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A NOTE ON THE MAGELLANIC CLOUDS

Eugenio E. Mendoza V.

SUMARIO

Hemos obtenido para treinta y seis estrellas pertenecientes a una de las dos Nubes de Magallanes, fotometría de banda angosta. Las observaciones se han calibrado con ayuda de las supergigantes galácticas para determinar las distancias de las dos Nubes. Los resultados para La Nube Mayor son excelentes. No así para La Nube Menor. Esto último se puede deber a posibles diferencias de evolución y/o composición química atmosférica entre las estrellas de nuestra Galaxia, las estrellas de la Nube Mayor de Magallanes y las de la Nube Menor.

The discovery by Thackeray and Wesselink (1953, 1955) of a small number of RR Lyrae variables near m = 19 in NGC 121 in the Small Magellanic Cloud and in NGC 1466 and NGC 1978 in the Large Magellanic Cloud has permitted to obtain perhaps the best value of the Clouds' distance moduli, namely, 18^m7 for the Large Cloud and 19^m0 for the Small Cloud; both values are corrected for interstellar extinction.

Borgman and Blaauw (1964) have derived, from intermediate-band photometry, reddening-free classification parameters to compute absolute magnitudes, intrinsic colors and distance moduli for a number of stars in different stellar aggregates of the Galaxy. A similar system to that employed by Borgman and Blaauw (1964) is the (33, 35, 37, 40, 45 ,52, 58, 63)-photometric system defined by Johnson, Mitchell, and Latham (1967).

This note shows the intermediate-band photometry of 36 objects that belong to either one or another of the two Magellanic Clouds, obtained with the 36-inch telescope of the Cerro Tololo Inter-American Observatory* in November 1968, in the (33, 35, 37, 40, 45, 52, 58)-system. The results of these observations are given in Table 1. The columns of this Table contain, first, the Radcliffe serial number, R (Feast, Thackeray, and Wesselink, 1960); second, the spectral type given by Feast *et al* (1969); third, the 52-magnitude; fourth through last, the color-indices (33–35), (35–37), (37–40), (40–45), (45–52), and (52–58), respectively. The stars were observed on one or two different nights. The probable error of a single observation at 1.0 air mass is approximately 0.015 mag. for the magnitude and colors listed in Table 1.

In order to use Borgman and Blaauw's (1964) β and δ parameters, our data must be changed into Borgman's system (1960, 1961). Eighteen galactic supergiants, between O 9.5 and B9, observed on both Johnson *et al,* and Borgman and Blaauw's photometric systems can be used for this transformation. The resulting equations are:

$$\begin{aligned} N-M &= 0.72\ (40-45) + 0.172 \\ \beta &= 1.20\ (37-40) - 0.50\ (40-45) + 0.695 \\ \delta &= 2.15\ (33-35) - 0.73\ (40-45) + 0.205 \end{aligned}$$

Borgman and Blaauw's calibrated β,δ-diagram (1964, Fig. 8) can also be used to investigate the absolute magnitudes of the stars listed in Table 1. When we do that we notice that many stars belonging to the Magellanic Clouds are more luminous than the most luminous supergiant stars in the Galaxy studied by Borgman and Blaauw (1964). The stars contained in Table 1, that belong to the Large Cloud, lie above the line $M_V = -7$ on the β,δ-diagram. Unfortunately, this region is not calibrated. However, since the scatter of these stars in this diagram is not large, we may assume, for the sake of simplicity, that all of them have a constant luminosity, larger than $M_V = -7$. If for instance, we put $M_V = -8$, we obtain for the Large Magellanic Cloud a distance modulus, corrected for interstellar extinction, equal to $18^m9 \pm 0^m2$, which is in perfect agreement with other determinations (Bok, 1966). This value has been obtained under the assumption that the ratio between total absorption and color-excess, A_V/E_{N-M}, is equal to 8.4, valid for h and χ Persei (Borgman and Blaauw, 1964). The V-magnitude was obtained from the equation:

$$V = (52) - 0.0059 - 0.5362\ (52-58)$$

(Johnson *et al,* 1967). The intrinsic color $(N-M)_o$ from the β,δ-diagram. Because the stars given in Table 1 have only a small reddening, the precise knowledge of the ratio A_V/E_{N-M} is not very important.

