Characterizing the CARMENES input catalogue of M dwarfs with low-resolution spectroscopy: metallicity

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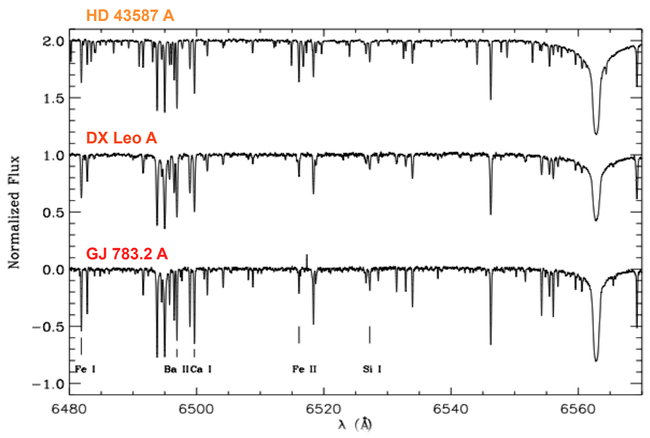
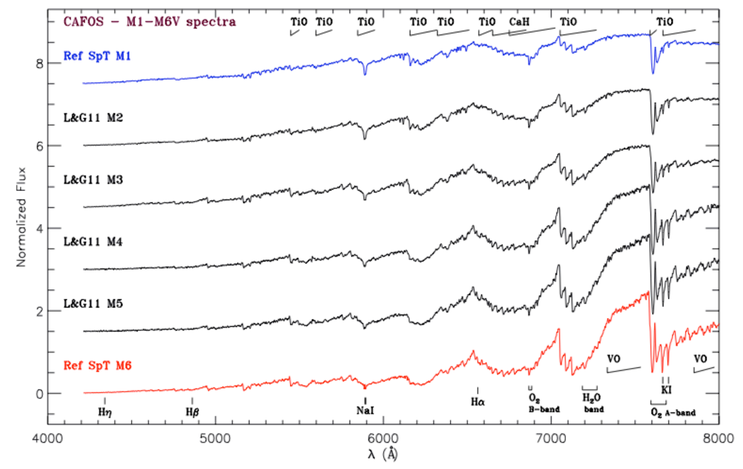
Abstract. In this contribution we summarise our science preparation activities to complete the CARMENES (http://carmenes.caha.es/) input catalogue of M dwarfs using low-resolution spectroscopy to derive spectral indices sensible to spectral type, gravity and metallicity as well as the level of chromospheric activity. We provide here all this information for 181 stars in addition to the 727 stars already published in Alonso-Floriano et al. (2015). We have developed a calibration of the M-dwarfs metallicity (Alonso-Floriano et al. 2016) using physical binaries composed of an F-, G- or K-dwarf primary and an M-dwarf secondary that allows us to provide the metallicity for all these M dwarfs.

M-dwarfs CAFOS low-res spectra were obtained at the 2.2-m Calar Alto Telescope (Almería, Spain) with the CAFOS spectrograph. The spectral resolution is 1500, the wavelength range covers from 4000 to 8000 Å and the S/N larger than 50 around the Hα line. A total of **908 late-K and M-stars** were observed: 727 already published by Alonso-Floriano et al. (2015) and 181 additional ones are included here.

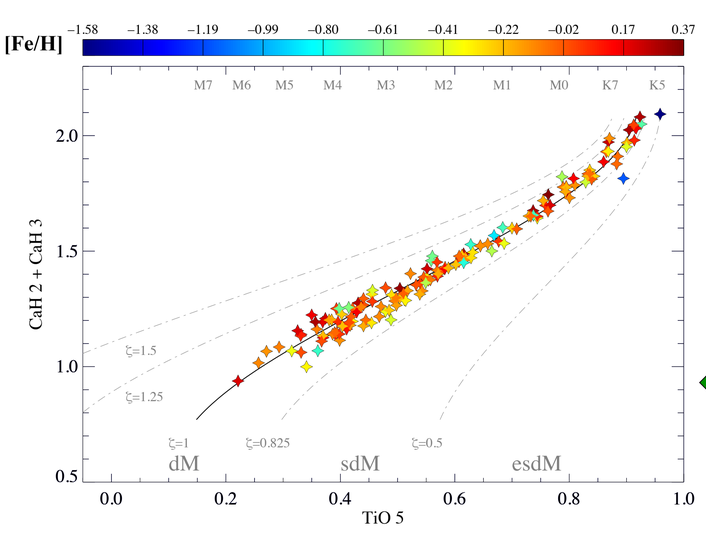


F-, G- or K-star HERMES high-res spectra were obtained at the 1.2-m Mercator Telescope in La Palma with the HERMES echelle spectrograph. The spectral resolution is 85000, and the wavelength coverage is from 3800 to 8750 Å. S/N range from 70 to 300. Stellar parameters (T_{eff}, log g, ξ and **[Fe/H]**) were determined using the code (*StePar*, Tabernero et al. 2012) with the EW method.



