M type subdwarfs in LAMOST survey

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2017.02.19

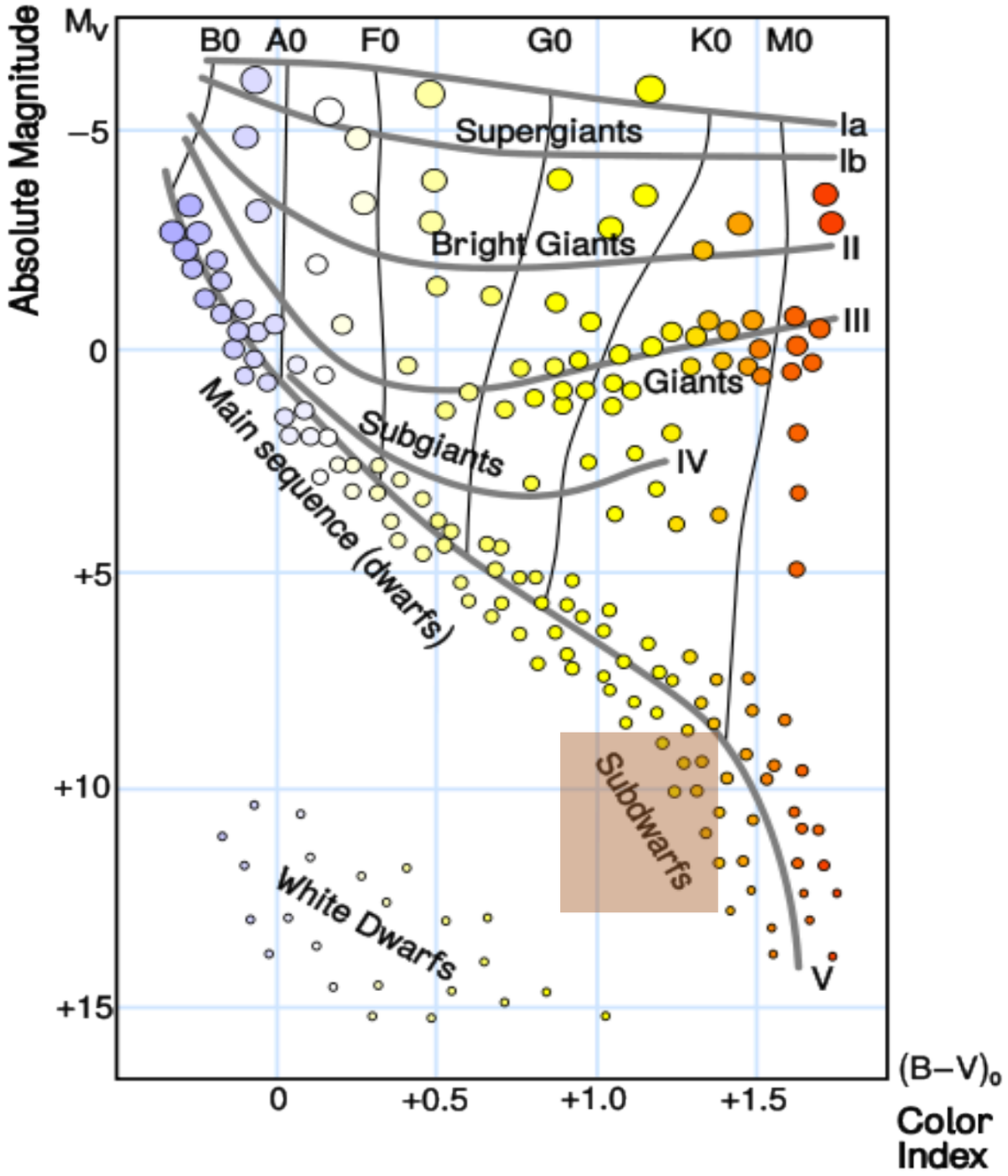
OUTLINE

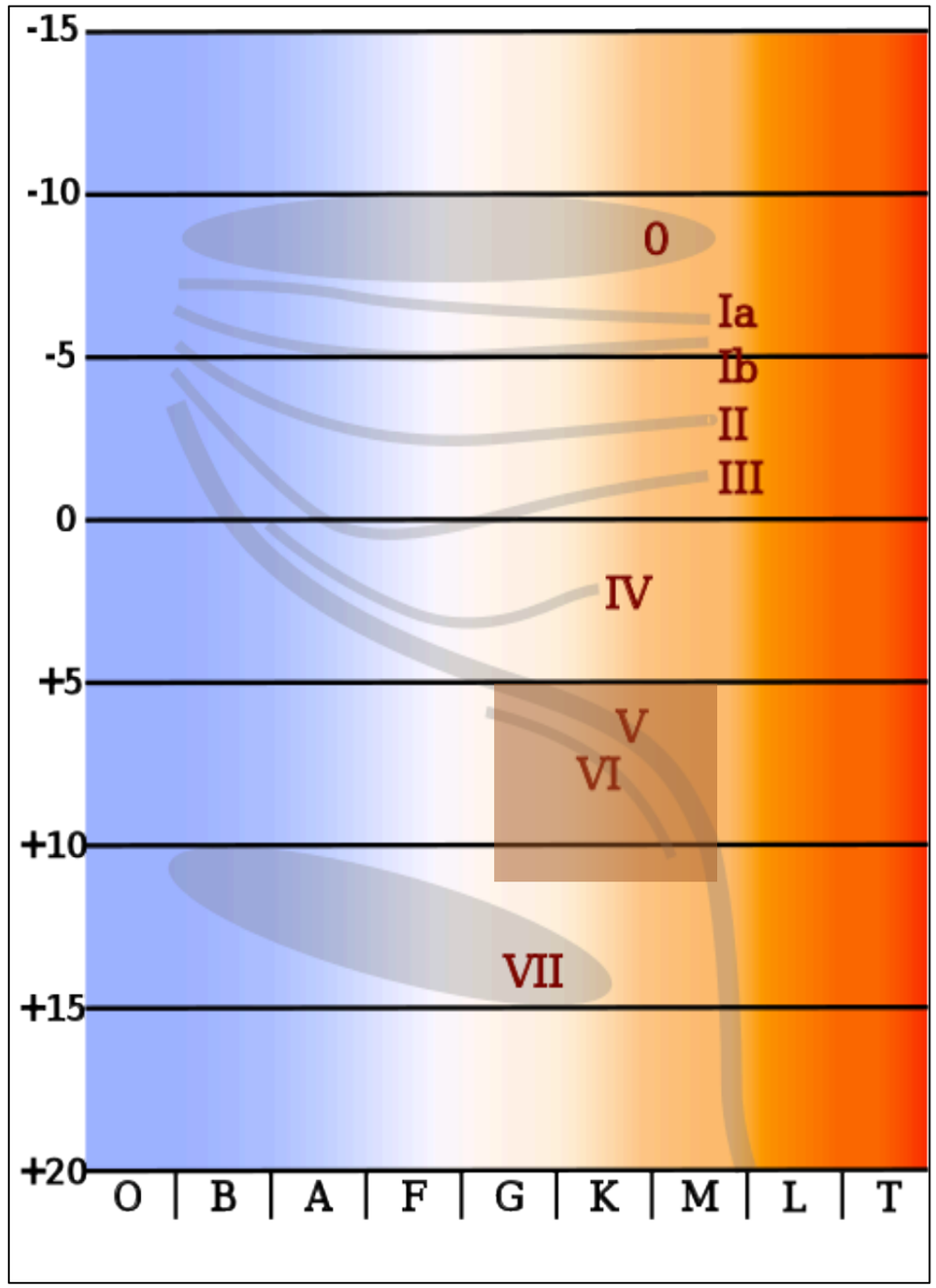
- I. History of the research on subdwarfs.

- II. The inadequacy of current classification method.

- III. The meaning and progress of establishing a new method.

I. HISTORY OF THE RESEARCH ON SUBDWARFS





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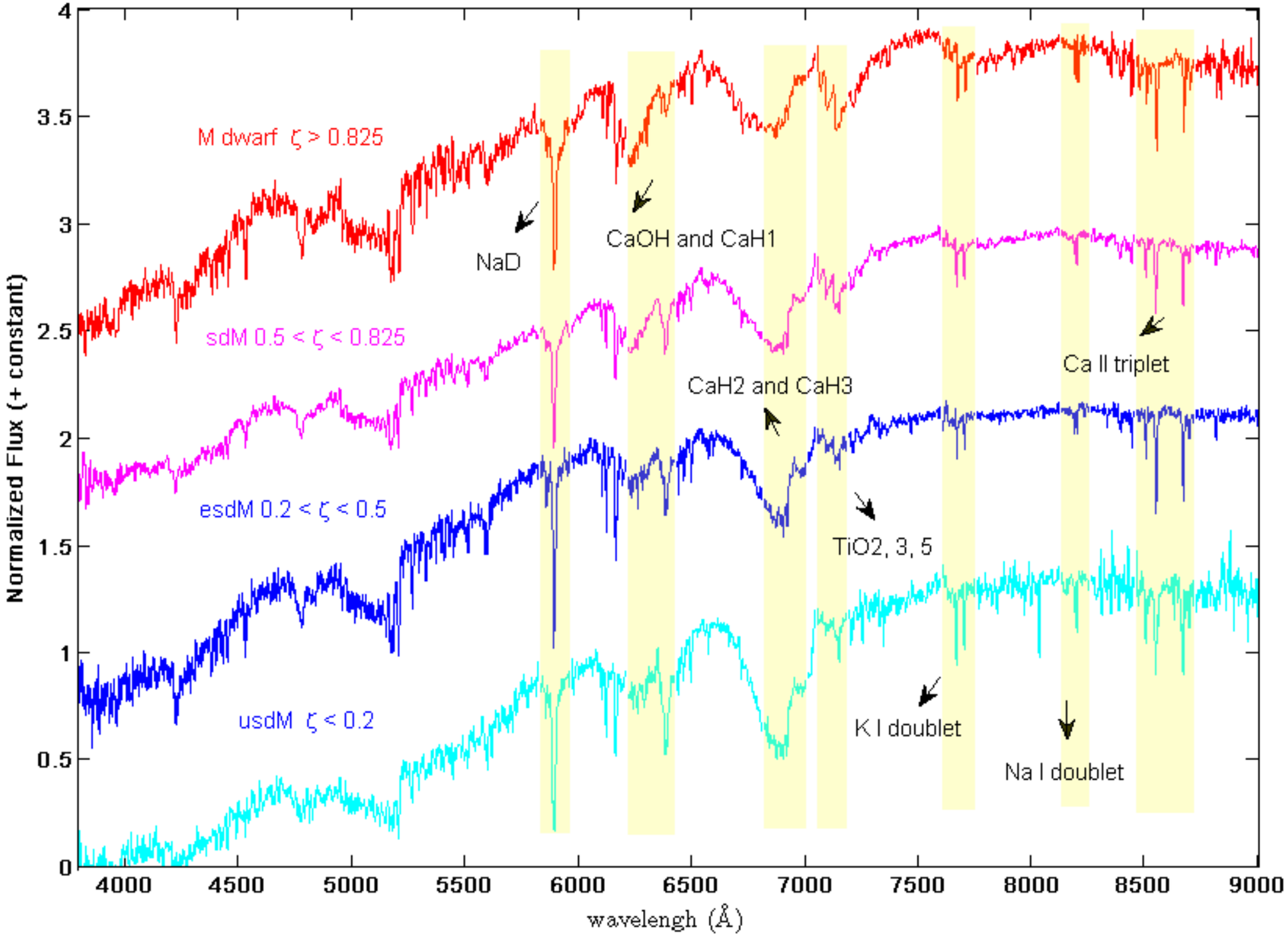

