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A NEW STELLAR LIBRARY IN THE K BAND

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Stellar population synthesis models are crucial for the understanding of the large amount of data which is being gathered for galaxies at low and high redshift, and provide the only way to compare the "real world" with the theoretical framework. The best models require extensive empirical stellar spectral libraries, which at present are starting to be quite complete in the optical range. However the situation is different in the near-infrared, which observational windows have been, until recently, poorly exploited. This is specially due to the lack of appropriate instrumentation. We present the preliminary results of an ongoing observational program aimed to overcome this problem and to provide a stellar library in the K band with the required coverage of physical stellar parameters: effective temperature, gravity, metallicity and non-solar abundance ratios. In particular, the CO feature at 2.3 μm is a very promising spectroscopic line-strength index that will help to face outstanding problems in galaxy formation and evolution. The availability of this library will be essential to interpret the stellar content of composite stellar populations with EMIR. In addition, this library will be also useful for other purposes, like the study of highly reddened objects, and the spectral classification of late type stars.

Previous work

Up to date, several authors have already compiled, for different purposes, small libraries in the K band (Johnson & Méndez 1970; Kleinman & Hall 1986; Lançon & Rocca-Volmerange 1992; Ali et al. 1995; Hanson et al. 1996; Wallace & Hinkle 1997). Due to the high S/N ratio of their spectra, it is interesting to highlight the library of Kleinman & Hall (1986), which contains 26 stars, with a spectral resolution R $\sim$ 3000, but with only solar abundances. Unfortunately, those libraries do not offer by far, sufficient variety of high quality spectra: there is no range in metallicity, and stars with non-solar abundance ratios are not included. Very recently, Ivanov et al. (2004) have just presented a larger library comprising the infrared spectra of 218 late type stars at R $\sim$ 2000–3000, spanning a range of [Fe/H] from -2.2 to $+0.3$. However these stars were not flux calibrated.

The sample

At present, our stellar library only comprises 97 stars observed with R $\sim$ 2500–3000, using Ω-CASS, the near-infrared spectrograph at the 3.5 m telescope in the Calar Alto Observatory (Almería, Spain). The stars have been selected to cover ample ranges in the stellar atmospheric parameters, namely $T_{\rm eff} \in [2500, 13400]$ K, $\log(g) \in [0.0, 5.3]$, and $[{\rm Fe/H}] \in [-2.6, +1.0]$.

The CO features

In Fig. 1 we show examples of typical spectra for similar stars but with different effective temperature, metallicity, and surface gravity. The CO absorptions (produced by roto-vibrational transitions) are the most conspicuous features in the K band. For illustration, in the same figure we indicate the bandpasses employed by Kleinman & Hall (1986) to measure the CO index at $\sim$ 2.29μm (one continuum bandpass at 2.2873–2.2925 μm, and the index bandpass at 2.2930–2.2983 μm). It is apparent from the figure the variation of the absorption strengths as a function of the atmospheric stellar parameters. Given the sensitivity of the CO features to those parameters, it is necessary to enlarge the present sample to obtain an appropriate coverage and sampling in $T_{\rm eff}$, [Fe/H] and $\log(g)$.

Incorporating the library into stellar population models

Evolutionary stellar population synthesis models would be able to incorporate the information con-

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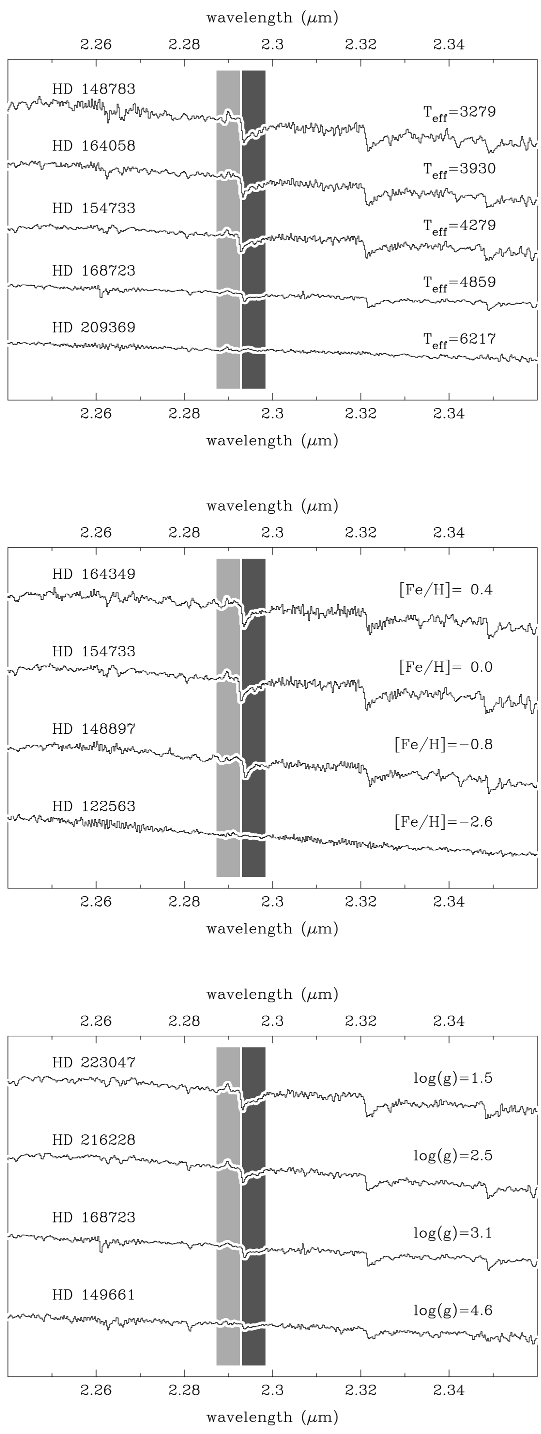

Fig. 1. Examples of typical spectra for similar stars with different $T_{\rm eff}$ (top panel), [Fe/H] (middle), and $\log(g)$ (bottom). The location of the bandpasses defining the CO index at $\sim 2.29\mu$m is shown with shaded regions. Two other CO features (at ~ 2.32 and $\sim 2.35\mu$m) are also clearly visible.

tained in this empirical stellar library in two different ways: either by computing the whole SED of the composite stellar population (preserving the spectral resolution of the input libraries; see e.g. Vazdekis et al. 2003), or by employing intermediate fitting functions of the spectroscopic features available in the considered wavelength range (e.g. Worthey 1994). The full K band library, as well as the fitting functions for the CO indices, will be provided in a forthcoming paper (Mármol-Queraltó et al. 2004).

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