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ORIGINAL ARTICLE

On the metallicity dependence of classical Cepheid light amplitudes

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Abstract Classical Cepheids remain a cornerstone of the cosmic distance scale, and thus characterizing the dependence of their light amplitude on metallicity is important. Period-amplitude diagrams constructed for longer-period classical Cepheids in IC 1613, NGC 3109, SMC, NGC 6822, LMC, and the Milky Way imply that very metal-poor Cepheids typically exhibit smaller V-band amplitudes than their metal-rich counterparts. The results provide an alternate interpretation relative to arguments for a null and converse metallicity dependence. The empirical results can be employed to check predictions from theoretical models, to approximate mean abundances for target populations hosting numerous long-period Cepheids, and to facilitate the identification of potentially blended or peculiar objects.

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1 Introduction

Establishing an empirically derived correlation between a classical Cepheid's light amplitude, pulsation period, and chemical composition is important for several reasons. For example, such a pertinent link is needed to help constrain theoretical models. Model-generated period-amplitude diagrams are acutely sensitive to the input physics, the adopted mass-luminosity relation, the inclusion of convective overshooting (Bono et al. 2000a, their Fig. 6) and rotation, the spatial resolution of the ionization zones (Petroni et al. 2003, their Fig. 10), and the generated amplitudes once transformed to Johnson V can be ∼20 % too large (Bono et al. 2000a, their Fig. 7). Bono et al. (2000a) found that metal-poor Cepheids typically exhibit larger amplitudes than their metal-rich counterparts, except for the 7 $M_\odot$ canonical and 9 $M_\odot$ convective overshooting models. Thus metal-rich 10–30^{d} (7–9 $M_\odot$) Cepheids may potentially exhibit larger amplitudes than their metal-poor counterparts. The availability of such testable model predictions is desirable, however, the diversity of opinion concerning the empirical picture (a partial account is provided below) hindered a comparison.

Figure 1 in Shapley (1942) highlights the sizable amplitude offset between ∼300+ SMC and Galactic Cepheids. Shapley (1942) argued that the discrepancy may be tied to systematic errors, whereas Arp and Kraft (1961) suggested the offset was attributable to differences in chemical composition between SMC and Galactic Cepheids (Δ[Fe/H] ~ -0.75, Luck et al. 1998; Romaniello et al. 2008). Schaltenbrand and Tammann (1970) instead noted a