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A NEW DOUBLE-MODE CEPHEID IN CASSIOPEIA

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In the course of the search for new classical Cepheids on Moscow archive plates, a new double-mode Cepheid (GSC 4015.0972; $\alpha = 0^{\rm h}25^{\rm m}18^{\rm s}.2$, $\delta = +60^\circ45'54''$ (J2000.0); $l = 119^\circ.7$, $b = -1^\circ.9$) was discovered. Note that the star was marked as a non-stellar object in the Guide Star Catalogue. The reason, possibly, is that this variable has a fainter north-western neighbouring star, so it is double.

GSC 4015.0972 was estimated by eye on 536 plates taken with the 40-cm astrograph for the interval from JD2437284 to 49933. B-band magnitudes of comparison stars were obtained based on the standard sequence in NGC 129 (Hoag et al., 1961). The range of variability is $14^{\rm m}.10 - 14^{\rm m}.95$. The comparison star b seems to be variable with a very small amplitude. On several plates it seems to become a little fainter than usually. In these cases, the comparison star b' was used to make the estimates. Finding chart and comparison stars are shown in Figure 1.

Frequency analysis shows the existence, in the spectrum, of two strong peaks at frequencies f_0 and f_1, and their day aliases (Fig. 2). The step in frequency is about $8 \cdot 10^{-6}$ c/d.

The periods and their ratio ($f_0/f_1 = P_1/P_0 = 0.7103$) led us to the classification of GSC 4015.0972 as a new double-mode Cepheid. The light elements are the following:

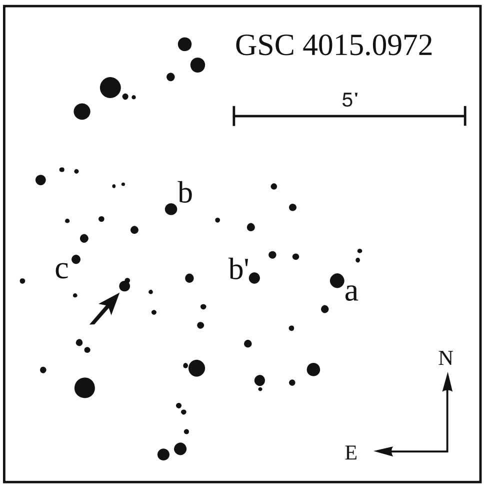
$$\mathrm{JD}_{\max} = 2443784.37 + 3^{\rm d}.73425 \times E \text{ (fundamental mode) and}$$

$$\mathrm{JD}_{\max} = 2444825.50 + 2^{\rm d}.65262 \times E \text{ (first overtone mode).}$$

In our case of power spectrum the peaks at coupling terms ($f_1 + f_0$ and $f_1 - f_0$) and at higher multiples ($2f_0$, $2f_1$ etc.) are almost absent. As mentioned by Alcock et al. (1995), this situation is possible if the shapes of the phased light curves are nearly sinusoidal. Phased light curves presented in Figure 3 confirm their statement. Figures 3a and 3b are based on the original estimates, Figures 3c and 3d are constructed for deviations from the mean phased light curve of the other oscillation. The peaks in the spectrum at f_0 and f_1, and the amplitudes of both pulsations ($A_0 \sim 0^{\rm m}.40$, $A_1 \sim 0^{\rm m}.38$) are almost equal.

Finally, we found a new relation between the period ratios P_1/P_0 and $\log_{10} P_0$ (Fig. 4). This relation is based on the data on fifteen Galaxy's double-mode Cepheids that pulsate in fundamental and first overtone modes. The data on fourteen beat Cepheids was taken from McMaster Cepheid Photometry and Radial Velocity Data Archive maintained by Dr. Welch. The new variable became the fifteenth one in our sample. The best fit now is:

$$P_1/P_0 = 0.722 - 0.030 \times \log_{10} P_0, \quad 0.3 < \log_{10} P_0 < 0.8.$$



