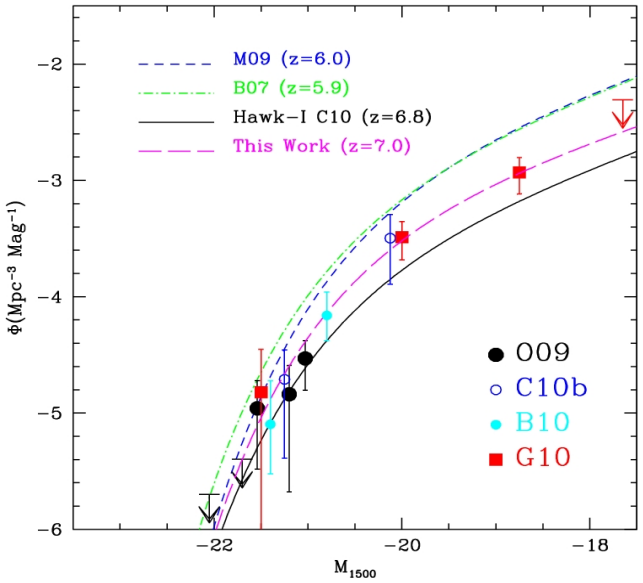
Current and future ASTRODEEP related research activity

Marco Castellano (INAF-OAR)

1) The physics of early galaxy evolution:

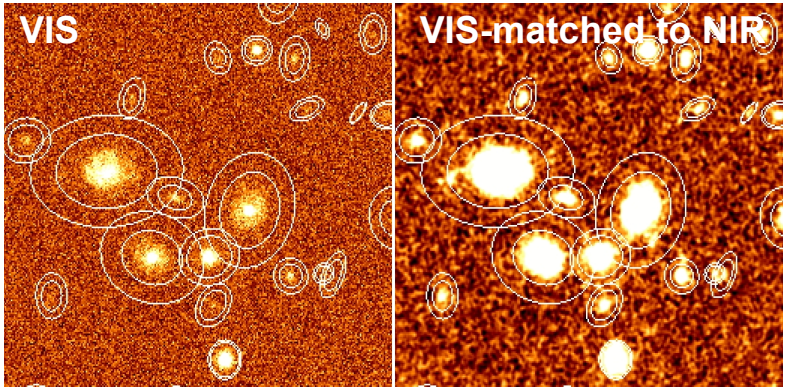
- Evolution of the UV LF and reionization epoch
(C10a,C10b, Grazian,Castellano et al. 2011,2012,
+ ever increasing spec. follow-ups)

- UV slope/dust extinction and SFRD
(C12, ***C14 A&A submitted+future prospects***)



2) Multiwavelength catalogue production:

- Algorithms for Euclid surveys



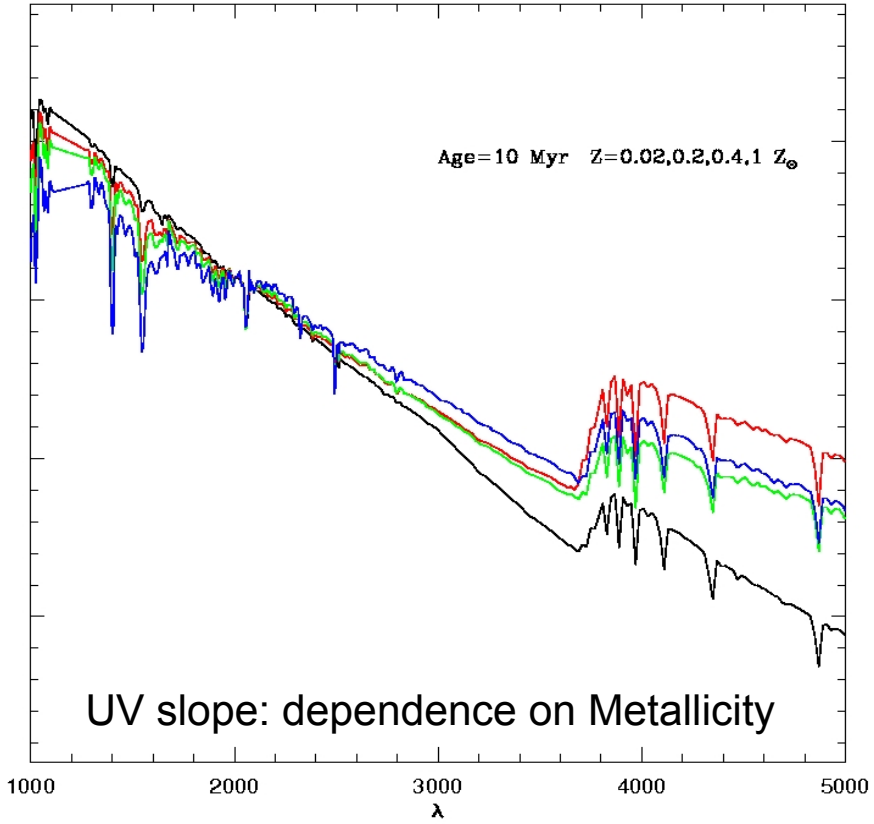
3) Data processing:

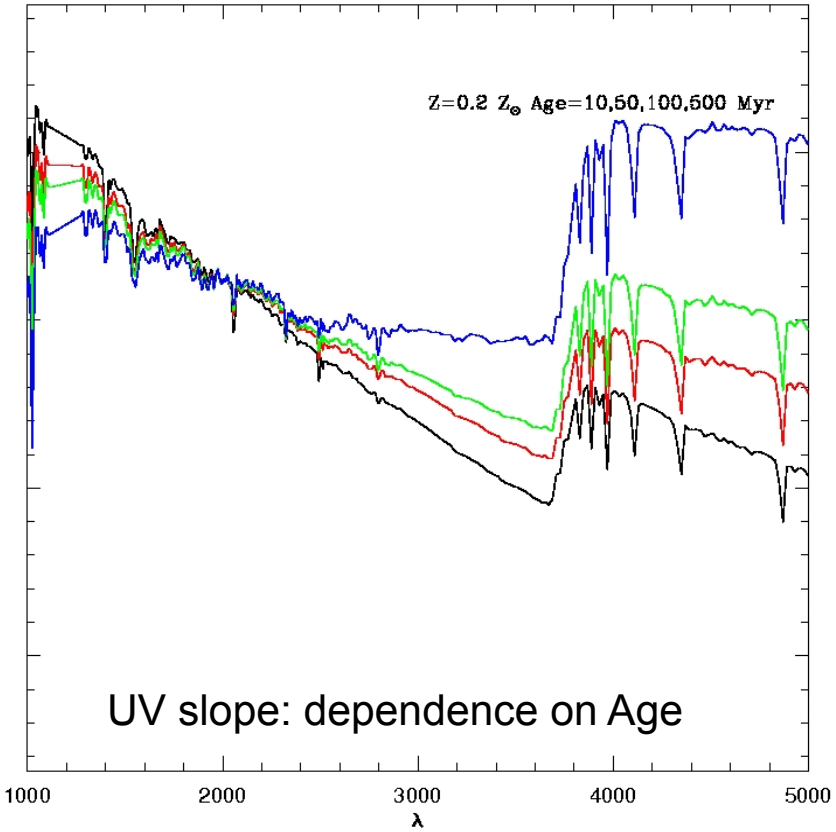
- Mathematical methods for image analysis: super-resolution, ***image denoising and decomposition***



1) The physics of early galaxy evolution: the origin of the UV slope

Castellano et al. A&A submitted





The UV slope is one of the most important observables at high-z, but we need both spectroscopic and photometric information to *understand* it and to *use it properly*.

Small but unique sample of 14 LBGs in GOODS-South with:

1) available spectroscopic measurement of stellar and/or gas phase metallicity
2) deep multi-band coverage and high photometric accuracy (CANDELS+HUGS+SEDS)

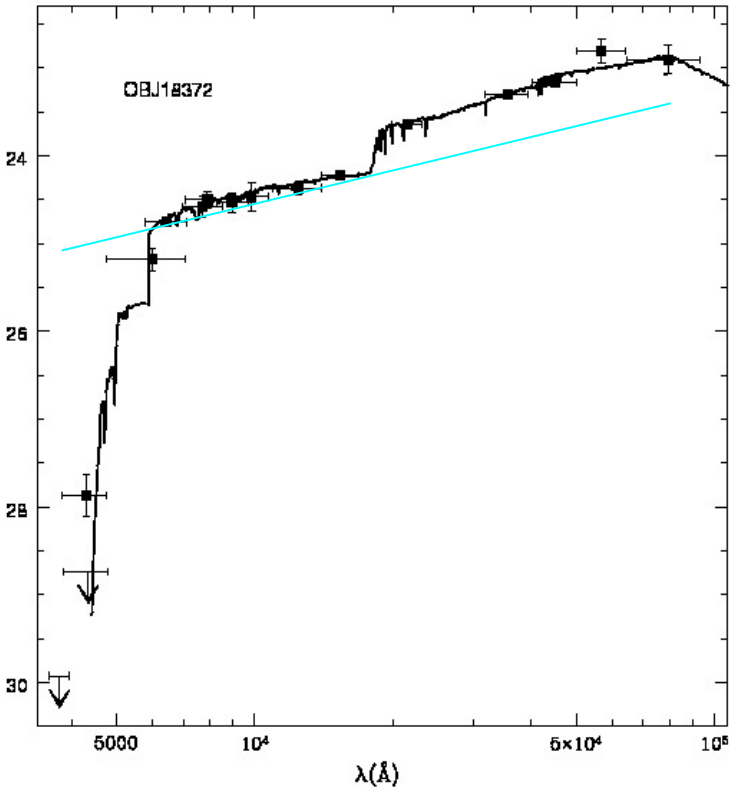
1) The physics of early galaxy evolution: the origin of the UV slope

