Spectroscopic sequences of cool and ultra-cool subdwarfs (sdM, esdM, usdM) from the Sloan Digital Sky Survey

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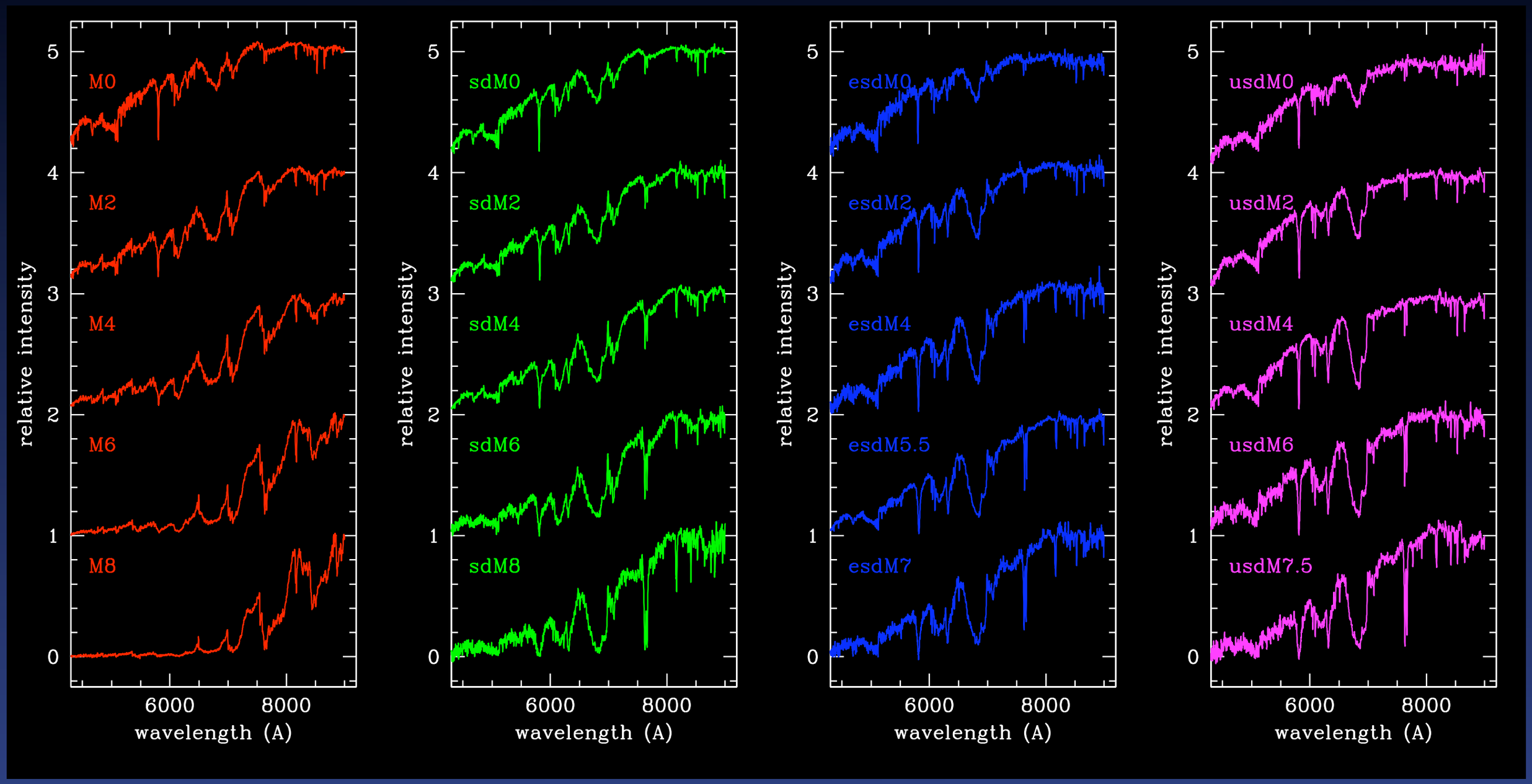
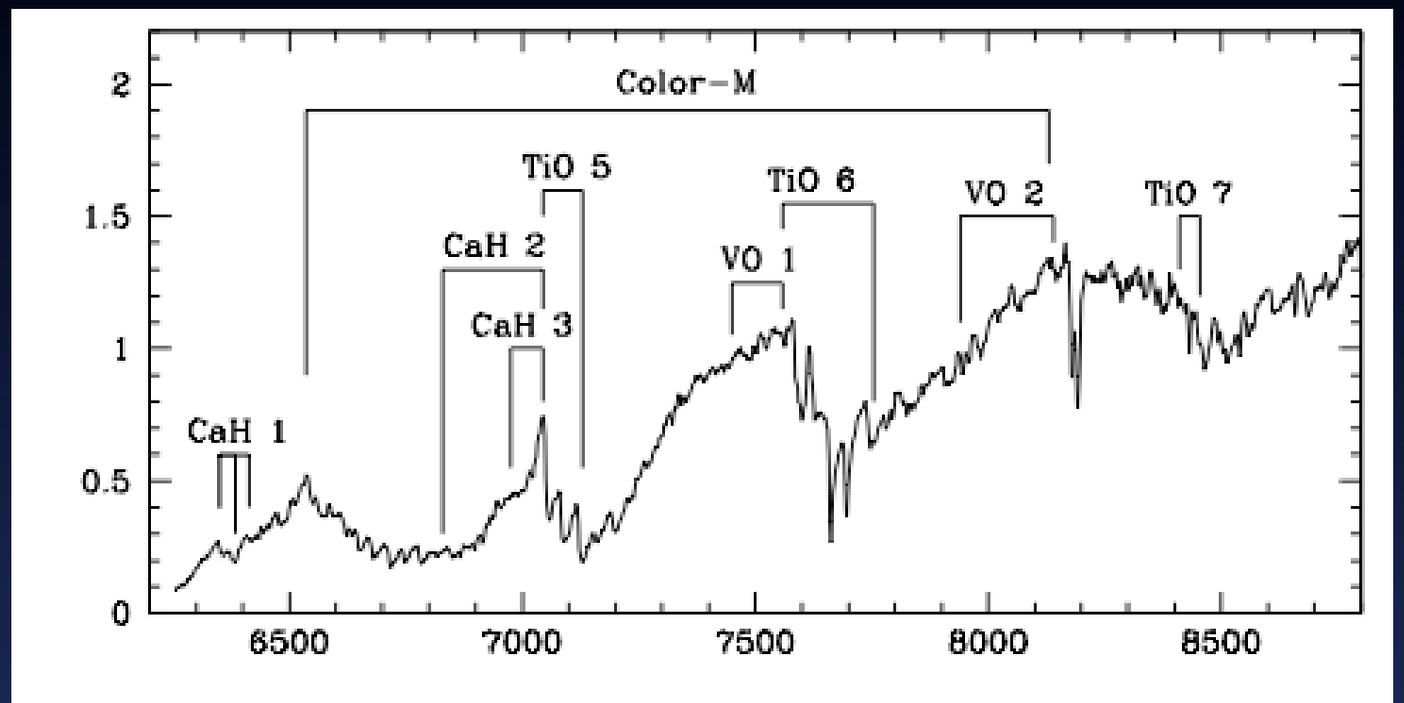
American Museum of Natural History, New York, NY, USA

AMERICAN MUSEUM OF NATURAL HISTORY

Cool subdwarfs in the Sloan Digital Sky Survey: new spectroscopy

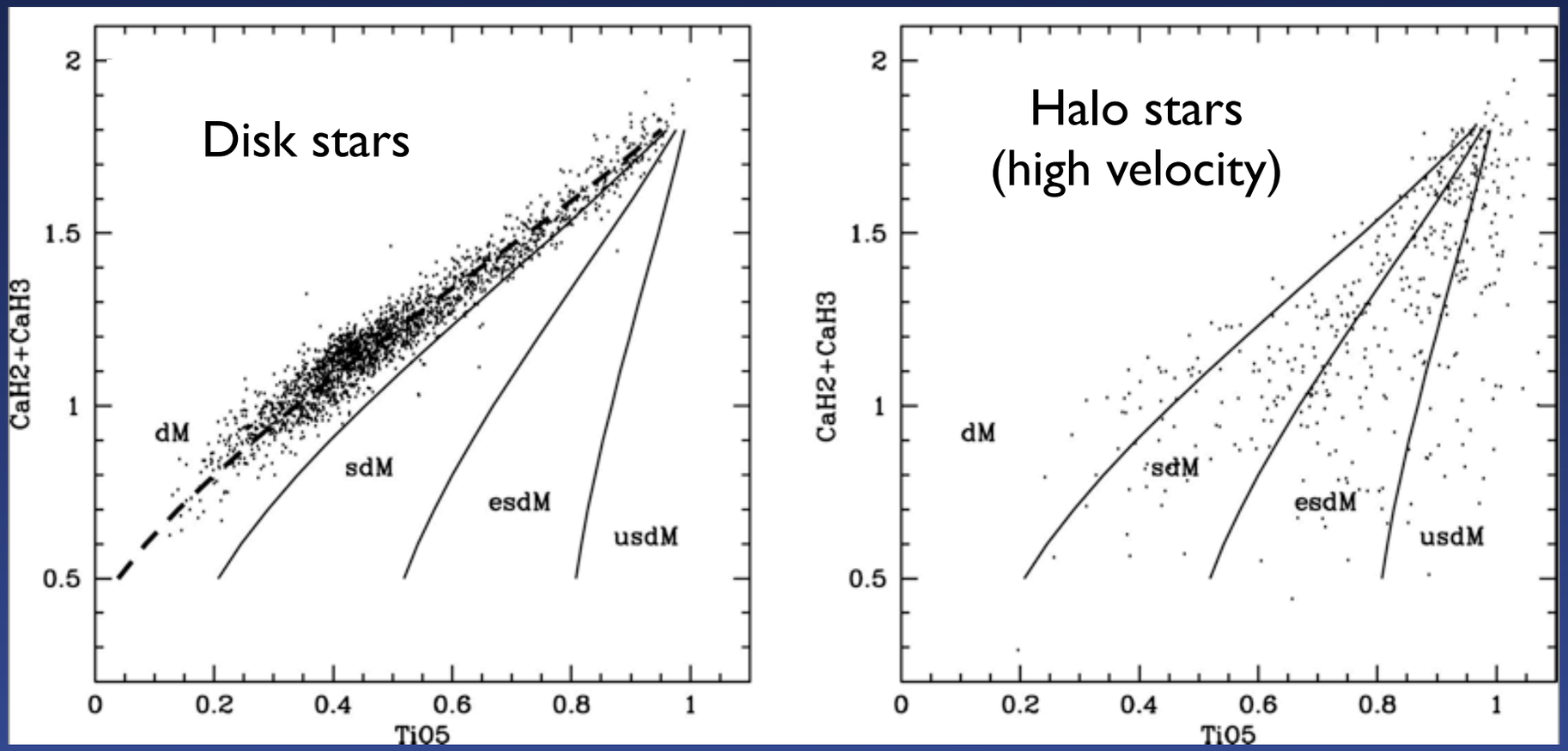


sdM / esdM / usdM subclass definition : $\frac{TiO}{CaH}$



Spectral indices used for the classification.

Require S/N > 30 with medium to high-res spectra



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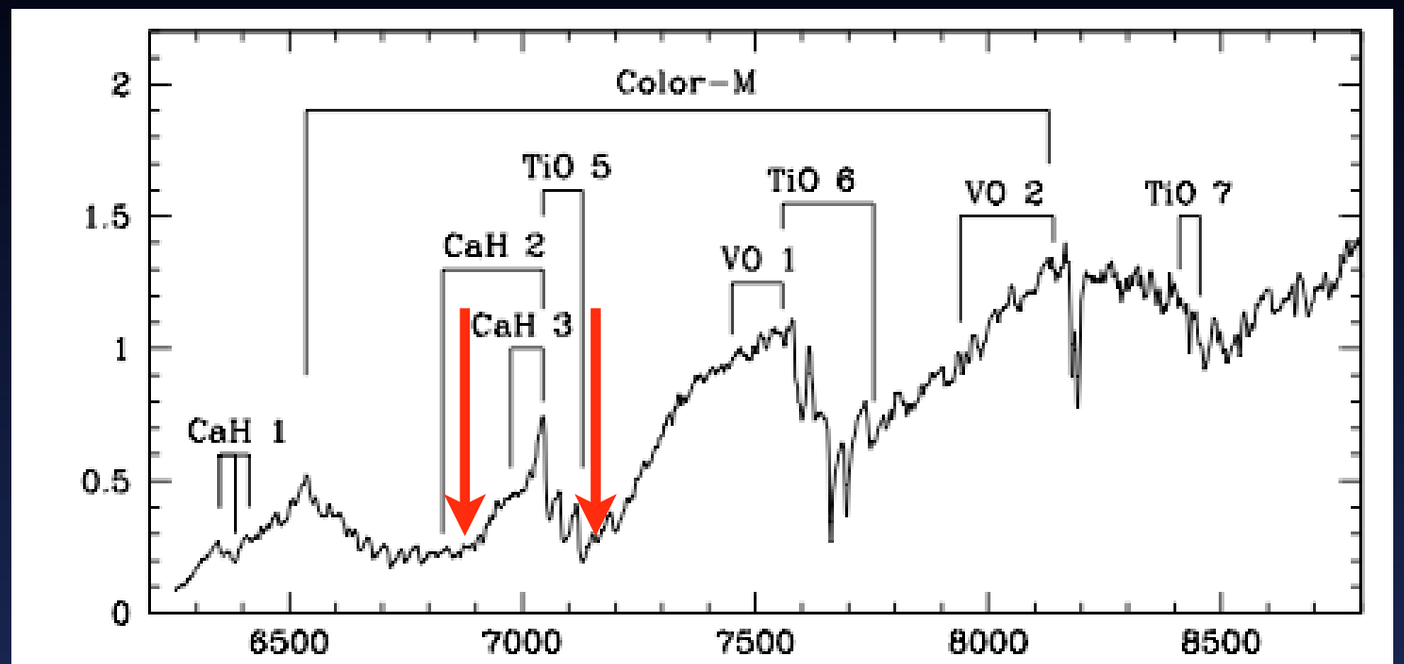

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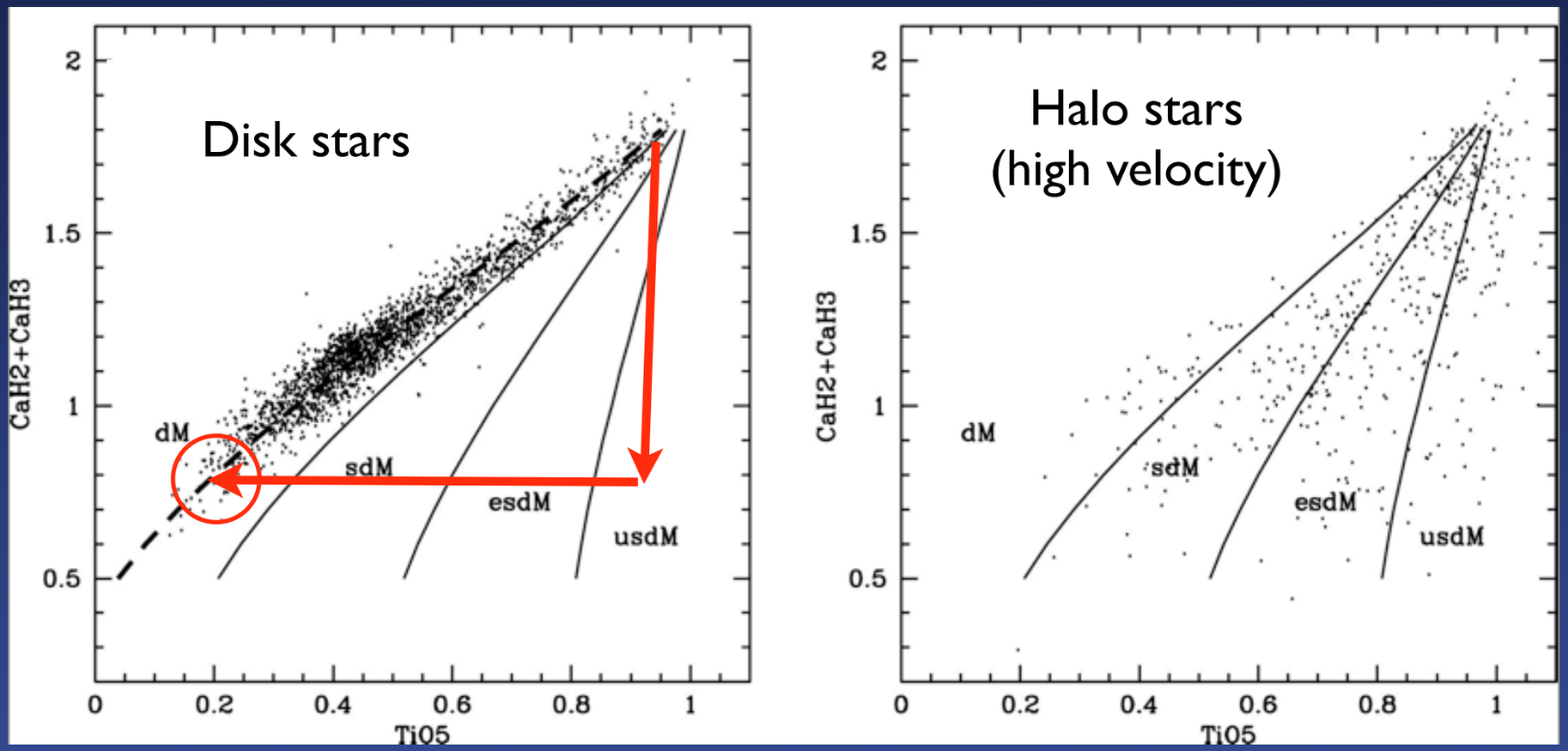

