The physical properties of high redshift Lyα emitting galaxies in the GOODS-South field

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Lyα emitters (LAE)vs Lyman Break galaxies (LBGs)

Still unclear what is the relation between the two classes of galaxies: are Lyα emitters just extremely young galaxies in their first phases of formation(e.g. Mori & Umemura 06)? Or could they (also) be galaxies at later stages of formation where the absence of dust allows the Lyα photons to escape ?

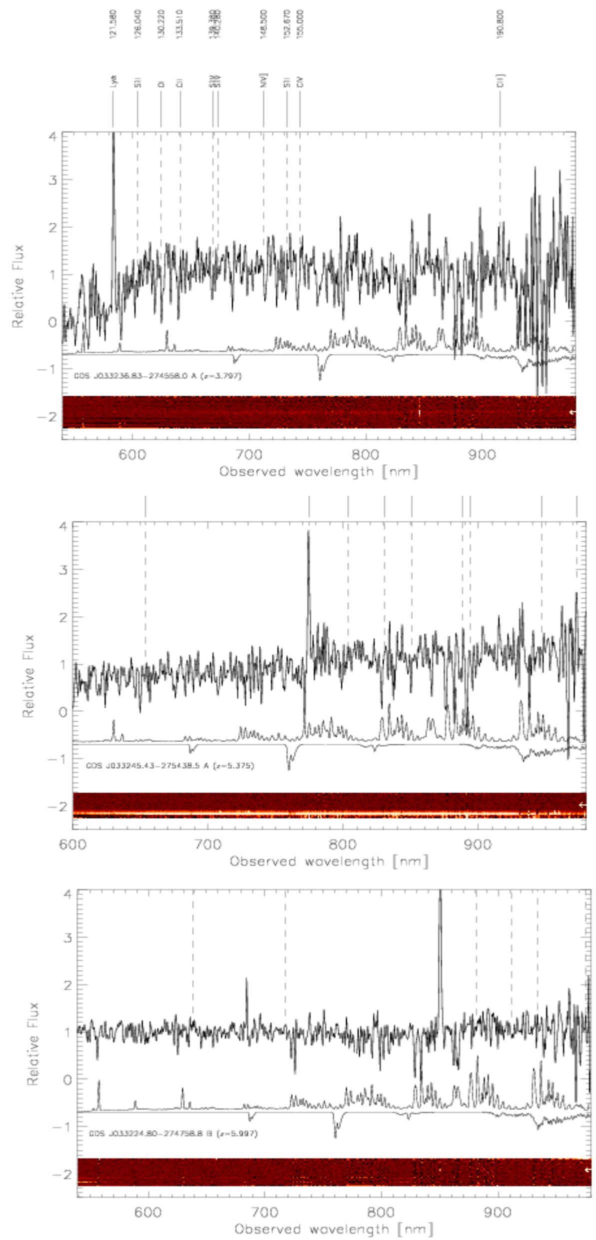
At z=4 Pentericci et al. 07 found that LBGs with Lyα in emission are less massive, younger and contain less dust than the general LBGs population, but other authors find that they are more evolved galaxies (Shapley et al. 03)

The main limitation of narrow band selected Lyα emitters is that they tend to be extremely faint in continuum therefore their physical properties (total stellar masses, ages etc) are hard to constraint for individual objects (e.g. Lai et al. 07)

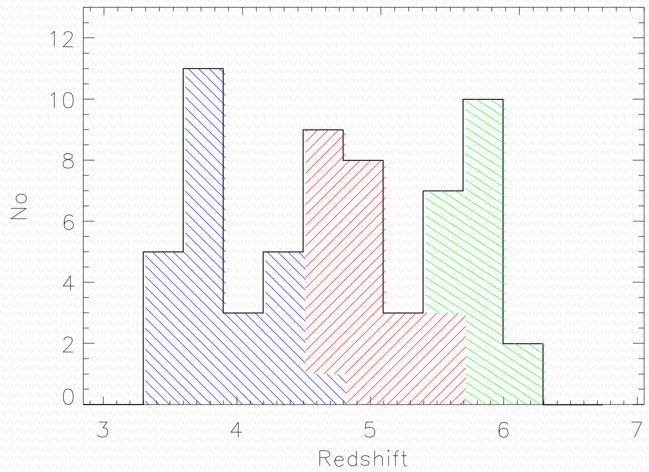
➡ we study Lyα emitting galaxies that have been selected from their continuum properties as LBGs

