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GY Peg, a new strongly varying Blazhko RRab variable

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SUMMARY

New CCD measurements are showing that the RRab type star, GY Peg, has a strong, but typical Blazhko effect. The Blazhko beat period is about 30.49 days.

RÉSUMÉ

De nouvelles measures CCD montrent que l'étoile de type RRab, GY Peg, a un fort effet Blazhko assez typique. La période Blazhko de battement est d'environ 30.49 jours.

RIASSUNTO

Nuevi misure CCD mostrano che la stella del tipo RRab, GY Peg, ha un forte, ma tipico Blazhko effetto. Il periodo Blazhko di battito è di circa 30.49 giorni

RESUMEN

Nuevas medidas CCD muestran que la estrella de tipo RRab, GY Peg, ha uno fuerte, pero tipico Blazhko efecto. Il periodo Blazhko de latido es alrededor de 30.49 días.

1. INTRODUCTION

In the GCVS 85, GY Peg is catalogued as RRab type star (22h 25 35.9; +34° 59.16; 2000) with mag. 12.2 to 13.4 (p) elements as of HJD 2441217.390 + 0.5034537 (1) and with a rising amplitude as 20% of the period. The references are Romano (1960) and Romano and Perissinotto (1972). Afterwards, the star seems to have been forgotten and G. Maintz (2005) failed to identify it around the GCVS 85 position. Fortunately, the new electronic version of the GCVS gives a more accurate position of GY Peg (22h 25 23.2; +34° 53 10; 2000) corresponding to GSC 2742 937.

In 2007, in the GEOS RR Lyrae database (Le Borgne et al. 2007-2009) the only times of maximum were the epoch of GCVS 85 and a normal maximum determined by measurements with the ROTSE automatic telescope.

2. NEW OBSERVATIONS

The problem of identification of GY Peg as experienced by G. Maintz (2005) has been raised by J. Vandenbroere and solved by discussion inside the GEOS group and with RR Lyrae observers. F.-J. Hambsch (HMB) decided to follow this variable star over a longer period of several months. He obtained long sets of observations during 21 nights between August 28 and December 12, 2007 using a 50 cm f/8.2 Richey Chrétien telescope and the STL 11000XM CCD camera with a clear filter situated in New Mexico (USA). He used GSC 2742 2015, mag. 14.44 (±0.40) as comparison star and GSC 2742 1019, mag. 13.95 (±0.40) and GSC 2742 1077, mag. 14.01 (±0.40) as check stars. He observed also from Belgium using B_u, V and I_s Schuler filters. Two times of maximum were also determined from the CCD measurements of S. Dvorak in the AAVSO database, one was published by G. Maintz in 2009 and two were privately communicated by J.M. Llapasset. In Fig. 1 a finder chart is given indicating the variable, comp. and check stars. Also three newly discovered variables are given. Details about them can be found in (Hambsch et al. 2008).