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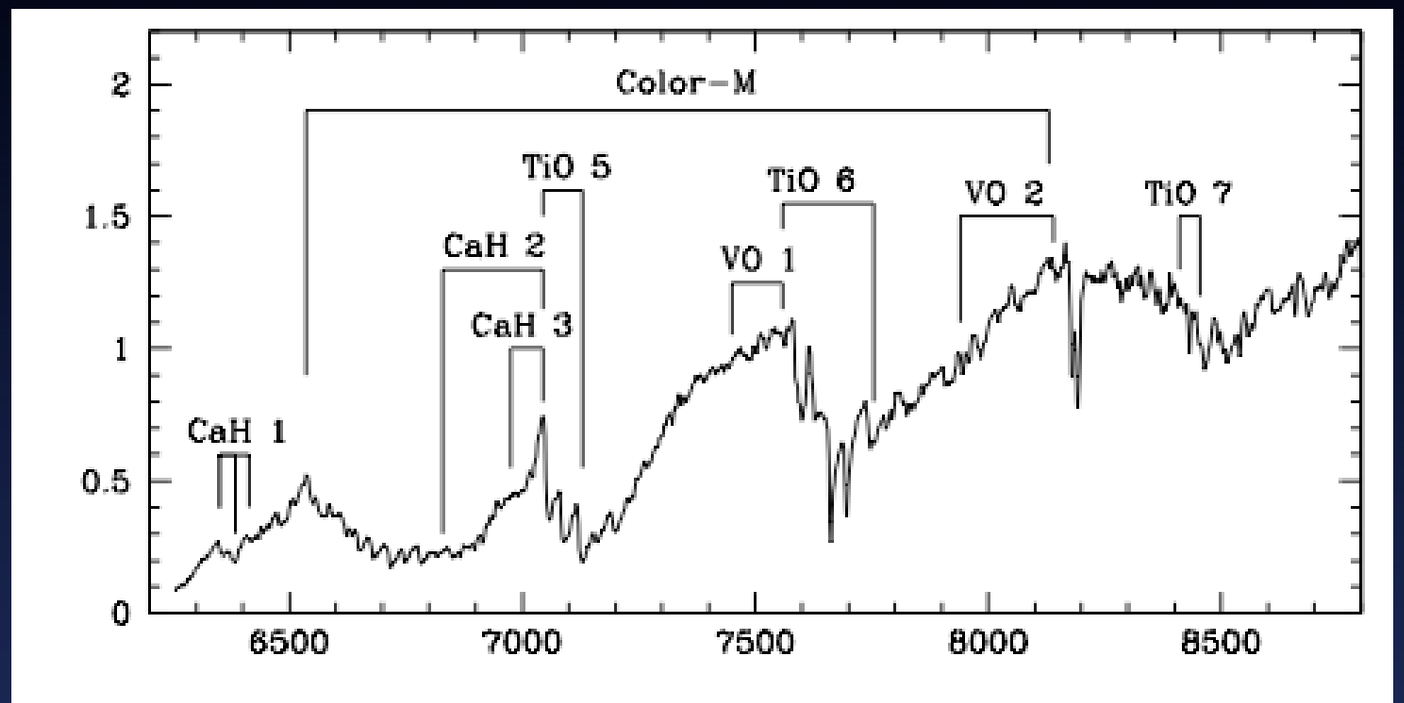

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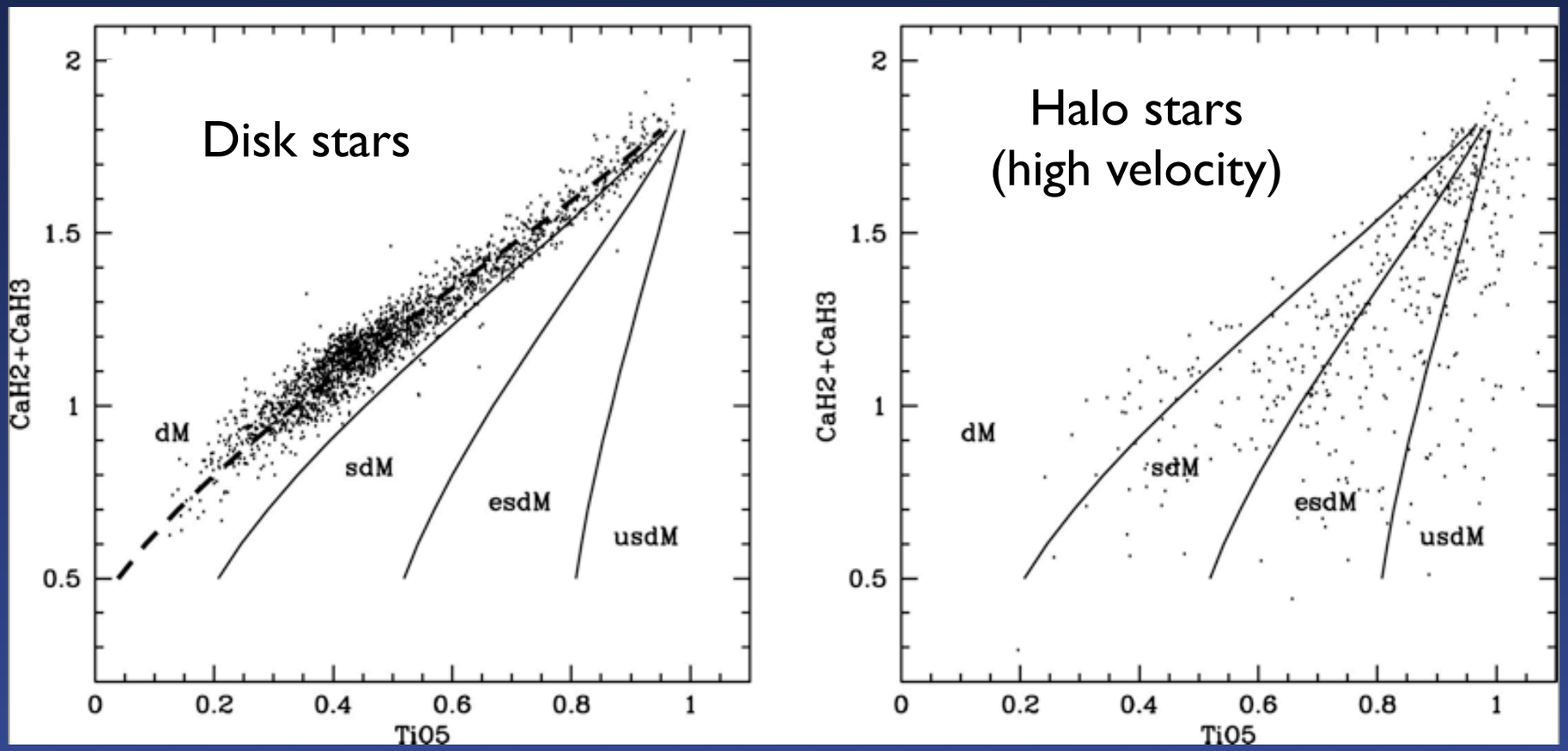

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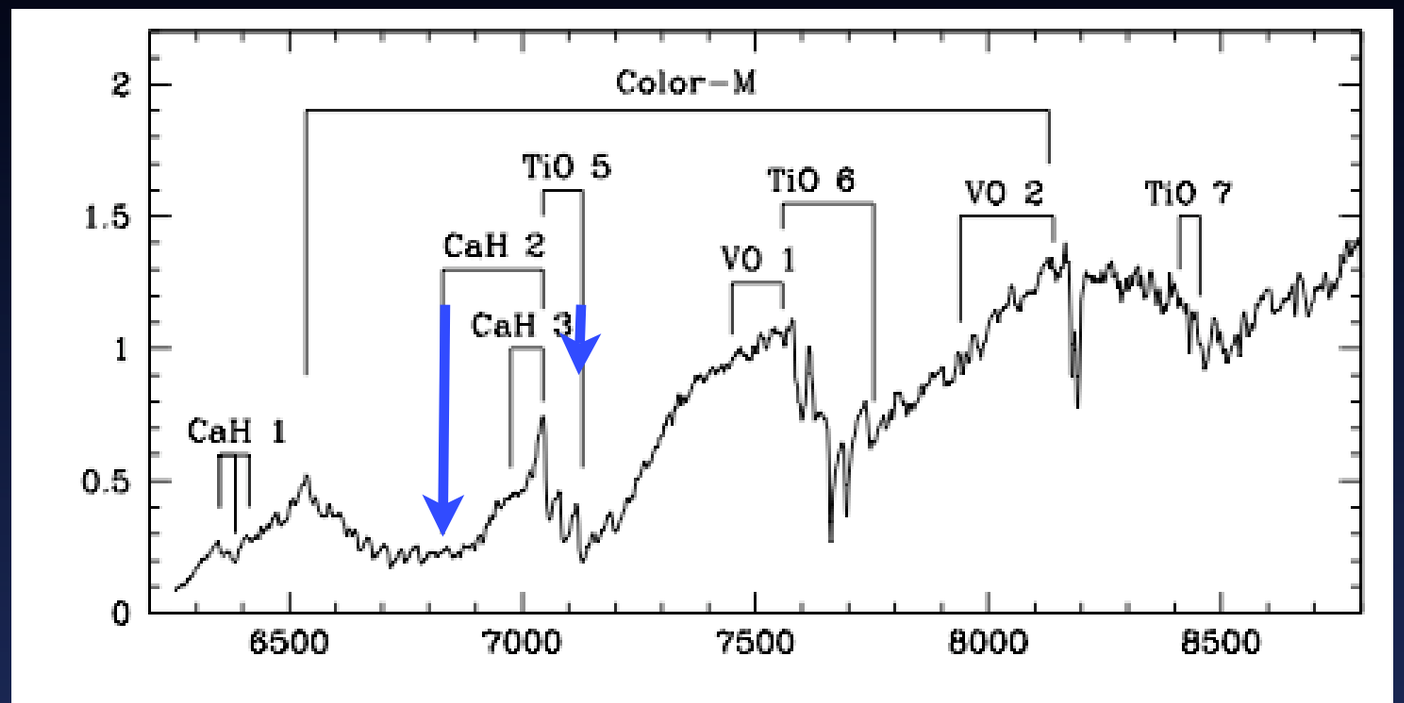

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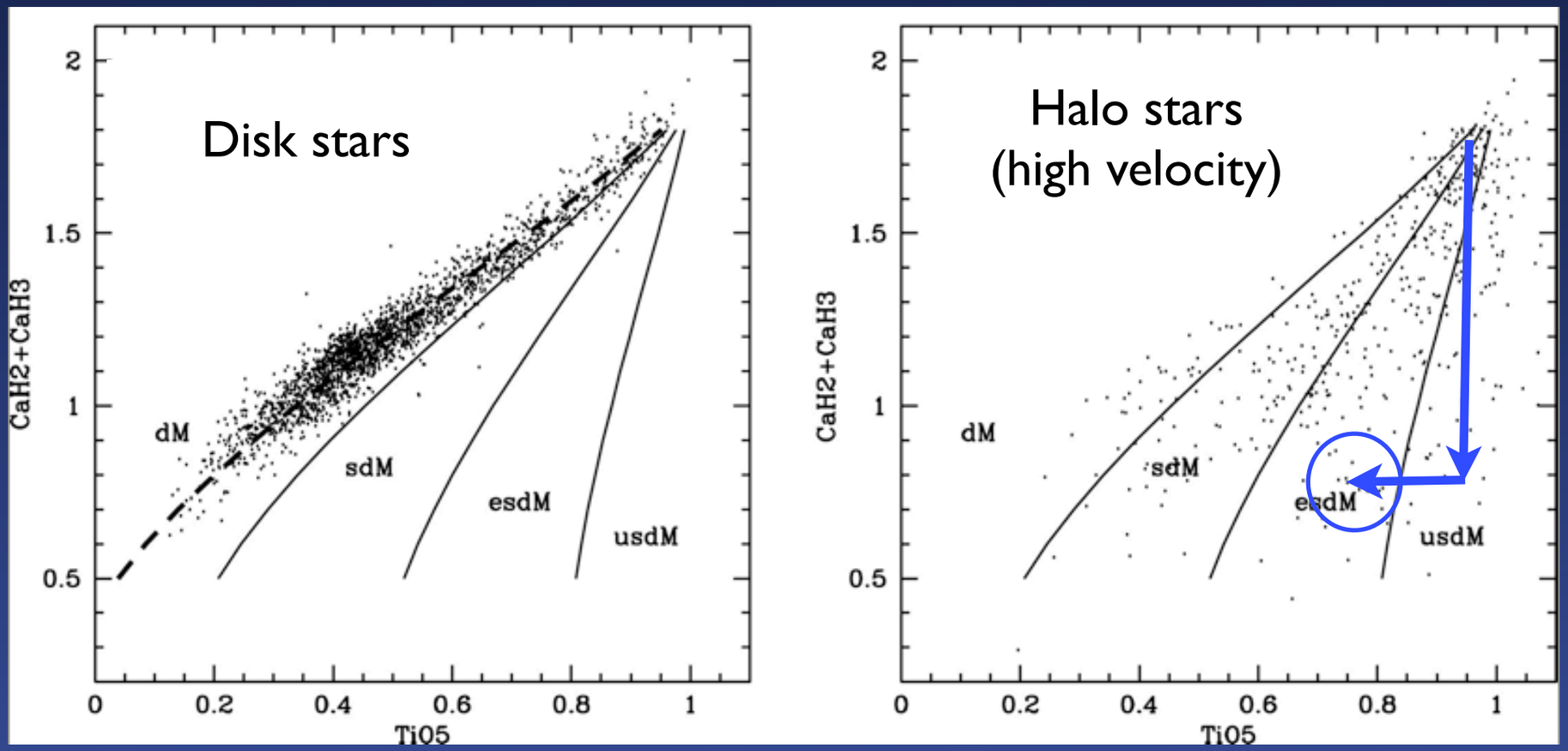

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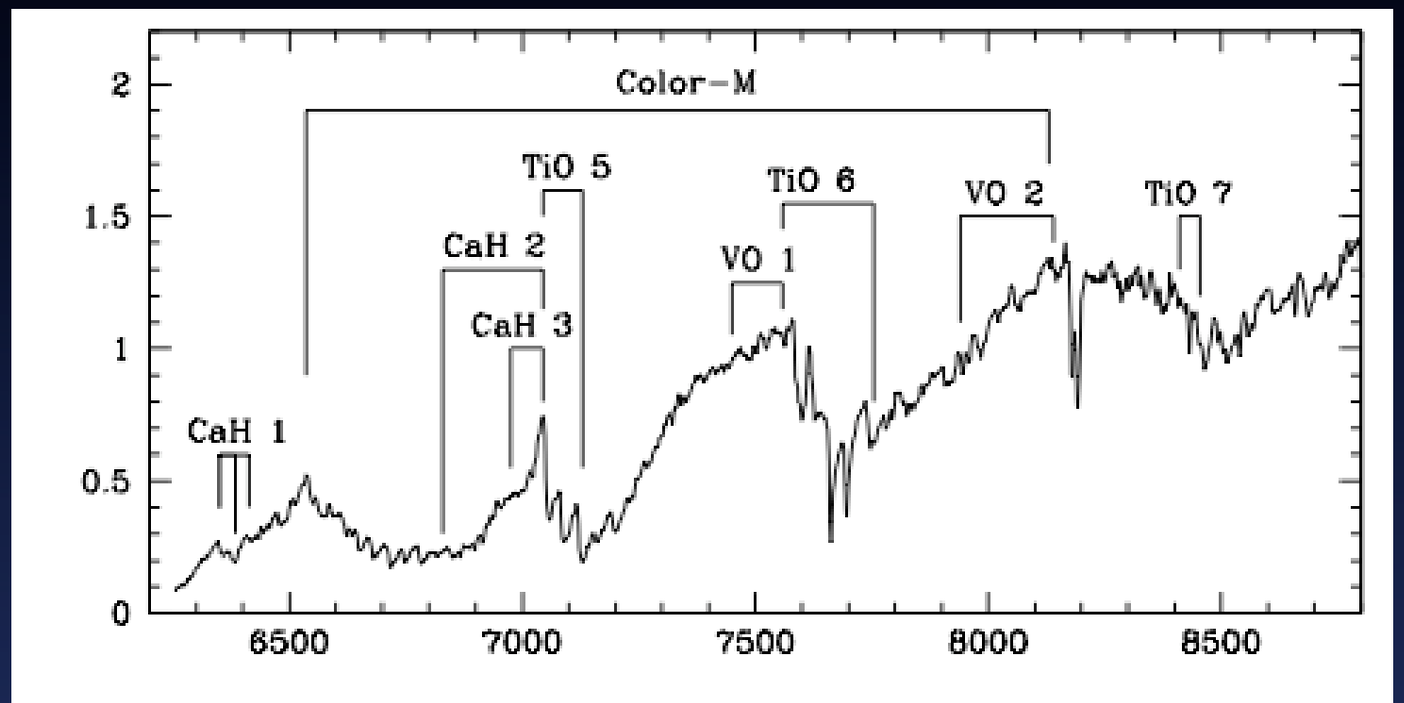

