Internship Report

CFHT
APRIL- AUGUST
2011

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Small mass galaxies and The star formation Scenarios

Introduction

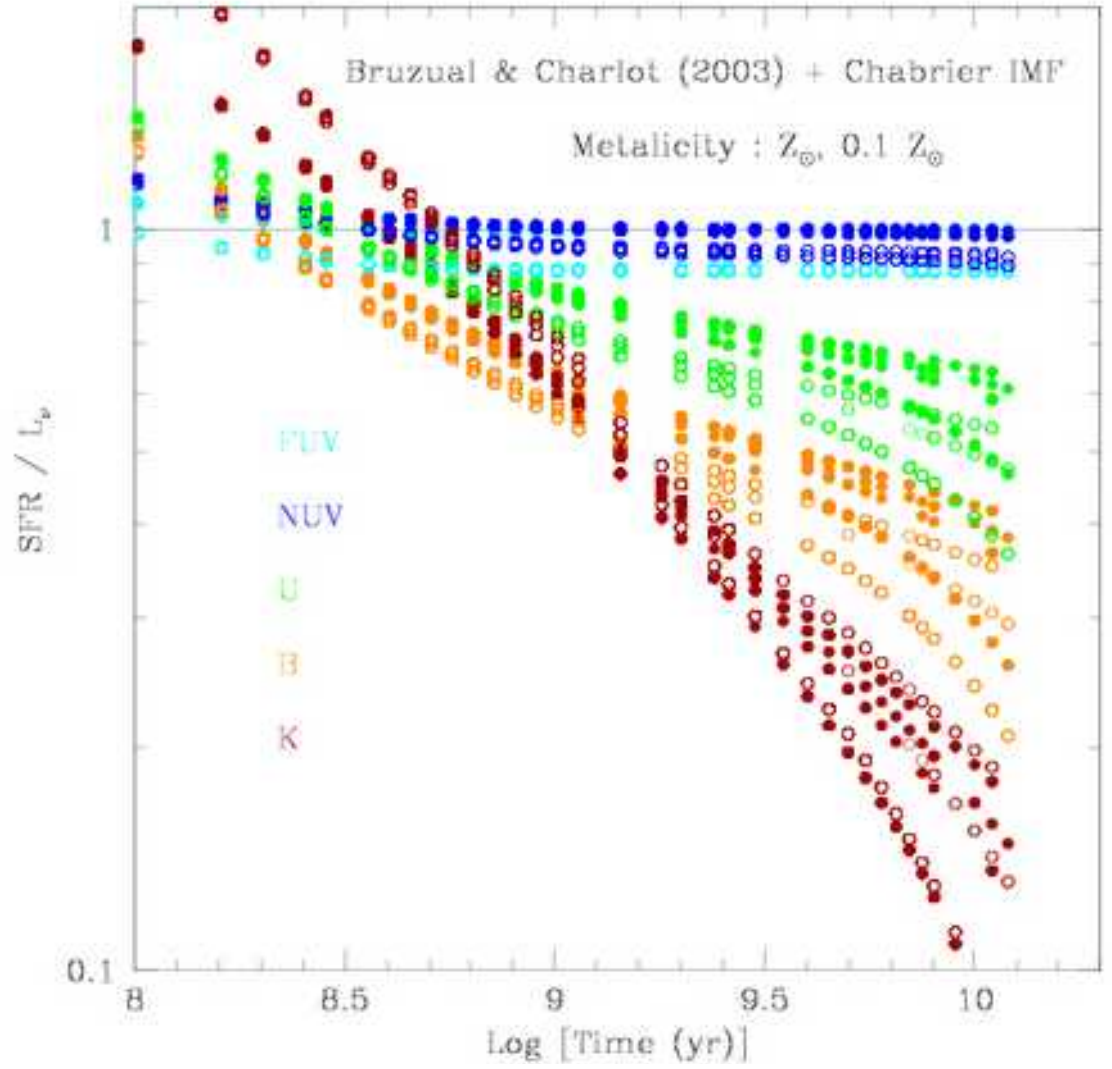
- Observational Cosmology
  - → Galaxies intrinsic evolution
    - → Star Formation Rate
    - → Star Formation History

- UV survey
  - → Small galaxies
    - → More efficient
    - → Different evolution

1/ Tracers of Star Formation

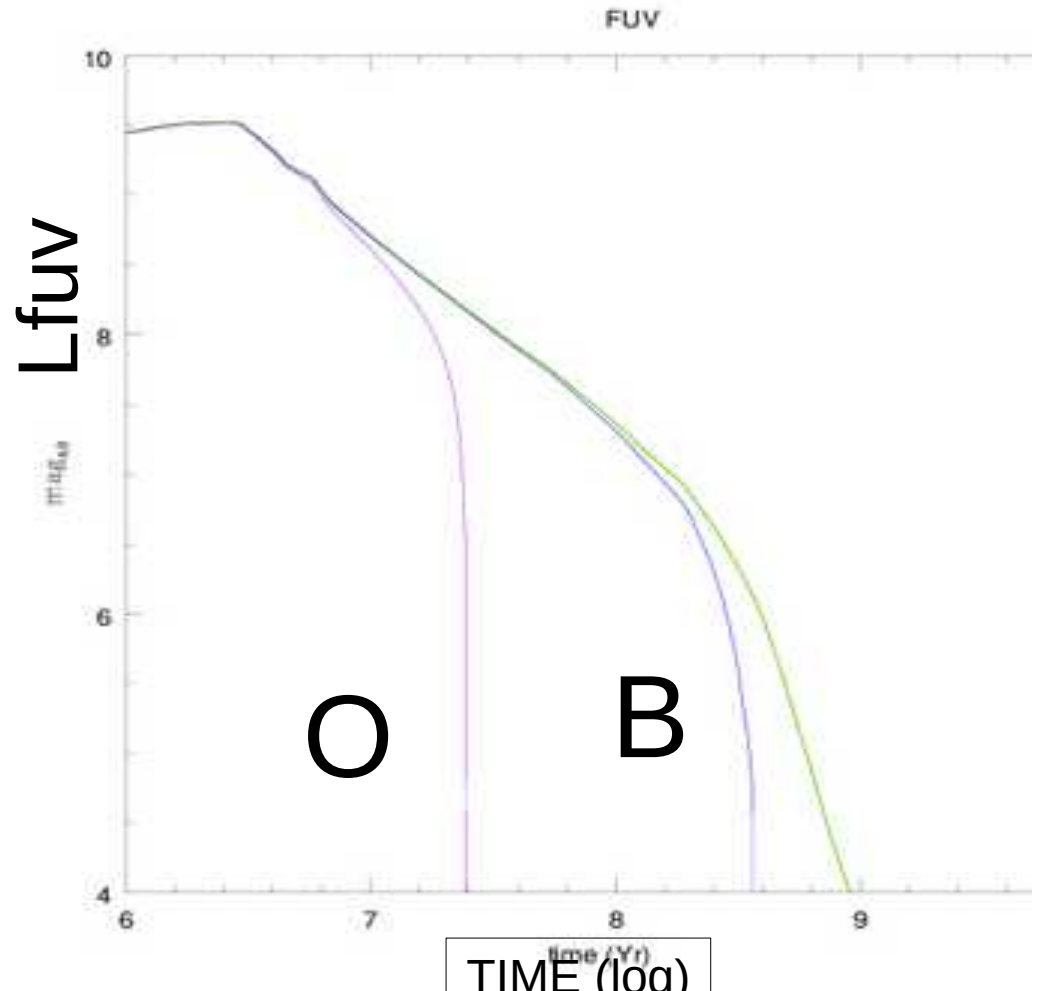
1/ Tracers of Star Formation

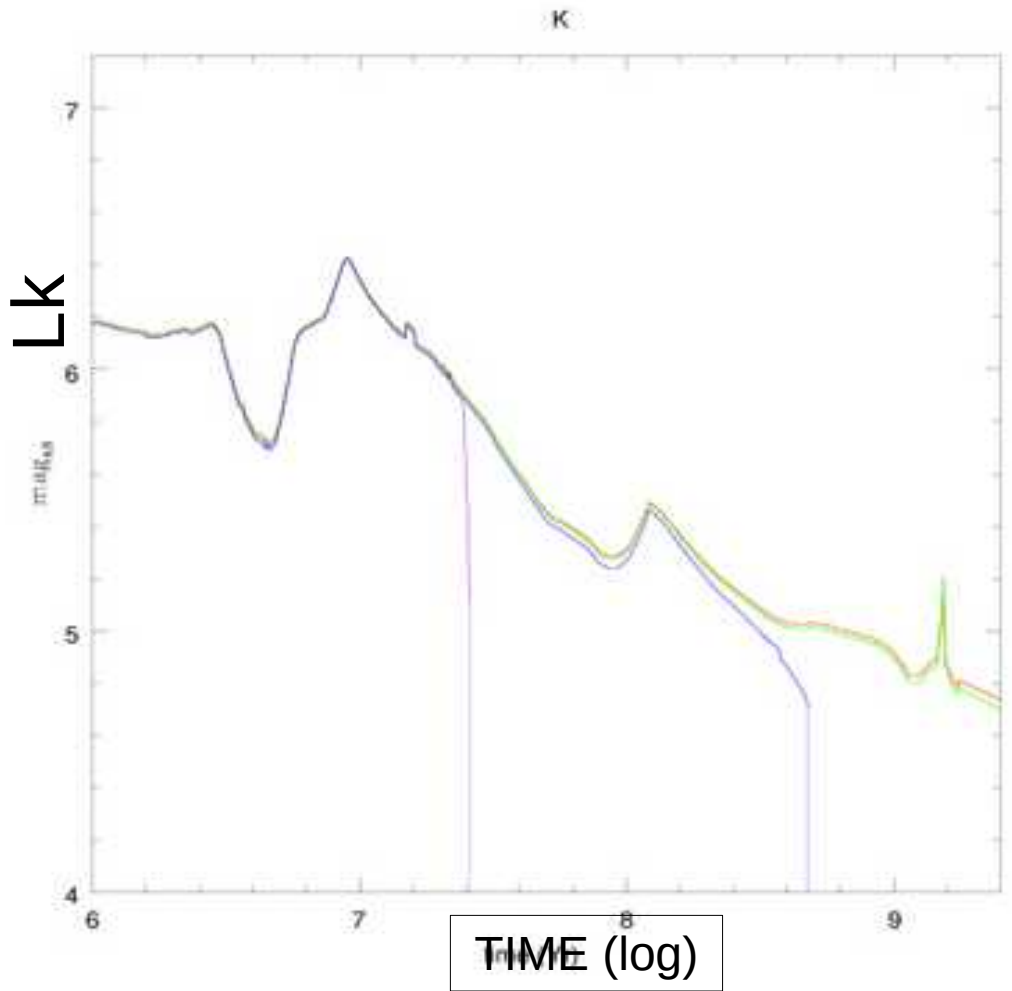
Model from Bruzual and Charlot 2003



1/ Tracers of Star Formation

Models from Starburst 99,
Luminosity of different Stars, (IMF 2.3)

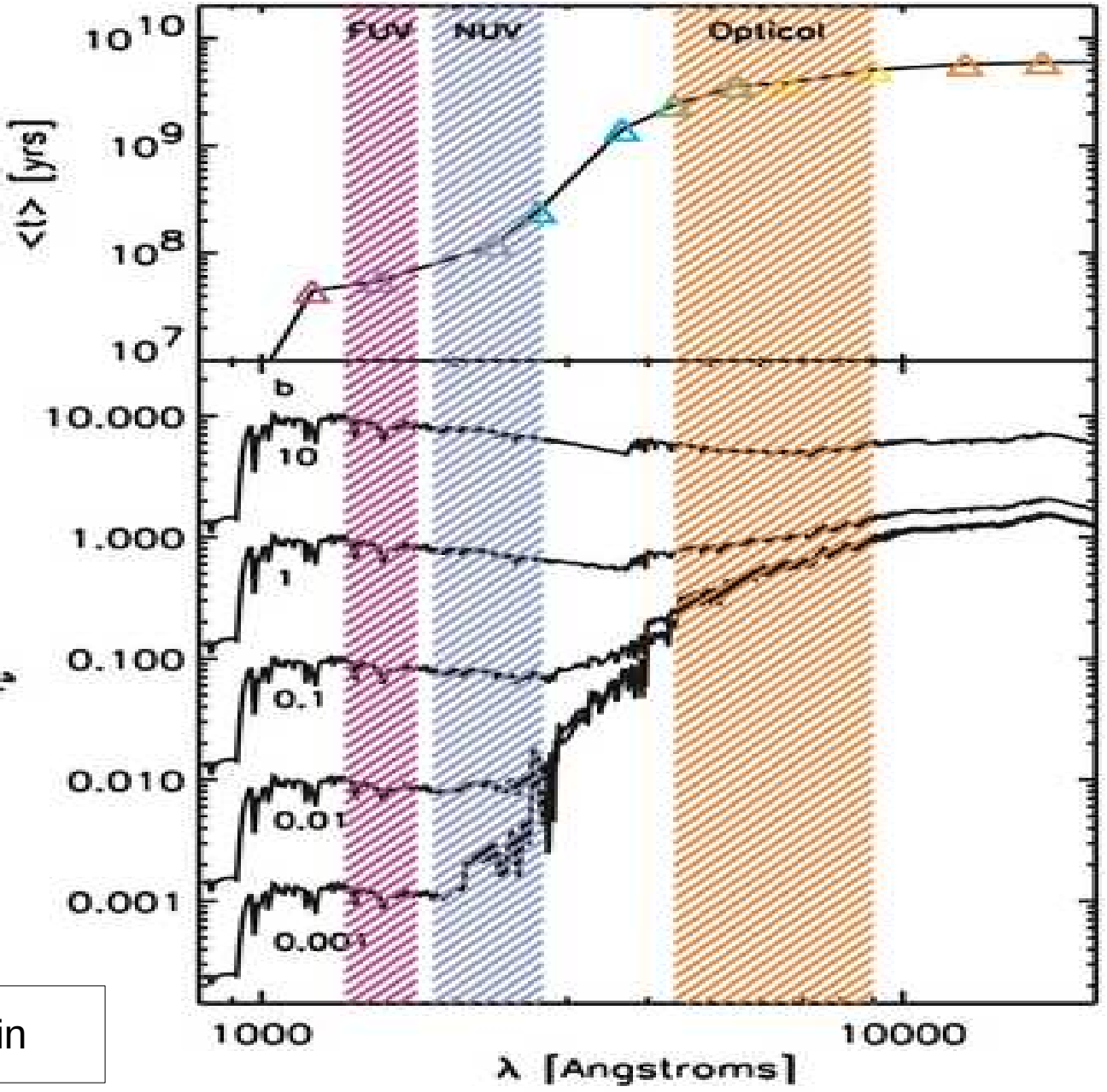




1/ Tracers of Star Formation

Each wavelength (x) trace the average SFR over Year (y)

Spectrum of Galaxies With different SFR



Model from Chris Martin

1/ Tracers of Star Formation

- 1- Fuv (1500-2800) = continuum
- 2- Hα (6563Å) z<0.5
- 3- OII (3727Å) z<1.6
- 4-Fir (8-1000 μm) =black body

1/ Tracers of Star Formation

$$\mathrm{SFR}\ (M_\odot\ yr^{-1}) = 1.4 \times 10^{-28}\ L_\nu\ (\mathrm{ergs\ s^{-1}\ Hz^{-1}}).$$

$$\mathrm{SFR}\ (M_\odot\ yr^{-1}) = 7.9 \times 10^{-42}\ L(H\alpha)\ (\mathrm{ergs\ s^{-1}}) = 1.08 \times 10^{-53}\ Q(H^0)\ (\mathrm{s^{-1}}).$$