This sample includes 175 lateK/M-dwarfs members of wide physical binaries and multiple systems which primary component is an F-, G- or K-star that we use to calibrate the metallicity, **[Fe/H]**.

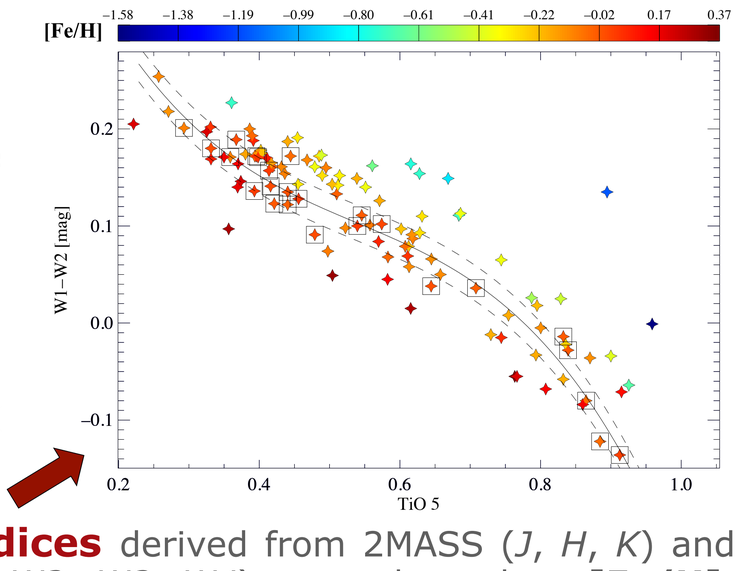
M-dwarf metallicity calibrations



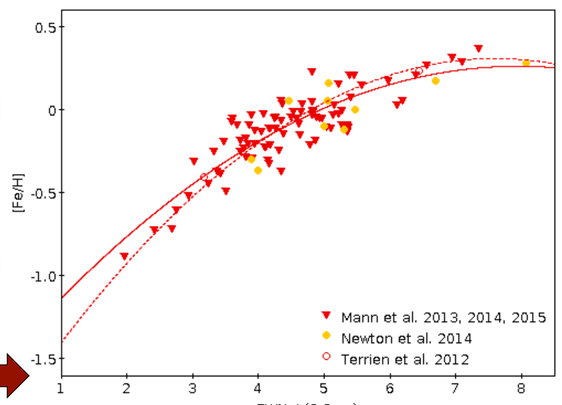
Spectral indices (TiO1-5 and CaH1-3, Reid et al. 1995) determined in our spectra of the M companions (Alonso-Floriano et al. 2015) allowed us to analyse in detail the metallicity-dependent relation between **TiO5** and **CaH2+CaH3** by means of the parameter $\zeta_{TiO5/CaH}$ defined by Lépine et al. (2007):

$\zeta_{TiO5/CaH} = [1\text{-TiO5}]/[1\text{-TiO5}_{\odot}]$

The dependence of $\zeta_{TiO5/CaH}$ on the metallicity (**[Fe/H]** derived by us with our high-res spectra of the FGK companions) is only clear for very low metal stars.

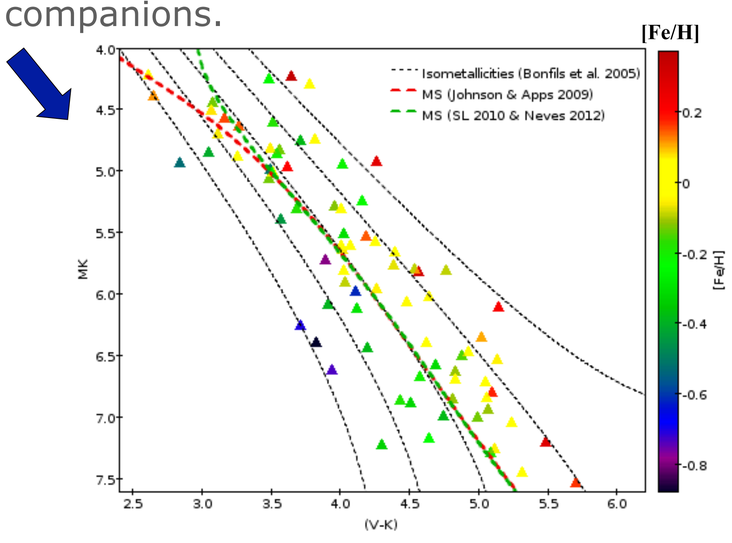


***EW*(NaI 2.2μm):** Spectral features in the IR K-band like the NaI line at **2.2μm** have an strong dependence on the metallicity (Rojas-Ayala et al. 2010, 2012; Terrien et al. 2012; Newton et al. 2014; Mann et al. 2012, 2013, 2015). We have taken the stars in common with these authors an use our uniform [Fe/H] determinations of the primaries to check this dependence. Dashed line (Newton et al. 2014), solid line (this work).

