

FUNDAMENTAL PARAMETERS : NORMAL A0 DWARF STARS OF THE SOLAR NEIGHBOURHOOD

M. GERBALDI

CNRS and Université de Paris Sud XI

Institut d'Astrophysique 98bis, Bd. Arago, 75014 Paris, France

R. FARAGGIANA

Dipartimento di Astronomia v. Tiepolo 11, 34131 Trieste, Italy

R. BURNAGE

CNRS, Observatoire de Haute Provence 04870 Saint Michel l'Observatoire, France

F. DELMAS

CNRS Institut d'Astrophysique 98bis, Bd. Arago, 75014 Paris, France

A. GOMEZ

DASGAL, Observatoire de Meudon, 92150 Meudon, France

AND

S. GRENIER

DASGAL, Observatoire de Meudon, 92150 Meudon, France

1. Introduction

The purpose of this paper is to define a set of "standard", "reference" or "comparison" stars, according to their use, of spectral type A0V in order to be used for further studies in the domain of peculiar stars as well as normal stars of this T_{eff} and luminosity range.

Among the early type stars in the solar neighbourhood the A0 dwarfs are the hottest for which a significant number of objects is available. The aim of this study is to determine the atmospheric parameters necessary to put them on the HR diagramme, the M_V being the value obtained from the HIPPARCOS parallaxes.

2. Selection of the sample

The sample was selected from the Bright Stars Catalogue (1982 edition), it consists of all the stars with a spectral type A0V excluding the stars recognized in this catalogue as being peculiar, shell stars or SB2. The papers by Abt and Morrell (1995) and Gray and Garrison (1987) have been scrutinized as well as the notes in the BSC in order to detect any quoted peculiarity. The final sample contains 230 objects.

3. Atmospheric Parameters

For such a set of stars, the best way to determine T_{eff} and $\log g$ is from photometry and for early-type stars the uvbyH β and Geneva are the most commonly used systems.

For the uvbyH β system we shall use the classical calibration of the photometric indices in terms of T_{eff} , $\log g$ by Moon and Dworetzky (1985) (noted hereafter MD) which has been tested and refined since more than a decade ago.

For the Geneva system, we took the calibration published by Künzli et al. (1997). The calibration of the Geneva photometric system is quite independent of the Strömrgren one in the sense that it does not include any narrow band centered on a Balmer line; it is therefore interesting to compare

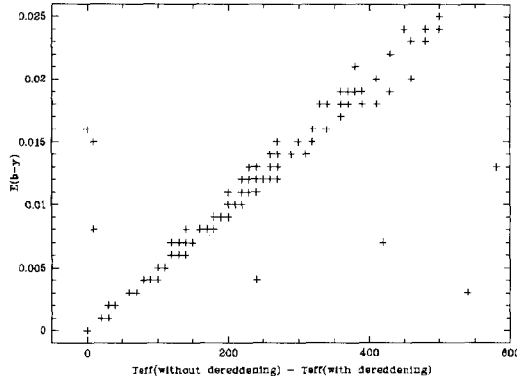


Figure 1. The effect of a moderate color excess on T_{eff} determination.

the results obtained with these two systems.

A final check of the reliability of these photometrically derived parameters can be done by comparing the observed spectra of a sub-sample of these stars with the synthetic spectra computed from models using as input data the photometrically determined parameters. The recent literature has widely demonstrated the validity of the computed spectra based on the last version of the Kurucz (1993) models.

We recall that as a first step dereddened colors must be computed; for our set of data de-reddening is expected to be very low or negligible; a severe reddening is likely to indicate a flux distortion due to spectral peculiarities or undetected binarity. The color excess $E(b-y)$ has been computed using Moon (1985) program UVBYBETA.

Slightly more than 140 stars have a color excess in the range: $-0.015 \leq E(b-y) \leq +0.015$.

For all the other stars having an $E(b-y)$ value either negative or positive, we have looked at their bibliography and found that in many cases, about 40 % of the sample, some peculiarities or binarity have been detected affecting the values of the color indices and therefore the computed color-excess.

4. Influence of the value of $E(b-y)$ on T_{eff} , $\log g$

For the stars with $E(b-y) \geq 0.0$ we computed T_{eff} and $\log g$ assuming $E(b-y)=0$ and we plotted the difference of the T_{eff} derived with and without dereddening of color indices, versus $E(b-y)$ in Fig.1.