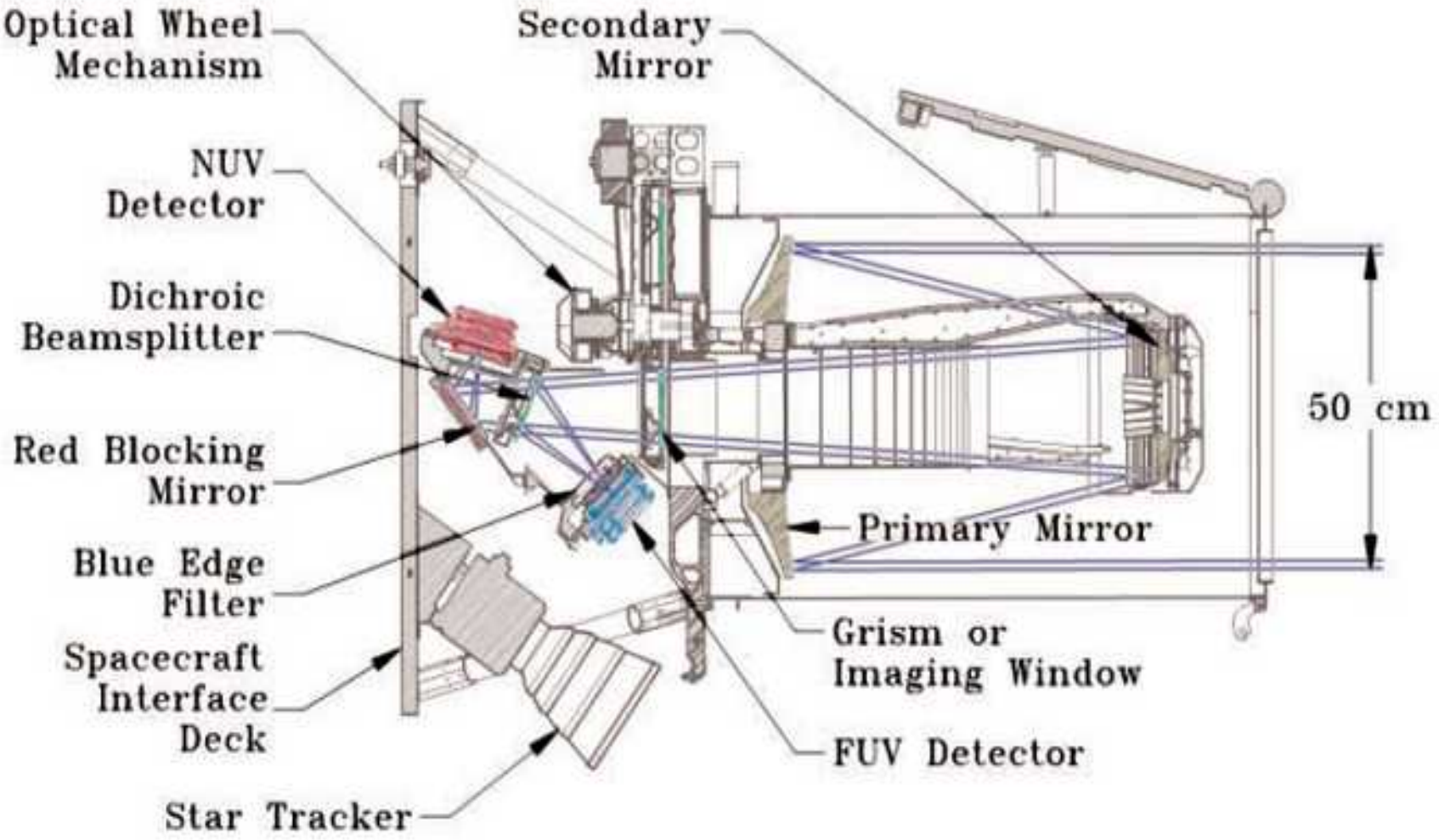
Kennicut 1998

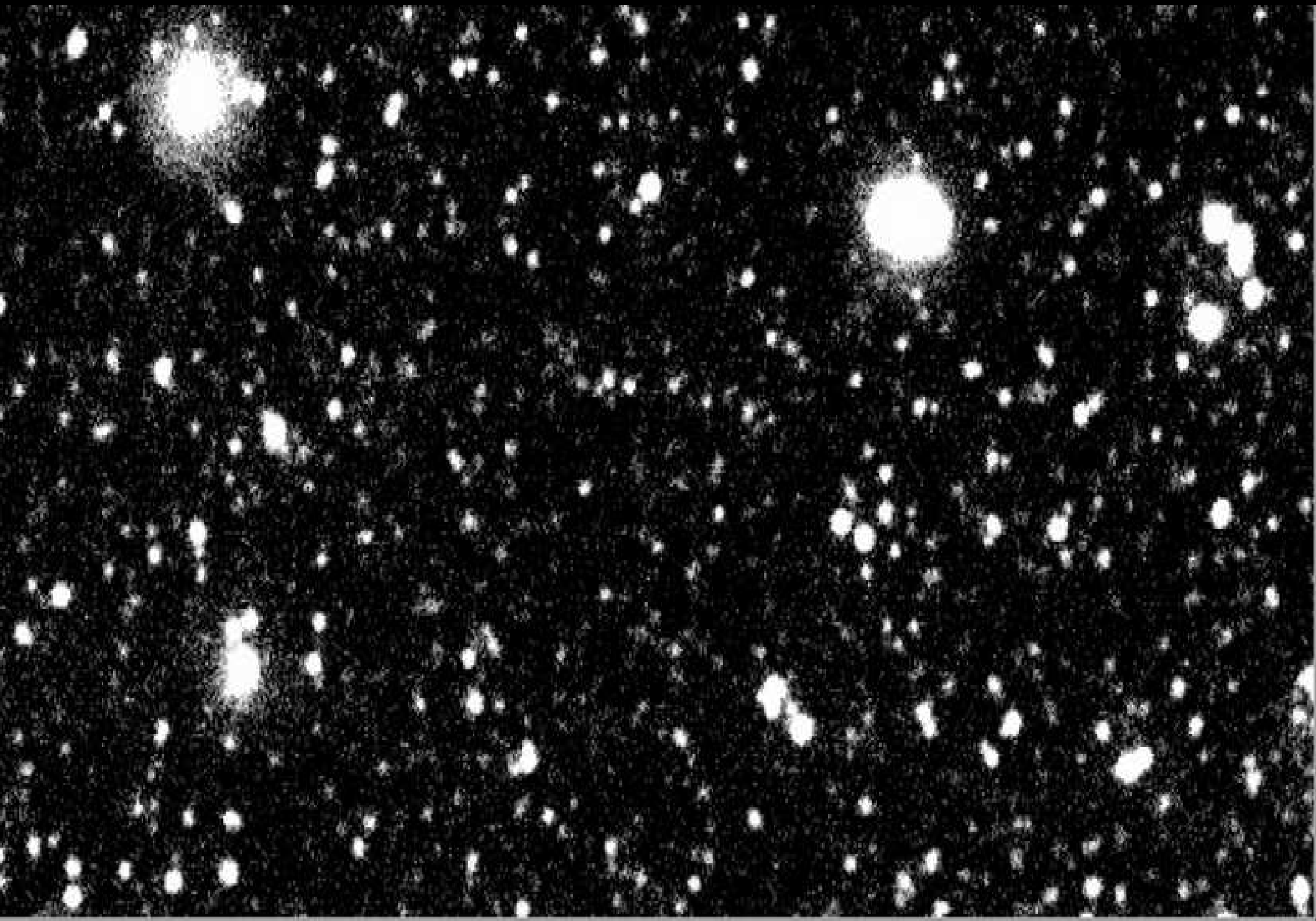
$$SFR\ (M_\odot\ yr^{-1}) = (1.4 \pm 0.4) \times 10^{-41}\ L[OII]\ (\mathrm{ergs\ s^{-1}}),$$

$$\mathrm{SFR}\ (M_\odot\ yr^{-1}) = 4.5 \times 10^{-44}\ L_{FIR}\ (\mathrm{ergs\ s^{-1}})\quad (starbursts)$$

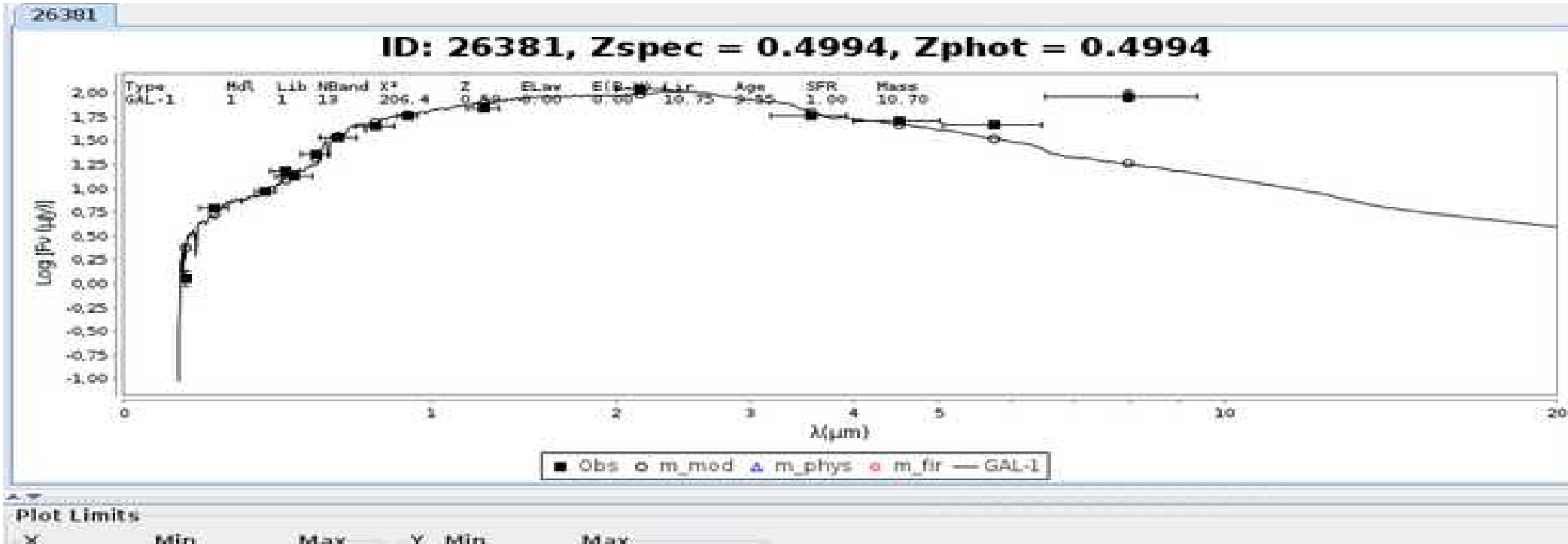
1/ Tracers of Star Formation

- GALEX (Satellite [0.5m])





2/ SED fitting

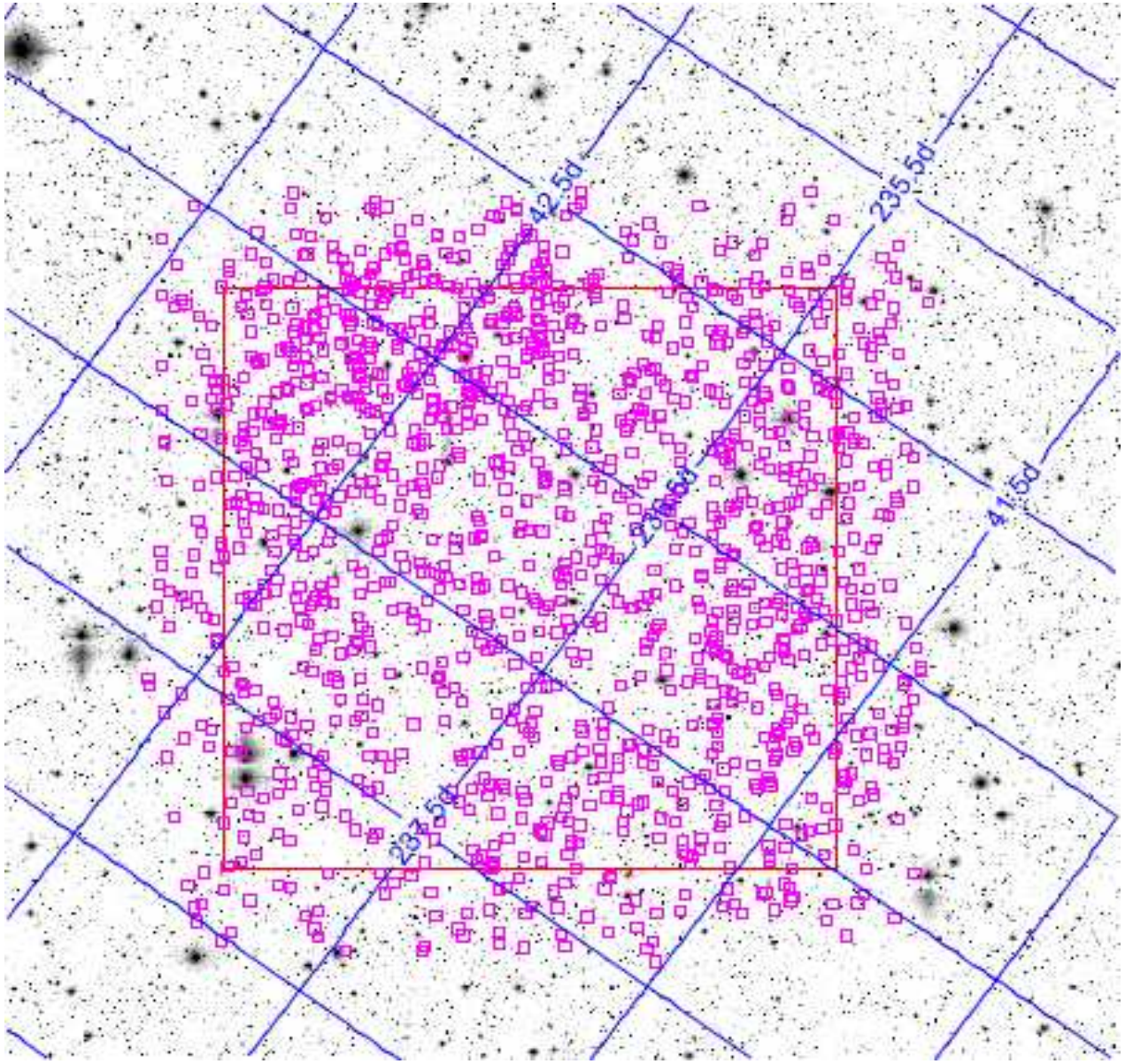


2/ SED fitting

COSMOS survey

- 2 square degree equatorial field
- Space (Hubble, Spitzer, GALEX, XMM, Chandra)
- Ground (Subaru, VLA, ESO-VLT, UKIRT, NOAO, CFHT, and others)
- 2 million galaxies

2/ SED fitting



2/ SED fitting

- PEGASE2 generates lots of templates of galaxies.
  (change Star Formation History)

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  (change Star Formation History)

→ LEPHARE choses the best fit template for the photometric catalog (NUV<25.5)

2 000 000 → 67 000

Paps v1.00.00

File Edit Plots

Plot Options

- [x] 0) Galaxies from First Library
- [x] 1) Gal 2nd Peak
- [x] 2) FIR Spectrum
- [x] 3) Spectrum from Physical Library: BC-STOCH
- [x] 4) QSO Spectrum
- [x] 5) Star Spectrum
- [x] 6) Sum of:(0) and (2)
- [x] 7) Sum of: (2) and (3)

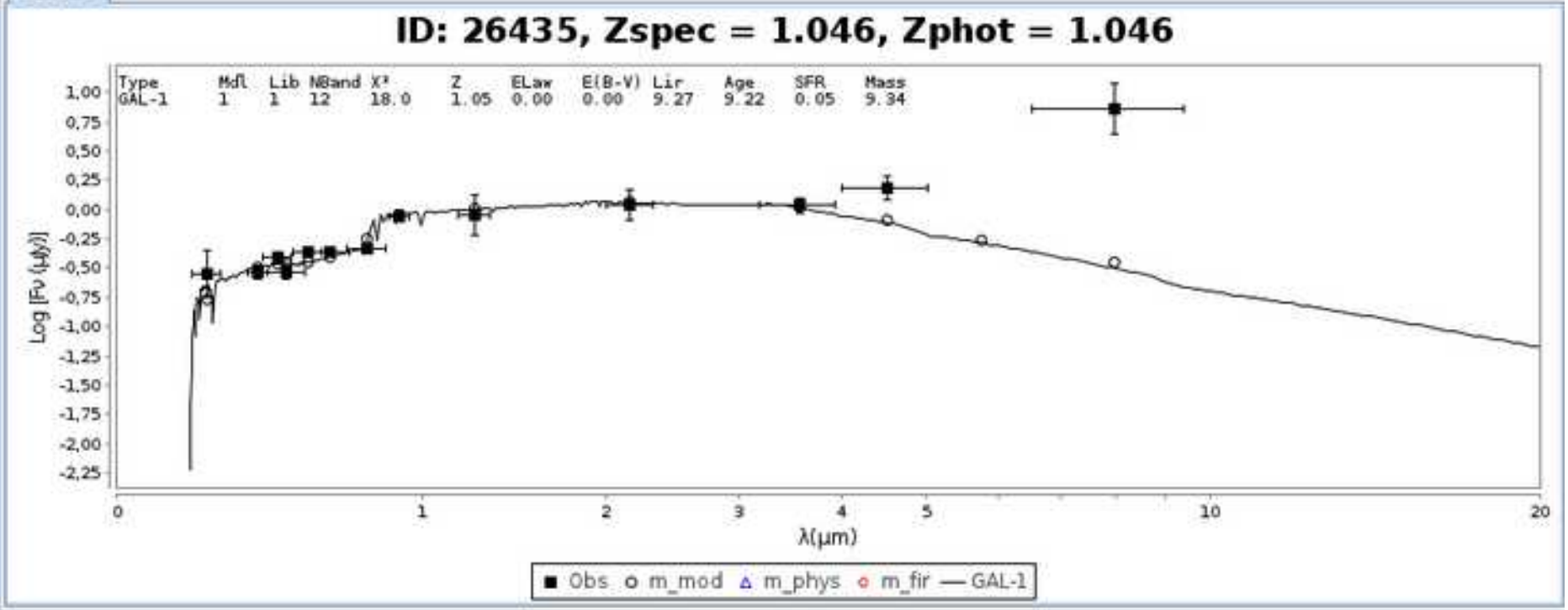
Files

File Name	ID	ZPhot	ZSpec	Filt.	Types
Id000026364.spec	26364	0.2985	0.2985	19	1
Id000026381.spec	26381	0.4994	0.4994	19	1
Id000026412.spec	26412	0.6238	0.6238	19	1
Id000026413.spec	26413	0.8093	0.8093	19	1
Id000026428.spec	26428	0.9360	0.9360	19	1
Id000026434.spec	26434	0.2257	0.2257	19	1
Id000026435.spec	26435	1.0460	1.0460	19	1
Id000026452.spec	26452	0.8501	0.8501	19	1
Id000026467.spec	26467	0.8358	0.8358	19	1
Id000026483.spec	26483	0.5756	0.5756	19	1
Id000026496.spec	26496	1.1660	1.1660	19	1
Id000026549.spec	26549	1.2902	1.2902	19	1

Plots Loaded Files: 23

Plots

26435



Plot Limits

Paps v1.00.00

File Edit Plots

Plot Options

- [x] 0) Galaxies from First Library
- [x] 1) Gal 2nd Peak
- [x] 2) FIR Spectrum
- [x] 3)
- [x] 4)
- [x] 5)
- [x] 6)
- [x] 7) Sum of: (2) and (3)

$$A = \frac{\sum_{i=1}^{N_{filt}} F_{obs,i} \times F_{pred,i}}{\sum_{i=1}^{N_{filt}} F_{obs,i}}$$

Files

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Id000026434.spec	26434	0.2257	0.2257	19	1
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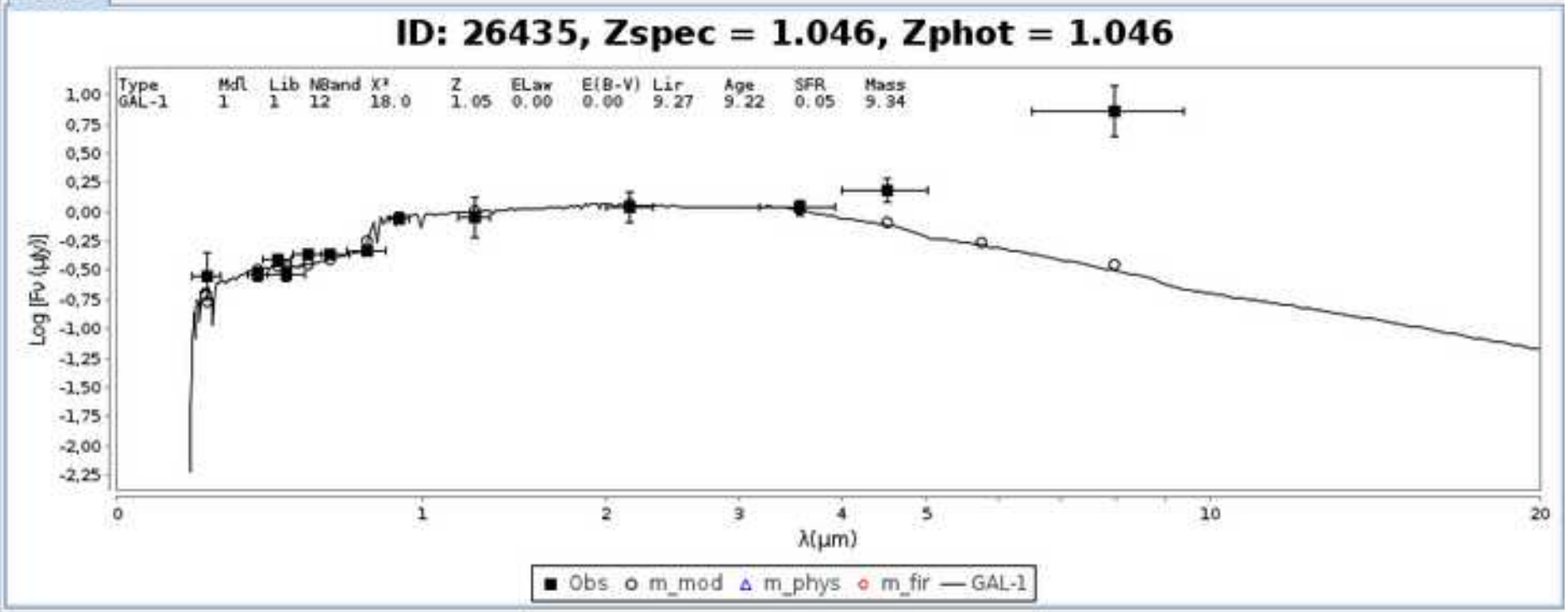
Id000026452.spec	26452	0.8501	0.8501	19	1
Id000026467.spec	26467	0.8358	0.8358	19	1
Id000026483.spec	26483	0.5756	0.5756	19	1
Id000026496.spec	26496	1.1660	1.1660	19	1
Id000026549.spec	26549	1.2902	1.2902	19	1

Plots

Loaded Files: 23

Plots

26435



Plot Limits

Paps v1.00.00

File Edit Plots

Plot Options

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Id000026483.spec	26483	0.5756	0.5756	19	1
Id000026496.spec	26496	1.1660	1.1660	19	1
Id000026549.spec	26549	1.2902	1.2902	19	1

