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Template Integrated Spectra of Star Clusters

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Abstract. We present a set of star cluster integrated spectra based on observations from the ultraviolet to the near-infrared. Mean template spectra were built following a ranking of clusters according to age and metallicity, which were taken from recent studies and put on consistent scales. The complete spectral database including *star clusters*, *galaxies* and *stars* (*templates* and *individuals*) is available through the CDS.

1. Introduction

The main intent of this work is to announce the availability of template and individual spectra of star clusters collected over the years at ESO, OHP, CFHT and CASLEO in the near-UV, optical and near-IR ranges, complemented by IUE observations (Bica & Alloin 1986; 1987a; Bica et al. 1990; Jablonka et al. 1992; Bica et al. 1994; Bonatto et al. 1995; Santos et al. 1995a). Although in the present work we discuss only the *globular cluster* spectra, the library also contains template and individual spectra of *open Galactic clusters*, *Magellanic Cloud clusters* and *M31 clusters*, as well as template and individual *galaxy* spectra (Bica & Alloin 1987a,b) and template and individual *star* spectra (Alloin & Bica 1989; Santos et al. 1995b). The library, which was submitted to the Centre de Données Astronomiques de Strasbourg (CDS), has been mainly used for studies of stellar populations in galaxies. The database contains spectra for 243 galaxies, 190 clusters and 72 stars, amounting to 868 energy distributions in the various spectral ranges. A discussion is presented on the rebuilding of template spectra based on a revised scale of age and metallicity of the Galactic globular clusters (GGCs). The template spectra are an average of object spectra with similar properties and were built using the same procedure as in the references mentioned above.

2. Galactic Globular Clusters: Age and Metallicity Scales

The [Fe/H] scale adopted is the one defined by Carretta & Gratton (1997, CG97). The metallicities are listed by Rutledge et al. (1997, R97). Cluster [Fe/H] only available in the Zinn & West (1984, ZW84) scale were transformed to the CG97 one by using the quadratic relation in CG97. The relative calibration of ages based on uniform VI CCD colour-magnitude diagrams, the CG97 [Fe/H] scale, and different sets of isochrones by Rosenberg et al. (1999, Ro99) have been employed together with the mean absolute age of 13.2 Gyr for the GGCs (Carreta et al. 2000). Since just 18 out of 58 clusters in our sample have ages in the Ro99 scale, we used the age-metallicity relation as given by them in order to get ages for the remaining 40 clusters. For the metal-rich clusters ($[\mathrm{Fe/H}]_{CG} > -0.7$) we assigned ages of 10.0 ± 2.0 Gyr. Fig. 1 is the resulting age-metallicity relation.

3. Templates of GGCs in the New Scale

We grouped GGCs in two bins of age, divided in two bins of HB morphological type, and by five bins of [Fe/H]. Compared to the original templates only 7 out of 40 globulars changed to an adjacent group. Since the original configuration of the groups is based on the same set of spectra averaged according to their spectral similarities and relative [Fe/H], we have basically reproduced the original templates. The GGCs spectral sequence in the optical is essentially determinated by [Fe/H], little sensitivity to HB morphology and insensitive to age (Fig. 2). In the UV, however, the HB morphology can be distinguishable in some cases (Bonatto et al. 1995).

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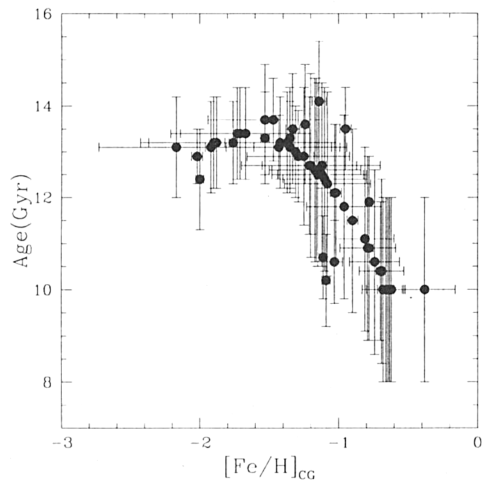

Figure 1. Age-metallicity relation for the GGCs sample according to calibrations by Carretta & Gratton (1997) and Rosenberg et al. (1999).

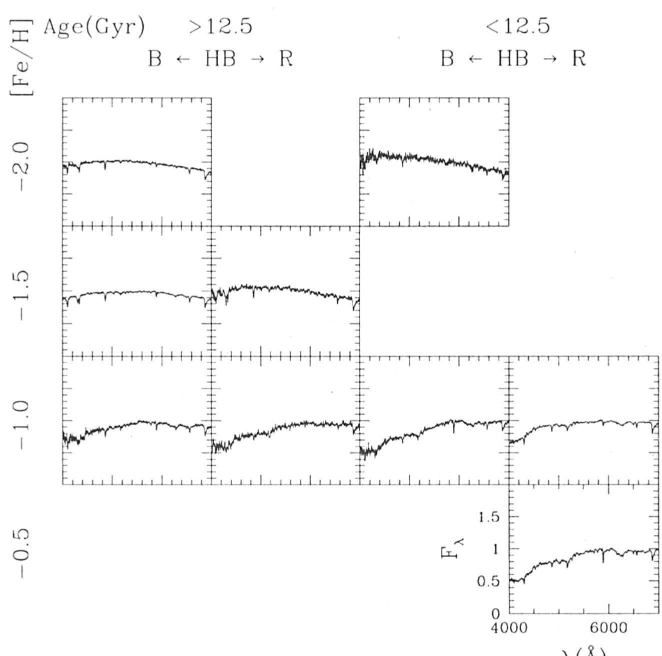

Figure 2. The optical integrated spectra of GGCs as a function of age, [Fe/H] and HB morphology.