



K-means search for low metallicity galaxies in SDSS/DR7

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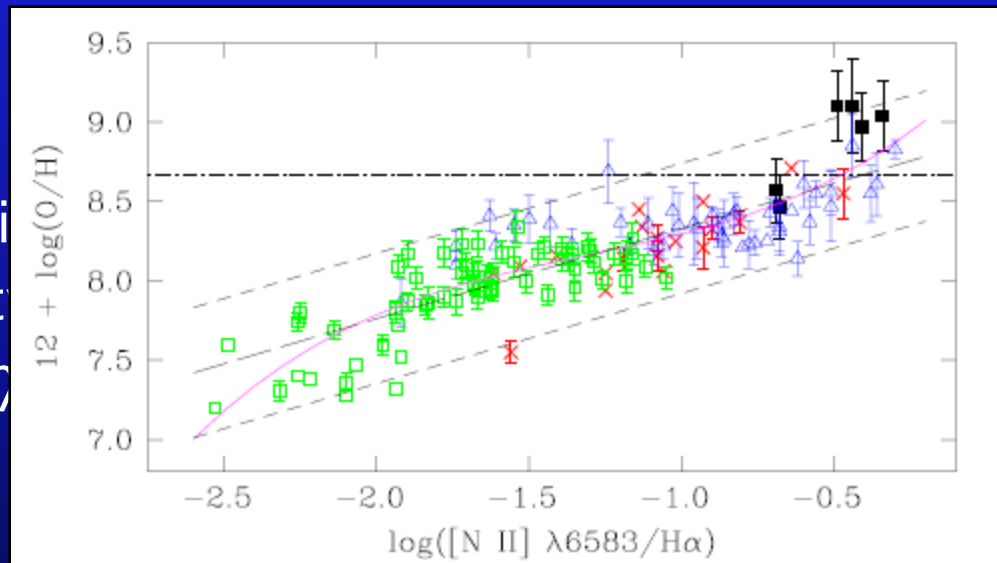
Introduction

- Deficient metal galaxies are probably unevolved fossils from the early universe:
 - May be the principal building blocks of the Universe on large scales.
 - Play a crucial role in the cosmic scenary.
- Unfortunately, they are rare.
- E.g., Kunth, D., & Östlin, G. 2000 give 31 low-metallicity galaxies with $12+\log(\text{O}/\text{H}) < 7.65$.
- We plan to extend the sample of metal poor galaxies.
 - We will describe a novel search for low metallicity galaxy candidates in SDSS/DR7, a database with some one million galaxies with spectra.

Procedure

- We use the [k-means cluster algorithm](#) (e.g. Sánchez Almeida et al. 2009). Details to be given elsewhere but, basically, [one class](#).

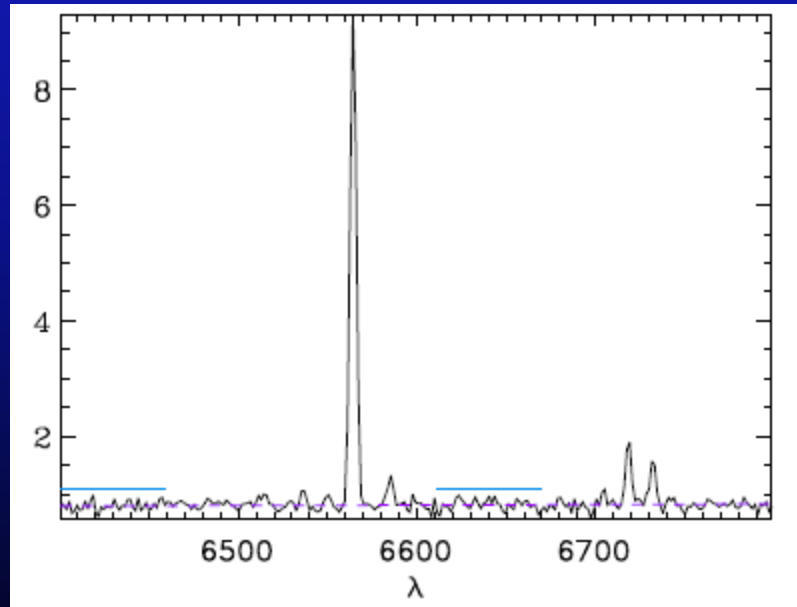
- The classification is based on the ratio of metallicities $12 + \log(O/H)$ and $[NII]\lambda 6583$.