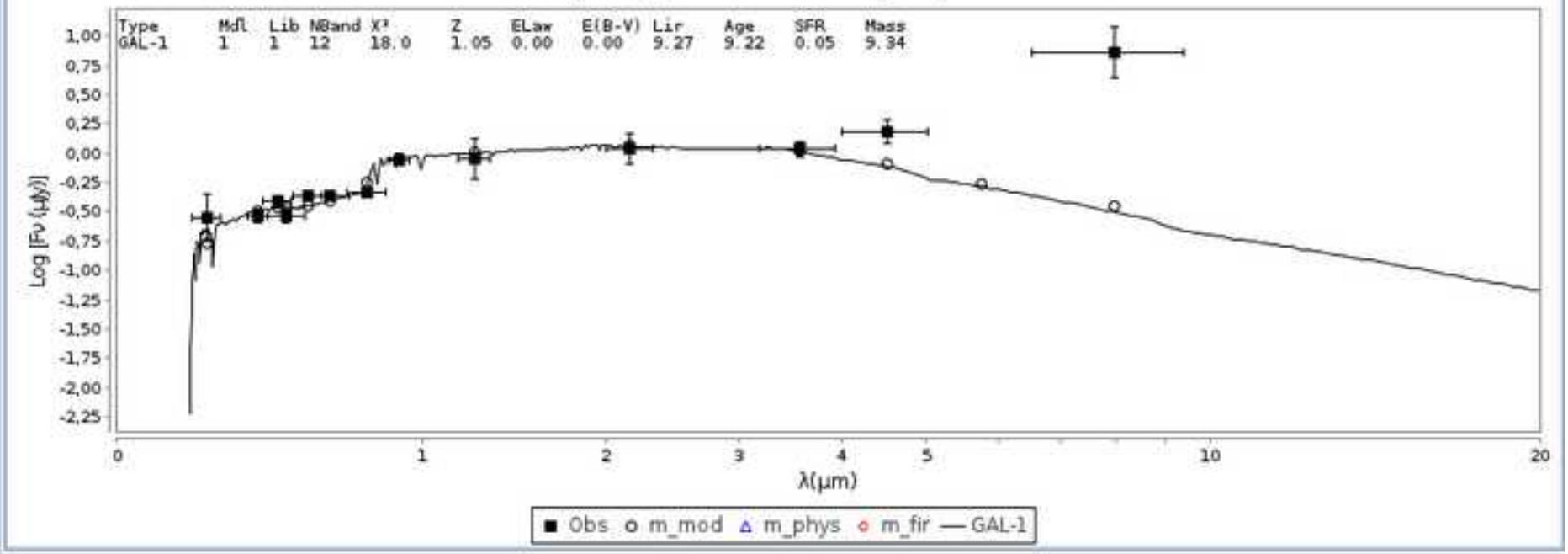
$$\chi^2(A, z, template) = \sum_{i=1}^{N_{filt}} \left(\frac{F_{obs,i} - A(z, template) \times F_{pred,i}(z, template)}{\sigma_{obs,i}} \right)^2$$

Plots | Loaded Files: 23

Plots

26435

ID: 26435, Zspec = 1.046, Zphot = 1.046



Plot Limits

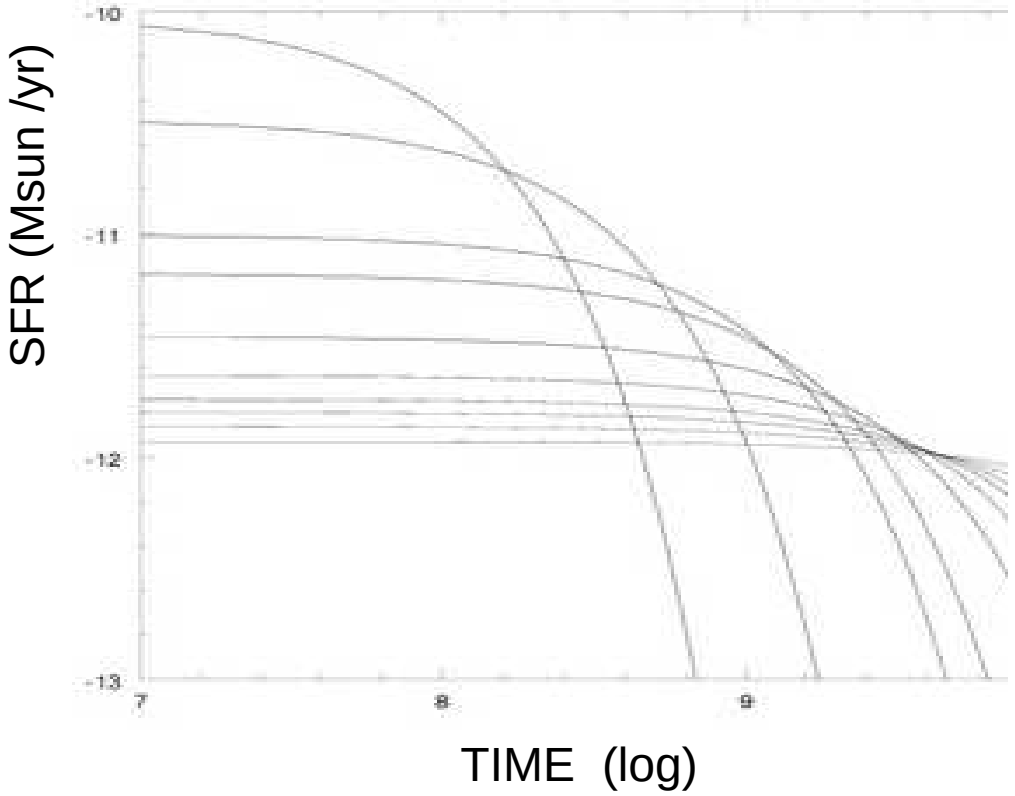
Are the small galaxies so young ?

