Diffuse Light in a cluster at z=2

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What is the diffuse light?

Stars stripped from the outer region of the galaxies during the cluster's formation

Coma cluster

The properties of the ICL in clusters, particularly the fractional luminosity, radial light profile, and presence of substructure, may hold important clues about the accretion history and dynamical evolution of galaxy clusters.

What is the Intra-Cluster Light (ICL)

Formation mechanism:

- Shredding of dwarf galaxies
- Tidal stripping
- In situ star formation
- Merging

Density

- Stripping process : high mass clusters have more ICL then low ones
- Merging : no correlation with the mass

De Maio 2014,Krick 2007

Diffuse light

Formation mechanism:

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- Tidal stripping
- In situ star formation
- Merging

When? -> Color

- Red : Stars are stripped early and then evolve passively towards red color
- Same color of the galaxies : remnant from ongoing interaction
- Blue : recent star formation activity has made

De Maio 2014,Krick 2007

Diffuse light

Formation mechanism:

- Shredding of dwarf galaxies
- Tidal stripping
- In situ star formation
- Merging

When? -> Spatial distribution

the morphology of the ICL changes as the cluster evolve: at the beginning is characterized by tidal features then they tend to mix to form a more diffuse halo.

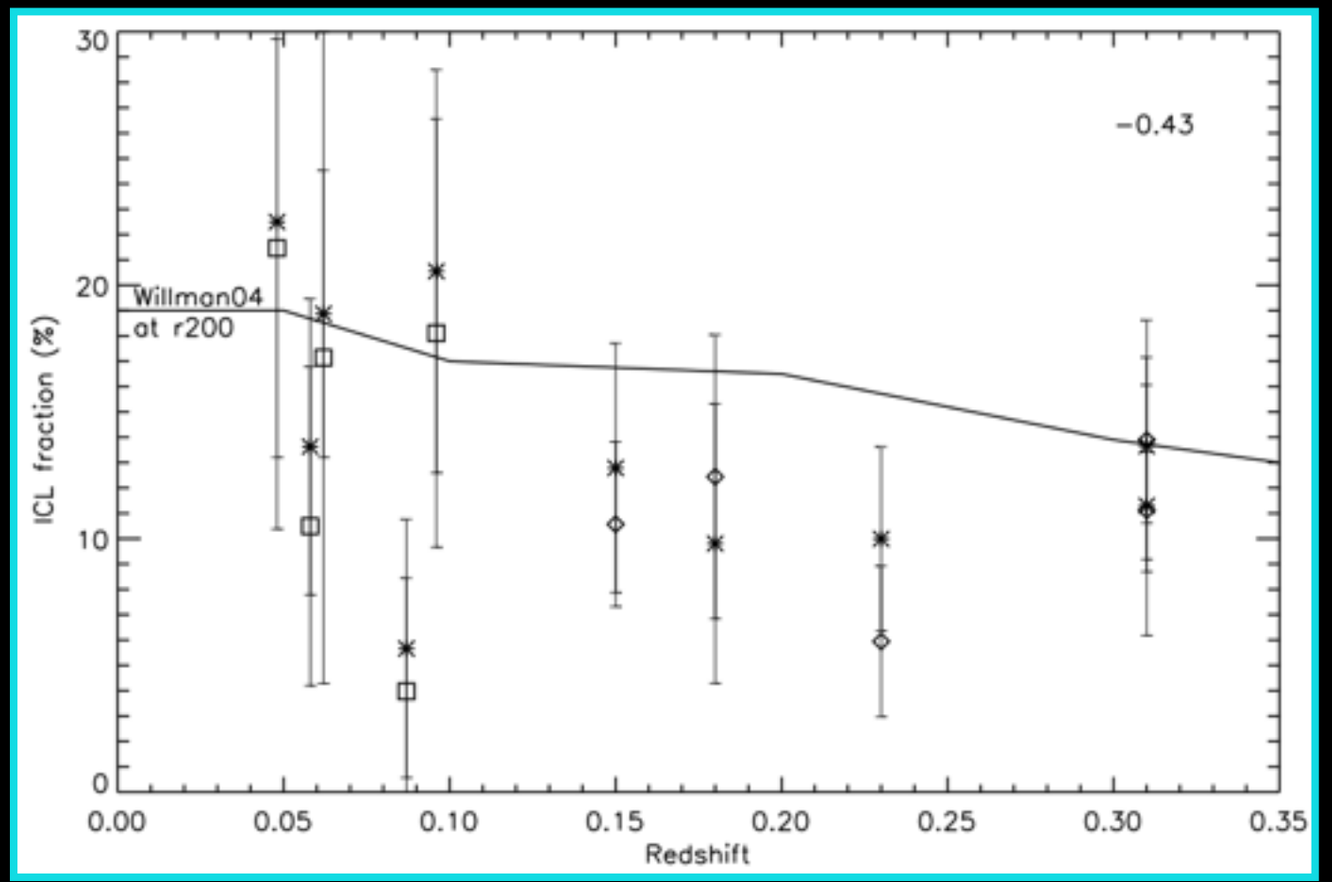
De Maio 2014,Krick 2007

From the letterature ...

- $0.8 < z < 1.2$ diffuse light : 1-4% (Burke et all 2012)

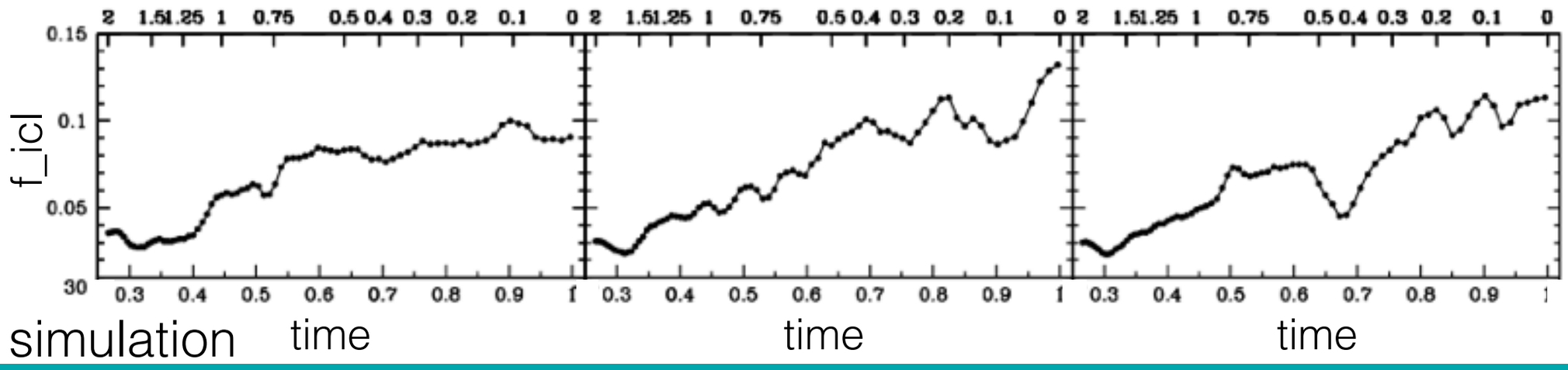
- Krick & Bernstein 2007

  $z < 0.4$ diffuse light fraction : 6-22 % (Krick 2007)



From the letterature ...

- ICL amount increase as cluster evolves ~ 10-15 % at z=0



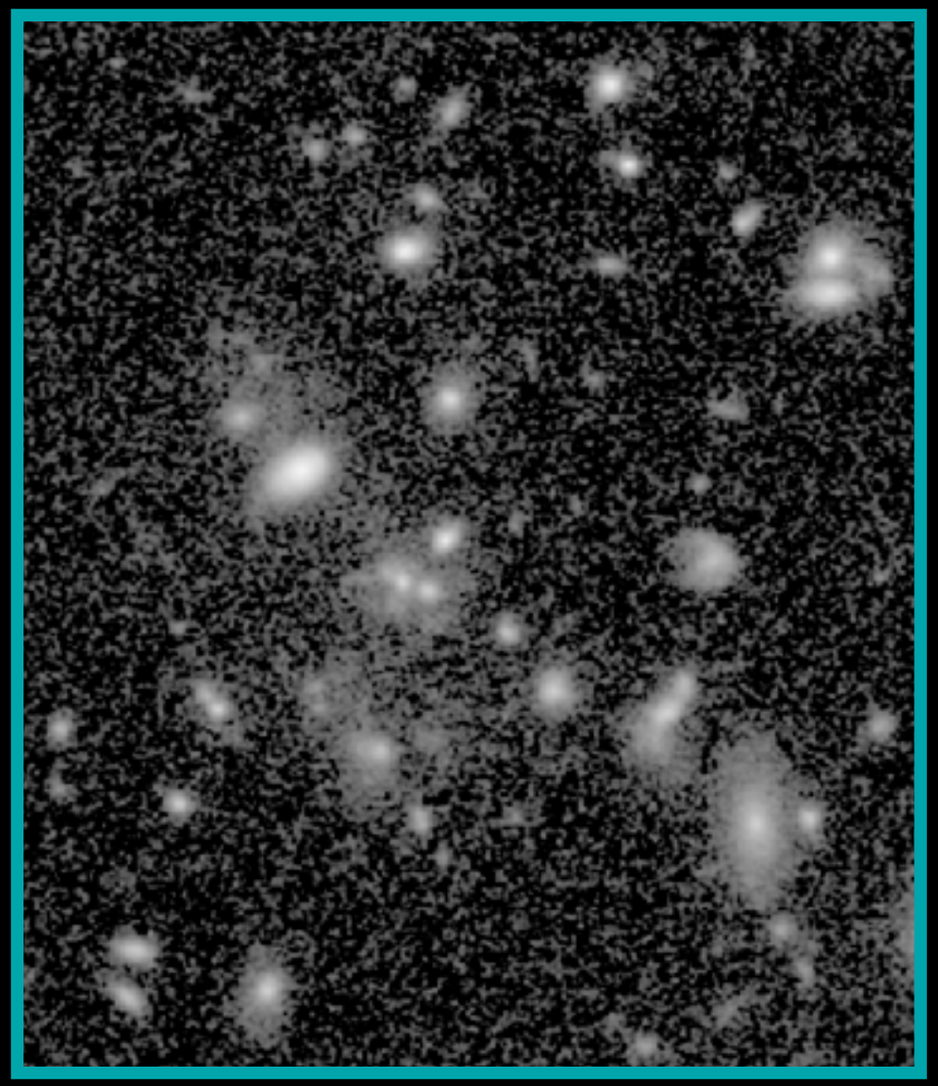
(Rudick 2006)

