Identifying and characterising red dwarf stars of spectral classes M3 to M8 in the Sloan Digital Sky Survey Data Release 7

by - Martin Nicholson, Daventry, England

Abstract:
I present an astrometric, photometric and spectroscopic analysis of over 7000 red dwarf stars from the Sloan Digital Sky Survey (SDSS) Data Release 7 (DR7). The use of photometric analysis as a means of predicting the spectral class of a star is investigated.

Methodology:

The SDSS-DR5 low-mass star spectroscopic sample (West et al, 2008) contains spectroscopic and photometric data on 44084 M type and L type dwarf stars.

The catalogue can be accessed via the Vizier web site http://vizier.u-strasbg.fr/viz-bin/VizieR using the catalogue identifier J/AJ/135/785.

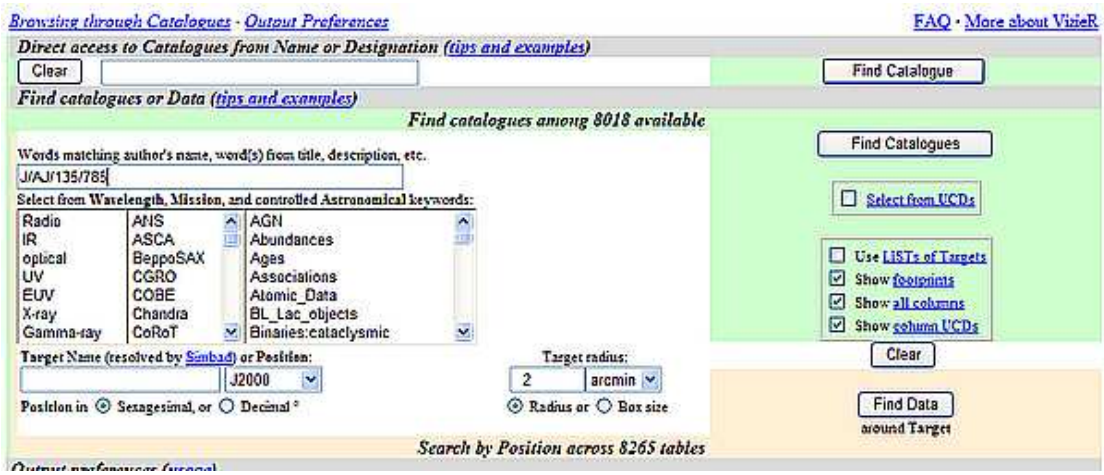


Figure 1 – Accessing the chosen catalogue

It is then possible to download a wide range of data including the spectral class of a star and the associated u, g, r, i and z band magnitudes. In the original study the spectral class of the star was determined using the HAMMER stellar spectral-typing facility using measurements of molecular bands and line strengths. Subsequent re-sampling by eye showed these results to be accurate to within 1 sub-type.

The number of stars for which spectral sky coverage is provided is greater for data release 7 (DR7) than that for data release 5 (DR5). It did not prove possible to obtain access to the HAMMER software to analyse the additional stars so an alternative method was devised. This involved plotting the spectral class of the previously analysed stars against their SDSS magnitudes. Four different plots were created.

