

Dating Star Clusters in the Small Magellanic Cloud

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Abstract. We have mainly estimated ages and foreground interstellar reddening values for 15 SMC concentrated star clusters, from integrated spectra in the range (3600-6800) Å. Most of the sample are young blue objects (6-60 Myr), while L 28, NGC 643 and L 114 are found to be intermediate-age clusters (1-6 Gyr). The present data also constitute a spectral library at the metallicity level of SMC clusters.

1. Introduction

This work is part of an ongoing long-term program which consists in obtaining and analyzing a large sample of CCD integrated spectra of SMC concentrated star clusters in view of: (i) studying the properties of such metal deficient clusters, especially the young and intermediate-age ones; and (ii) making them available as template spectra for studies of star clusters in more distant dwarf galaxies.

2. Cluster Sample and Observations

We present flux-calibrated integrated spectra for 15 SMC clusters, about half of them unstudied objects. The sample includes clusters in the surroundings and main body of the SMC. For comparison purposes, we also provide the spectrum of NGC 416, a well known SMC intermediate-age cluster (Mighell et al. 1998). The observations were carried out with the 2.15 m telescope at the Complejo Astronómico El Leoncito (CASLEO, San Juan, Argentina). The spectral coverage was (3600-6800) Å, with an average dispersion of ≈ 140 Å/mm (3.46 Å/pix). The slit width was $4''.2$, resulting in a resolution of ≈ 14 Å.

3. Cluster Fundamental Parameters

A direct reddening-independent age estimate was first obtained from equivalent widths of the Balmer absorption lines in each spectrum by interpolating these values in the calibration of Bica & Alloin (1986b, hereafter BA86b). In the

present study, we adopted $\tau = 12$ Gyr for globular cluster ages. Then, we selected an appropriate set of template spectra according to the age provided by the Balmer lines and varied reddening and template to get the best match of continuum, and Balmer and metal lines of the observed spectrum to that of the template that most resembles it. As examples, we show in Figures 1 and 2 comparisons of the observed spectra of HW 73 and L 28 with the templates that best match them.

The spectrum of L 48 is bluer than the template corresponding to its Balmer age, probably due to the fact that this cluster suffers from atypically low internal reddening. Contrary to what happens with the younger star clusters, wherein the upper main sequence dominates their visible spectra, the intermediate-age clusters (IACs) are known to share similar spectral properties with metal-poor globular clusters, especially in the blue-violet region (e.g. Bica & Alloin 1986a; BA86b). Since the SMC is metal deficient, this similarity is further enhanced because of the weaker metal lines and overall blanketing. This is the case for L 114, whose spectral features are comparable to those of the G5 globular cluster template but its Balmer lines indicate a much younger age. The best match is found for the NGC 416 template (5.6 Gyr; Mighell et al. 1998). The resulting ages (in Myr) and foreground reddening values for the cluster sample are shown in Table 1. The present data constitute a spectral library at the metallicity level of SMC clusters.

We found that most of the sample are young blue clusters with ages ranging between 6 and 60 Myr, while three objects (L 28, NGC 643 and L 114) are found to be IACs. Previous age determinations for 8 clusters by Pietrzyński & Udalski (1999) using OGLE database and Padova isochrones, agree with the present ones within a factor two.

Table 1. Reddening and age determinations

Cluster	E(B-V)	Balmer Age	Template Age	Adopted age
HW 73	0.07±0.01	60	60	60 ± 5
IC 1624	0.03±0.02	40	45	45 ± 5
L 114	0.00±0.02	4500	5600	5500 ± 500
L 28	0.03±0.02	1200	1000	1000±200
L 48	-	40	-	40 ± 10
L 56	0.05±0.02	20	15	15 ± 5
NGC 121	0.02±0.02	12000	12000	12000 ± 1000
NGC 241	0.03±0.02	45	35	35 ± 10
NGC 242	0.00±0.02	< 10	8	8 ± 5
NGC 256	0.15±0.02	50	45	45 ± 5
NGC 265	0.10±0.01	20	45	40 ± 20
NGC 290	0.04±0.02	40	40	40 ± 5
NGC 306	0.12±0.01	30	35	35 ± 5
NGC 643	0.08±0.02	2000	1000	1000±200
NGC 796	0.03±0.03	50	6	6±5

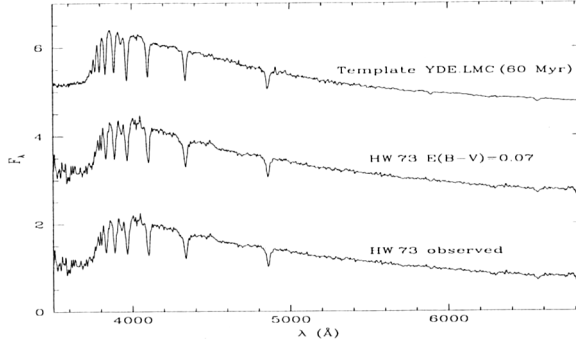


Figure 1. Observed integrated spectrum of HW 73, the reddening-corrected spectrum ($E(B-V)=0.07$), and the template which best matches it. Spectra are in relative flux units normalized at $\lambda = 5800\text{\AA}$.

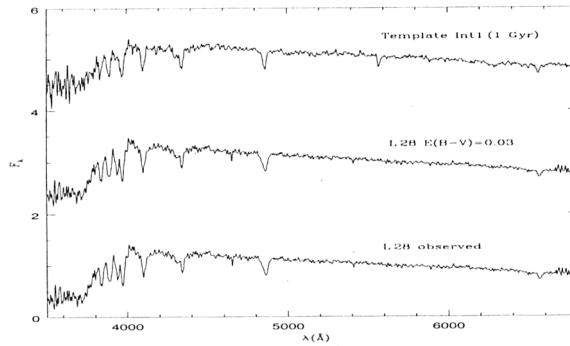


Figure 2. Comparison of the observed (bottom) and reddening-corrected spectra of L28 with the Int1 (LMC IACs around 1 Gyr) template. Units as in Figure 1.

References

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