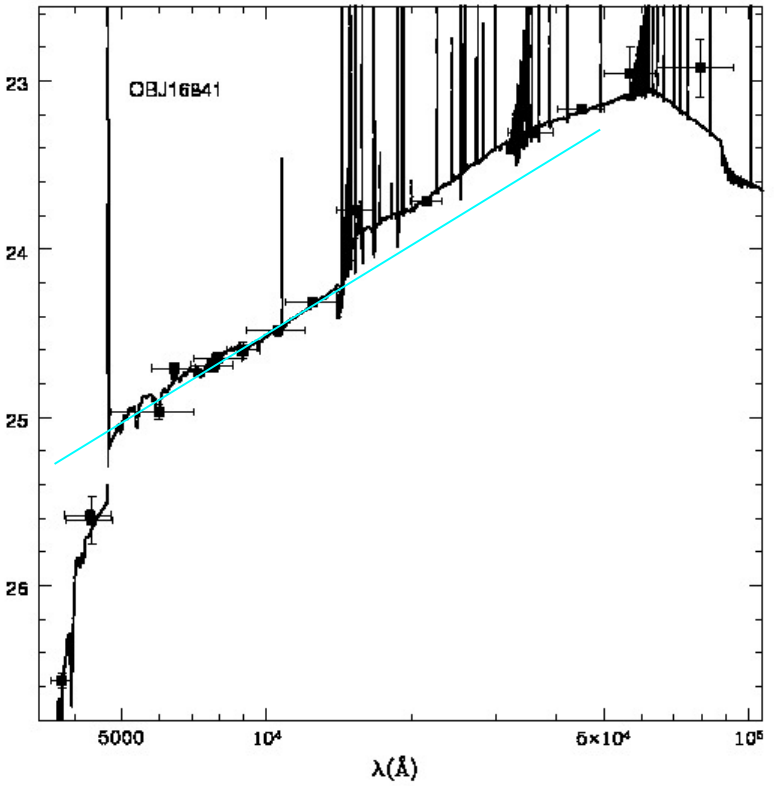
Castellano et al. A&A submitted

Our goal: compare SFR and E(B-V) estimates, SED fitting vs. "standard recipe".

1) best available SED-fitting : metallicity from UV spectroscopic indicators. Balmer break sampled by deep IR observations.

2) "standard recipe"= UV slope (from multi-band CANDELS-HST obs.) --> A1600 (Meurer+99) --> SFR from Madau+98 on corrected UV magnitudes