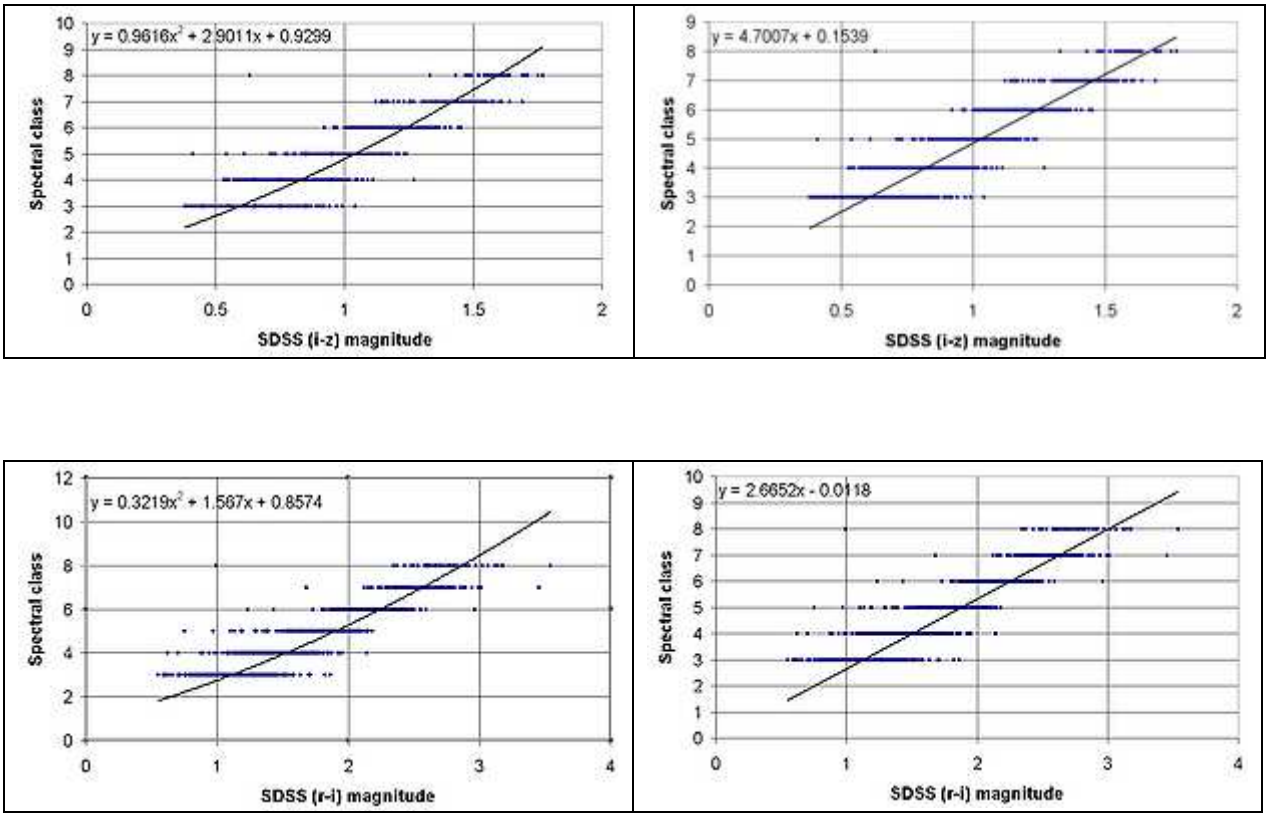
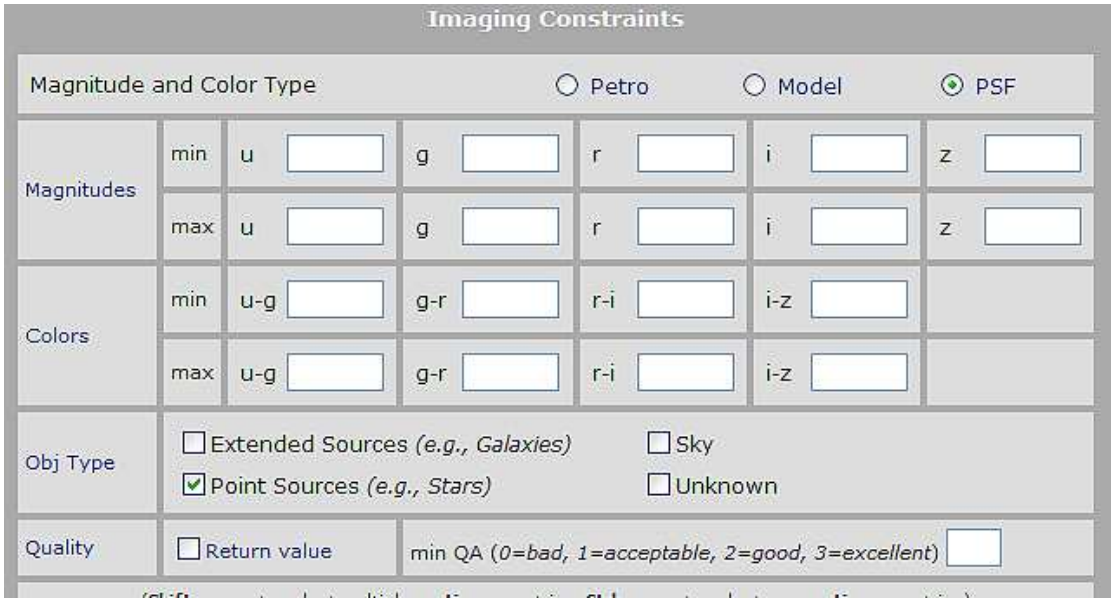


