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VZ Gru: A BLAZHKO-TYPE RR Lyr, NOT A CV

TAPPERT, C.[1]; SCHMIDTOBREICK, L.[2]; CATELAN, M.[1]

[1] Departamento de Astronomía y Astrofísica, Pontificia Universidad Católica, Av. Vicuña Mackenna 4860, 782-0436 Macul, Santiago, Chile, email: ctappert@astro.puc.cl

[2] European Southern Observatory, Alonso de Córdova 3107, 763-0581 Vitacura, Santiago, Chile

VZ Gru was first classified as an irregular variable (Is) by Meinunger (1976). It was observed later again by Meinunger (1979) who maintained her initial classification, but as a side remark noted that the observed variations would also fit a RR Lyrae-type variability. With this information the star is also included in the actual General Catalogue of Variable Stars (Samus et al. 2004). Subsequently, the star has received little attention, until Cieslinski et al. (1997, 1998) presented photometric and spectroscopic data, respectively. Their observations showed VZ Gru to be moderately faint ($\langle V \rangle = 15.2$), slightly bluish ($\langle U–B \rangle = 0.16$, $\langle B–V \rangle = 0.30$), and of spectral type F4–F6. The star caught our attention since it is included in the Downes et al. (2001) catalogue as a candidate cataclysmic variable (CV).

We observed the star in 4 nights in 2002 as a back-up target at the 0.9 m CTIO/SMARTS telescope using direct CCD imaging in the R passband. See Table 1 for details.

The data were reduced in the usual way, using IRAF[1] routines for bias subtraction and flat-fielding. Aperture photometry and light curves were obtained for the target and a number of field stars with IRAF's DAOPHOT package and the stand-alone daomatch and daomaster programs (Stetson 1992). The differential light curve for the target was computed with respect to 5 suitable comparison stars.

Table 1: Log of observations.

date	HJD	$n_{\rm data}$	$t_{\rm exp}$ [s]	Δt [h]
2002-09-17	2 452 535	60	90	2.30
2002-09-18	2 452 536	70	90	2.74
2002-09-19	2 452 537	70	90	2.63
2002-09-22	2 452 540	100	120	4.17

From the resulting light curves (Fig. 1) it becomes immediately clear that VZ Gru is not a CV, but a pulsating variable of type RRab, in good agreement with the spectral

[1] IRAF is distributed by the National Optical Astronomy Observatories.

