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Cepheids and LPVs in and around Magellanic Cloud Clusters

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Abstract. V and I band CCD photometry of the young clusters NGC 330 (SMC), NGC 1850, NGC 2058 and NGC 2065 (LMC) has been used to find variable stars in and around the clusters. The variables detected are mostly Cepheids and long-period variables (LPVs). Here we outline some results of these studies.

1. Introduction

This study was designed to address a number of problems: firstly, the disagreement between pulsation mass and evolution mass (Cox 1980), which may be resolved by allowing the convective cores of intermediate mass stars to overshoot beyond the classical Schwarzschild limit (Chiosi et al. 1992; Moskalik, Buchler & Marom 1992); secondly, the mass-period relation for LPVs, which can be studied by finding LPVs in Magellanic Cloud clusters; and, thirdly, the Mira pulsation mode, which can be determined by comparing large and small amplitude LPVs in either the clusters or the field.

2. Results

Pulsation masses for Cepheids were derived from $<V>$ and $<V> - <I>$ and the $V, V-I, M, P$ relation in Chiosi, Wood & Capitanio (1993). Evolution masses were derived by fitting the Cepheids to the core helium burning loops of the isochrones of Bertelli et al. (1994). These tracks included a moderate amount of main-sequence convective core overshoot (λ=0.5). The pulsation masses are compared to evolution masses in Figure 1.

For the Cepheids around NGC 1850 (Sebo & Wood 1995), pulsation masses are ≈20% smaller than evolution masses for stars with $M \gtrsim 5\ M_\odot$. It thus appears that for stars in this mass range, a large amount of main-sequence convective core overshoot ($\lambda \sim 1$) may be needed to bring pulsation and evolution masses into agreement. One of the Cepheids around NGC 1850 was a bump Cepheid and detailed fitting of the light curve with nonlinear pulsation models gave excellent agreement with the pulsation mass. Most of the Cepheids in the field around NGC 330 are less massive ($M \sim 3\ M_\odot$) than those near NGC 1850, and for these objects small to intermediate amounts of overshoot ($\lambda \lesssim 0.5$) are indicated (Sebo & Wood 1994).

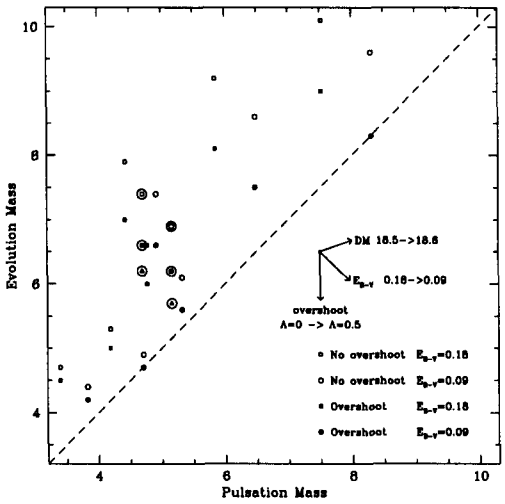

Figure 1. Evolution mass plotted against pulsation mass in $M_\odot$ for the seven Cepheids in the field centred on NGC 1850. Each Cepheid is plotted 4 times according to the amount of core overshoot and reddening. The Cepheid which is a member of NGC 1850 is circled. The triangle shows this star plotted using the evolution mass derived from the cluster age and E_{B-V} =0.09 and 0.18. The arrows show the effect of changing the amount of overshoot, distance modulus and reddening.

A large number of LPVs were found in the fields around the clusters, although no cluster red giants were found to be variable. A (K,logP) diagram for the LPVs shows two distinct sequences which can be understood if the Mira variables are fundamental mode pulsators while the small amplitude variables are first overtone pulsators.

References

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