Astrophys Space Sci (2012) 341:99–104
DOI 10.1007/s10509-012-0988-7

ORIGINAL ARTICLE

Problems and possibilities in fine-tuning of the Cepheid P-L relationship

L. Szabados · P. Klagyivik

Received: 31 August 2011 / Accepted: 9 January 2012 / Published online: 17 January 2012

Abstract Factors contributing to the scatter around the ridge-line period-luminosity relationship are listed, followed by a discussion how to eliminate the adverse effects of these factors (mode of pulsation, crossing number, temperature range, reddening, binarity, metallicity, non-linearity of the relationship, blending), in order to reduce the dispersion of the P-L relationship.

Keywords Stars: variables: Cepheids · Stars: distances

1 Introduction

The century-long history of the period-luminosity (P-L) relationship of Cepheids can be characterised as a permanent attempt at improving the calibration of this relationship fundamental for securing the cosmic distance scale. In spite of tremendous effort, the distribution of the points in the P-L plots derived for any galactic system shows a wider dispersion along the ridge-line approximation than hoped for (Fig. 1). The current situation is summarized concisely by Marconi (2009) and, in a broader context—from the point of view of determining the Hubble constant—by Freedman and Madore (2010).

Lately, most works on the P-L relationship deal with the metallicity dependence of the luminosity of Cepheids and the possible non-linearity of the relationship. There are, however, other factors contributing to the dispersion of the empirical P-L relation. The aim of this paper is to list all these factors and discuss the elimination of their adverse effect.

L. Szabados (✉) · P. Klagyivik
Konkoly Observatory, Budapest, Hungary
e-mail: szabados@konkoly.hu

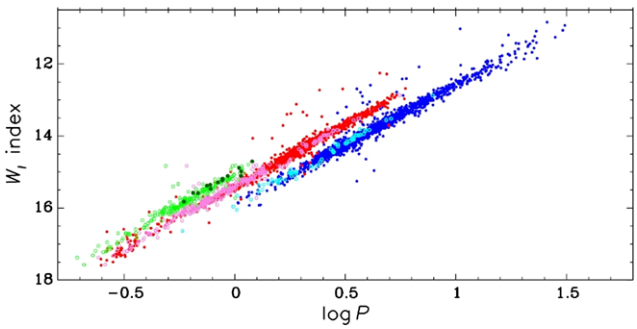

Fig. 1 Empirical P-L relationship for Cepheids in the Large Magellanic Cloud. To decrease the scatter, Wesenheit magnitudes are indicated along the vertical axis (Soszyński et al. 2008). *Blue* and *cyan points* show fundamental-mode pulsators, *red* and *magenta* denote first-overtone, *green* characters second overtone pulsators. *Solid dots* are single-mode Cepheids, *empty circles* represent the respective mode of double-mode Cepheids. The dispersion is still about $0\overset{m}{.}5$

2 Causes of the dispersion of the P-L relationship

The following factors contribute to the width of the empirical P-L plot:

- pulsation mode,
- crossing number (evolutionary stage),
- effective temperature of the star,
- interstellar reddening,
- binarity,
- blending,
- metallicity,
- helium content,
- nonlinearity of the relationship,
- other (magnetic field; overshooting; depth effect in the host galaxy; etc.).