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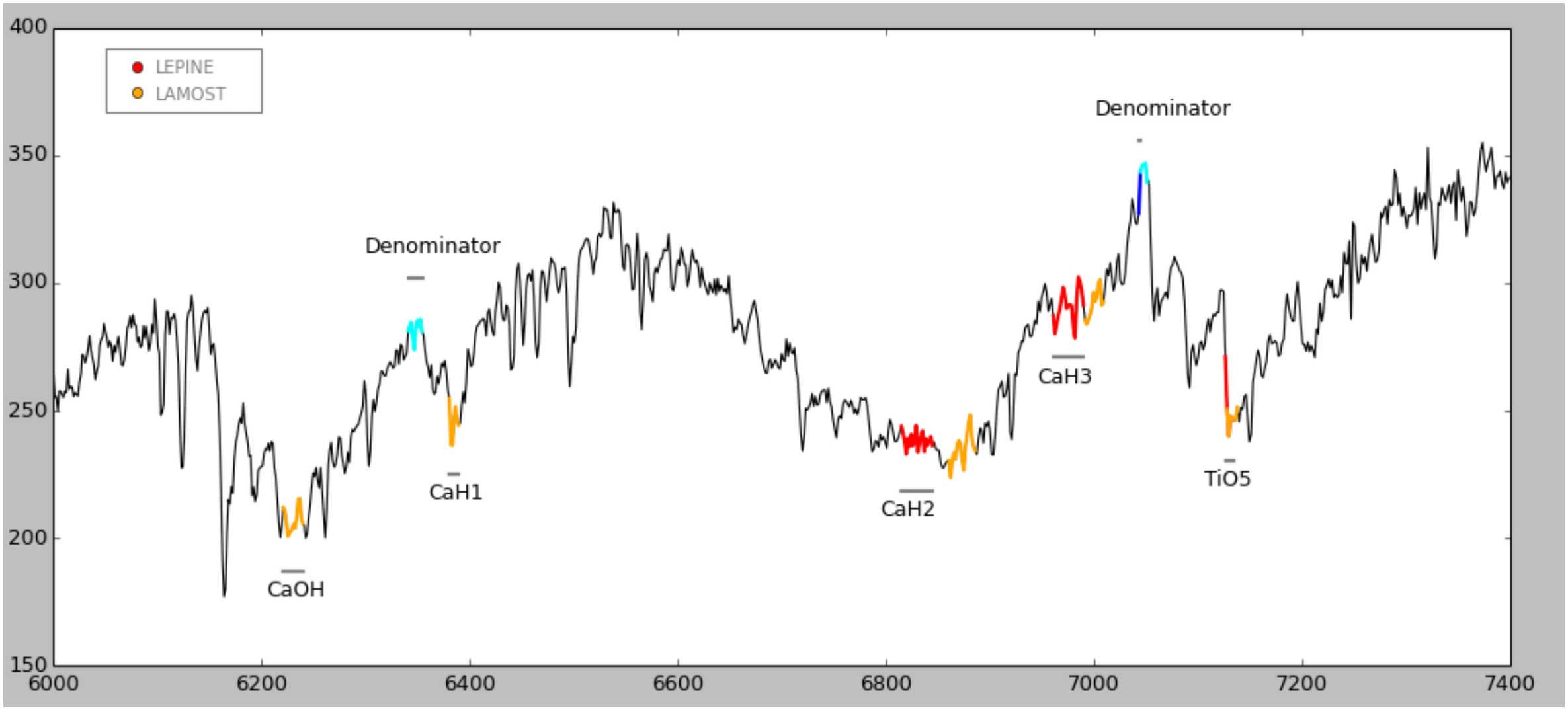

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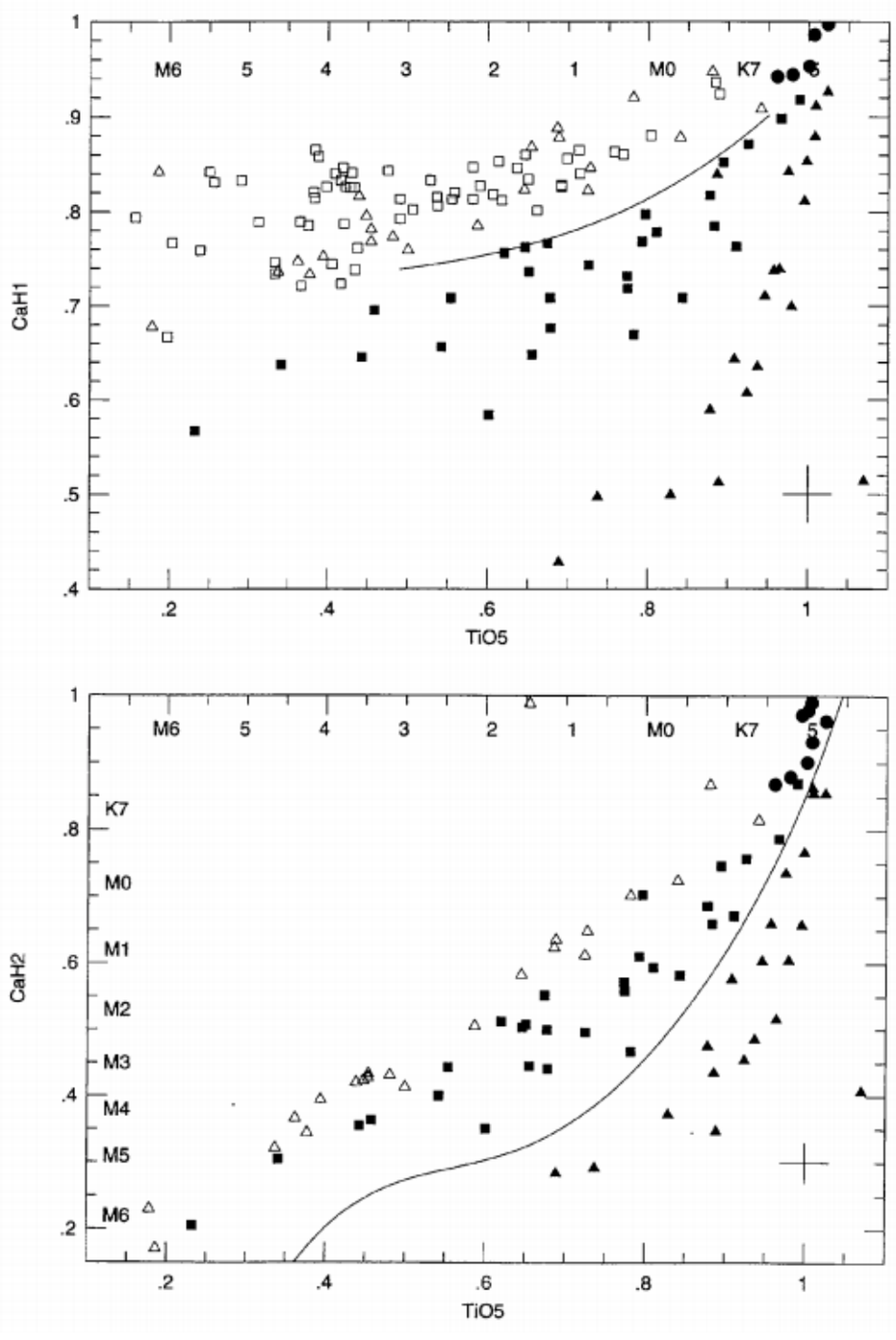

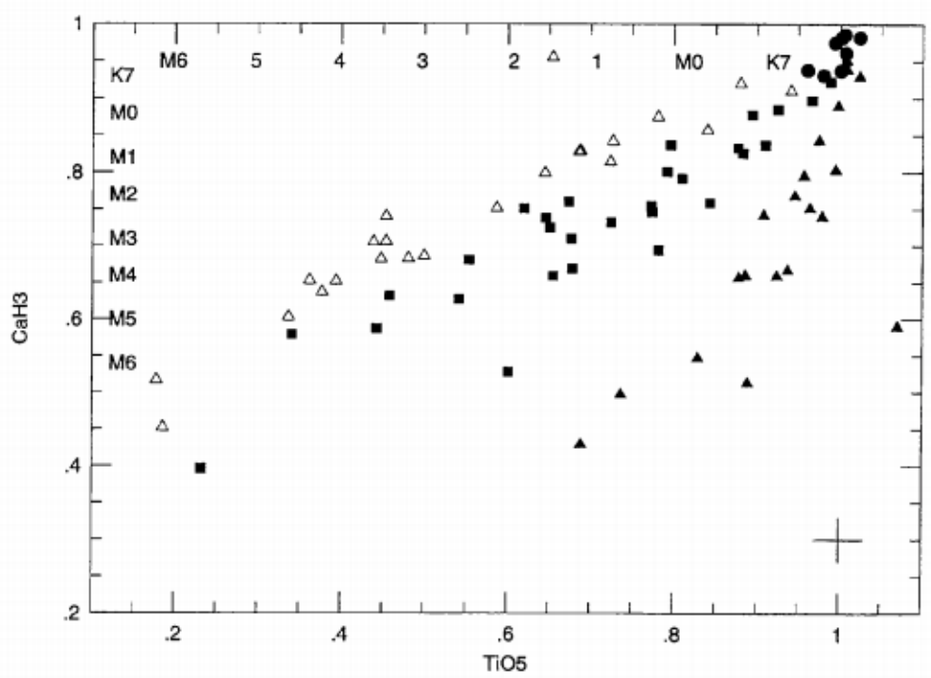

$$\mathrm{CaH1} < 0.695 \times \mathrm{TiO5}^3 - 0.818 \times \mathrm{TiO5}^2 + 0.413 \times \mathrm{TiO5} + 0.651, \quad (4)$$

$$\mathrm{CaH2} < 0.968 \times \mathrm{TiO5}^3 - 1.358 \times \mathrm{TiO5}^2 + 1.315 \times \mathrm{TiO5} - 0.033, \quad (5)$$

$$\mathrm{CaH3} < 0.639 \times \mathrm{TiO5}^3 - 1.199 \times \mathrm{TiO5}^2 + 1.161 \times \mathrm{TiO5} + 0.307. \quad (6)$$

