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Period changes in cluster and association Cepheids

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Abstract. Cepheids belonging to open clusters and associations exhibit identical characteristics to field Cepheids in terms of their period changes.

Key words. Stars: Cepheids – Stars: evolution

1. Introduction

The distances to open clusters are presently established with considerable precision through main-sequence fitting. Cepheids belonging to open clusters therefore have accurately established luminosities, making them ideal calibrators for the period-luminosity relation. Yet it is also important to establish that cluster Cepheids do not differ fundamentally from field Cepheids in their properties. A prominent and very important characteristic observed in Cepheids is the systematic manner in which they undergo changes in their periods of pulsation. Here we compare the behavior of such changes in 170 field Cepheids with those exhibited by the 40 cluster Cepheids listed by Turner & Burke (2002).

2. Method of Analysis and Observational Data

To study period changes in Cepheids we applied the generally used analytical technique of O–C diagrams in conjunction with our version of the well-known Hertzsprung method (Berdnikov 1992). We calculated O–C data from published photoelectric, photographic, and visual observations collected in our Cepheid database, as well as from magnitudes for some stars estimated from patrol plates of their fields contained in the Harvard College Observatory Photographic Plate Collection.

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3. Results

We investigated the O–C diagrams for 40 cluster Cepheids, 30 of which exhibit systematic parabolic trends indicative of period increases (21 stars) and period decreases (9 stars). Figure 1 displays results for ζ Gem, where the O–C data are dominated by a parabolic trends expected for stellar evolution. Figure 2 displays results for GY Sge, which shows cyclical waves in the O–C data.

4. Conclusions

In the cluster sample 10 Cepheids exhibit frequent, abrupt, period changes that result in cyclical waves in their O–C diagrams. For 9

Table 1. Comparison of Period Changes in Cluster Cepheids and Field Cepheids

Group	No. of Stars	Increasing Periods	Decreasing Periods	No Systematic Trends	Abrupt Period Changes $\geq 0.1P$
Field Cepheids	170	86 (51%)	33 (19%)	51 (30%)	37 (22%)
Cluster Cepheids	40	21 (53%)	9 (23%)	10 (25%)	9 (23%)

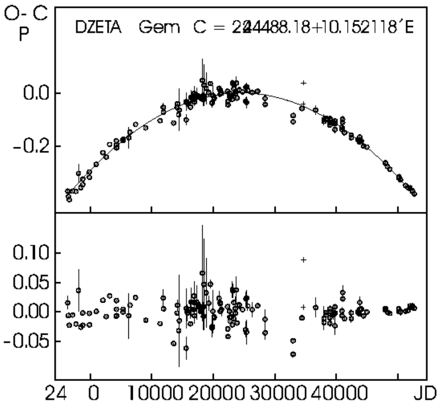

Fig. 1. O–C data, calculated evolutionary trend, and residuals from a parabolic fit (below) for ζ Gem.

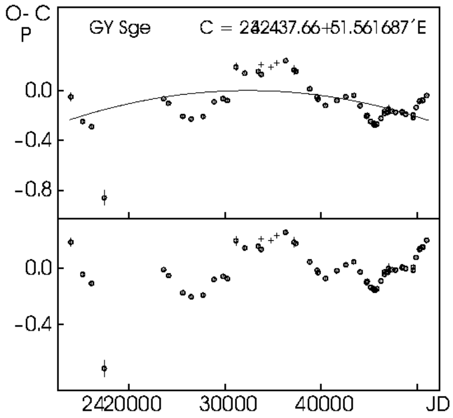

Fig. 2. O–C data, calculated evolutionary trend, and residuals from a parabolic fit (below) for GY Sge.

of them the amplitude of such oscillations in the O–C residuals exceeds 10% of their period lengths. In Table 1 we compare the results with the statistics obtained for 170 field Cepheids studied previously. The two groups are essentially identical in terms of the proportions of objects in each category of period change. The results of this study indicate that the general characteristics of period changes in Cepheids belonging to open clusters and associations are the same as those for Cepheids belonging to the Galactic field.

References

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