Astrophysical Applications of Stellar Pulsation
ASP Conference Series, Vol. 83, 1995
R. S. Stobie and P. A. Whitelock, eds.

Accurate CCD Light Curves of Cepheids in the Large Magellanic Cloud

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1. Introduction

In the past years, in a series of papers (Antonello & Poretti 1986, Antonello et al. 1990, Mantegazza & Poretti 1992, Poretti 1994) the Fourier decomposition was successfully applied to the light curves of galactic Cepheids with P< 8 d. The separation of these Cepheids into two groups was evident. The first, more numerous (195 stars after the latest inclusion) group is constituted by the classical Cepheids, i.e., the Cepheids which follow the Hertzsprung progression: they occupy a narrow region in the $\phi_{21} - P$ plane and are also characterised by a R_{21} ratio larger than 0.20. The second group, containing 30 objects, is constituted by Cepheids which deviate from the Hertzsprung progression, describing a "Z" crossing the classical sequence in the $\phi_{21} - P$ plane; their R_{21} values are smaller than 0.20. The relation between stars of the upper and lower sequence of the "Z" is confirmed by the $\phi_{31} - P$ plane, where these stars describe an unique sequence. As first suggested by Antonello & Poretti (1986), the splitting of Cepheids into two groups can be explained by a different pulsation mode: while the classical Cepheids are pulsating in the fundamental radial mode, the other Cepheids are pulsating in the first overtone radial mode.

2. Observations of Cepheids in the LMC

As a natural extension of this work, the same method should be applied to extragalactic Cepheids. For the Cepheids belonging to the same galaxy, we directly observe a separation between fundamental and first overtone objects since for a given period the former are fainter than the latter. The Magellanic Clouds objects were considered as the first target; photographic light curves were available, but their precision was not adequate for our purposes. Hence, we planned to obtain CCD measurements of the Cepheids in the Large Magellanic Cloud. 21 Cepheids with periods between 2.4 and 4.0 d were selected and about 20 CCD measurements for each star were obtained at the Dutch 90–cm telescope at La Silla (Chile) in December 1993. The reduction of the 450 science images has been completed and it shows that the requested precision has been achieved: the standard deviations of the fits are usually <0.010 mag and also the measurements of the constant stars as bright as the Cepheids show a standard deviation better than 0.010 mag. Figure 1 shows the measurements of four LMC Cepheids with the fitted light curve.

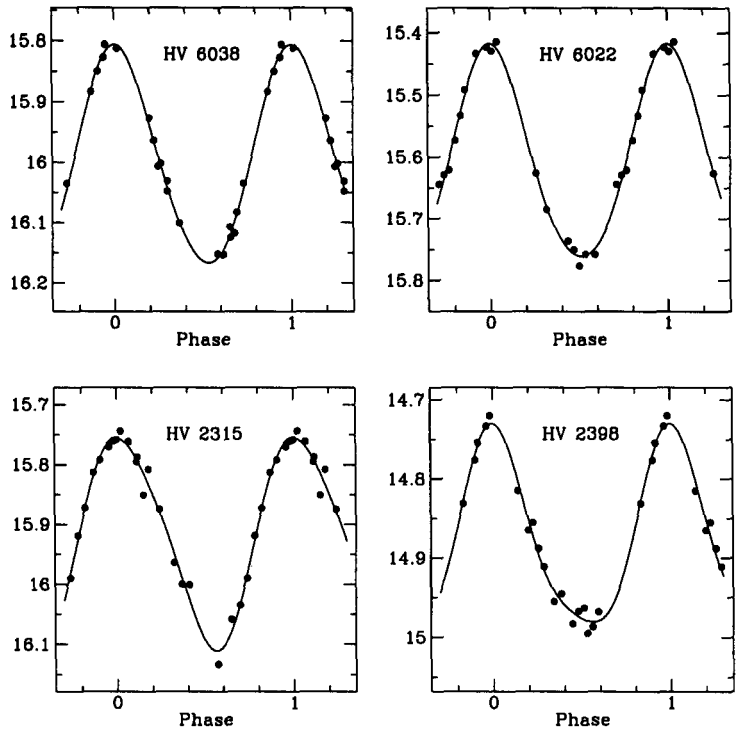

Figure 1. LMC Cepheids light curves: HV 6038 (P=2.796 d), HV 6022 (P=3.651 d), HV 2315 (P=2.412 d), HV 2398(P=3.276 d).

About 30–40 stars were surveyed in each stellar field and six new Cepheids were discovered. The collected data are not sufficient to uniformly cover the light curves of the whole sample and, in some cases, no reliable Fourier decomposition can be performed. For this reason, another 600 images of the same stellar fields were obtained in November 1994. When the data reduction of these images is also completed, we are confident we will obtain very precise values of the Fourier coefficients for the whole sample. The preliminary values confirm the subdivision of the Cepheids into two well–separated subgroups, in agreement with the characteristic observed in the Galaxy.

References

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https://doi.org/10.1017/S0252921100037581 Published online by Cambridge University Press