- Semi-analitic model z<=1 : ICL vary between 5-25 % (Contini 2014)

- The formation of the ICL has no preferred redshift and is a cumulative power-law process up to redshift z = 0. (Murante et all 2007)

Goal of this work

CL J1449+0856



$$M_{tot} \simeq 6 * 10^{13}\ M_{\odot}$$

$$z = 1.99$$

Instrument: HST WFC3
Bands: F105, F140

First step : Optimal background removing

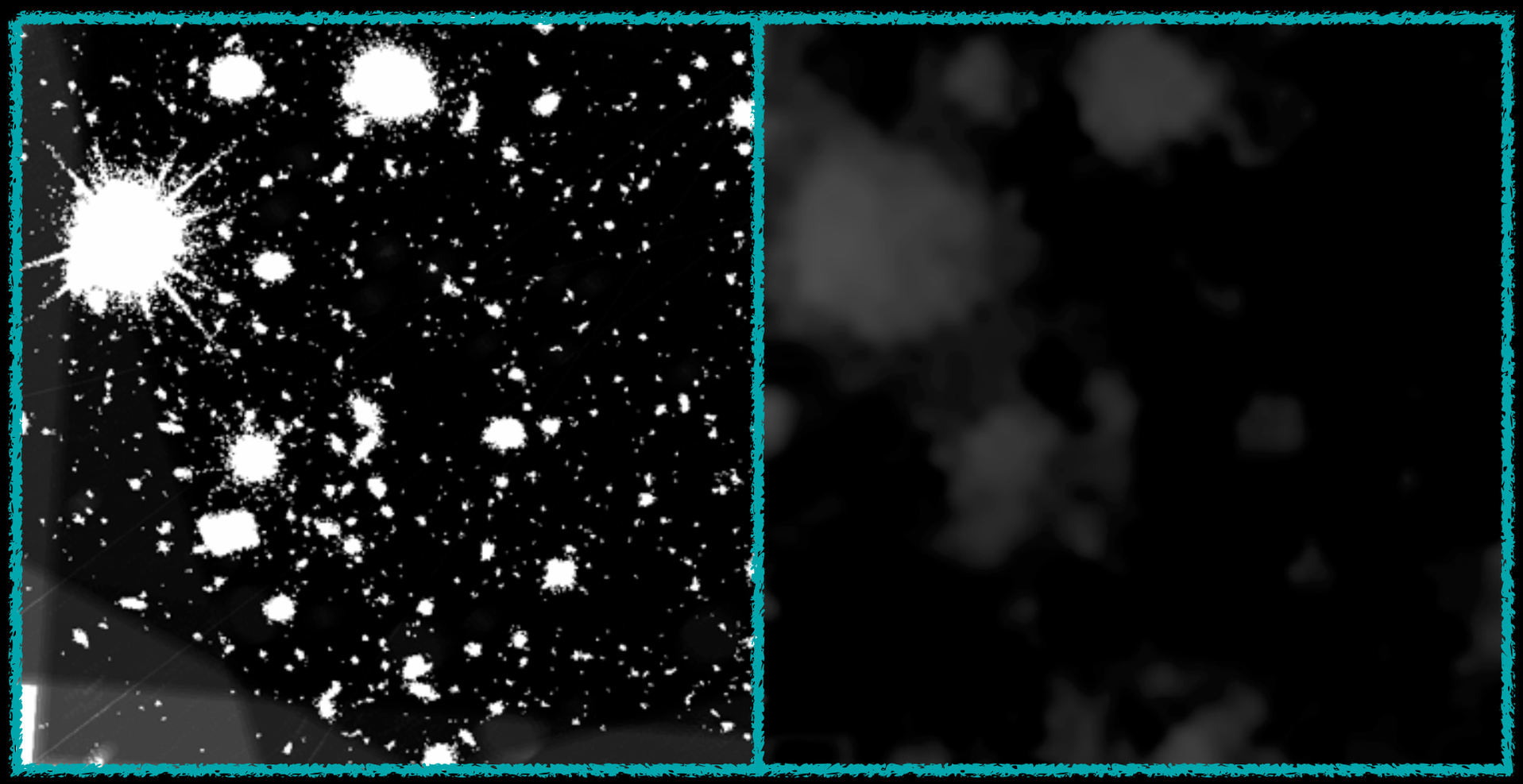
What is new?

- Remove contamination / gradient from bright sources
- Preserve the diffuse halo of low surface brightness : ICL

The solution

Dynamical masking to cover wide range of size

First step : Optimal background removing



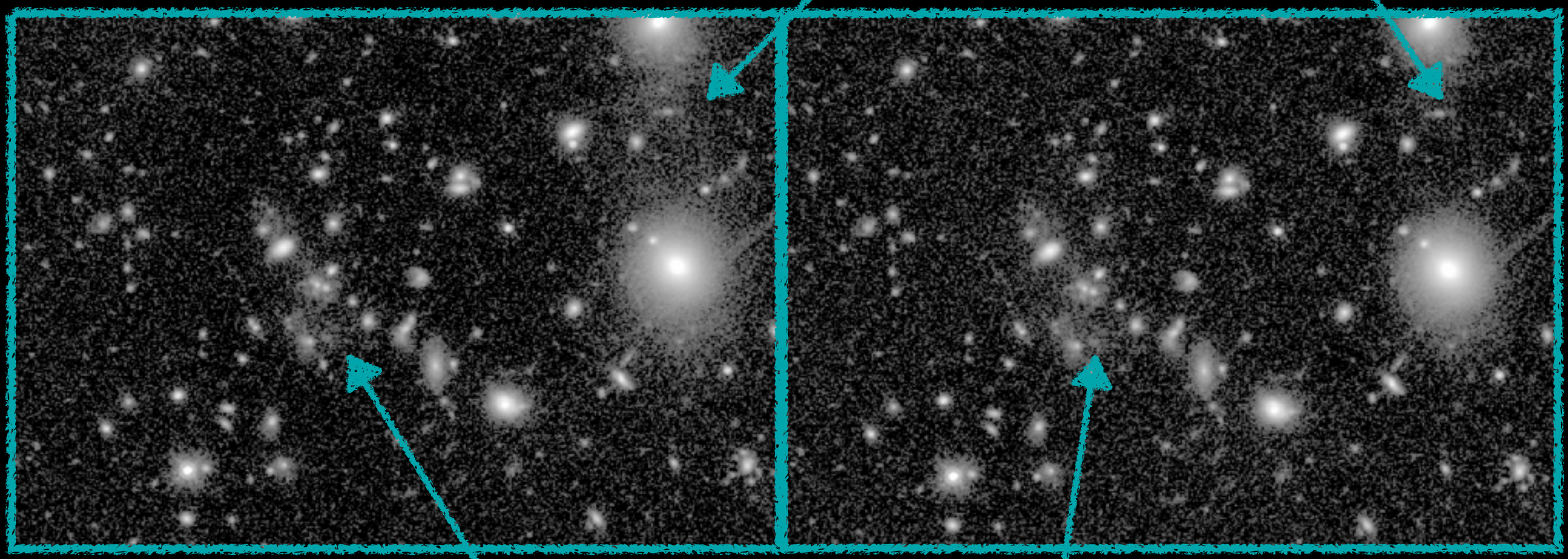
Mask Background map

The background map is estimated using Sextractor.
In the masked region is interpolated from the neighboring region