Figure 2 – The four photometric predictors of spectral class

Subsequent Identification and characterisation of the M3 to M8 red dwarf stars is a five stage process.

1 – Download data for all stars in DR7 for which spectra exist and where i<20 and (i-z)>0.55 and (r-i)>1.1. This is most conveniently done using the table below that can be accessed via

http://cas.sdss.org/astro/en/tools/search/SQS.asp



2 - Remove from the resulting list all stars already published in the earlier study.

3 – For the remaining stars calculate the spectral class using the 4 formulae shown above.

4 - Accept results as being from an M3 to M8 red dwarf star whenever there is a maximum of 1 sub-class between the 4 results.

5 – Validate a sample of the spectral results for these stars against the SDSS spectra for stars from the previous survey.

Results and Objects of Particular Interest:

Results covering 7196 red dwarf stars are presented in this study. The breakdown between the different spectral classes is :-

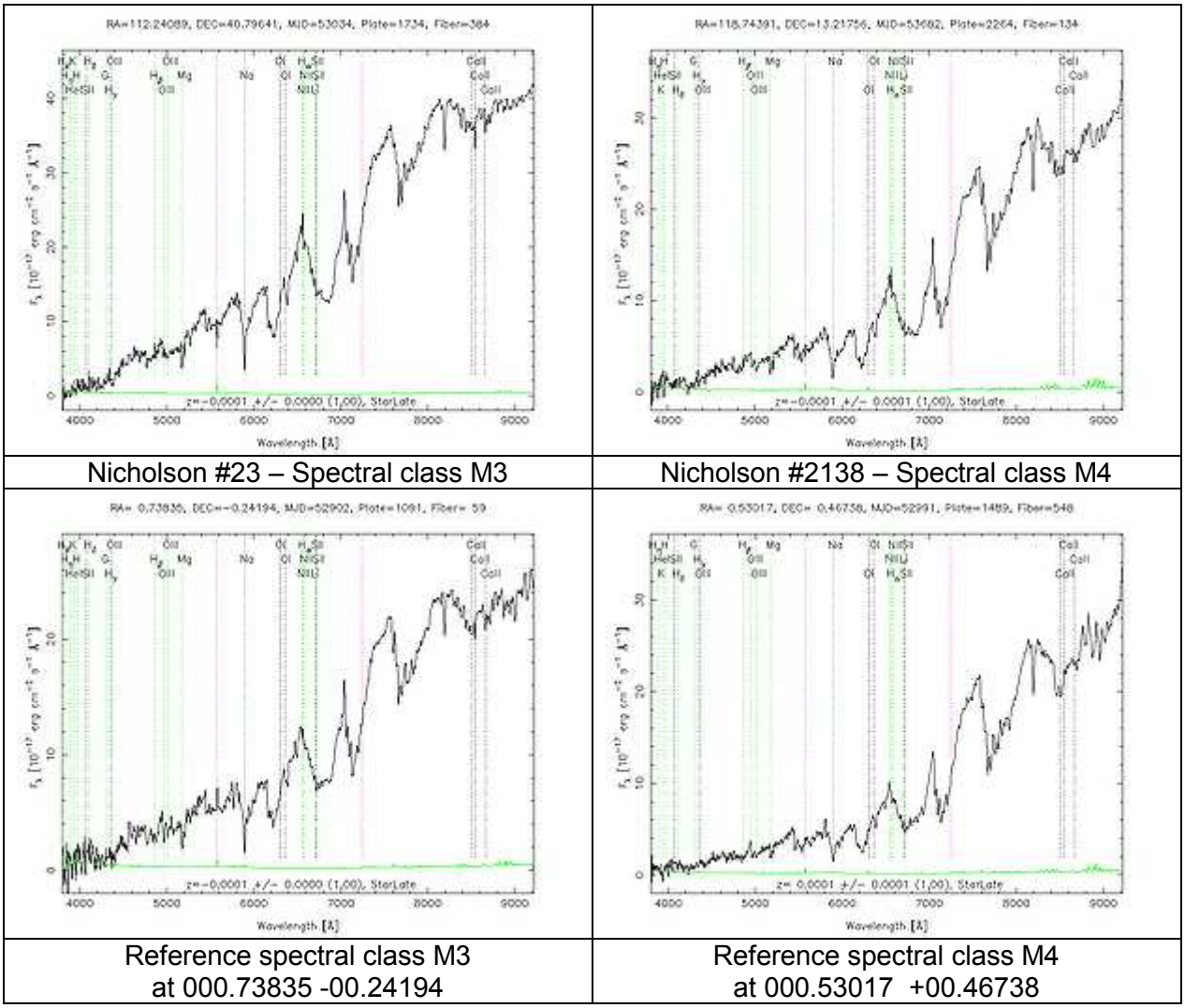
Spectral Class	Number of stars
M3	2105
M4	1426
M5	1911
M6	1230
M7	367
M8	149
M9	8

