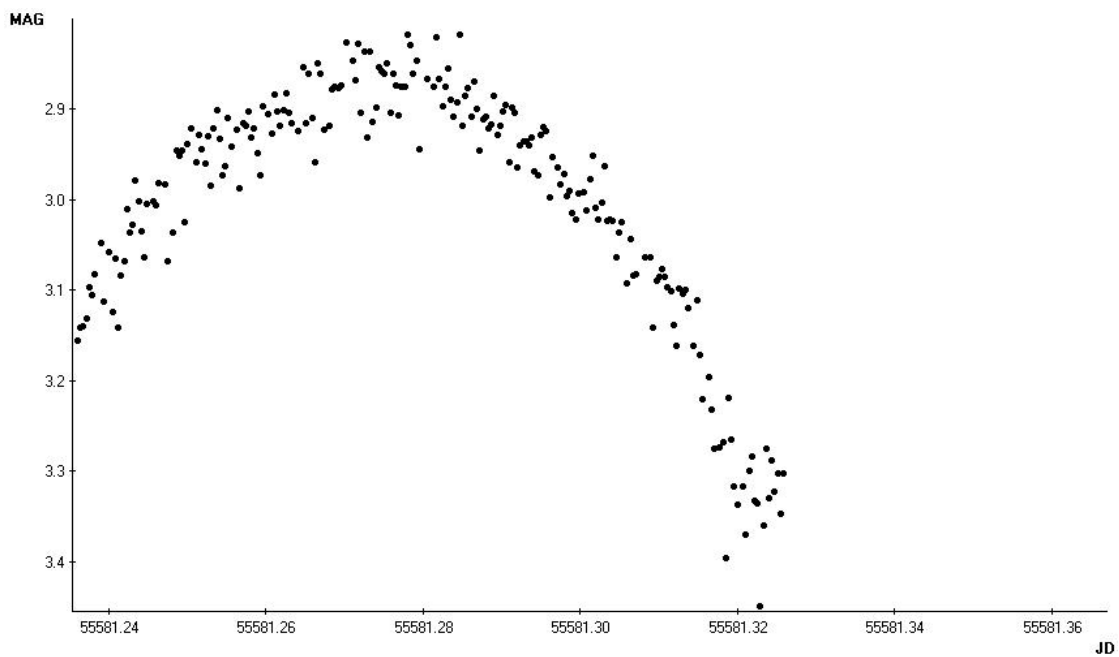
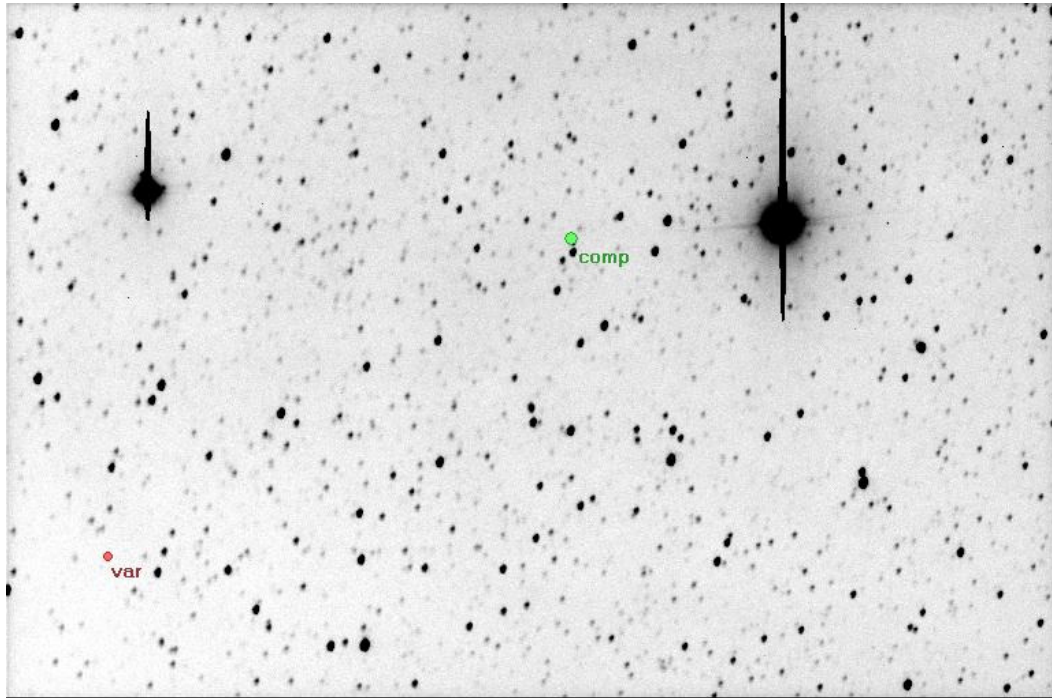
**USNO 1535-0121961**

Variation M.instr.: 15.1-15.7

P:?

Epoch: 2455581.3231

Class EW-EB?

 $\alpha$  03h49m32s $\delta$  +63° 31' 37"

Though this star was observed on only one night, that of 2011 January 19, the kind of variation and its amplitude give us the certainty of its variability.

