COMMISSIONS 27 AND 42 OF THE IAU
INFORMATION BULLETIN ON VARIABLE STARS

Number 5744

Konkoly Observatory
Budapest
2 January 2007

HU ISSN 0374 – 0676

NEWLY DISCOVERED VARIABLE STARS IN THE GLOBULAR CLUSTER NGC 1261

SALINAS, R.[1,2]; CATELAN, M.[2]; SMITH, H.A.[3]; PRITZL, B.J.[4]

[1] Grupo de Astronomía, Facultad de Ciencias Físicas y Matemáticas, Universidad de Concepción, Concepción, Chile; email: rsalinas@astro-udec.cl

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

[3] Department of Physics and Astronomy, Michigan State University, East Lansing, MI 48824, USA; email: smith@pa.msu.edu

[4] Macalester College, 1600 Grand Avenue, Saint Paul, MN 55105, USA; email: pritzl@macalester.edu

NGC 1261 (RA $03^{\rm h}12^{\rm m}15\overset{\rm s}{.}3$, DEC $-55°13'01''$, J2000) is a distant (R_{GC} = 18.2 kpc; Harris, 1996) globular cluster with an intermediate metallicity ([Fe/H] = −1.35) and horizontal branch (HB) morphology not unlike NGC 1851's, with evidence of an HB bimodality — i.e., with fewer known RR Lyrae variables than either red HB or blue HB stars (Ferraro et al., 1993).

The RR Lyrae population in the cluster was discovered in photographic studies by Laborde & Fourcade (1966), Bartolini et al. (1971), Wehlau & Demers (1977), and Wehlau et al. (1977). To the best of our knowledge, no CCD study tackling the variable star populations in this cluster has ever appeared in the literature. In the present note, we report on the discovery of additional variable stars in the cluster. This work is part of a larger effort to bring to light the variable star population properties of several globular clusters that have not been properly investigated with modern CCD images (Catelan et al., 2006).

The cluster images were obtained using the Danish 1.54-m telescope at La Silla, Chile, from September 17 to September 22, 2005. The 2048 × 2048 RINGO CCD was used. Given its $0\overset{''}{.}395$ pixels, the total observed field was $13\overset{'}{.}5 \times 13\overset{'}{.}5$. The time series data consist in 104 B,V pairs, with typical exposure times of 100 sec in B and 35 sec in V. Here we report the results based on the B data only.

To search for variability in our data, we have adopted the image subtraction technique (ISIS v2.1; Alard, 2000). In recent years, this technique has provided the most powerful tools for finding variable stars in crowded regions without the need of large apertures (e.g., Olech et al., 1999; Contreras et al., 2005). Its main drawback is the difficulty to reliably transform relative fluxes into calibrated magnitudes, and even to derive accurate pulsation amplitudes (Corwin et al., 2006, and references therein).

Making use of ISIS we were able to re-discover 19 out of the 21 variables listed in the Clement et al. (2001) catalog, confirming the non-variability of V1 already noted by Wehlau & Demers (1977), but not finding any variability for V18. The latter appears rather surprising, given that Wehlau et al. (1977) found a very precise period (P =

0.33653 d) for V18. However, taking the original data for V18 from Table 1 in Wehlau et al. (1977), we do not find any period that phases the data correctly (Fig. 1). Considering that the position of this variable is only 25″ from the cluster center, and that the magnitudes of Wehlau et al. (1977) were derived by eye, we are confident to discard it as an RR Lyrae star. In the case of V19, Wehlau et al. (1977) do not give a period; we estimate it to be near 0.653 d. For the rest of the known variables we agree with the periods listed in the Clement et al. (2001) catalog.