Full details of the results can be downloaded from:-

http://www.martin-nicholson.info/jadm/reddwarf.xls

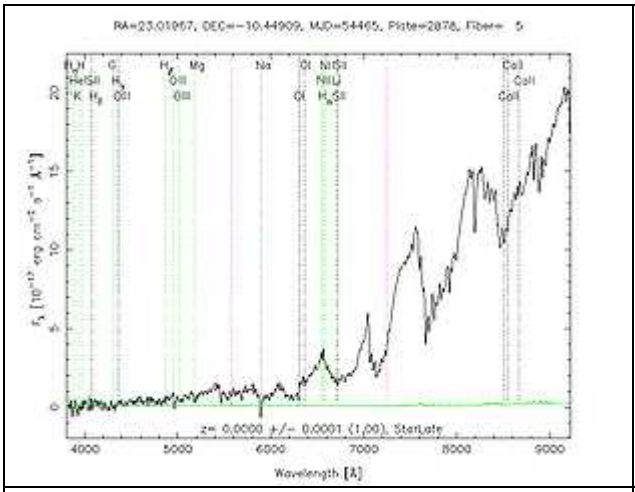
The photometric parallax of the stars, using the method described by Davenport et al. (2006), varies between 12 and 1721 parsec and information on those stars within 25 parsec is given below.

#	RA	DEC	Distance parsec	Spectral Class
6795	154.14422	27.86293	12	M7
5722	137.87725	22.80300	13	M6
7160	215.60115	21.26878	14	M8
6971	220.09529	13.65579	15	M7
6451	225.20375	-1.52853	19	M6
7116	180.13689	20.81465	19	M8
6789	152.12714	59.29207	21	M7
7043	43.10972	0.93963	22	M8
6113	184.44955	28.12026	23	M6
3942	140.43133	10.69621	23	M5
5455	62.34103	-6.08852	23	M6
6238	193.09801	25.47942	23	M6
6757	145.73789	23.85514	24	M7
7155	210.41029	19.98463	25	M8
5527	125.29987	9.82947	25	M6
7121	183.97283	0.84726	25	M8
5920	156.36715	22.50615	25	M6
6698	125.93609	10.58070	25	M7