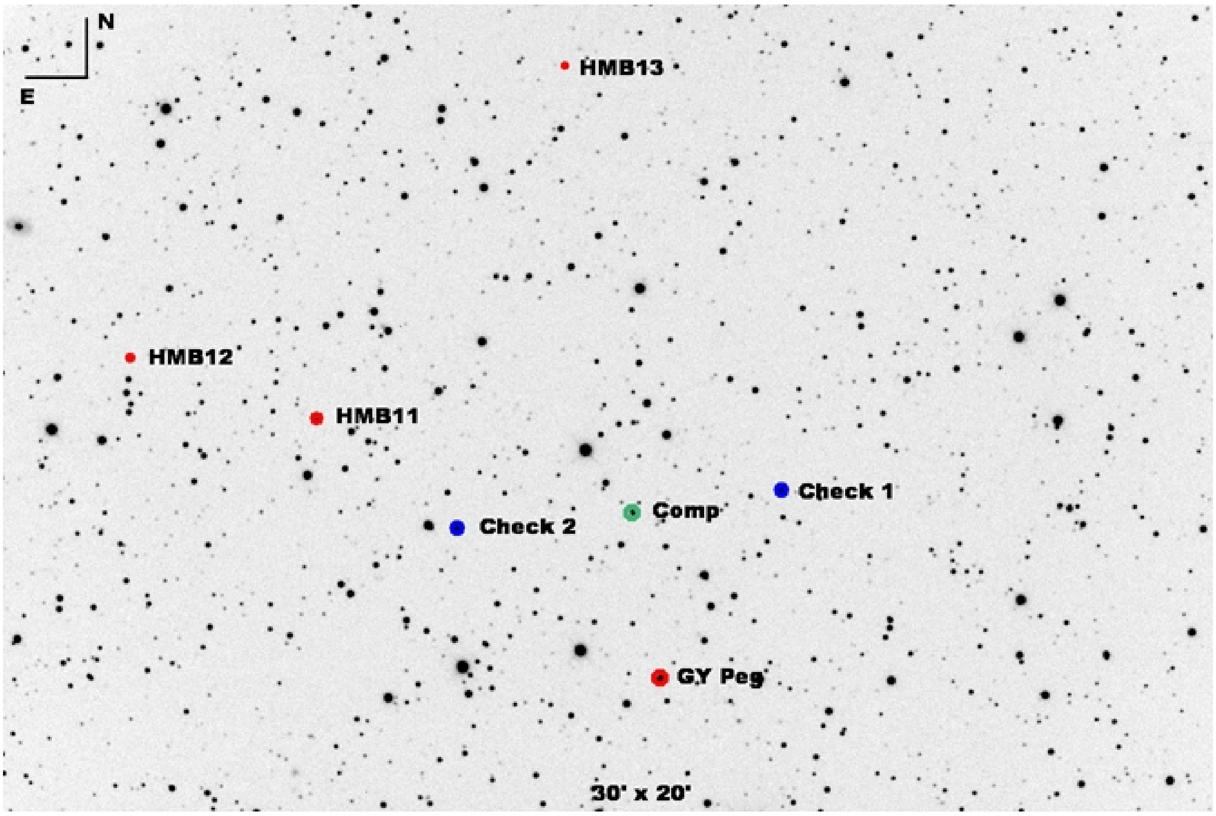

Fig. 1. Finding chart of GY Peg as well as newly discovered variables (red circles) including comparison (green circle) and check stars (blue circles).

3. PERIOD ANALYSIS AND STUDY OF THE BLAZHKO EFFECT

With the epoch of the GCVS 85 and all the times of maximum at disposal (see Table 1), we have calculated a linear regression and obtained the following new elements of the period of GY Peg:

$$\text{HJD } 5441217.3873\ (\pm 0.003) + 0.50344433\ (\pm 0.0000008)\ E \qquad (2)$$

The standard deviation of the O-C = ±0.0110 d.

Even with the large gap of 28 years between the epoch of the GCVS and the other maxima, it seems nevertheless that the period of GY Peg has been constant concerning its long term behaviour. On the other hand, concerning the short term behaviour and that is a discovery, the CCD measurements of F.-J. Hambsch are showing that GY Peg is an RRab type star with a strong Blazhko effect with a modulation of the O-C values and different heights of the maxima (see Fig. 2).

Unfortunately, all the new data for GY Peg cannot be analyzed simultaneously (different instrument sizes and different filters used) and the various series of measurements do not allow to find more details about the Blazhko effect via algorithms. However, a search using only the heights of the maxima of HMB for GY Peg gives a period of 30.49 days which is a good approximation of the Blazhko beat period. Fig. 3 shows the power spectrum based on the O-C values. The spectrum clearly shows a peak at 0.0328 c/d (30.49 d). The y-axis is the reduction factor of the variance, i.e. the ratio between (1 minus the variance after introducing the periodicity) and (the initial variance of the O-C values). The calculation was done by E. Poretti.