2/ SED fitting

2 Mains Star formation Histories

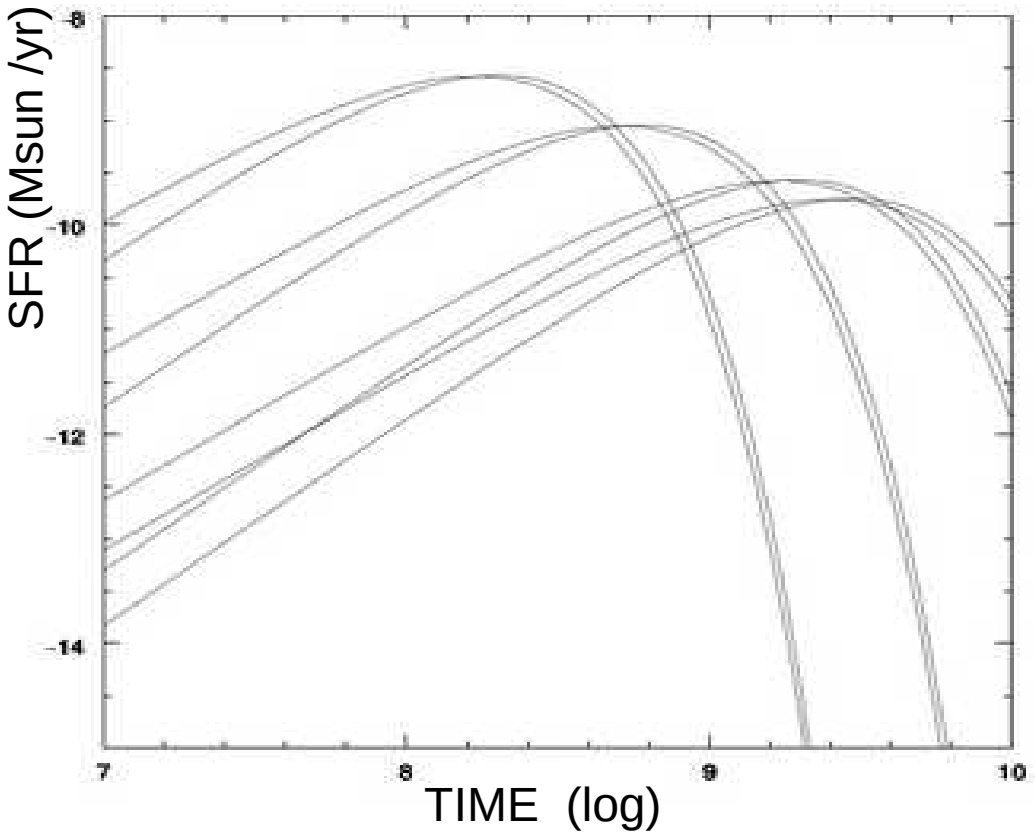
Exponentially decressing

$sfr(t) = \exp(-t/\tau)$



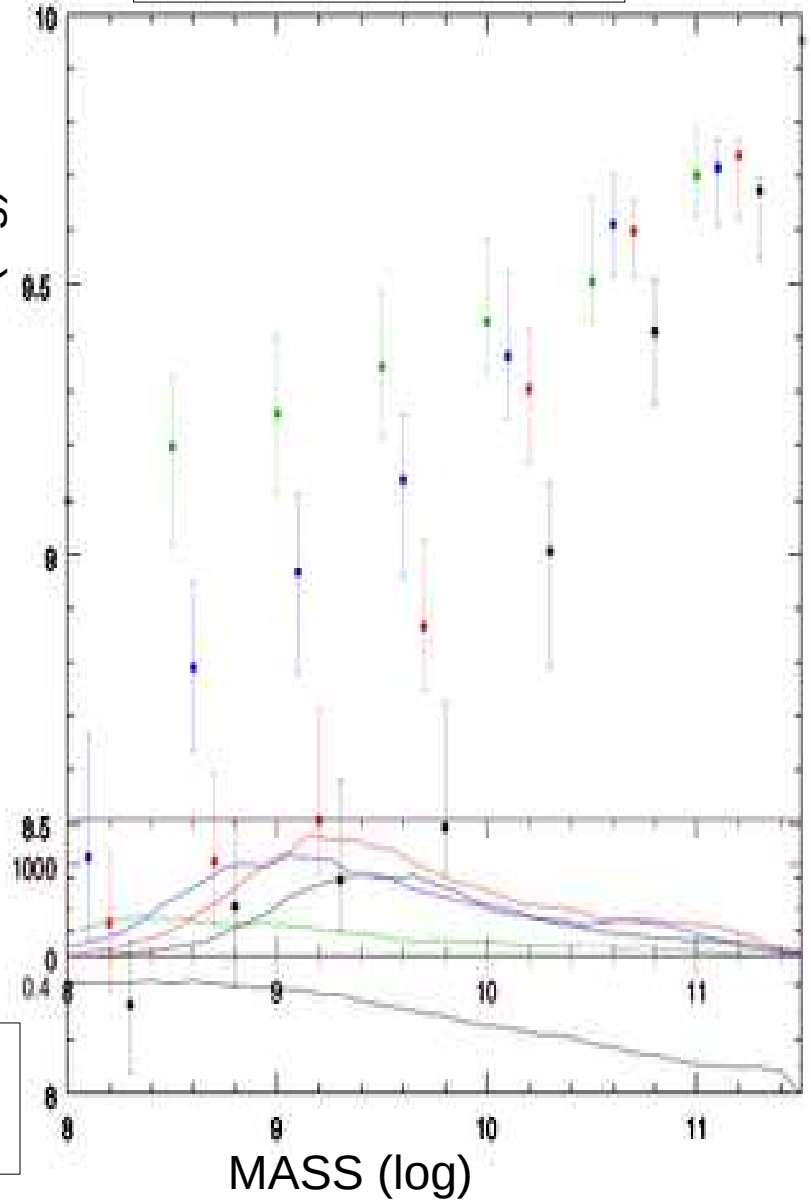
Delayed

$sfr(t) = (t/\tau)^{\alpha} * \exp(-t/\tau)$

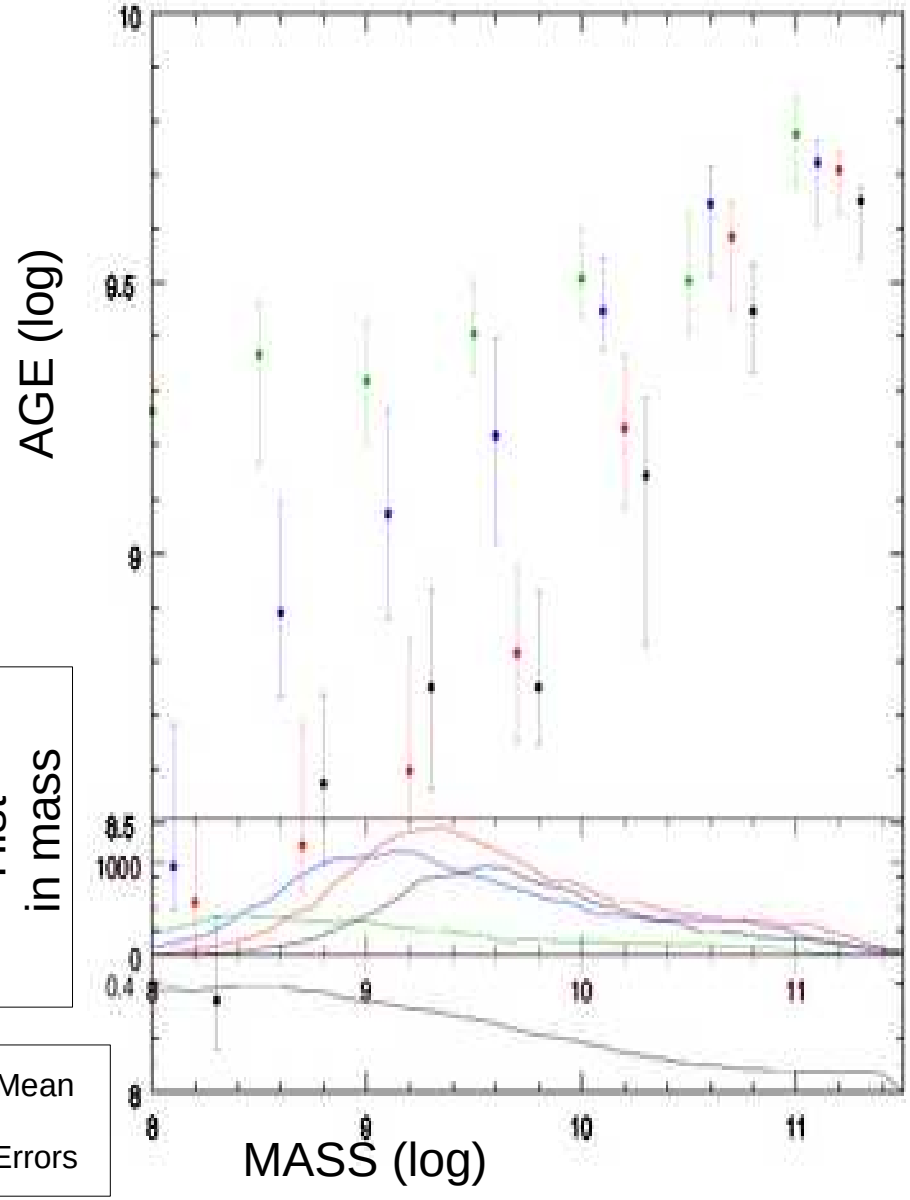


2/ SED fitting

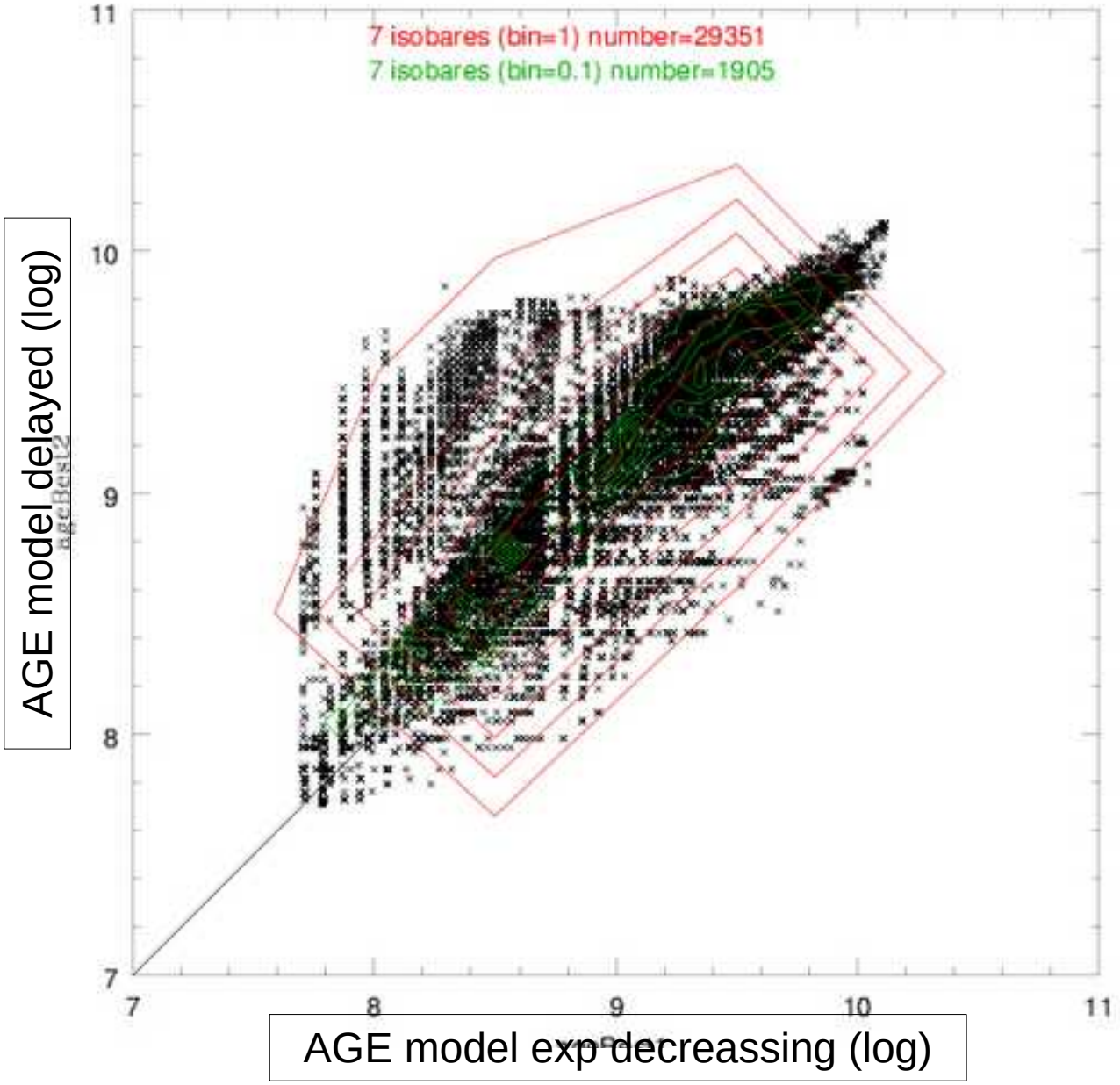
Exp decay model



Delayed model

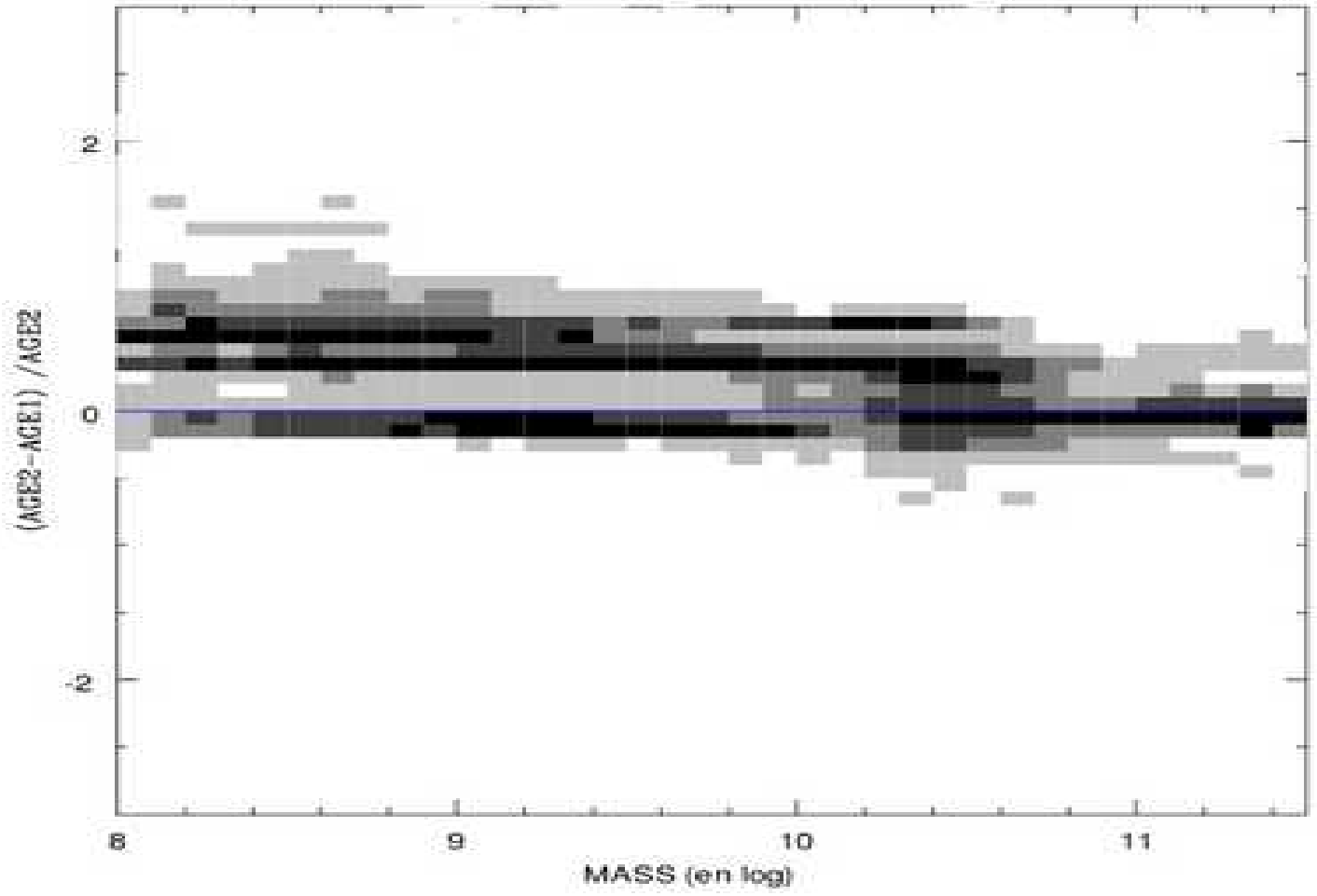


2/ SED fitting



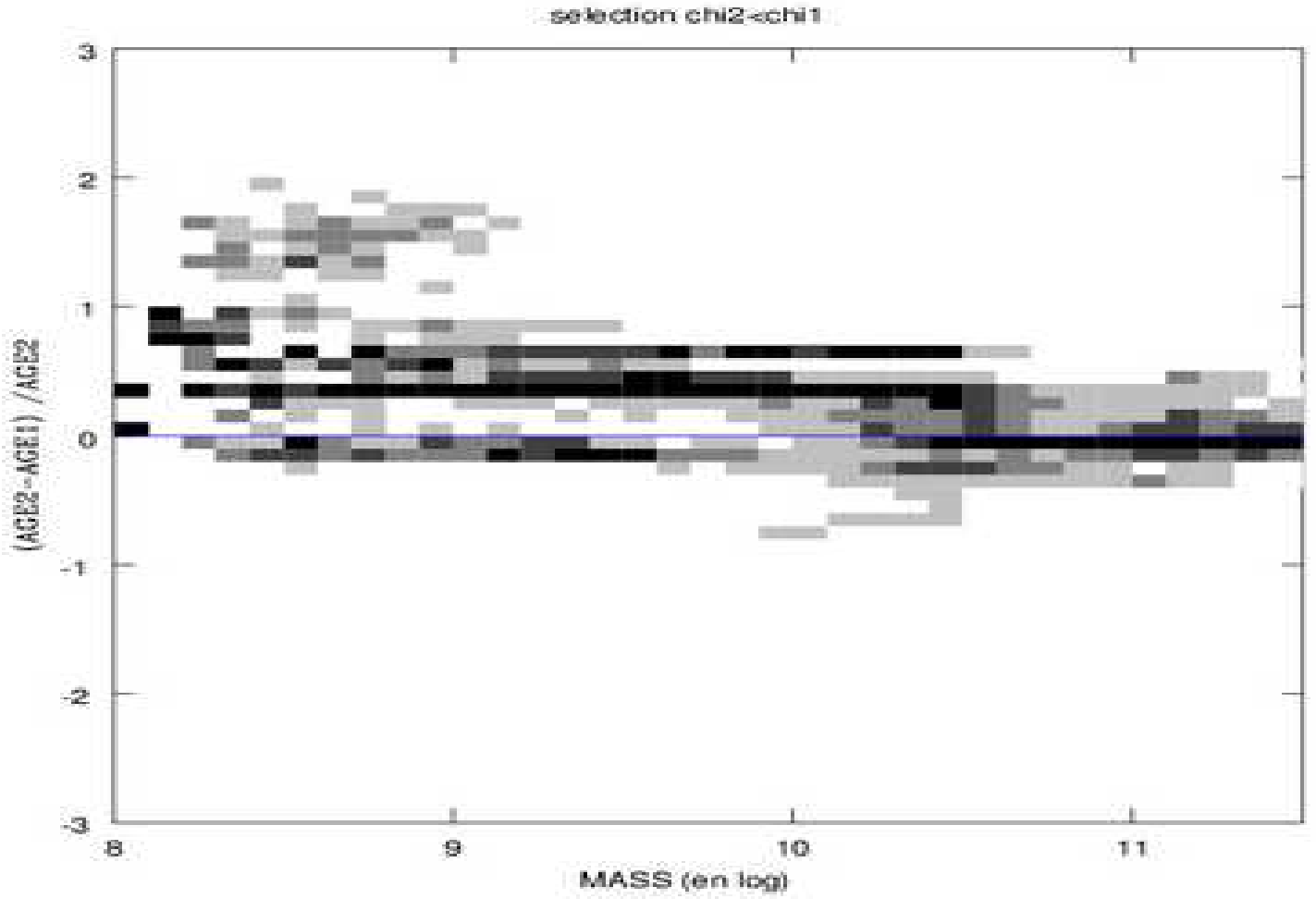
2/ SED fitting

- Different ages for the 2 models (function of mass)



2/ SED fitting

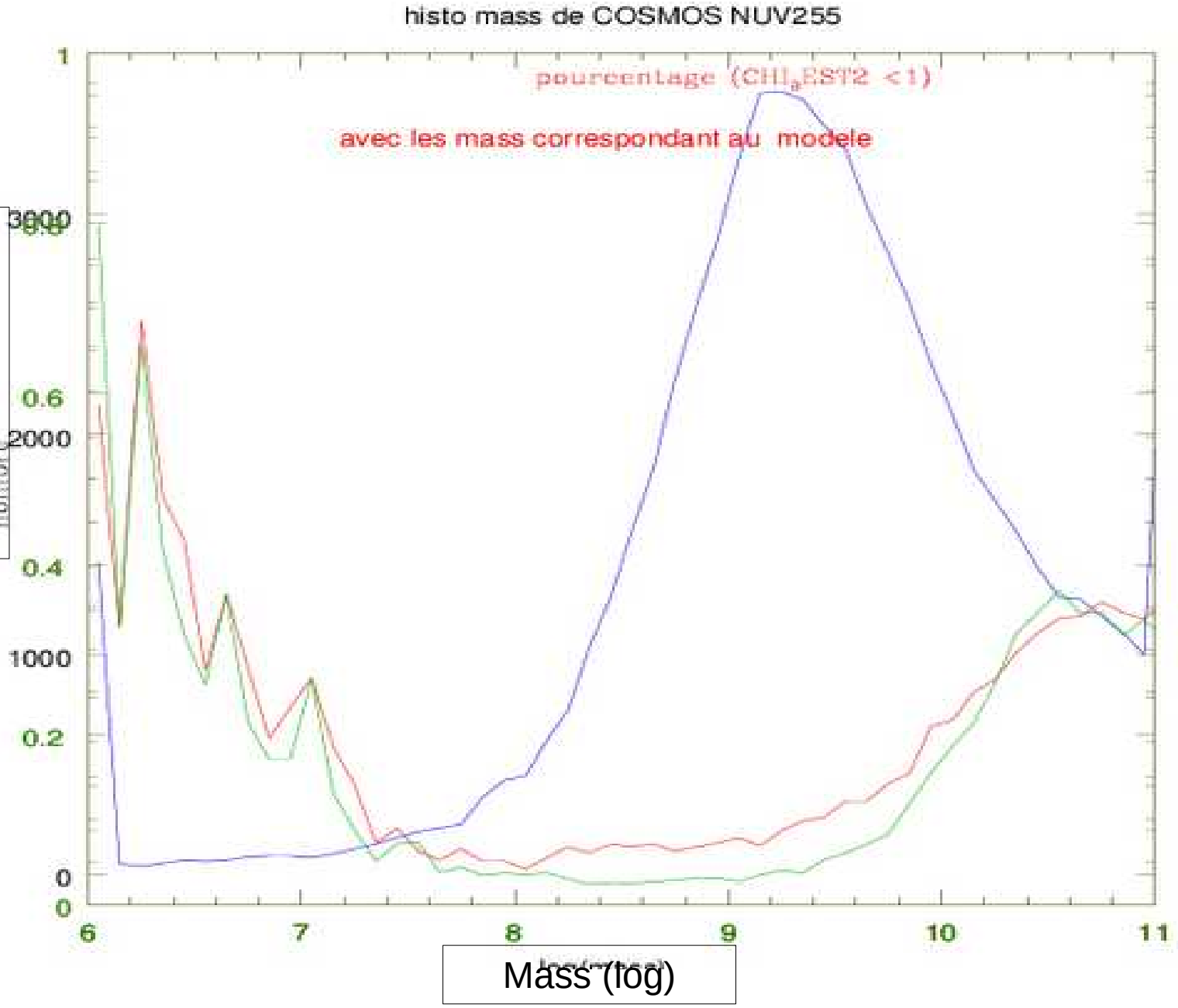
- Different ages for the 2 models (function of mass)
  Only the galaxies which fits best with model 2



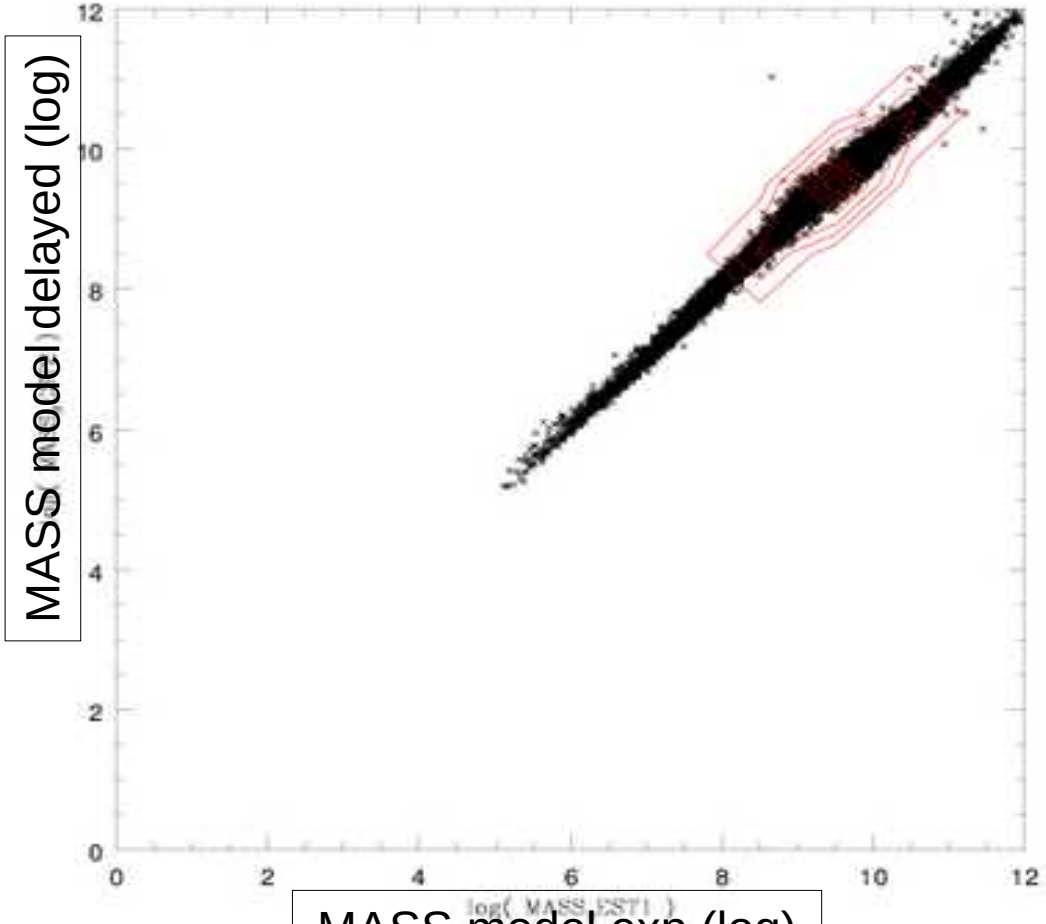
2/ SED fitting

Pourcentage of Best Fits with delayed Model

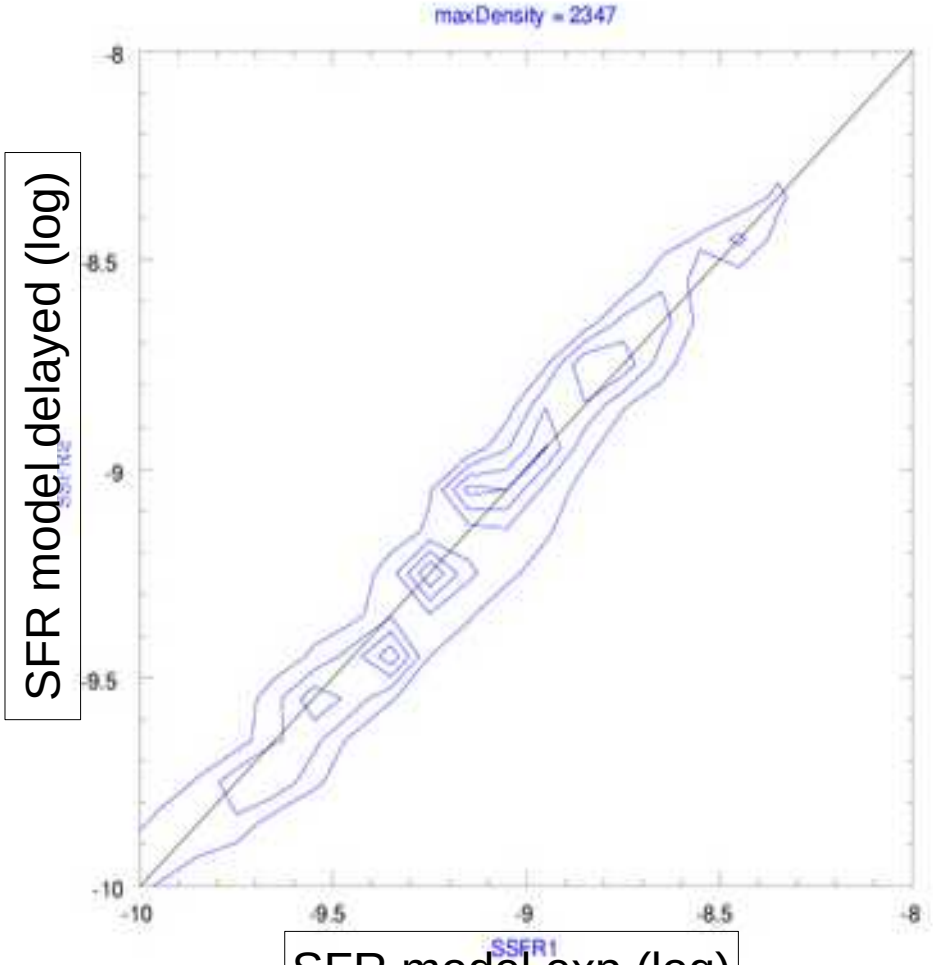
Red : α=2
Green : α=1.7
Blue : Hist Mass



2/ SED fitting



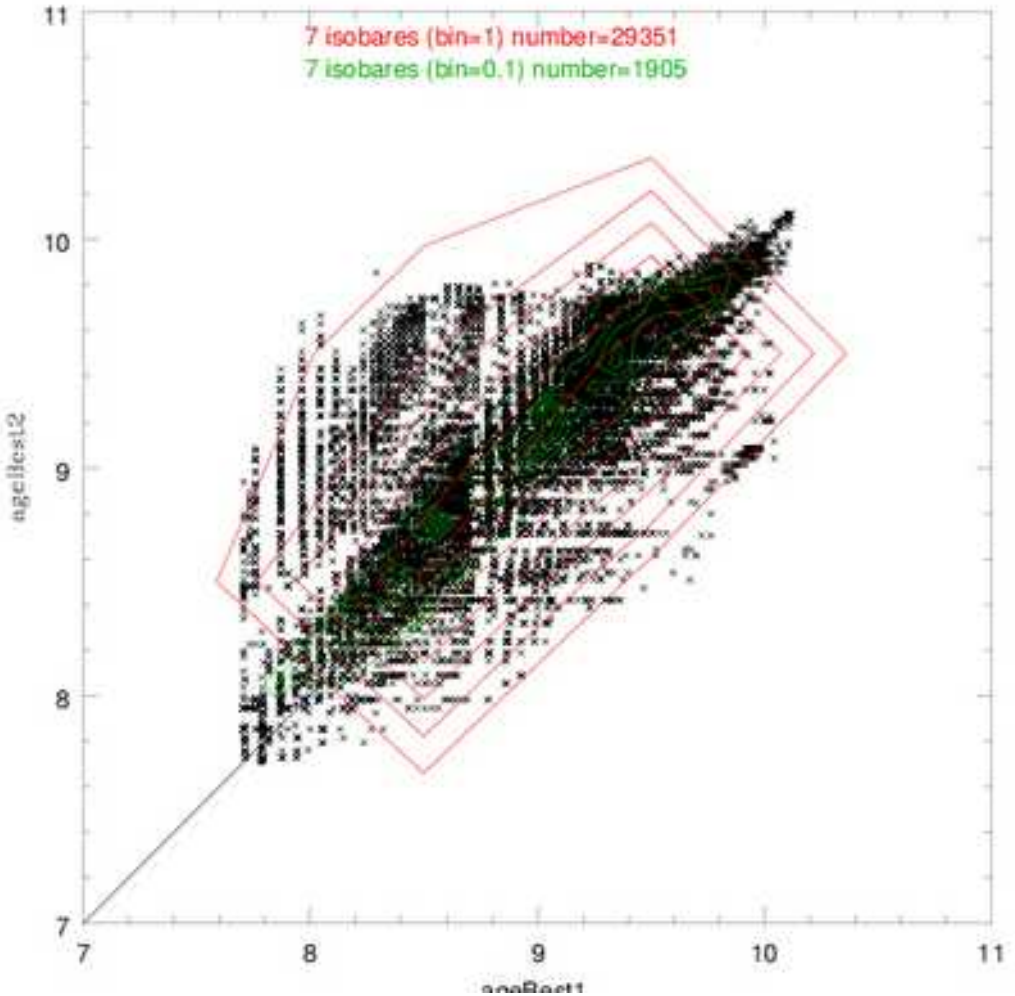
Intern Error 1 : 0.16
Intern Error 2 : 0.15
Extern Error 1 Vs 2: 0.16



Intern Error 1 : 0.24
Intern Error 2 : 0.21
Extern Error 1 Vs 2: 0.13

2/ SED fitting

- AGE + SFH (+ IMF) = Degenerate



Intern Error 1	: 0.37
Intern Error 2	: 0.32
Extern Error 1 Vs 2	: 0.28

Who is contributing
to the cosmic SFR ?

And

How
does this contribution
evolve with time?

3/ Luminosity functions

3/ Luminosity functions

Our selection

- No Stars, no AGN, only galaxies +
- FUV<26
- Or NUV<25.2
- Or U<25.5
- Or K<23.5
- Or 24µm<19.2

Result : 500 000 galaxies

3/ Luminosity functions

- How to caculate luminosity functions.
  - 1-> Exctinction (Intrinsic From Galaxies)
  - 2-> Across the Universe
  - 3-> InterGalactic Medium

3/ Luminosity functions

- How to caculate luminosity functions.