$$Sp_{\mathrm{sdM}} = -16.02 \times \mathrm{CaH3} + 13.78, \quad (7)$$

$$Sp_{\mathrm{esdM}} = -13.47 \times \mathrm{CaH3} + 11.50. \quad (8)$$

（Gizis 1997）

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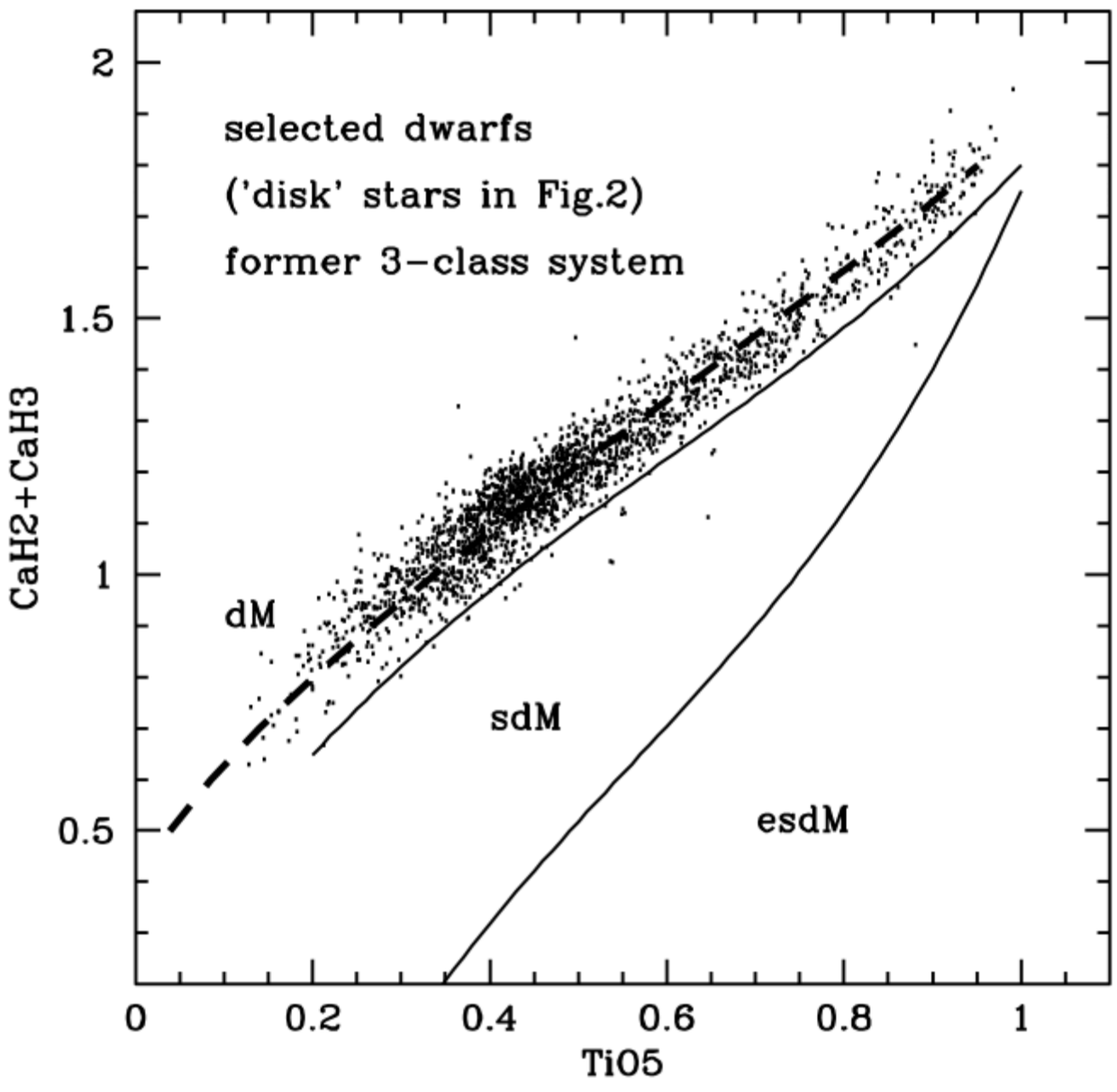
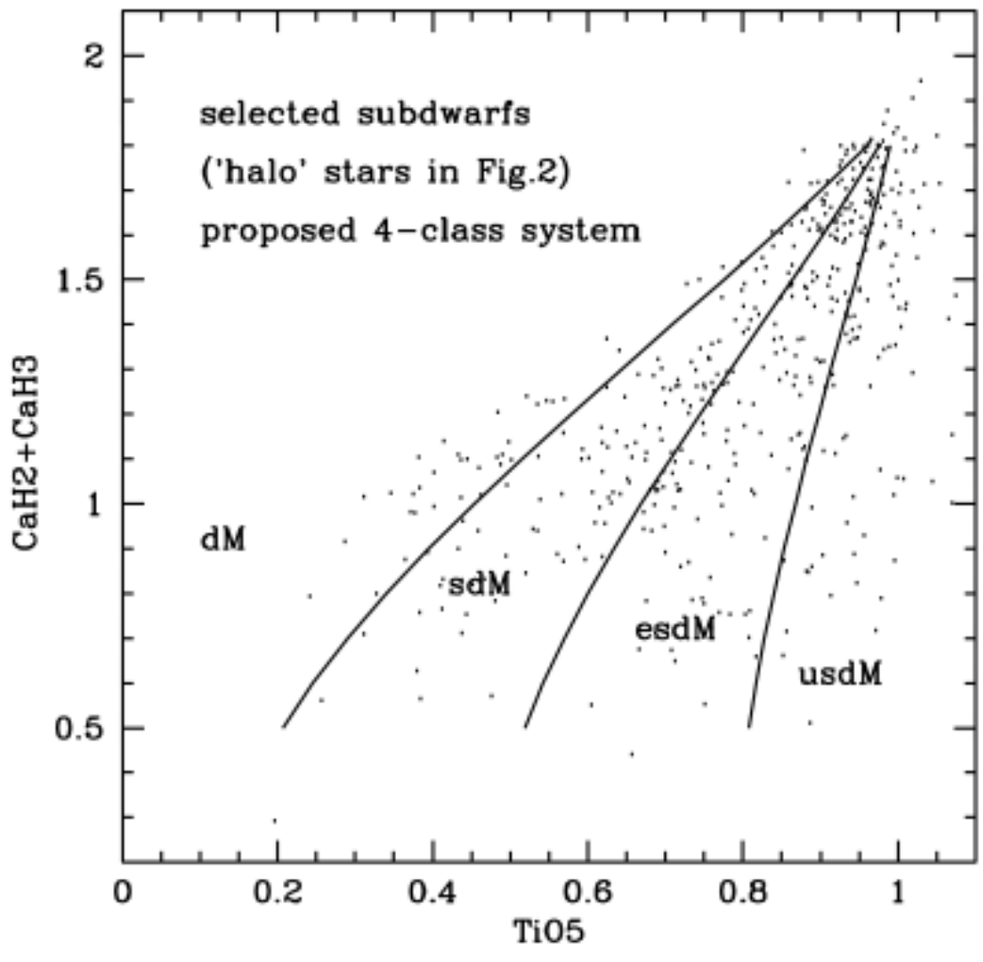
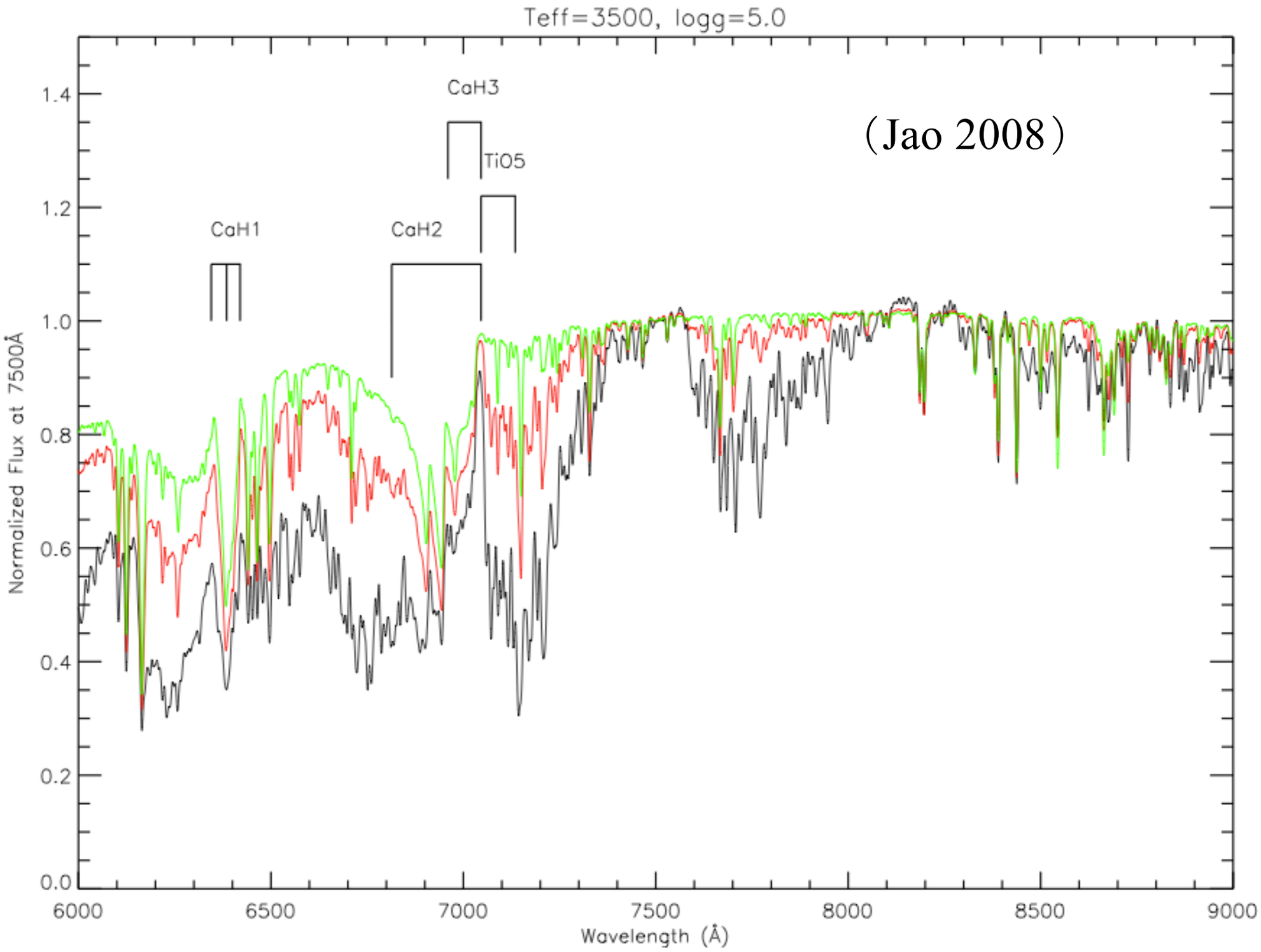


