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# ON THE VARIABILITY OF THREE GUIDE STAR CATALOGUE STARS

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Ground based CCD photometry of three Guide Star Catalogue (GSC) stars (GSC 0742602146, 0777501959 and 0781801912) is presented. Two of these objects (GSC 0742602146 and 0781801912) were already reported as variable by Zwintz et al. (2000). They have analyzed photometric data of the Fine Guidance Sensors of the Hubble Space Telescope. It is especially important to confirm these results with ground based observations in order to prove the reliability and stability of these sensors. Kuschnig et al. (1997) already reported the confirmation for two of such objects. But further data are needed to unambiguously establish the capability of these instruments to detect even very low amplitude variability.

The photometric observations were made in the nights 26/27.05. and 30/31.05.1995 with the 61-cm Bochum telescope at ESO–La Silla (observer: E. Paunzen). The telescope was equipped with a nitrogen-cooled Thompson 7882 CCD ($384 \times 576$ pixel) corresponding to a field-of-view of about $3' \times 4'$. Continuous observations with an integration time of 60 seconds using a standard Johnson $V$ filter were made.

A spectrum of GSC 0777501959 was observed with the 190-cm telescope at the South African Astronomical Observatory with the long slit spectrograph in the night of 31.01/01.02.2001 (observer: C. Foellmi). The 300 lines/mm grating gave a resolution of about 5 Å and covered a spectral range from 3000 to 8000 Å. The exposure time was 300 seconds.

The basic reduction steps (bias-subtraction, dark-correction, flat-fielding) were carried out within standard IRAF routines. Standard aperture photometry within the IRAF task APPHOT was performed. For each program star, three comparison stars within the corresponding field were chosen. These objects are listed in Table 1. They all turned out to be constant. For the final light curves (Figure 1) the differences of all comparison stars with respect to the corresponding program stars were calculated, but for reasons of clarity, only one differential light curve for each object was plotted in the corresponding figure. Since no photometric standard regions were observed, it is not possible to transform the final values to Johnson $V$. However, we are only interested in the variability of the program stars and not in determining more accurate apparent visual magnitudes.