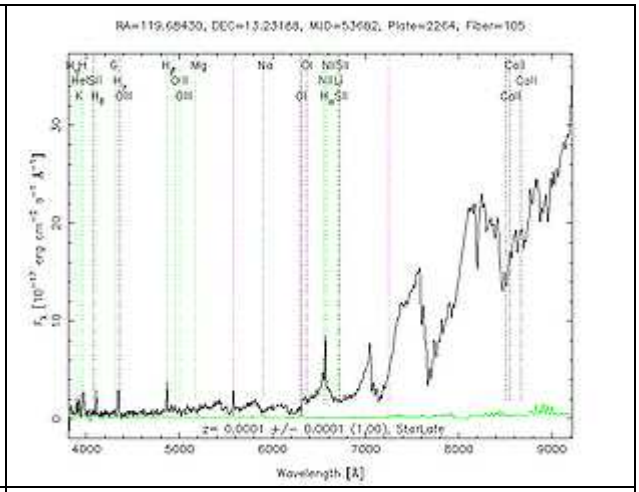


Nicholson #23 – Spectral class M3	Nicholson #2138 – Spectral class M4
Reference spectral class M3 at 000.73835 -00.24194	Reference spectral class M4 at 000.53017 +00.46738

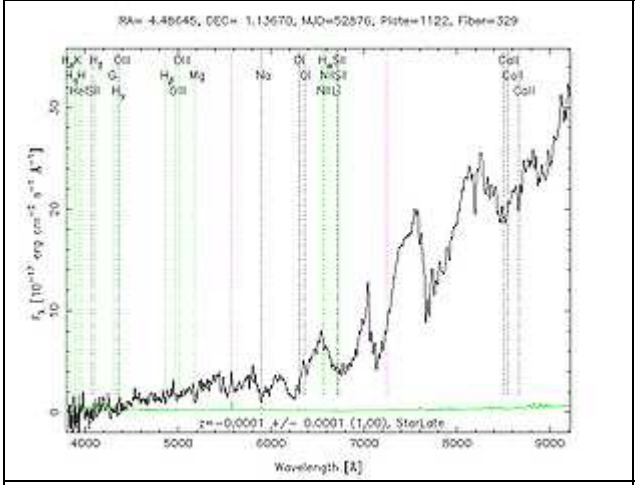
Figure 3 – Comparison of the two approaches to determining the spectral class (M3 and M4)



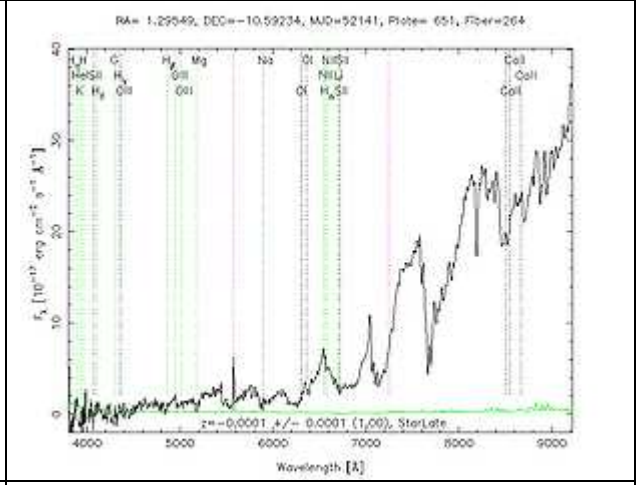
Nicholson #3547 – Spectral class M5



Nicholson #5466 – Spectral class M6



Reference spectral class M5
at 004.48645 +01.13670



Reference spectral class M6
at 001.29549 -10.59234

Figure 4 – Comparison of the two approaches to determining the spectral class (M5 and M6)

