AN EMPIRICAL Hγ - LUMINOSITY CALIBRATION

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ABSTRACT. High signal-to-noise Reticon spectra for 87 members of 8 open clusters and associations together with 37 stars having reliable parallaxes (early A-type stars with reliable trigonometric parallaxes, eclipsing binaries, and visual binaries) have been used to calibrate the W(Hγ)-Mv relation for spectral types O to early A of luminosity classes III-V. The new calibration has a mean probable dispersion of $\pm$0.28 mag. The distance modulus of the Pleiades is 5.54 $\pm$ 0.06 mag, which is in excellent agreement with other, recent determinations, as are the distance moduli for all the calibrating clusters. The use of visual-binary parallaxes implies a Hyades distance modulus of about 3.0 which is significantly smaller than the Hanson (1980) value of 3.30 mag. Although no spectral-type corrections are necessary, stellar evolution probably affects the construction of the new calibration and special care should be taken when determining distance moduli from slightly evolved cluster sequences or for individual stars. Systematic departures from the calibration may be present for stars with Vsin i $\geq$ 220-250 km/sec. Significant residuals are found between our values of W(Hγ) and those of Petrie in the range 1-13 Å equivalent width, which are due in part to systematic errors in Petrie's W(Hγ) measures. Our distance modulus of 11.11 mag for NGC 2244 is in excellent agreement with the photometric distance. The new calibration is compared to other early type star calibrations for main sequence stars. It is 1.2 mag brighter than Petrie's (1965) Hγ calibration at spectral type O6 and 0.7 mag brighter at A3. For types B1 and earlier the new calibration averages 0.4 mag brighter than the Balona and Crampton (1974) Hγ calibration. There is generally good agreement with the Blaauw (1963) MK calibration although the latter is 0.4 mag brighter at spectral type B0. The Crawford (1978) Hβ calibration is up to 0.5 mag brighter for the earlier spectral types and 0.4 mag fainter for later types. More complete discussions of the Hγ-luminosity calibration are available in Millward and Walker (1984, 1985).

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DISCUSSION

ROUNTREE: What is the systematic difference between your new H-gamma calibration and some other well known absolute-magnitude calibrations for early-type stars - for example the H-gamma calibrations of Petrie and Guetter, the H-beta calibration of Crawford and the more general calibration of Blaauw?

MILLWARD: Our calibration is up to 1.2 magnitudes brighter than the Petrie H-gamma calibration for the O stars. It is up to 0.4 magnitudes fainter than Crawford's H-beta calibration for spectral types earlier than BO V and averages 0.3 magnitudes brighter for later spectral types. The same type of systematic difference between various H-gamma calibrations and Crawford's H-beta calibration has been noted by others. Shobbrook has recently indicated that Crawford's H-beta calibration may be too bright for the earlier spectral types. This may explain some of the residuals. There is generally good agreement with the Blaauw-MK calibration except at type BO V where we are about 0.5 magnitudes fainter. This gives support to the claims of Walborn and Turner that the Blaauw calibration is too bright for types O9 - B2 V.

Finally, our new H-gamma calibration averages 0.4 magnitudes brighter than the Balona and Crampton H-gamma calibration for types earlier than about B2. A number of comparisons are shown in the poster paper.

LYNGÅ: Does emission in B stars worry you? For H-beta measurements this is quite serious.

MILLWARD: Emission is less severe at H gamma than at H beta and with our high signal-to-noise Reticon spectra any features observed in the H-gamma line can be assumed to be real, whether it is a blend in the line wings or emission in the line core. It is a very straightforward matter to correct for any emission that is present unless it is so severe that it is filling in most of the line.

FRACASSINI: I would remind Dr. Millward and Dr. Walker that Dr. Martin of the Observatory of Marseille published similar results in 1959 (Compt. Rend. Acad. Science, Paris, 248, 1776) and in 1964 (thesis presented at the Faculty of Sciences of the University of Marseille). The equivalent widths were determined by means of the method of the Swedish astronomer Ohman.

PARTHASARATHY: Rotation, emission in the line and duplicity may influence the M_V-H-gamma calibration.

MILLWARD: We have investigated the effect of rotation on the calibration and find that the systematic effect, if present, is only important for Vsini > 220 - 250 km/sec. Even though the lines are broad and shallow, any emission present can be detected easily and corrected for due to our high signal-to-noise spectra. Binarity can be a problem with the H gamma calibration as it affects both the apparent magnitude and the H gamma index. However, we have made corrections to known and suspected binaries in the calibration.

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