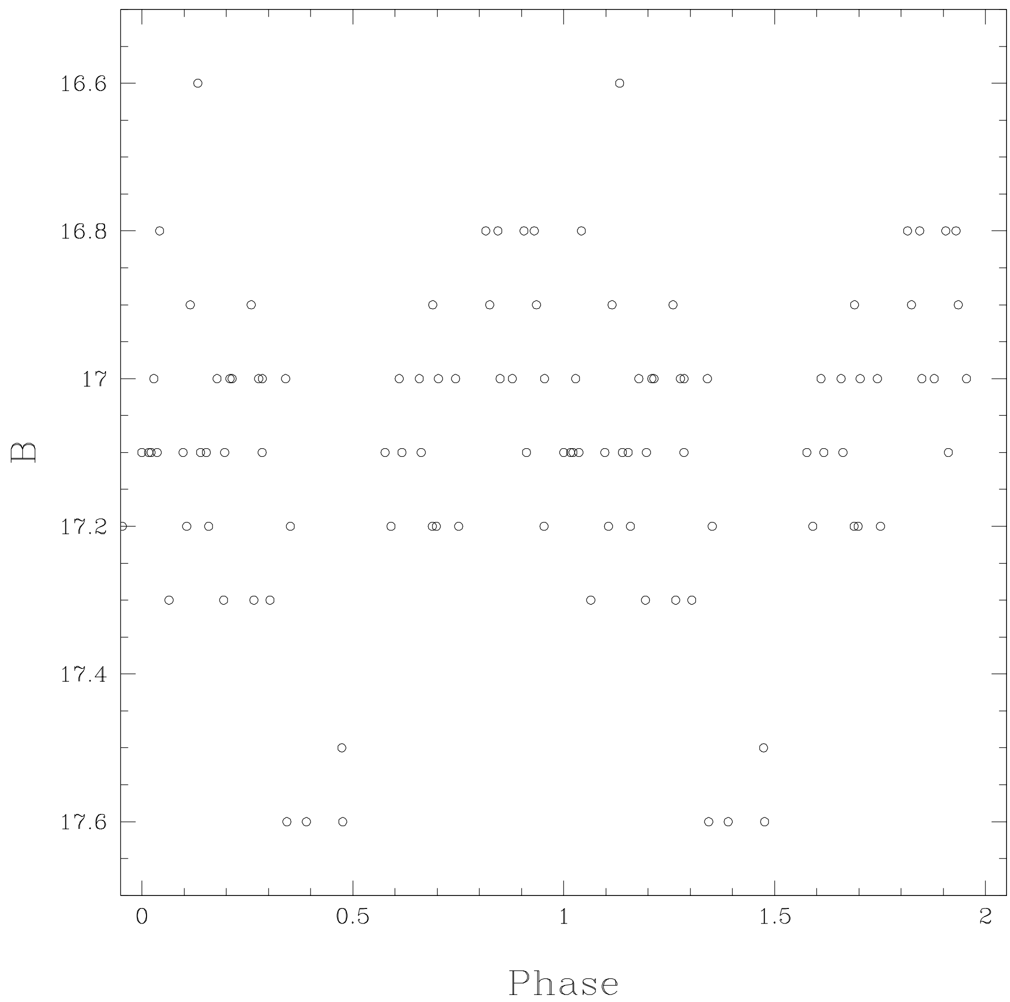

Figure 1. Light curve of V18, using data from Wehlau et al. (1977), with a period of 0.33653 d

Also we have found nine new variables of different types: one long period variable (LPV), three SX Phoenicis and five RR Lyrae stars (3 RRc and 2 RRab). The location, classification and tentative periods for these new variables are given in Table 1. In this table, the x and y coordinates are in arcseconds with respect to the cluster center, as given in the online Clement et al. (2001) catalog. Also a finding chart with all the new variables can be seen in Figure 2.

Due to the relatively small time coverage, it is not possible to give an estimate of the period of V23. For the RR Lyrae stars we think periods are good only up to the third