Star	B_{pg}
a	13.65
b	14.28
b'	14.38
c	14.89

Figure 1. The finding chart and the comparison stars

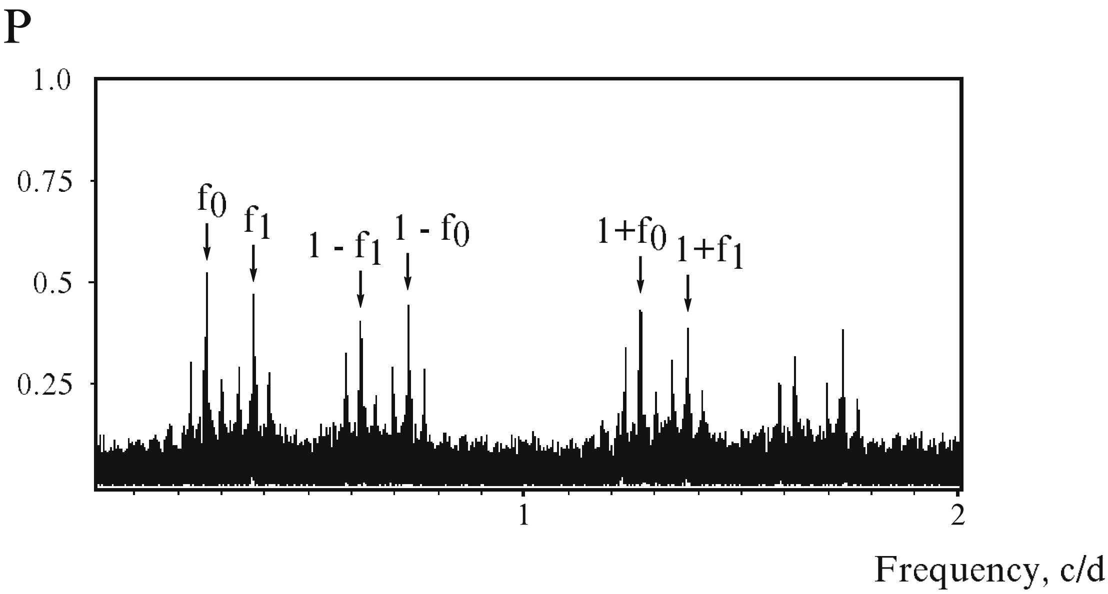


Figure 2. The power spectrum

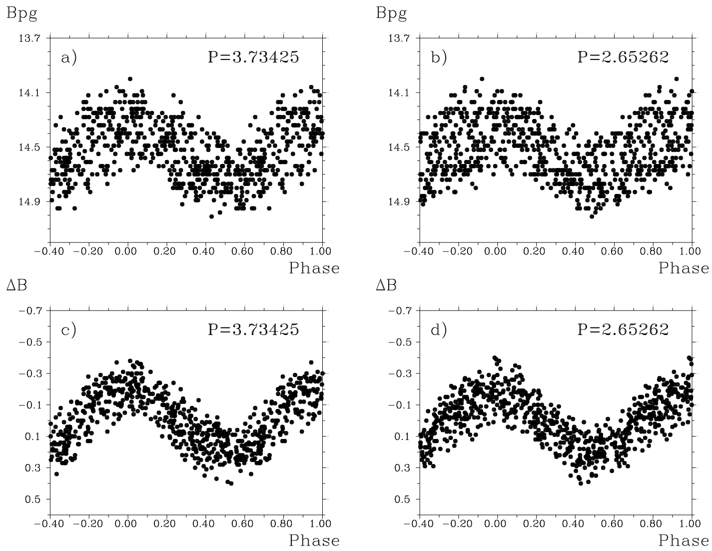


Figure 3. The phased light curves: a) the fundamental mode; b) the first overtone mode; c) the fundamental mode where the first overtone has been whitened; d) the first overtone where the fundamental mode has been whitened

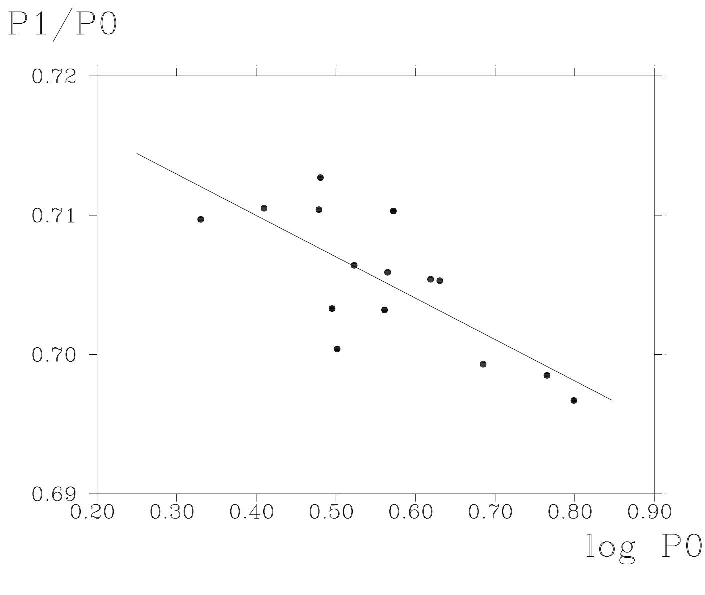


Figure 4. The relation between the ratio P_1/P_0 and $\log_{10} P_0$ for Galaxy's double-mode Cepheids

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