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GSC 5002-0629: A NEW BRIGHT DOUBLE-MODE RR LYRAE VARIABLE

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The variability of GSC 5002-0629 was first announced by Henden and Stone (1998) who found it in the Sloan digital survey calibration fields. This star also received the denomination of FASTT1 0687 in the list of new Sloan variables. In a collaborative work between the US Naval Observatory Flagstaff Station, the Esteve Duran Observatory Foundation, and the Grup d'Estudis Astronomics, GSC 5002-0629 was included in a list of selected bright FASTT1 variable stars to confirm their variable nature and, if possible, characterise them.

Once the variability of this star was confirmed from Mollet Observatory and a tentative variable type assigned, GSC 5002-0629 was intensively observed for 35 nights, from 1 April 1997 to 22 January 1998 with the 0.6-m Cassegrain telescope at Esteve Duran Observatory in the V band, and the 1-m Ritchey–Chrétien telescope at the US Naval Observatory Flagstaff Station in the B, V, R_c, and I_c bands. A total of 1508 photometric datapoints were collected. Several stars in the field of GSC 5002-0629 were placed in the standard system by using Landolt (1992) standards. GSC 5002-0506 was used as primary comparison and GSC 5002-0636 as check star, but the latter could not be included in the CCD frames taken with the 1-m telescope and therefore this object could not be standardised. Table 1 lists the standard V magnitudes and color indices of comparison stars near the variable whereas Figure 1 shows the field of GSC 5002-0629.

Table 1

Star	GSC	V	$B-V$	$V-R$	$R-I$
A	5002-0506	11.503 ± 0.014	0.537 ± 0.006	0.336 ± 0.006	0.329 ± 0.005
B	5002-0525	13.528 ± 0.019	0.655 ± 0.015	0.390 ± 0.014	0.381 ± 0.015
C	5002-0566	12.936 ± 0.015	0.545 ± 0.011	0.339 ± 0.014	0.344 ± 0.012
D	5002-0650	13.550 ± 0.016	0.923 ± 0.012	0.543 ± 0.012	0.515 ± 0.014

Observations show that GSC 5002-0629 is a new field double-mode RR Lyr variable star. To date this is the seventh known RRd pulsator in the Milky Way field (Jerzykiewicz and Wenzel 1977; Clement et al. 1991; Garcia-Melendo and Clement 1997; Moskalik 2000; Clementini et al. 2000). GSC 5002-0629 is also particularly interesting because,

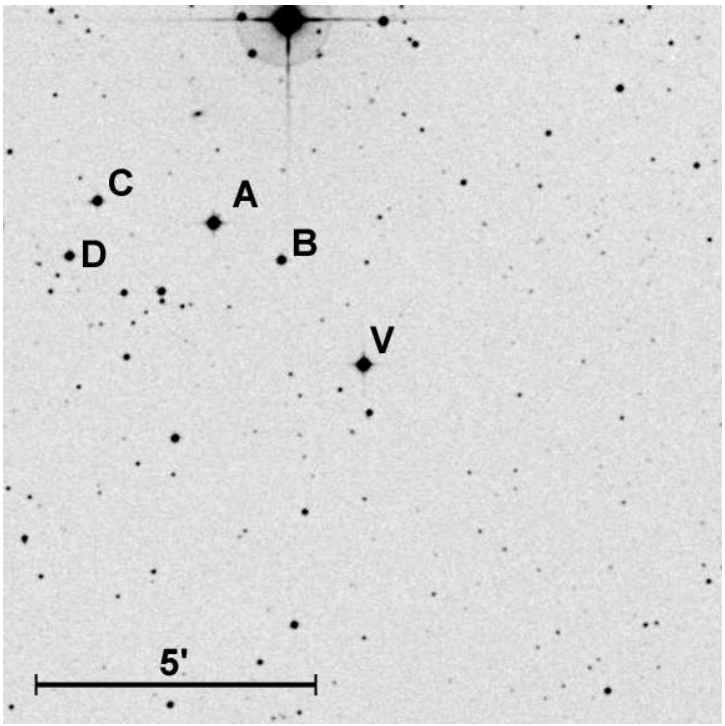

Figure 1. Field of GSC 5002-0629. See Table 1 to identify stars. V = GSC 5002-0629. Image retrieved using Aladin Previewer at Centre de Données astronomiques de Strasbourg, from the Science and Engineering Research Council at the Space Telescope Science Institute. North is on top