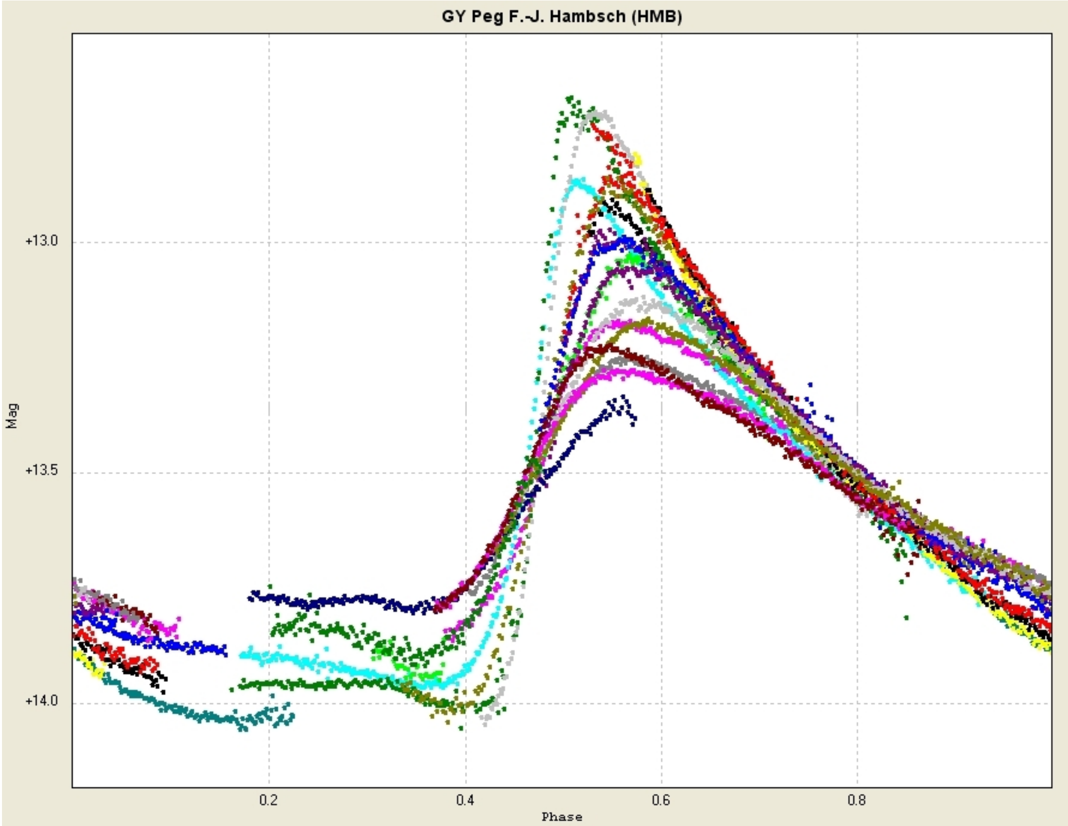

Fig. 2: Folded light curve of GY Peg based on the New Mexico measurements of HMB

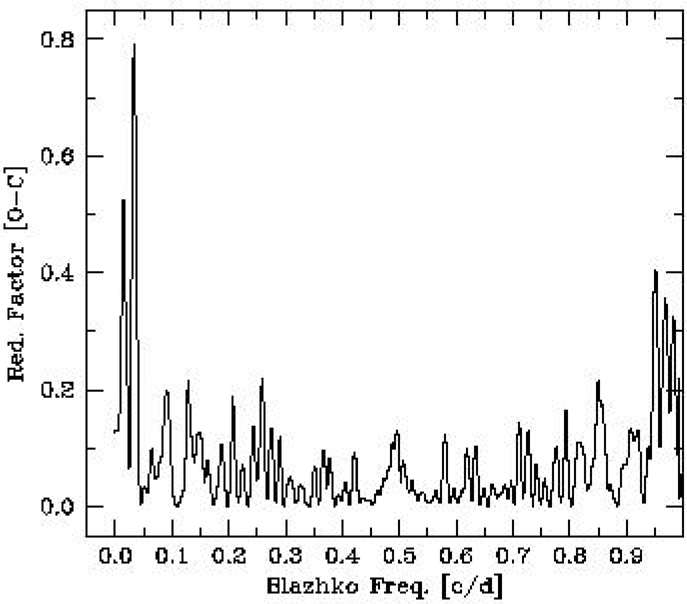

Fig. 3: Power spectrum based on the O-C values, showing a peak at 0.0328 c/d (30.49 d), the Blazhko beat period