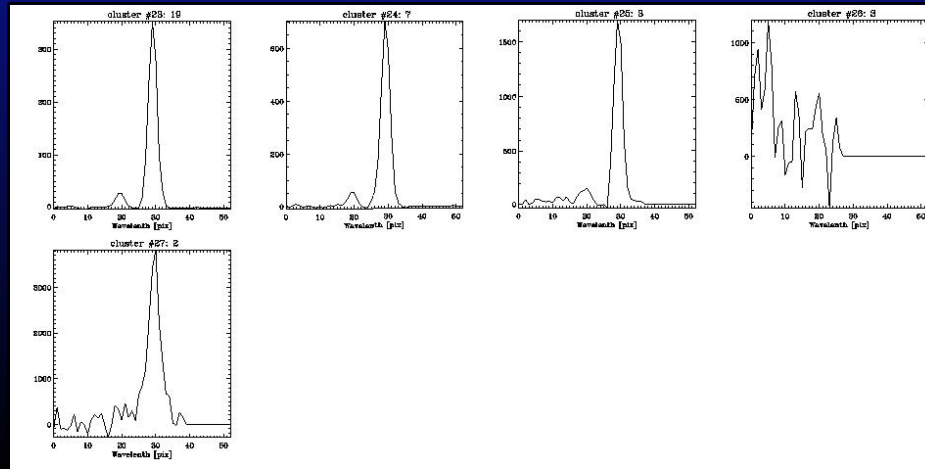
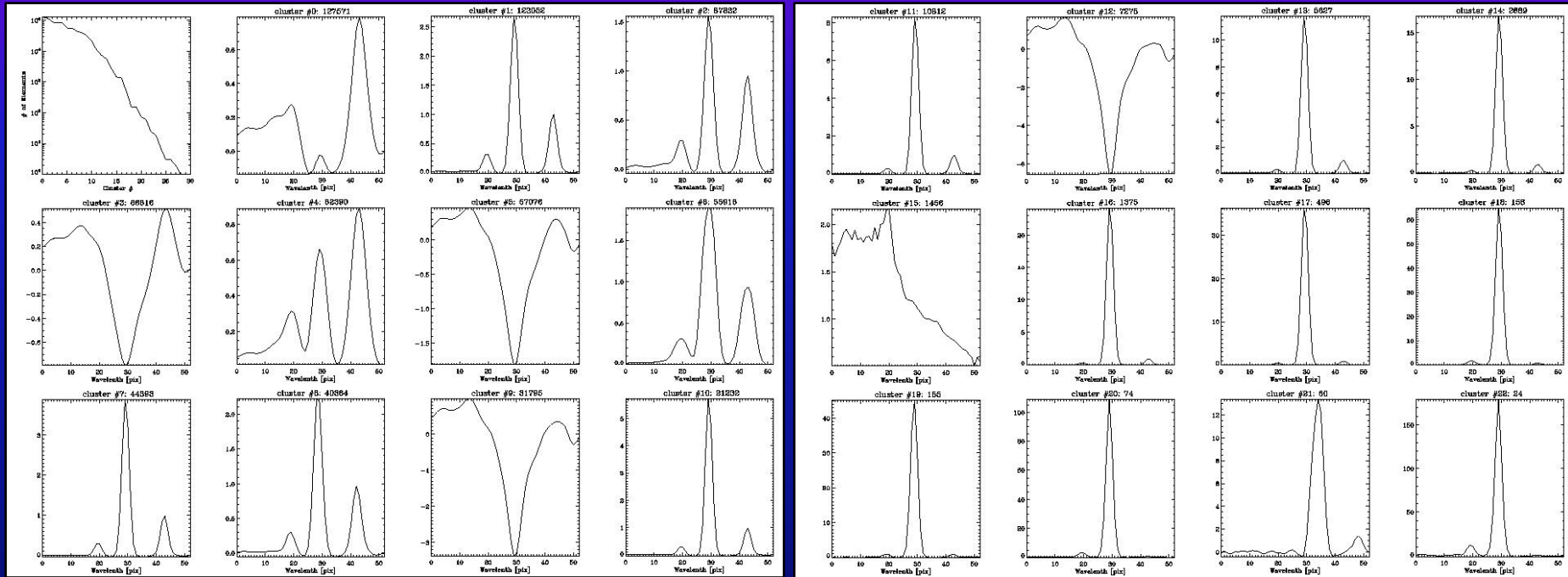
- We expected the algorithm provided one or several classes of galaxies with low metallicity. i.e., those with [low \$\[NII\]\lambda 6585\$](#) and [high \$H\alpha\$](#) .