Sample of LBGs with Lyα in emission selected from GOODS-South field

- Galaxies were selected from the GOODS-MUSIC z-detected sample (Grazian et al. 06) as B,V and i dropouts (color selection as in Giavalisco et al. 04)
- We then selected galaxies with published spectroscopic confirmation mostly from GOODS/FORS 2(Vanzella et al. 06,07) or other papers
- Only objects with Lyα line in emission were retained
- No AGNs were included (no X emis.)



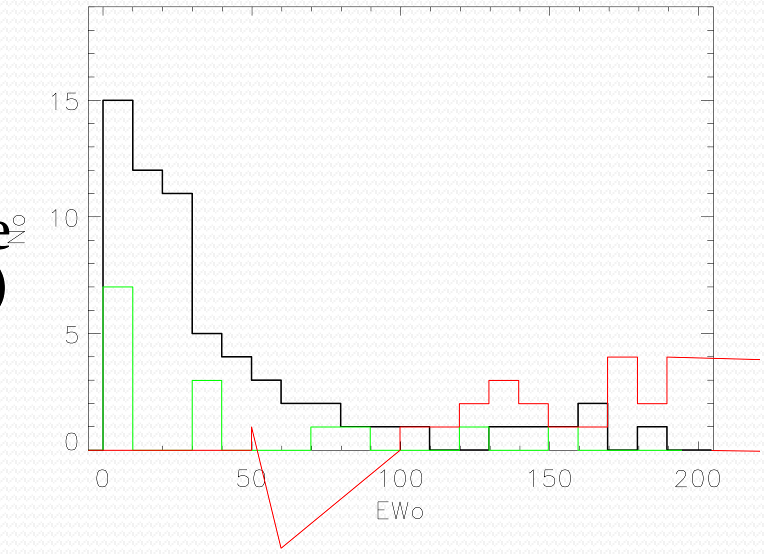
Redshift and EW distribution



Redshift distribution showing the B , V and i dropouts: ≈70 galaxies

Restframe EW distribution:

- > 50% has EW larger than 20Å so they would be selected as Lyα emitters in classical NB searches
- For comparison we plot the LBGs sample by Tapken et al. 07 (continuum selected) at z=3-5 (green histogram) and the 22 Lyα emitters from Finkelstein et al. 07 at z=4.5 which have detections also in at least 2 continuum bands (LALA- red histogram)



SED modelling

The full multi-wavelength information consisting of 14 bands (VIMOS -U, 2 .2m U, HST/ACS BVIz , VLT JHK, IRAC 3.6, 4.5,5.8,8 μ) was retrieved from the GOODS-MUSIC catalog (Grazian et al. 06) that uses the ConvPhot algorithm (DeSantis et al. 07) to match photometry from the different instruments