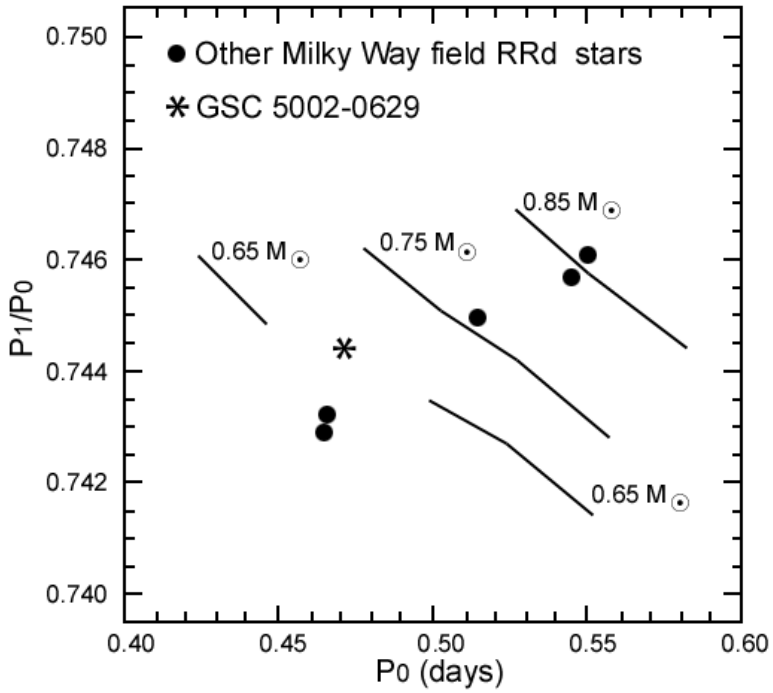

Figure 2. Position of GSC 5002-0629 on the Petersen diagram with pulsation models for 0.85, 0.75, and 0.65 solar masses adapted from Clementini et al. (2000). The other represented Milky Way field RRd stars are AQ Leo (Jerzykiewicz et al. 1982), VIII-10, VIII-58 (Clement et al. 1993), V2493 Oph (Garcia-Melendo and Clement 1997), and CU Com (Clementini et al. 2000)

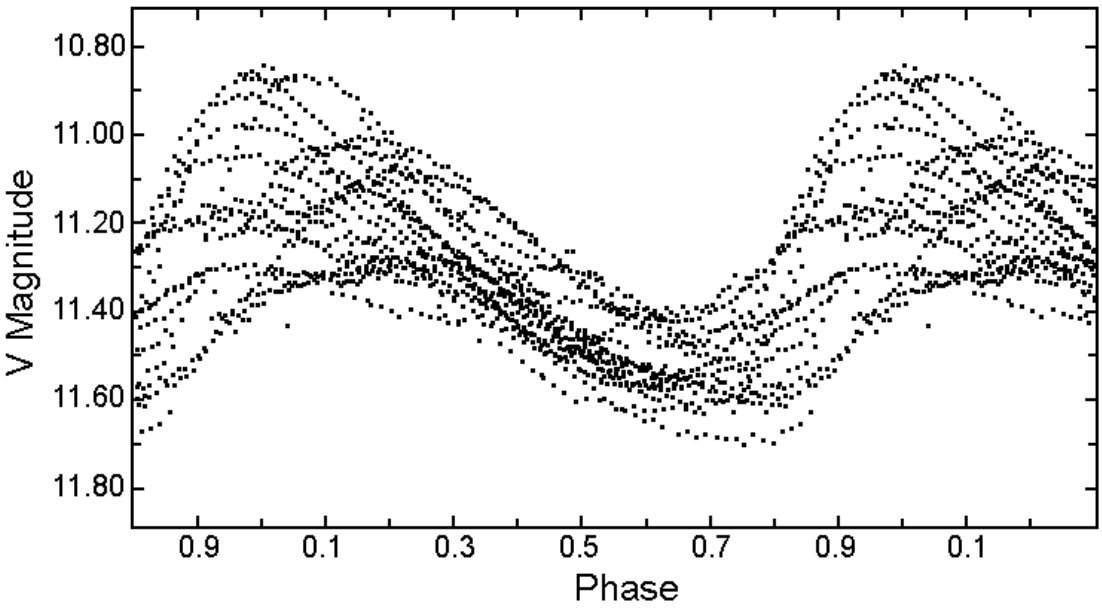

Figure 3. Light curve of GSC 5002-0629 folded according to P_1. The arbitrary HJD 2450548.664 date was taken as origin

with an average V magnitude of 11.32, it is the brightest of all known RRd variables to date. Therefore it will allow observers to obtain accurate spectroscopic data to study its metallicity. After performing a Fourier analysis following the same approach described by Garcia-Melendo and Clement (1997), it was found that this star pulsates with periods $P_0 = 0\overset{\mathrm{d}}{.}47125$ and $P_1 = 0\overset{\mathrm{d}}{.}35079$ with a P_1/P_0 ratio of 0.7444, a common value for double-mode RR Lyr stars. Table 2 summarizes all the relevant measured parameters for GSC 5002-0629. A Fourier decomposition of the light curve of this star also showed, as is typical among RRd pulsators, that the first overtone is the dominant mode of pulsation, in this case $A_1(V)/A_0(V) = 1.4$ ($A_0(V)$ and $A_1(V)$ are the amplitudes in the V band associated to the P_0 and P_1 components respectively). The P_0 and P_1/P_0 values place this star on the theoretical low-mass side of the Petersen diagram (Figure 2). Figure 3 shows the photometric data obtained in the V band folded according to P_1.

Table 2: Relevant data of GSC 5002-0629

P_1 (days)	0.35079 ± 0.00020
P_0 (days)	0.47125 ± 0.00020
P_1/P_0	0.7444
$\langle V \rangle$	$11\overset{\mathrm{m}}{.}32$
$\langle B-V \rangle$	$0\overset{\mathrm{m}}{.}38$
$\langle V-R \rangle$	$0\overset{\mathrm{m}}{.}26$
$\langle R-I \rangle$	$0\overset{\mathrm{m}}{.}29$
$V_{\max} - V_{\min}$	$0\overset{\mathrm{m}}{.}86$
$A_1(V)$	$0\overset{\mathrm{m}}{.}20$
$A_0(V)$	$0\overset{\mathrm{m}}{.}14$

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