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TABLE 1

Observational data

Small and Large Magellanic Cloud Stars

R	*Sp.*	*52*	*33-35*	*35-37*	*37-40*	*40-45*	*45-52*	*52-58*
5	B3 I	11.01	−0.07	−0.36	−0.61	−0.12	0.04	0.03
6	B6 I	11.06	−0.01	−0.33	−0.56	−0.01	0.09	0.07
8	A0 Ia:	11.24	0.01	−0.48	−0.77	−0.05	0.09	0.04
9	B3 Ia:	11.12	−0.12	−0.55	−0.66	−0.13	0.02	0.01
10	A0 Ia:	10.97	0.10	0.25	−0.39	0.04	0.14	0.09
11	B6 Ia	10.81	−0.02	−0.37	−0.58	−0.03	0.28	0.05
16	B	12.54	−0.03	−0.05	−0.45	−0.03	0.06	0.10
18	B0.5 I	12.07	−0.12	−0.58	−0.60	−0.17	−0.01	0.04
19	A3 Ia	11.62	0.15	0.64	−0.18	0.03	0.11	0.08
21	A0 Ia:	11.42	−0.01	−0.02	−0.48	−0.05	0.05	0.04
22	A3 I	12.33	0.14	0.59	0.02	0.03	0.10	0.03
23	A1 I	12.11	−0.05	−0.24	−0.39	−0.09	0.07	−0.09
24	A0:	12.55	0.32	0.43	−0.26	−0.19	0.14	−0.03
25	B1:	12.81	−0.18	−0.46	−0.61	−0.22	0.02	−0.19
27	B9 Ia	10.90	0.00	0.05	−0.50	−0.05	0.08	0.06
28	B0 I	13.94	−0.17	−0.61	−0.67	−0.20	−0.27	0.20
31	0: f:	12.28	−0.28	−0.14	−0.78	−0.10	−0.10	−0.07
32	B	12.72	−0.18	−0.34	−0.62	−0.09	−0.01	0.01
33	B	12.67	−0.11	−0.56	−0.62	−0.15	0.02	−0.03
35*	B1 I:	12.59	−0.09	−0.27	−0.51	−0.12	−0.03	−0.03
36	B3 I	11.34	−0.05	−0.41	−0.62	−0.09	0.02	−0.01
37	B6 I	11.28	−0.05	−0.25	−0.58	−0.04	0.06	0.04
42	B2.5 I	11.04	−0.19	−0.40	−0.66	−0.13	0.00	−0.01
51	B1.5 Ia:	11.37	−0.05	−0.51	−0.64	−0.06	0.09	0.06
52	B8 I	10.56	−0.01	−0.27	−0.54	0.00	0.11	0.10
53	B0 Ia	11.36	−0.14	−0.58	−0.67	−0.17	−0.03	−0.04
56	B2 Ia	11.67	−0.09	−0.50	−0.62	−0.19	0.01	−0.04
57	B3 I	10.83	−0.07	−0.45	−0.64	−0.11	−0.01	0.00
58	B5 I	11.08	−0.06	−0.08	−0.56	−0.08	0.11	0.07
61	A0 Ia	10.85	−0.03	−0.21	−0.54	−0.06	0.04	0.01
68	B8 I	11.02	−0.02	−0.23	−0.54	−0.07	0.03	0.00
70	B3 I	11.21	−0.08	−0.39	−0.58	−0.14	0.04	−0.01
72	A0 Ia	11.72	−0.06	−0.42	−0.60	−0.12	0.03	0.01
73	B8 Ia	10.62	−0.07	−0.33	−0.60	−0.09	0.05	0.03
75	A0 Ia	10.40	0.03	−0.16	−0.54	−0.03	0.10	0.07
79	B5 I	12.08	−0.10	−0.40	−0.57	−0.09	0.01	0.06

* A faint companion included in the diaphragm.

A few of the stars that belong to the Small Cloud fall in the calibrated region of the β,δ-diagram, the remaining lie above the line $M_V = -7$. If we use the stars that are above and below this line or either one of these groups, we obtain the same puzzling result, namely, that the distance modulus of the Small Magellanic Cloud is smaller than the distance modulus of the Large Magellanic Cloud. The difference could be as much as 0.5 mag.

It is known that the parameters to determine photometric distances can be affected by age effects and/or atmospheric chemical composition (see, for instance, Mendoza 1967). Perhaps these results indicate that there exist differences in evolution, atmospheric chemical composition and/or age between the Large Cloud, the Small Cloud and the Galaxy.

More observations are needed, in order to confirm or reject the above provisional results.

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