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Calibrating Stellar Population Models in the Near-IR: Implications Due to the Presence of Carbon–Rich AGB Stars

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Abstract. We present our near-IR integrated spectral library of six globular clusters in the LMC and compare the data with existing stellar populations models. We find good agreement between models and data in the case of old, metal-poor clusters, while for intermediate-age and more metal-rich clusters we observe a deviation from the models. We find that this disagreement is due to the different CO absorption strengths of the carbon-rich Milky Way TP-AGB stars used in the models and the LMC carbon stars in our sample.

1. Motivation of the Project

Traditionally the fossil evidence of galaxy evolution in stellar populations is explored at optical wavelengths, using evolutionary population synthesis models to interpret the integrated light of galaxies. However, most optical spectral indicators are degenerate, i.e. influenced simultaneously by different population parameters (e.g. Worthey 1994), due to the fact that several important stellar evolutionary phases contribute almost equally to the optical light. The way ahead is the near-IR wavelength range, which recently became accessible to us and where the spectrophotometric signature of single stellar phases can be isolated. Theoretical studies give evidence that this spectral window can be used not only for interpreting the light of old systems, but also to trace recent star formation (Maraston 2005). Despite the fact that current models have their largest uncertainties precisely in the infrared portion of the spectrum, recent observational studies have started to show that some near-IR spectral features react to the presence of young (0.2 – 3 Gyr) stars (e.g. Silva et al. 2008), while others show predominantly a dependence on chemical composition (e.g. Mármol-Queraltó et al. 2008).

Using VLT/SINFONI, we observed six globular clusters in the Large Magellanic Cloud: NGC 1754, NGC 2005, and NGC 2019 ([Fe/H] ≈ -1.4, age > 10 Gyr); and NGC 1806, NGC 2162, and NGC 2173 ([Fe/H] ≈ -0.4, age 1 – 2 Gyr). We obtained integrated, luminosity-weighted spectra for the six clusters. Our data cover the central $24'' \times 24''$ of each cluster, plus additional spectra of AGB stars within the tidal radii of the clusters.

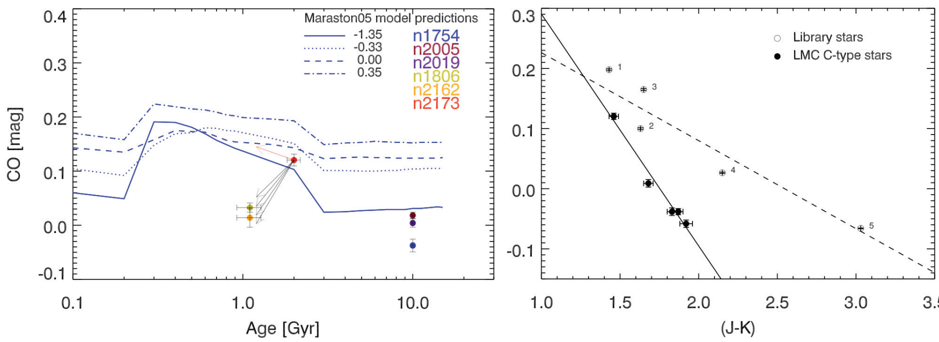

Figure 1. *Left*: Comparison of the SSP models of Maraston (2005) and our data. *Right*: CO line strength vs. *J–K* color for carbon-rich stars from the Lançon & Mouhcine (2002) library (*open symbols*) and the ones from our LMC sample.

2. Comparison with Stellar Population Models

In Figure 1, left panel, our old (> 10 Gyr) and metal-poor ([Fe/H] ≈ −1.4) clusters have CO index values consistent with the models of Maraston (2005). However, the agreement is not so good in the case of the intermediate-age (1 – 3 Gyr) and more metal-rich clusters ([Fe/H] ≈ −0.4). For clusters with ages ∼1 Gyr we observe the opposite: the CO strength is significantly weaker. At the same time, published data on the integrated colors of the clusters are consistent with these models. We explain these discrepancies as due to the different origin of the carbon-rich AGB stars used to calibrate the models and the ones in our data sample. The stars used for model calibration are Milky Way carbon stars (Lançon & Mouhcine 2002), while our carbon stars are from the LMC. We support this scenario with Fig. 1, right panel, where we show that carbon-rich stars in the Milky Way and LMC with similar *J–K* color have very different CO line strengths. A more detailed discussion is given in Lyubenova et al. (2010).

References

Lançon, A., & Mouhcine, M. 2002, A&A, 393, 167
Lyubenova, M., Kuntschner, H., Rejkuba, M., et al. 2010, A&A, 510, A19
Maraston, C. 2005, MNRAS, 362, 799
Mármol-Queraltó, E., Cardiel, N., Cenarro, A. J., et al. 2008, A&A, 489, 885
Silva, D. R., Kuntschner, H., & Lyubenova, M. 2008, ApJ, 674, 194
Worthey, G. 1994, ApJS, 95, 107