DDO PHOTOMETRY AND METALLIC ABUNDANCES OF E AND SO GALAXIES AND GLOBULAR CLUSTERS OF THE LMC AND SMC

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Abstract. Metallicity of 8 E and SO galaxies as well as that of red globulars of the LMC and SMC were obtained by means of DDO integrated photometry calibrated with galactic globular clusters (Bica and Pastoriza, 1983; hereafter referred to as Paper I). A correction was obtained in order to reduce the colors of the galaxies to zero redshift. The relation metallicity vs $M_r$ for the galaxies is analyzed (adding to our sample the observations of McClure and Van den Bergh, 1968; and Faber, 1973a). For the Magellanic Clouds we found metallicity ranging from intermediate to poor.

1. Introduction

Although the reddening free $C(42-45)$ index for late type stars is particularly sensitive to temperature (McClure and Van den Bergh, 1968; McClure, 1979), it is highly correlated with metallicity in measures of the integrated light of globular clusters (McClure and Van den Bergh, 1968, Figures 10 and 11). This evidence was used in Paper I to derive a calibration of the index corrected of reddening $C(42-45)_0$ vs $[\text{Fe}/\text{H}]$ based on three linear regression of $C(42-45)_0$ against Butler's (1975; and references in Paper I) $[\text{Fe}/\text{H}]_{\lambda_{\text{dr}}}$, Janes's (1979) $[\text{Fe}/\text{H}]_{\text{DDO}}$ and Searle and Zinn's (1978) $[\text{Fe}/\text{H}]_{<s>}$ with 16, 17, and 16 clusters respectively. The resulting calibration is given by

$$[\text{Fe}/\text{H}] = 6.73 \, C(42-45)_0 - 5.19,$$

which is applied in this paper to E and SO galaxies and red globular clusters of the LMC and SMC.

2. The Observations

Integrated light photometry of 11 LMC and 3 SMC red globular clusters and 8 E and SO galaxies was carried out with a photon counter device equipped with and EMI 9658 RAM photomultiplier attached to a 50 cm $f/13$ Cassegrain reflector. The observations were made in the $B, V, 41, 42, 45$, and 48 bandpasses of the $UBV$ and DDO systems respectively. Each night the observations for an object were made in the order $O-B-O-B-O$ ($O$ = object, $B$ = sky background). $UBV$–DDO standard stars from the list of McClure (1976) and mean extinction coefficients were used in the reductions. A field star superimposed to NGC 1786 was discounted by observing it with a 5"

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diaphragm. The obtained data are quoted in Table I. We give by columns: (1) the NGC or IC number; (2) the $V$ apparent magnitude; (3), (4), (5), and (6) the ($B - V$) and DDO colors, respectively; (7) 48 apparent magnitude; (8) the diameter of the diaphragm in arc min; (9) number of nights. The standard errors of the observations are given below each value of magnitude and color in Table I.

3. Color Corrections

3.1. Reddening in the LMC and SMC

In this paper we adopt $E(B - V) = 0.06$ magn for the LMC and $E(B - V) = 0.03$ magn for the SMC (Mould and Aaronson, 1980).

3.2. Reddening for the Galaxies

The ($B - V$) color was corrected according to de Vaucouleurs and de Vaucouleurs (1964) and the $V$ magnitude through the normal reddening law $A_V = 3E(B - V)$. The reddening for the DDO system was obtained with the cosecant law $E(B - V) = 0.06 \csc b$, and the relations (McClure, 1979)

$$E(41 - 42) = 0.07E(B - V)$$

$$E(42 - 45) = 0.23E(B - V)$$

$$E(45 - 48) = 0.31E(B - V)$$

The magnitude 48 was corrected using the reddening law of Whitford (1958) resulting $A_{48} = 1.15A_V$.

Special attention deserves the redshift influence on the intermediate and narrow passband filters. Faber (1973a) took into account this effect by observing 4 galaxies with velocities around 1500 km s$^{-1}$ through unredshifted and redshifted filters, correcting the colors of a redshifted galaxy under the assumption that the correction required is a linear function of the velocity of the Galaxy. In our case we have proceeded in the following way:

(a) We choose 2 DDO standard stars with a wide difference between their colors and a Galaxy, which we have observed in the DDO system. Those objects are respectively $\epsilon$ Tau, HD4098, and NGC7213. Spectrophotometry scans for the stars are available from Pritchet and Van den Bergh (1977) and for NGC7213 from Philips (1979).

(b) Instrumental magnitudes were obtained for the 3 objects by calculating

$$m_F = -2.5 \log \int_0^{\infty} T_F(\lambda) Q(\lambda) f(\lambda) \, d\lambda,$$

where $f(\lambda)$ is the flux from the object; $Q(\lambda)$ the quantum efficiency of the photomultiplier; $T_F(\lambda)$ the transmission curve of the filter; $F = 41$, 42, 45, and 48, respectively.

(c) Transformation coefficients from the instrumental colors to the standard ones were obtained from (a) and (b).