（Burgasser 2006）

（Lépine 2007）



II. INADEQUACY OF CURRENT CLASSIFICATION



（Jao 2008）

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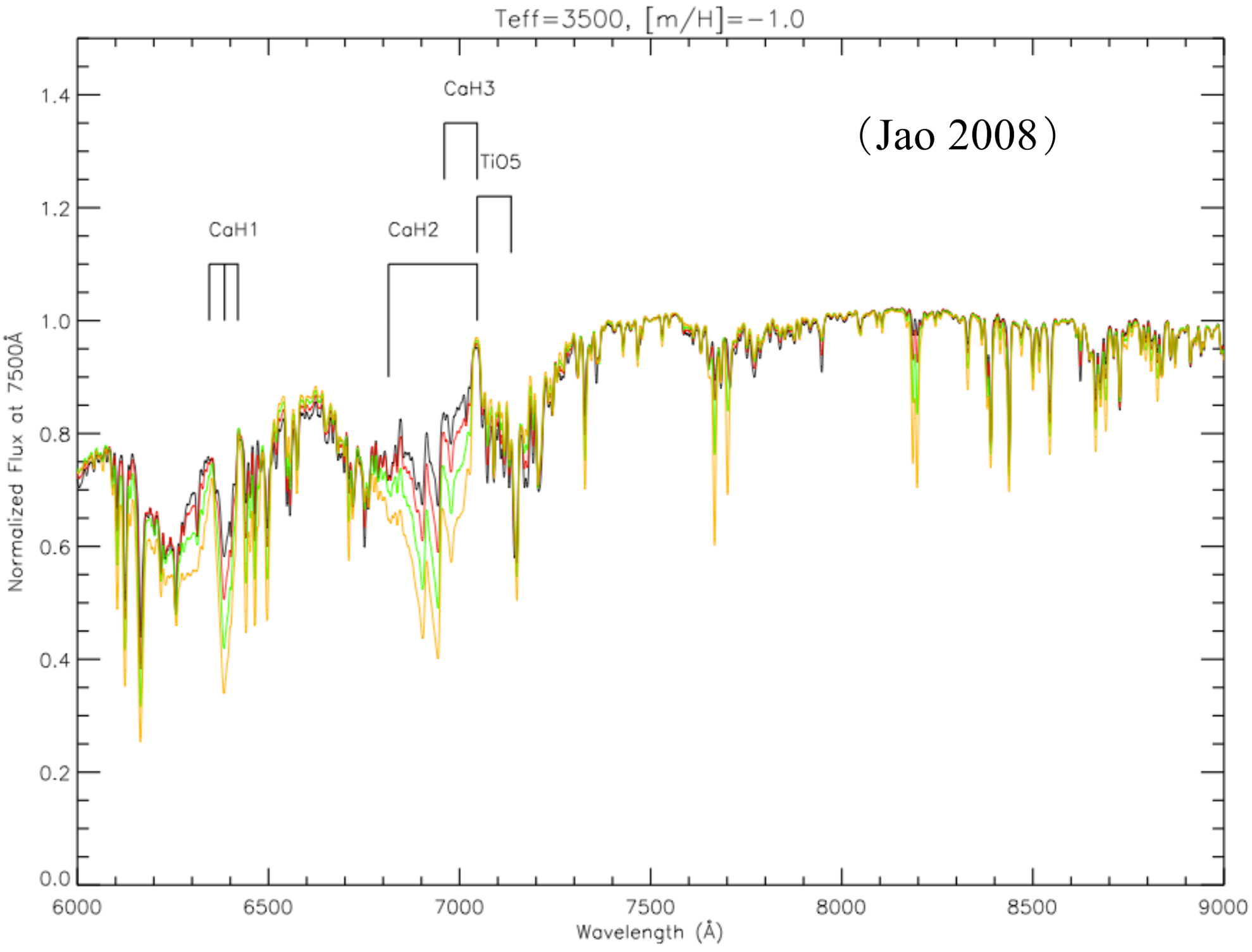


（Jao 2008）

II. INADEQUACY OF CURRENT CLASSIFICATION

Problem （Jao 2008）

Spectral

- **Difference between dwarfs and subdwarfs**
- **Dwarfs → Teff => spectral sequence;**
- **Subdwarfs → influenced by gravity.**

Subtype

- **Spectral types not directly linked to either the main-sequence or giant counterparts**
- **Many are assigned different subtypes though their differences are limited to CaH**

Metallicity

- **Empirically, the values of the indices are affected by a complicated interplay of temperature, metallicity, and gravity effects. One cannot separate these three factors simply based on the indices.**
- **“sd, esd, usd” infers the ratio of TiO and CaH, but which may not influenced by**

II. INADEQUACY OF CURRENT CLASSIFICATION

（Jao 2008）

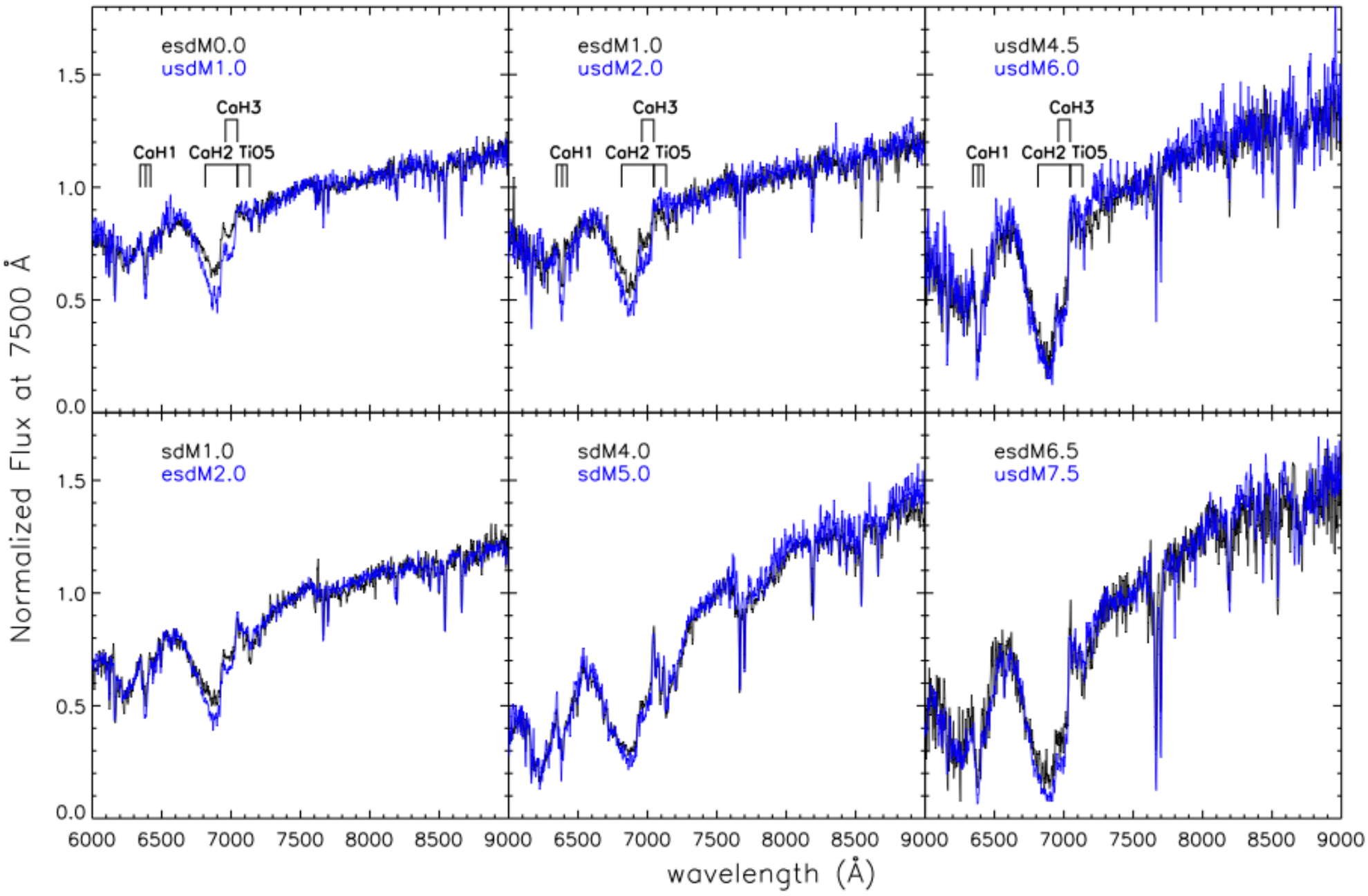


Figure 34. Spectra from Lépine et al. (2007) with their published types. The colors (black and blue) represent different spectra, and their colors match with labels. Each pair has almost the same overall spectral shape, but each star is assigned a different subtype and identification as extreme or ultra. Spectra are normalized at 7500 Å.

II. INADEQUACY OF CURRENT CLASSIFICATION

Solution (Jao 2008)

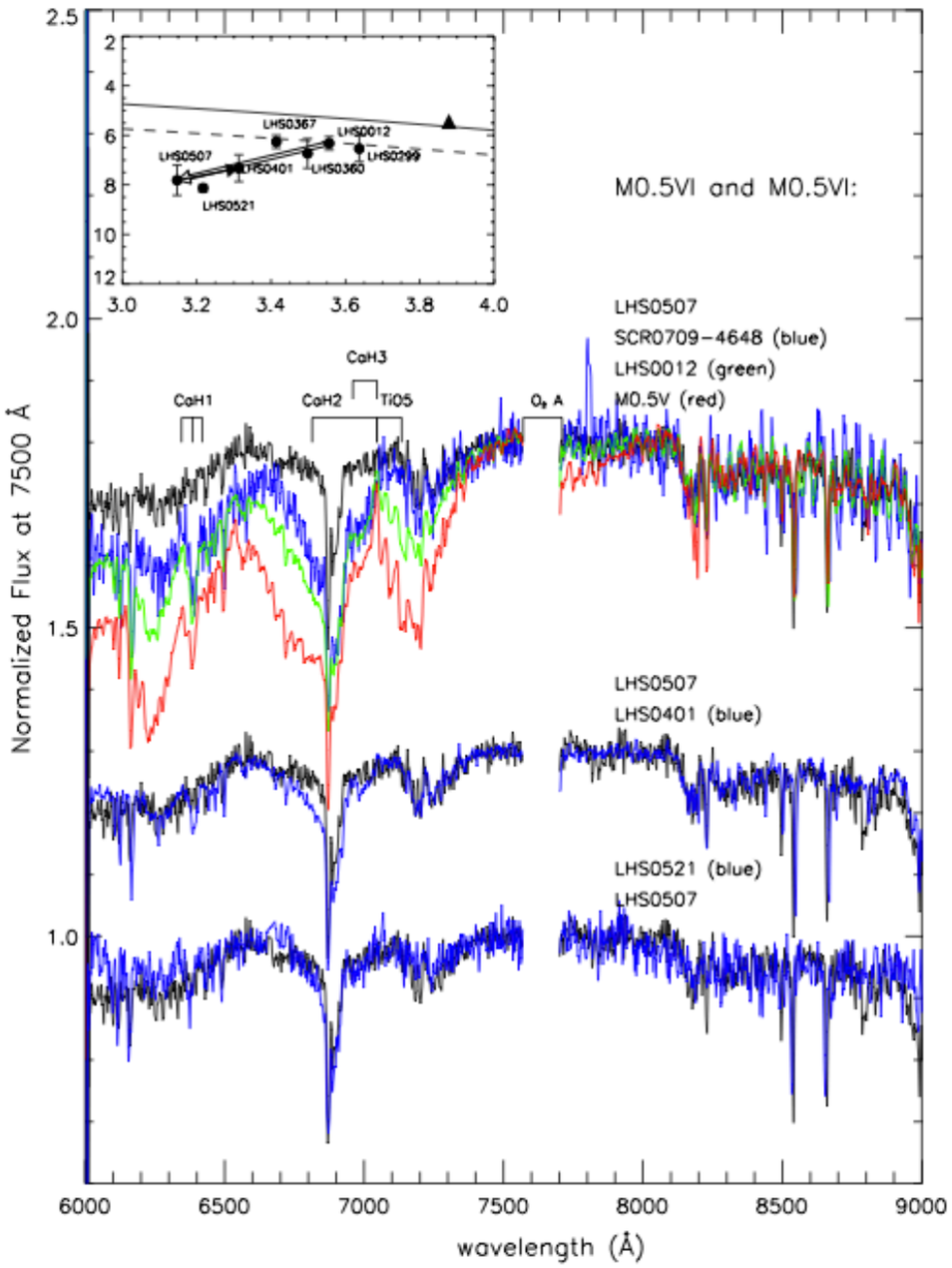
Spectral
- **Consideration of the overall slope of red dwarf spectra.**