  1-> Exctinction

  2-> Across the Universe

  3-> InterGalactic Medium

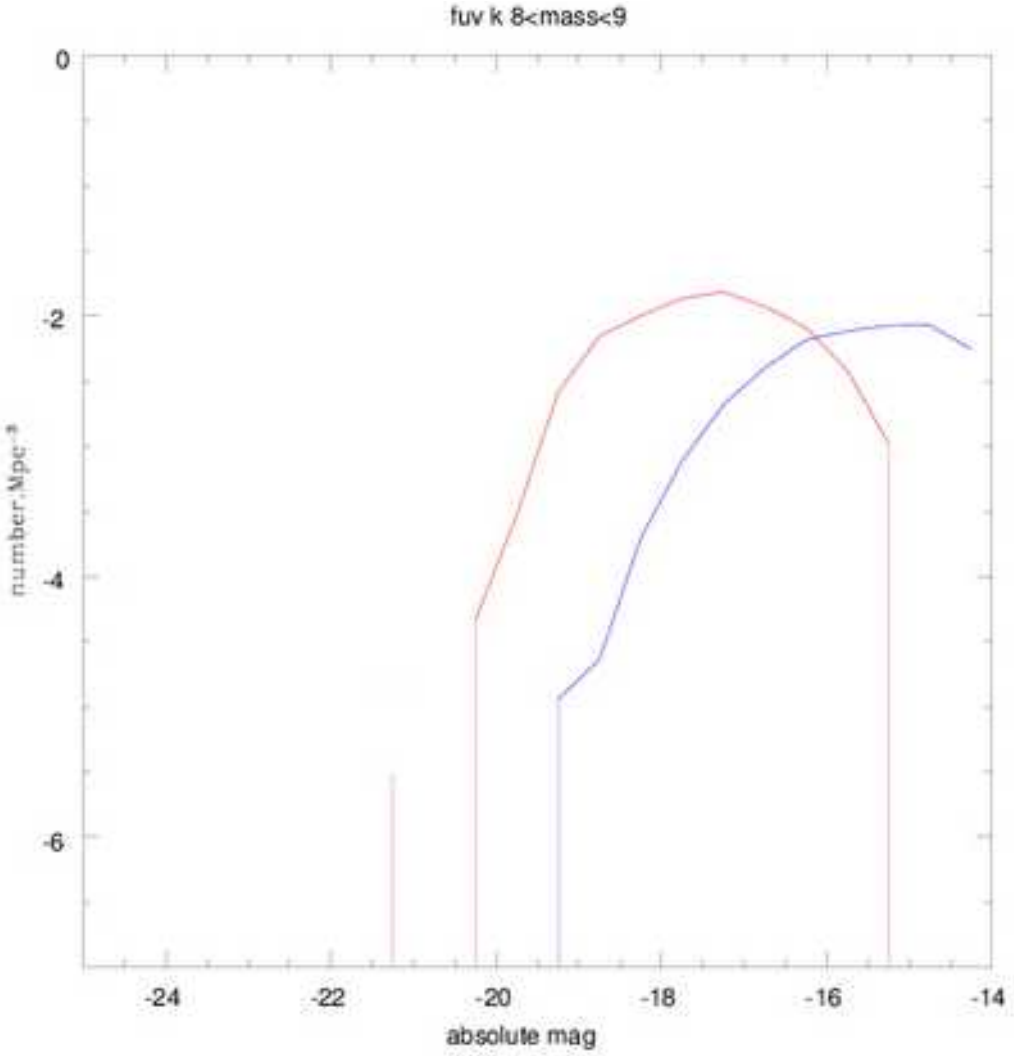
  (4-> Milky Way)

  (5-> Atmosphere)

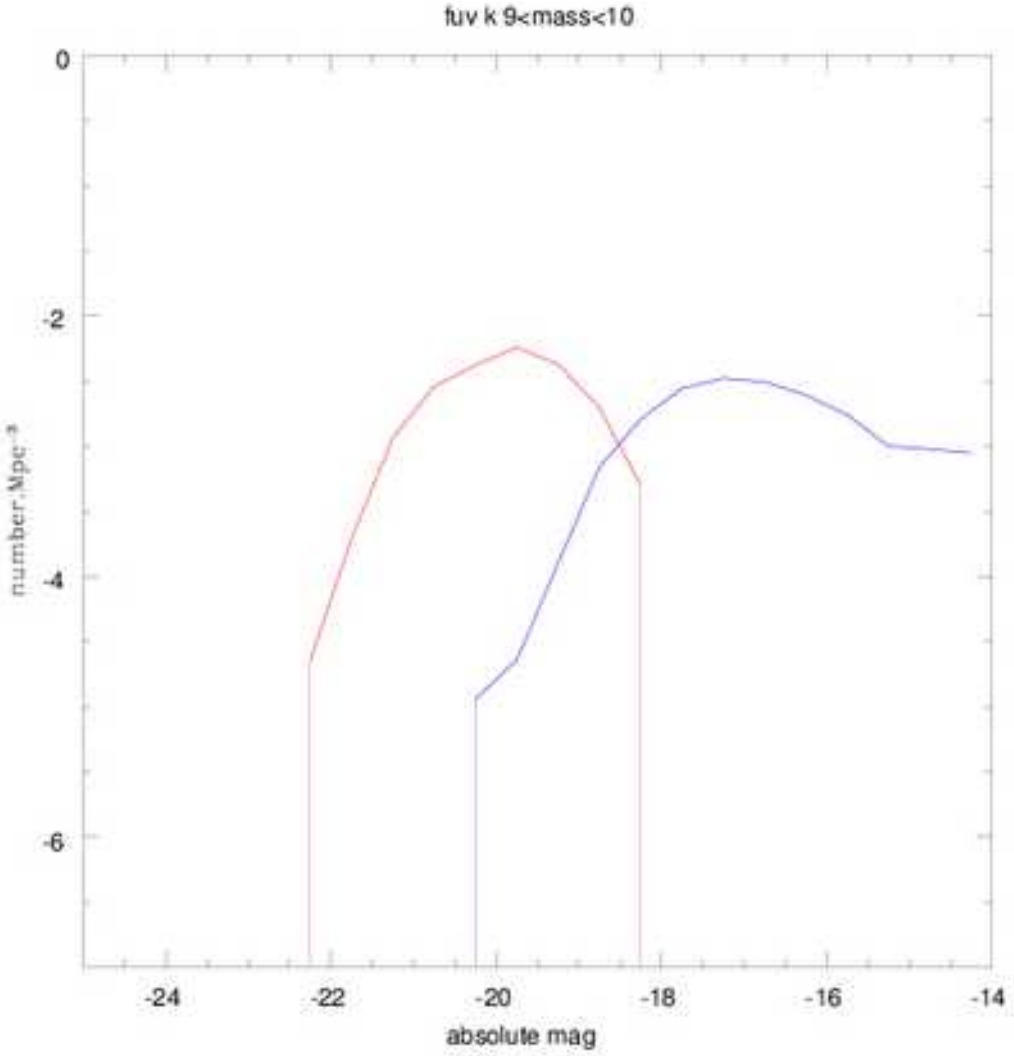
  (6-> Telescope)

  (7-> My Computer)

3/ Luminosity functions



3/ Luminosity functions



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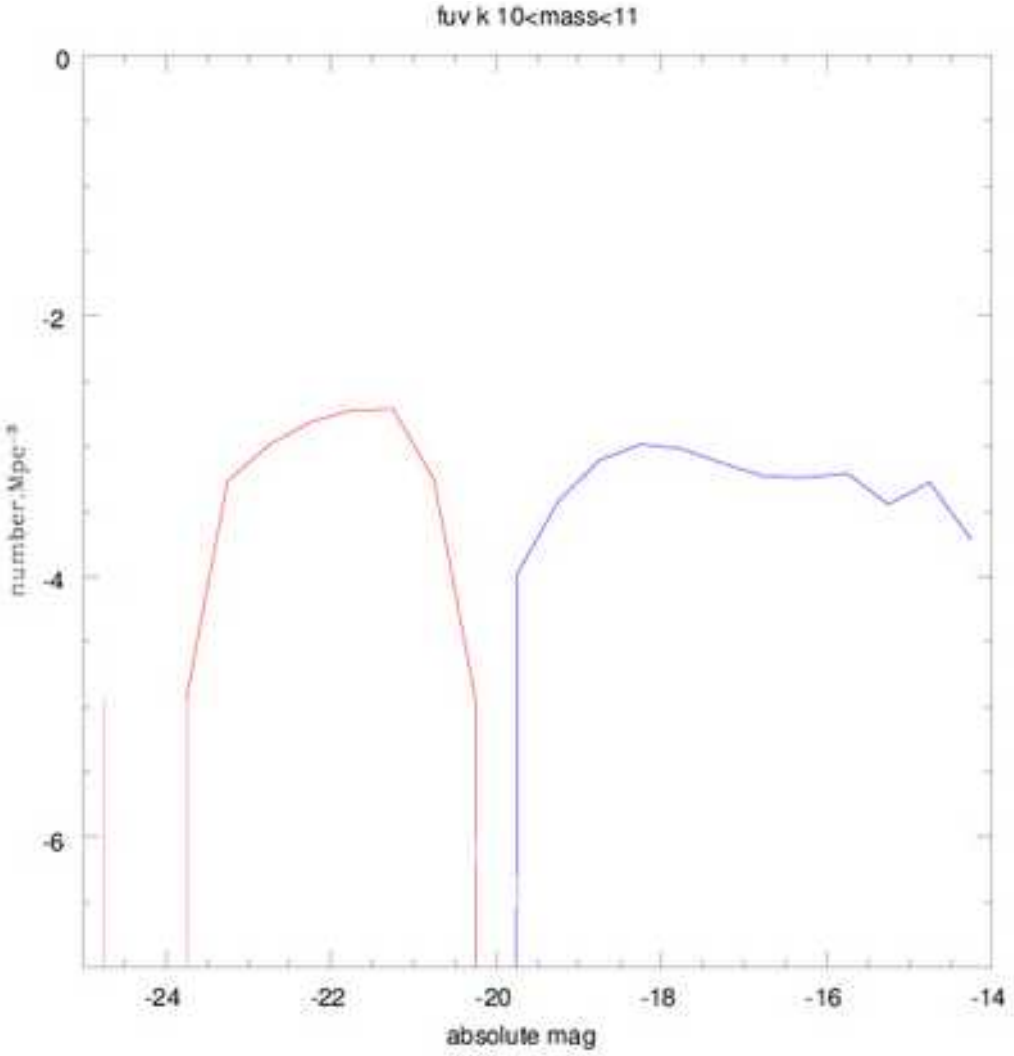

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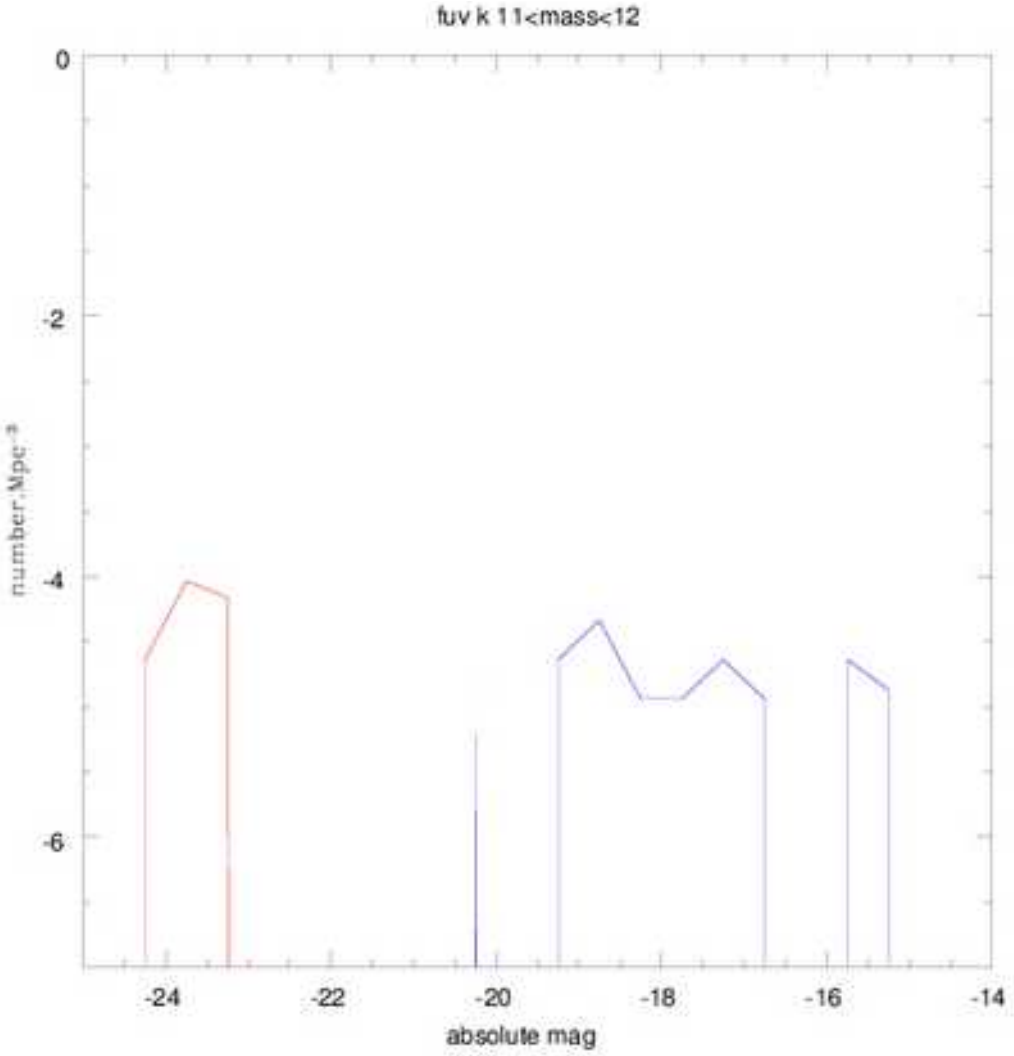
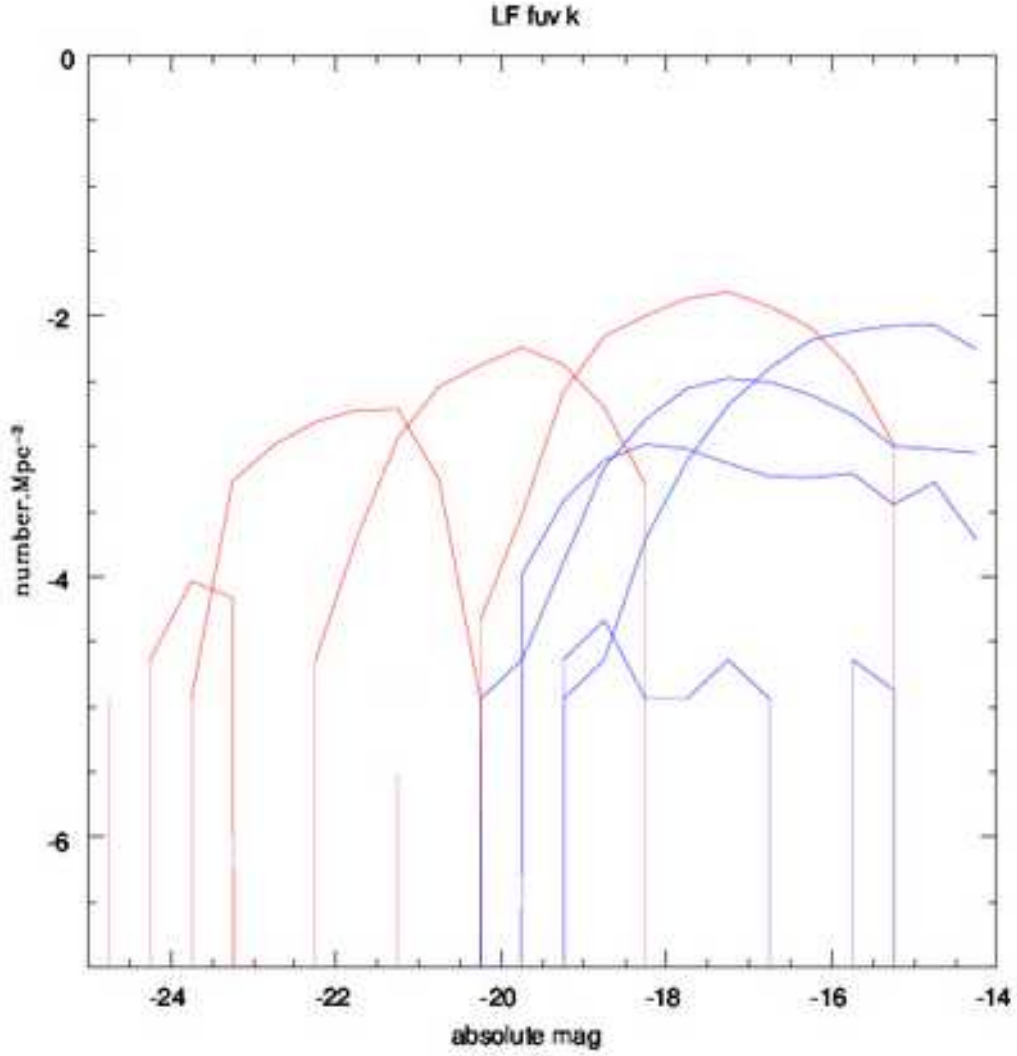


3/ Luminosity functions



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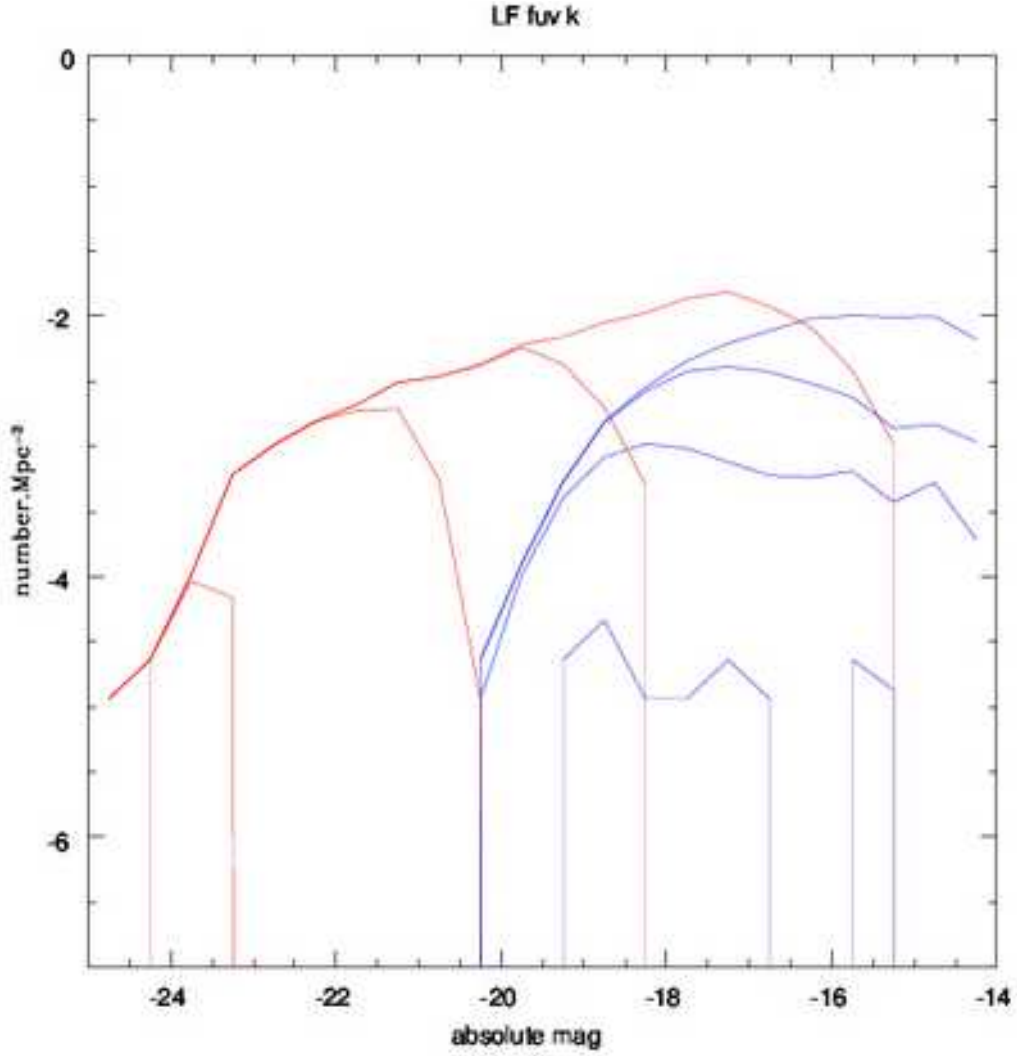