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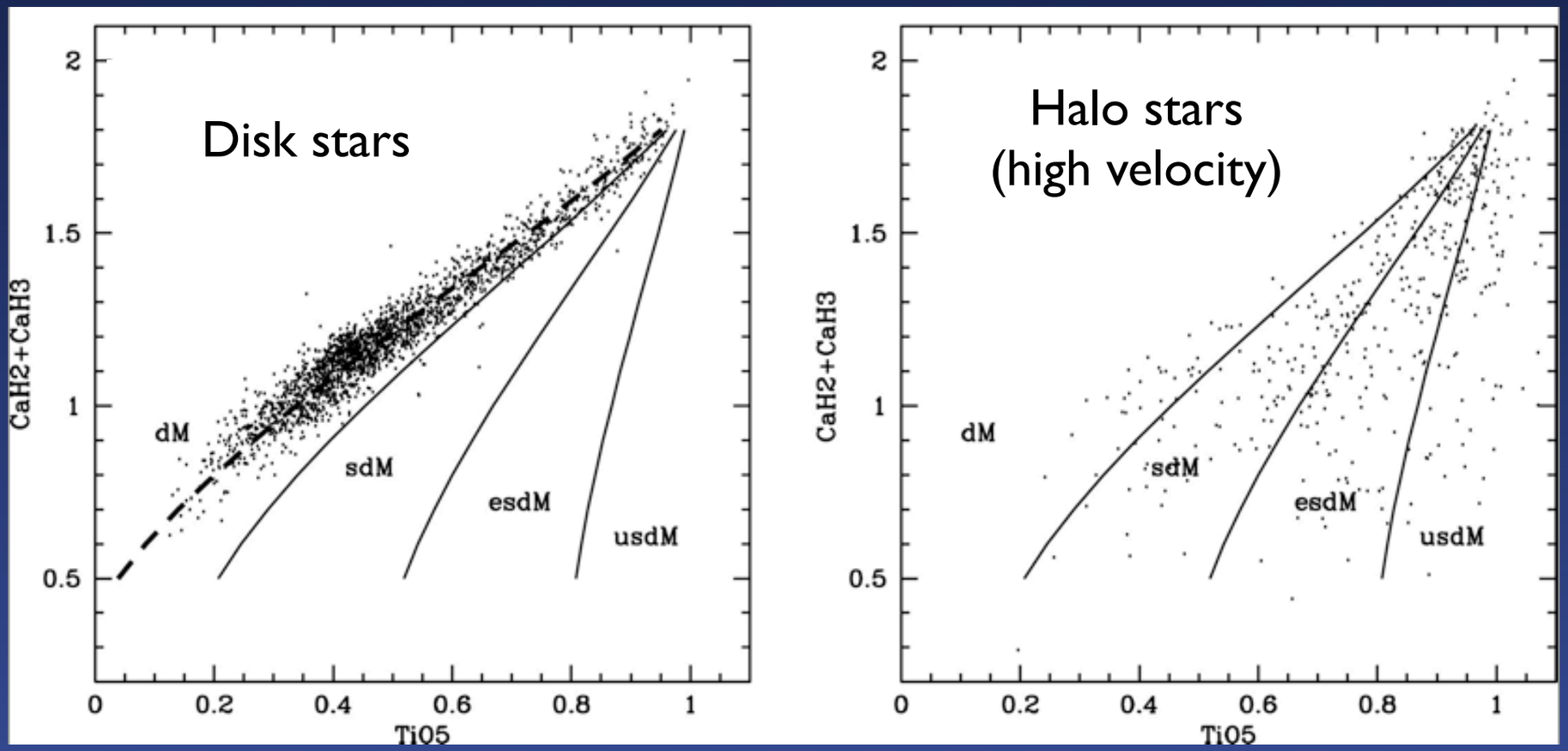
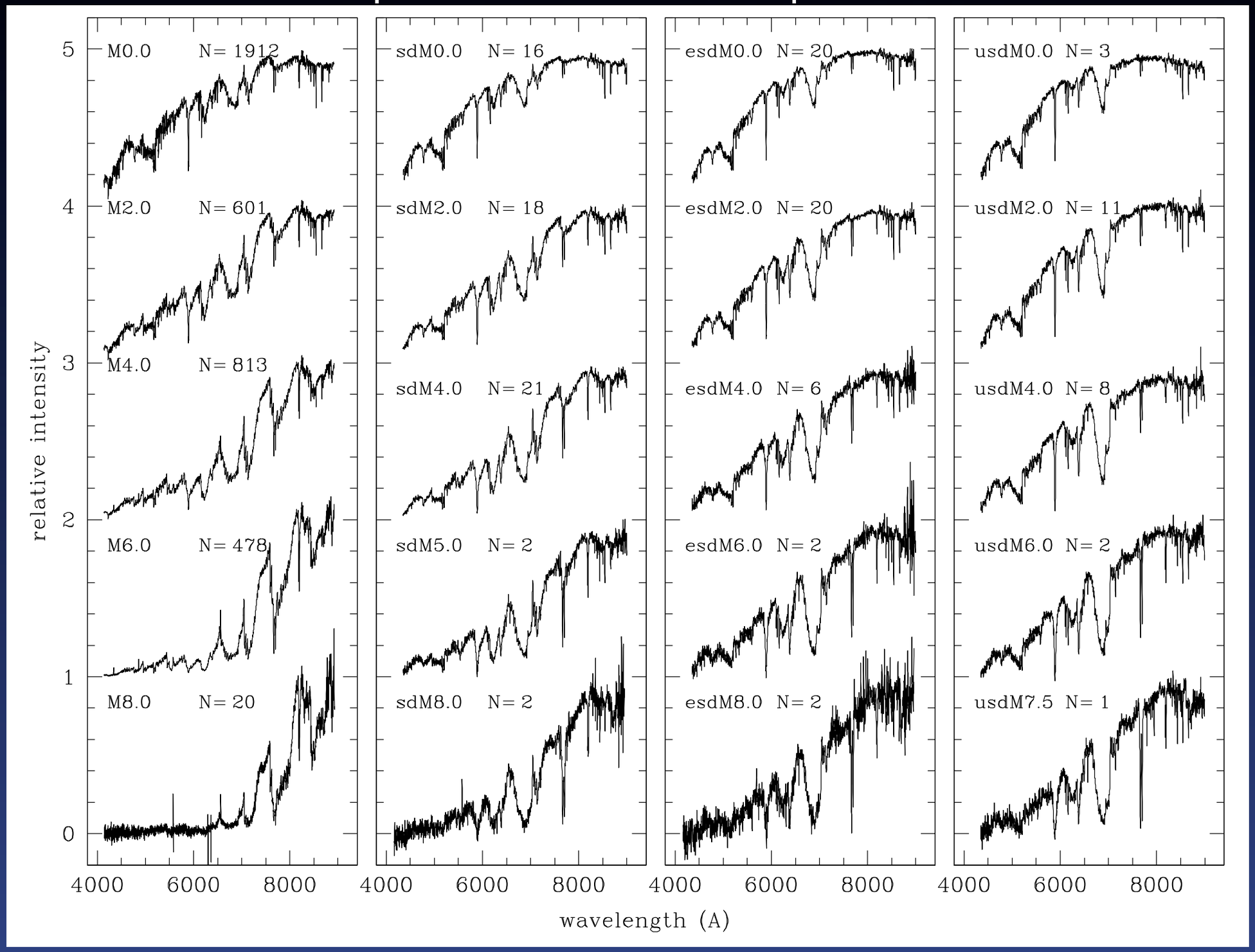


Classification of the SDSS subdwarfs is no longer based on the TiO5, CaH2, CaH3 indices.
Instead, new classification templates are introduced, composites of SDSS stars with S/N >10.



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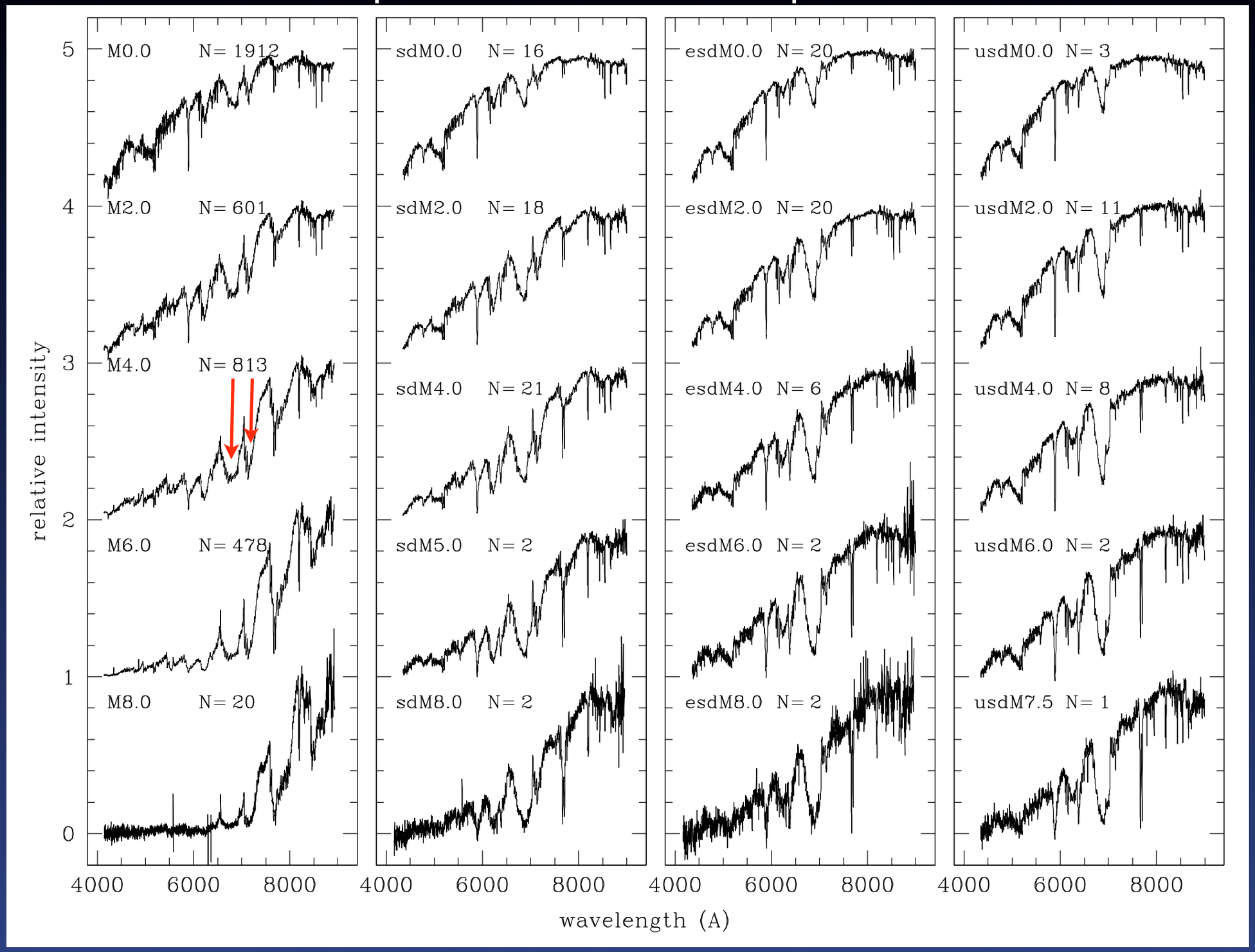

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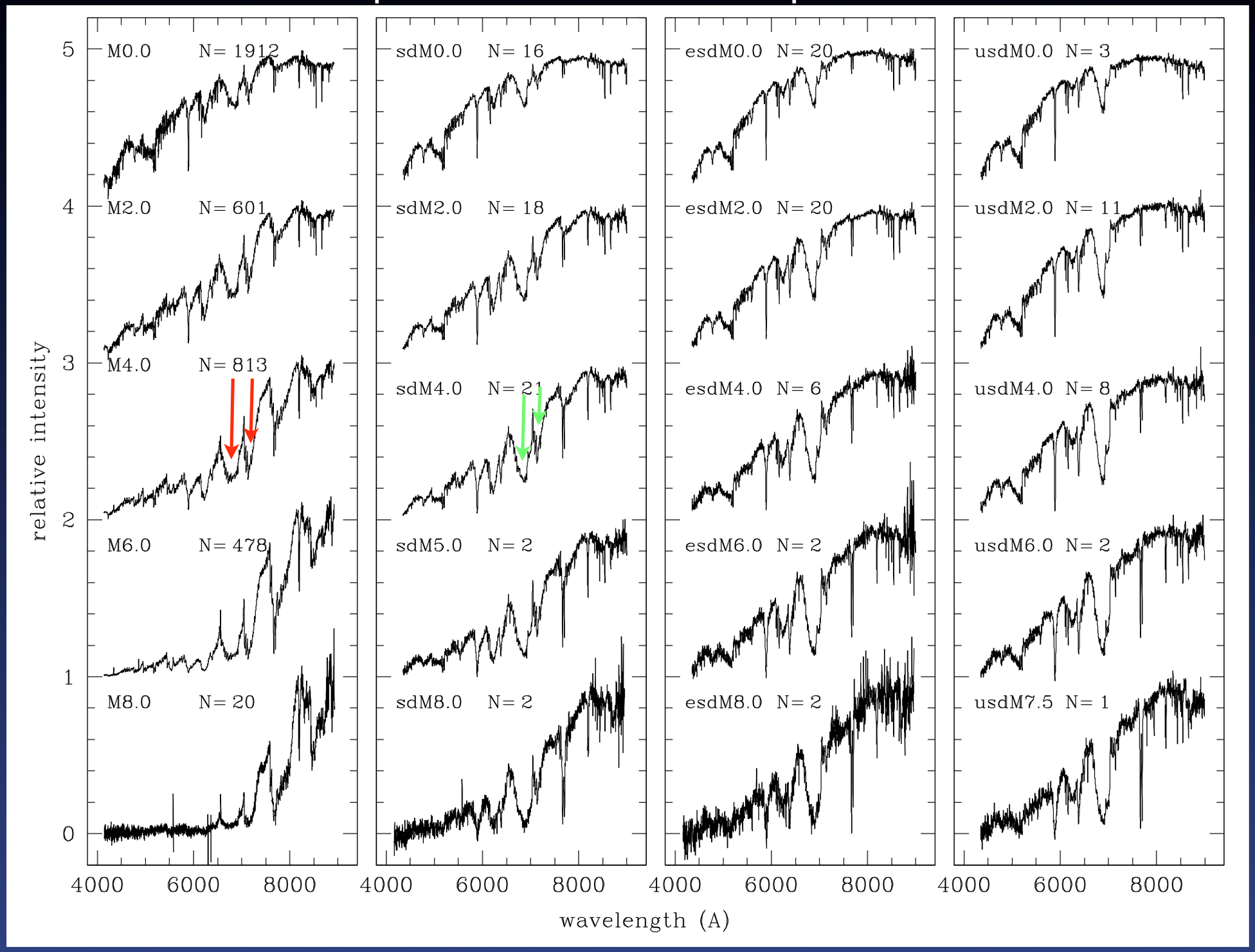

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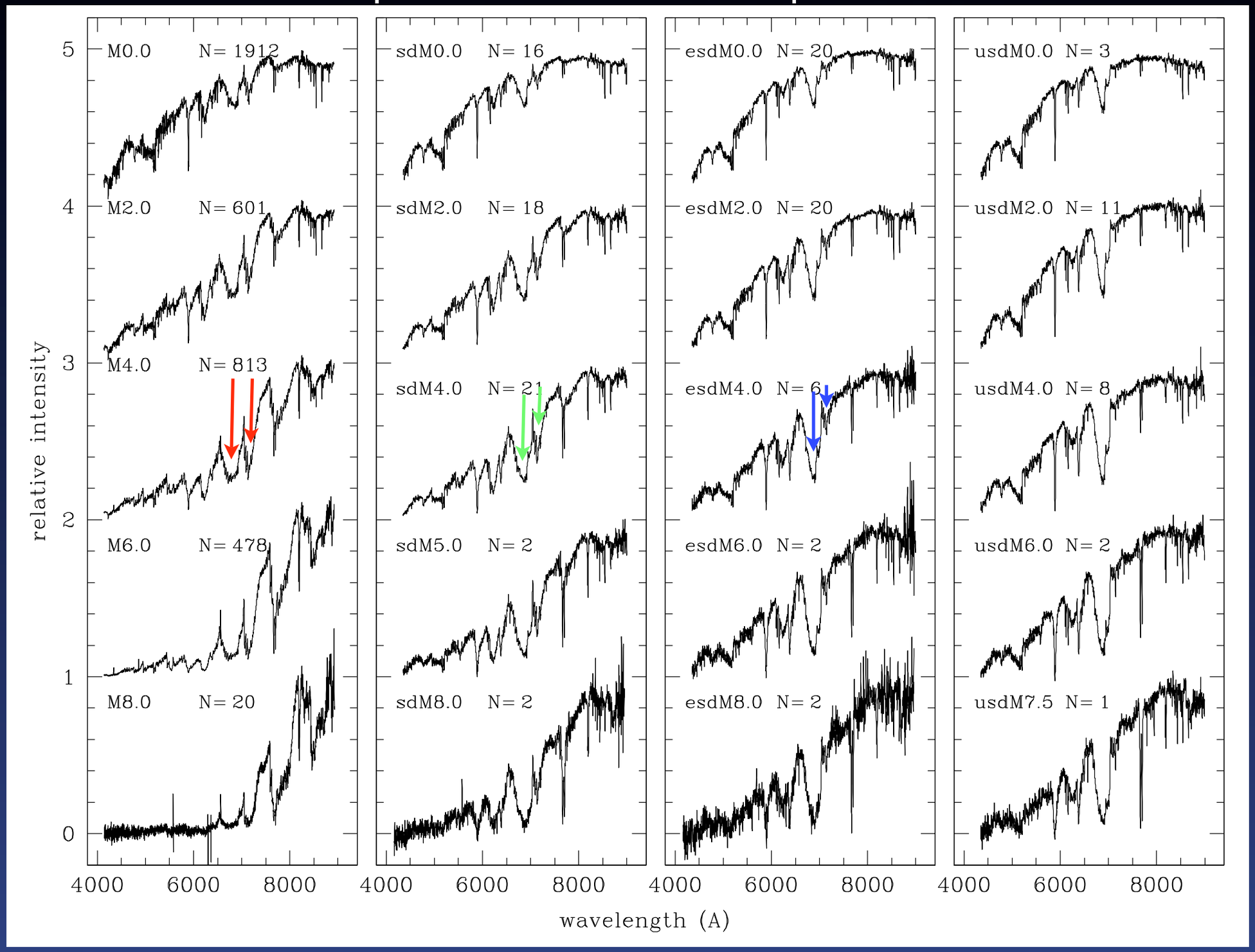