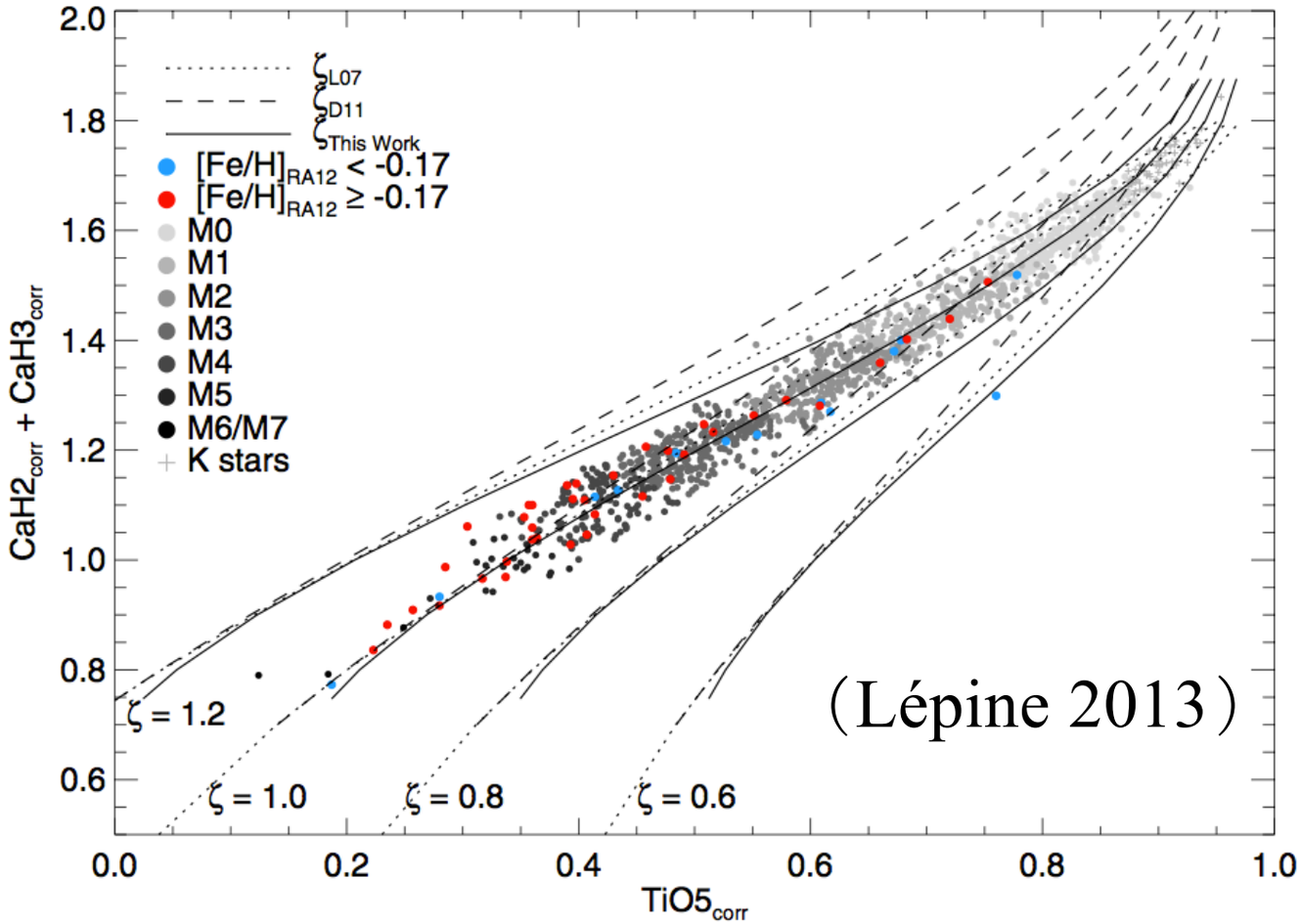
Subtype
- **Opacity-free region: 8200~9000A.**

Metallicity
- **“VI” instead of “sd” prefix (including esd, usd)**
- **Use m - - - - - and g + + + + for metallicity and gravity.**

II. INADEQUACY OF CURRENT CLASSIFICATION

（Jao 2008）





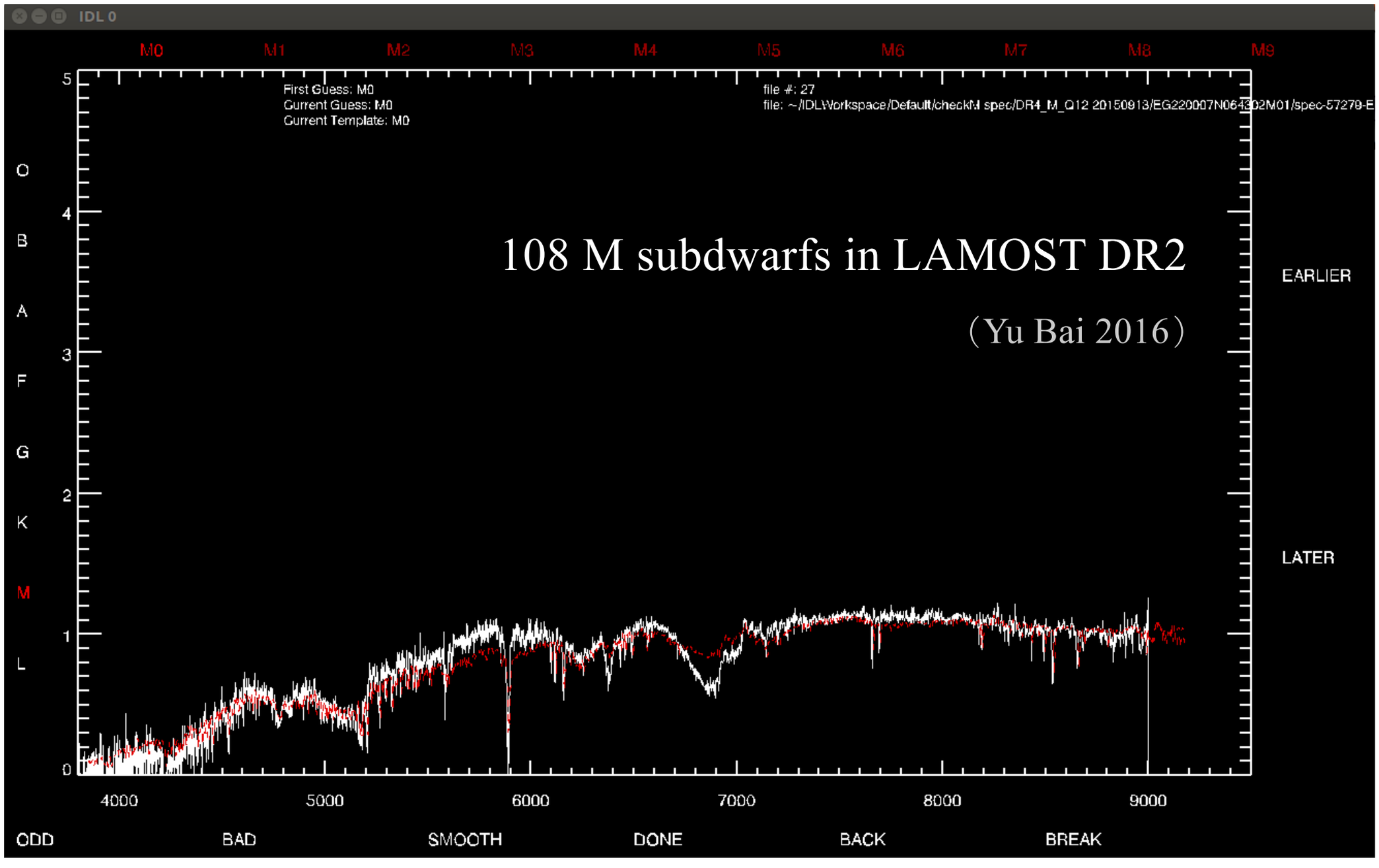
（Lépine 2013）

3517 in **SDSS DR7** （Savcheva 2014）

1288 in **LAMOST DR1** （Zhang L. 2016）

III. THE MEANING AND PROGRESS OF ESTABLISHING A NEW METHOD

Hammer Eye-check Program



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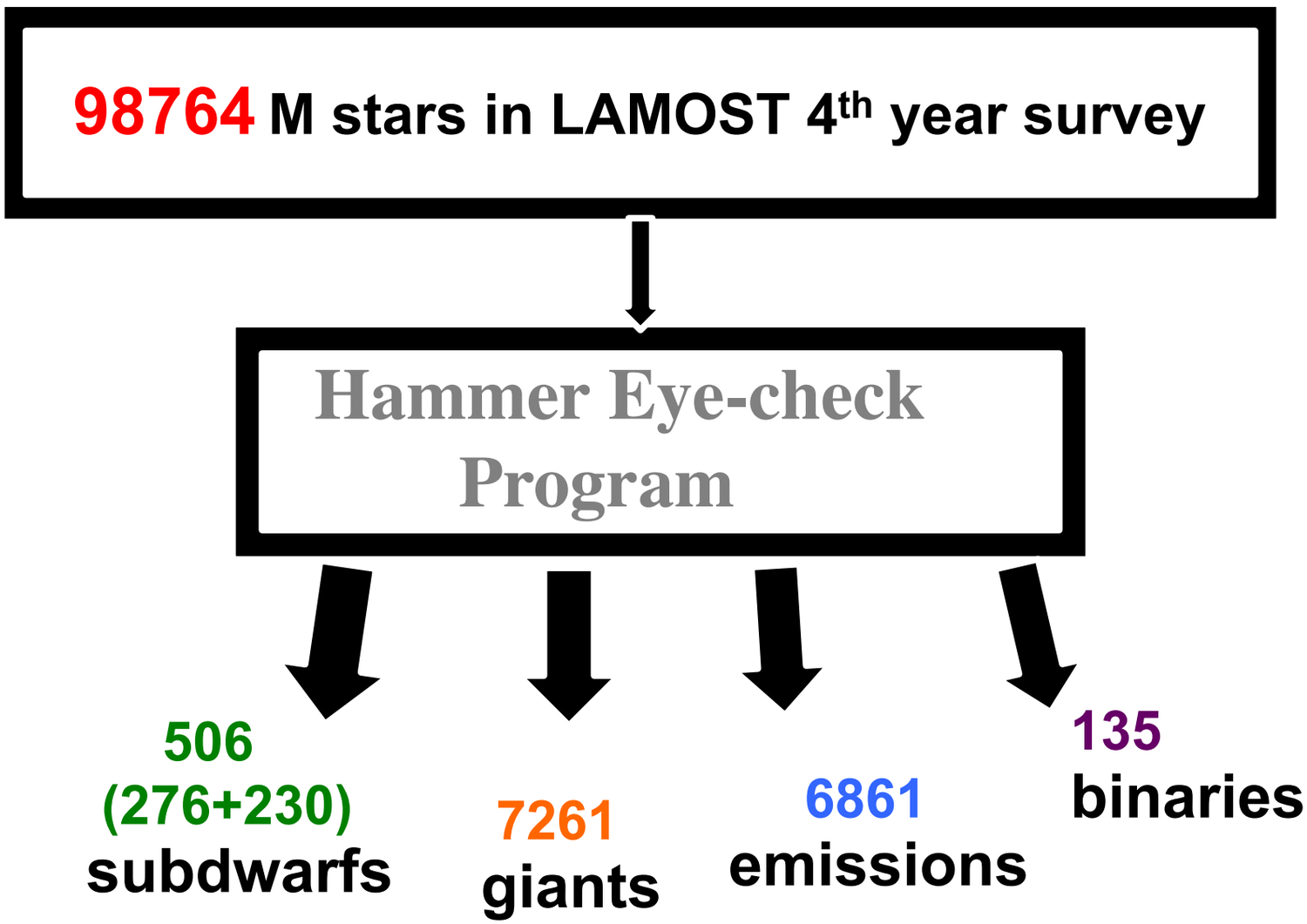