As expected a mean linear relation is found and the scatter around the mean value increases with the color excess. It is important to underline that the introduction of a moderate reddening of $E(b-y)=0.01$ produces a difference in T_{eff} of 200 K.

Some stars lie completely outside from this mean relation: the value of their color indices was outside the limits of the grid used by MD.

The effect of a moderate reddening is negligible on the $\log g$ determination (Fig.2)

5. Comparison between T_{eff} and $\log g$ determined from uvbyH β and Geneva Photometry

For stars with $-0.015 \leq E(b-y) \leq +0.015$, we have compared the values, in each photometric system, the value of $E(b-y)$ was taken as 0.0. The T_{eff} determined by the calibration of MD is systematically higher than that from the Geneva photometry. The mean value of the difference is 70 K (rms=137 K). There is a systematic effect on $\log g$ in the sense that for $\log g \leq 3.9$ the value com-

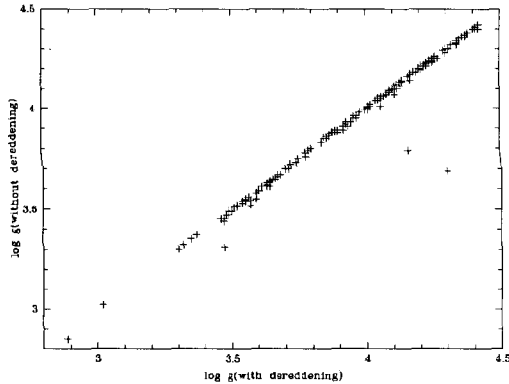


Figure 2. The relation between $\log g$ computed with a correction of the color excess and without correction.

puted from Geneva photometry is higher than that from MD and it is the reverse for $3.9 \leq \log g$; all these differences are within 0.2 in $\log g$.

6. The HR diagramme

We found that even with a carefully selected sample from the BS Catalogue, we may still discover peculiar stars using spectroscopic data. To plot the HR diagramme for A0V stars we restricted our sample to all the stars for which we had obtained spectra at resolution of 28 000 with the Echelec spectrograph at the ESO 1.52m telescope. Among the 70 stars so far observed, 50 remain with a "normal" spectrum that is, with no obvious duplicity or any kind of peculiarity.

Fig.3 shows the HR diagramme : in abscissa is plotted T_{eff} derived from the uvbyH β system, and M_V is from the HIPPARCOS parallax data. The error on M_V for all these stars is less than 0.3 mag.

The evolutionary tracks of Claret and Giménez (1992) are overlapped in Fig.3.

On this diagramme we note the spread of the points over a large range of M_V which points out the difficulty to assign a luminosity class in this range of T_{eff} for dwarf stars.

According to the accuracy of T_{eff} and M_V for this sample we note that it is possible to give a reliable age for field stars; stars as young as 7.5 in log(years) are present in the solar neighbourhood.

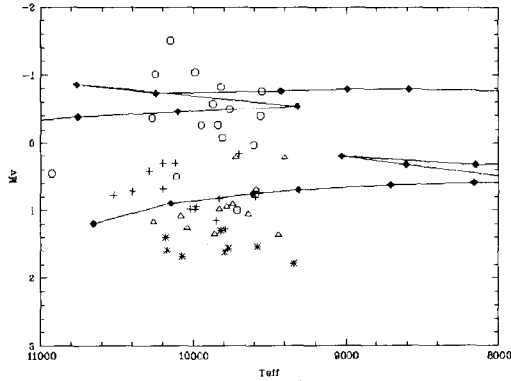


Figure 3. The HR diagramme; the upper evolutionary track is for $3.16 M_{\odot}$, the lower for $2.51 M_{\odot}$. The various symbols correspond to the following values of the gravity : hexagon : $3.3 < \log g \leq 3.8$; cross : $3.8 < \log g \leq 4.15$; triangle : $4.15 < \log g \leq 4.3$; star : $4.3 < \log g \leq 4.5$.

To conclude we put the emphasis on the number of binary stars that we found in this sample from our spectroscopic survey, the two members having similar spectral types. This binarity, when non detected produces a color excess which can be interpreted as a reddening and so is hampering the determination of T_{eff} from any photometric calibration.

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