Procedure

- Taking out the continuum, we normalize to [NII] λ 6585 to maximize the contrast between H α and [NII] λ 6585 .
- K-means separate galaxies spectra in an efficient way.



Clasificación

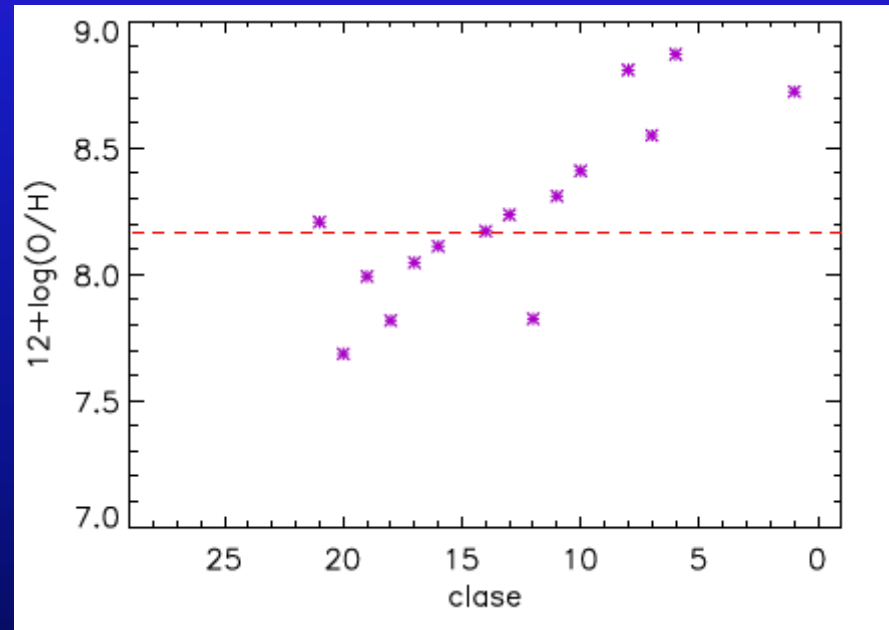


Clasificación

- We obtain an approximate metallicity value using average spectrum that we have after clasification
- We use the fit of Pettini & Pagel 2004:

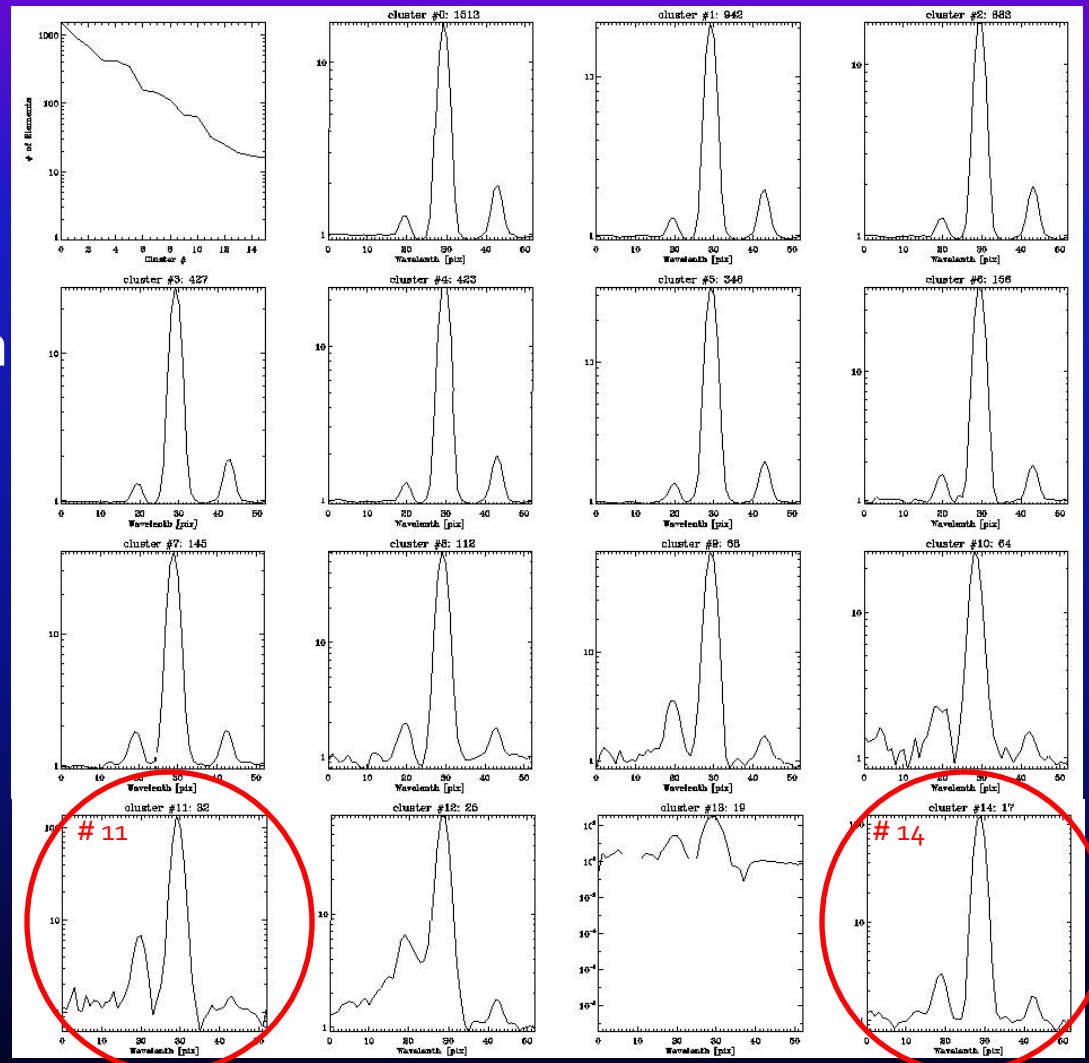
$$12 + \log(O/H) = 9.37 + 2.03 \times N2 + 1.26 \times N2^2 + 0.32 \times N2^3$$

- The low metallicity galaxy candidates must have metallicities values close to 7.
- We decided take de low-metallicity classes and we clasified their spectra again.