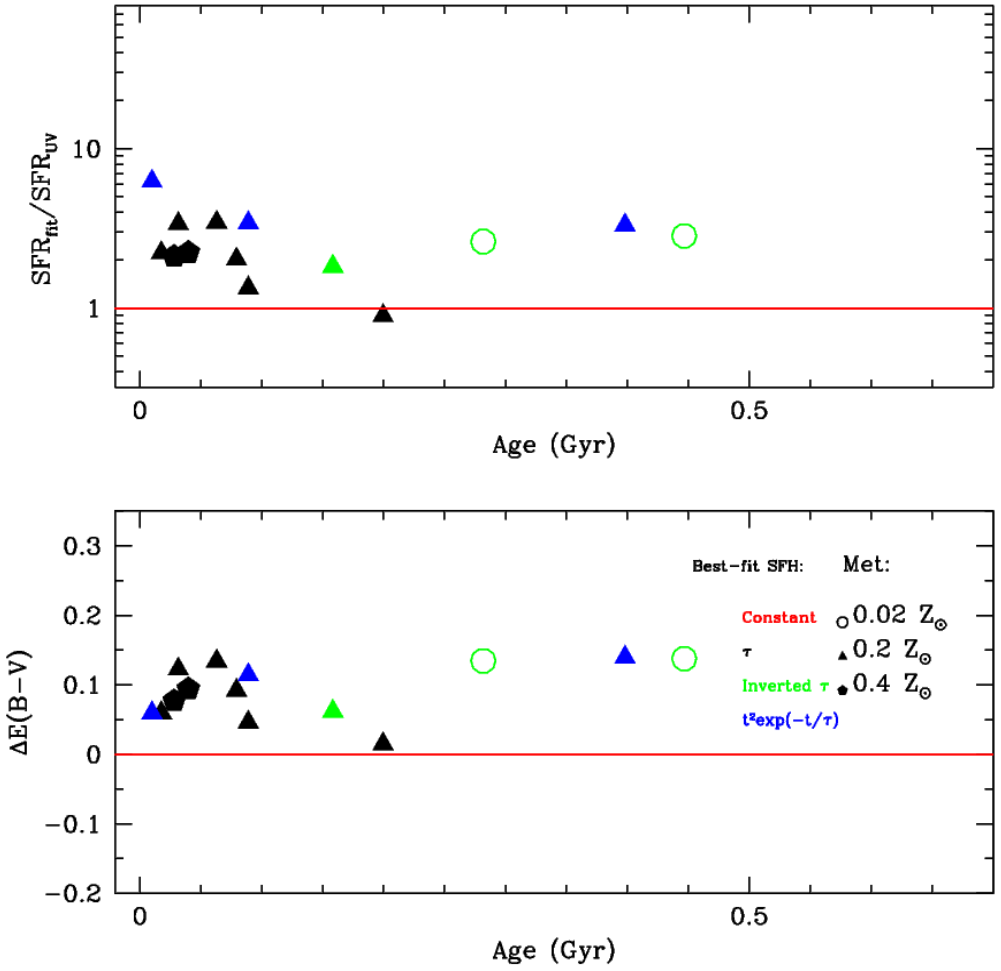




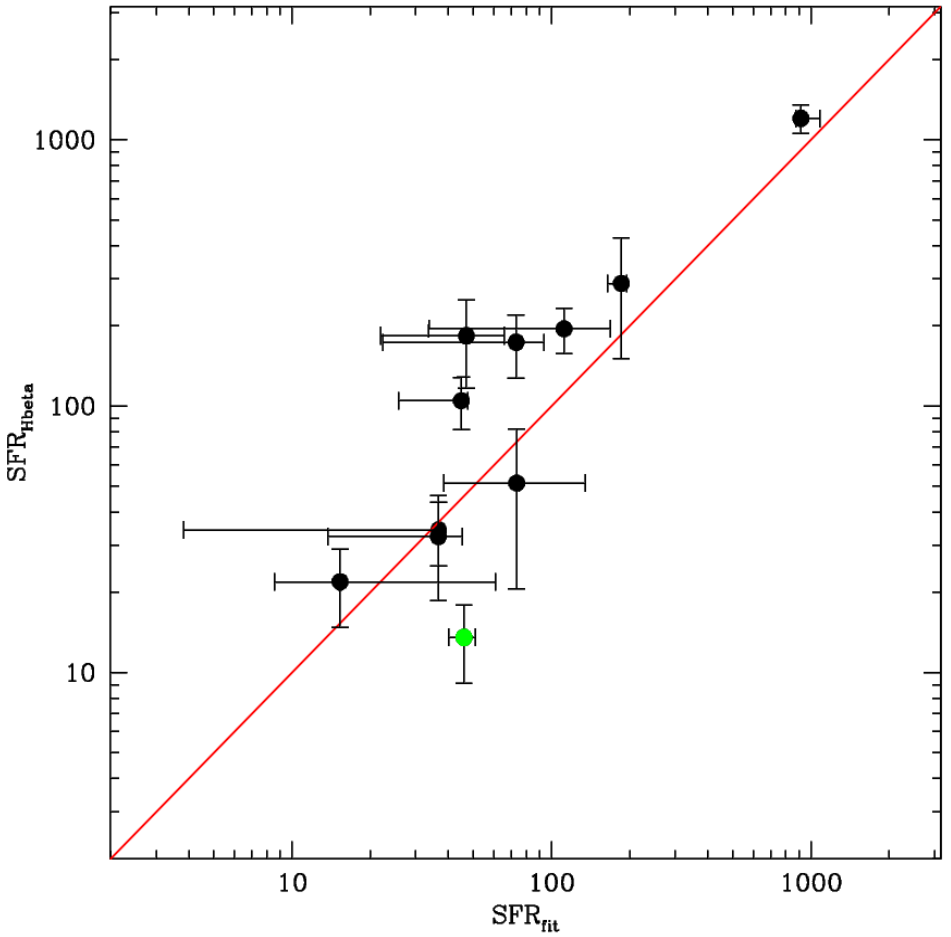
1) The physics of early galaxy evolution: the origin of the UV slope

Castellano et al. A&A submitted

Result: low metallicities, and young ages imply a much bluer intrinsic spectrum,
---> higher extinction is required to explain the observed spectral energy distributions.



1) Significant discrepancy between SED-fitting parameters and "standard recipe".