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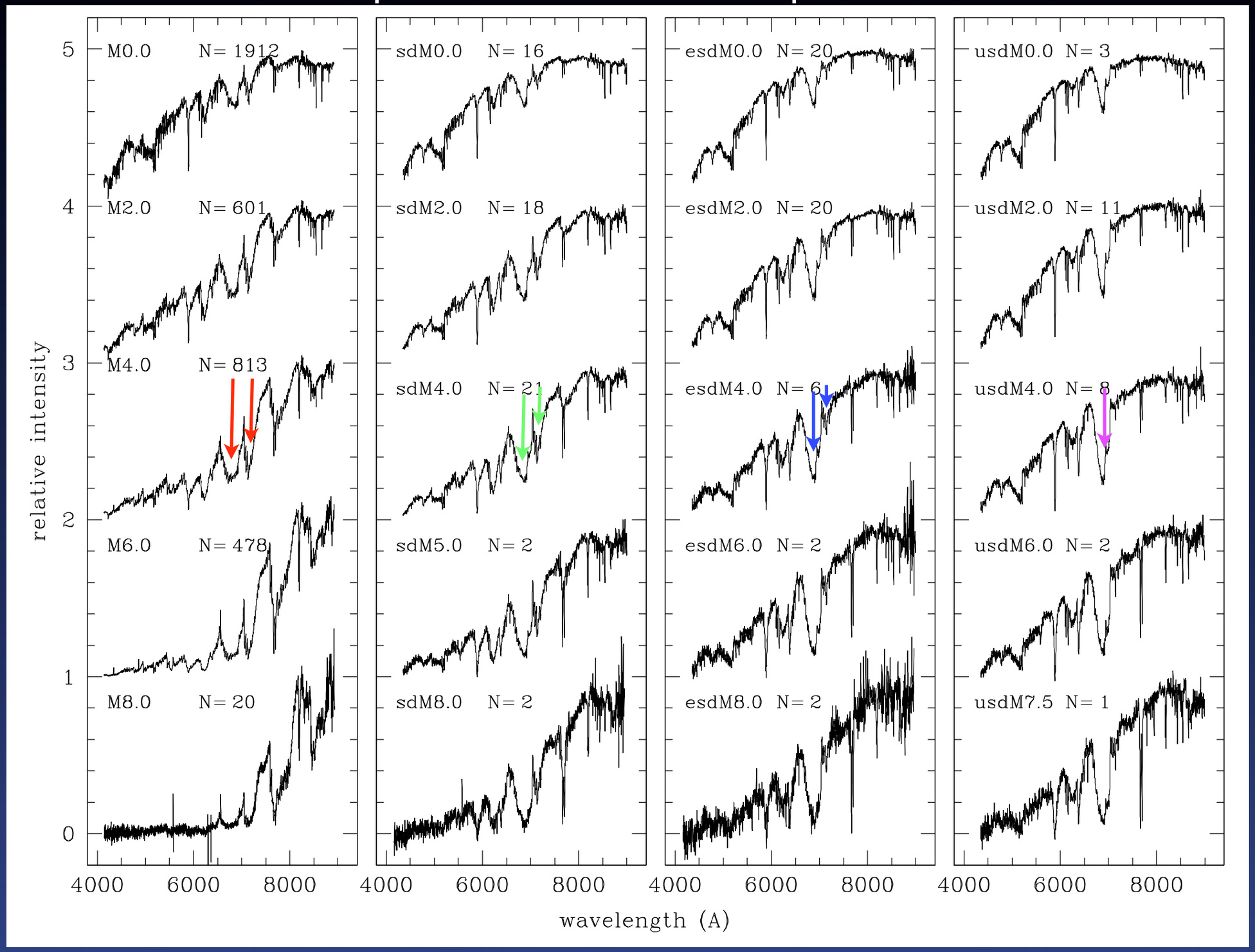

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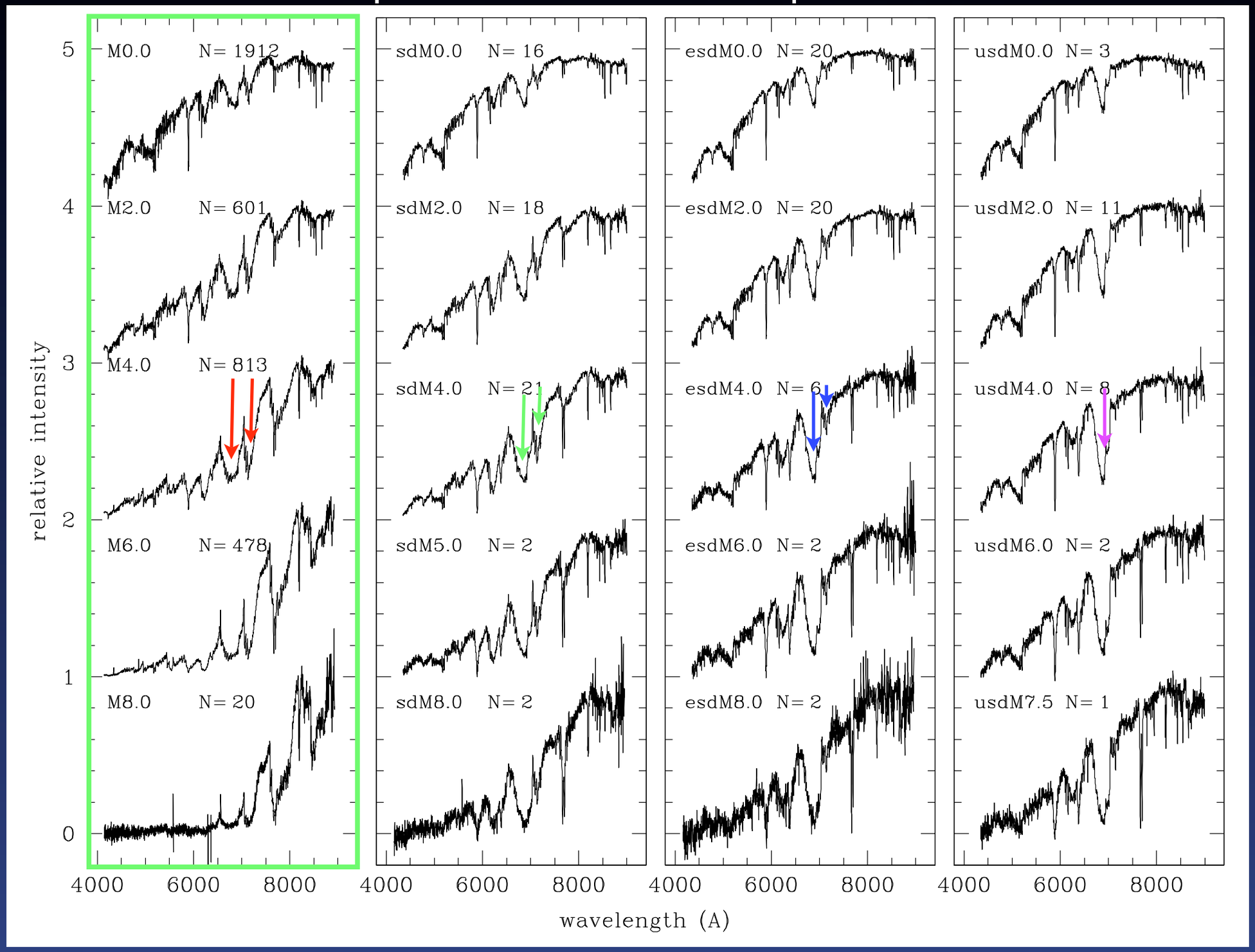

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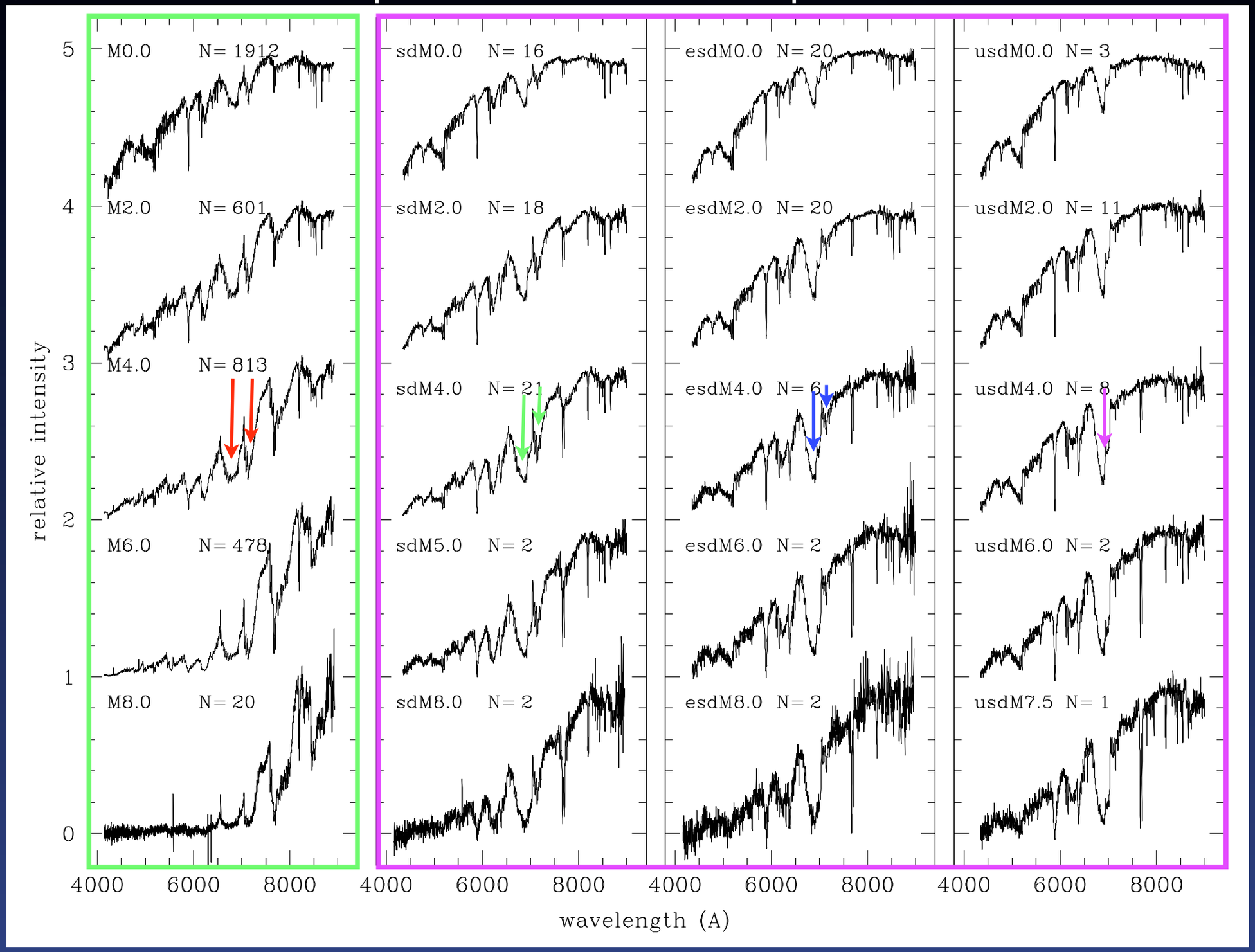

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color variation with subclass and subtype

As shown in the next 4 plots, subdwarfs populate the g-r/r-i color-color diagram according to their spectral subclass and subtype.

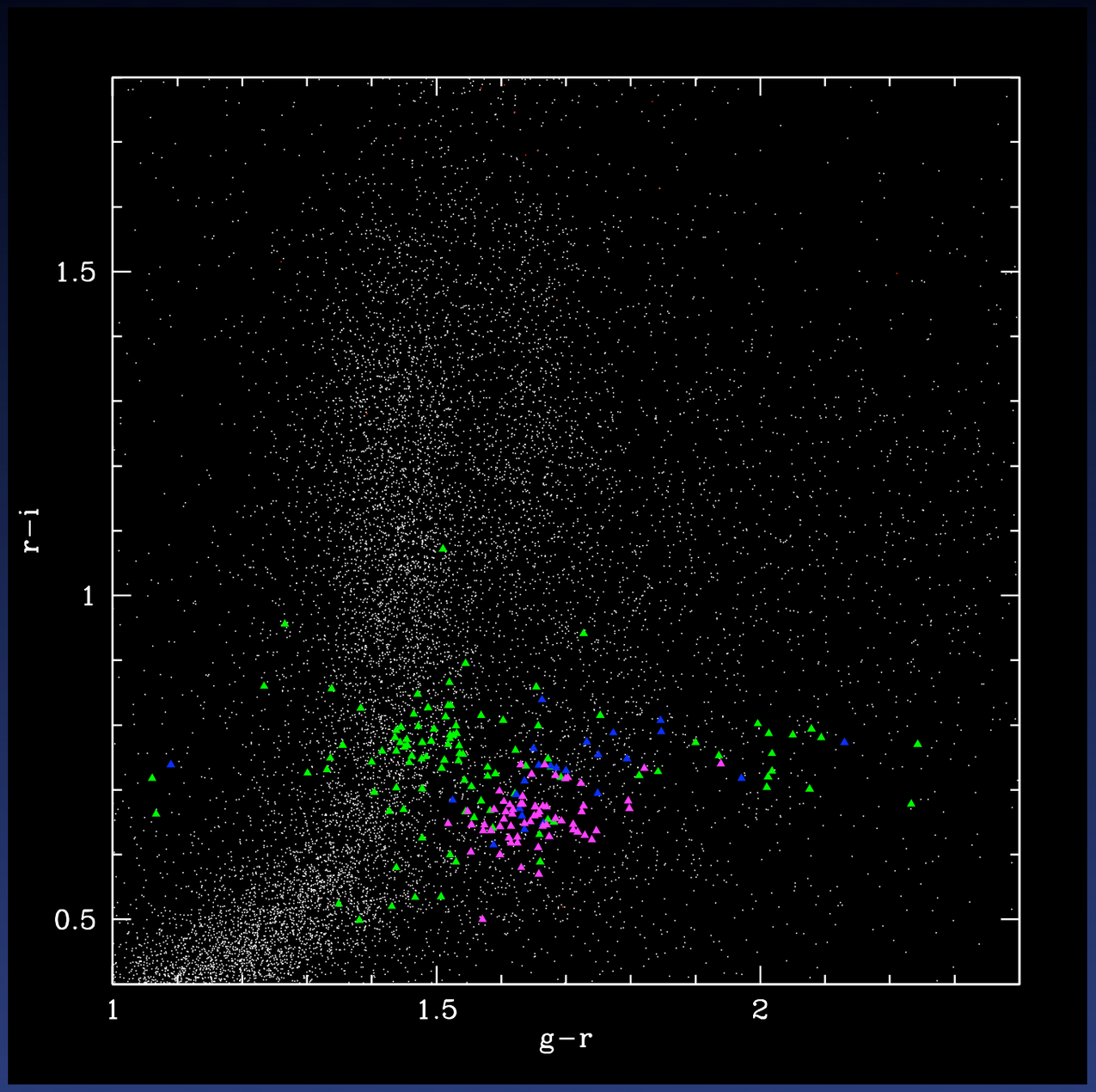
This suggests that faint subdwarfs could be classified based on their g-r. r-i color alone. In particular, the 4 subclasses (M/sdM/esdM/usdM) populate very distinct loci.

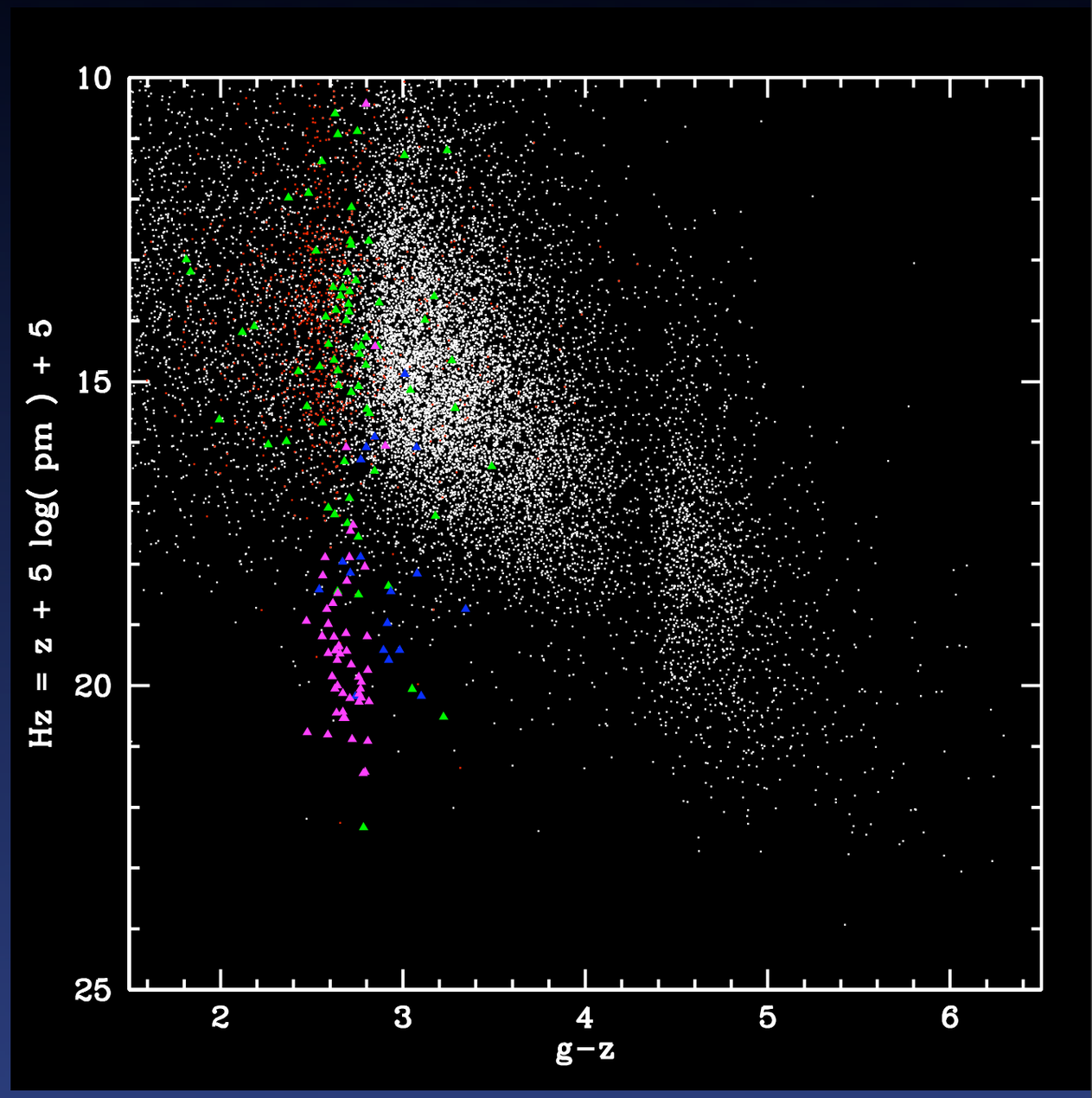
The loci "fan out" at later subtypes, which makes the ultra-cool subdwarfs even easier to identify and classify.

