ROTATIONAL EFFECTS ON THE PHOTOMETRIC DETERMINATIONS OF ABSOLUTE MAGNITUDES FOR A- AND F-TYPE STARS

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Abstract. The effects of rotation on the determinations of absolute magnitudes by means of the c_1 vs $(b-y)$ and d vs $(B_2 - V_1)$ diagrams are discussed.

These effects mainly concern field stars, for which absolute magnitudes are determined by means of the c_1 vs $(b-y)$ diagram (Strömgren, 1963) or the d vs $(B_2 - V_1)$ diagram (Hauck, 1966). We consider here the case of uniform rotation, which has received some observational supports for upper main-sequence stars (e.g. Maeder and Peytremann, 1970, 1972). Figure 1 shows the rotational tracks in the c_1 vs $(b-y)$

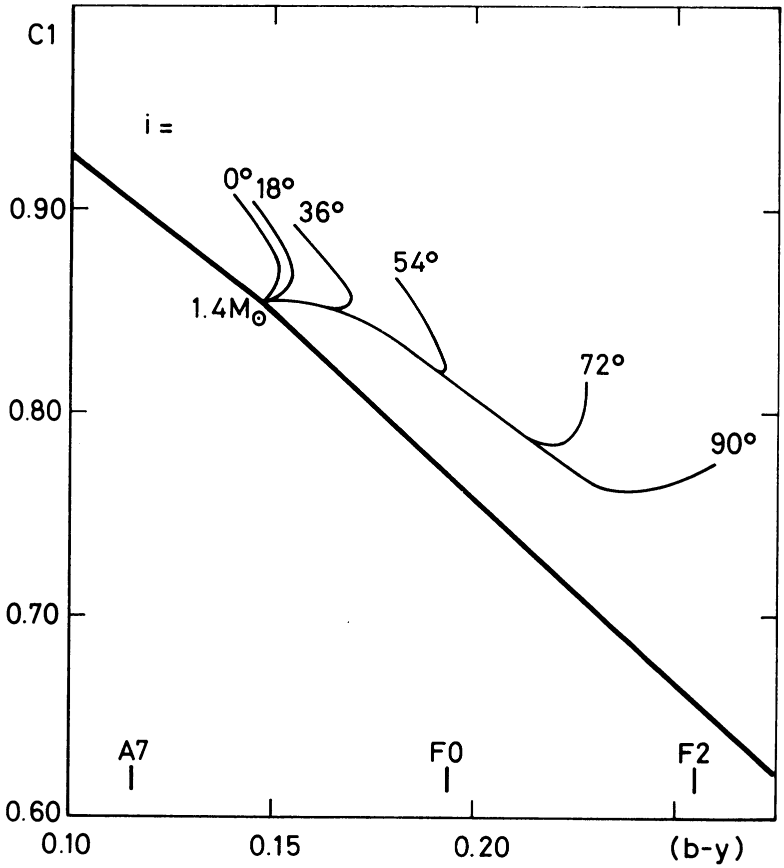

Fig. 1. Rotational tracks in the c_1 vs $(b-y)$ diagram.

B. Hauck and B. E. Westerlund (eds.), Problems of Calibration of Absolute Magnitudes and Temperature of Stars, 41–43.

diagram, as they are predicted by the models of uniformly rotating stars with hydrogen- and metallic-line blanketing (Maeder and Peytremann, 1972). The determinations of M_v make use of the ratios $\Delta M_v/\Delta c_1$ or $\Delta M_v/\Delta d$, which have been calibrated by Strömgren (1963) and Hauck (1972). Table I gives the rotational shifts ΔM_v, Δc_1, Δd, as they are predicted by the models; ω is the ratio of the angular velocity of the star to the value at the break-up point, v_R is the equatorial velocity and i the aspect angle. One sees that the mentioned ratios are far from being conserved by rotation. The last two columns of Table I give the difference δM_v between the real M_v and the value found by the application of the methods using the c_1 vs $(b-y)$ and the d vs (B_2-V_1) diagrams. Figure 2 illustrates these differences in the case of the d vs (B_2-V_1) diagram. Both methods lead to an overestimate of brightness for rapidly rotating stars, which are seen equator-on and to an underestimate for those, which are seen pole-on. For rapidly rotating stars later than F0, attention has to be given to the fact, that all observed effects appear in the same sense, but twice as large (Maeder and Peytremann, 1972) as those predicted by the models. Figure 2 does not give a mean for correcting the effects of rotation, because this would require the knowledge of the angle i; it only gives an indication on the sense and size of the effects of rapid rotation in M_v determinations of this kind.