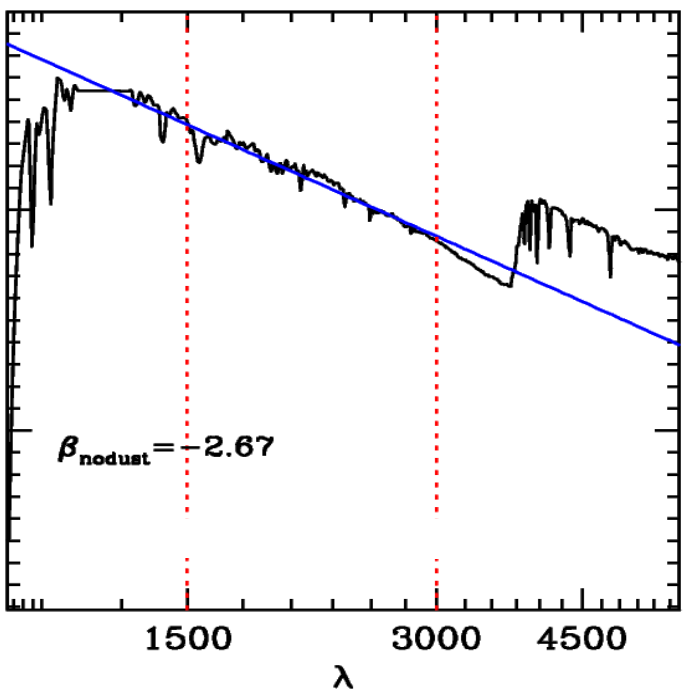


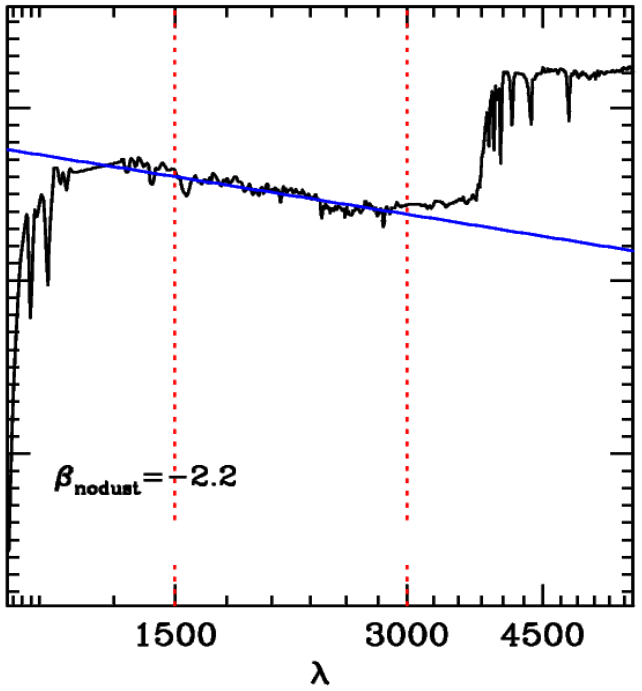
2) Agreement between SED-fitting SFRs and independent diagnostics (X, radio, Hbeta, Herschel)

1) The physics of early galaxy evolution: the origin of the UV slope

Castellano et al. A&A submitted

Result: low metallicities, and young ages imply a much bluer intrinsic spectrum,
---> higher extinction is required to explain the observed spectral energy distributions.





The average $\Delta E(B-V)=0.09$ implies an increased extinction :

$\Delta A1600=0.89$ mags.

This yields to a new A1600-β relation:

A1600=5.32+1.99β

In place of Meurer 99 one.

i.e. the UV slope of a dust free population is β~-2.67 rather than β~-2.23

When folding in this new relation in the estimate of the z~3 SFRD (with available UV slope distributions and UV LF, and the average L-UV-SFR relation in the sample), yields to:

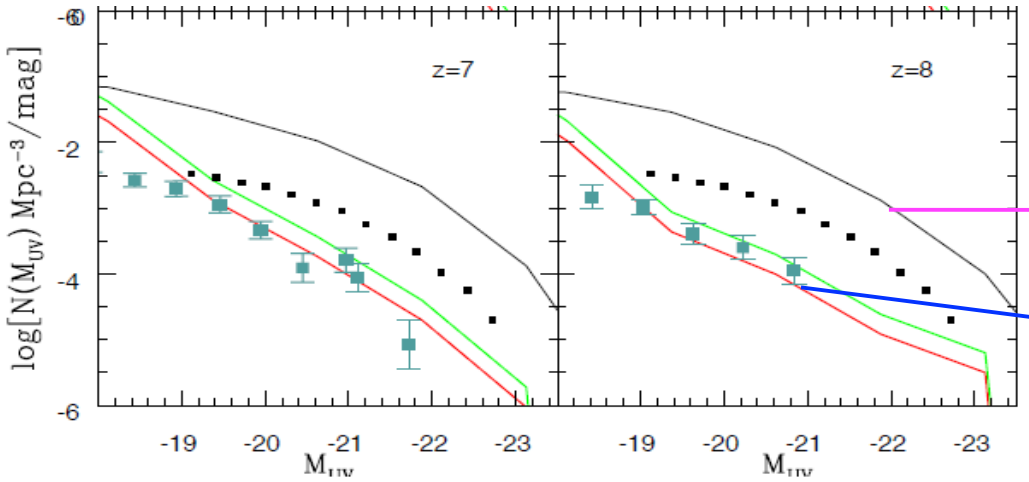
$$\boldsymbol{SFRD = 0.39\ M_{sun}/yr/Mpc^3}$$

~2.4 times higher than previous estimates based on M99 UV slope-extinction relation.