The reduced proper motion diagram indicates that esdM and usdM subclasses are dominated by high velocity stars from the halo (high transverse velocity => higher reduced proper motion Hz => shifted down on the reduced proper motion plot), while the M and sdM are consistent with the low velocity disk population.

color variation with subclass and subtype

M0 / sdM0 / esdM0 / usdM0



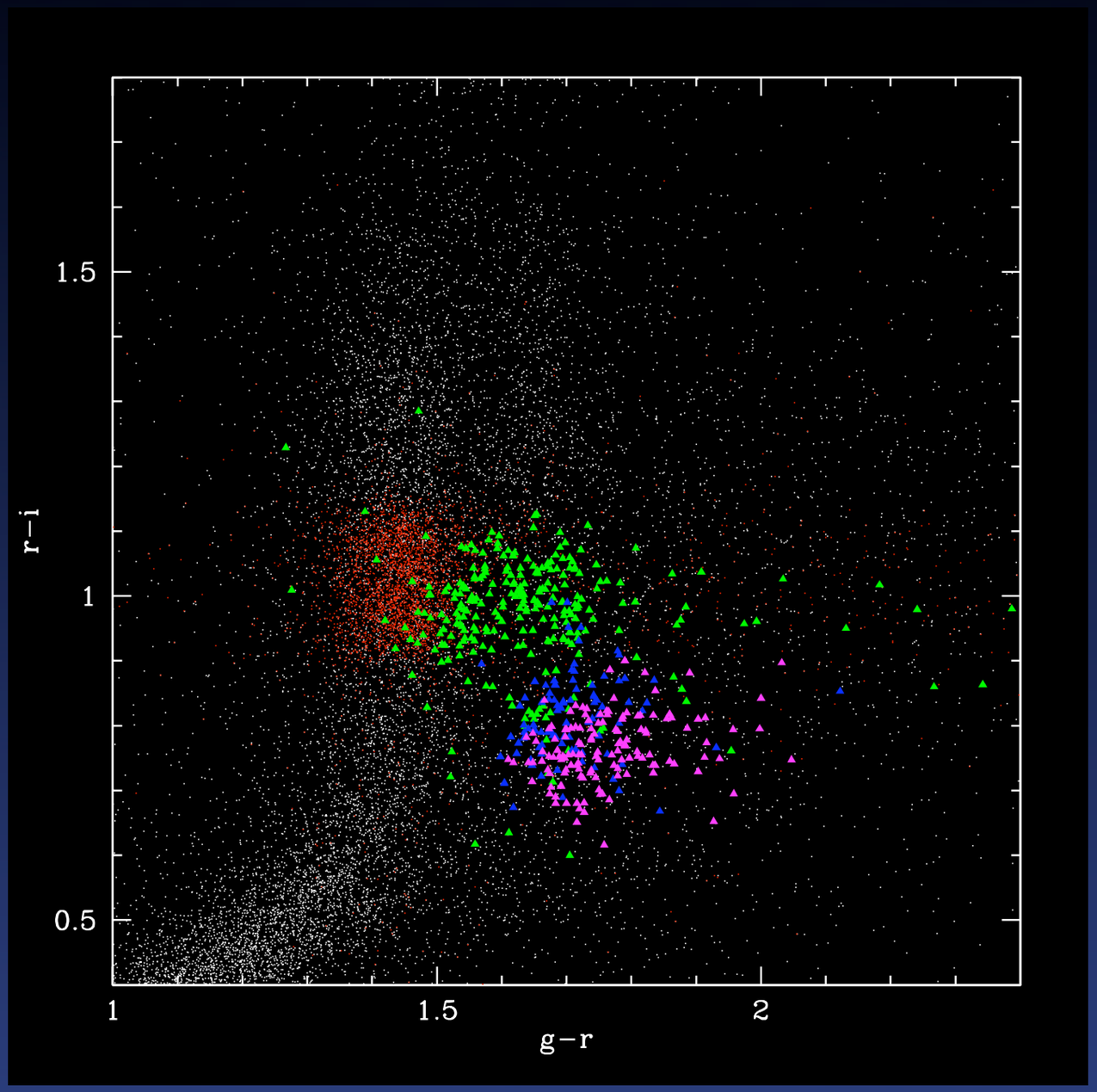


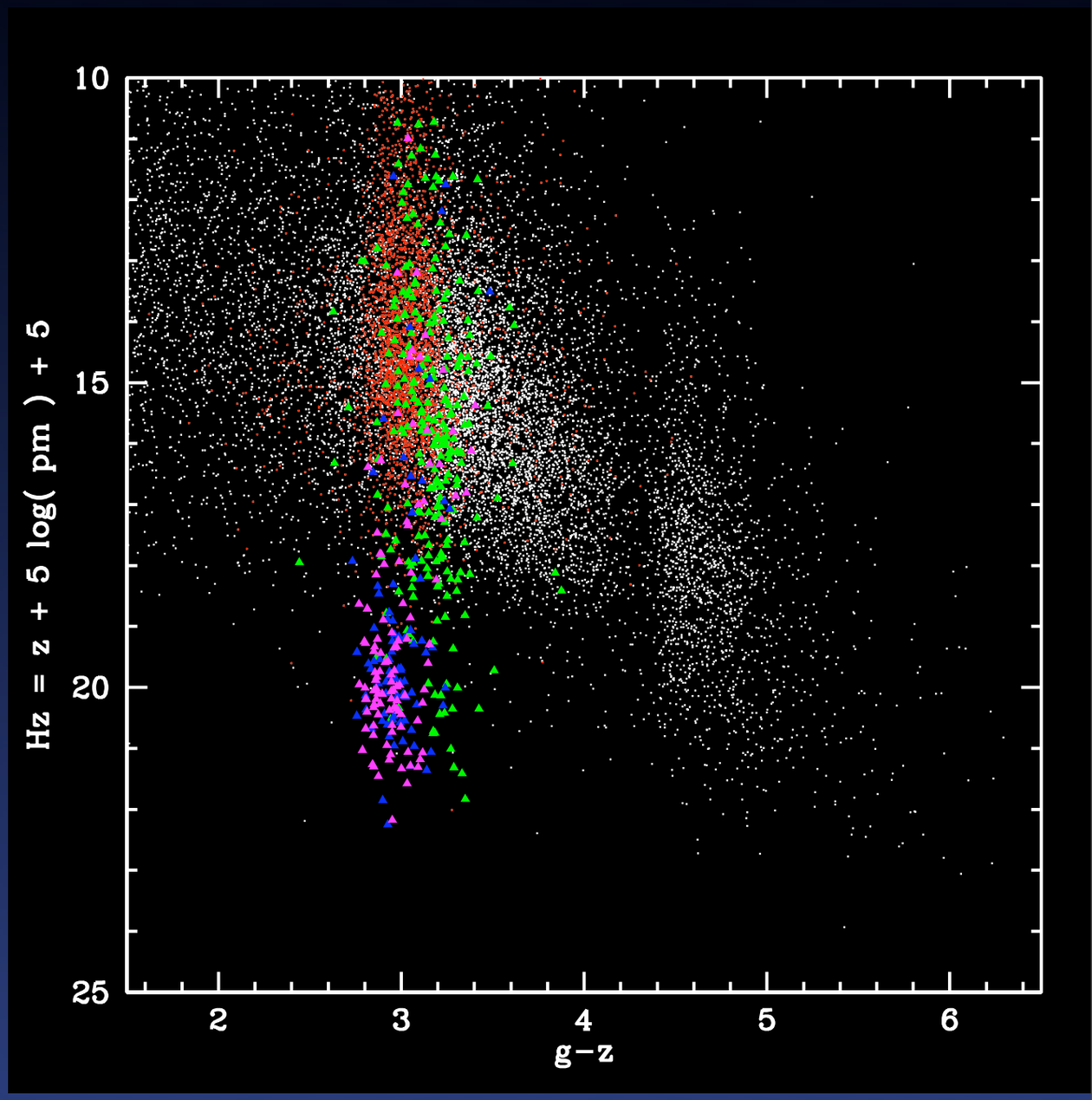
color-color (g-r / r-i)

reduced proper motion

color variation with subclass and subtype

M2 / sdM2 / esdM2 / usdM2



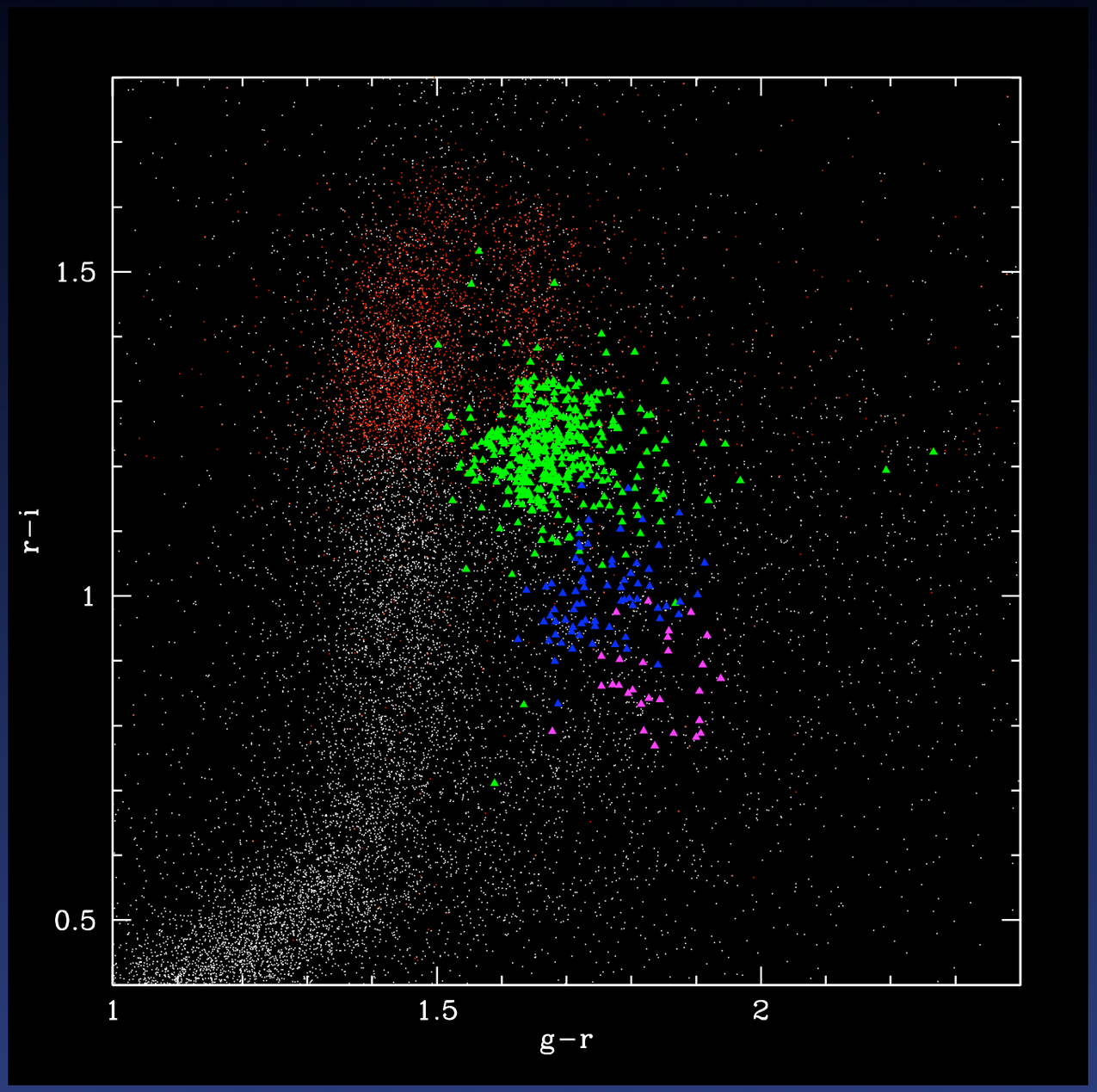


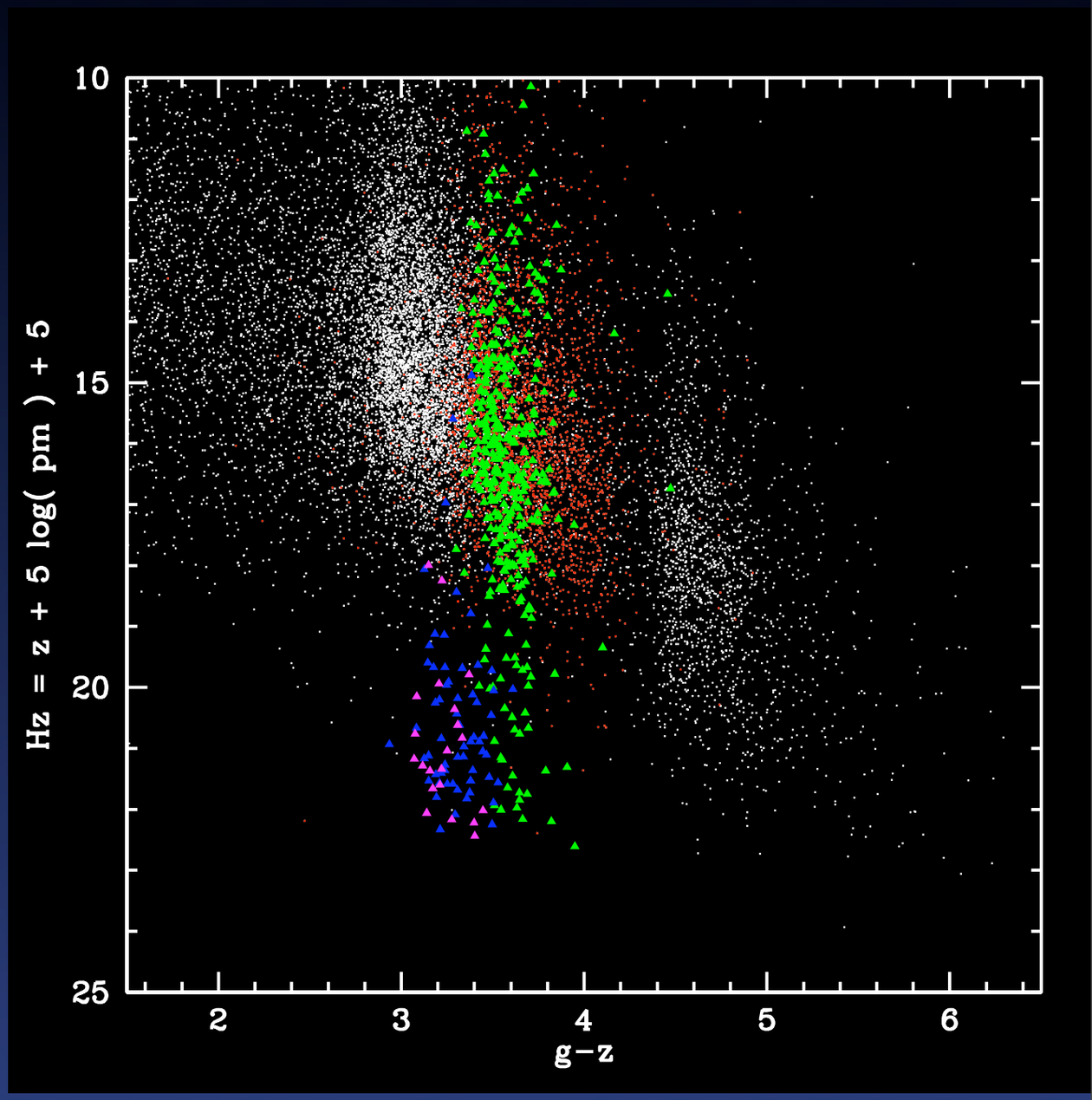
color-color (g-r / r-i)