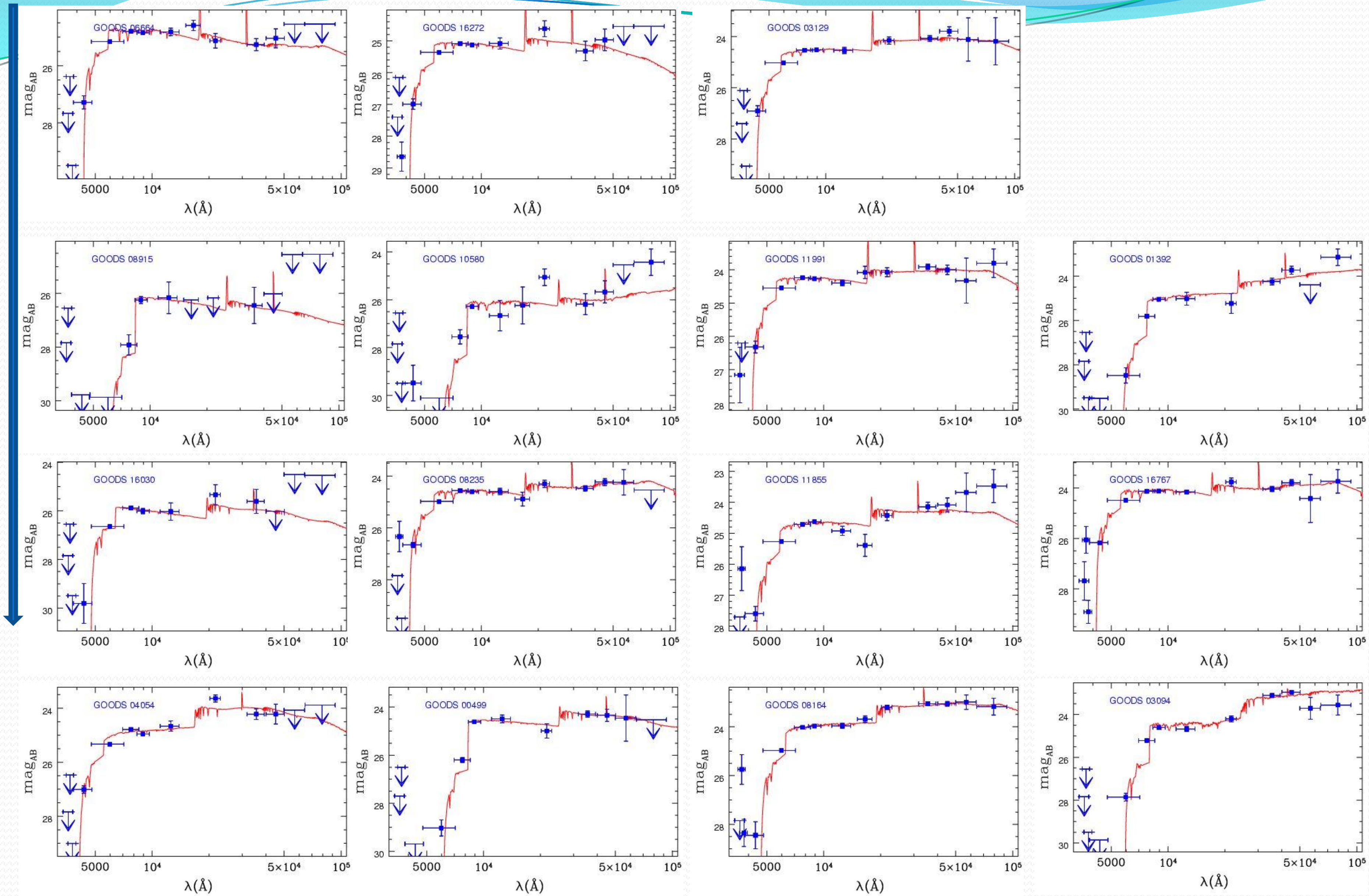
Spectro-photometric fit using both the B&C 03 and C&B07 models: Salpeter IMF; exponentially declining SFR with e-folding time τ , $0<E(B-V)<1.1$, Calzetti or SMC law; $Z=0.002-2.5\ Z_{sol}$

➡ OUTPUT: Total stellar masses (with uncertainties reduced thanks to the inclusion of the mid-IR IRAC bands- Fontana et al.06) ,SFR , stellar ages and dust extinction

The fits are well constrained for most of the galaxies and we can determine individual physical properties