First step : Optimal background removing

Filter : F140

The gradient are removed

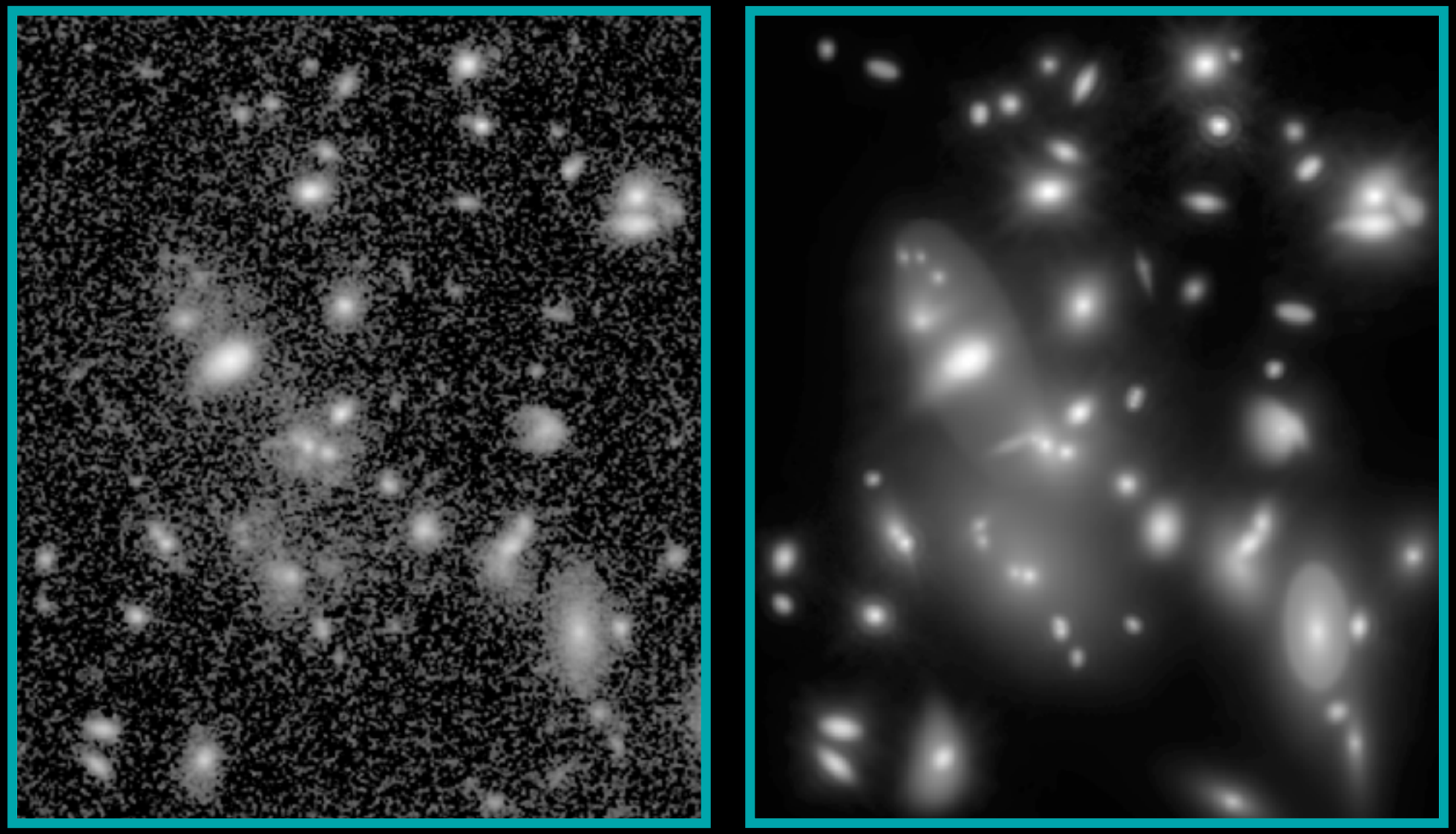


Before

After

but the halo are preserved

Second step : Fit the models



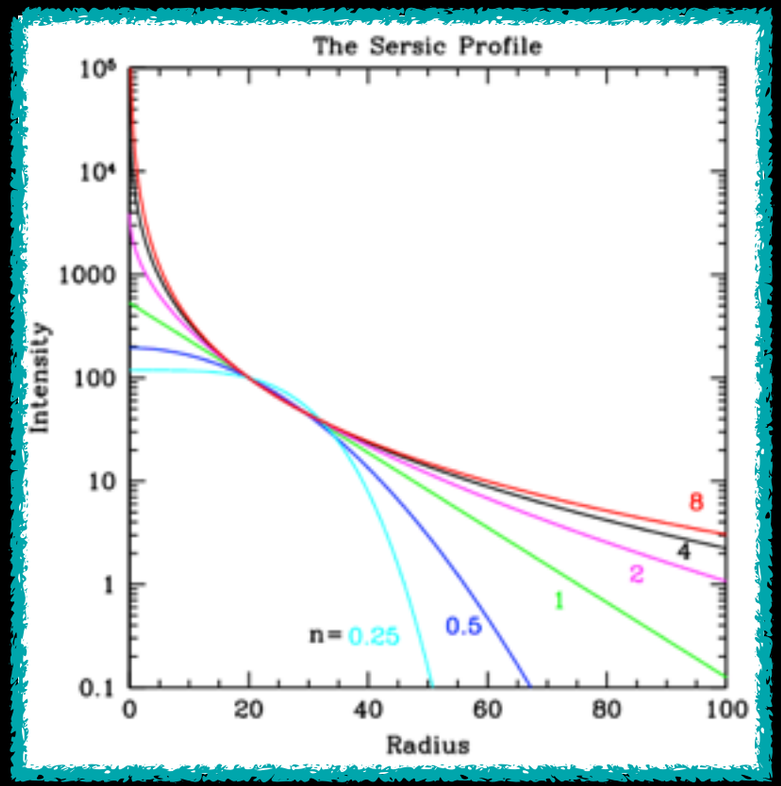
Filter : F140

The models are done using Galfit (Peng et al 2010)