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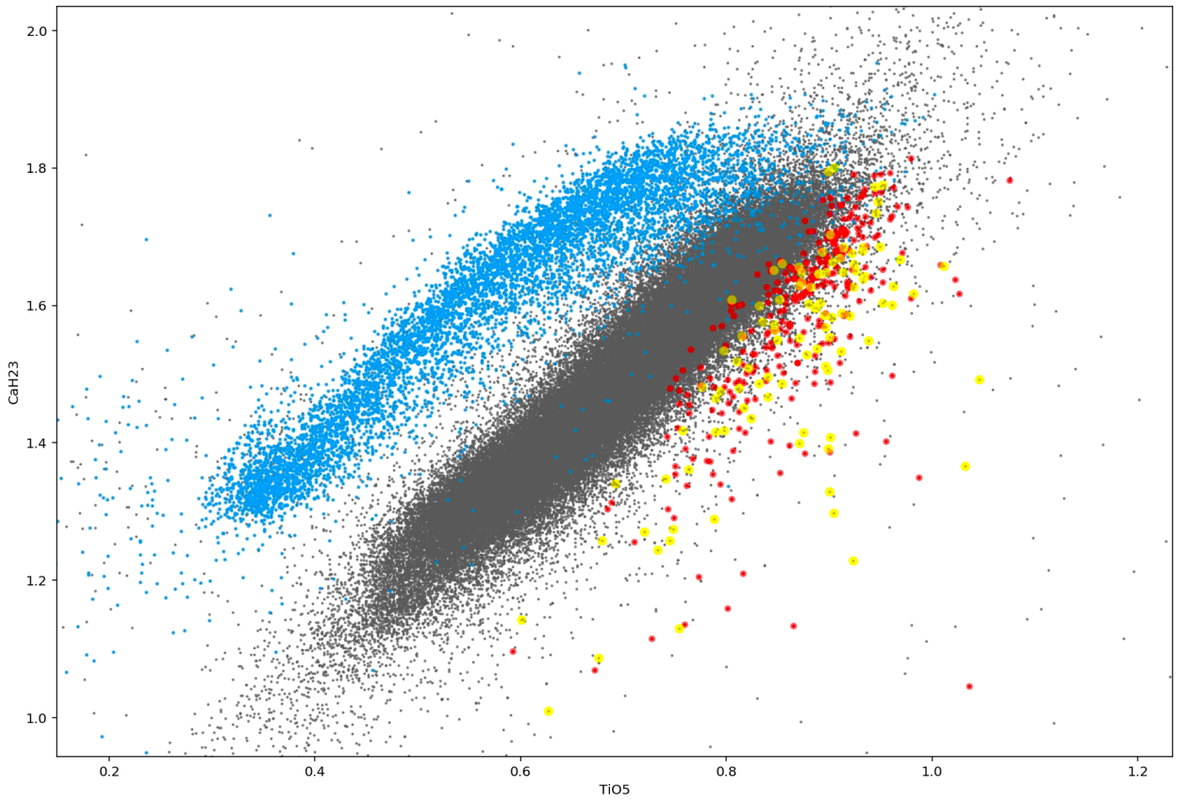

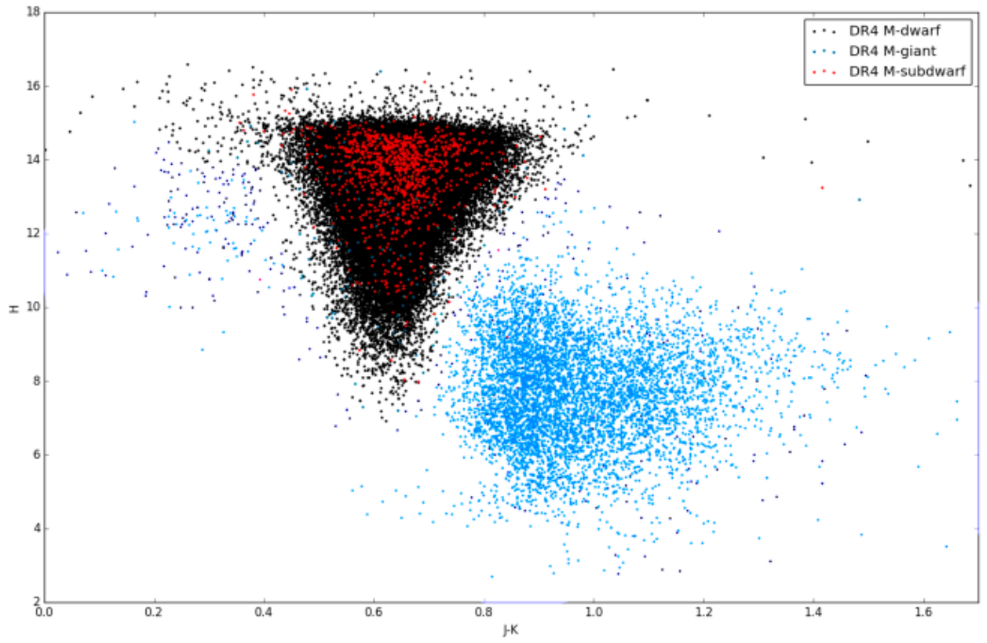

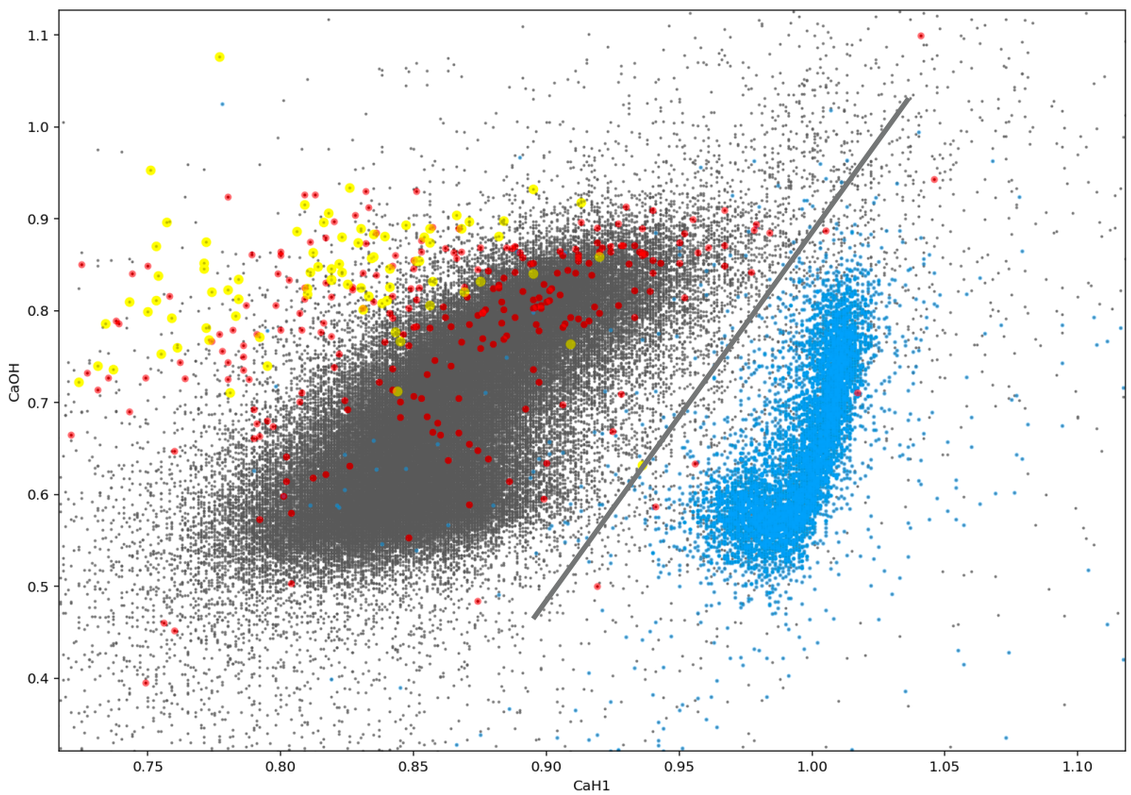

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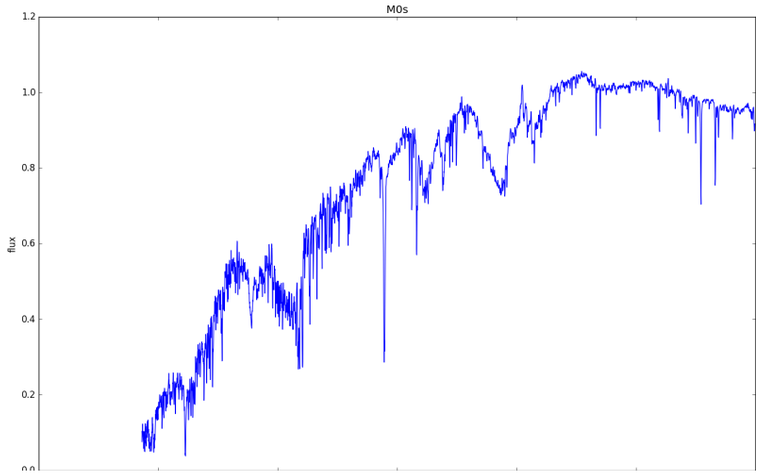