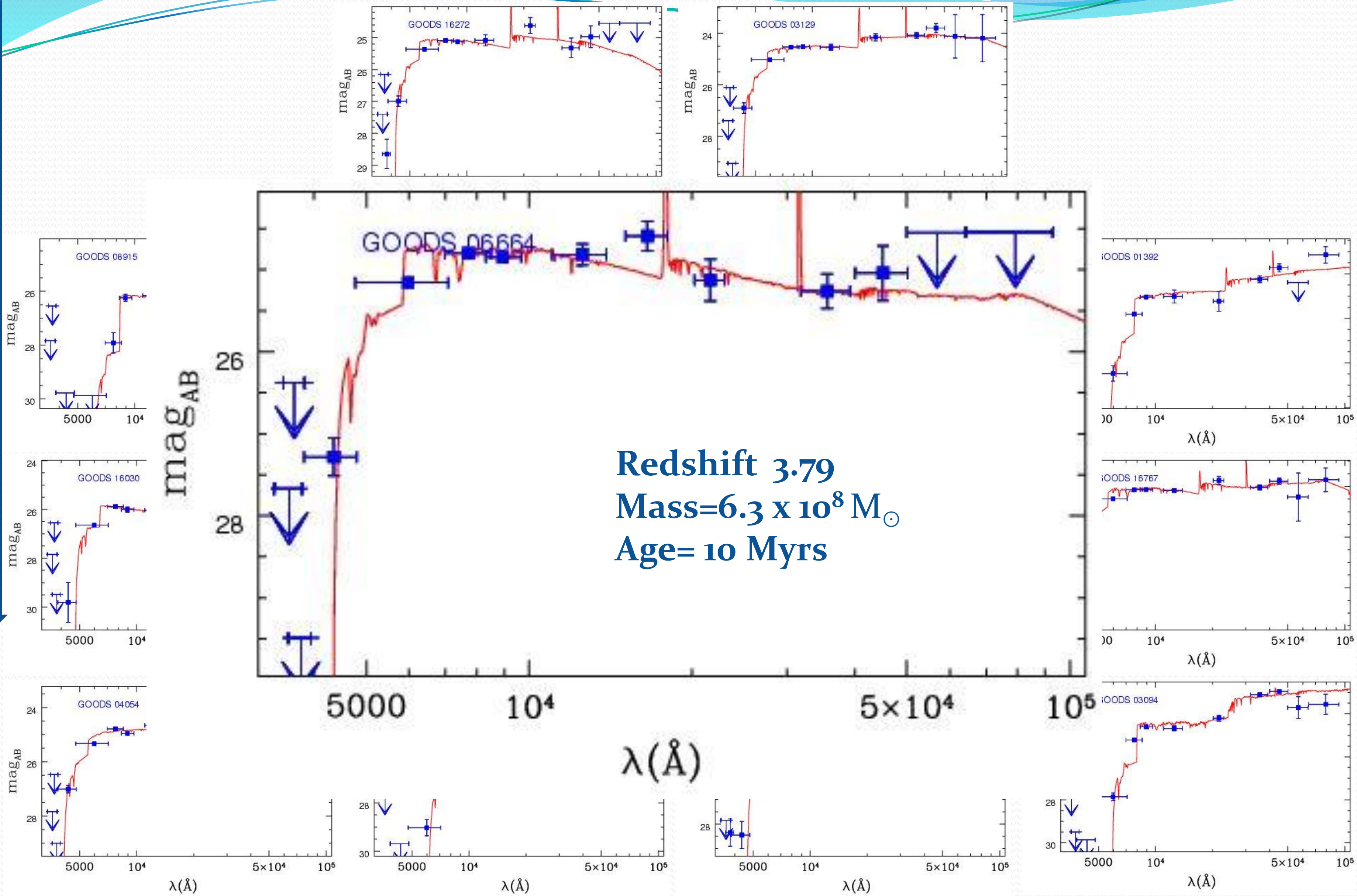
For galaxies with EW> 20 Å, a second fit was performed **excluding the band that contains the Lyα line**: these fits give totally comparable results as the first.