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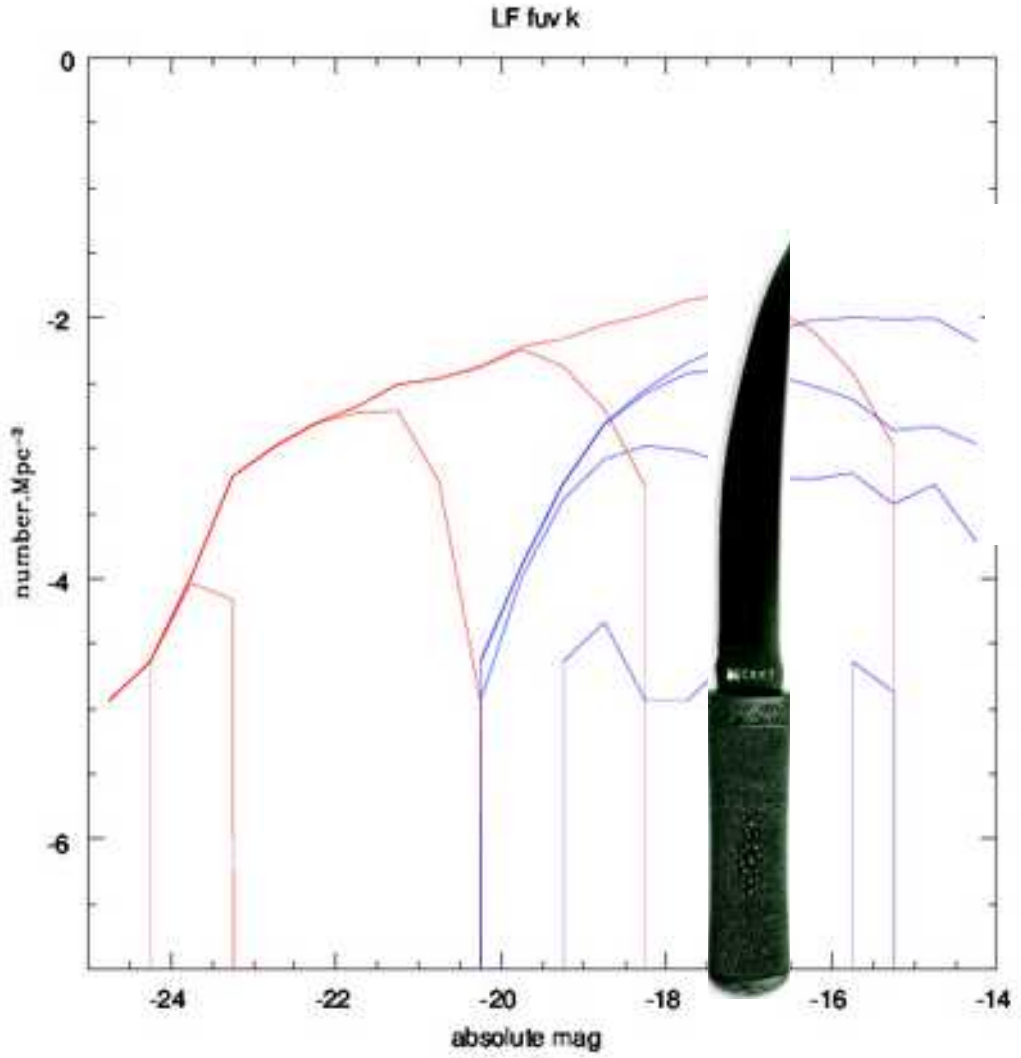
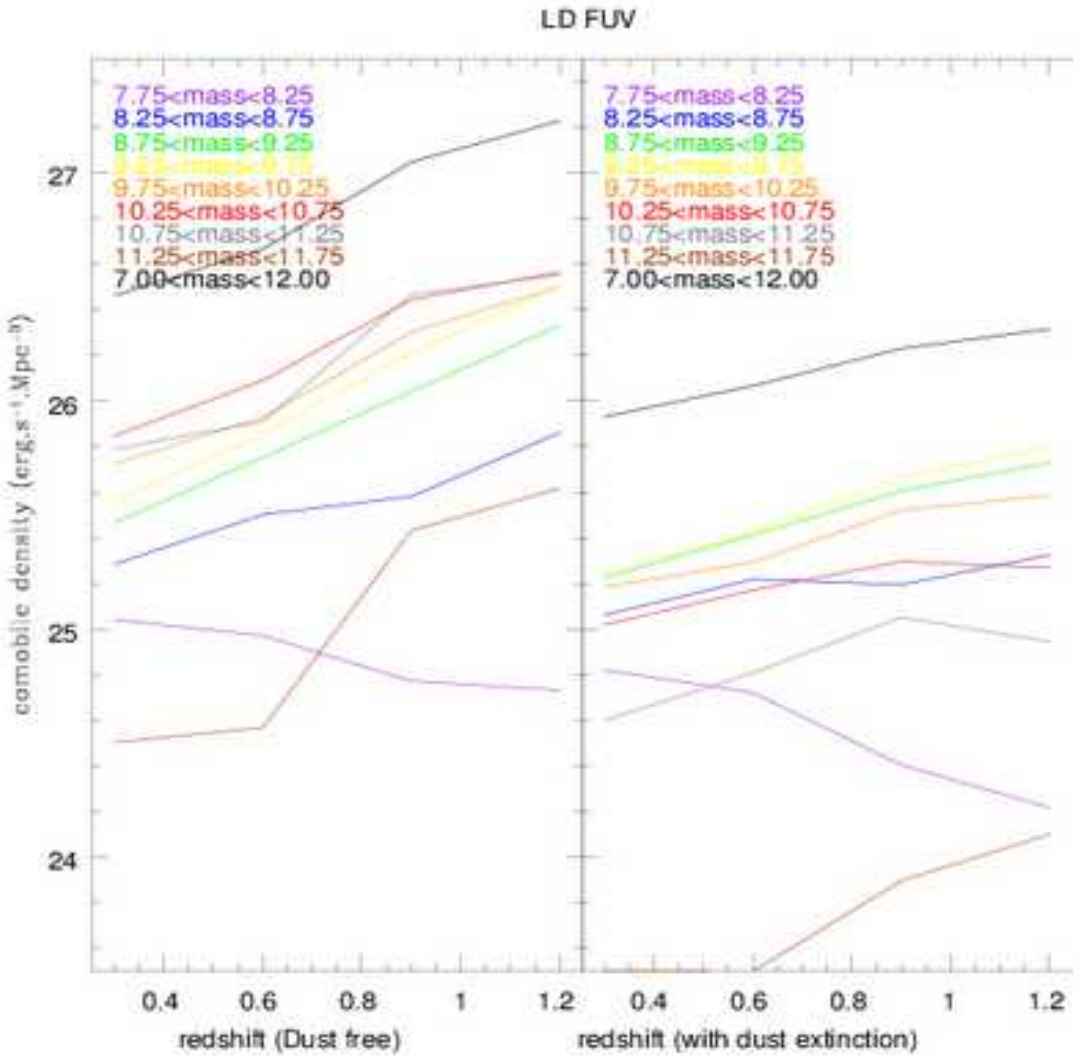


3/ Luminosity functions

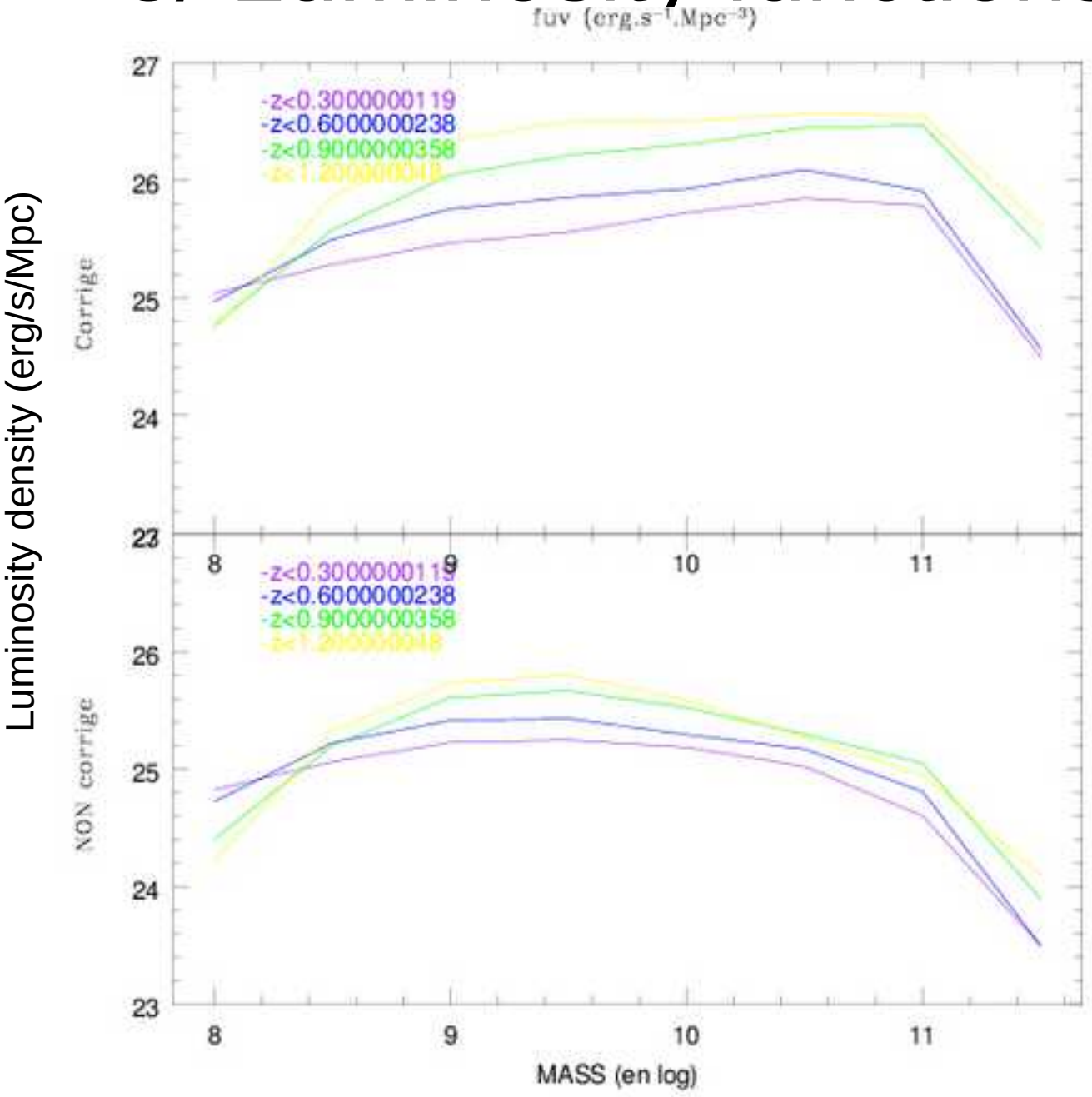
Luminosity density

$$\rho_L = \int \phi(L) L dL$$

3/ Luminosity functions

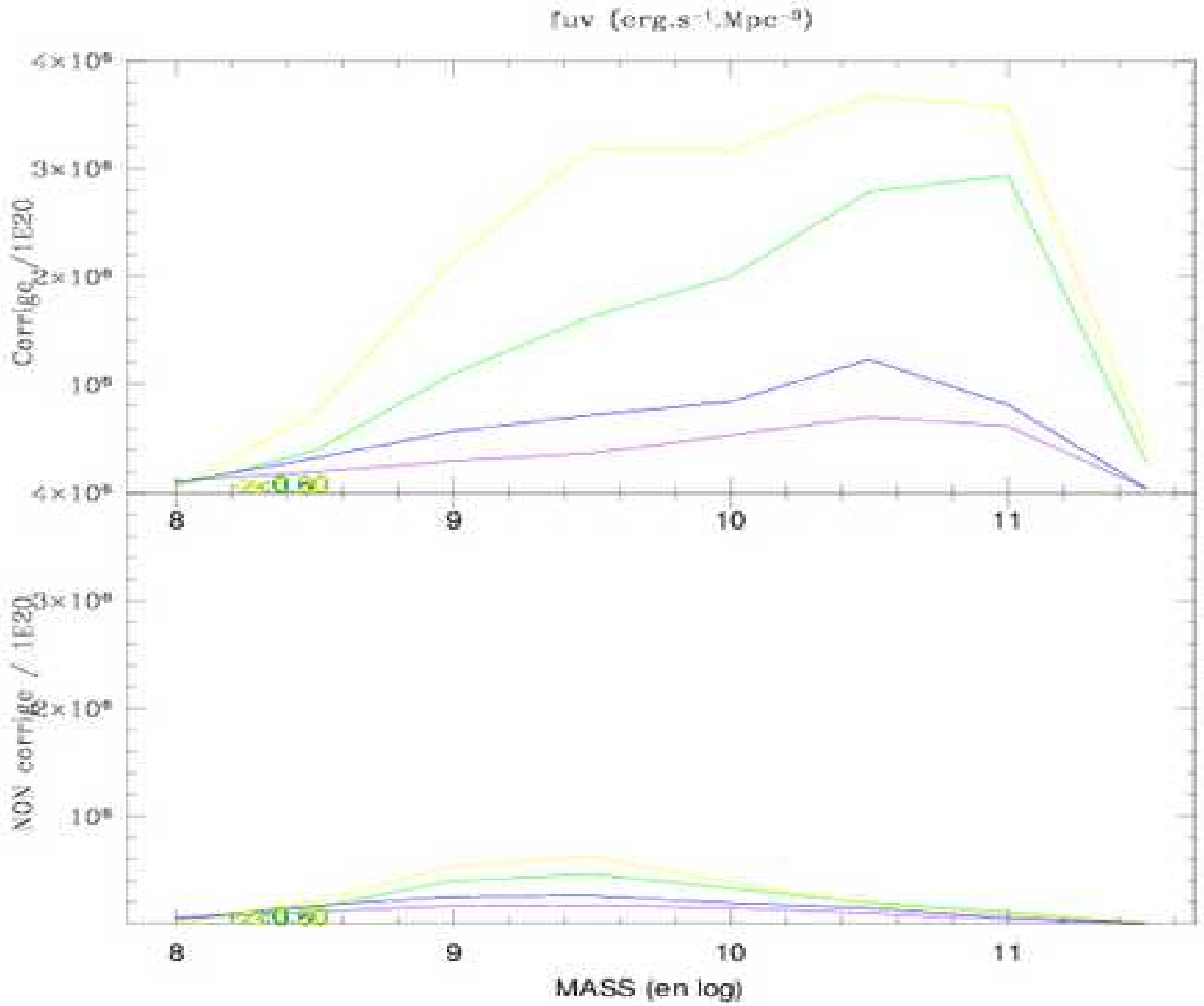


3/ Luminosity functions



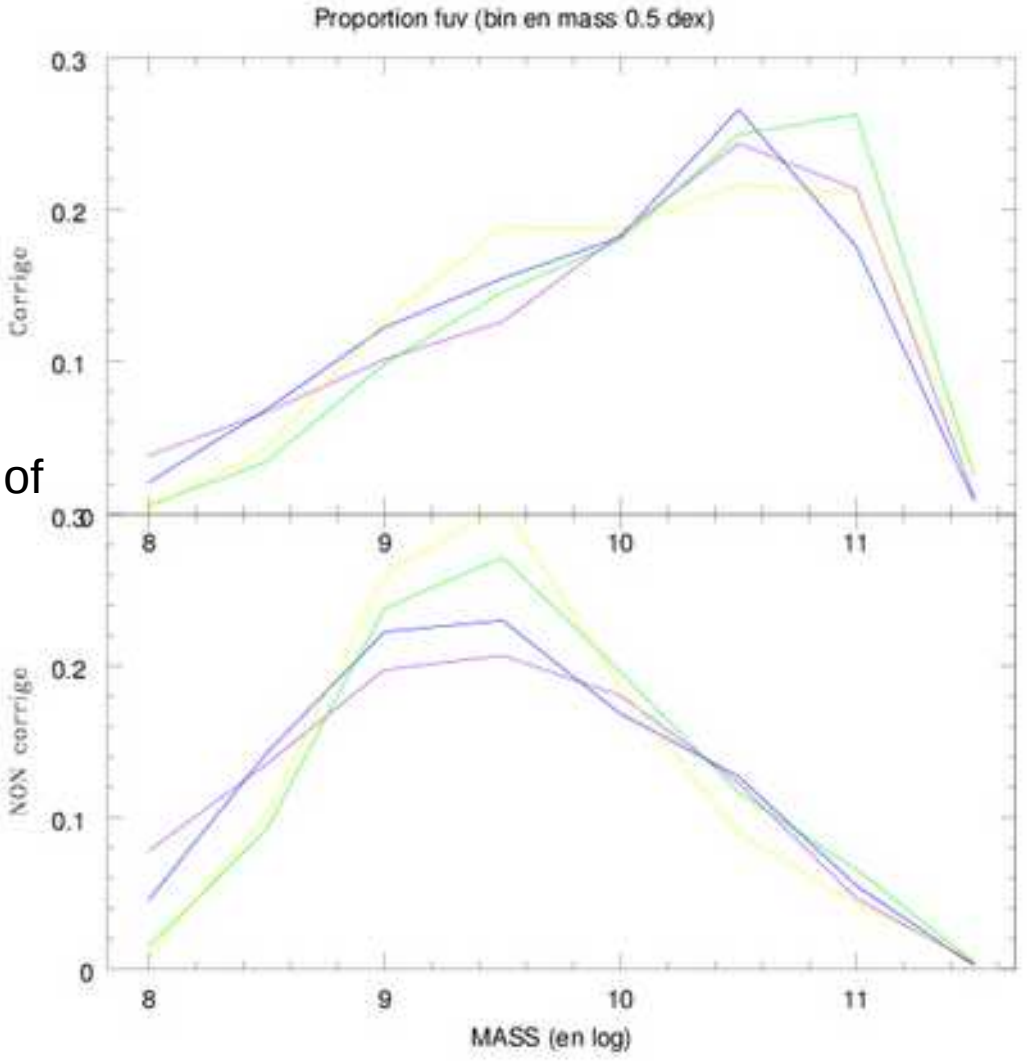
3/ Luminosity functions

Luminosity density (erg/s/Mpc)



3/ Luminosity functions

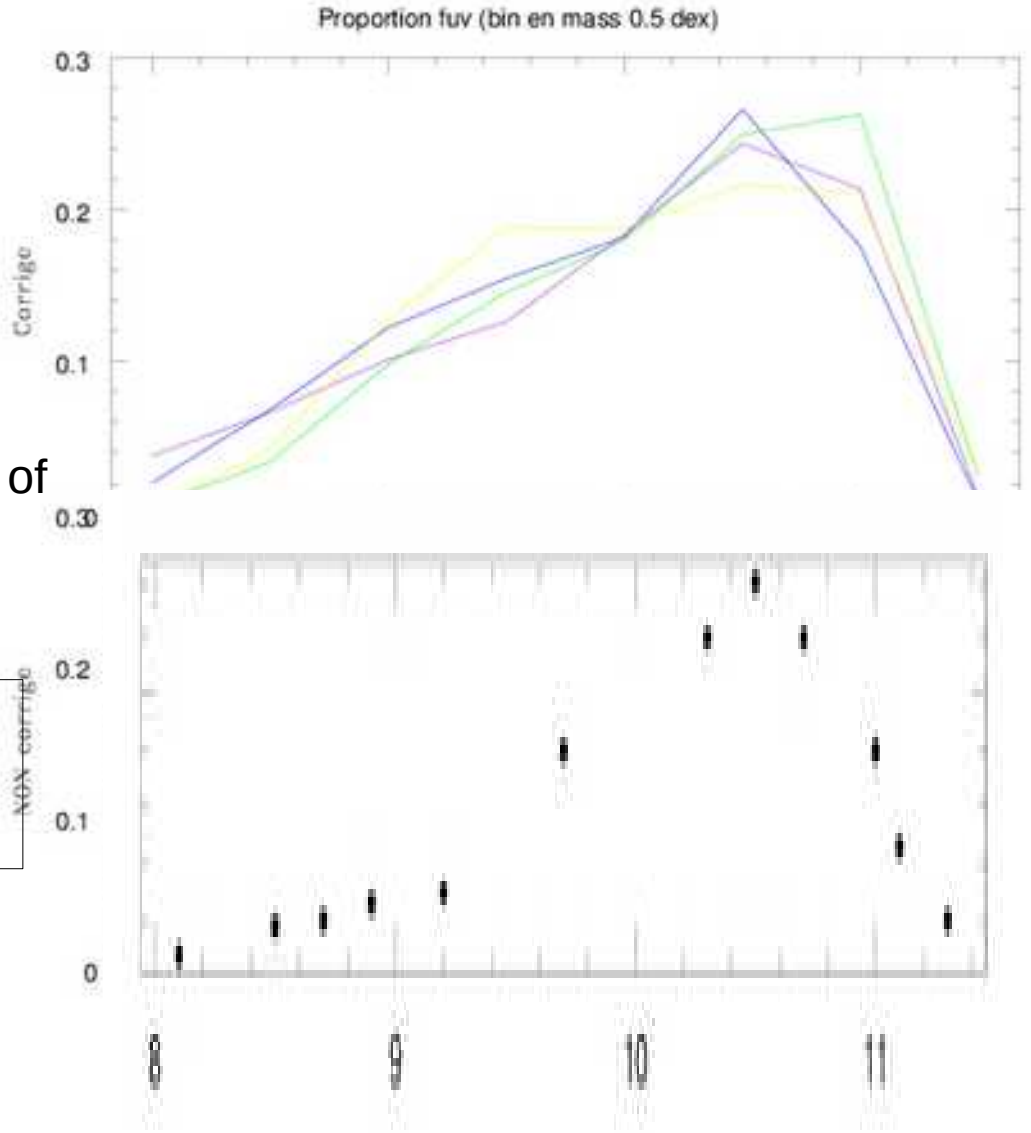
For each mass fraction of total
Luminosity density



The last of the last

For each mass fraction of total
Luminosity density

Sloan SDSS
(z=0)
(from Gilbang)



Conclusion

- UV traces O and B star + IMF = SFR
- Small galaxies appear very young (whatever the redshift) and have a continuous high SFR.
- After z=1.2 ,we do not see Cosmic downsizing ??

