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Baade-Wesselink Analysis of a Sample of Equal Period SMC Cepheids. A progress report.

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Abstract. We present a progress report on a project to investigate the differences in absolute physical parameters for a sample of five equal period SMC Cepheids from a Baade-Wesselink analysis of the stars.

1. Introduction

With the recent observations of Cepheids in Virgo galaxies (Pierce et al. 1994 and Freedman et al. 1994) the Period-Luminosity (PL) relation is finally being applied to objects at cosmologically interesting distances. As the PL relation is a statistical relation for an ensemble of stars and not an exact physical relation, it is important to understand how this relation can be affected by differences in the sample. This is particularly important when applying the relation to distant galaxies where the properties of the stellar populations are not well known but might well be significantly different from the local and well studied ones. As demonstrated by Mateo (1992) the ensembles obtained from one young cluster to the next in the LMC can lead to significantly different slopes of the PL relation. The reason for this discrepancy is not entirely clear, but abundance differences might provide part of the explanation. In an attempt to understand better the physical properties of Cepheids, in particular with respect to differences in abundances, we will apply the Baade-Wesselink (BW) method to a sample of five SMC Cepheids of similar period. The BW analysis gives the absolute physical properties for the individual stars and we will investigate how the physical parameters for the stars, at a fixed period, change as a function of color and luminosity. Comparing these results with similar results for galactic stars will enable us to assess the effect of abundance variations on luminosity which could be important for the application of the PL relation to stars in other galaxies.

2. The sample

To obtain a good baseline in metallicity with respect to the galactic Cepheids it is preferable to observe SMC Cepheids ([Fe/H] $\approx$ –0.65) over LMC Cepheids. Also, the SMC has a lower dust content than the LMC, and thus the reddening corrections are in general smaller and more uniform.

Three of the stars (HV1328, HV1333, and HV1335) are in the south-eastern part of the SMC, whereas HV822 and HV1345 are located in the southern end of the bar of the SMC. Although the SMC possess a significant depth the BW method will provide distances that we hope will be able to disentangle such problems.

All the stars have periods close to 15 days, short enough to limit the problems with the model atmospheres for the very extended envelopes, and at the same time long enough to reduce the contamination of the sample by overtone pulsators.

ID	HV822	HV1328	HV1333	HV1335	HV1345	
Period	16.742	15.8396	16.289	14.96	13.4767	(days)

3. The data

We have collected about 2000 BVRI CCD frames at Las Campanas and Cerro Tololo for these stars and additional stars in the LMC. The magnitudes have been derived using DoPHOT1.0 (Schecter, Mateo & Saha, 1993) modified to run on a SUN workstation. A database package has been developed within IRAF to keep track of the magnitudes of all the objects in the frames. This package enables us to achieve the optimal relative calibration of the frames and to find and study the other variable stars in the field as well.

The radial velocities have been derived from high resolution echelle, low signal to noise, spectra obtained at Las Campanas supplemented with data from ESO. These data have been reduced using IRAF and the package `xcor`.

4. The Baade-Wesselink analysis

The temperature is the most critical parameter for the BW analysis. Fry & Carney are currently determining excitation temperatures for galactic Cepheids in open clusters, and they find good agreement between their temperatures and temperatures from the (B–V) colour index combined with the Buser & Kurucz (1992) model atmospheres. Thus we can use the model atmosphere data for the temperature determination and follow the recipe used for the RR Lyrae stars described in Storm et al. (1993).

References

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