1) The physics of early galaxy evolution: the origin of the UV slope

Future developments:

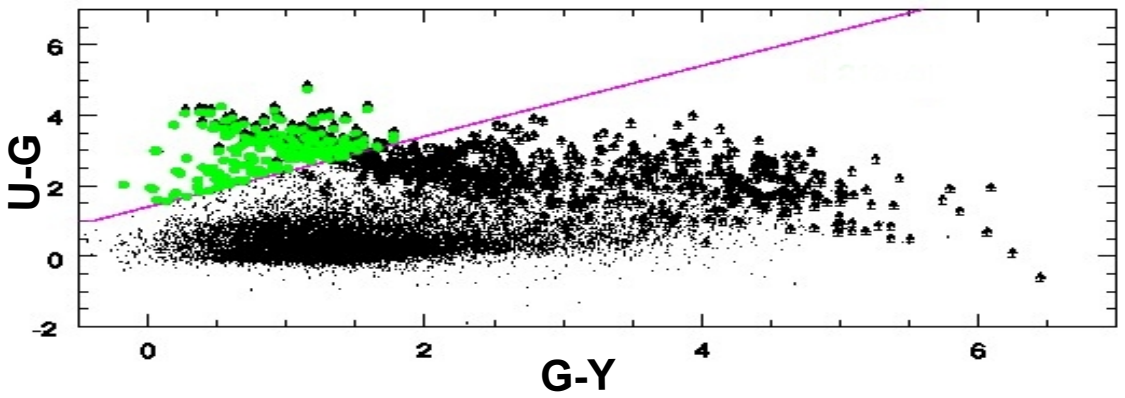
1) Self consistent comparison between observations and SAMs on
   a) UV slopes; b) UV luminosity function at high-z

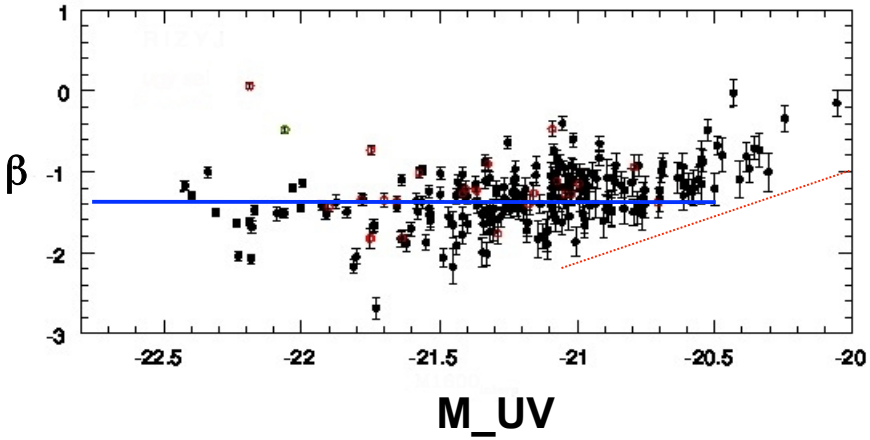


Intrinsic LF

Observed LF

2) SFRD with an in-depth characterization of UV slopes at z~3 on multi-band data: LBT+ULTRAVISTA on COSMOS; CANDELS



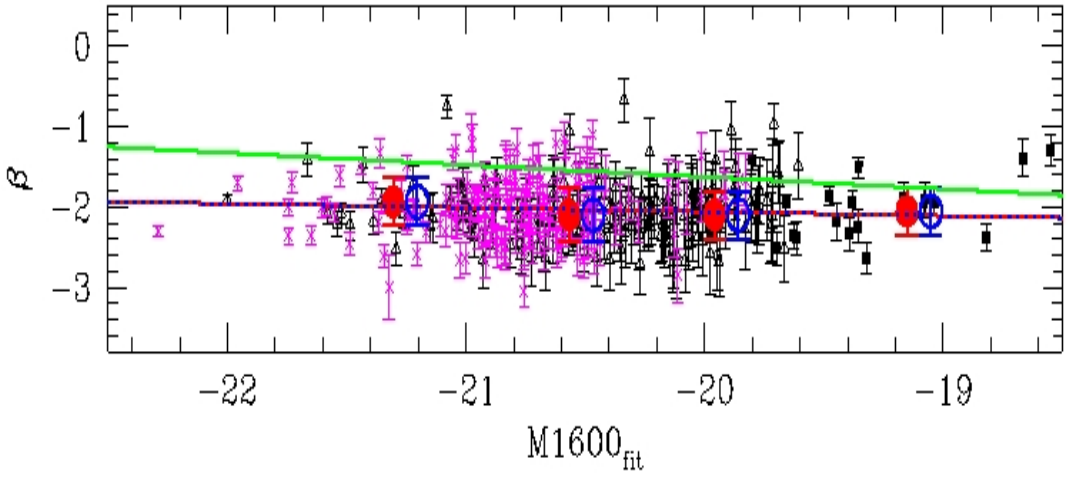


1) The physics of early galaxy evolution: the origin of the UV slope

Future developments:

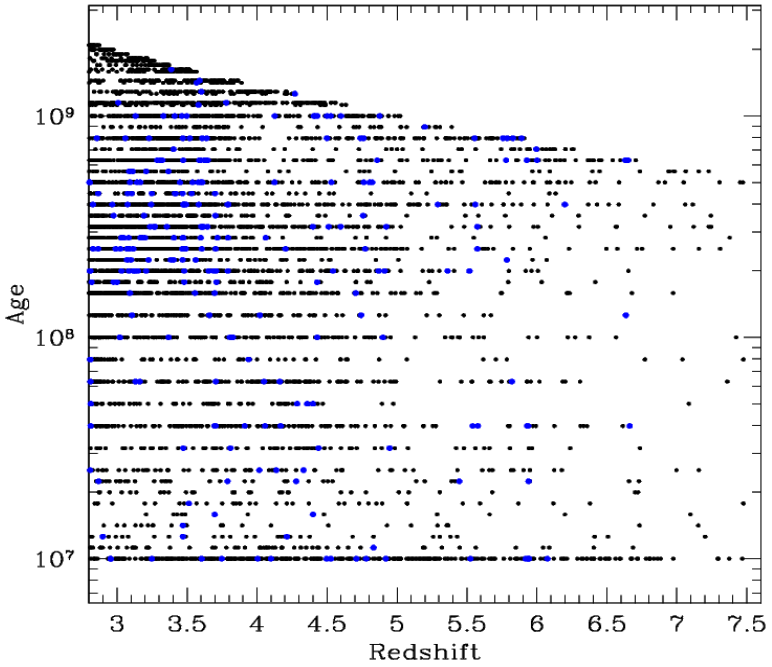
3) Explore the effect on SFRD estimate when putting all elements together:

- UV slope vs. mag., and UV LF evolution as a function of redshift



- Some motivated assumption on metallicity (or mass-metallicity) evolution

- Age estimate on full CANDELS dataset by varying SFH, assumptions etc.



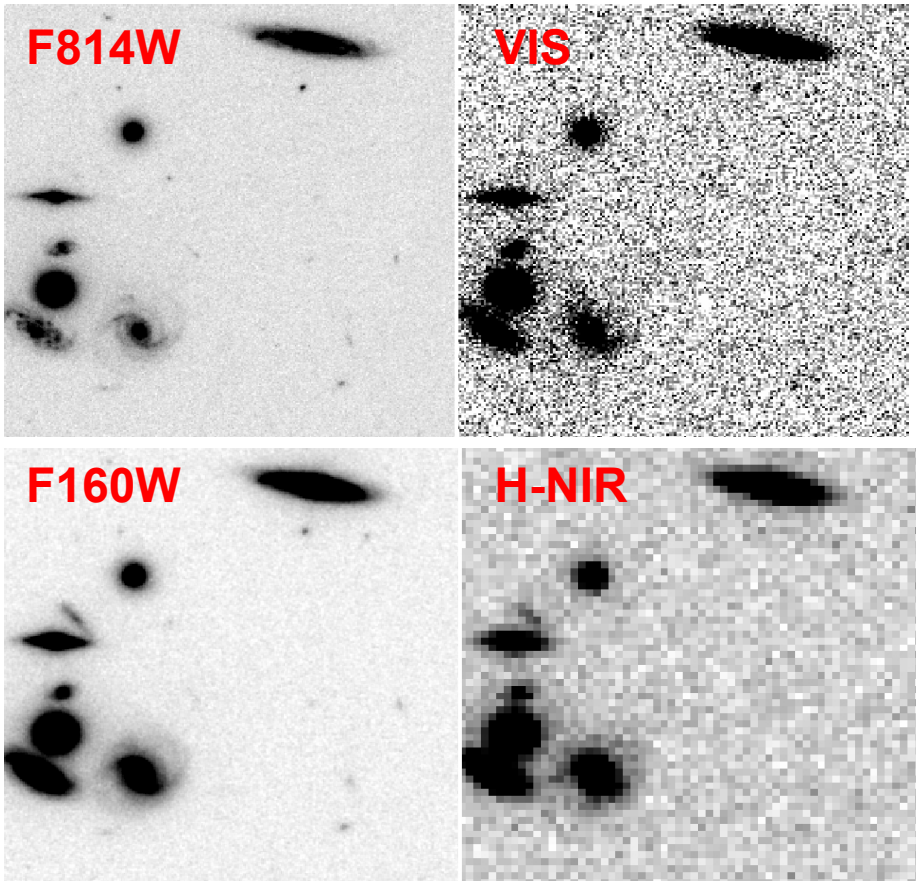
2) Multiwavelength catalogue production

EUCLID “Data Challenge”

Loop between OUs (MER and PHZ to begin with) to define:
- optimal procedure for source detection
- optimal color estimate for photo-z measurement
- evaluate different detection and photometry algorithms

* We developed a software to obtain realistic simulations of the expected VIS/NIR/EXT images by degrading (PSF, pixel-scale, depth) CANDELS-HST images at similar wavelength.