THE END

ANY QUESTIONS :

the first is the most difficult
so let's start directly by the second

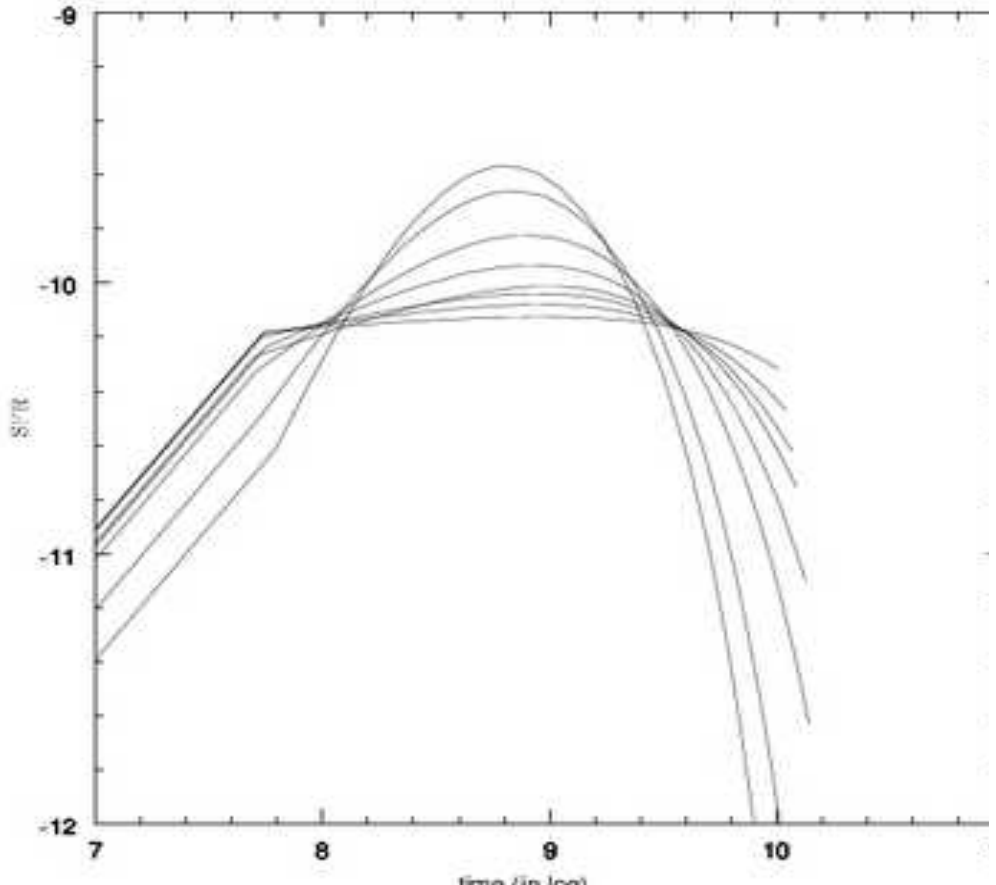
ANNEXE

ANNEXE

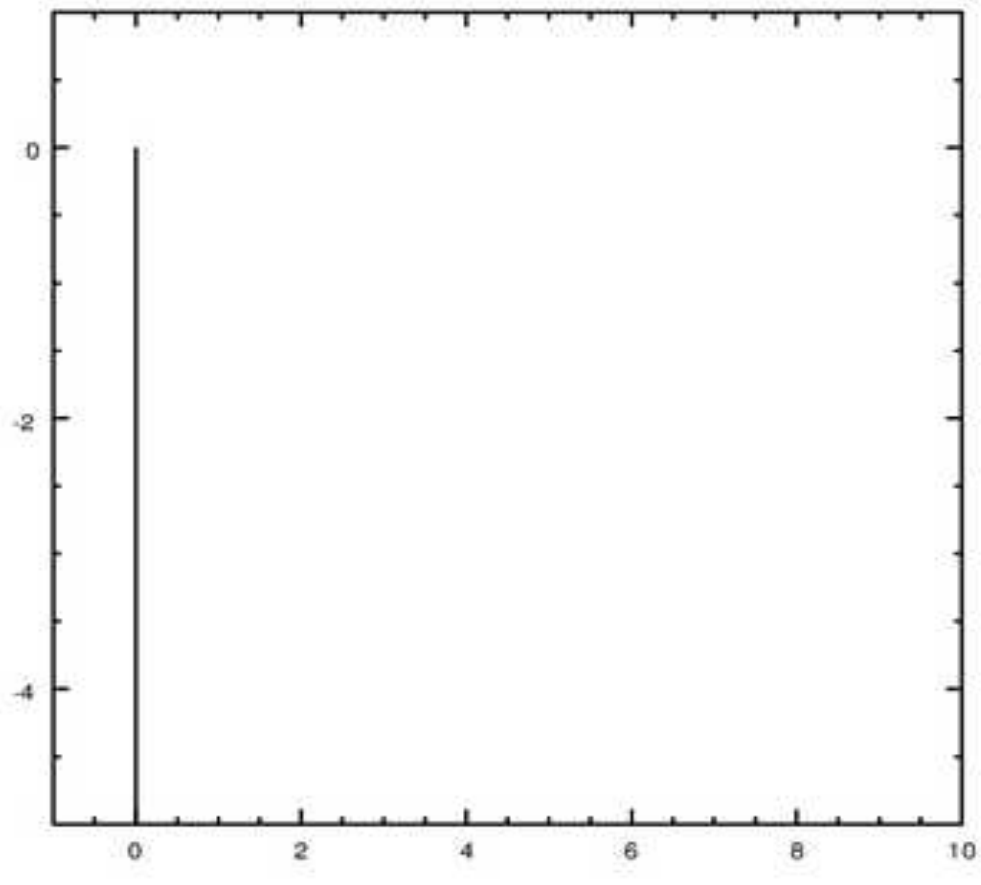
2/ SED fitting

2 Other Star formation Histories

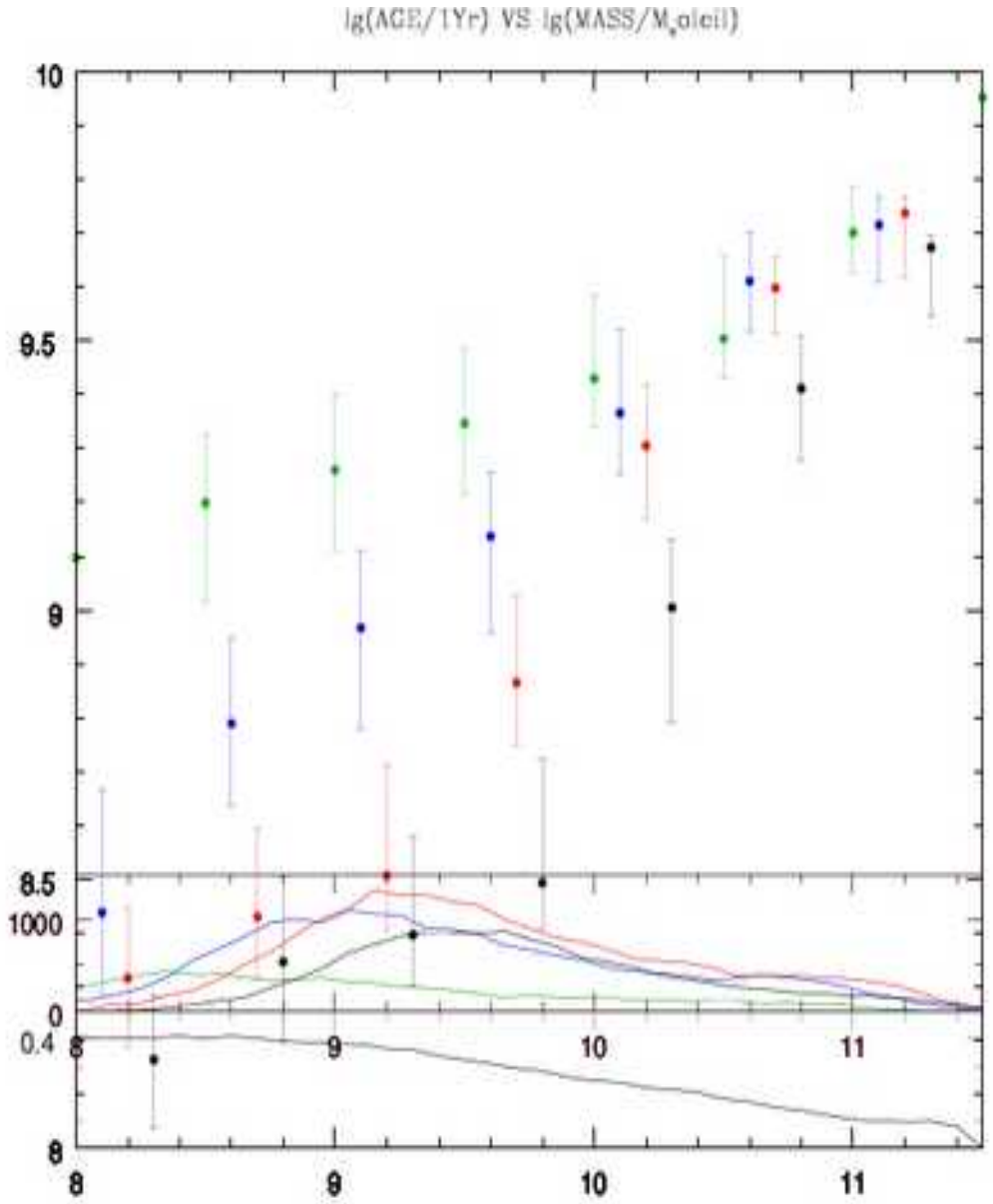
Retarded 1Gyr

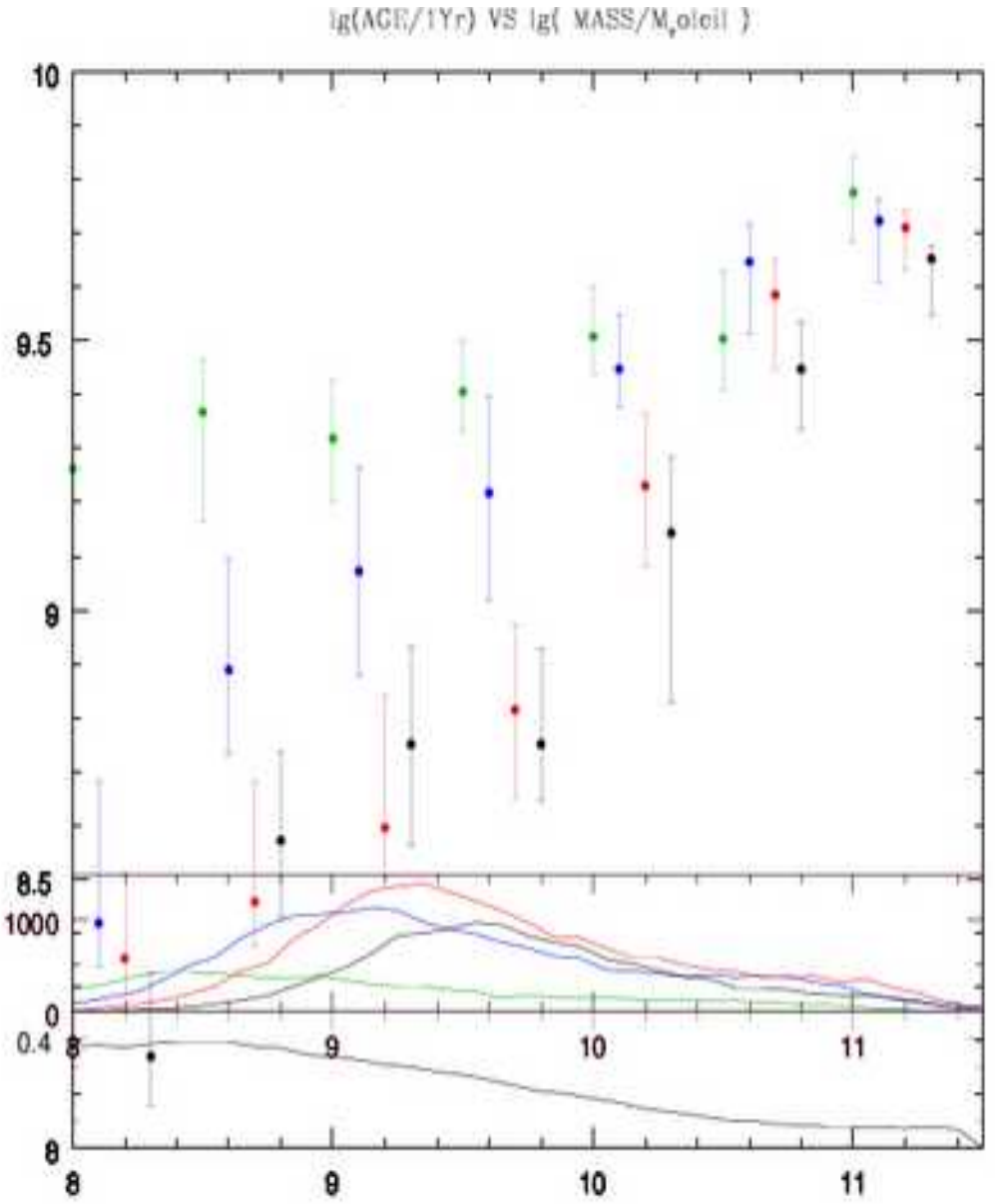


Instantaneous



2/ SED fitting





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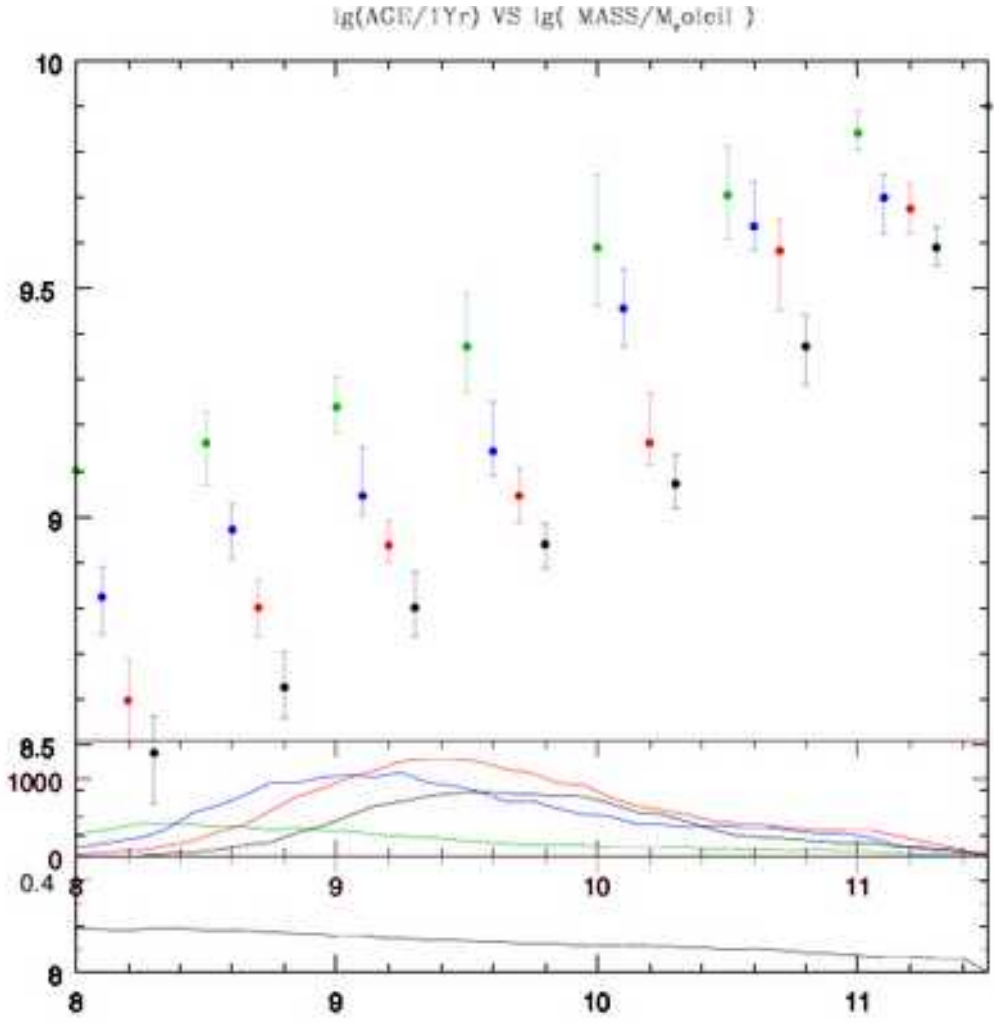