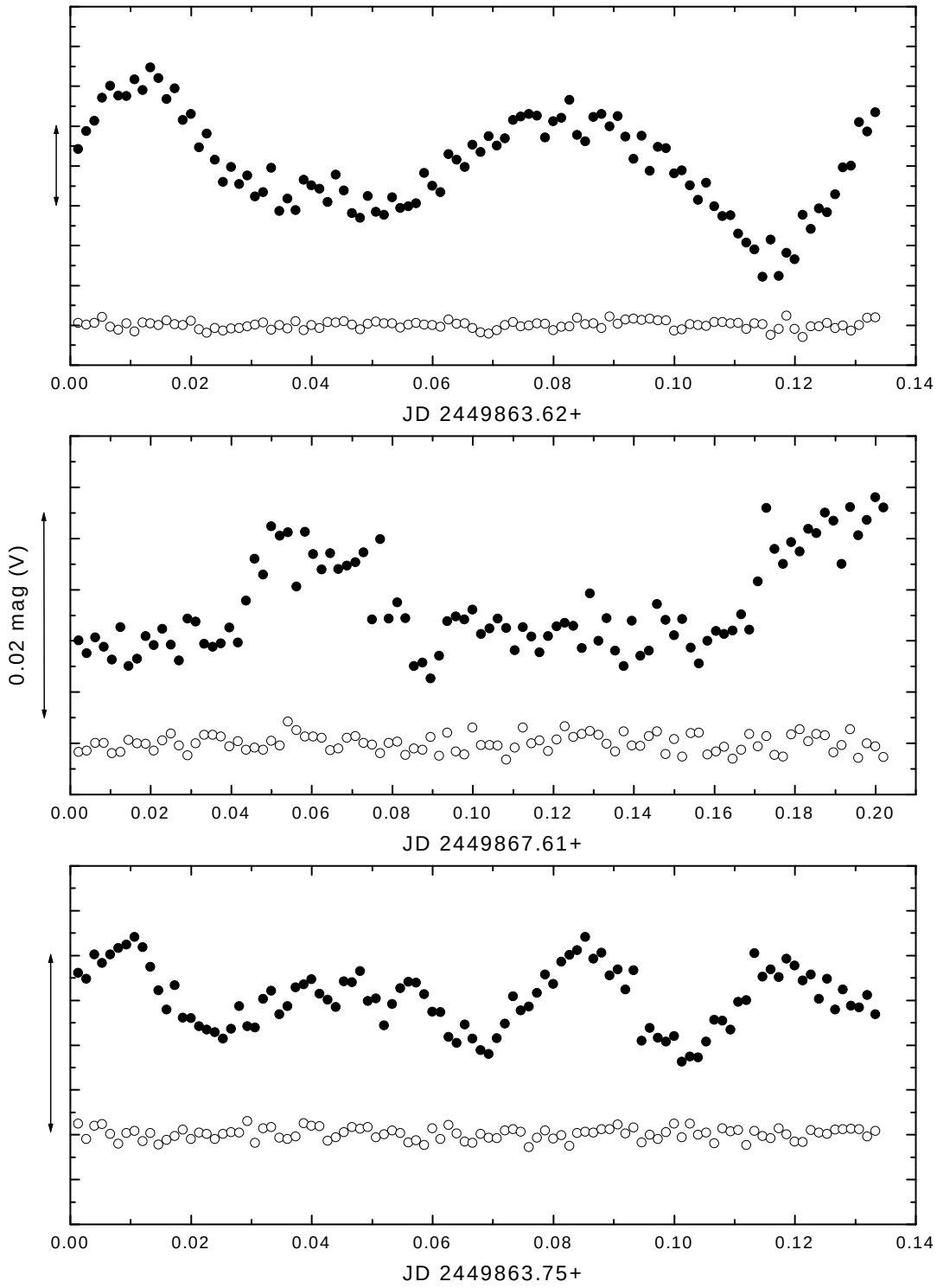


**Figure 1.** The light curves of GSC 0742602146 (upper panel), GSC 0777501959 (middle panel) and GSC 0781801912 (lower panel). The full circles are the differential data for (V − C1) whereas the open circles correspond to (C1 − C2). The arrows mark $0\overset{\mathrm{m}}{.}02$ ($V$)

Table 1: All observed program and comparison stars

| GSC | $\alpha$ (2000) | $\delta$ (2000) | $V$ | |
|---|---|---|---|---|
| 0742602146 | 19 40 00 | −31 13 16 | 12.0 | V |
| 0742602121 | 19 40 05 | −31 12 40 | 14.9 | C1 |
| 0742602105 | 19 40 05 | −31 12 15 | 14.5 | C2 |
| 0742602163 | 19 39 53 | −31 14 26 | 14.8 | C3 |
| 0777501959 | 12 49 09 | −41 12 26 | 12.4 | V |
| 0777501766 | 12 49 10 | −41 12 04 | 14.9 | C1 |
| 0777501872 | 12 49 12 | −41 12 27 | 14.6 | C2 |
| 0777501935 | 12 49 09 | −41 13 29 | 15.6 | C3 |
| 0781801912 | 14 32 00 | −44 26 29 | 11.6 | V |
| 0781801932 | 14 32 06 | −44 27 09 | 12.8 | C1 |
| 0781802269 | 14 32 03 | −44 28 38 | 14.4 | C2 |
| 0781802447 | 14 31 54 | −44 26 04 | 14.7 | C3 |