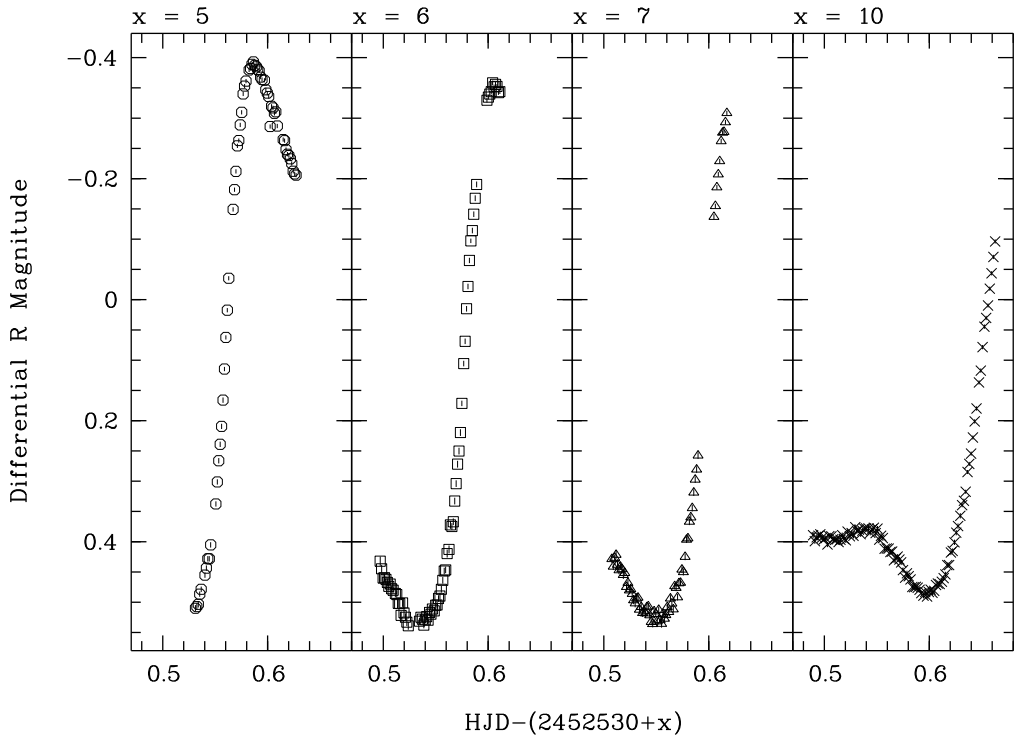

Figure 1. Individual light curves from 2002-09-17/18/19/22 (from left to right). Note that the photometric error bars are included but do not exceed the size of the symbols.

type determined by Cieslinski et al. (1998). In our observations we have been lucky to record a minimum or maximum for all nights, so that a determination of the pulsation period should be possible. However, Fig. 1 also demonstrates the presence of a Blazhko (1907) effect that changes the maximum and minimum magnitude and the slope between those two extrema in VZ Gru (Table 2).

In order to search for the period we prepared the data set by correcting for the differences in the extrema with respect to the data from 2002-09-18, which includes both a maximum and a minimum. A periodogram was then computed using the Scargle (1982) algorithm implemented in MIDAS. The resulting frequency spectrum shows a large number of aliases (Fig. 2). However, taking into account the distinctive shape of the RRab-type light curve together with the period distribution of these systems, we find that the peak corresponding to $P = 0.511$ d $= 12.3$ h represents the only viable choice.

Table 2: Differential R magnitudes for the observed maxima and minima. The errors have been estimated with respect to the spread of data points near the extrema.

date	max	min
2002-09-17	−0.391(10)	
2002-09-18	−0.357(05)	0.537(10)
2002-09-19		0.529(08)
2002-09-22		0.488(05)

In order to estimate the uncertainty of this period we folded the data set with a number of nearby trial periods. The overall best visual result was achieved with $P = 0.508$ d, with a range of acceptable periods within ± 0.004 d (Fig. 3). Note that the Blazhko effect possibly introduces a systematic uncertainty that cannot be resolved in our data set due to the low number of recorded extrema, and that can be suspected to be somewhat larger than the uncertainty derived by us. Further observations with a much longer time base of this field RRab star will be needed to disentangle the fundamental pulsation from the Blazhko contribution, and to provide a period for the latter.