Increasing Age



Increasing Stellar Mass

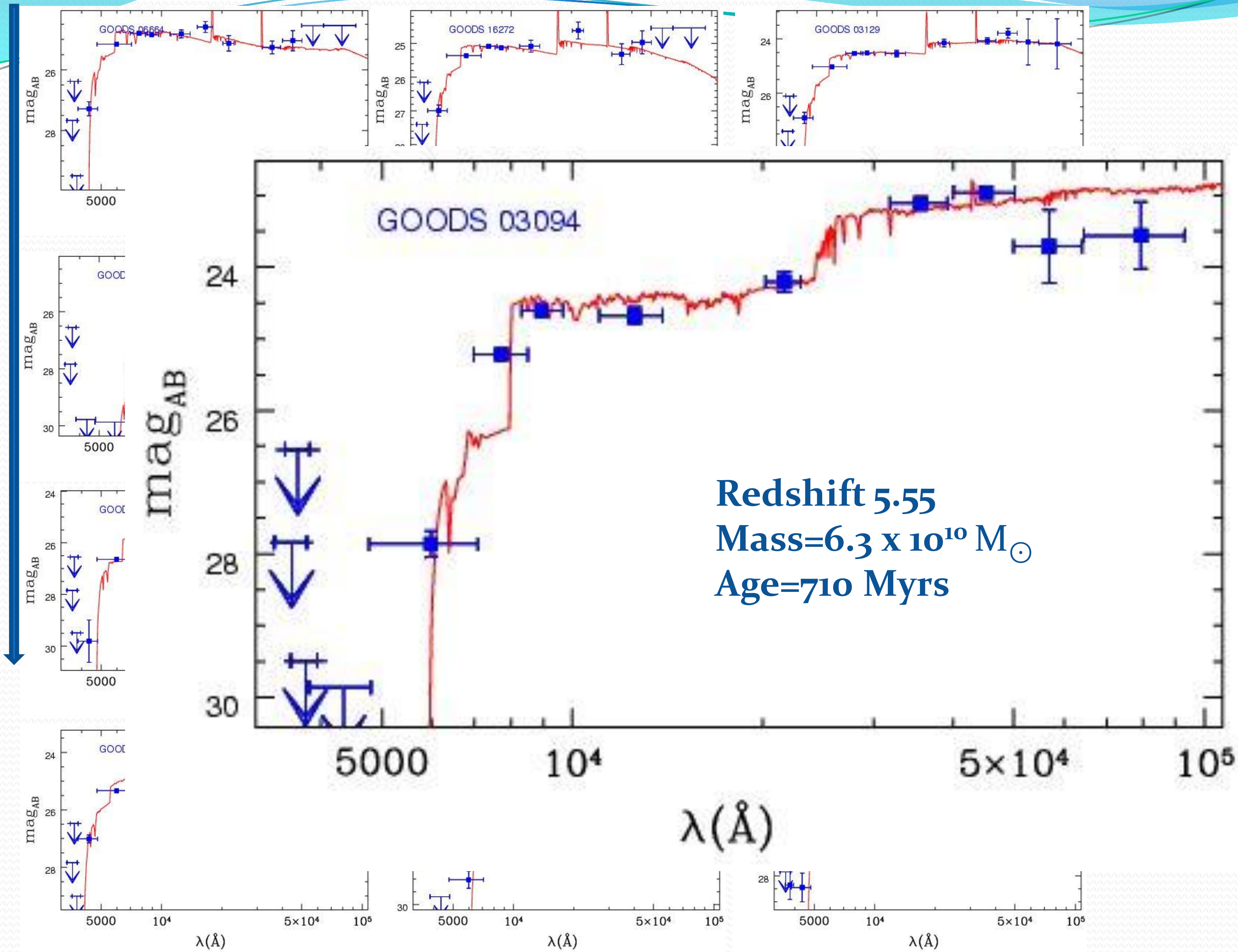
Increasing Age



Redshift 3.79
Mass=6.3 x 10^8 $M_\odot$
Age= 10 Myrs

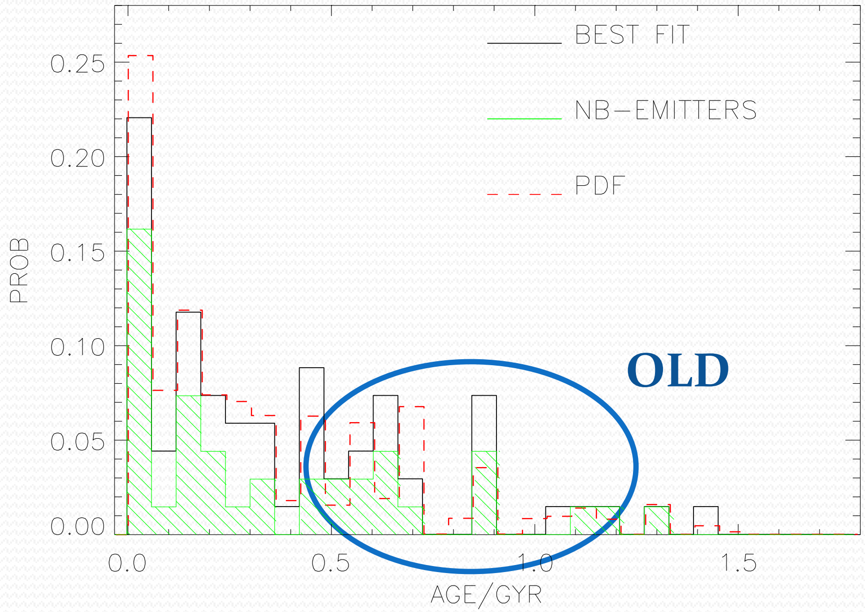
Increasing Stellar Mass

Increasing Age



Increasing Stellar Mass

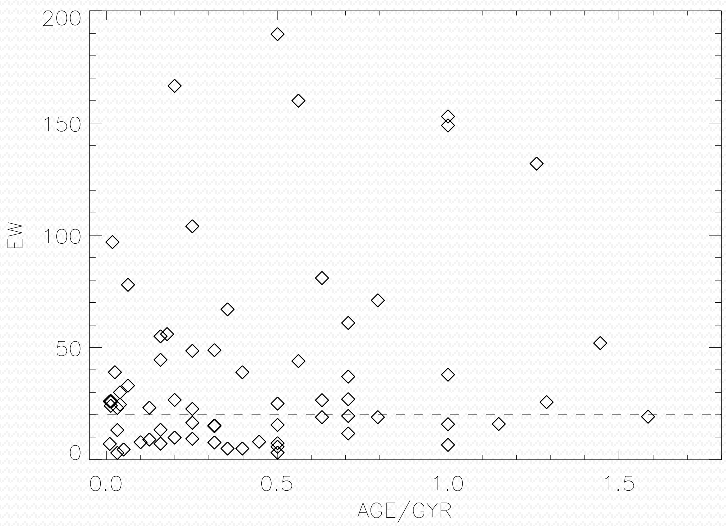
Ages: old Lyα emitters?



- Age distribution is shown, both using the best fit values and the sum of the Probability Distribution function of each galaxy (a more robust determination)
- Most galaxies are modeled with very young stellar populations (T= 10-200 Mys) as expected and comparable to what found by NB selected LAEs