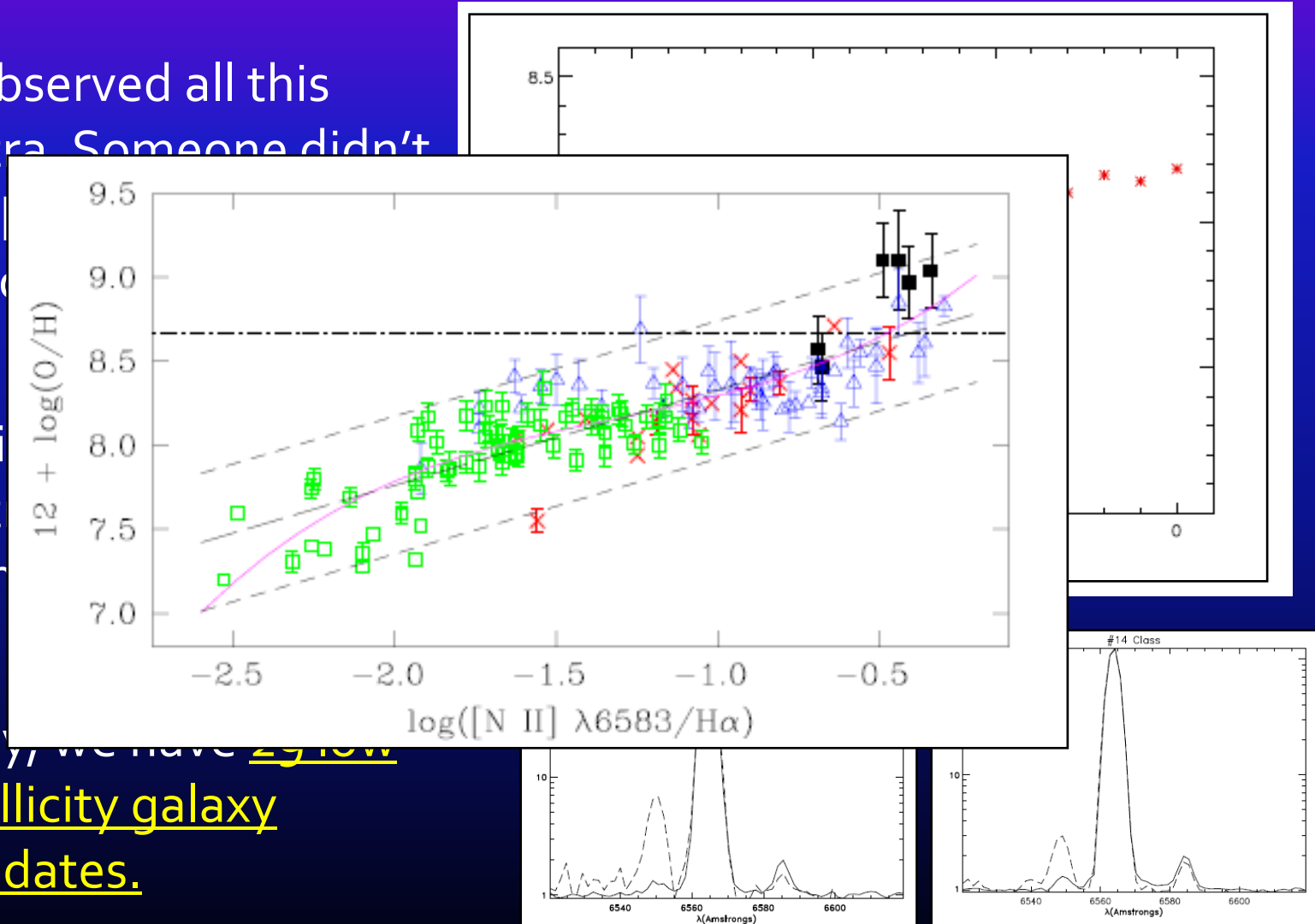
Classification

- The algorithm separate galaxies spectra that we had in 5-6 classes in 15 classes.
- The classes 11 and 14 may contain the low metallicity galaxy candidates.



Classification

- We observed all this spectra. Someone didn't have the correct correction.
- We did not observe all spectra. We have new members.
- Finally, we have 29 low metallicity galaxy candidates.