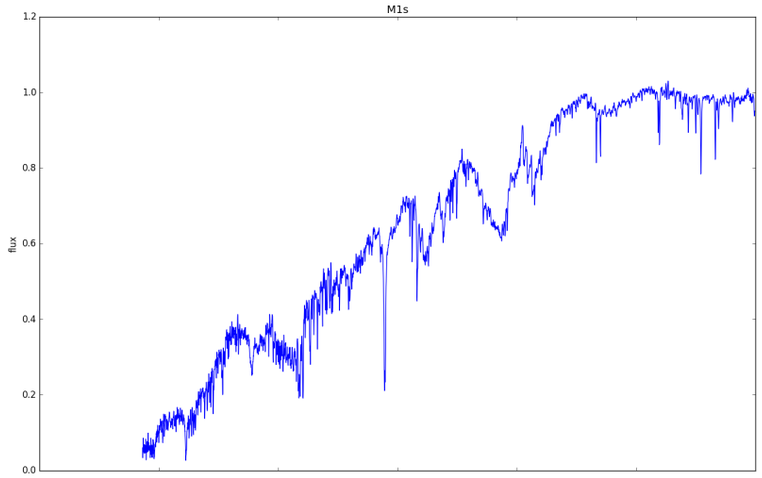

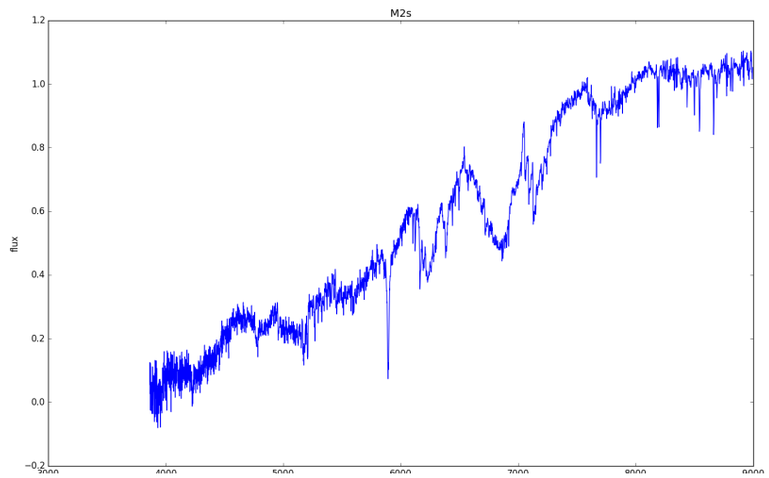

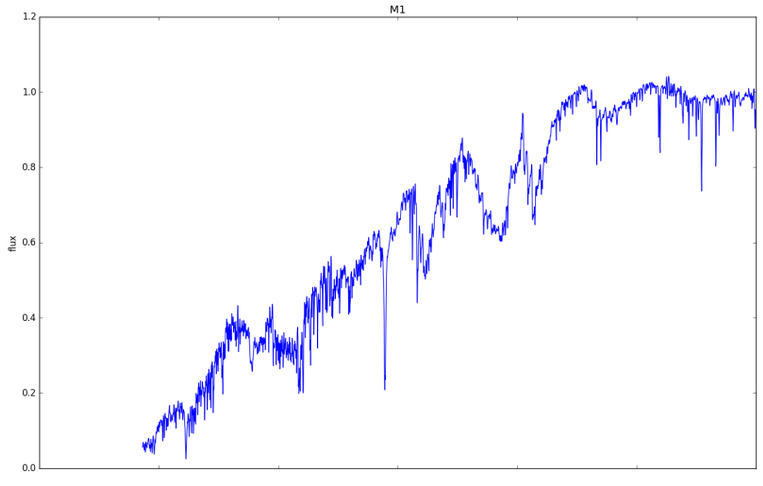

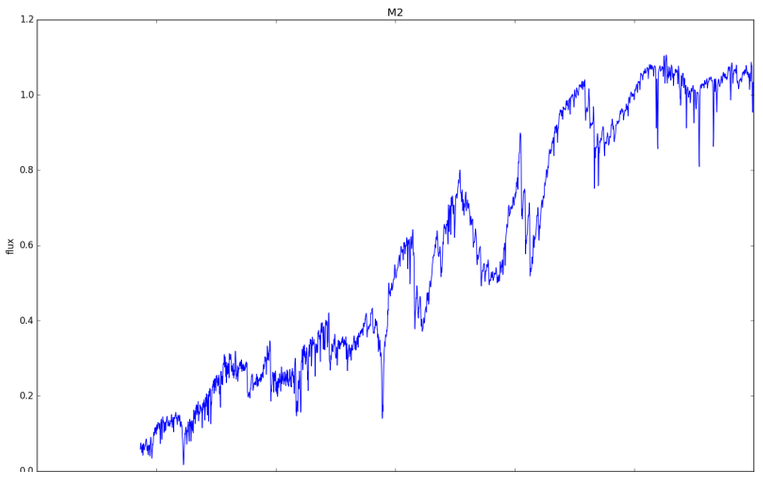

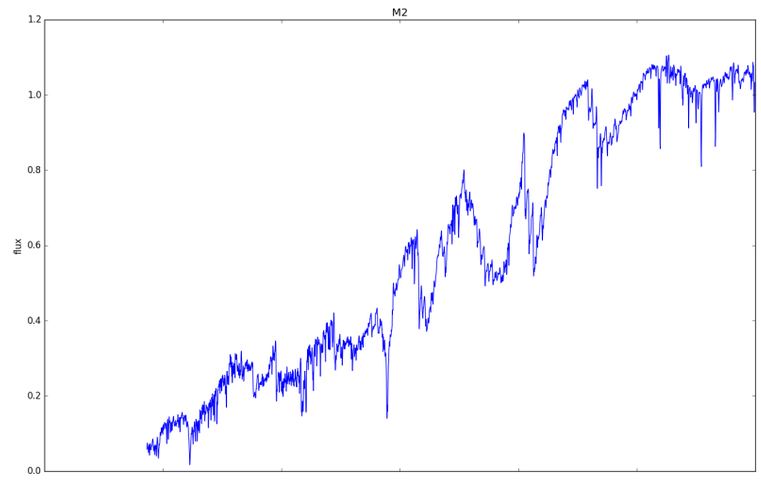

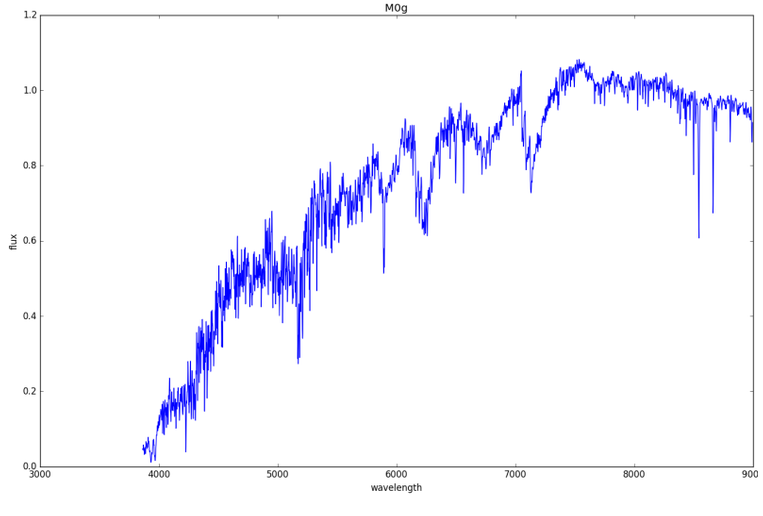

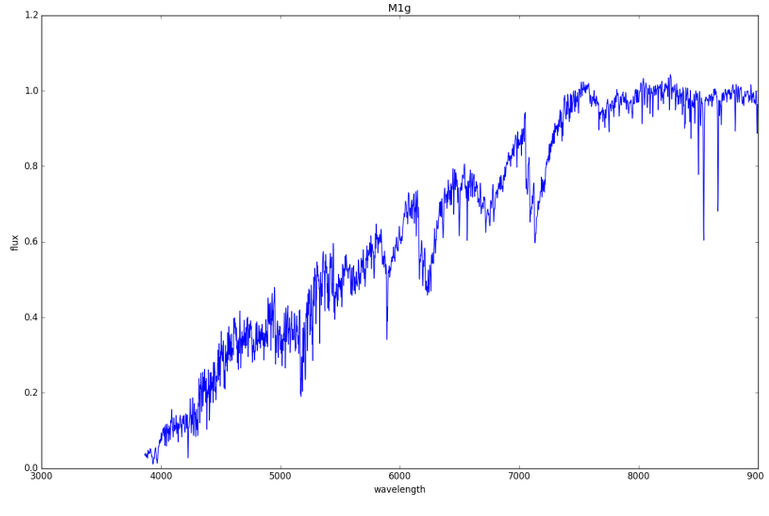

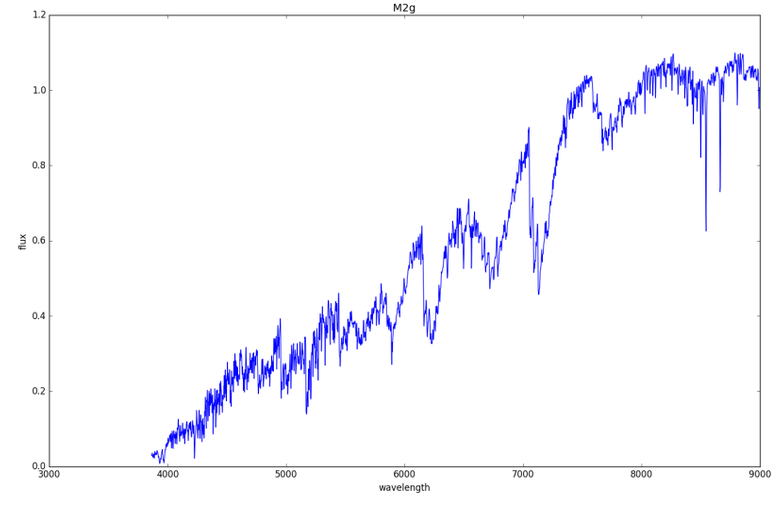

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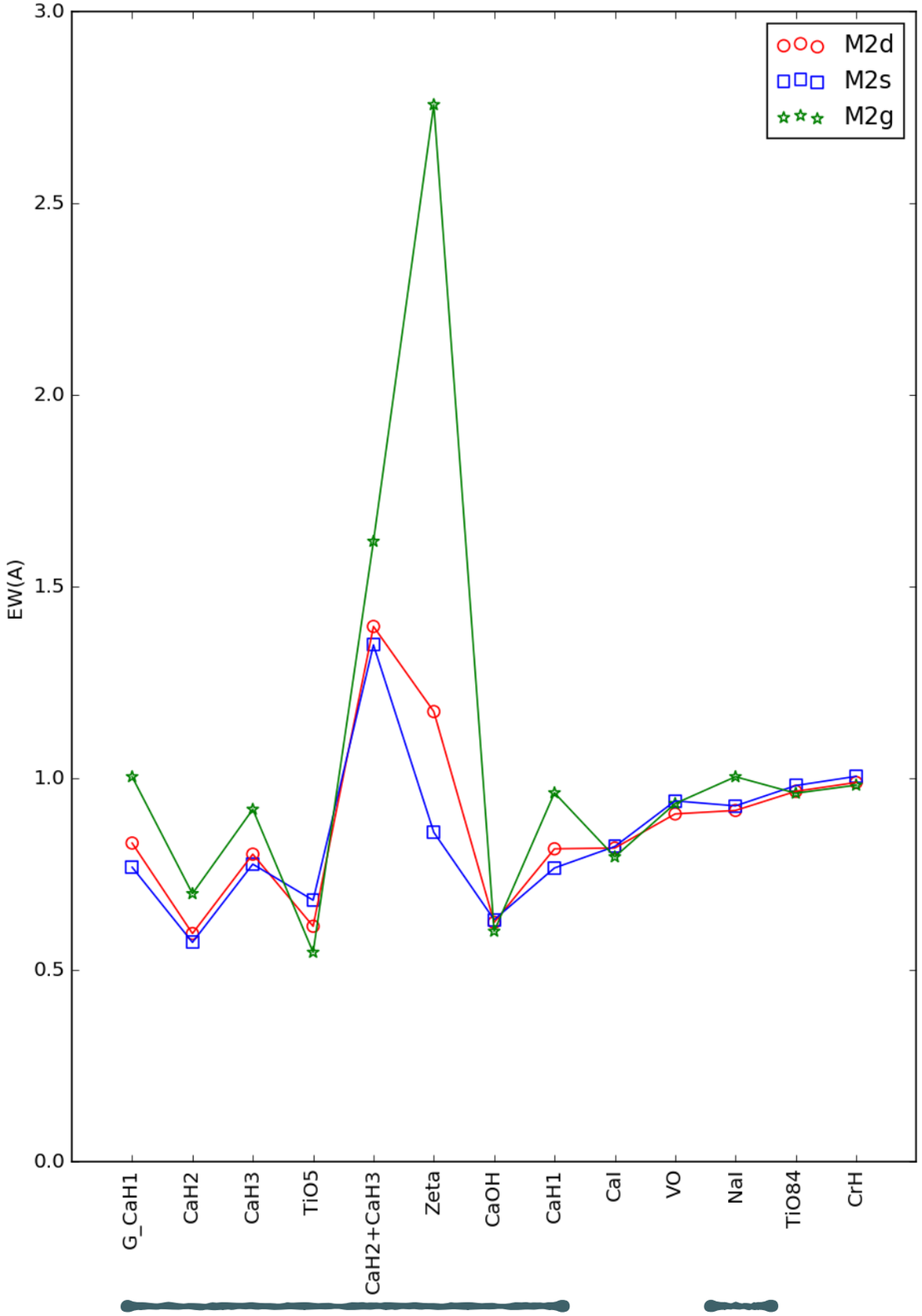
