THE LIGHT CURVES OF DOUBLE–MODE CEPHEIDS: THE CO AUR CASE

E. PORETTI AND I. PARDO
Osservatorio Astronomico di Brera
Via E. Bianchi 46, 22055 Merate, Italy

1. Fourier decomposition

In two recent papers (Pardo & Poretti 1997; Poretti & Pardo 1997) we analyzed all the available photometry of galactic double–mode Cepheids (DMCs) with the aim of detecting in each case the importance of the harmonics and of the cross coupling terms. We found that no a priori fit can be reliably applied to the measurements of a DMC, but a careful frequency analysis must be done to evaluate the importance of each term. As a further application of this technique, we obtained very precise indications about the properties of the Fourier parameters. When discussing the generalized phase differences $G_{i,j}$ we demonstrated that plotting them as a function of the order $|i|+|j|$, there are well–defined regions where they are confined: the second order terms have $\pi < G_{i,j} < 3\pi/2$; the third order terms have $\pi/2 < G_{i,j} < \pi$; the fourth order terms cluster around 2π.

2. CO Aurigae

By performing the Fourier decomposition of the light curves we found a close similarity between the parameters of the classical Cepheids and those of the fundamental mode of the DMCs and also between the parameters of the s–Cepheids and those of the 1^{st} overtone mode of the DMCs. This fact is an independent confirmation of the different pulsation mode in Classical and s–Cepheids, as first suggested by Antonello *et al.* (1990) on the basis of the different progressions in the $\phi_{21} - P$ diagrams. Moreover, it seems that in the DMCs the light curve shape in one mode is not influenced by the simultaneous excitation of the other one.

The importance of this result can be appreciated if we consider the case of CO Aur, the only galactic DMC pulsating in the 1^{st} and 2^{nd} overtone. There is no clear indication of the presence of single–mode 2^{nd} overtone pulsators in the Galaxy and we do not know their light curve shape; for an approach to the subject, see Antonello & Kanbur (1997). If we consider the similarity discussed above, we can infer that the shape of a 2^{nd} overtone light curve should be similar to the 2^{nd} overtone component of CO Aur. Figure 1 shows the light curves of the two periods of CO Aur; as can be seen, the f_2 curve is symmetrical, with no appreciable deviation from a sinusoid.

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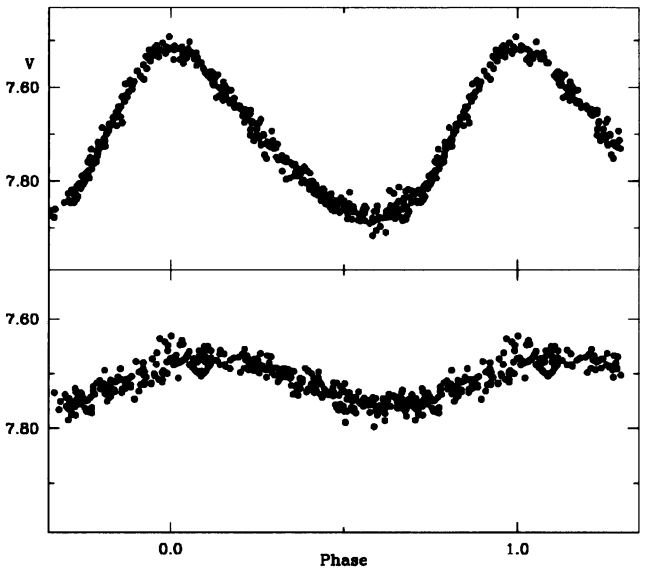

Figure 1. Light curves of the two independent frequencies f_1=0.560844 c d^{-1} (1st overtone; top panel) and f_2=0.700390 c d^{-1} (2nd overtone; bottom panel) as obtained from the all available V photometry of CO Aur

This result deserves further analysis, but it is clear that very accurate measurements should be performed to detect the $2f$ contribution in the 2nd overtone candidates. On the other hand, the f_1 curve is asymmetrical, since the $2f_1$ term has an amplitude of 0.031 mag; this fact confirms the need of calculating the harmonic content for each independent frequency, without applying an a priori fit, since in this case insignificant terms will be included, distorting the results.

References

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