Second step : Fit the models

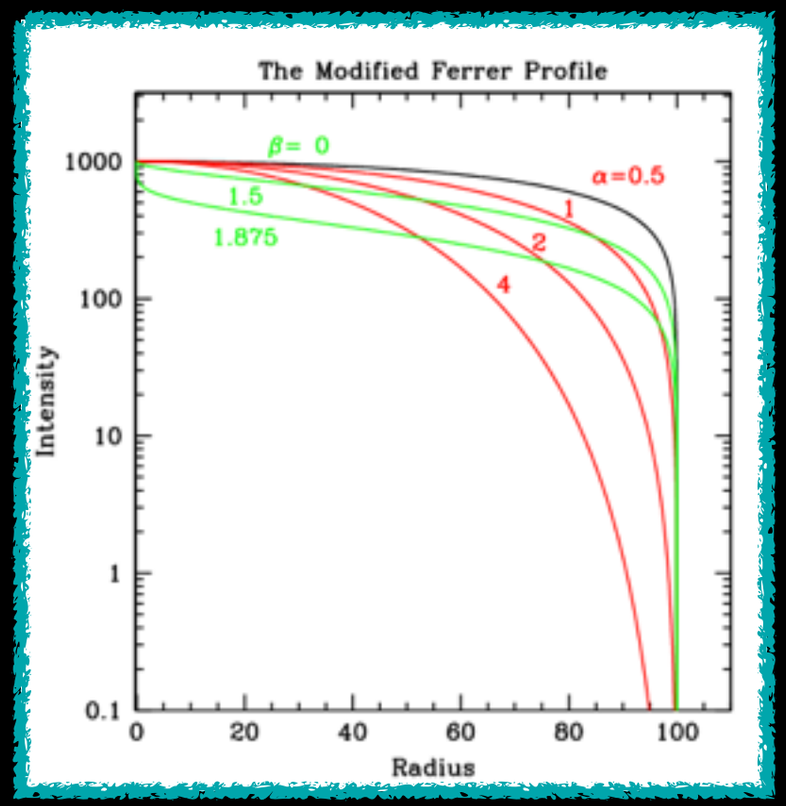
Sersic profile

$$\Sigma(r) \ = \Sigma_e[-k(\frac{r}{r_e})^{\frac{1}{n}} - 1]$$

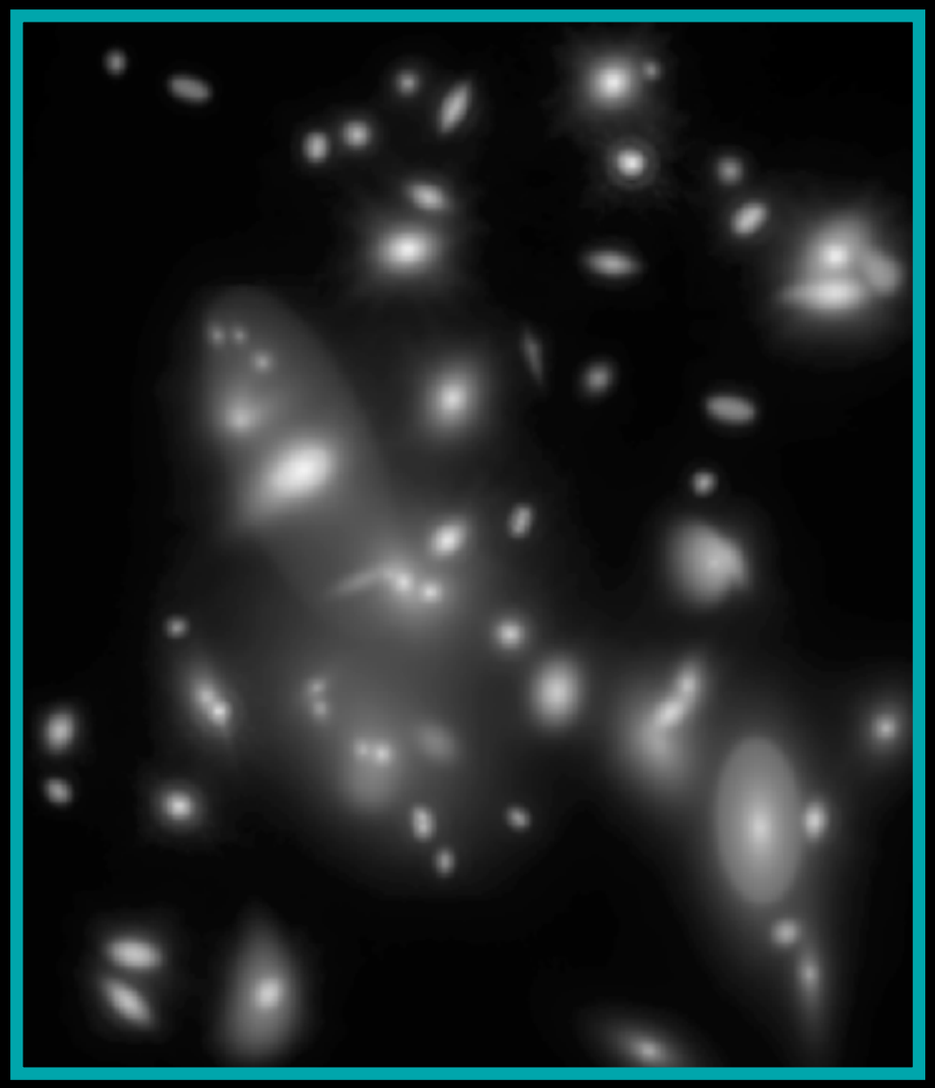


Ferrer profile

$$\Sigma(r) = \Sigma_0(1 - [\frac{r}{r_{out}}]^{2-\beta})^{\alpha}$$

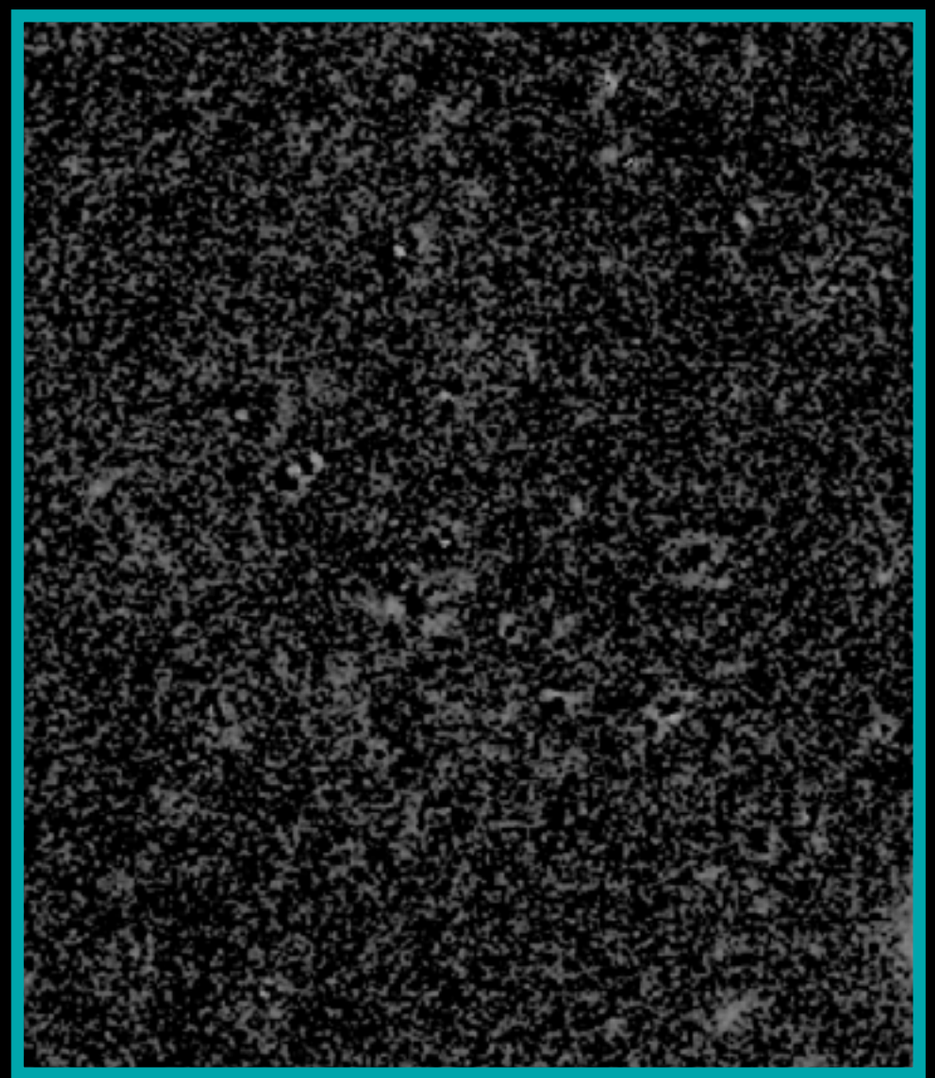


Third step : Diffuse light, model and result



Filter : F140

