MAIN SEQUENCE COMPANIONS TO WHITE DWARFS: THE AGE-METALLICITY RELATION

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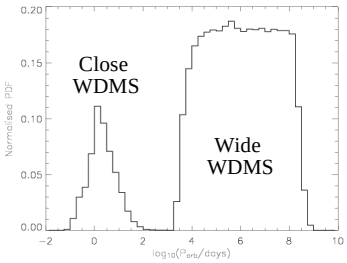
ABSTRACT

The age-metallicity relation is a fundamental observational tool for constraining the chemical evolution of the Galactic disc in time. In this work we analyse the observational properties of this relation using binary stars consisting of a main sequence star -from which we can derive the metallicity- and a white dwarf -from which we can derive the total age of the system. Our sample consists of 49 wide WDMS binaries, identified within the Sloan Digital Sky Survey, that evolved avoiding mass transfer episodes. The 49 objects were observed with the VLT/X-Shooter and GTC/Osiris+EMIR telescopes/instruments.

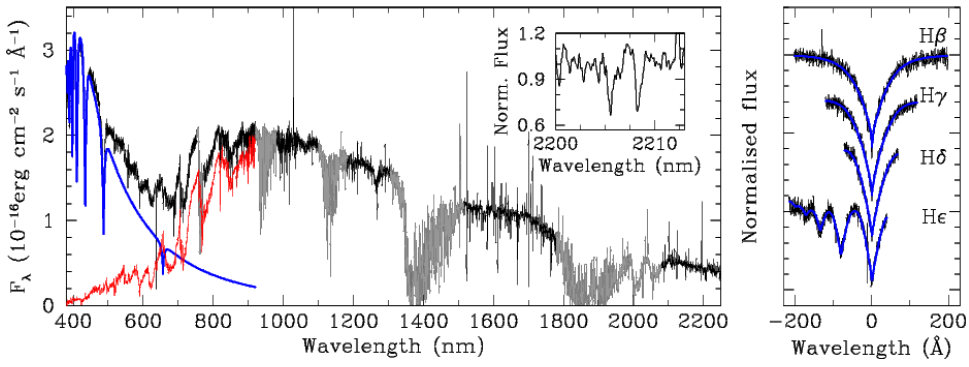


Simulated orbital period distribution of WDMS binaries (Willems & Kolb 2004).

AGES AND METALLICITIES

Ages: we first use the decomposition/fitting routine of Rebassa-Mansergas et al. (2007) to subtract the MS contribution from the optical spectra. We then fit the normalised spectral Balmer lines of the residual WD with the model grid of Koester (2010) to derive the WD Teff and log(g). We interpolate these values in the cooling sequences of Camisassa et al. (2016) to derive the WD masses and cooling ages. Adopting the initial-to-final mass relation of Miller Bertolami et al. (2016) we determine the WD progenitor masses. The WD progenitor lifetimes are obtained interpolating the WD progenitor masses in the BASTI isochrones adopting the metallicities derived from the MS companions. The WD cooling ages added to the MS progenitor lifetimes provide the total ages of the binaries.

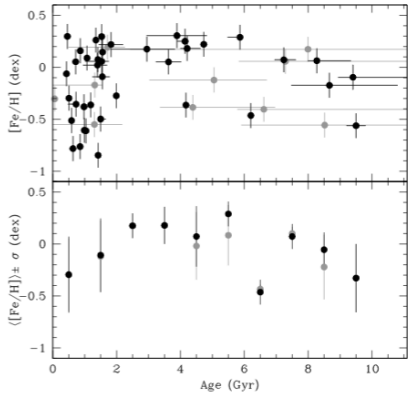
[Fe/H] abundances: we obtain the metallicities from the K-band, NIR spectra of the MS companions following the procedure described in Newton et al. (2014). This method provides [Fe/H] following a semi-empirical multivariate linear regression based solely on the Na I absorption doublet (2205/2209 nm) equivalent width.



RESULTS

The age-metallicity relation that results from our analysis of 49 SDSS WDMS binaries is shown in the top panel of the Figure to the right. The average [Fe/H] per 1 Gyr bin and the corresponding standard deviations are illustrated in the bottom panel. Our averaged age-metallicity relation fluctuates between -0.5 to +0.5 dex, but does not show any strong correlation.

The grey points indicate systems for which the ages have relative errors larger than 40%.



CONCLUSIONS

We find a large scatter of metallicities, i.e. [Fe/H] abundances, at all ages thus confirming the lack of correlation between age and metallicity in the solar neighbourhood also found in previous studies focused on analysing single main sequence stars. The most plausible explanation for this is radial migration (Feuillet et al. 2019).

REFERENCES

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