Table 1: Times of maximum of GY Peg

Observer	Mode	SITE	HJD (2400000+)	Accuracy	E	O-C (2)
GCVS	phot		41217.390		0	+0.003
ROT	CCD		51306.912		20041	–0.003
ROT	CCD		51361.780		20150	–0.011
DKS	CCD	USA	54054.710	0.002	25499	–0.004
DKS	CCD	USA	54100.536	0.003	25590	+0.008
HMB	CCD	NM	54333.621	0.002	26053	–0.001
HMB	CCD	NM	54336.646	0.002	26059	+0.003
HMB	CCD	NM	54341.679	0.002	26069	+0.001
HMB	CCD	NM	54345.711	0.0025	26077	+0.006
HMB	CCD	NM	54348.738	0.003	26083	+0.012
HMB	CCD	NM	54357.773	0.001	26101	–0.015
HMB	CCD	NM	54361.799	0.001	26109	–0.016
HMB	CCD V	M	54365.335	0.002	26116	–0.004
HMB	CCD Bu	M	54365.335	0.002	26116	–0.004
HMB	CCD Rs	M	54365.335	0.004	26116	–0.004
HMB	CCD	NM	54365.838	0.001	26117	–0.005
HMB	CCD V	M	54366.345	0.002	26118	–0.001
HMB	CCD Rs	M	54366.345	0.003	26118	–0.001
HMB	CCD Bu	M	54366.346	0.003	26118	–0.000
HMB	CCD	NM	54368.869	0.002	26123	+0.005
HMB	CCD	NM	54370.890	0.002	26127	+0.013
HMB	CCD	NM	54376.922	0.003	26139	+0.003
HMB	CCD V	M	54379.450	0.004	26144	+0.014
HMB	CCD Bu	M	54379.455	0.006	26144	+0.019
HMB	CCD Rs	M	54379.455	0.005	26144	+0.019
HMB	CCD Bu	M	54380.448	0.005	26146	+0.005
HMB	CCD V	M	54380.450	0.003	26146	+0.007
MAI	CCD	D	54380.451	0.0025	26146	+0.008
HMB	CCD Rs	M	54380.453	0.004	26146	+0.010
HMB	CCD V	M	54381.453	0.003	26148	+0.003
HMB	CCD Bu	M	54381.454	0.004	26148	+0.004
HMB	CCD Rs	M	54381.455	0.004	26148	+0.005
LLA	CCD	F	54392.503	0.001	26170	–0.022
LLA	CCD	F	54395.564	0.0015	26176	+0.018
HMB	CCD	NM	54400.590	0.003	26186	+0.009
HMB	CCD	NM	54401.605	0.005	26188	+0.017
HMB	CCD	NM	54402.616	0.002	26190	+0.022
HMB	CCD	NM	54403.626	0.002	26192	+0.025
HMB	CCD	NM	54408.648	0.002	26202	+0.012
HMB	CCD	NM	54410.653	0.002	26206	+0.003
HMB	CCD V	NM	54418.695	0.001	26222	–0.010
HMB	CCD Bu	NM	54418.696	0.002	26222	–0.009
HMB	CCD Is	NM	54419.699	0.002	26224	–0.012
HMB	CCD Bu	NM	54419.700	0.002	26224	–0.011
HMB	CCD V	NM	54419.701	0.002	26224	–0.010
HMB	CCD V	NM	54420.704	0.003	26226	–0.014
HMB	CCD Is	NM	54420.704	0.002	26226	–0.014
HMB	CCD Bu	NM	54420.706	0.002	26226	–0.012
HMB	CCD Is	NM	54423.725	0.002	26232	–0.014
HMB	CCD Bu	NM	54423.726	0.002	26232	–0.013
HMB	CCD V	NM	54423.727	0.002	26232	–0.012
HMB	CCD Is	NM	54426.750	0.002	26238	–0.010
HMB	CCD Bu	NM	54426.751	0.002	26238	–0.009
HMB	CCD V	NM	54426.753	0.003	26238	–0.007
HMB	CCD Bu	M	54428.265	0.005	26241	–0.005
HMB	CCD Rs	M	54428.266	0.003	26241	–0.004
HMB	CCD V	M	54428.272	0.004	26241	+0.002

Notes : GCVS = epoch of GCVS 85; ROT = normal maxima determined with the ROTSE measurements; DKS = S. Dvorak; HMB = F.-J. Hambsch; MAI = G. Maintz and LLA = J. M. Llapasset

Sites : NM = New Mexico (USA) ; M = Mol (Belgium)