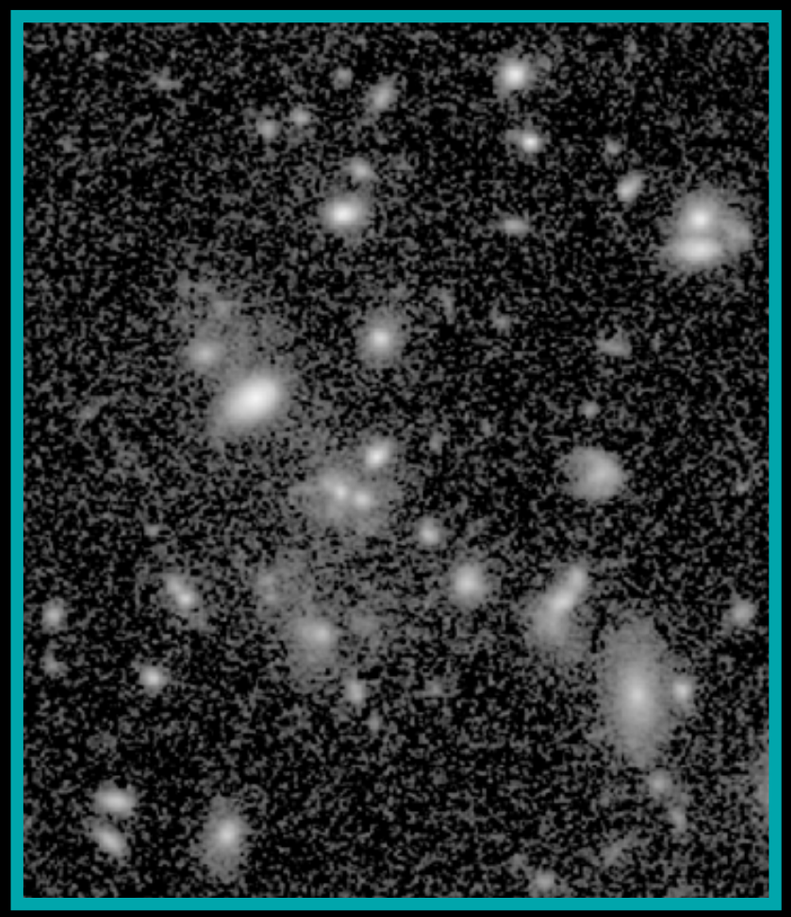
Galfit model



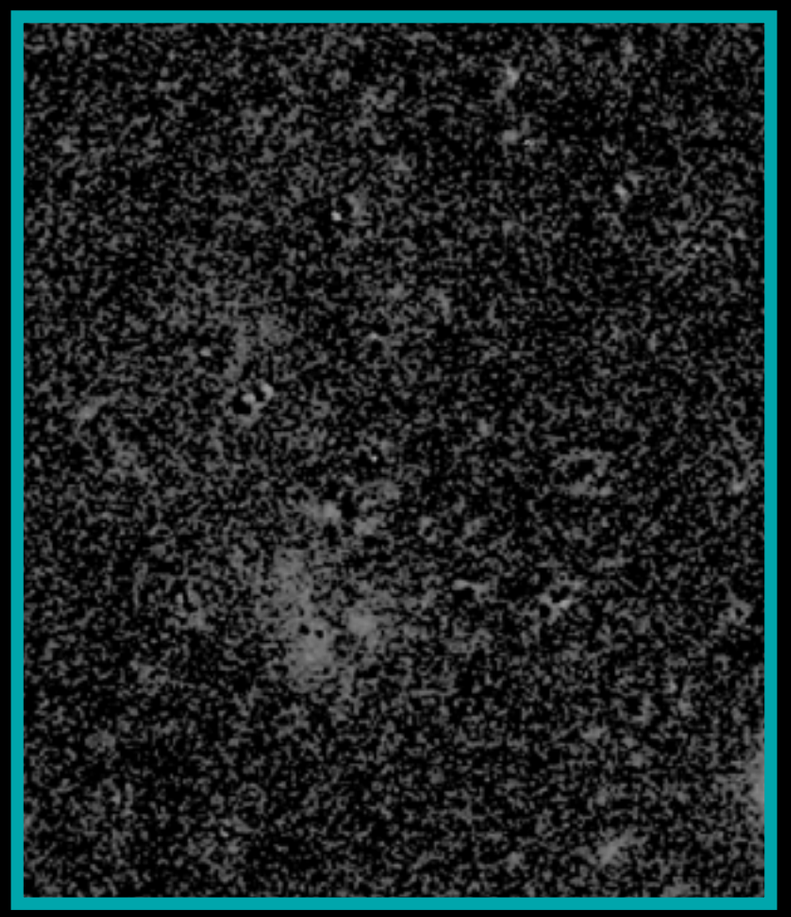
Residual map

Third step : Diffuse light, model and result

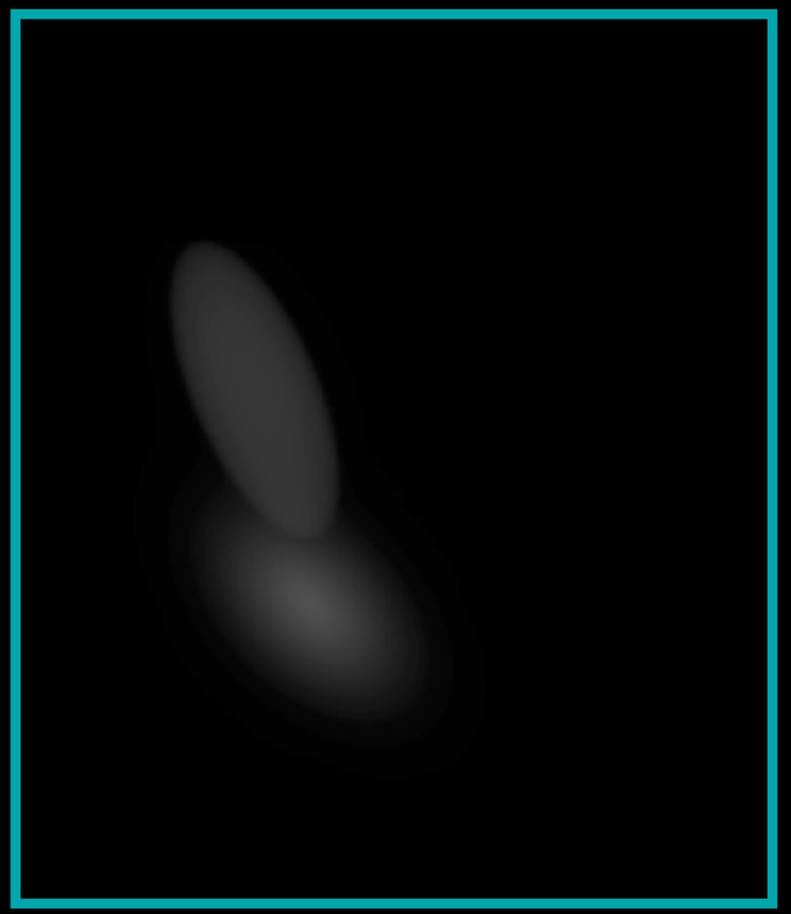
Original image



ICL



ICL model



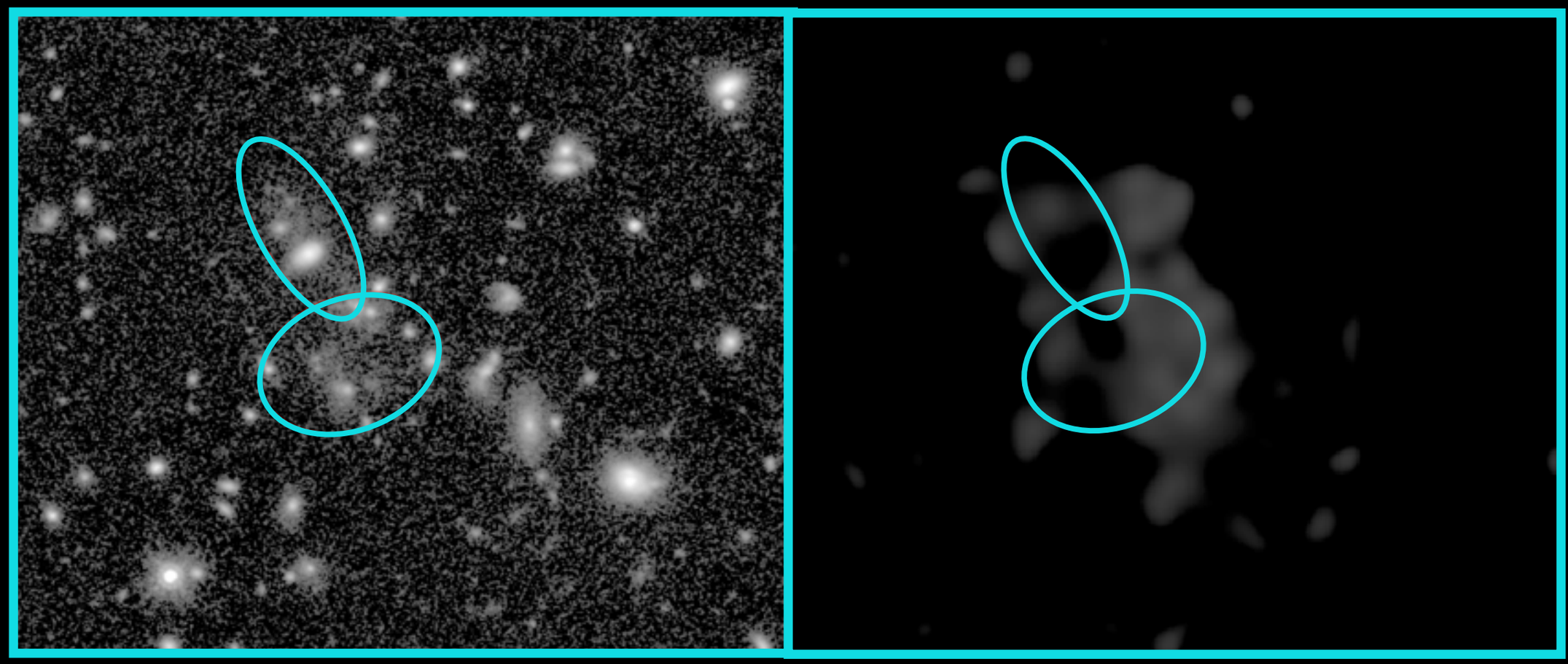
Filter : F140

F105 : $mag = 24.00$

F140 : $mag = 23.00$

Test …

Is it a O III emission associated to the Lya nebula ?



