A PARAMETRIC APPROACH TO THE SLOPE OF THE GLOBULAR CLUSTERS GIANT BRANCHES

VITTORIO CASTELLANI and DANIELE PALMA
Laboratorio di Astrofisica Spaziale, Frascati, Italy

(Received 18 June, 1976)

Abstract. A new parameter is introduced to measure the slope of the red giant branches. It is shown that an adequate description of the shape of the observed branches requires a bi-parametric approach; this procedure allows us to keep track of the slope variation along the branches.

1. Introduction

The location in the H-R diagram of globular cluster red giants has been recognized early as a useful tool for classification of the observed evolutionary differences among the Population II objects. For this purpose Sandage and Wallerstein (1960) introduced the parameter $A_V$ - i.e., the luminosity above the horizontal branch of the red giants at $(B-V)_0=1.4$. Hartwick (1968) called attention to the fact that $A_V$ is, in principle, dependent upon both the colour of the giant branch at the HB luminosity - the so-called $(B-V)_0.5$, defined by Sandage and Smith (1966) - and upon the slope of the red giant branch up towards larger luminosities. In this context he suggested measurement of this last quantity by means of the reddening-free parameter $S=2.5/A(B-V)_{2.5}$. In this formula $A(B-V)_{2.5}$ is the difference in colour along the red giant branch between stars 2m5, above, and at HB luminosity.

Such a parameter has become increasingly popular, supporting a large amount of elaboration and comparison with the observations. Nevertheless, we became increasingly aware that the indeterminacy on the $S$-value can hardly be believed to be generally kept down to $AS\approx \pm 0.3$, as initially suggested by Hartwick for sufficiently well-observed clusters. A search among the data given in the literature allowed us to assemble a fairly large number of cases in which the difference in the value of $S$ is not supported by consistent differences in the H-R diagram. As an example we show in Figure 1 that the available cluster loci for M10 and M2 can overlap, even though quite different evaluations of $S$ exist (5.0 and 6.8, respectively; Hartwick, 1968).

Let us add that Hartwick's definition of $S$ in a few cases (as in the metal-rich clusters NGC 5927 and NGC 6352) is made inapplicable by the absence of giants 2m5 above the HB.

2. A New Slope-Indicator Parameter

Such being the case, we wish to investigate a possible substitution of $S$ with another
reddening-free parameter 'slope indicator'. As a matter of fact, we found that the slope of the giant branch above the HB luminosities can be well defined if we assume the colour, rather than the luminosity, as the independent variable. Owing to the decreased slope of the giant branch at the higher luminosities, we hope in this way to reduce the errors connected with the indeterminacy in the HB luminosity.

We define a 'slope indicator' $\delta_{(B-V)}$ as the increase in luminosity along the giant branch following an increase in colour $\Delta(B-V)$ with respect to the RG at the HB-luminosity level. The larger the assumed value of $\Delta(B-V)$, the larger becomes the sensitivity of $\delta$; but also the larger the number of clusters that do not reach the required range in colour.

By the inspection of available H-R diagrams we suggest the parameter $\delta_{0.6}$ as a best guess for approaching a parametrical evaluation of the slope of the giant branch.