Criteria for spectral classification of cool stars using high-resolution spectra

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We have compiled a large number of optical spectra of cool stars taken with different high-resolution echelle spectrographs ($R \simeq 40\,000$). Many of those are available as spectral libraries (Montes *et al.* 1997, 1998, 1999, <http://www.ucm.es/info/Astrof/invest/actividad/spectra.html>).

We intend to include all these spectra in the Virtual Observatory (VO) following the standards of the International Virtual Observatory Alliance (IVOA).

The many VO tools that are or will be ready for the astrophysical community will make easier the use of these spectra in many areas, such as the study of chromospheric activity, spectral classification, determination of atmospheric parameters (T_{eff}, $\log g$, [Fe/H]), modeling stellar atmospheres, spectral synthesis applied to composite systems, and spectral synthesis of stellar population of galaxies.

In this contribution, as an example of the potential use of these spectra, we describe different spectral classification criteria for the cool stars (F5 to M5) based on equivalent width and equivalent width ratios of several photospheric lines, which are sensitive to effective temperature and luminosity class. To calibrate these relationships we have used a large number of optical spectra of spectral type standard stars (Morgan and Keenan (MK) standards) taken with different echelle spectrographs of similar spectral resolution. In addition, we have tested the behaviour of the photospheric lines with temperature by using synthetic spectra of main sequence stars ($T_{eff} = 6500 - 3500\,K$) with solar abundance computed using the ATLAS9 code by Kurucz (Kurucz, 1993), adapted to work under linux platform by Sbordone *et al.* (2004) and Sbordone (2005).

We describe in detail the behaviour of the equivalent width of photospheric lines like Fe I $\lambda6430$, Ca I $\lambda6439$, and Ti I $\lambda5866$. Some equivalent width ratios as Fe I $\lambda6430$/Fe II $\lambda6432$, and Fe I $\lambda4071$/Sr II $\lambda4077$ and broad indices like MI6 $(\lambda5125–5245)/(\lambda5245–5290)$ are specially useful to determine effective temperature and discriminate between dwarf and giant stars.

The use of additional high-resolution spectra of MK standard stars throughout the VO will be very useful to improve these calibrations and obtain good criteria for spectral classification.