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CCD PHOTOMETRY IN THE FIELD OF V959 Oph

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Götz (1957) classified V959 Oph as an RR Lyrae star, type RRc, varying between $12\overset{\mathrm{m}}{.}4$ and $13\overset{\mathrm{m}}{.}1$ based on the analysis of plates taken in 1940. He reported a variation with a mean amplitude of $0\overset{\mathrm{m}}{.}6$ for the June data and a decrease by a factor of two in amplitude (only $0\overset{\mathrm{m}}{.}3$) for the July data. A period of 0.084857 days was found. Poretti (1981) analyzed visual measurements obtained by G.E.O.S.-members but could not confirm the strong amplitude variations reported by Götz (1957). A shorter period and smaller amplitude ($0\overset{\mathrm{m}}{.}2$–$0\overset{\mathrm{m}}{.}3$) were also suggested. We intended to perform follow-up observations in order to better determine the period and the type as Rodríguez et al. (1994) classified it among the δ Scuti stars. Very recently Hintz et al. (1999) reported new observations demonstrating a drastic amplitude decrease as well as a period variation for this object.

We observed V959 Oph in 1996 and 1999. A total of 18.6 hours of CCD photometry, resulting in 650 datapoints was obtained. We used a 0.4-m telescope equipped with a Hisis24 camera in 1996 and a SBIG-ST7 camera in 1999. In both cameras the chip is a Kodak KAF400. Observations were obtained without filter. The field-of-view has dimensions $12' \times 8'$. The 1996 frames were calibrated and reduced using the profile fitting algorithm of the software package MIPS (Buil et al. 1993). The 1999 frames were treated with the aperture photometry procedure of the MIRA AP software package[†]. One night of data was reduced with both techniques, giving similar results. In each case our datafiles contain the heliocentric Julian date and the differential magnitude in the sense variable minus comparison star. We refer to Fig. 1 for the identification of the stars we analyzed:

- star 0 = GSC 435 595 ($11\overset{\mathrm{m}}{.}2$);
- star 1 = V959 Oph = GSC 435 926 ($12\overset{\mathrm{m}}{.}1$; the identification was checked and corresponds to the coordinates listed by Poretti (1981) and Hintz et al. (1999));
- star 2 = GSC 435 1757 ($12\overset{\mathrm{m}}{.}6$);
- star 3 = GSC 435 1599 ($14\overset{\mathrm{m}}{.}0$);
- star 4 = V497 Oph = GSC 435 1680 ($15\overset{\mathrm{m}}{.}0$).

All differential magnitudes were computed with respect to our principal comparison star, hereafter star 0. Star 2 was used as a check star. The differences between check and comparison star show a standard deviation of respectively $0\overset{\mathrm{m}}{.}008$ in the 1996 and $0\overset{\mathrm{m}}{.}005$ in the 1999 season (different signal-to-noise ratio). We adopted these figures as the 1-sigma value. We used a 2-sigma detection limit for the analysis of the other stars in the field.

[†] The MIRA AP software is distributed by Axiom Research, Inc.

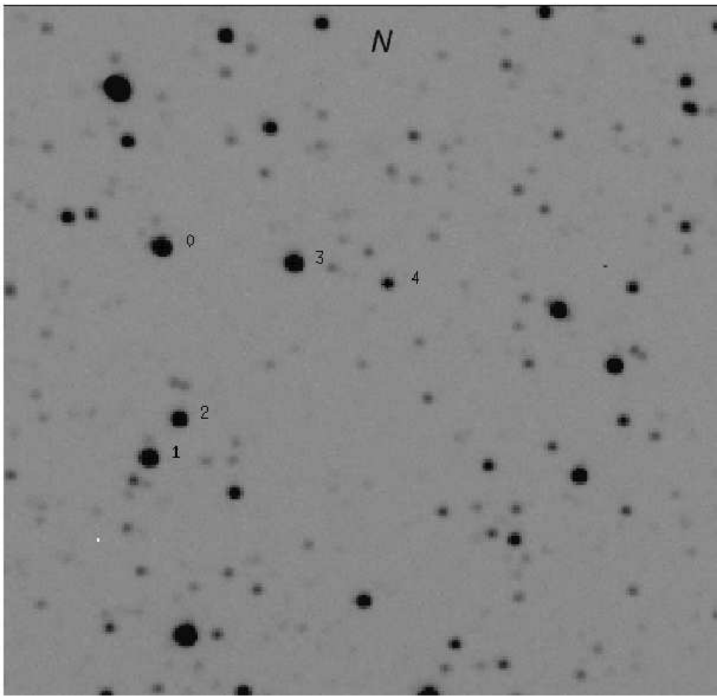

Figure 1. Zoom-in of CCD field-of-view for V959 Oph with star labels as discussed in the text.