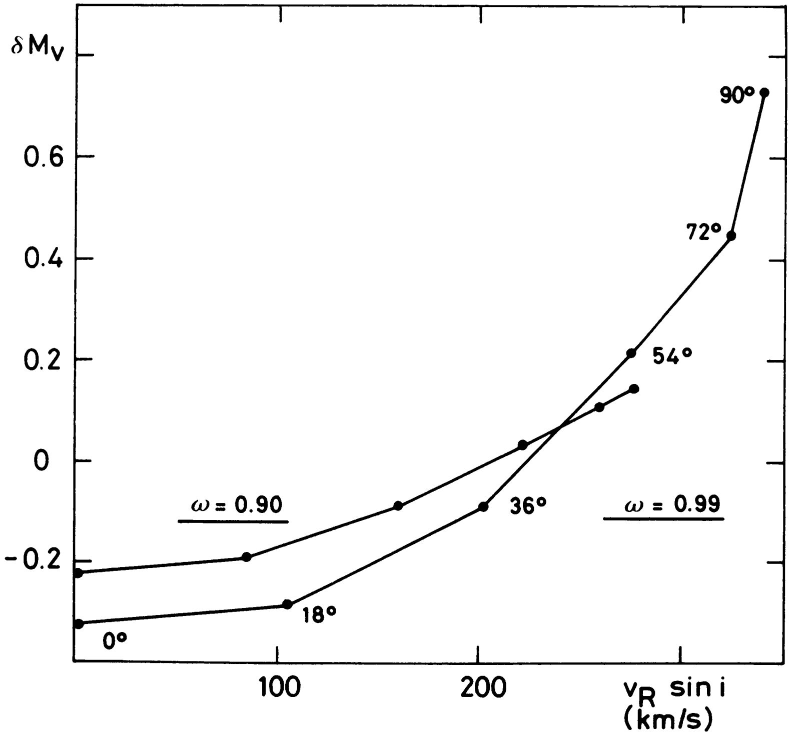

Fig. 2. Difference between the real M_v and the value of M_v determined by means of the d vs (B_2-V_1) diagram in function of $v_R \sin i$ and i for $\omega = 0.9$ and 0.99.

https://doi.org/10.1017/S0074180900055066 Published online by Cambridge University Press

TABLE I

Results of the 1.4 $M_\odot$ model

ω	v_R (km s^{-1})	i	ΔM_v	Δc_1	Δd	δM_v ($c_1/b-y$)	δM_v (d/B_2-V_1)
0.90	272	0°	0.33	0.026	0.016	−0.12	−0.23
		54°	0.26	0.045	0.048	+0.10	+0.03
		90°	0.33	0.064	0.076	+0.22	+0.13
0.99	341	0°	0.46	0.043	0.024	−0.12	−0.32
		54°	0.19	0.072	0.067	+0.39	+0.21
		90°	0.33	0.126	0.140	+0.83	+0.72

References

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DISCUSSION

Pecker: I doubt if even a good index can give valuable information on the rotation; the reason is that the interpretation is strongly depending upon the *assumed* distribution of temperature with latitude, and upon, therefore, the internal structure etc.

Crawford: Have you compared your model predictions with observations? I do not like Praesepe for these comparisons. The Pleiades or α Per cluster is better, for the A stars are not evolved. One can more easily separate parameters therefore.

Maeder: The comparisons between the observations and H-lines blanketed atmospheric models of rotating stars have been made in *Astron. Astrophys.* **7**, 120 (1970), and for the hydrogen-and metallic-lines atmospheric models in *Astron. Astrophys.*, in press (1972). Rotational effects may only be put in evidence by discussion of *differential* effects. So the fact that the A-type stars of Praesepe are evolved has no importance, because it suffices to compare the slow and the fast rotating stars without considering the position of the ZAMS. Praesepe has the advantage, compared to the Pleiades and the α Persei cluster, that no differential reddening corrections have to be applied.

Kodaira: What coefficient of the ω^2-term have you adopted? In the last years the coefficient, adopted by Strittmatter-Hardorp, was revised to a smaller one. The theoretical model is still not acurate enough, one should make more effort to detect the effect observationally. My attempt to find the effect in Balmer-jump excess for a given $(b-y)_o$, resulted in a contradiction of the theoretical prediction (*Astrophys. J.* **159**, 931). The deviations found by me are rather along the line of 'pole-on' effect (equivalent to enlarging $\log g$), in agreement with the Mt. Stromlo data presented here today by Jones. The possible error in M_v, indicated by I_β of the Mt. Stromlo data, would be still explained by a rotational effect, or an unknown effect equivalent to enlarging $\log g$.

Maeder: I have adopted the coefficients given by Faulkner *et al.* (1968, *Astrophys. J.* **151**, 203), which are also in agreement with those given by Sackmann and Anand (1970, *Astrophys. J.* **162**, 105).

Thomas: In the paper by Roxbourgh *et al.* the coefficient for ω^2 corresponded to a maximum decrease in luminosity of 25% but all later authors obtained values of about 7% to 8%, which is the value also used by Dr Maeder in his talk.

Code: I should like to comment with respect to rotation that comparison of stars in the ultraviolet from the Balmer jump to about 1500 Å, based on OAO-2 spectrophotometry show no dependence on $V \sin i$ even for large rotational velocities. This photometry is accurate to about $0^m\!.02$.