reduced proper motion

color variation with subclass and subtype

M6 / sdM6 / esdM6 / usdM6



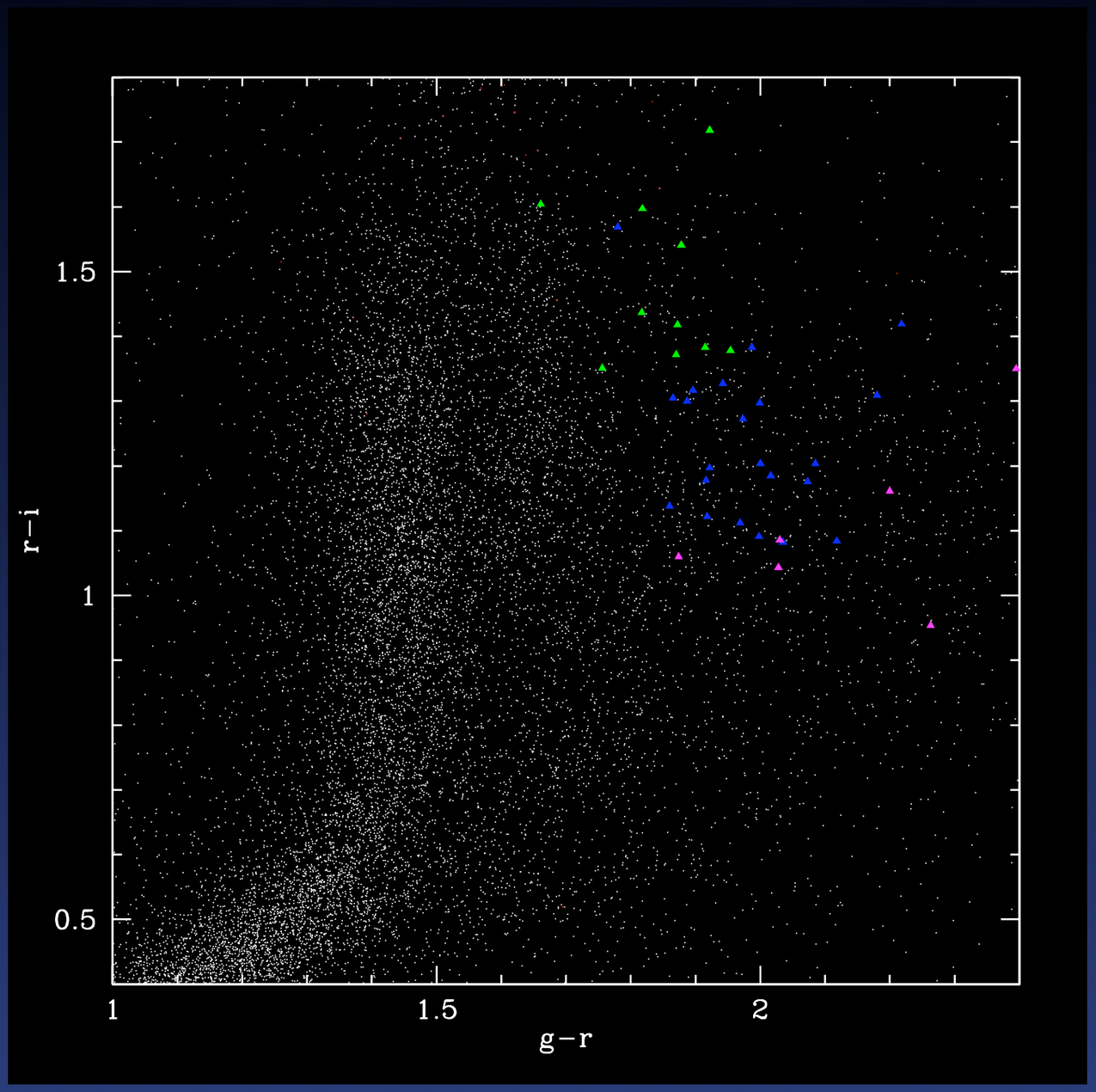


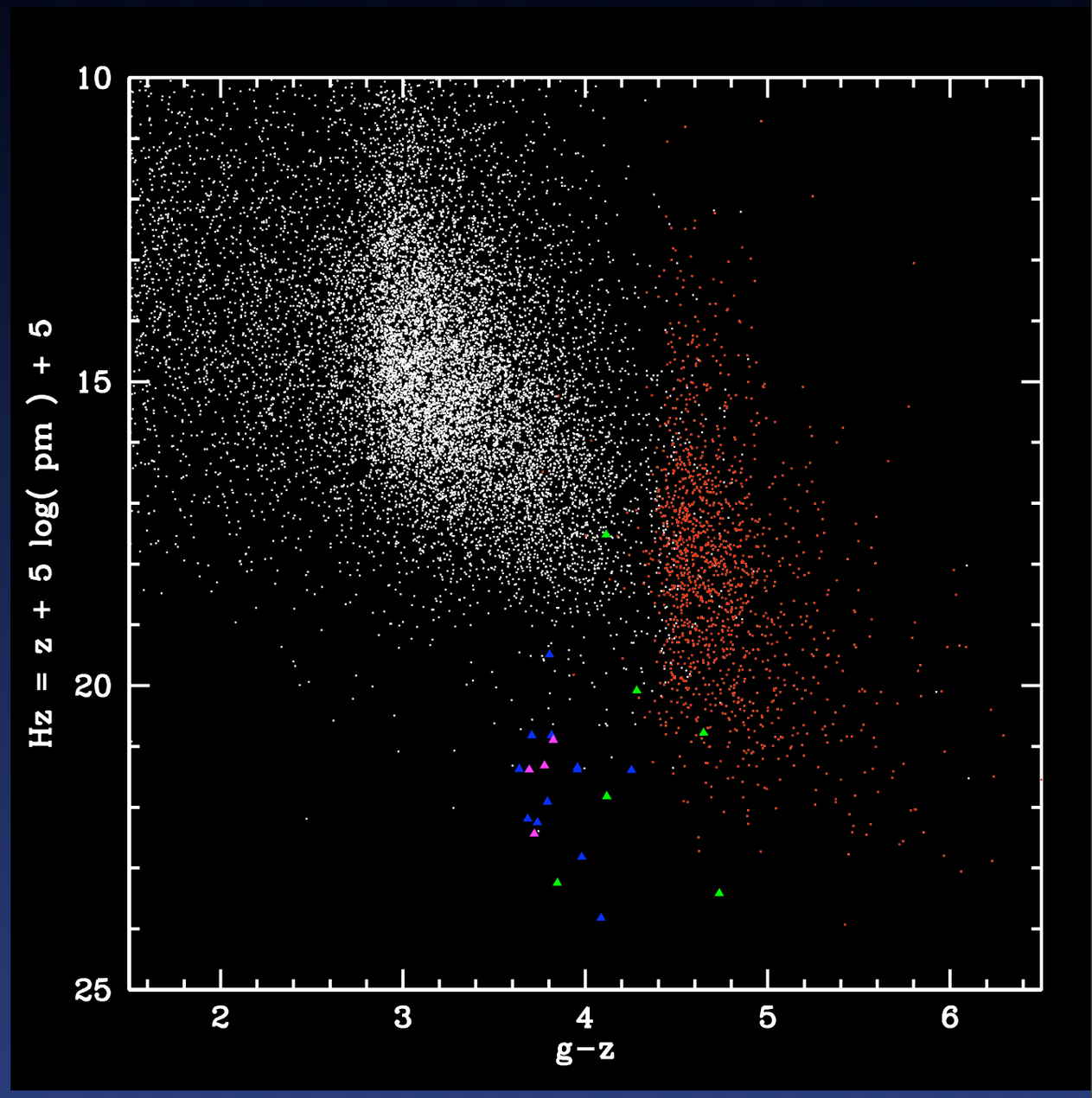
color-color (g-r / r-i)

reduced proper motion

color variation with subclass and subtype

M8 / sdM8 / esdM8 / usdM8

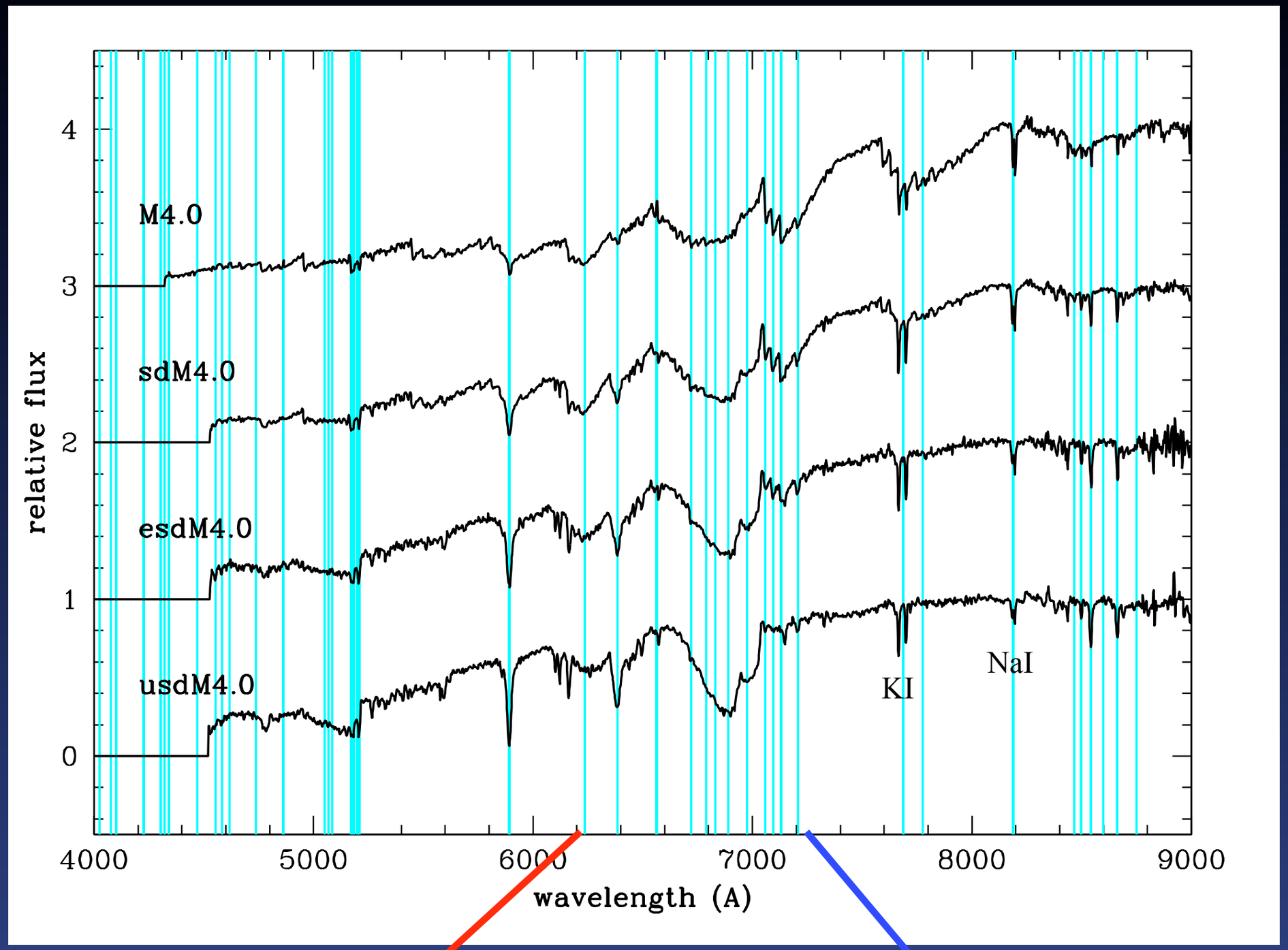




color-color (g-r / r-i)

reduced proper motion

New classification features - mid subdwarfs:



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Traditional classification features

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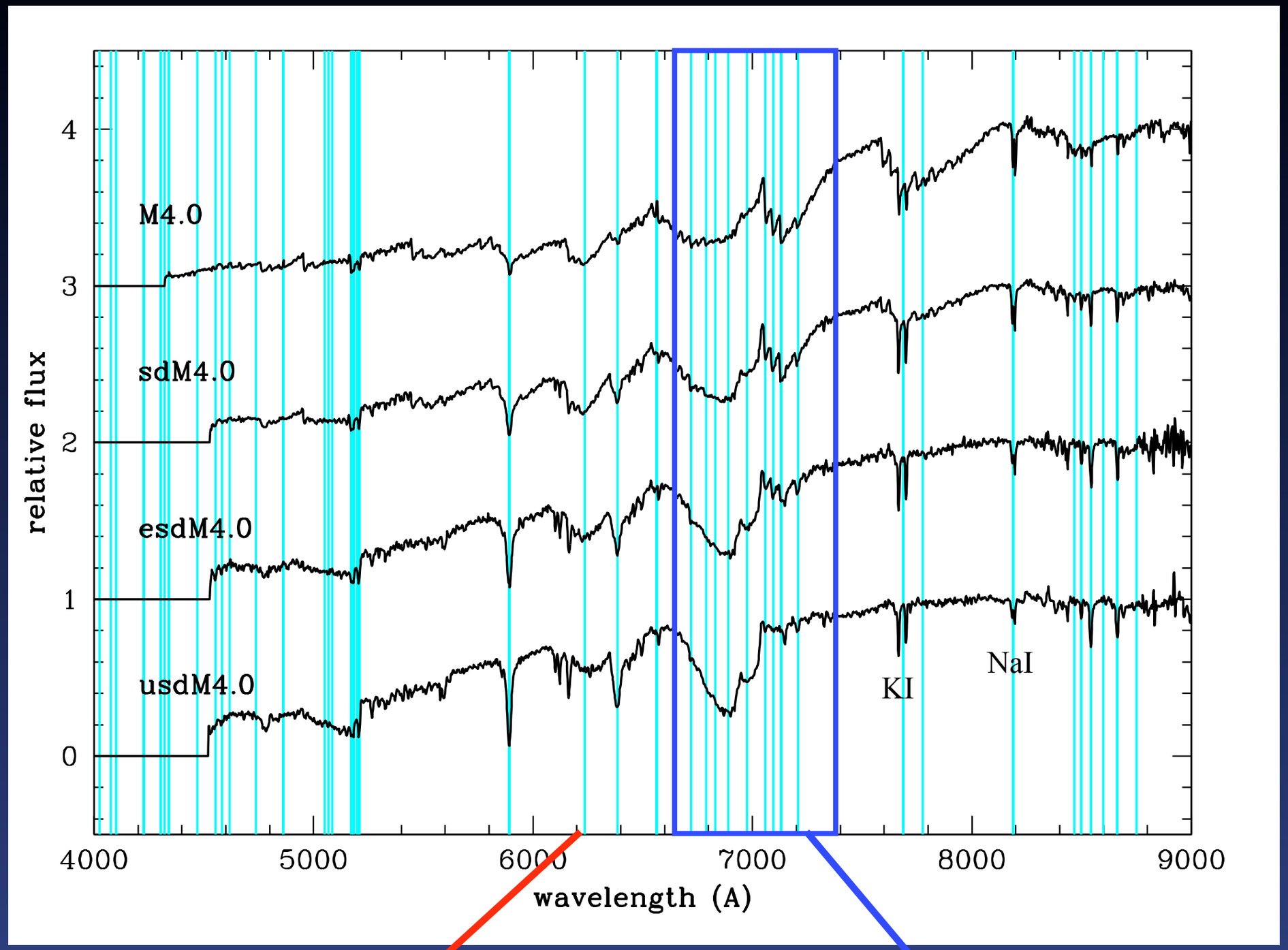

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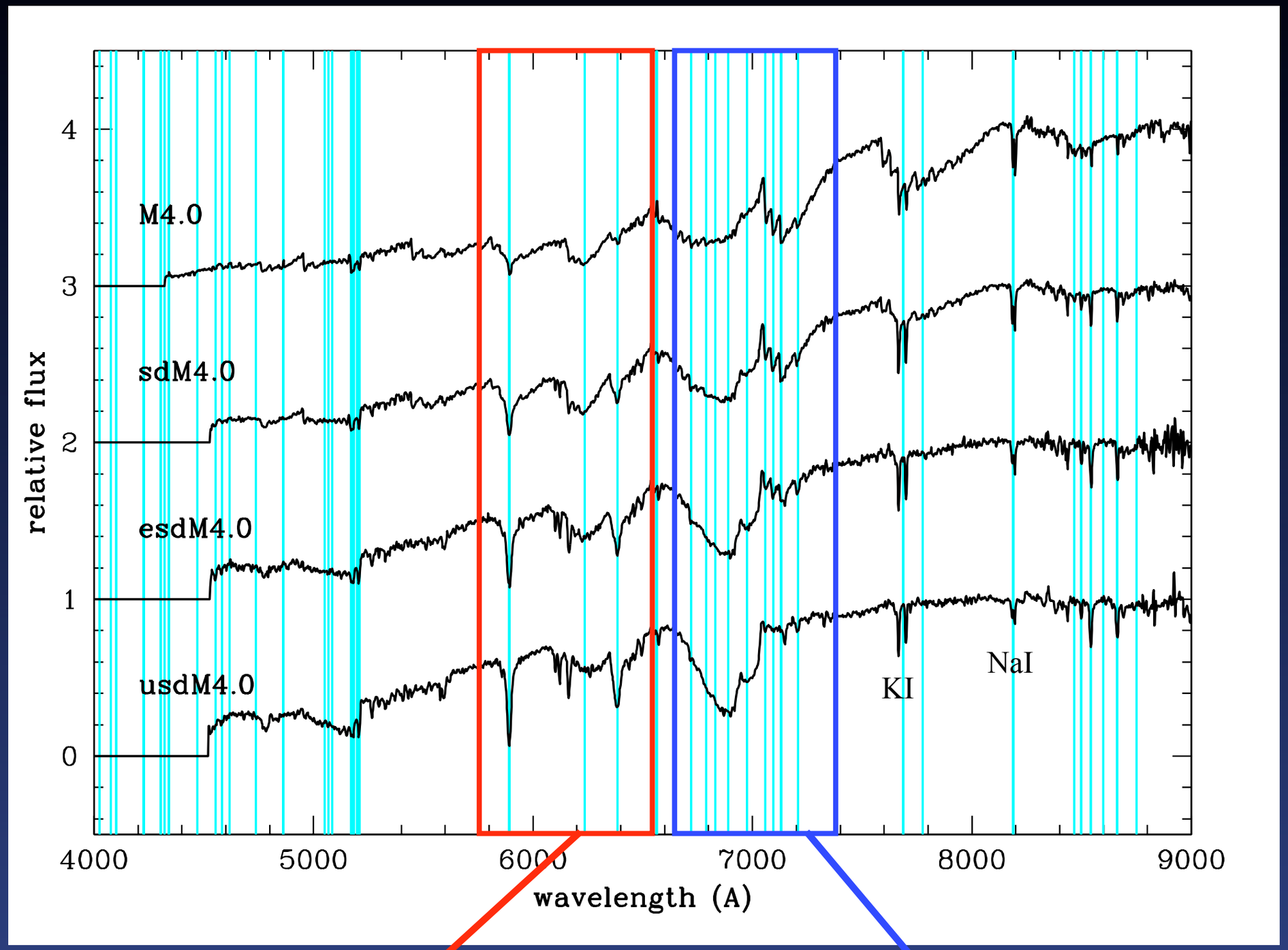