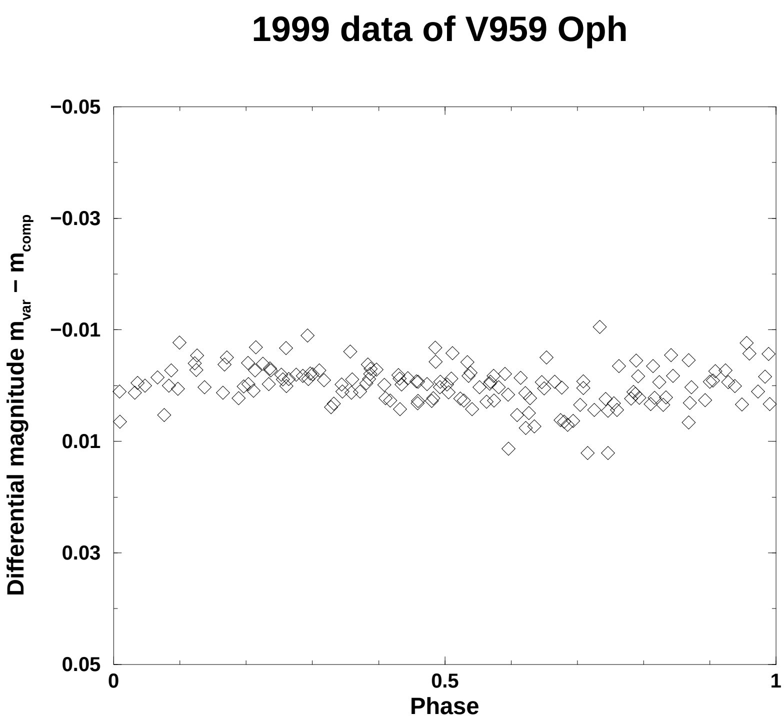

Figure 2. Phase diagram of the 1999 data against the frequency of 10.12433 c/d.

We obtained 9.7 hours of photometric data in 1996 for V959 Oph. It was immediately clear that the large amplitude variations first reported by Götz (1957), later by Poretti (1983) were not present. We concluded that this star was constant at the 2-sigma level, i.e. the amplitude could not be larger than $0^{\rm m}.016$. Hintz et al. (1999) reported a period of 0.09880 days (frequency = 10.1246 c/d) with a semi-amplitude of $0^{\rm m}.0075$. Probably due to a low signal-to-noise ratio in our data, we cannot confirm this.

For our subsequent observations we used longer exposure times. The estimated photometric accuracy is now $0^{\rm m}.005$. Based on 8.9 hrs of data in 1999 we could not detect any short-period variation with a semi-amplitude larger than $0^{\rm m}.1$. We also can exclude longer period variations as daily averages stay constant over the full length of one observational season. An independent period search was performed but did not reveal any short-period fluctuation. In Fig. 2 we present the phase diagram for our 1999 data fit with the frequency derived by Hintz et al. (1999). However, the fit produced an amplitude with the value of only $0^{\rm m}.002$. We conclude that the amplitude of this short-period variable has further decreased in the course of 1999, until well below (our) detection level.

Other variables in the field of V959 Oph:

- star 3 = GSC 435 1599, is a new variable star. The differential magnitude with respect to the comparison star shows a standard deviation of $0^{\rm m}.047$ in the 1999 data, about 10 times larger than the 1-sigma limit. The data indicate slow daily variations with a periodicity much larger than 3 hours (i.e. our longest single observing run). Day-to-day variability with an estimated total amplitude larger than $0^{\rm m}.1$ is present.
- star 4 = V497 Oph = GSC 435 1680. This star is classified as a slow irregular variable (Kholopov 1985, 1987). A slow, monotonous decrease of the brightness with respect to star 0 was indeed found over a 50-day interval.

In conclusion, we state that no significant short-period variations were found for V959 Oph in 1996 and 1999. Therefore, independently from Hintz et al. (1999), our 1996 observations do not confirm the large amplitude and short-period variation reported by Götz (1957) and by Poretti (1981, 1983). Our 1999 data are constant at the 2-sigma level and cannot be fit with the frequency reported by Hintz et al. (1999). This illustrates the further amplitude decrease for V959 Oph, at least below $0^{\rm m}.005$. There is momentarily no reason to classify it as a large amplitude δ Scuti variable star! In the same field a new variable star was found, with a periodicity considerably longer than 3 hours and an observed peak-to-peak amplitude larger than 0.1 mag. We also confirm the slow variation of V497 Oph.

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References:

Buil, C., Klotz, A. et al., 1993, *Manual for the Microcomputer Image Processing System*, V2.0

Götz, W., 1957, *Veröff Sternw. Sonneberg*, **4**, No. 2

Hintz, E.G., Hintz, M.L., Joner, M.D., Joner, L.A., 1999, *Inf. Bull. Var. Stars*, No. 4796

Kholopov, P.N. (ed.), 1985, 1987, *The General Catalogue of Variable Stars*, 4th ed., Moscow "Nauka"

Poretti, E., 1981, G.E.O.S., *Note Circulaire*, No. 300, 1

Poretti, E., 1983, G.E.O.S., *Note Circulaire*, No. 377, 1

Rodríguez, E., Lopez de Coca, P., Rolland, A., Garrido, R., Costa, V. 1994, *A&AS*, **106**, 21