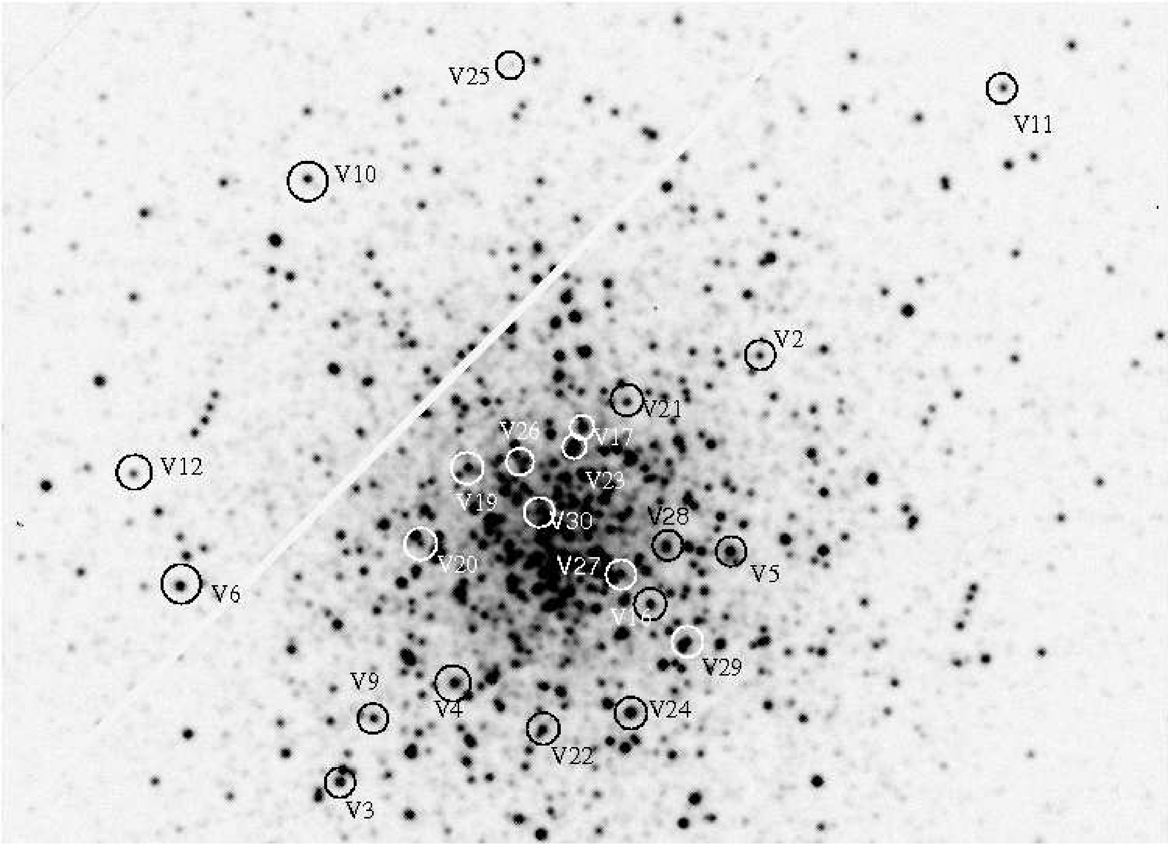

Figure 2. Finding chart for the innermost variable stars in NGC 1261. The field size is approximately $3' \times 2'$. North is up and East to the left

Table 1: Locations and tentative periods for new variable stars in NGC 1261

Variable	x ($''$)	y ($''$)	Period (d)	Type
V22	4.1	−41.3	0.302	RRc
V23	−2.3	15.9	–	LPV
V24	−13.1	−37.8	0.626	RRab
V25	11.2	94.3	0.0535	SX Phe
V26	9.5	12.9	0.0799	SX Phe
V27	−11.6	−9.5	0.341	RRc
V28	−20.9	−3.6	0.287	RRc
V29	−25.3	−23.4	0.593	RRab
V30	4.9	3.0	0.0591	SX Phe