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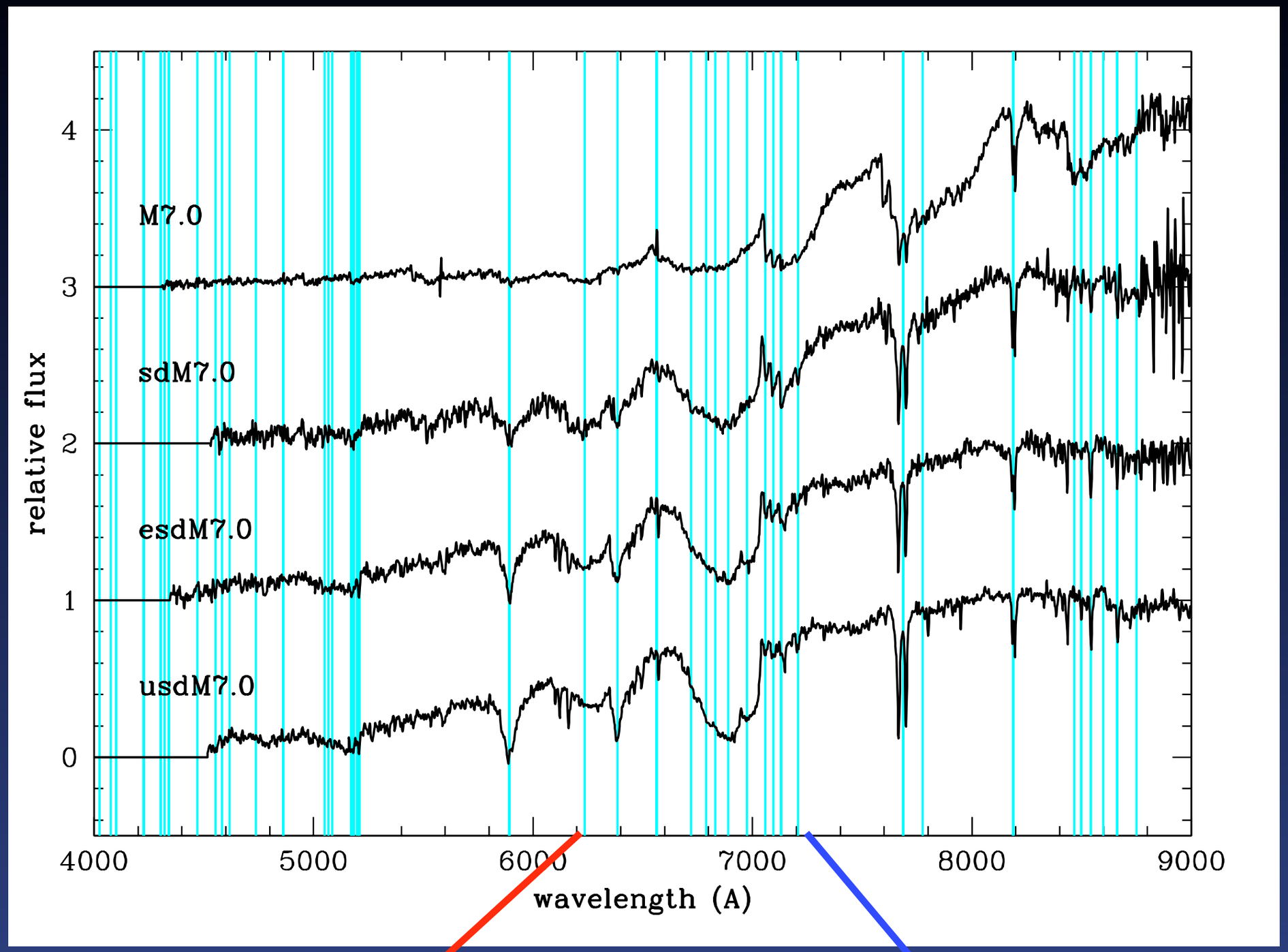

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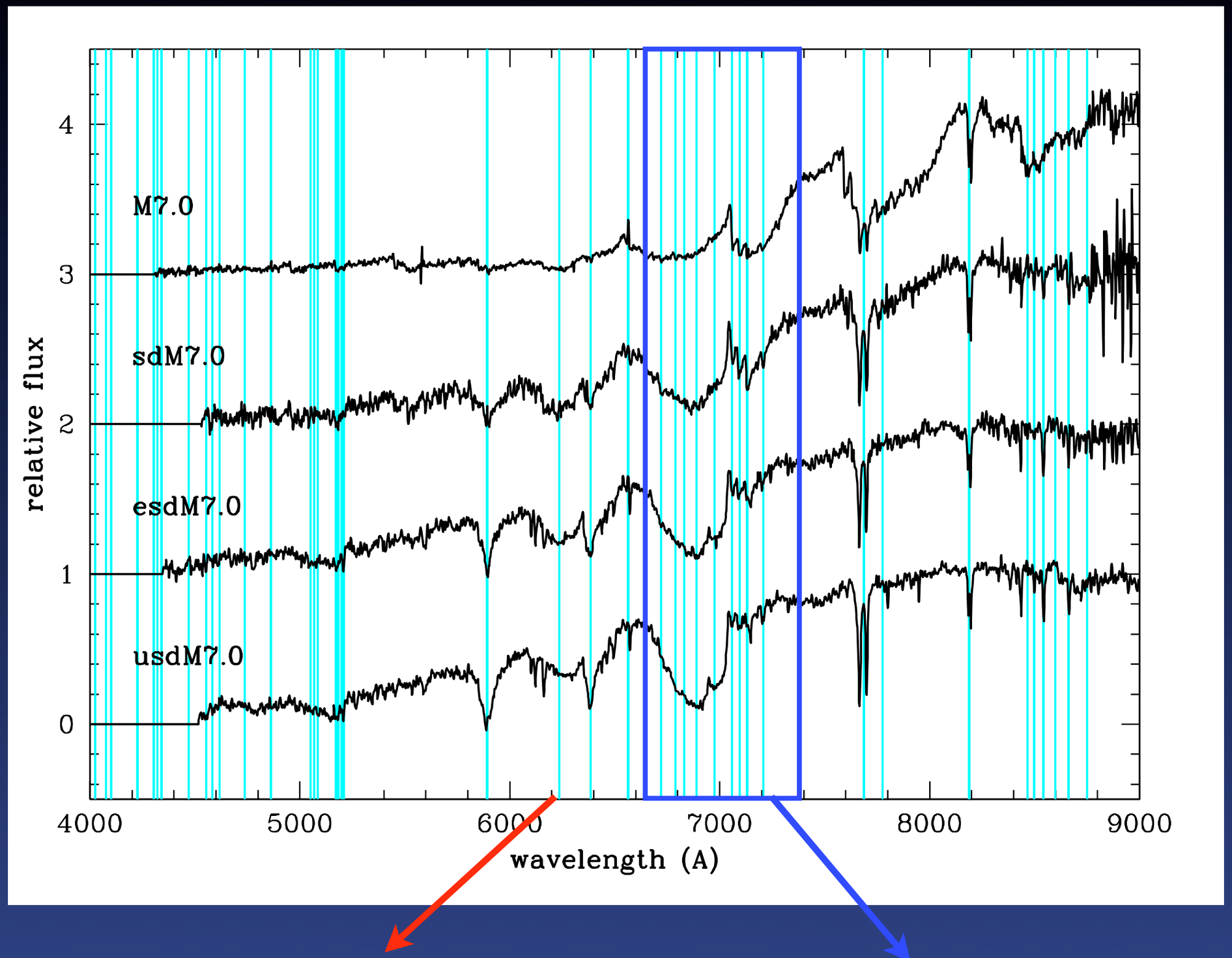

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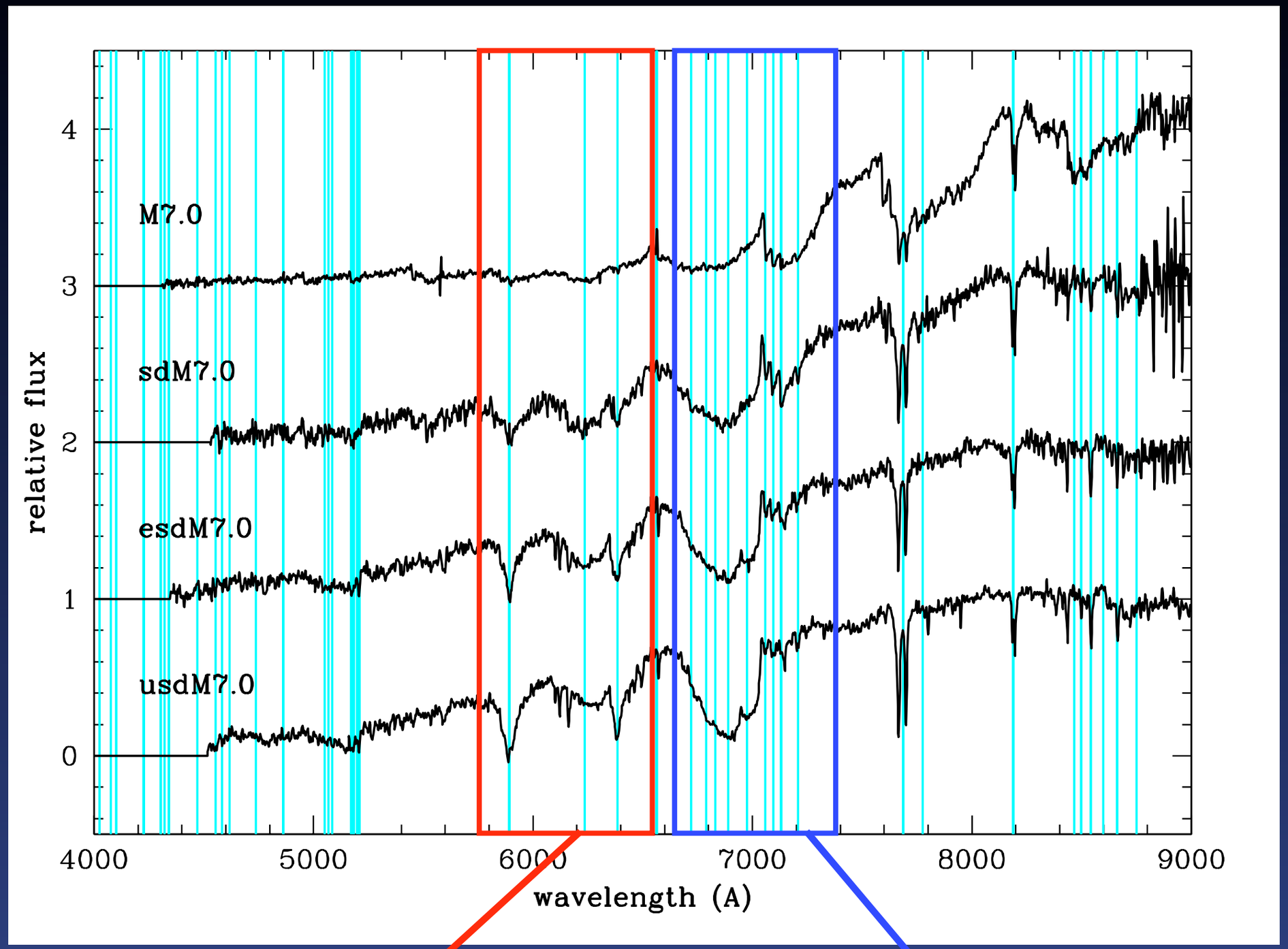

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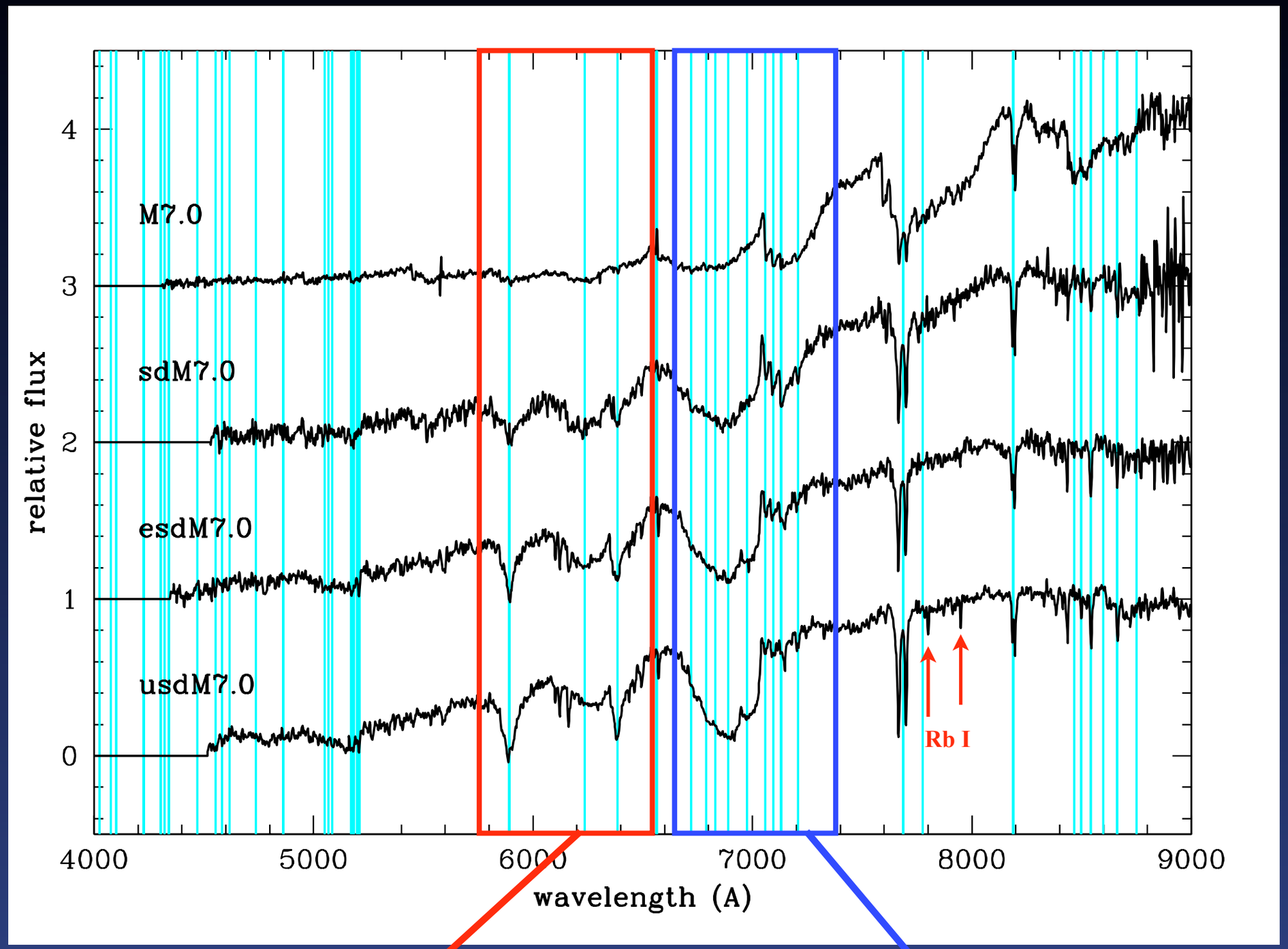
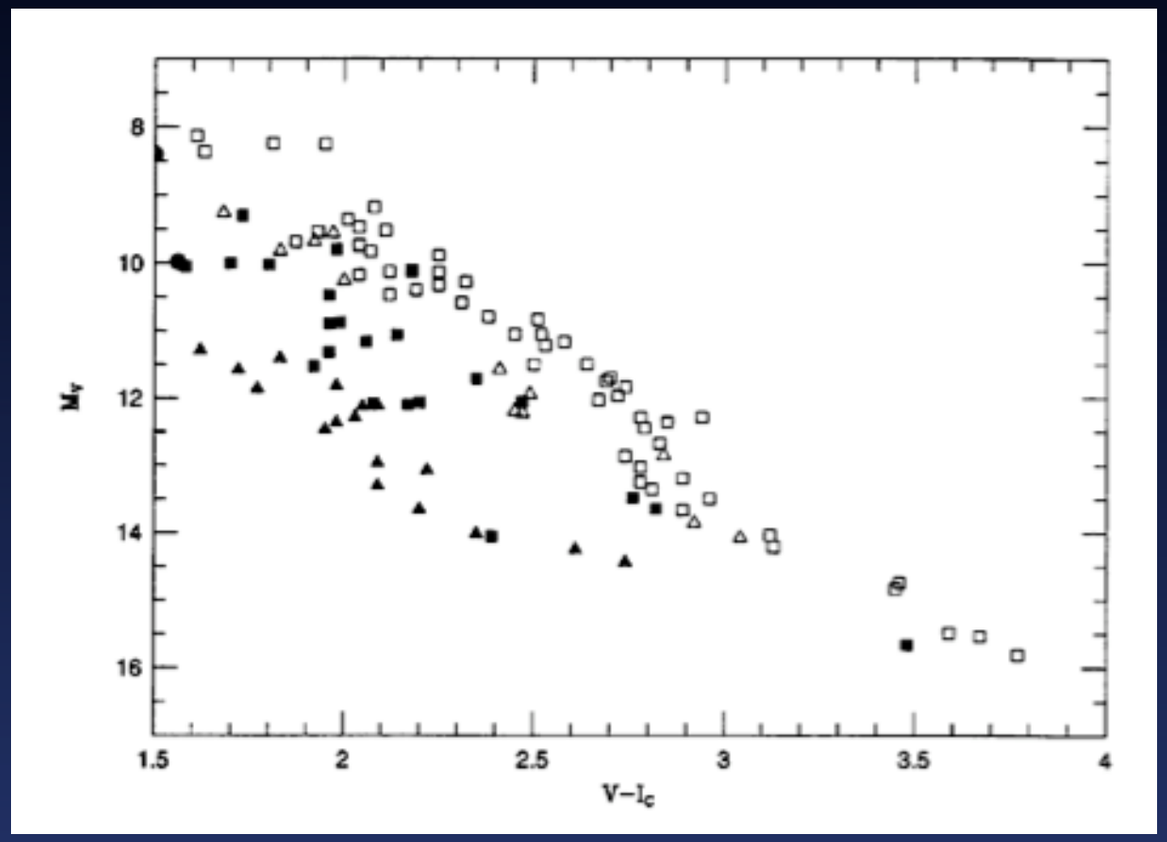


New classification features

Traditional classification features

Do we need the 4 “flavours” of low-mass stars?



Gizis (1997)

Getting the subclass (M/sdM/esdM/usdM) is critical for:

1 - Calibrating the color magnitude relationship to determine photometric distances.
2 - Simple estimating of the metallicity / population membership study.