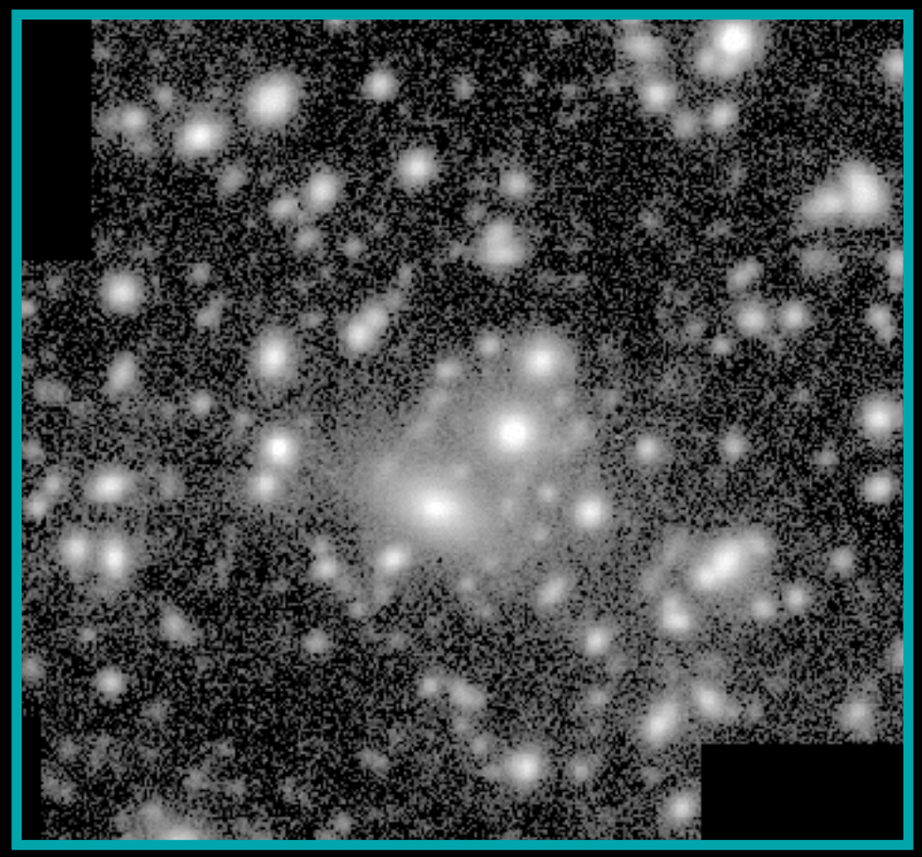
Filter : F140

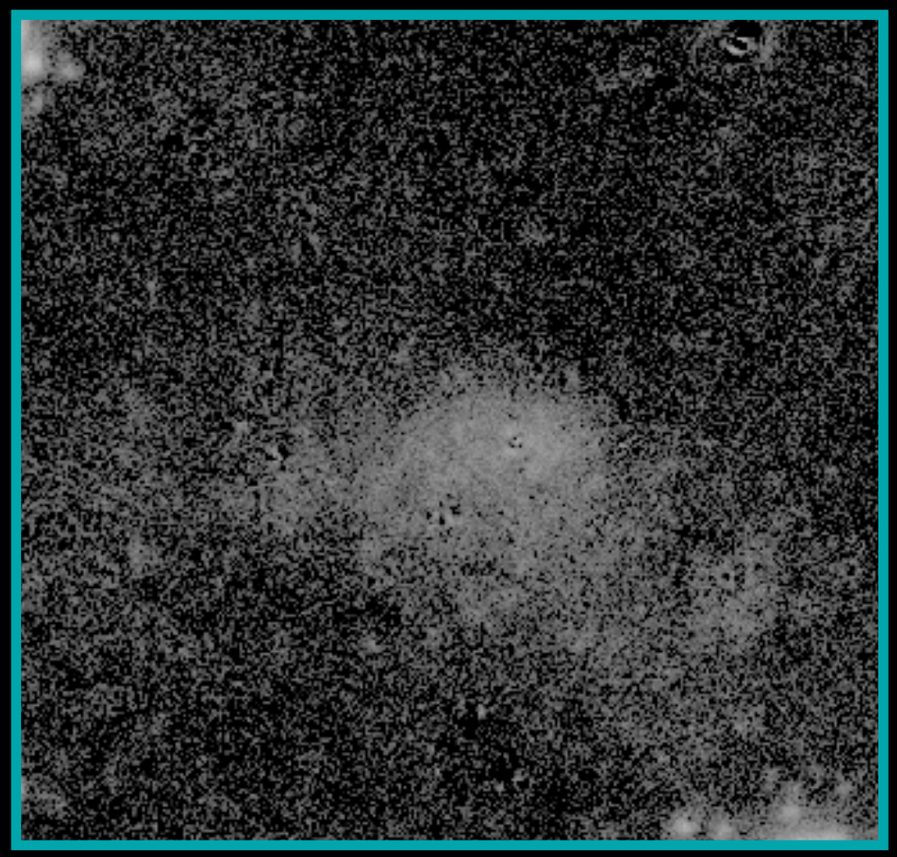
$$mag = 23.00 \longrightarrow mag = 25.9$$

Valentino 2016

Results :

z~0.49





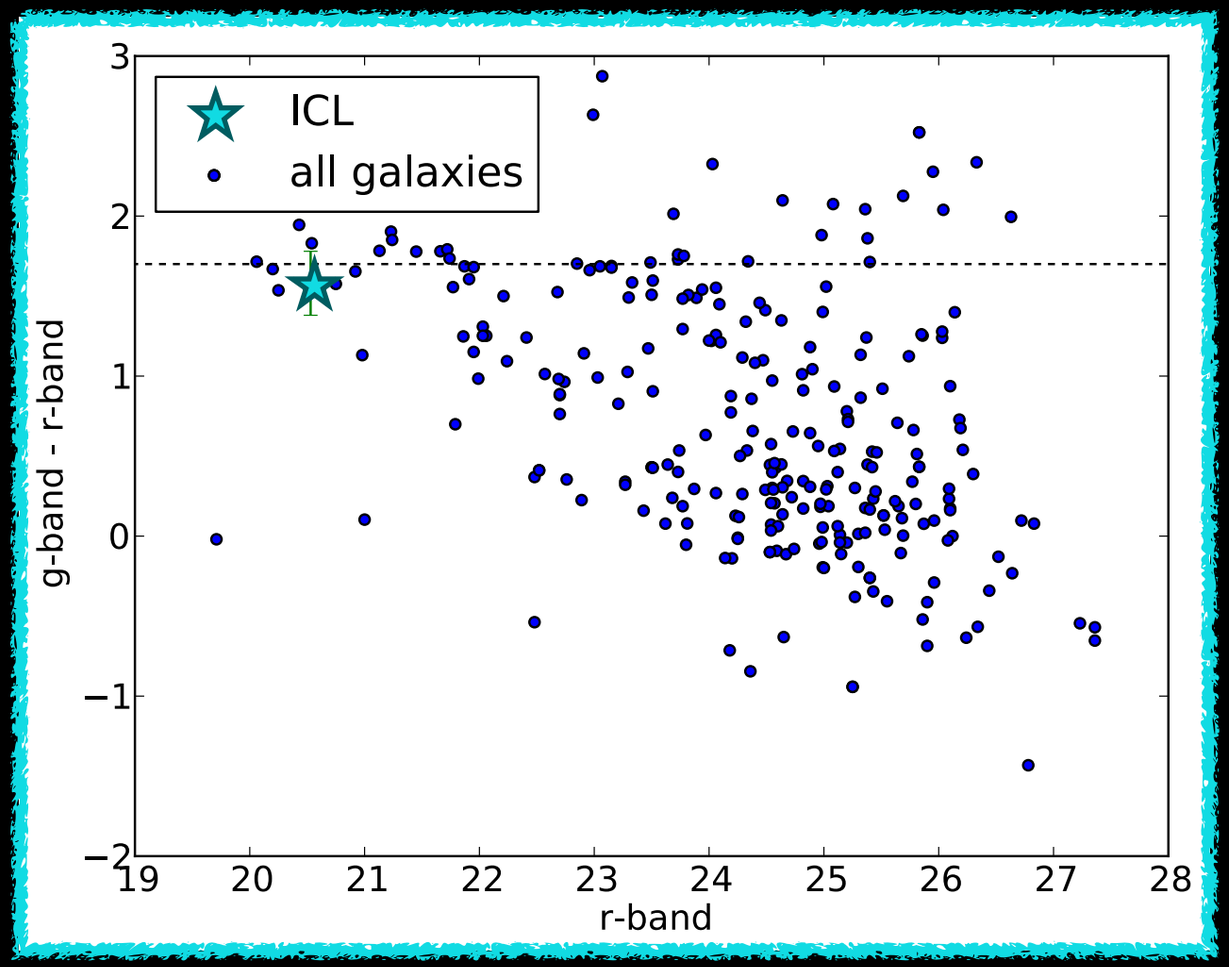
Instrument: Large Binocular Telescope
Bands: r,g

