



VO-compliant libraries of high resolution spectra of cool stars



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ASTRONOMICAL SPECTROSCOPY & THE VIRTUAL OBSERVATORY

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Abstract

In this contribution we describe a Virtual Observatory (VO) compliant version of the libraries of high resolution spectra of cool stars described by Montes et al. 1997; 1998; and 1999. Since their publication the fully reduced spectra in FITS format have been available via ftp and in the World Wide Web: <http://www.ucm.es/info/Astrof/invest/actividad/spectra.html>. However, in the VO all the spectra will be accessible using a common web interface following the standards of the International Virtual Observatory Alliance (IVOA). These libraries include F, G, K and M field stars, from dwarfs to giants. The spectral coverage is from 3800 to 10000 Å, with spectral resolution ranging from 0.09 to 3.0 Å. These spectra include many of the spectral lines most widely used as optical and near-infrared indicators of chromospheric activity. The spectra have been obtained with the aim of providing a library of high and mid-resolution spectra to be used in the study of active chromosphere stars by applying a spectral subtraction technique. However, these spectra can also be utilized in a wide variety of ways ranging from radial velocity templates to study of variable stars and stellar population synthesis. These libraries can also be used for spectral classification purposes and determination of atmospheric parameters (T_{eff} , $\log g$, [Fe/H]).

Observations

For the spectra included in the three libraries see the references (Montes et al. 1997; 1998; 1999). For the new spectra taken from 1999 - 2006 we have used the following telescope/instrument configuration:

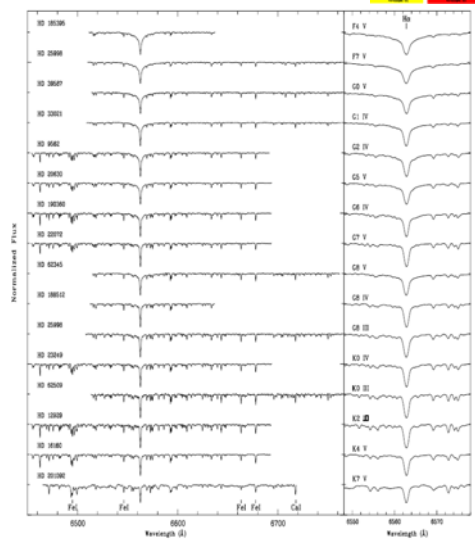
Telescope - spectrograph	Wavelength range	Spectral resolution
• 2.2m-FOCES Fibre Optics Cassegrain Echelle Spectrograph CAHA, (Almeria Spain)	3910 - 9075 Å	0.09 - 0.26 Å
• INT-MUSICOS 2.3 m Isaac Newton Telescope, ESA-MUSICOS spectrograph	4430 - 10225 Å	0.16 - 0.30 Å
• INT-IDS Intermediate Dispersion Spectrograph (La Palma, Spain)	3554 - 5176 Å	0.48 Å
• NOT-SOFIN 2.56 m Nordic Optical Telescope, Soviet Finnish High Resolution Echelle Spectrograph (La Palma, Spain)	3525 - 10425 Å	0.14 - 0.32 Å
• TNG-SARG 3.3 m Telescopio Nazionale Galileo, Spectrografo di Alta Risoluzione Galileo (La Palma, Spain)	4960 - 10110 Å	0.08 - 0.17 Å
• HET-HRS 9.2 m Hobby-Eberly Telescope, High Resolution Spectrograph (McDonald Observatory in Texas, USA)	5040 - 8775 Å	0.15 - 0.28 Å

Libraries of high and mid-resolution spectra of cool stars available in the WWW

<http://www.ucm.es/info/Astrof/invest/actividad/spectra.html>

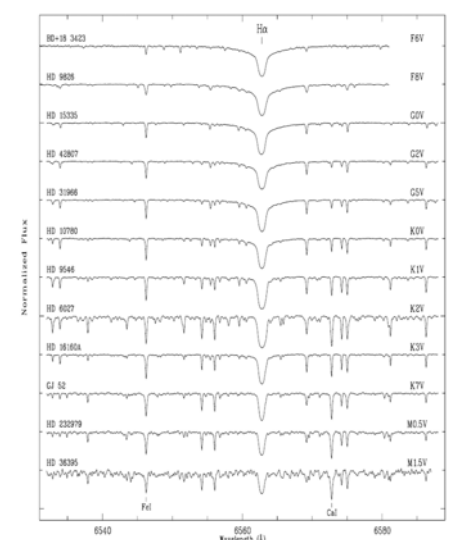
I. Library of high and mid-resolution spectra in the Ca II H & K, H β , and Na I D₁, D₂, and He I D₃ lines regions of F, G, K and M field stars.

(Montes et al. 1997, A&ASS, 123, 473)
intermediate resolution (0.2-3 Å)
Ca II H&K, H β , Na I D₁, D₂, & He I D₃, H α
170 spectra, 116 stars (V, IV, III)



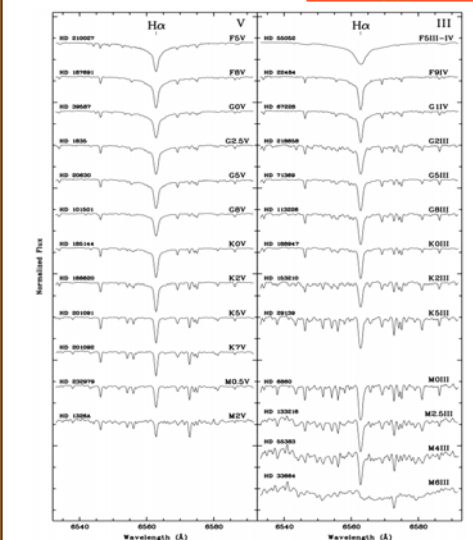
II. Library of high-resolution UES echelle spectra of F, G, K and M field dwarf stars.