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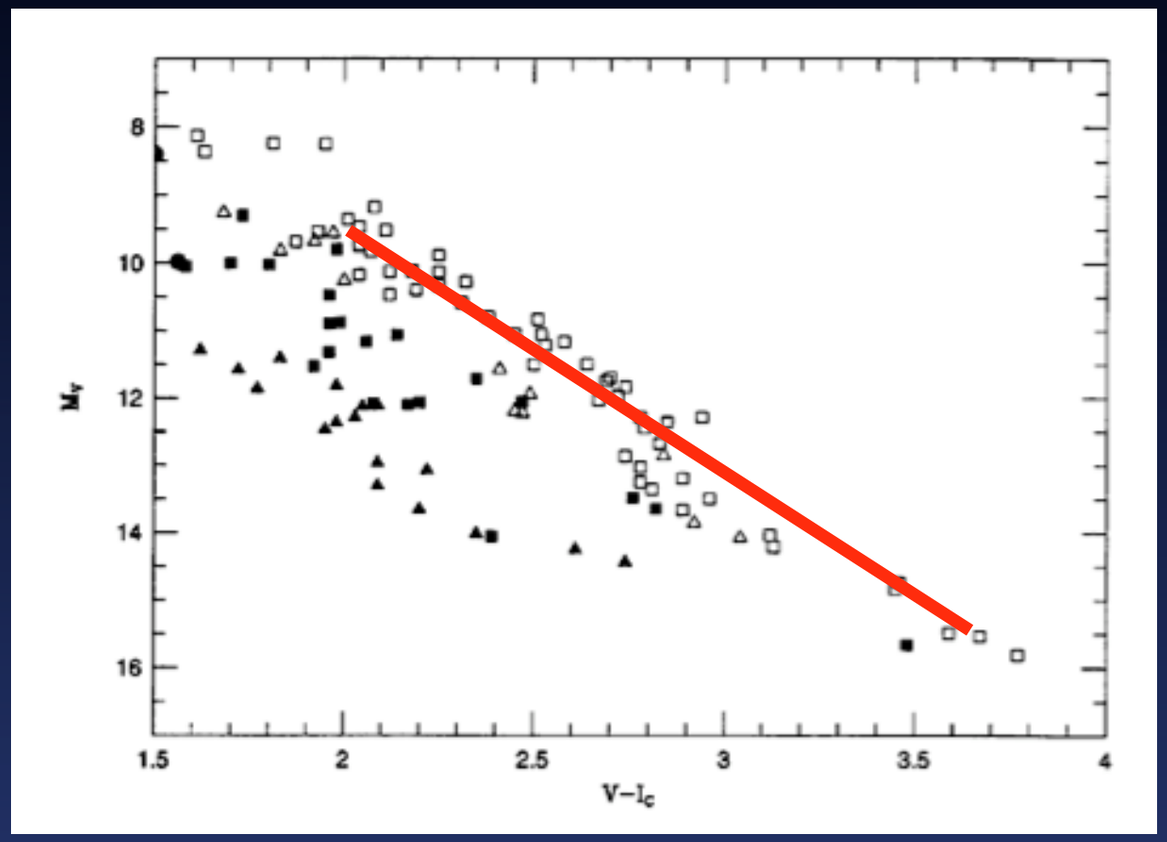

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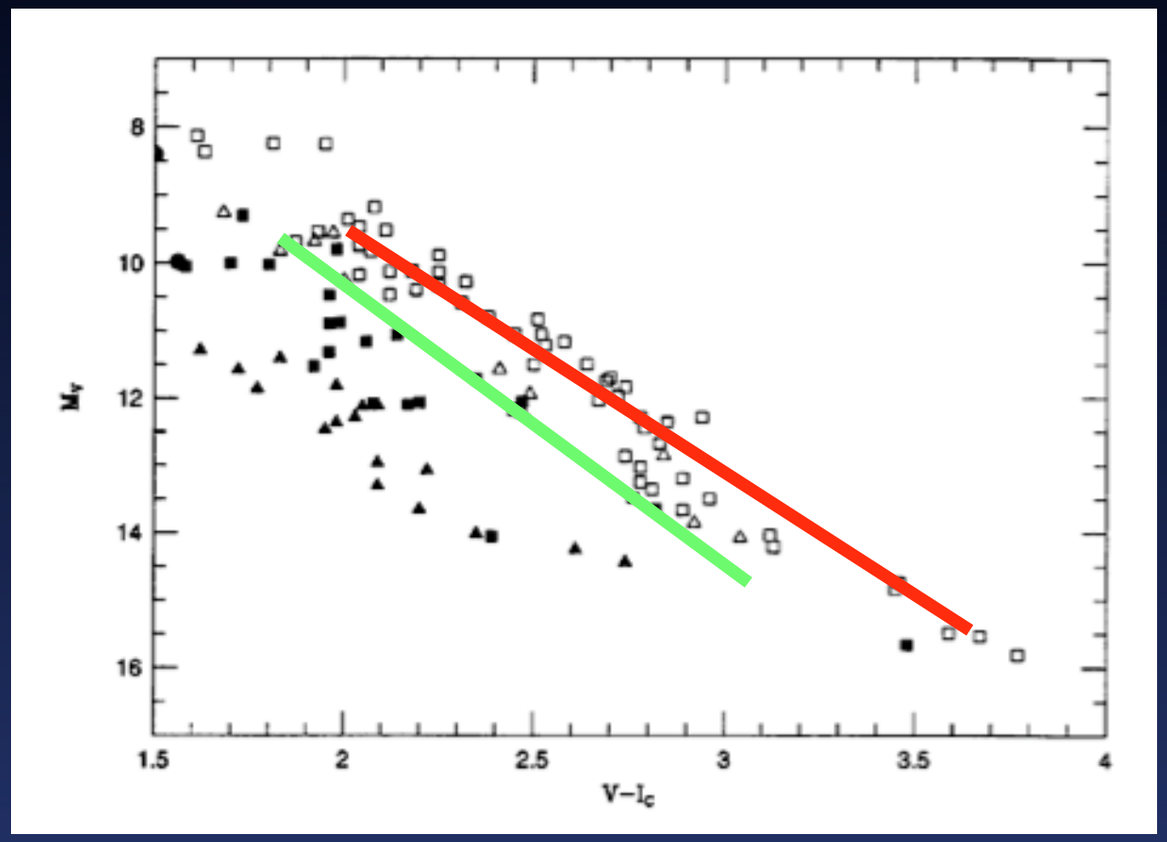

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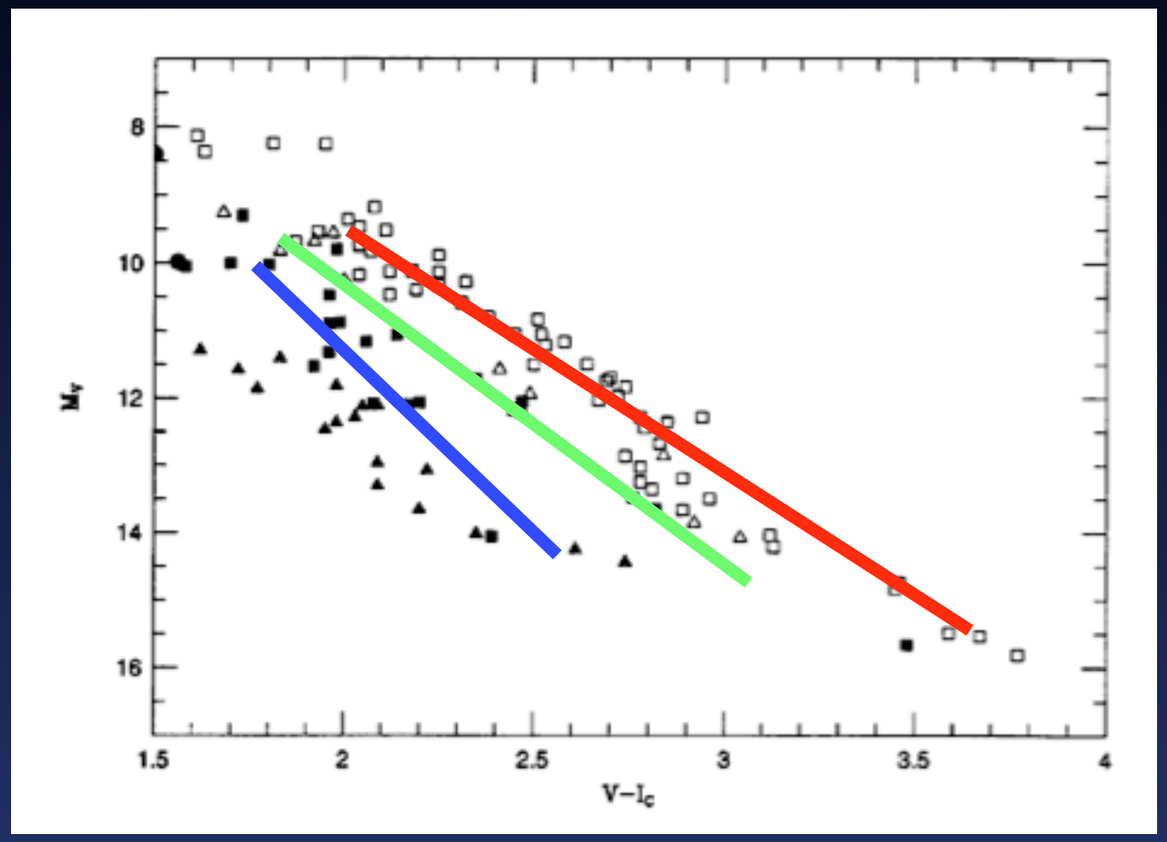

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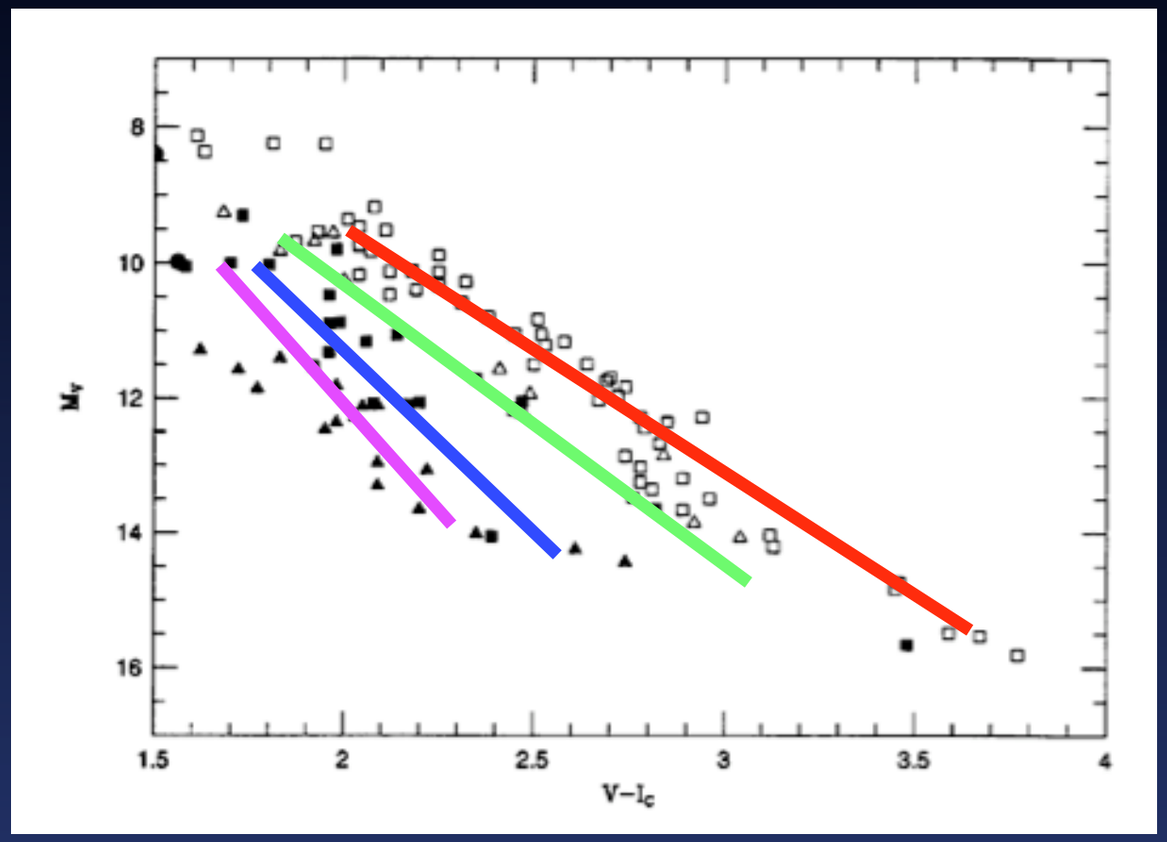

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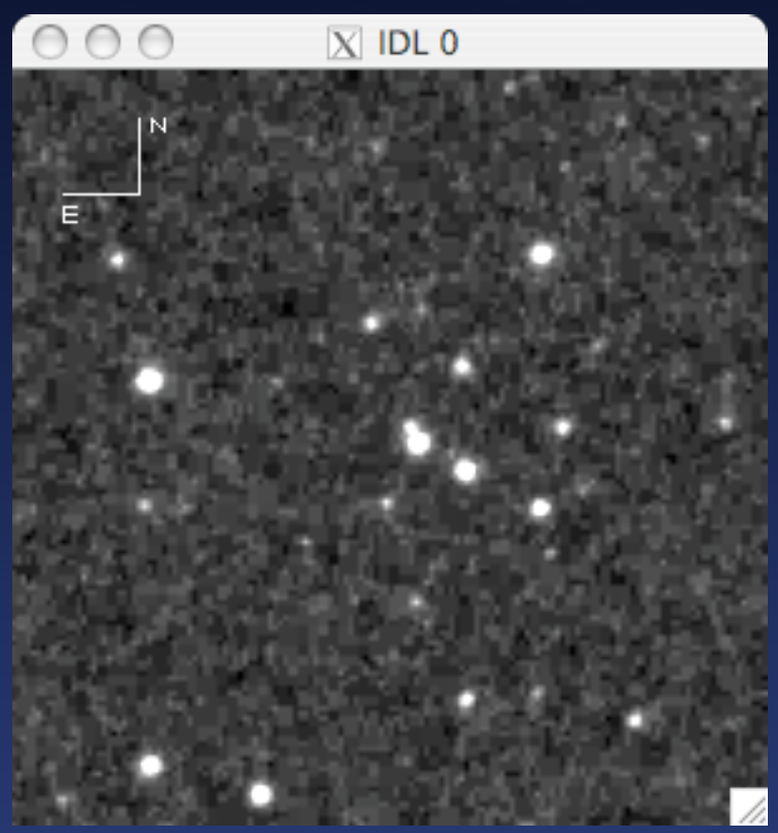
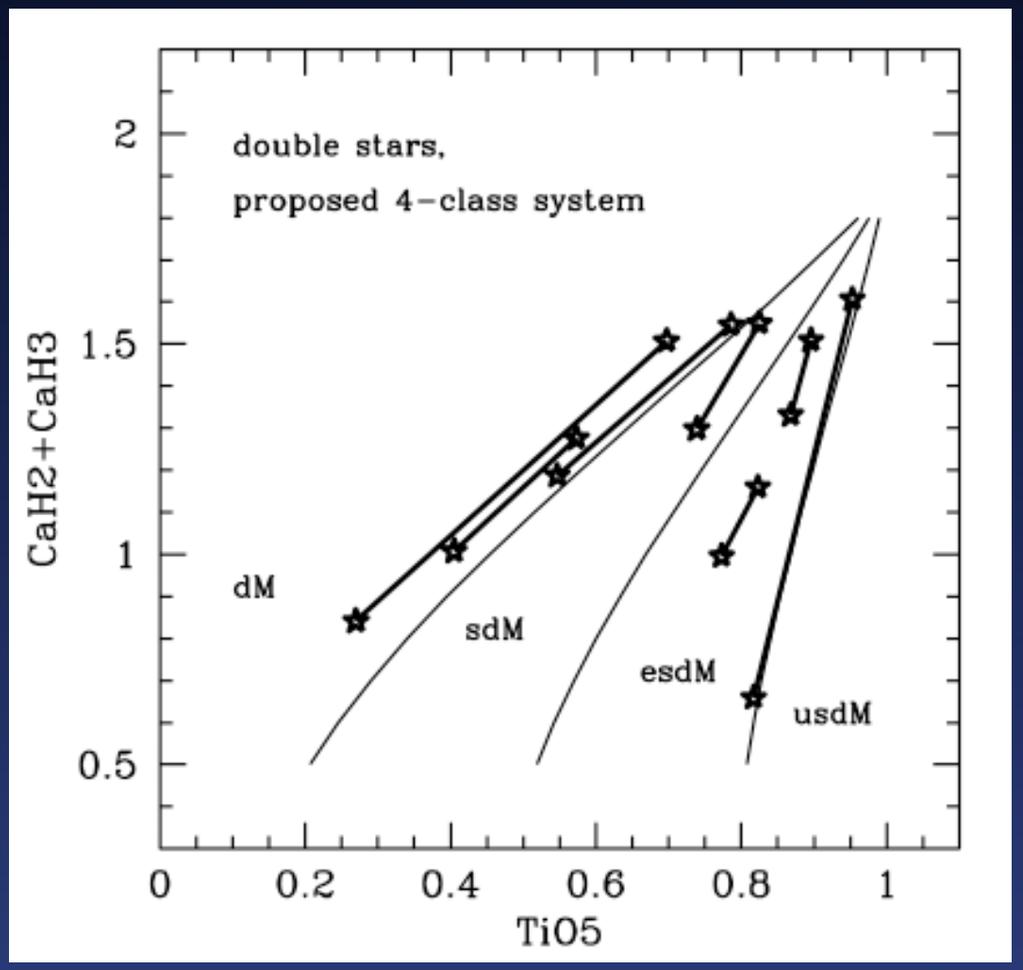
But are we sure these are metallicity effects?

Best evidence: the common proper motion pairs.





But there's not enough pairs which have been classified.
More are needed: this is the key to this problem!

U.S. National Science Foundation

- SIM / NStars grant AST-0087313
- Galactic Astronomy grant AST-0607757
- Research Experience for Undergraduates (REU) program

- Kalbfleich Research Fellowship
- Mr. Hilary Lipsitz