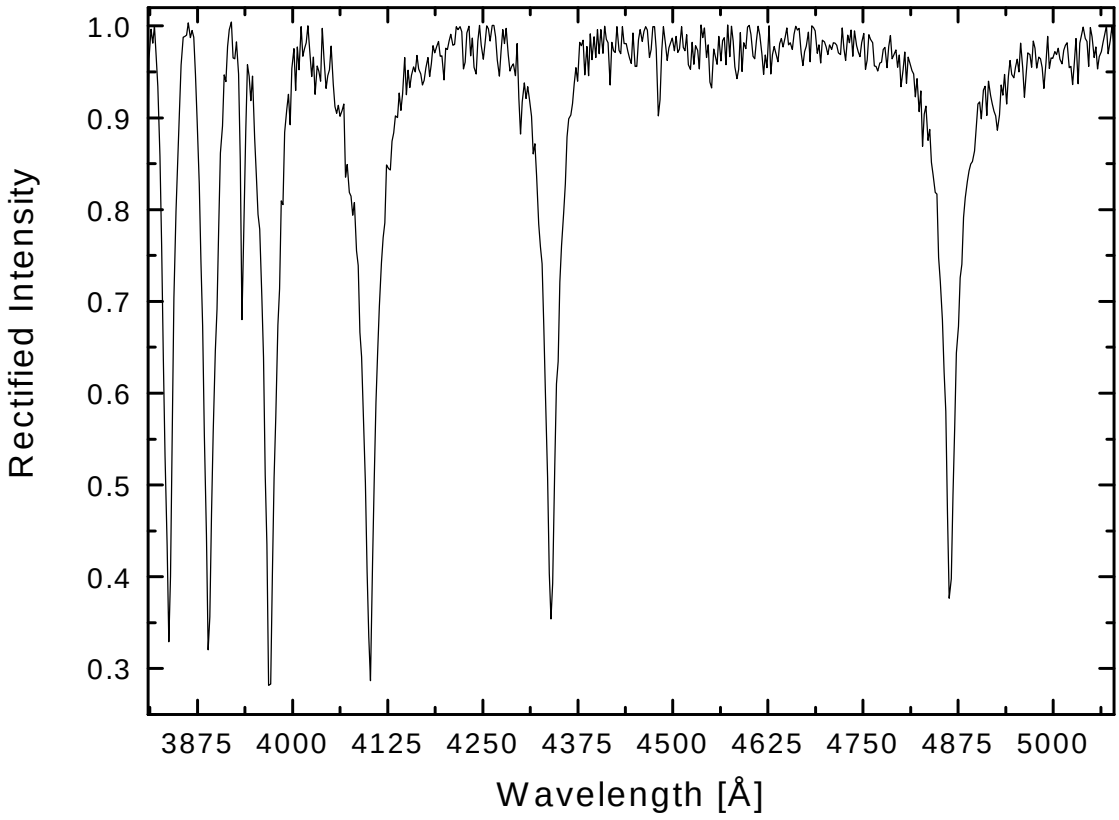


**Figure 2.** The classification spectrum of GSC 0777501959 which results in a spectral type of A3 V

Zwintz et al. (2000) reported $\delta$ Scuti type pulsation for GSC 0742602146 (VGS 17 therein) and GSC 0781801912 (VGS 19). VGS 17 shows multiperiodicity which is in line with the spectral classification (A9). The light curve presented in Figure 1 (upper panel) confirms this result. A dominant period of 120 minutes and an amplitude of $0\overset{\mathrm{m}}{.}02$ was found using a standard Fourier technique. Due to the rather short time scale of the observations, no additional period could be established.

The variability of VGS 19 was a matter of debate (Zwintz et al. 2000). The reasons were the reported apparent period (about 50 minutes which is approximately half the orbital period of the Hubble Space Telescope) and the very low amplitude (1.5 mmag). Furthermore, the $B-V$ value from the TYCHO catalogue ($0\overset{\mathrm{m}}{.}54$) was not compatible with Strömgren $uvby\beta$ photometry ($b-y = 0\overset{\mathrm{m}}{.}179$) (Zwintz et al. 2000). It is out of scope of this note to solve this discrepancy. However, the light curve shown in Figure 1 (lower panel) results in a formal numerical solution with a period of 70 minutes and an amplitude of $0\overset{\mathrm{m}}{.}008$ confirming a $\delta$ Scuti type pulsation.

The photometric variability of GSC 0777501959 is evident from Figure 1 (middle panel; note that no other time resolved photometric data have been published yet) with a period of about 75 minutes and an amplitude of $0\overset{\mathrm{m}}{.}01$. But the nature of it was not clear at first sight because TYCHO photometry ($B-V = -0.269 \pm 0.175$) results in an early type spectral classification. Taking the (unknown) interstellar reddening into account (although with a galactic latitude of +21 degrees, it should not be very large), one derives a spectral type of B5 or even earlier. We therefore have decided to obtain a classification resolution spectrum. The classification follows the standard procedures within the MK classification scheme (Paunzen 2000). We derive a spectral type of A3 V (Figure 2) which places this star within the classical instability strip. One tends to believe that the $V$ and $B$ colors listed in the TYCHO catalog are mixed up resulting in $B-V = +0\overset{\mathrm{m}}{.}269$. However, we are confident that these objects show multiperiodic $\delta$ Scuti type pulsation.

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