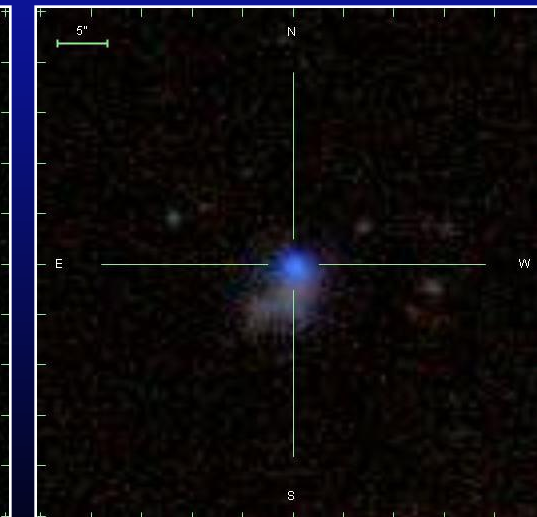
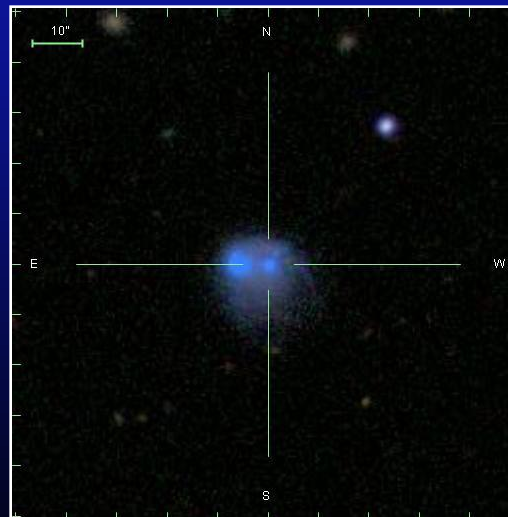
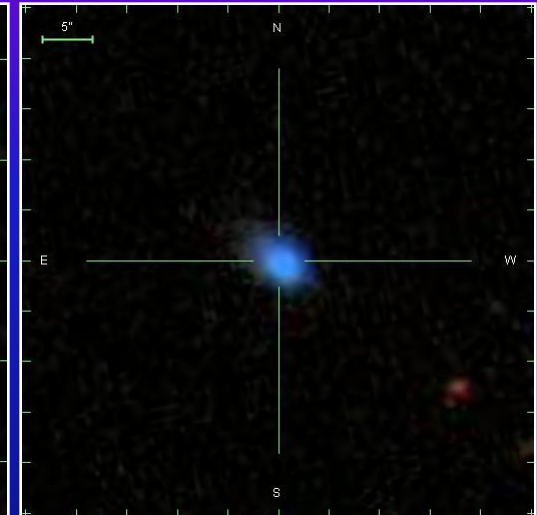
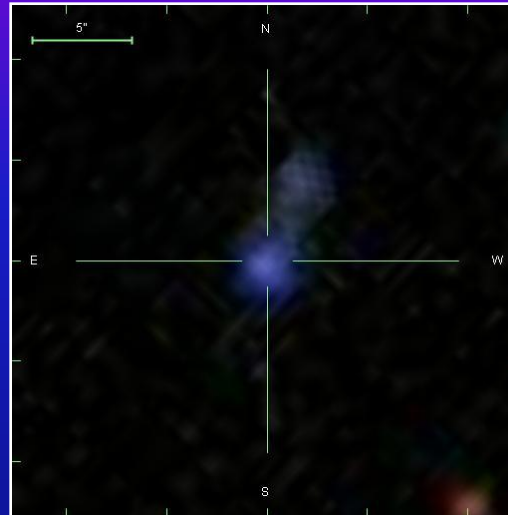
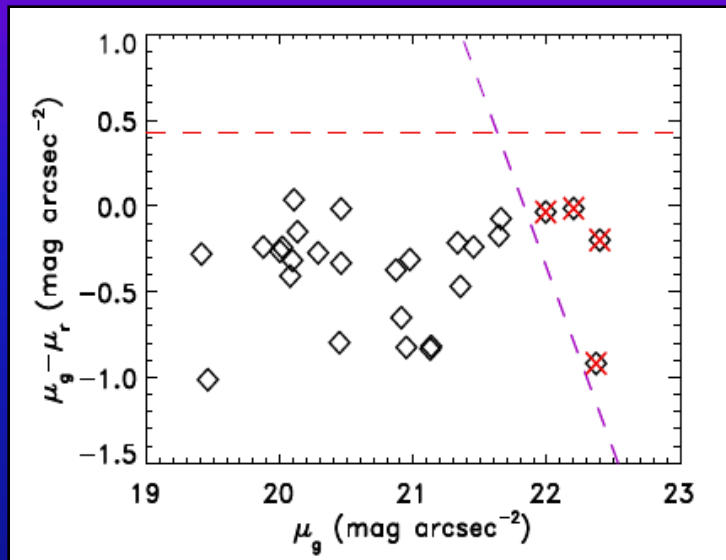


Are they BCDs?