g-band : $mag = 20.52$

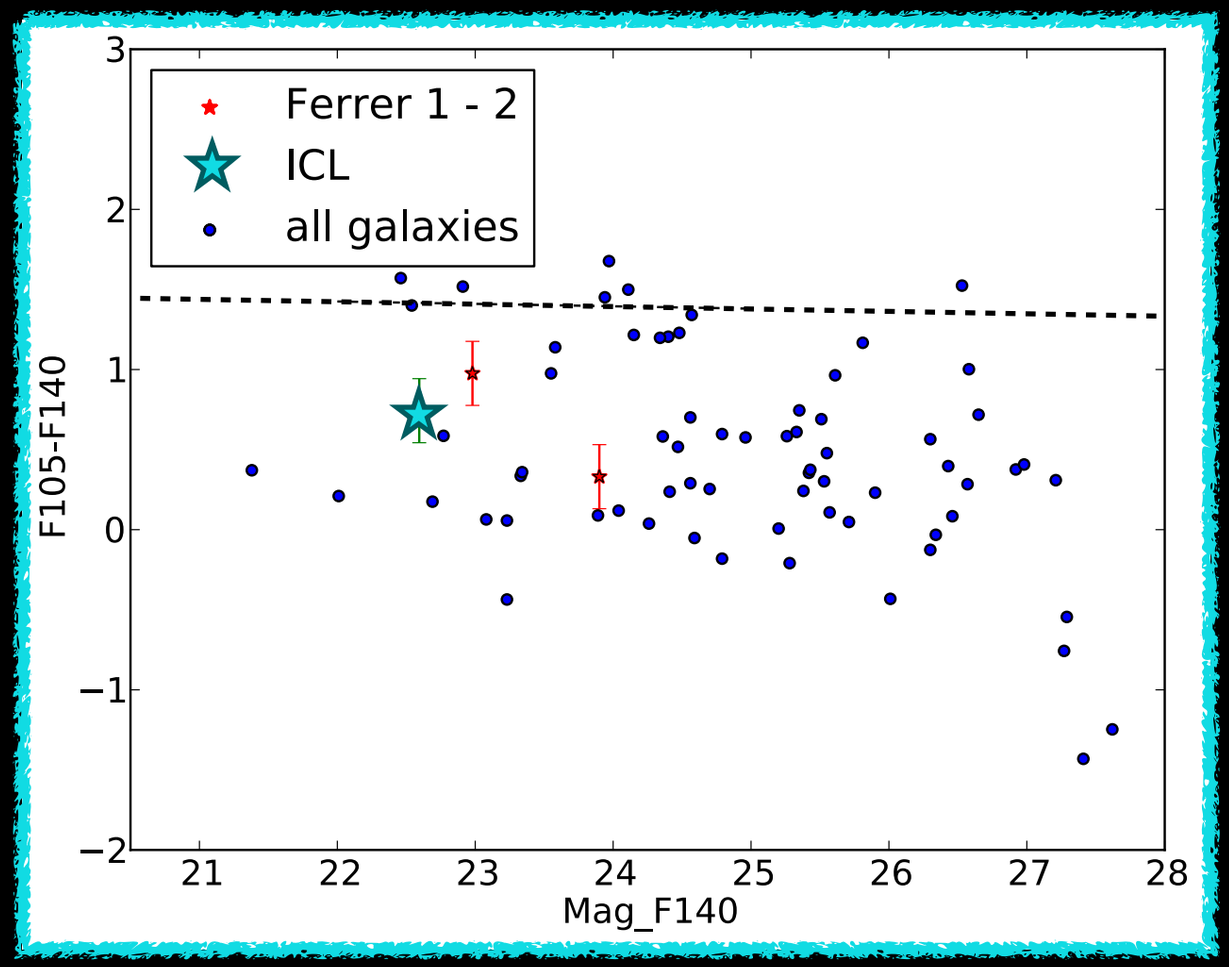
r-band : $mag = 18.94$

Dimauro,Giallongo in prep

Results : Color



z = 0.49

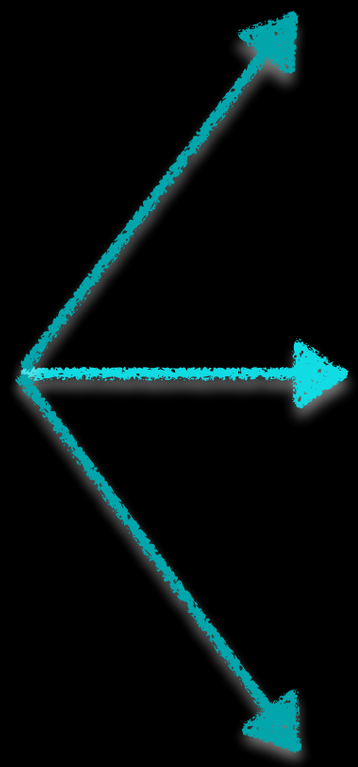


z = 1.99

Preliminary results

Results : Color

ICL



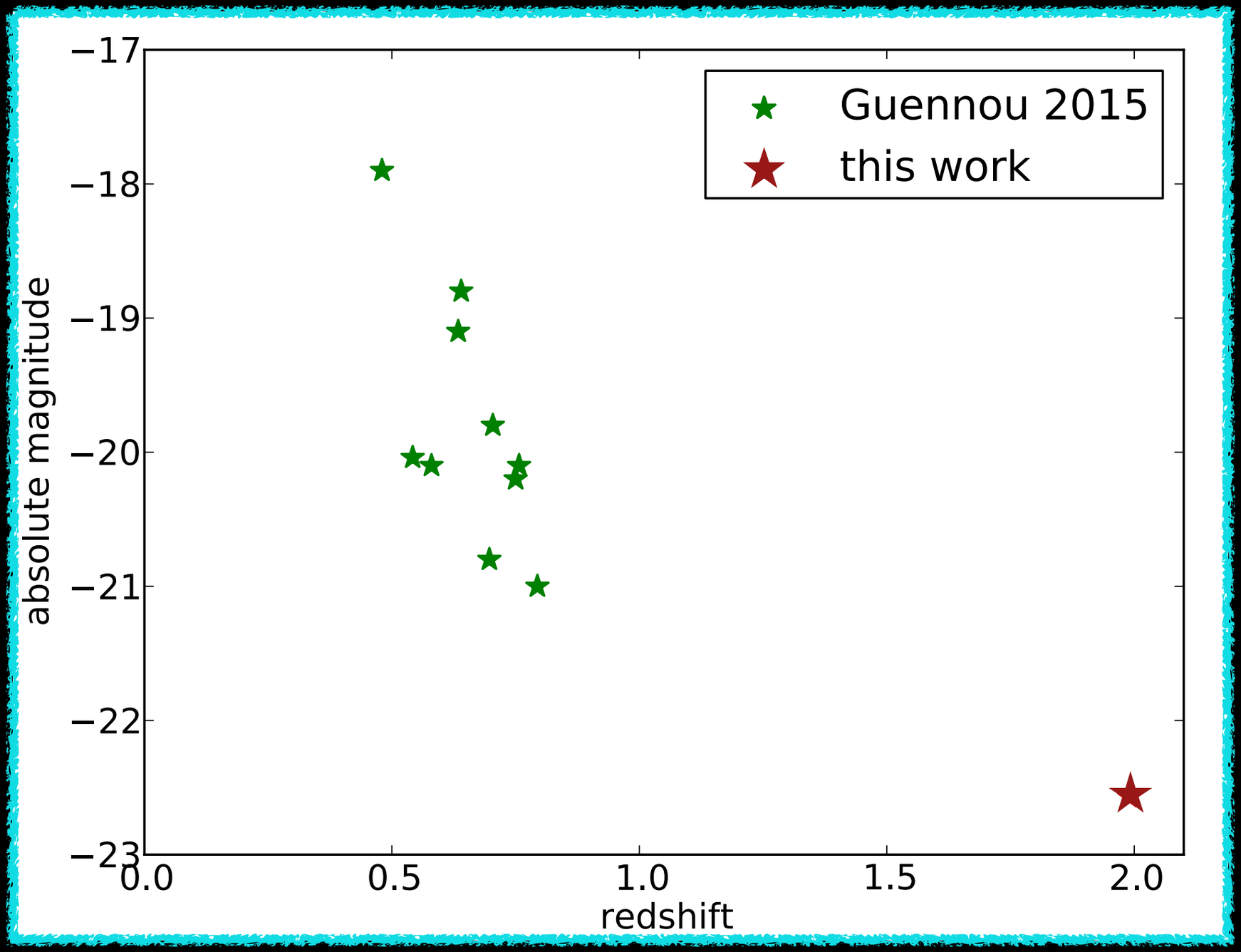
Red: Stars are stripped early and then evolve passively towards red color

Same color of the galaxies : remnant from ongoing interaction

Blue : recent star formation activity has made

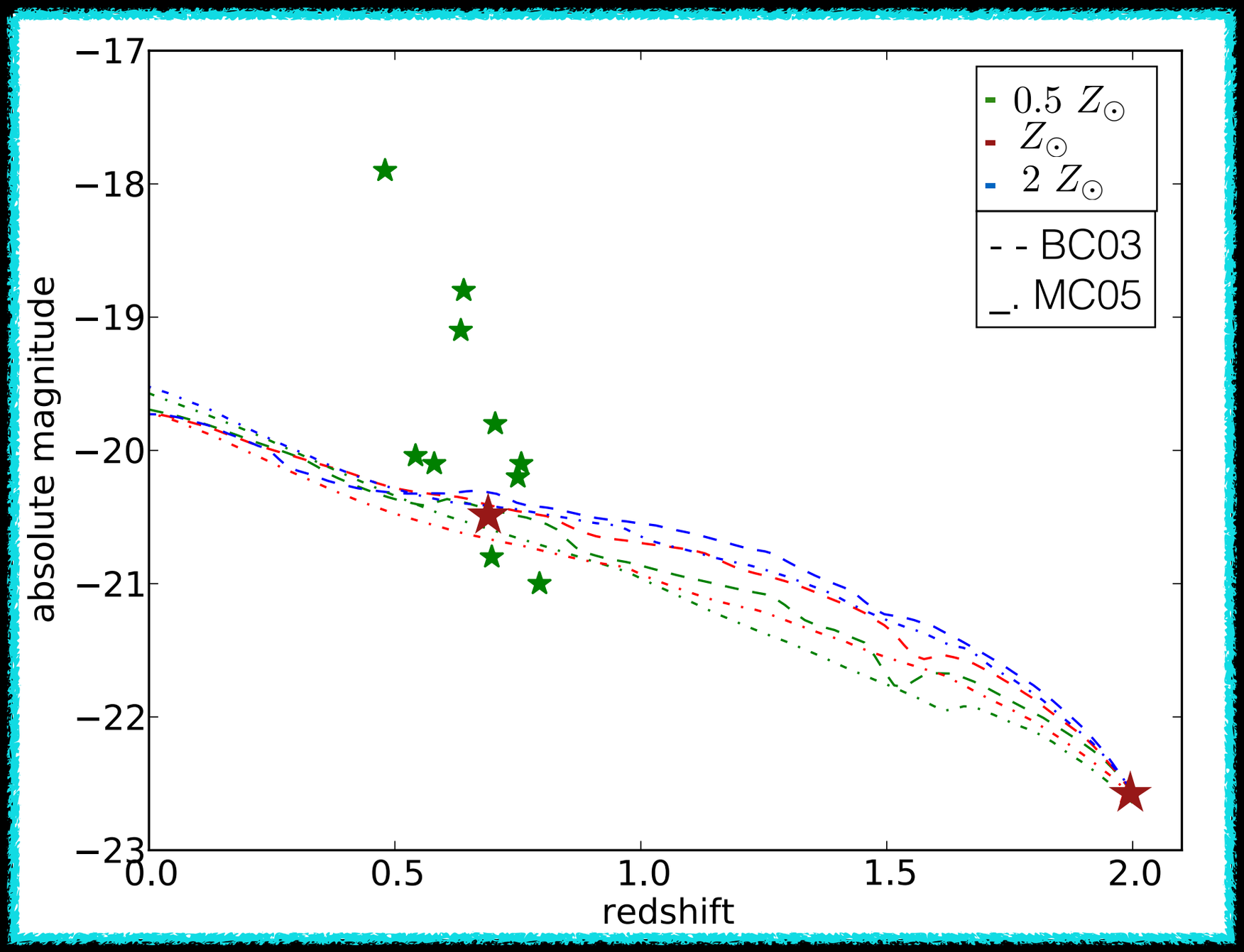
Krick 2006

Results : Absolute magnitude



Preliminary results

Results : Absolute magnitude



Preliminary results

Results : Mass ratio

$$M_* \simeq 0.5 - 1 * 10^{12} M_\odot$$

$$M_{ICL} \simeq 3 - 5 * 10^{10}\ M_\odot$$

$$\frac{M_{ICL}}{M_*} \sim \textbf{3- 10 \%}$$

Higher than what is predicted by the simulation

Preliminary results

Conclusion

Measure the diffuse light in a cluster at z~2 :

