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Angular diameter amplitudes of bright Cepheids

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Abstract. Expected mean angular diameters and amplitudes of angular diameter variations are estimated for all monoperiodic Classical Cepheids brighter than $\langle V \rangle = 8.0$ mag. The catalog is intended to help selecting best Cepheid targets for interferometric observations.

Key words. Stars: fundamental parameters, distances, variables: Cepheids – Techniques: interferometric

1. Introduction

Classical Cepheids play a central role in establishing cosmological distance scale. An accurate calibration of their $P-L$ relation is, therefore, crucial. While the slope of this relation is well determined by Cepheids of the Large Magellanic Cloud, its zero point still remains uncertain. The long-baseline optical interferometry offers a novel way of Cepheid distance determination, by using purely geometrical version of the Baade-Wesselink method (*e.g.* Kervella et al. 2004). So far, the technique was successfully applied only to a handful of Cepheids, but with increased resolution of next generation instruments (CHARA and AMBER) more stars will become accessible. The goal of this work is to identify Cepheids, which are most promising targets for observations with existing and future interferometers. For that purpose, we calculated expected mean angular diameters and angular diameter amplitudes for all monoperiodic Cepheids brighter than $\langle V \rangle = 8.0$ mag. The resulting catalog can serve as a planning tool for future interferometric observations. Full version of the catalog can be found in Moskalik & Gorynya (2005; hereafter MG05).

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2. Method

First, Cepheid absolute magnitudes were estimated with the period–luminosity relation of Fouqué et al. (2003). The observed periods of first overtone Cepheids were fundamentalized with the empirical formula of Alcock et al. (1995). Comparison of derived absolute magnitudes and dereddened observed magnitudes yielded Cepheid distances. The mean Cepheid radii were estimated with the period–radius relation of Gieren et al. (1998). Variations of Cepheid radii during pulsation cycle were calculated by integrating the observed radial velocity curves. For all Cepheids we used the same constant projection factor of $p = 1.36$. With the mean radius, the radius variation and the distance to the star known, the mean angular diameter, $\langle \theta \rangle$, and the total range of angu-

Table 1. Predited Angular Diameters of Bright Cepheids (for full table see MG05)

Star	$\log P$	$\langle V \rangle$	$\langle \theta \rangle$	$\Delta\theta$
ℓ Car	1.551	3.724	2.854	0.545
SV Vul	1.653	7.220	1.099	0.270
U Car	1.588	6.288	1.059	0.252
RS Pup	1.617	6.947	1.015	0.250
η Aql	0.856	3.897	1.845	0.226
T Mon	1.432	6.124	0.949	0.219
β Dor	0.993	3.731	1.810	0.214
X Cyg	1.214	6.391	0.855	0.184
δ Cep	0.730	3.954	1.554	0.181
RZ Vel	1.310	7.079	0.699	0.170
ζ Gem	1.006	3.918	1.607	0.160
TT Aql	1.138	7.141	0.800	0.158
W Sgr	0.881	4.668	1.235	0.151

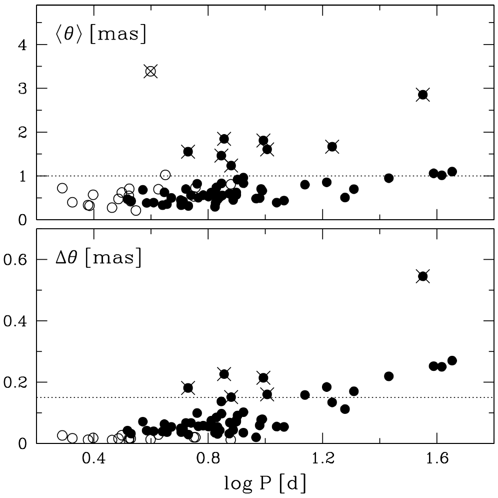

Fig. 1. Predicted mean angular diameters (top) and angular diameter amplitudes (bottom) for Pop. I Cepheids with $\langle V \rangle < 8.0$ mag. Fundamental and overtone pulsators plotted with filled and open circles, respectively. Stars with published interferometric measurements displayed with crossed symbols.

lar diameter variation, $\Delta\theta$, can be easily calculated.

3. Results

Results of our calculations are summarized in Table 1. In Fig. 1, we display $\langle \theta \rangle$ and $\Delta\theta$ *vs.* pulsation period for all Cepheids of our sample. At the level of technology demonstrated already by VINCI/VLTI and PTI instruments, the achievable accuracy of $\langle \theta \rangle$ determination is about 0.01 mas. This implies a lower limit of $\langle \theta \rangle = 1.0$ mas, if measurement with 1% accuracy is required. Angular diameters of 13 Cepheids are above this limit, four of which have not been yet observed (SV Vul, U Car, RS Pup and overtone pulsator FF Aql).

Most interesting for interferometric observations are Cepheids, whose angular diameter *variations* can be detected. This has been possible for stars with $\Delta\theta > 0.15$ mas. 13 Cepheids are above this limit. These objects cover uniformly the period range of $\log P = 0.73 - 1.65$ and are well suited for calibration of Cepheid $P - L$ and $P - R$ relations. Until now, angular diameter variations have been measured only for six of them. The remaining seven, so far unobserved Cepheids, are SV Vul, U Car, RS Pup, T Mon, X Cyg, RZ Vel, and TT Aql. We encourage observers to concentrate their efforts on these objects. With shorter wavelength (H-band instead of K-band) and longer baselines, the new CHARA and AMBER interferometers will offer substantial increase of resolution. Consequently, the list of Cepheids with measurable amplitude diameter variations will grow to ~ 30 objects, creating excellent prospect for very accurate calibration of Cepheid $P - L$ and $P - R$ relations.

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