- 13/68 galaxies have best fit ages > 0.5 Gyrs & Age_{min} > 300 Myrs so <u>they are most certainly not primaeval galaxies.</u>

old Lyα emitters?

The Age distribution of NB emitters is consistent with that of the entire Sample: no correlation is seen Between Age and Lyα EW



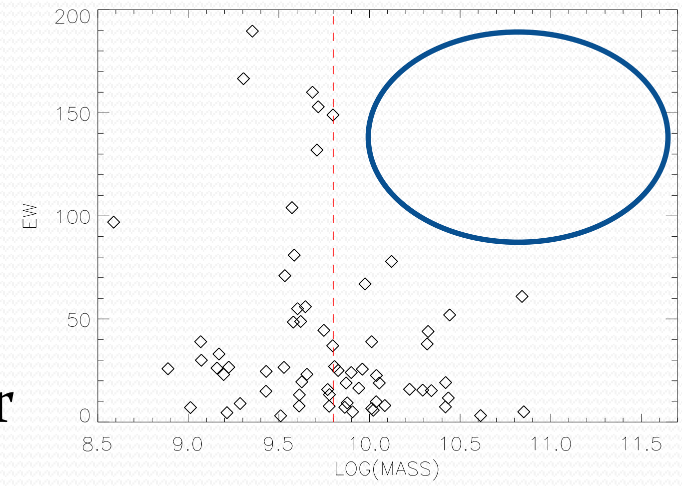
Median Age =300 Myrs

(Median Age=250 Myrs for sub-sample with EW>20 Å)

Total stellar masses

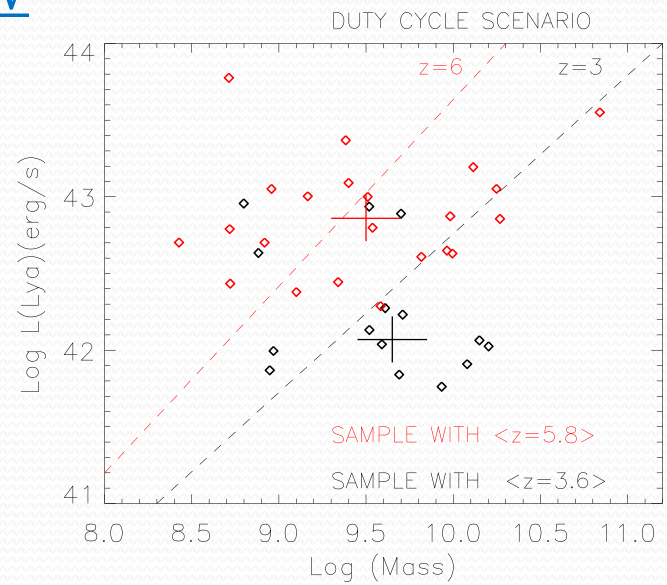
Masses are in the range $10^{8.5}$ -10^{11} $M_\odot$