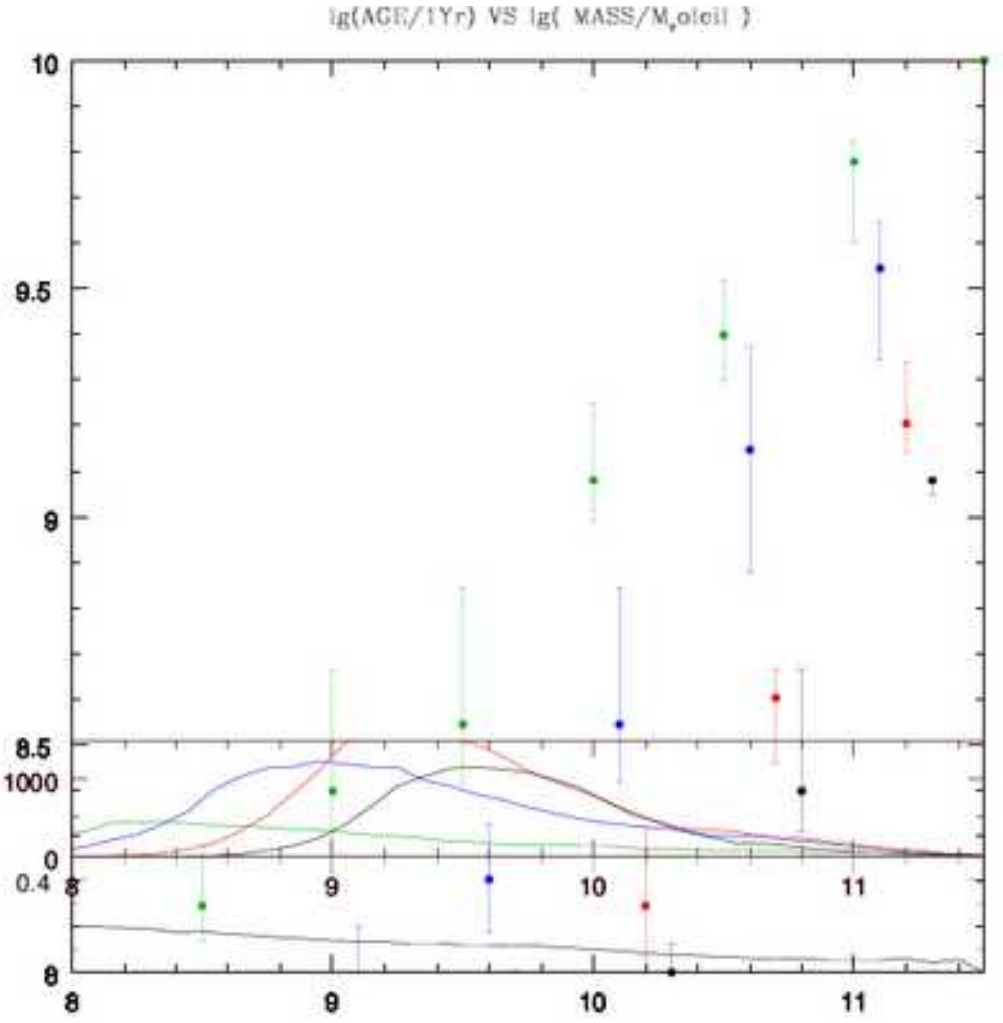
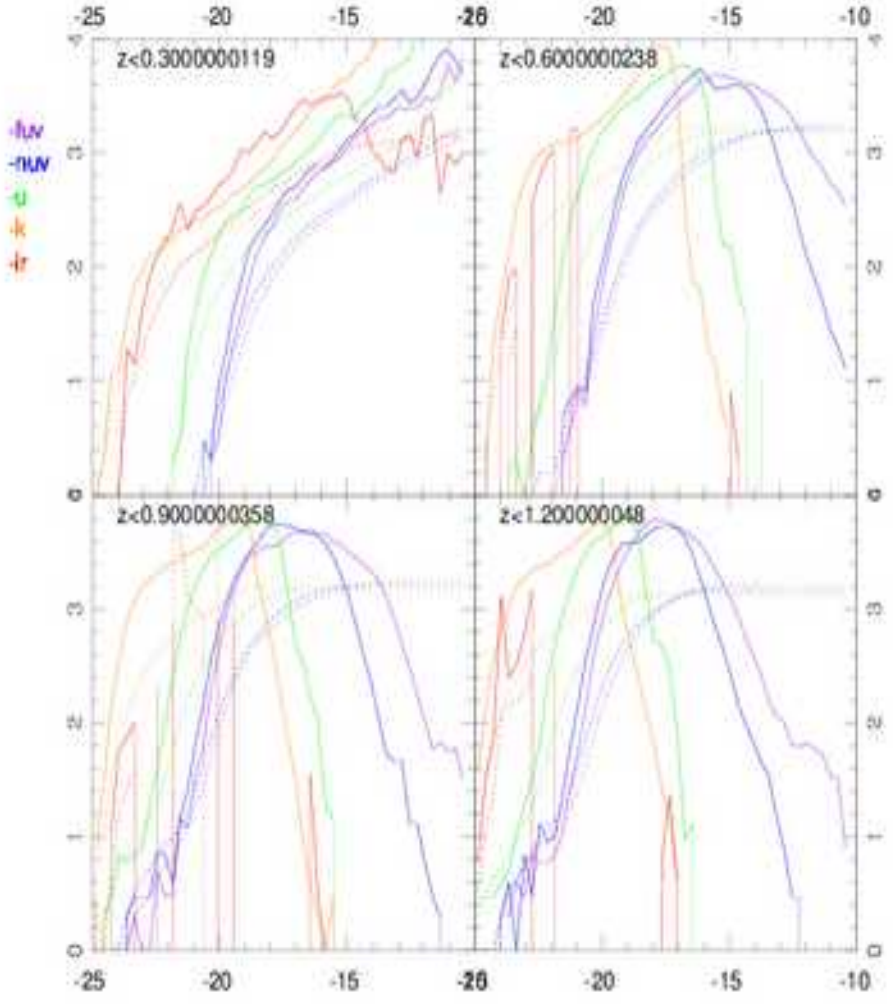
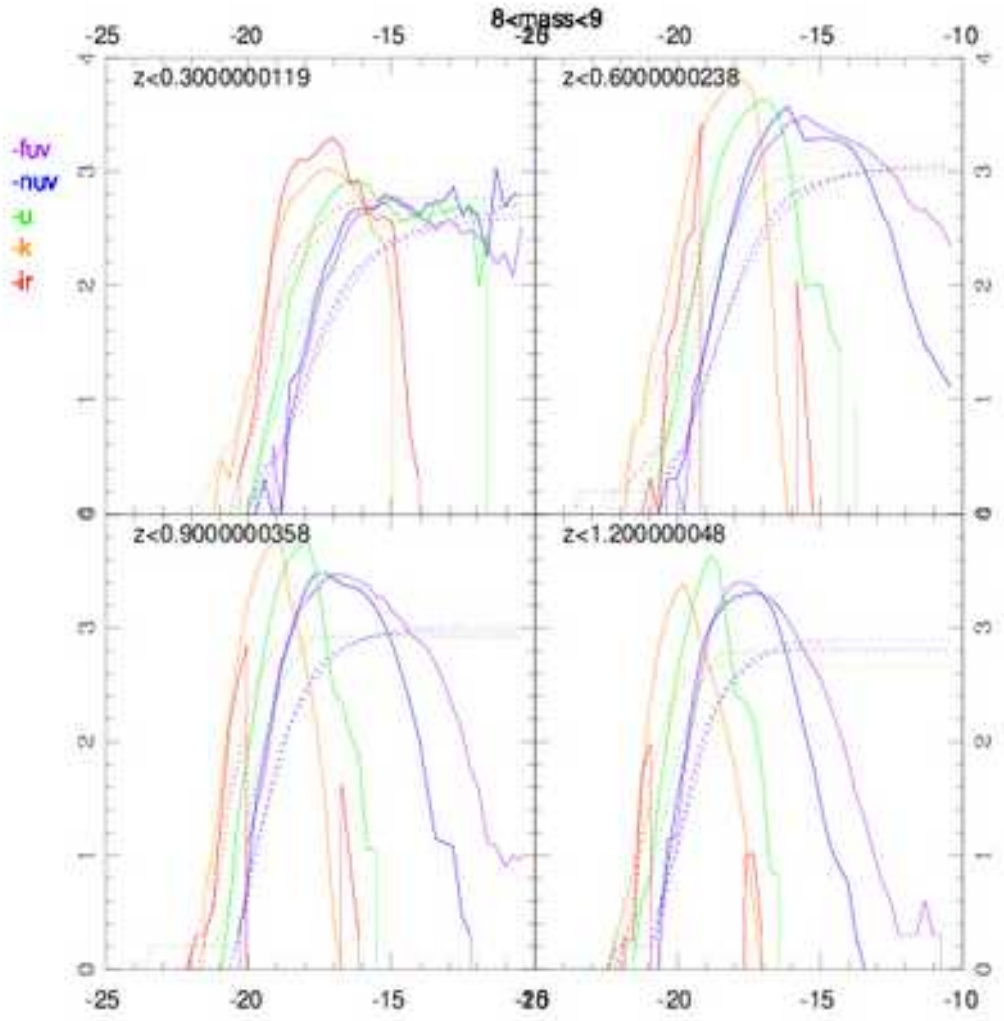


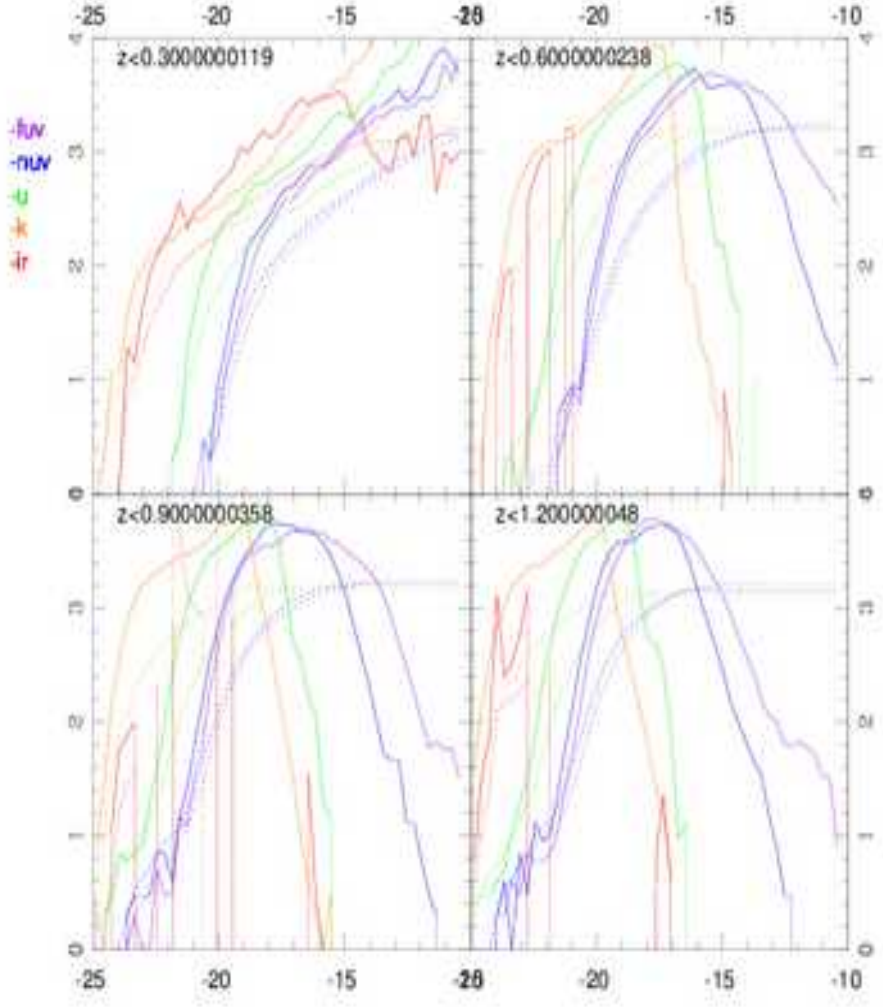


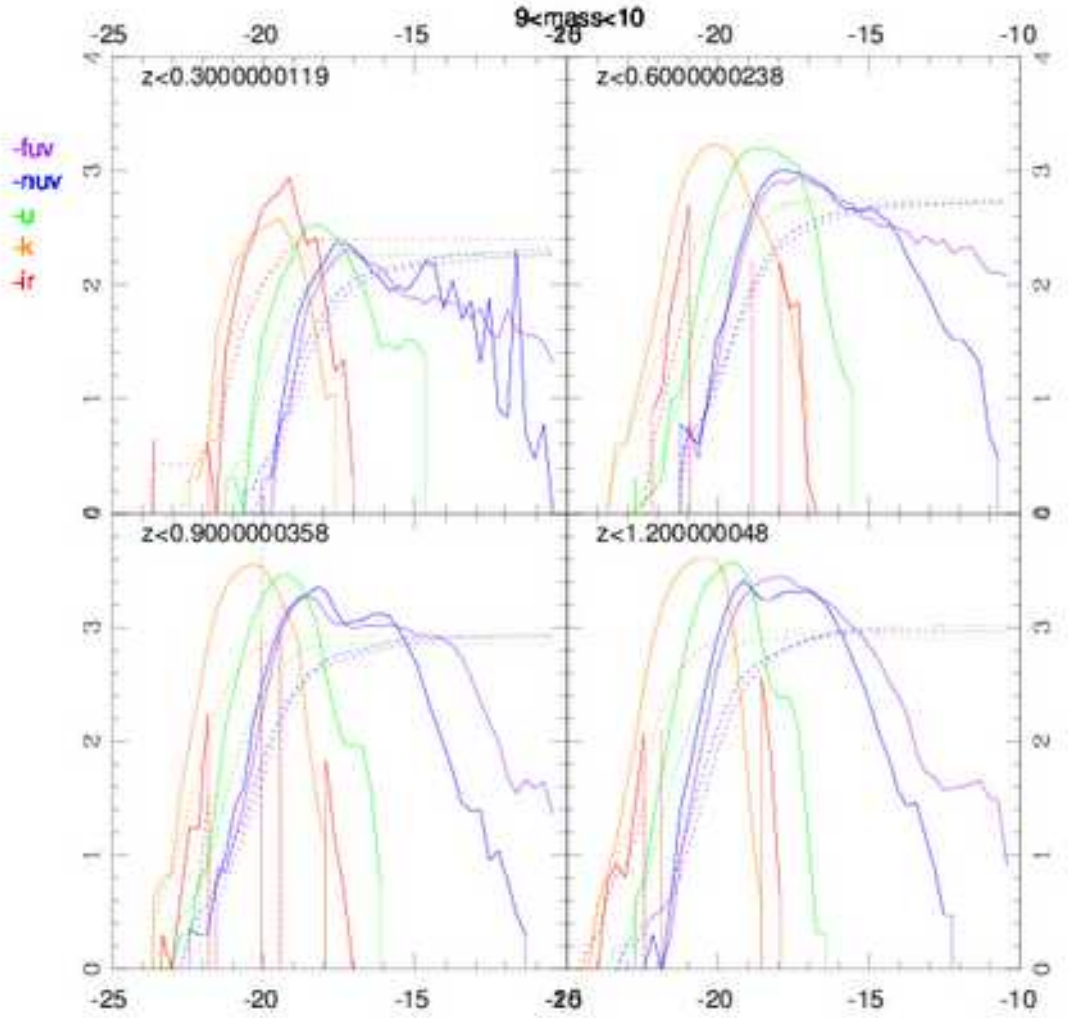
3/ Luminosity functions



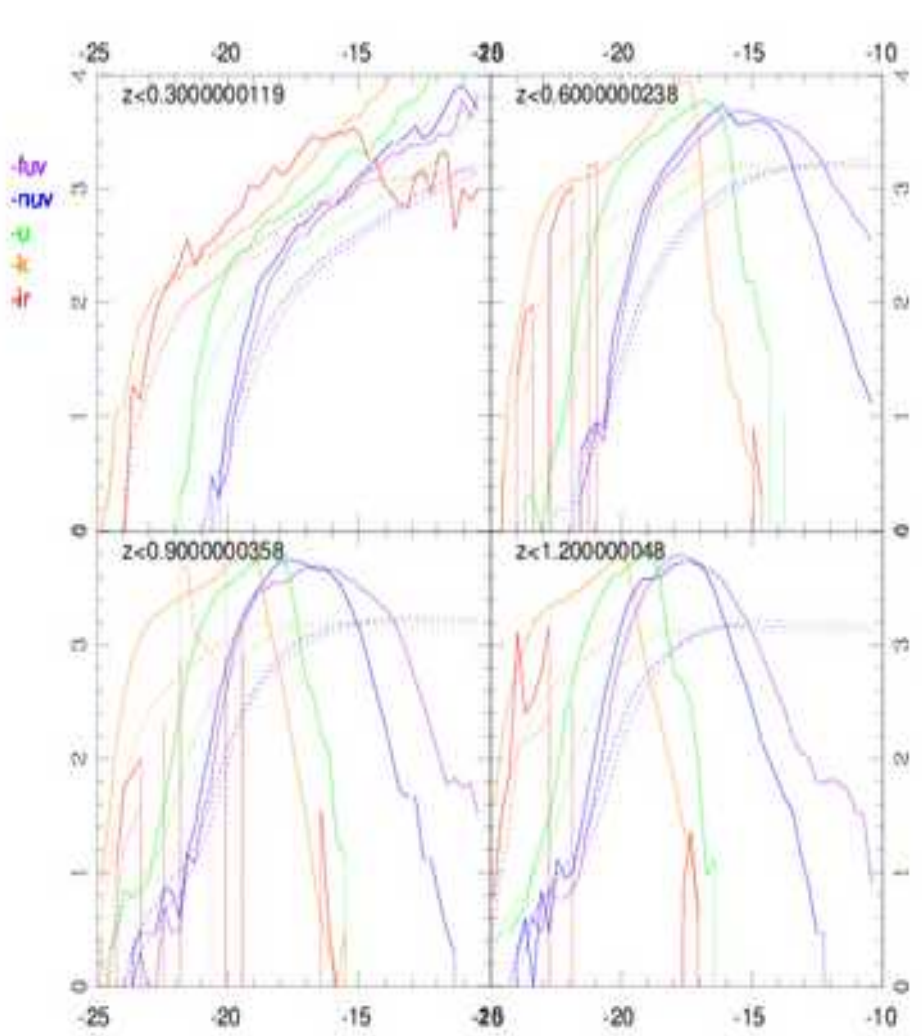


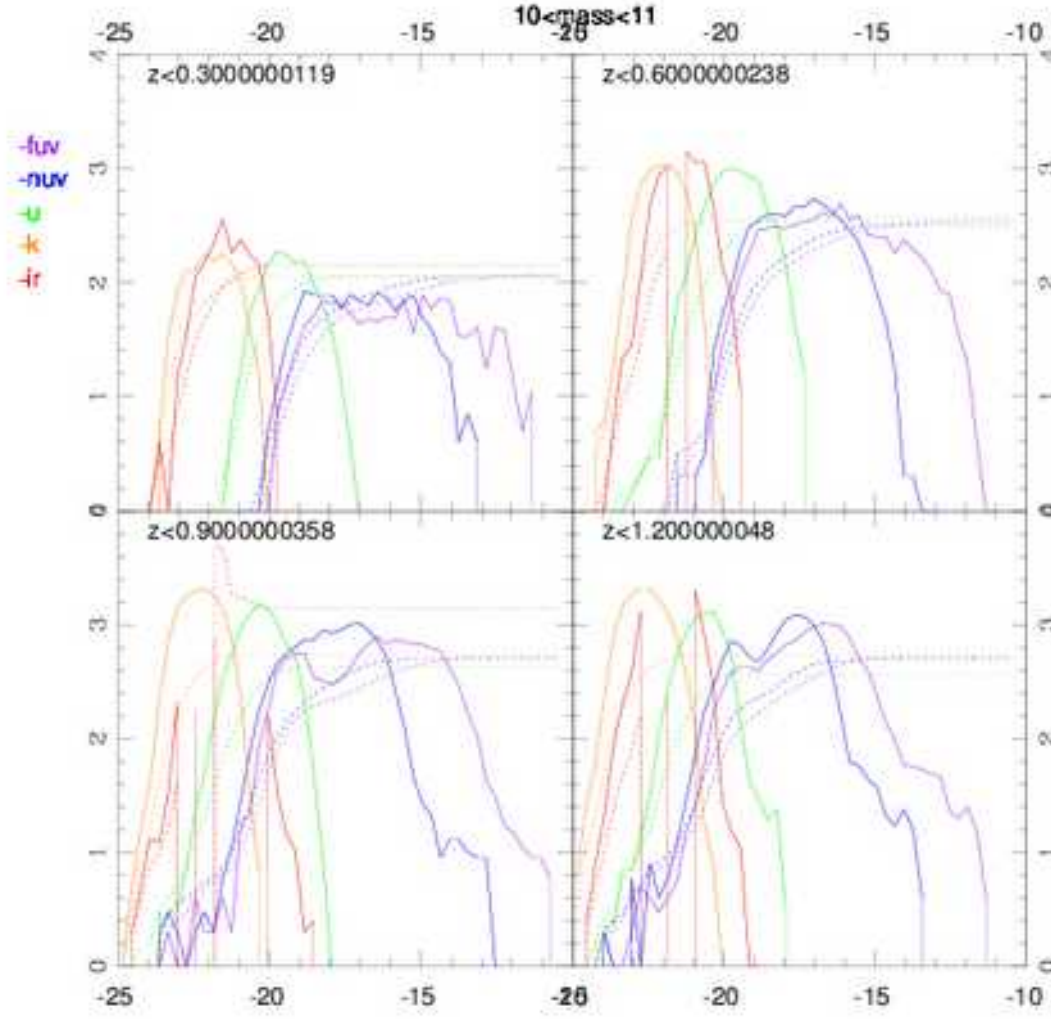
3/ Luminosity functions





3/ Luminosity functions





3/ Luminosity functions