(Montes & Martín 1998, A&ASS, 128, 485)
high resolution (0.09-0.19 Å)
echelle (4800 - 10600 Å)
105 spectra, 83 stars (V)



III. Library of medium-resolution Fiber Optic Echelle spectra of F, G, K and M field dwarfs to giants stars.

(Montes, Ramsey & Walty 1999, ApJS, 123, 283)
intermediate resolution (0.5 Å)
echelle (3900 - 9000 Å)
345 spectra, 130 stars (V, IV, III, II, I)



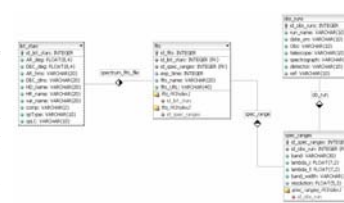
Additional spectra to be included:

In addition to the spectra of these libraries (Montes et al. 1997; 1998; 1999), during the last years (1999 - 2006), we have compiled a large number of optical spectra of cool stars taken with different high resolution echelle spectrographs as the FOCES spectrograph (2.2m telescope Calar Alto Obs.). The spectral range covers from Ca II H&K (3933, 3968 Å) to Ca II IRT (8498, 8542, 8662 Å). The spectral resolution varies from 0.08 to 0.35 Å. See the "Spectroscopic survey of cool stars members of young stellar kinematic groups" (Montes et al. 2001, López-Santiago 2005) (http://www.ucm.es/info/Astrof/invest/actividad/skg/skg_SS.html). These spectra will be available soon in the web and the VO.

Furthermore, other similar spectra taken (from 2005-2007) in the framework of the "Characterization of the cool stars in the solar neighborhood: Preparatory activities for the Darwin mission", (Montes D., Eiroa C., Montesinos B., Martínez-Arnáiz, R.M., Maldonado J., Ribas I., Solano E.) will be available soon throughout the VO-tool: DAMA (Darwin Madrid Archive), <http://sdc.laeff.inta.es/darwin> (Solano et al. 2007, TPF/Darwin workshop).

VO-compliant libraries

The UCM cool stars group in close collaboration with the staff of the Spanish Virtual Observatory (SVO) are working together in order to make available a VO-compliant version of this libraries of stellar spectra. A database with all the relevant information of the stars and the spectra has been developed. Now we are developing a web-based interface to access this data. In this way it will be possible to accessing, visualizing, filtering and retrieving all the relevant information of these spectra and generate the corresponding VOTables, using the SSAP, Simple Spectra Access Protocol. 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.



An application: Criteria for spectral classification of cool stars using high resolution spectra

As an example of the potential use of these spectra, we describe different spectral classification criteria based on equivalent width ratios of several photospheric lines, which are sensitive to effective temperature and luminosity class.

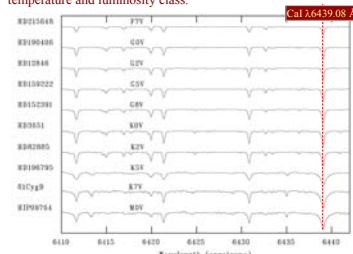


Fig.1 Representative spectra of Main Sequence stars (F7 - M0)

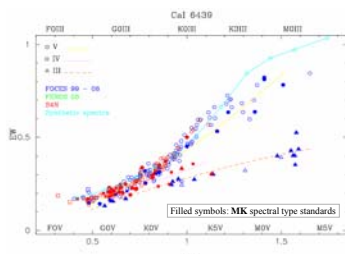


Fig. 5 Ca I 8439 EW versus color index (B-V)

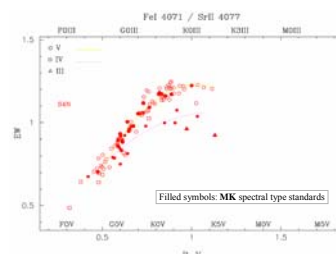


Fig. 10 Fe I 4071/Sr II 4077 EW ratios vs color index (B-V)

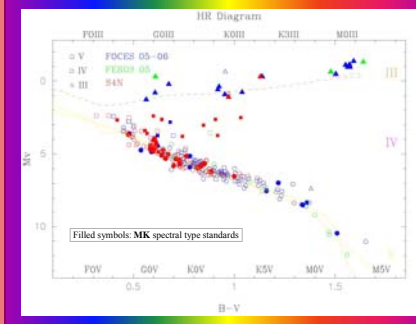


Fig. 6 HR Diagram, absolute magnitude (M_v) vs. the color index (B-V). Symbols are as in Figs. 4 & 5. As can be seen our sample covers the range of the cool stars from F0 to M4 and luminosity classes from main sequence (V) to giants (III).

The EW(Fe I 46439) (see Fig. 5) and the Fe I 4071/Sr II 4077 EW ratio (Fig. 10) can be used to distinguish Giant (triangles), Subgiant (squares) and Main Sequence (circles) stars. Filled symbols represent Morgan & Keenan (MK) standard stars. The tendency curves for each group of luminosity class, build up taken into account only the MK standards have been included in the plots.