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FUNDAMENTAL PROPERTIES OF BLUE COMPACT AND HIGH SURFACE BRIGHTNESS STAR CLUSTERS IN THE LARGE MAGELLANIC CLOUD

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RESUMEN

Usando espectros integrados, se determinan enrojecimientos y edades para una muestra de 29 cúmulos azules, compactos y de alto brillo superficial de la Nube Mayor de Magallanes (NMM). Los enrojecimientos fueron estimados a partir del método de ajuste de plantilla y usando mapas conocidos de extinción interestelar publicados para la región de los cúmulos, en tanto que las edades fueron derivadas a partir de los métodos de ajuste de plantilla y de los anchos equivalentes (AEs), respectivamente. En este último caso, usamos calibraciones empíricas en función de la edad/metalicidad, juntamente con diagramas de diagnóstico que involucran la suma de AEs de características espectrales seleccionadas. El rango de edades derivado oscila entre $\sim$ 5 y 800 millones de años. Se encuentra en general un buen acuerdo entre los resultados obtenidos a partir de los dos métodos. La presente muestra de cúmulos complementa otras muestras ya existentes en un intento por proporcionar una biblioteca espectral para la NMM con varios cúmulos por intervalo de edad.

ABSTRACT

Foreground reddening values and ages are determined from integrated spectra for a sample of 29 blue, compact and high surface brightness Large Magellanic Cloud (LMC) clusters. Cluster reddening values were estimated by using both the template matching method and interstellar extinction maps, while cluster ages were derived from template matching and equivalent width (EWs) methods, respectively. In the this case, empirical age/metallicity calibrations were used together with diagnostic diagrams involving the sum of EWs of selected spectral lines. The derived cluster ages range from $\sim$ 5 to 800 Myr. In general, a good agreement is found between the results obtained from the two methods. The present cluster sample complements previous ones in an attempt to provide a spectral library for the LMC with several clusters per age interval.

Key Words: galaxies: star clusters — Magellanic Clouds — techniques: spectroscopic

1. OBSERVATIONS

We present flux-calibrated integrated spectra for 29 LMC star clusters, most of them of type II (Table 1) in the sequence defined by Searle et al. (1980, hereafter SWB). The spectroscopic observations were carried out with the 2.15 m telescope at the Complejo Astronómico El Leoncito (CASLEO, San Juan, Argentina). The spectral coverage was $\approx$ 3600–6800 Å, with an average dispersion of $\sim$ 3.46/pixel. The slit width was 4.2″, resulting in a resolution of $\sim$ 14 Å. The reduction of the spectra was carried out with the IRAF package at the Observatorio Astronómico, Universidad Nacional de Córdoba, Argentina.

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2. RESULTS

Cluster ages were derived by two methods: the template matching and the EWs methods (see, e.g., Santos et al. 2006). In the latter case, diagnostic diagrams involving the sum of EWs of selected spectral lines denoted S_h and S_m were employed together with their calibrations with age and metallicity (Santos & Piatti 2004, hereafter SP). Then, the sum of EWs of the three metallic lines S_m (K CaII, G band and MgI), and of the three Balmer lines S_h (Hδ, Hγ and Hβ) were formed, which prove to be useful in the discrimination of old, intermediate-age and young system (SP). Foreground reddening $E(B-V)$ values were estimated from the template matching method and from Burstein & Heiles (1982, hereafter BH) interstellar extinction maps. The template matching method consists in achieving the best possible match between the analyzed cluster spectrum and a template spectrum of known age and metallicity. In this process we selected, from the available template spectra, the ones which minimize the flux residu-

TABLE 1

CLUSTER PARAMETERS

Cluster	SWB	$E(B-V)$ Template	$E(B-V)$ BH	Age (Balmer) Myr	Age (S_h,S_m) Myr	Age (template) Myr	Age (adopted) Myr
SL 14	II	0.18±0.02	0.08	≤ 10	8	10–20	10±5
NGC 1695	III	0.16±0.02	0.06	~ 50	70	50–110	70±10
SL 56	II	0.05±0.02	0.10	10–50	18	12–40	40±20
SL 58	III	0.13±0.03	0.10	~ 50	50	35–65; 50–110	60±10
SL 79	III	0.06±0.02	0.09	~ 100	115	100	100±10
SL 76	III	0.08±0.02	0.03	50–70	28	12–40; 60	50±30
NGC 1732	II	0.00±0.02	0.03	50	20	60	60±10
SL 116	II	0.00±0.02	0.02	50–100	34	35–65	60±20
SL 168	III	0.01±0.01	0.03	100	23	35–65	60±20
NGC 1822	II	0.05±0.02	0.05	50–100	-	100–150	125±25
HS 109	II	0.08±0.02	0.08	50–100	110	35–65	70±20
SL 234	II	0.00±0.00	0.06	10–50	24	3–6	15±10
SL 255	II	0.10±0.02	0.10	10–100	22	45–75	60±10
NGC 1887	II	0.05±0.02	0.04	50	18	45–75	70±20
SL 364	II	0.02±0.02	0.09	~ 50	19	40	40±10
SL 360	0	0.10±0.02	0.07	< 10	5	3–6	5±2
SL 386	II	0.17±0.02	0.03	30–50	16	60	70±20
NGC 1944	III	0.07±0.02	0.07	50–100	22	45–75	60±10
SL 463	II	0.00±0.03	0.06	10–50	22	35–65	65±10
SL 477	II	0.03±0.01	0.07	10–50	14	35–65	40±20
NGC 1972	II	0.00±0.02	0.07	30–50	20	70	60±10
NGC 2000	II	0.02±0.01	0.07	50–100	42	40	50±10
NGC 1986	II	0.10±0.01	0.07	30–50	23	45–75	50±10
SL 551	II	0.27±0.02	0.07	10–30	171	10–20	20±10
SL 566	III	0.15±0.02	0.09	10–50	22	45–75	50±10
NGC 2053	II	0.08±0.02	0.06	~ 50	21	50–110	70±30
SL 763	II	0.04±0.02	0.08	50–100	41	45–75	70±20
NGC 2137	II	0.05±0.02	0.07	1000	170	1000	800±200
NGC 2140	II	0.04±0.01	0.04	50–100	60	50–110; 12-40	60±20

als, calculated as the normalized difference (cluster-template)/cluster. The reddening corrections were performed using the Seaton's (1979) interstellar reddening law and adopting R$= A_v/E(B-V) = 3.0$. The results are shown in Table 1, whose columns are self-explanatory. Note that good agreement is found in general between ages derived from the two mentioned methods. The current cluster sample complements previous LMC ones, in attempt to provide a spectral library with several clusters per age interval.

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