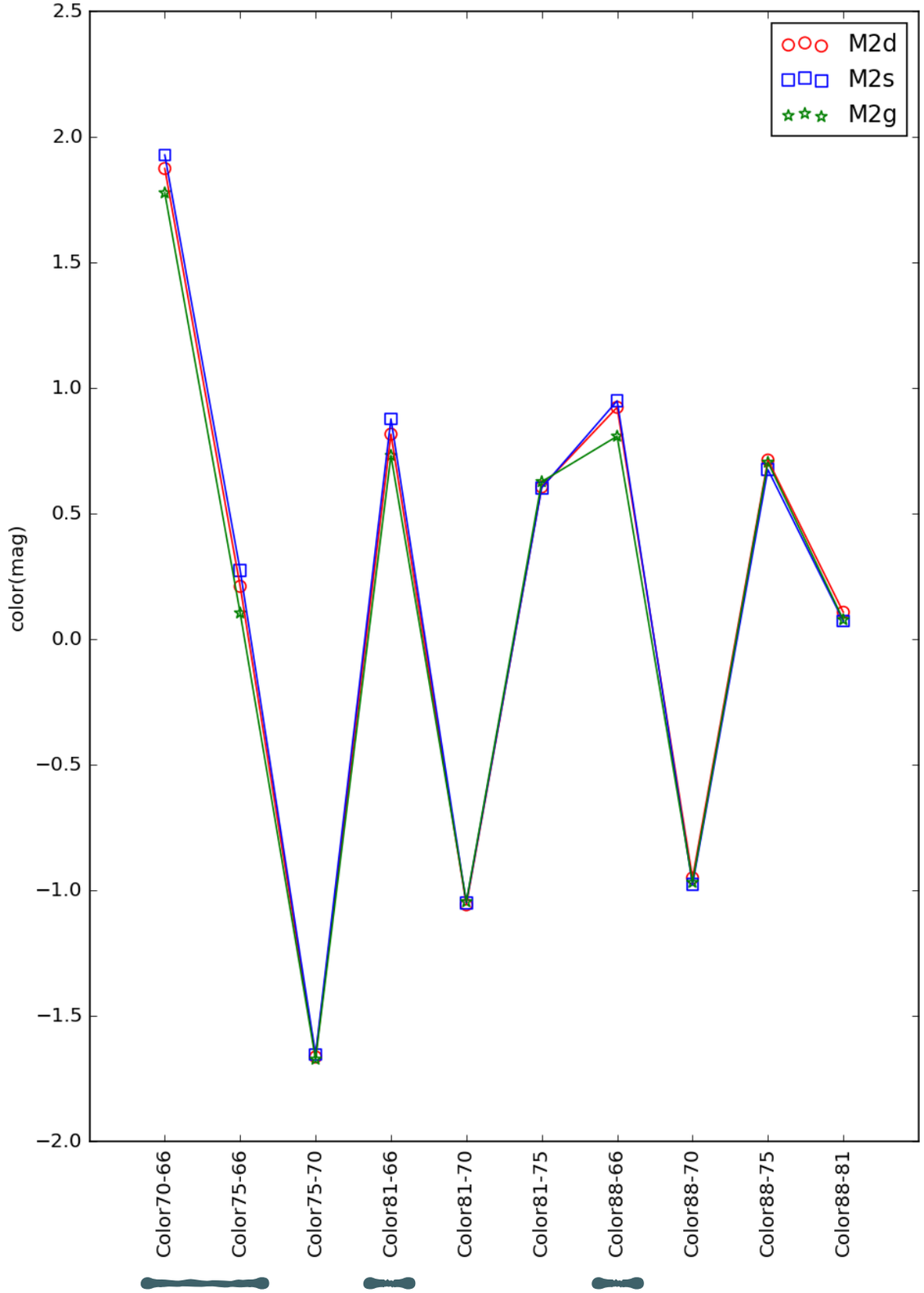
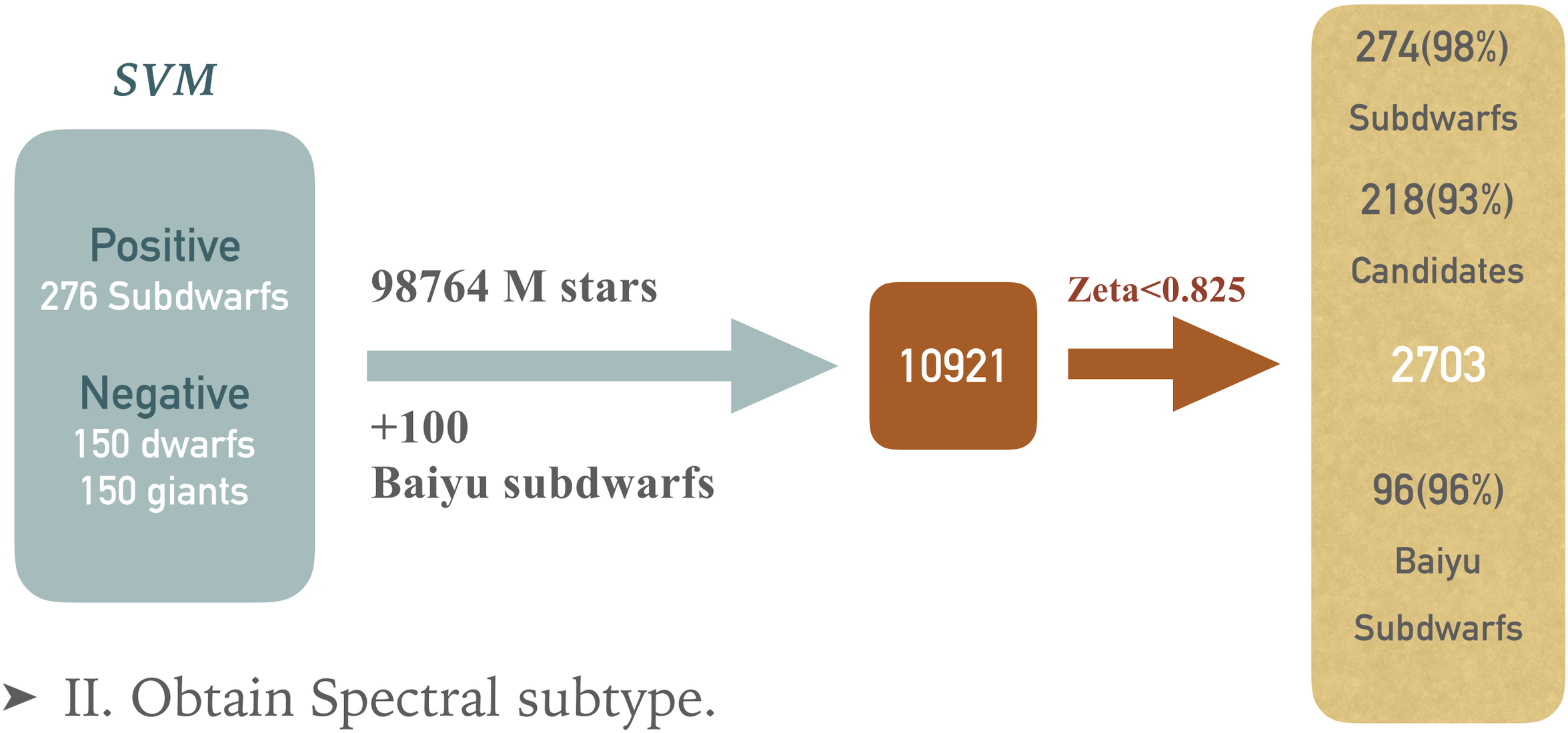




III. THE MEANING AND PROGRESS OF ESTABLISHING A NEW METHOD

➤ I. Select subdwarfs



➤ II. Obtain Spectral subtype.

Template Matching.

Accuracy: 97%

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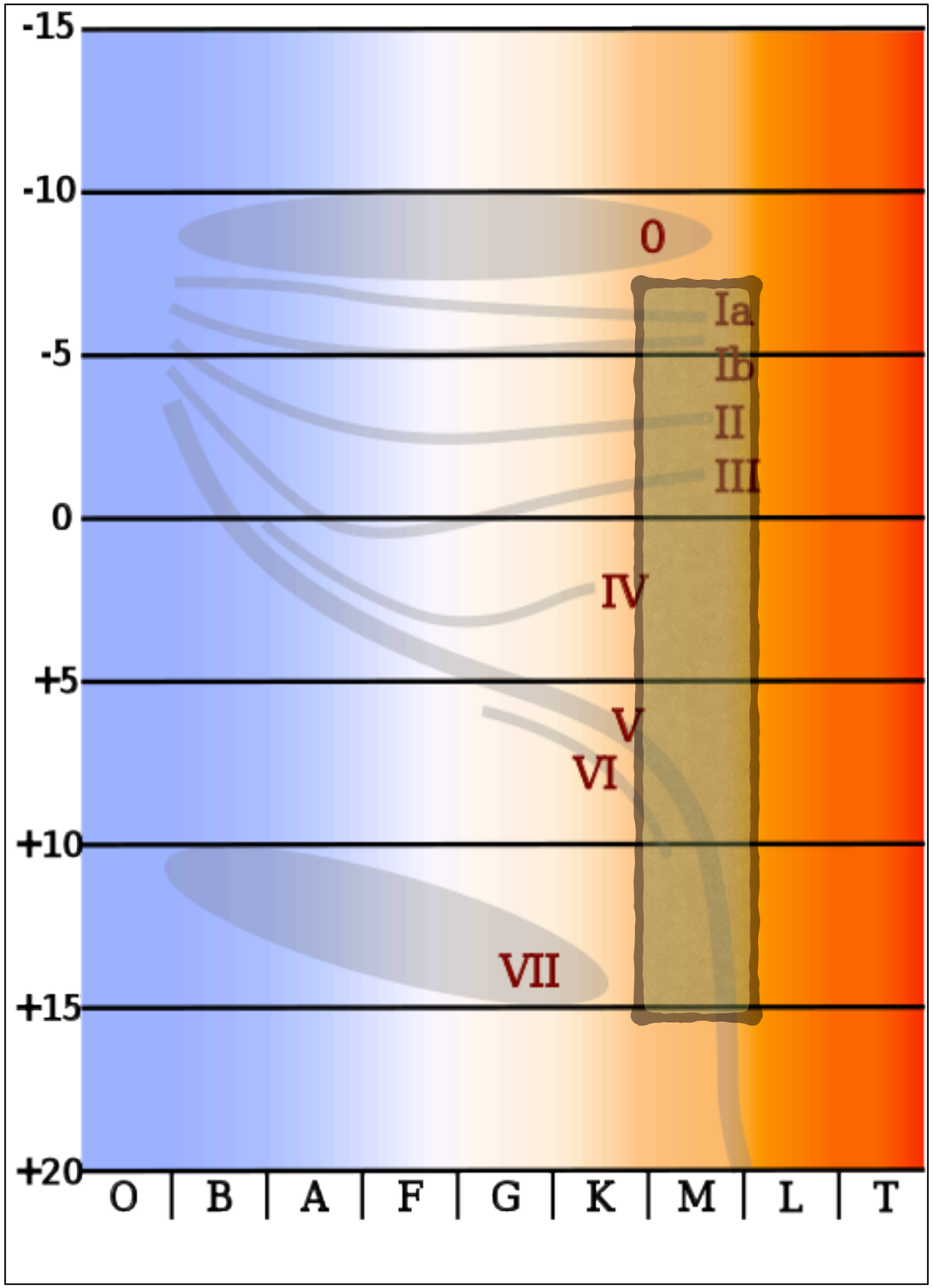

Thank you!