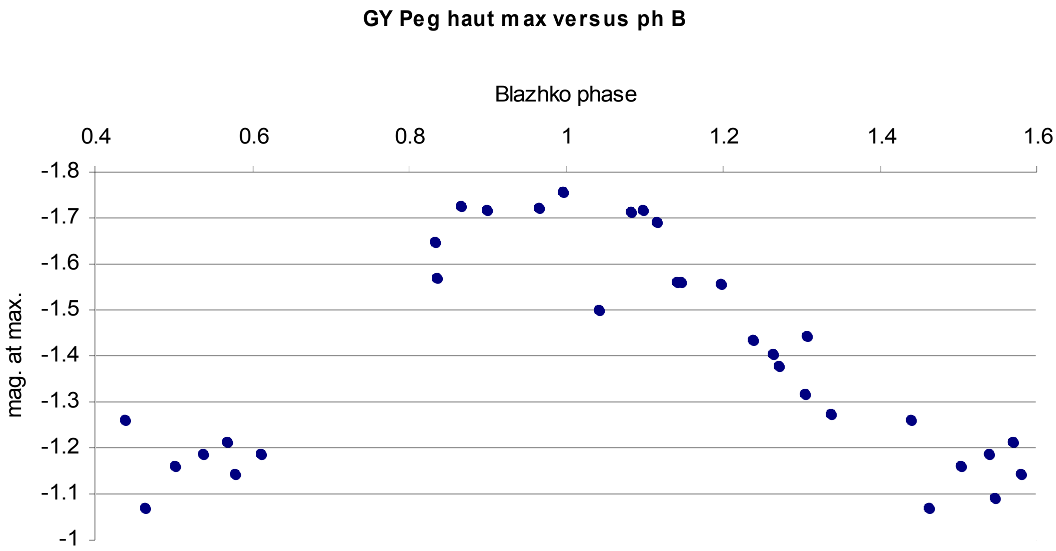

Fig. 4: GY Peg: magnitude at maximum versus Blazhko phase

The data of Figs. 4 and 5 cover a little more than three Blazhko periods. However, they are not perfectly distributed over all the Blazhko phases and they result from measurements of two telescopes situated in two different continents. We can nevertheless see that the highest maxima are occurring sooner than the lowest one's. This behaviour is typical for some of the Blazhko effect stars, but other Blazhko RRab stars have different characteristics, i.e. CX Lyr (de Ponthière et al., 2009). Hence this behaviour can not generally been used to determine the Blazhko period. The magnitude of the maxima of GY Peg fluctuates with an amplitude of ± 0.6 magnitudes along the Blazhko period while their O-C are going from about +0.02 to –0.02 d during the same time. In fact, the full light curve of GY Peg is changing along the Blazhko period with a total amplitude of variation for a cycle of the main pulsation going from 0.5 to 1.3 magnitude. However, not only the maximum amplitude is changing but the minimum amplitude, too (see Fig. 2).

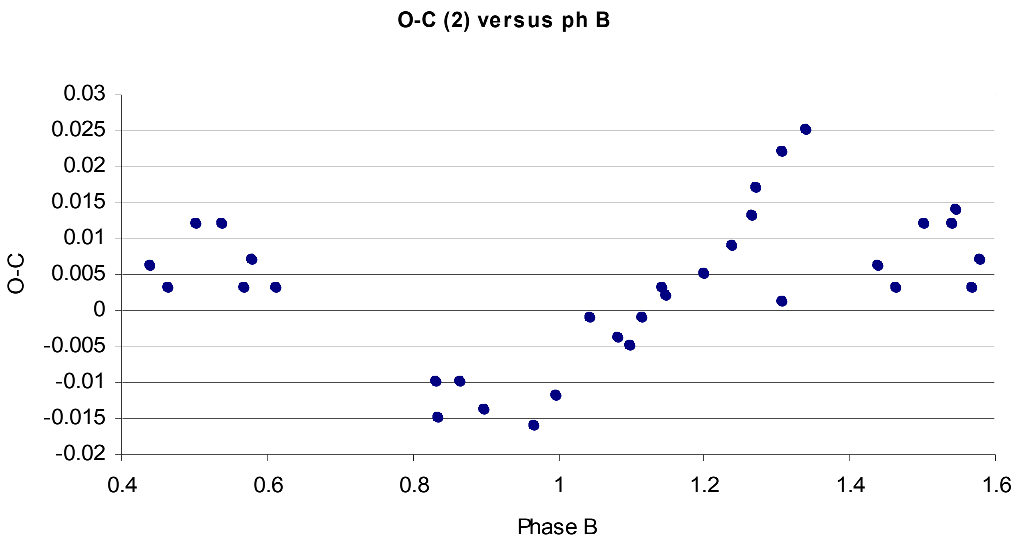

Fig. 5: GY Peg: O-C of maxima versus Blazhko phase

From Fig. 5 we observe that the (O-C) value is negative when the magnitude of the maximum is high and that the (O-C) value increases abruptly when the magnitude of the maximum decreases. Again a typical behaviour of many of the Blazhko effect, but nevertheless some Blazhko RRab stars also show for this quantity a different characteristics, i.e. CX Lyr (de Ponthière et al., 2009).

5. CONCLUSION

GY Peg was known as an RRab variable star. New CCD measurements have allowed us to determine its period of pulsation with more accuracy and it has been discovered that GY Peg exhibits a strong Blazhko effect. The beat period is around 30.49 days with large differences in the shape of the light curves, the higher maxima having more negative O-C values. The sets of data with photometric filters are insufficient to make a more comprehensive study of the Blazhko effect of GY Peg.

6. BIBLIOGRAPHY

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