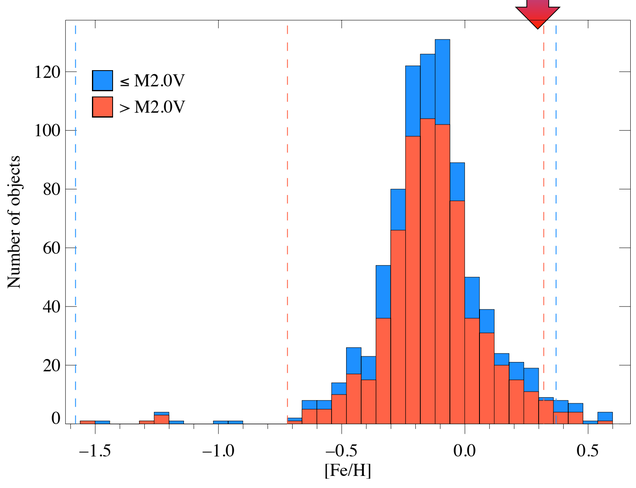


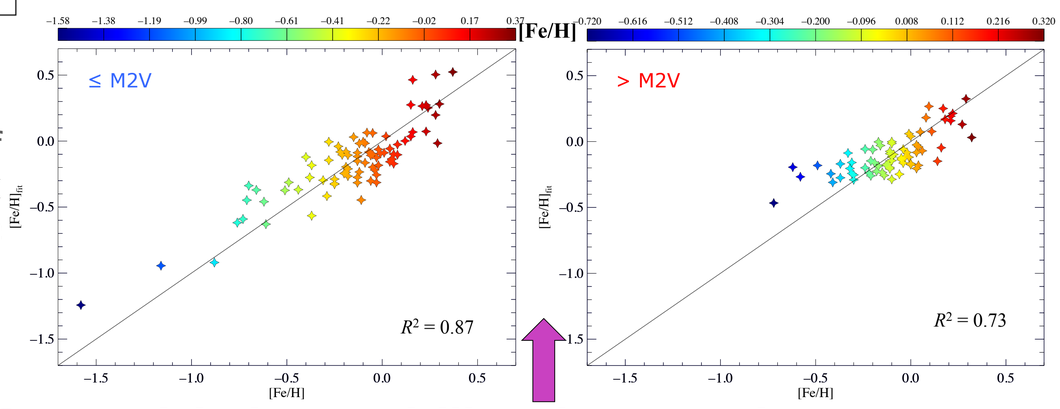
IR color indices derived from 2MASS (*J*, *H*, *K*) and AllWISE (*W1*, *W2*, *W3*, *W4*) mags depend on **[Fe/H].** The strongest dependence is observed in the ***W1-W2*** color vs **TiO5** spectral index diagram. Where Ti05 was derived from our low-res spectra of the M-companions as in Alonso-Floriano et al. (2015). The fit (solid line) in these figures was done using the stars with solar metallicity ([Fe/H]=0.0 ±2σ, marked with a box in the figures). Dashed lines are the 1σ around the fit.

Color-Magnitude Diagram (M_K vs V-K) adopting the distance and [Fe/H] of the FGK primary and a solar metallicity main sequence we calibrate **Δ(*V-K*)** vs **[Fe/H]** for the M-companions.



The histogram shows the **[Fe/H]** derived for our late-K/M-dwarf sample using our spectral index based calibration and the range of validity (dashed lines).





Spectral index multilineal regression. We studied combinations of several indices among the 38 indices derived by us (31 from Alonso-Floriano (2015) and 7 from Mann et al. (2015)) to obtain a multilineal regression to our [Fe/H] values. We found the most profitable regression using **10 indices** for SpT **≤ M2V** (TiO5; CaH2; VO; log(Color-M); VO-a; VO-b; Na-8190; F02; F05; F06) with R^2 = 0.87 and **> M2V** (CaH 2, I2, PC1, PC2, VO-7912, VO-7434, TiO-7140, VO-b, Na-8190, F03) with R^2 = 0.73.

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