- BCD (Blue Compact Dwarf) are metal-poor systems undergoing vigorous star formation (e.g., Thuan 1991, Gil de Paz et al. 2003)
- Criteria used to select BCD galaxies (Sánchez Almeida et al. 2008, inherited from Gil de Paz et al. 2003) :

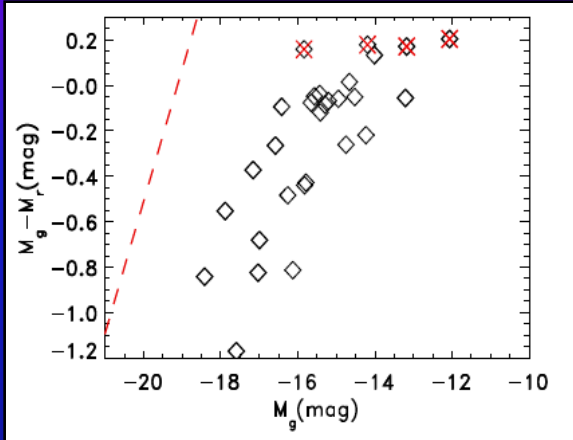
Criterion	Implementación
Be blue enough	$\langle \mu_g \rangle - \langle \mu_r \rangle \leq 0.43 \text{ mag arcsec}^{-2}$
Be compact	$\langle \mu_g \rangle < 21.83 - 0.47(\langle \mu_g \rangle - \langle \mu_r \rangle) \text{ mag arcsec}^{-2}$
Be dwarf	$M_g > -19.12 + 1.72(M_g - M_r) \text{ mag}$
Having large SFR	H α Equivalent Width $> 50 \text{ \AA}$
Be metal-poor	$12 + \log(\text{O}/\text{H}) < 8.43$
Not to be confused with AGNs	Neglect AGN contamination
Be isolate	No bright galaxy within $10R_{50}$

Are they BCDs?

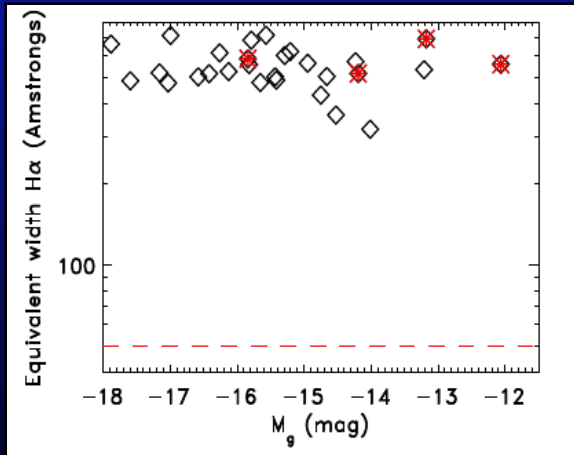


- Are four of our galaxies no compact?
- SDSS sizes have been overestimated!
- They are blue and compact.

Are they BCDs?



They are dwarf

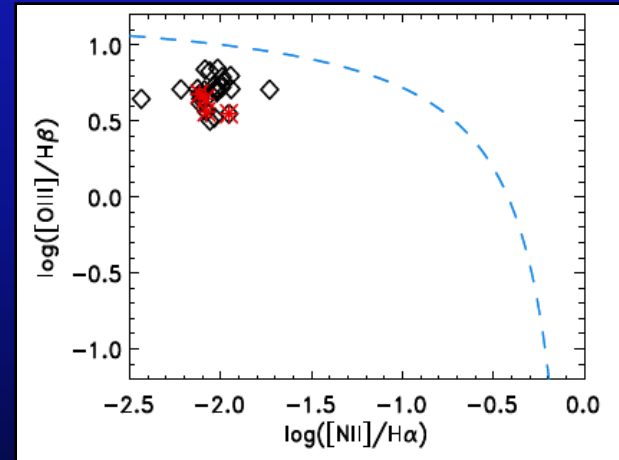


They have large SFR

- An emission-line galaxy is an AGN if :

$$\log \frac{[OIII]\lambda 5007}{H\beta} > 1.3 + 0.61 / \left(\log \frac{[NII]\lambda 6583}{H\alpha} - 0.05 \right)$$

(Baldwin, Phillips & Terlevich (1981),
Kauffmann et al. 2003)



Neglect AGN contamination

Conclusions

- K-means get to find low-metallicity galaxy candidates in SDSS/DR7. This is a systematic and therefore comprehensive search.
- We find only 29 candidates in this database that has one million galaxies ! We will be able to quantify how 'rare' they are.
- This 29 low-metallicity galaxy candidates are BCD.
- True metallicity must be determined.
- They will be studied in depth using WHT and GTC. (...observing time already granted).