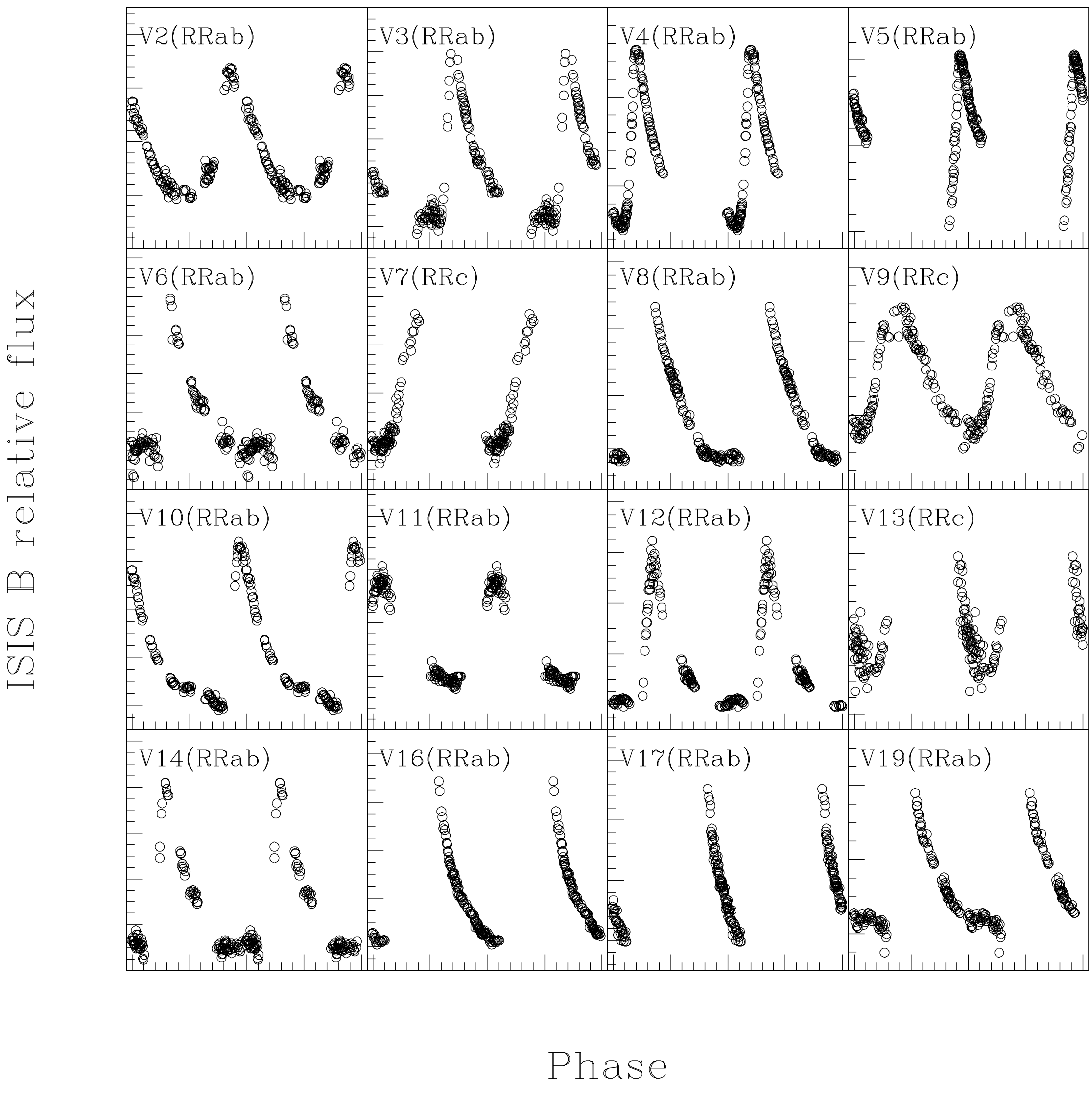

Figure 3. *B*-band differential light curves for previously known variable stars in NGC 1261