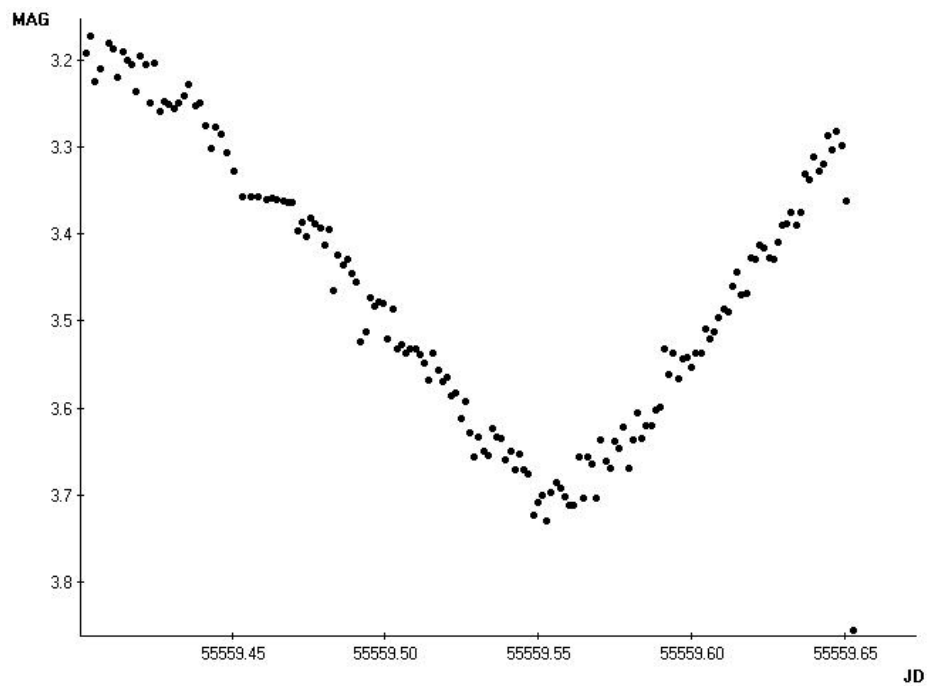
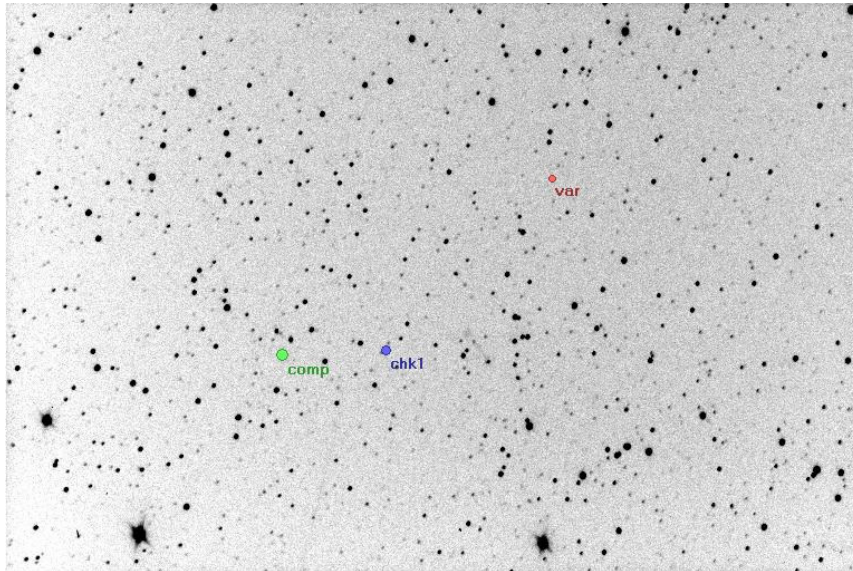
In the next season we will clarify the exact kind of variation, and the characterizing parameters.



**4. CoRoT Field**

**USNO 0897-0088960** Variation M.instr.: 15.6 -16.1 P:? Epoch: 5559.5547  
Class EA?

$\alpha$  06h 29m 06,8s  
 $\delta$  -00° 15' 28,32"



This new variable star in Monoceros showed an unequivocal light variation on the night of 2010 December 28, giving evidence of a typical EA minimum. This phenomenon did not repeat during all the very long and very intense observational period. In fact we observed this field until 2011 February 11 taking 26 206 images on 26 nights thanks to a very favourable weather.

So we think it will not be easy to obtain the parameters for classifying this star, and for this reason we are looking forward to a collaboration with other observatories placed on different longitudes (New Zealand, Australia or other countries) in order to obtain very long observational sessions (several days for instance), in order to increase the possibility to catch some more minima.

The stars used as Comparison and Check are:

USNO 0897-89439 Mg 12.01  $\alpha$  06<sup>h</sup> 29<sup>m</sup> 55<sup>s</sup>  $\delta$  -00° 17' 53"

USNO 0897-89305 Mg 14.02  $\alpha$  06<sup>h</sup> 29<sup>m</sup> 43<sup>s</sup>  $\delta$  -00° 15' 14"

## 5. Conclusions

The discovered stars have been individualized during the observation of other variable stars (BL and UU Cam and a CoRoT variable in Monoceros). For this reason we invite other observers who in the future will observe these stars methodically to see that they are also included into the field of view of their cameras in order to give a contribution to their knowledge.

Acknowledgement: We wish to thank Ennio Poretti for his kind and patient collaboration for compiling this article.

## Bibliography

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Otero et al., 2004, IBVS 5770: "New eclipsing binaries found in NSVS database".

Pribula, Kreimer, Tremko, 2003, Contr. Astr. Obs. Skalnat Pleso, 33, 38-70: "Catalogue of the field contact binary stars"

Muniwin program - David Motl [c-munipack.sourceforge.net](http://c-munipack.sourceforge.net)