OBSERVATIONS OF CLASSICAL CEPHEIDS

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I Introduction

Calibration of the Period-Luminosity relation for Classical Cepheids is still far from settled: the debate continues as to whether there is a unique relation from galaxy to galaxy and what the precise form is in any one system. In the Milky Way we suffer from poor sample size; in the Magellanic Clouds it is still a matter of low accuracy in the observations. Work is in progress at several observatories to alleviate both of these problems through studying not only galactic Cepheids but also those in the LMC, SMC, M33 and NGC 300.

II New Surveys In Progress

Arellano & Percy (CTIO/DDO) have begun a photoelectric monitoring of the apparently brightest F & G supergiants in the Milky Way. The aim is to detect near-by very-low-amplitude Cepheids which are binaries or are intrinsically low amplitude variables. This should provide a better qualitative hold on the sense of the amplitude dependence on effective temperature, as well as the true fequency of the cepheid phenomenon.

Encouraged by the case of TW Nor, the longest-period (11^d) Cepheid discovered in a cluster, van den Bergh and Brosterhus (DAO) have begun a photographic survey of long-period Cepheids in the southern Milky Way, in search of sparse groupings of OB stars around these young Cepheids.

Grieve (DDO) is carrying the search for new low-amplitude Cepheids out to the two Magellanic Clouds. All known F & G supergiant Cloud members are being monitored so as to put amplitude and luminosity limits to the instability strip. Several of these stars are already known to be variable but their characteristics remain to be determined.

An extension of the earlier spectral classification work of Code and Kraft is being made by Gauthier (DDO) in the southern hemisphere. At the same time Harris (U.Washington) is using Canterna's photometric system, calibrated with selected curve-of-growth studies, to determine metal abundances at a variety of positions throughout the Galaxy. Extension of this work to the Magellanic Clouds would be most welcome.

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III Methodology

There is always a danger in simplifying a problem in order to make some progress early on. Often the intent of redressing the simplification at a later date, is forgotten. Early calibrations of the PLC which involved extragalactic Cepheids assumed a two-component model for the reddening: a uniform foreground component and a component internal to the parent galaxy. Most of the time this internal component was set to zero. Early spectra of extragalactic Cepheids indicated that this was not the case and (U-B) photometry supported that conclusion, but now (V-I) photometry (SAAO) suggests that the original low reddenings are more appropriate. One problem is in assessing the significance of reddening whatever its claimed magnitude. Most galactic observers would find E(B-V)= 0.08 mag. routinely acceptible, however if Cepheids in the Magellanic Clouds fall in an intrinsic strip only 0.2 mag. wide then a variable reddening component with mean E(B-V)=0.08 mag. will overwhelm almost all information on the intrinsic-colour properties of the instability strip.

To emphasize this and other methodological points Brodie & Madore (IOA, Cambridge) have run numerical simulations of cepheid observations in order to study the calibration process. The derived coefficients of the PLC: $M = a \log P + b\ (B-V) + c$, are very sensitive in a systematic way, to both the reddening errors and random errors in the photometry. For observations with reddening-correction errors, $b \rightarrow R = A_V/E(B-V) \sim 3$, and for large random errors in the photometry, b artificially tends toward zero. This is due to the constraint of finite width of the instability strip, a problem not usually encountered in standard least-squares theory. Cogan (Stromlo) and Martin, Warren & Feast (SAAO) have suggested that if the errors can be estimated then future solutions of the PLC should use maximum-likelihood methods of regression; however the effects of constraints on the available data need to be studied in this case too.

IV Expectations

If we can extend the high-precision photometry (akin to the galactic work of Pel & Lub) to just a handful of Magellanic Cloud Cepheids, we will be in far better shape than increasing the sample size at present standards of accuracy. In principle only three or four extremely-well observed Cepheids could serve to calibrate the PLC. (In as much as duplicity among Cepheids is now thought to run as high as 30%, the selection of the calibrating sample will of course be a crucial step.)

Nevertheless, far extragalactic work is going ahead in anticipation of improved calibrations. For the Local Group, Blackwell (Oxford), Hanes (Cambridge) & Madore (DDO) are reducing photographic and electronographic exposures of two fields in M33. Slightly farther afield, Graham (CTIO), Madore (DDO) & Smith (ROE) are in the final stages of gathering plate material on Cepheids in NGC 300, a probable member of the Sculptor Group of southern galaxies.The obvious next step is to use the Space Telescope to discover and study Cepheids as far away as the Virgo cluster.