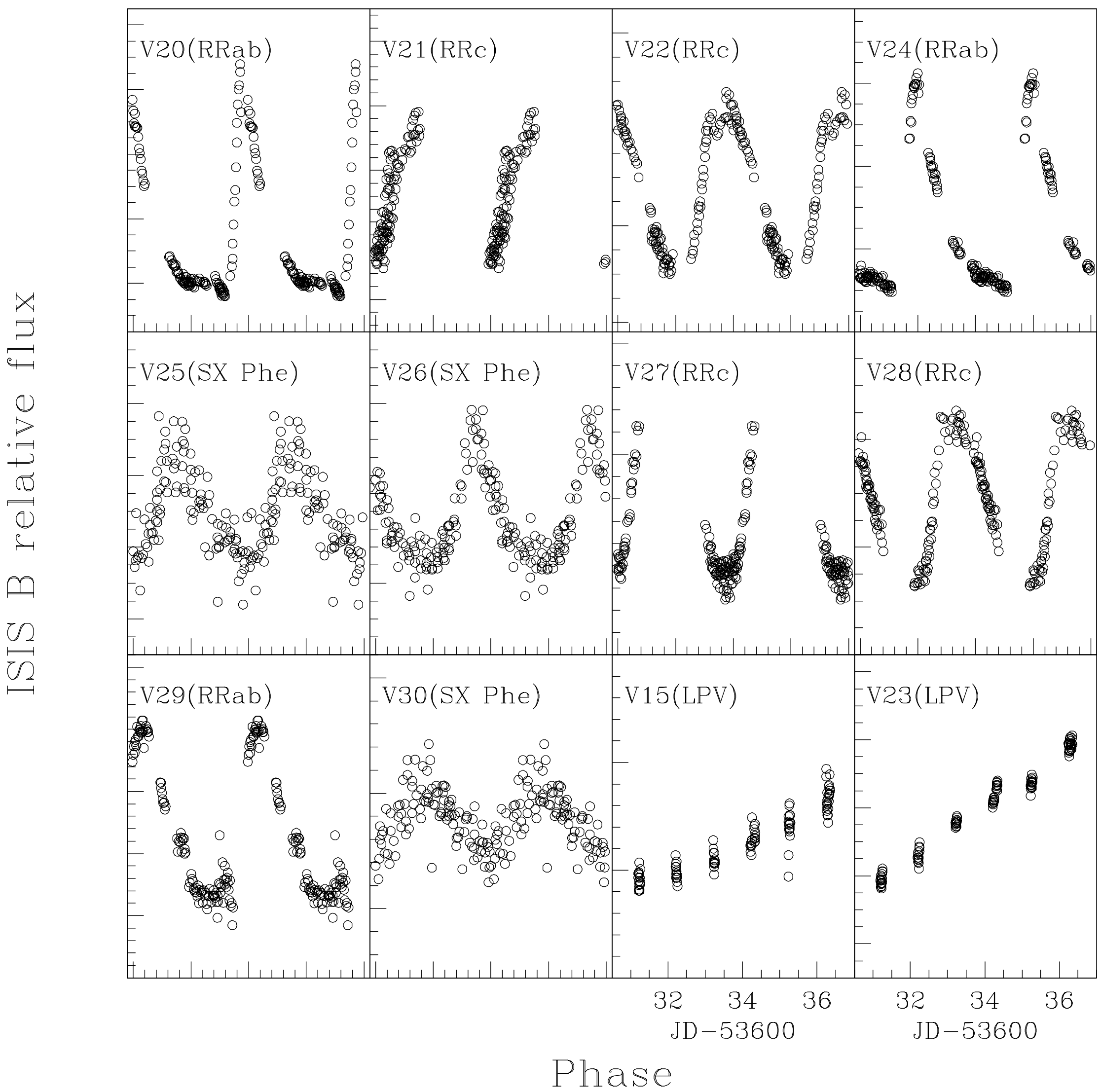

Figure 4. *B*-band differential light curves for the known variables V19, V20 and V21; and for all the newly identified variables. Note that the light curves of V15 and V23 are not phased

decimal place, and for the SX Phe variables we can determine periods to four significant figures.

With our new discoveries, and assuming the new RR Lyrae stars to be cluster members, the value of $\langle P_{ab} \rangle$ changes slightly with respect to Wehlau et al. (1977), from 0.555 d to 0.568 d, and $N_c/(N_c + N_{ab})$ changes from 0.26 to 0.30. In addition, one finds $\langle P_c \rangle$ = 0.319 d, $P_{ab}^{\rm min} = 0.49286$ d, and $P_c^{\rm max} = 0.341$ d. These results do not change NGC 1261's classification as an Oosterhoff type I cluster.

Acknowledgements. We thank R. Leiton for helping us with the data transfer from Concepción to Santiago. R.S. acknowledges support by a CONICYT Doctoral Fellowship. M.C. acknowledges support by Proyecto FONDECYT Regular No. 1030954. H.A.S. acknowledges the NSF for support under grant AST 02-05813.

References:

Alard, C., 2000, *A&AS*, **144**, 363

Bartolini, C., Grilli, F., Robertson, J.W., 1971, *IBVS*, No. 594

Catelan, M., et al., 2006, *MmSAI*, **77**, 202

Clement, C.M., et al., 2001, *AJ*, **122**, 2587

Contreras, R., Catelan, M., Smith, H.A., Pritzl, B.J., Borissova, J., 2005, *ApJL*, **623**, L117

Corwin, T.M., Sumerel, A.N., Pritzl, B.J., Smith, H.A., Catelan, M., Sweigart, A.V., Stetson, P.B., 2006, *AJ*, in press (astro-ph/0605569)

Ferraro, F.R., Clementini, G., Fusi Pecci, F., Vitiello, E., Buonanno, R., 1993, *MNRAS*, **264**, 273

Harris, W.E., 1996, *AJ*, **112**, 1487

Laborde, J.R., Fourcade, C.R., 1966, *MmSAI*, **37**, 251

Olech, A., Woźniak, P.R., Alard, C., Kaluzny, J., Thompson, I.B., 1999, *MNRAS*, **310**, 759

Wehlau, A., Demers, S., 1977, *A&A*, **57**, 251

Wehlau, A., Flemming, T., Demers, S., Bartolini, C., 1977, *IBVS*, No. 1361