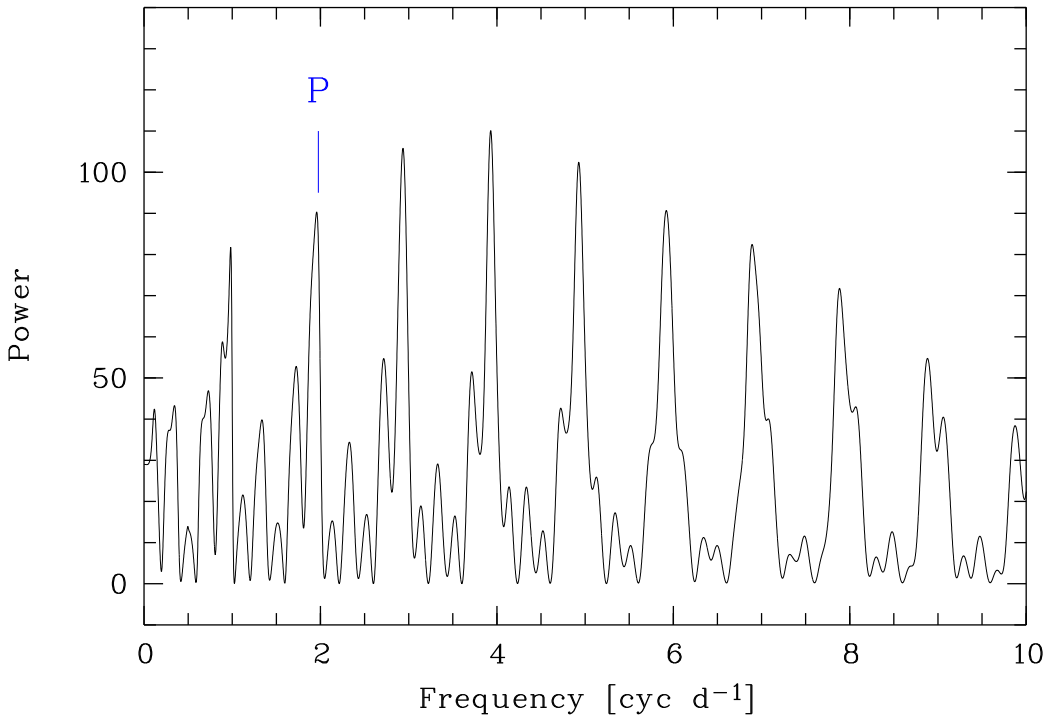

Figure 2. Scargle periodogram. The period $P = 0.511$ d is indicated.

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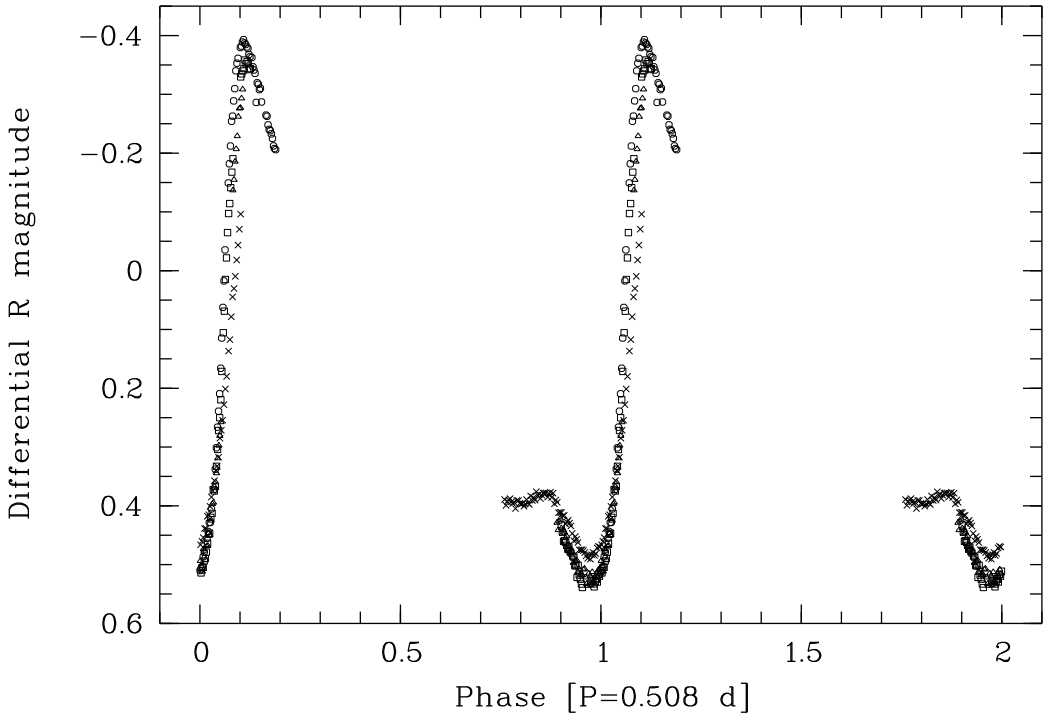

Figure 3. Light curve folded on $P = 0.508$ d. Different symbols indicate different nights (see Fig. 1).

References:

Blazhko, S., 1907, Astron. Nachr., 175, 325
Cieslinski, D., Jablonski, F. J., Steiner, J. E., 1997, A&AS, 124, 55
Cieslinski, D., Steiner, J. E., Jablonski, F. J., 1998, A&AS, 131, 119
Downes, R. A., Webbink, R. F., Shara, M. M., Ritter, H., Kolb, U., Duerbeck, H. W., 2001, PASP, 113, 764
Meinunger, I., 1976, Mitt. Veränd. Sterne, 7, 188
Meinunger, I., 1979, Veröff. Sternwarte Sonneberg, 9, 105
Samus, N. N., Durlevich, O. V., et al., 2004, VizieR On-line Data Catalog: II/250

Scargle, J. D., 1982, ApJ, 263, 835
Stetson, P. B., 1992, *ASP Conf. Ser.*, **25**, 297, in: *Astronomical Data Analysis Software and Systems I*, ed. D.M. Worrall, C. Biemesderfer & J. Barnes