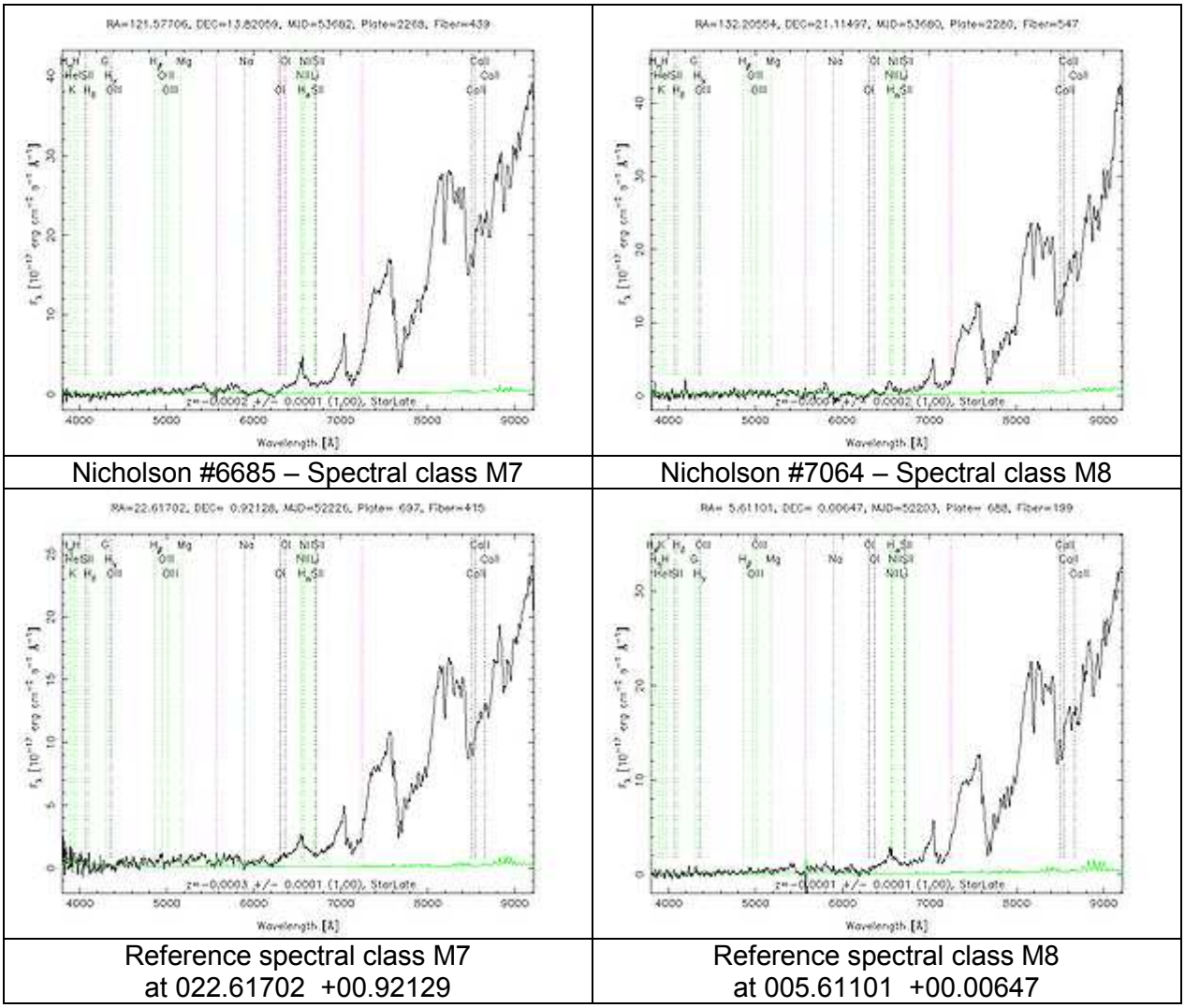


Figure 5 – Comparison of the two approaches to determining the spectral class (M7 and M8)

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