Median stellar Mass≈6 (4) x 10^9 $M_\odot$ comparable to the values of Lai et al. (07) for IRAC detected LAEs at z=5 and the IRAC detected subsample of LAEs at z=3.1 from MUSYC (Gawiser et al. 07) but higher than most other estimates for LAEs at redshift 3-6 (Pirzkal et al. 07 Finkelstein et al. 07 Gawiser et al. 06)



Significant lack of massive galaxies with large EW (similar to the lack of bright galaxies with large EW found by Ando et al. 07)

Masses and Lyα luminosities are in broad agreement with those predicted by models: e.g. SPH simulations by Nagamine et al. 2008

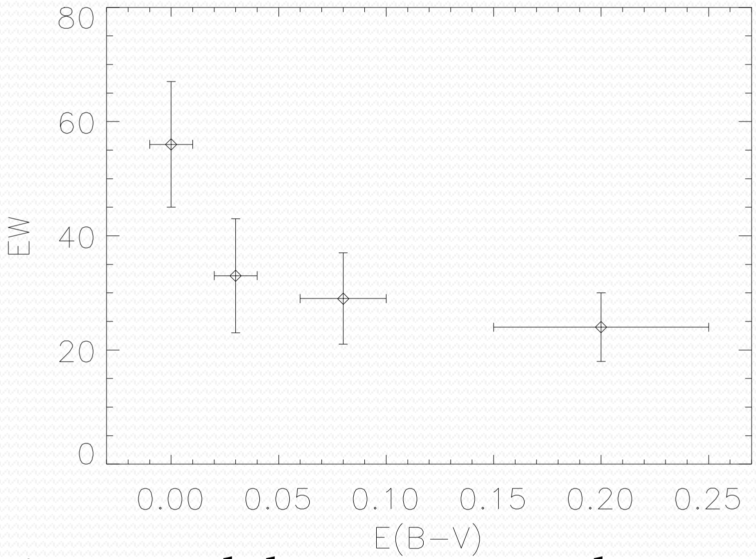


Right figure: predictions atz=3 and z=6 compared to our data

Dust content:

The presence of dust (although in small amounts) is required by the SED fits of many galaxies . There is a significant correlation between E(B-V) determined from the continuum fit and the Lyα EW from the spectra.

In agreement with Shapley et al.(03) for LBGs at z=3 and with Pentericci et al. (07) for LBGs at z=4 who find that LBGs without line emission are dustier than LBGs with line emission



If the most massive galaxies are also dustier this could explain the lack of massive galaxies with high EW

A scenario where all LBGs are intrinsic Lyα emitters and dust suppress the emission has been recently proposed by Schaerer & Verhamme (07) and could explain some of the observed trends

In summary….

- Most Lyα emitters are extremely young galaxies but a non negligible fraction contains an evolved stellar pupulation:

  Scenarios to explain the older galaxies with line emission include :

1. A double line emission phase (e.g. Thommes & Meisenheimer 05)
2. Differential dust extinction i.e. galaxies where clumpy dust could suppress the continuum emission more that the line , therefore enhancing the line EW (e.g. Finkelstein et al. 07,08, Hansen &Oh 06)
3. In more evolved galaxies dust could have been destroyed or blown out e.g. by starburst superwinds (Shapley et al. 01)

- The derived masses are larger than those of NB-selected galaxies
- There is a lack of massive galaxies with large EW
- Masses and SFRs are in broad accordance with some model predictions (e.g. Nagamine et al.08)
- There is a net correlation between line EW and dust extinction:

  if the most massive galaxies are also dustier this could explain the lack of massive galaxies with very large EW .