- The color is more blu than the red sequence
- is brighter than the diffuse light found in cluster at low-z
- the mass fraction is 3-10 % higher then what is predicted by the simulation

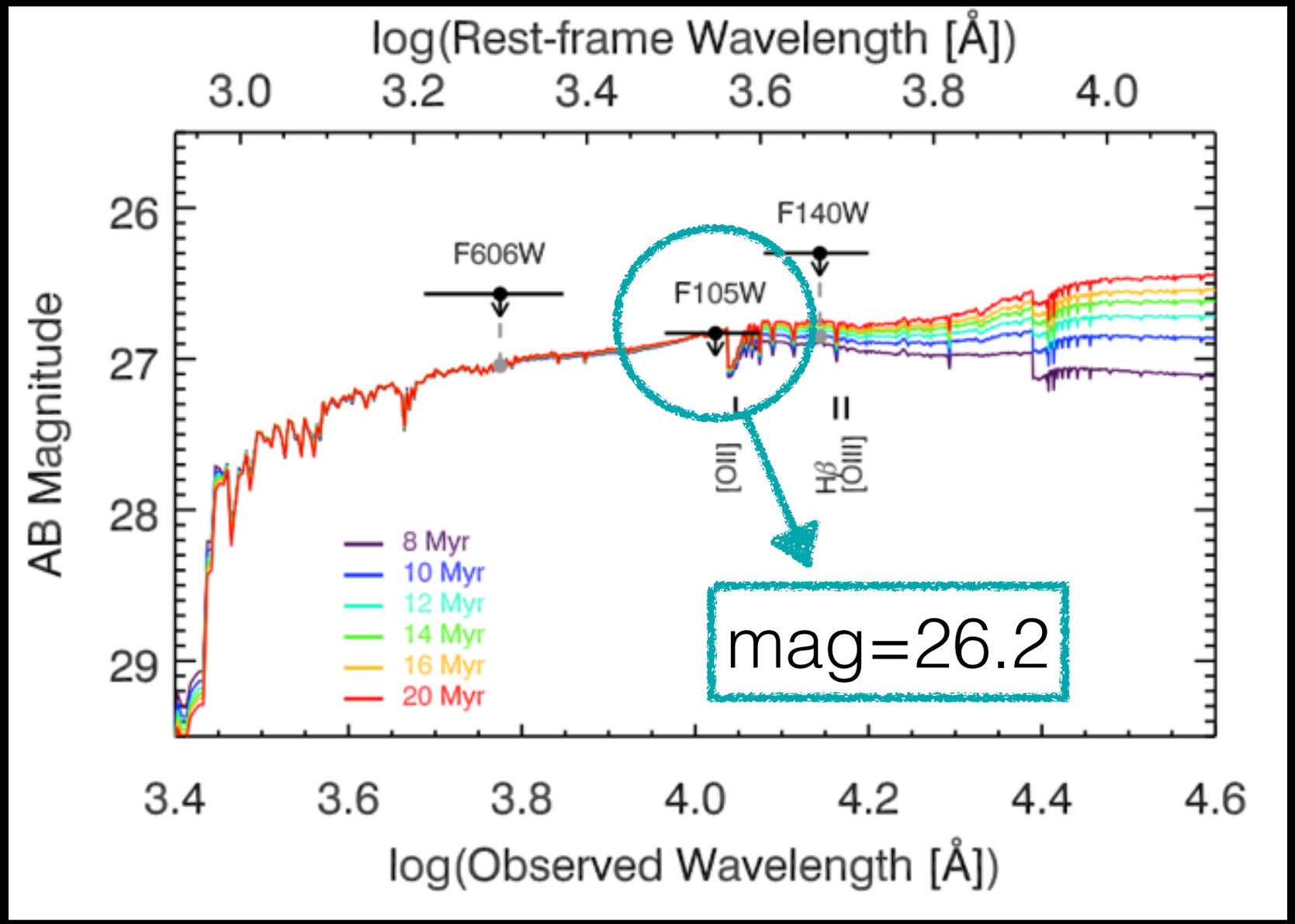
Our result is in agreement on what is found in other clusters

The fraction of diffuse light increase with the redshift and it depend on the mass assembly story of the cluster and on the different proper.

Conclusion

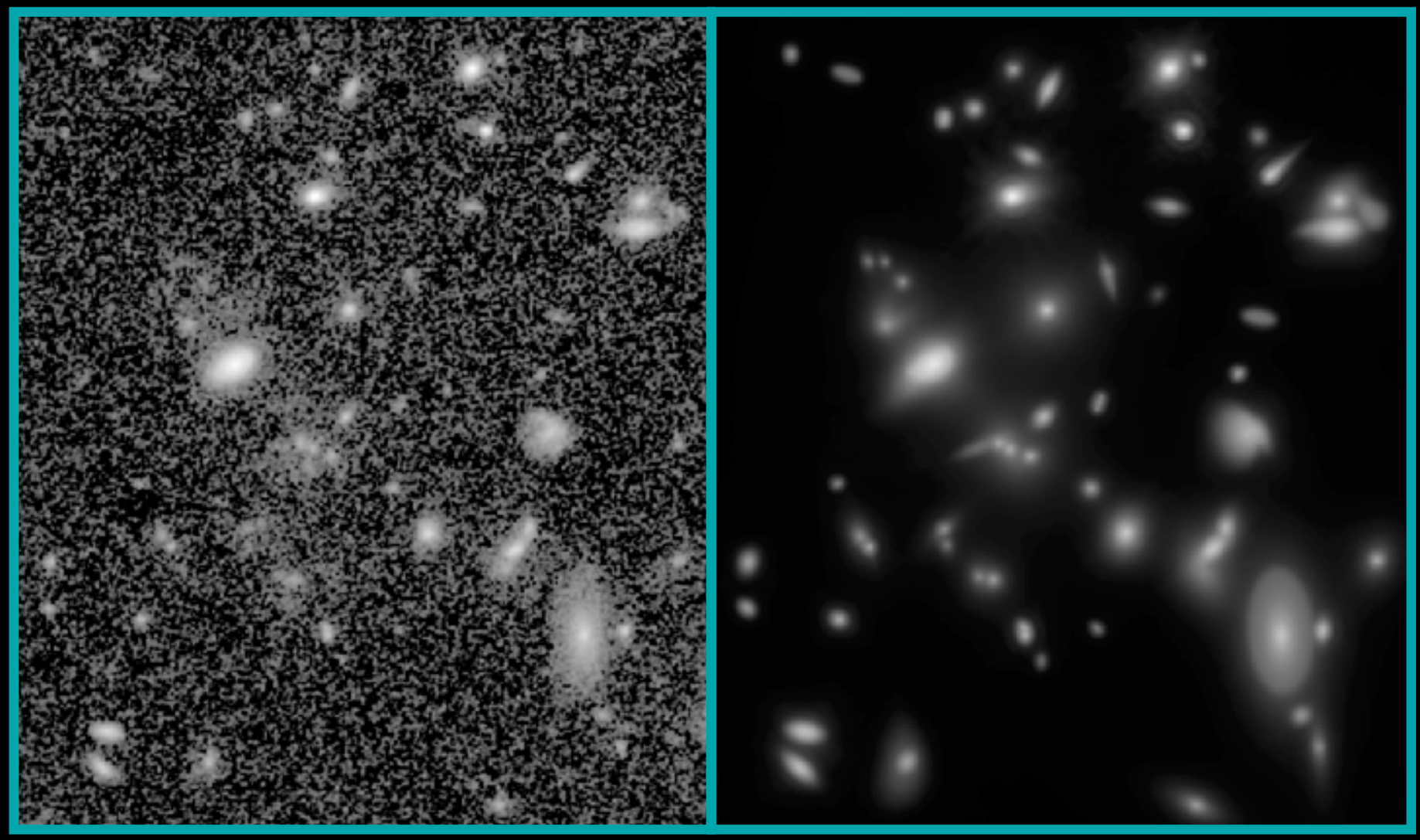
- Absolute magnitude : brighter than low z
- Mass ratio : almost the same
- Color : bluer than the red-sequence of the cluster at z~1.99

from the letterature …



Zanella 2015

F105



F105