* We extract multi-band catalogs from the simulated EUCLID dataset following different approaches to photometry.



“Data Challenge n.1”:

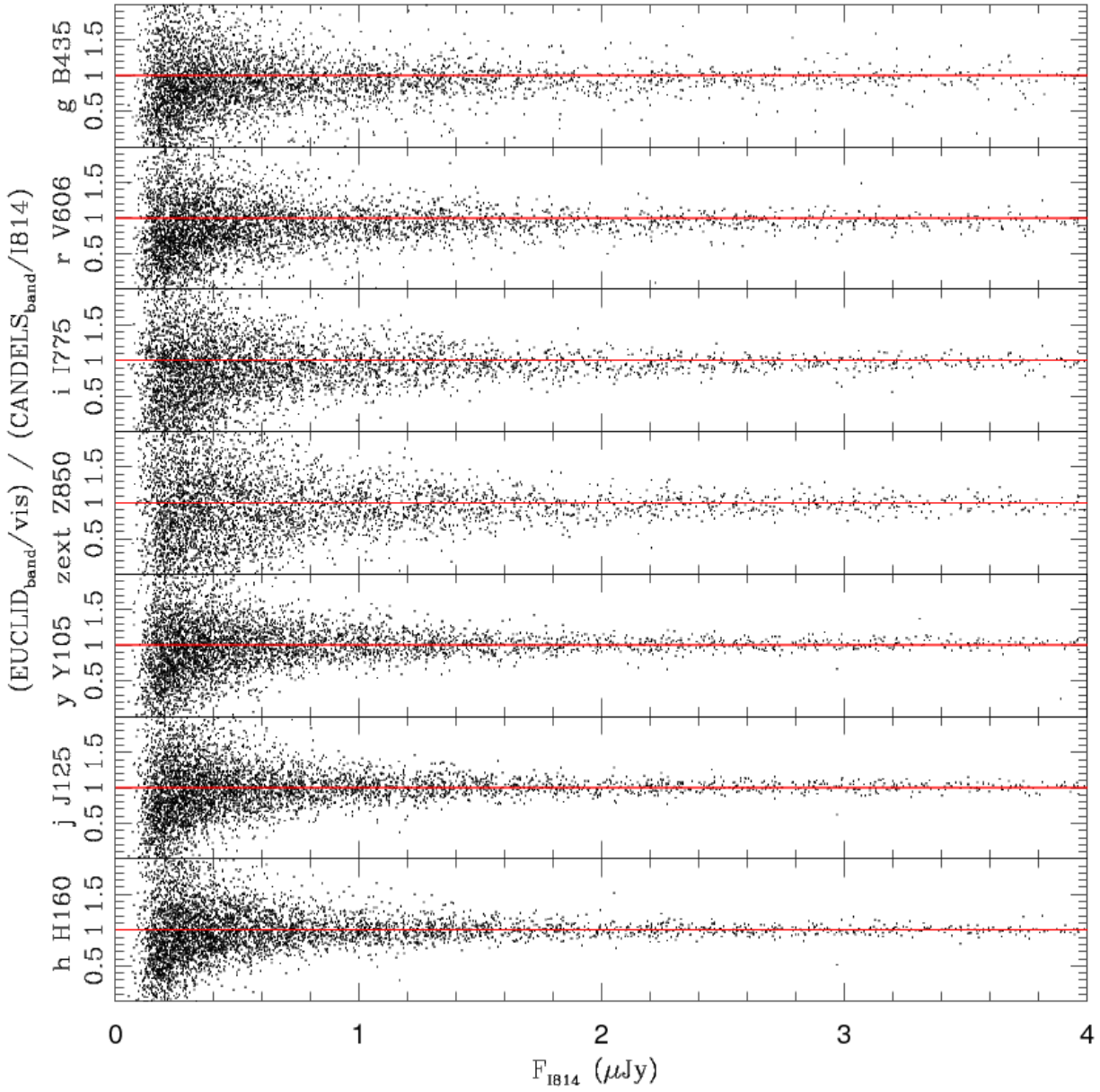
- 8 bands (4xEXT,VIS,3xNIR) from ACS/WFC3 G-S
- 10 different realizations (independent noise)
- detection on VIS, two approaches of aperture photometry on PSF-matched images, colors in 1/2/3 FWHM apertures :

1) $$F_{tot}(Mband) = \left(\frac{F(Mband)}{F(Dband_{M-matched})} \right)_{aper} \times F_{tot}(Dband)$$

2) $$F_{tot}(Mband) = \left(\frac{F(Mband_{g-matched})}{F(Dband_{g-matched})} \right)_{aper} \times F_{tot}(Dband)$$

2) Multiwavelength catalogue production

EUCLID “Data Challenge n.1”



Colors are well matched to the equivalent CANDELS ones.

Distributed to OU-PHZ:

Waiting to see the effect of the shallower EUCLID exposures on photo-z accuracy.

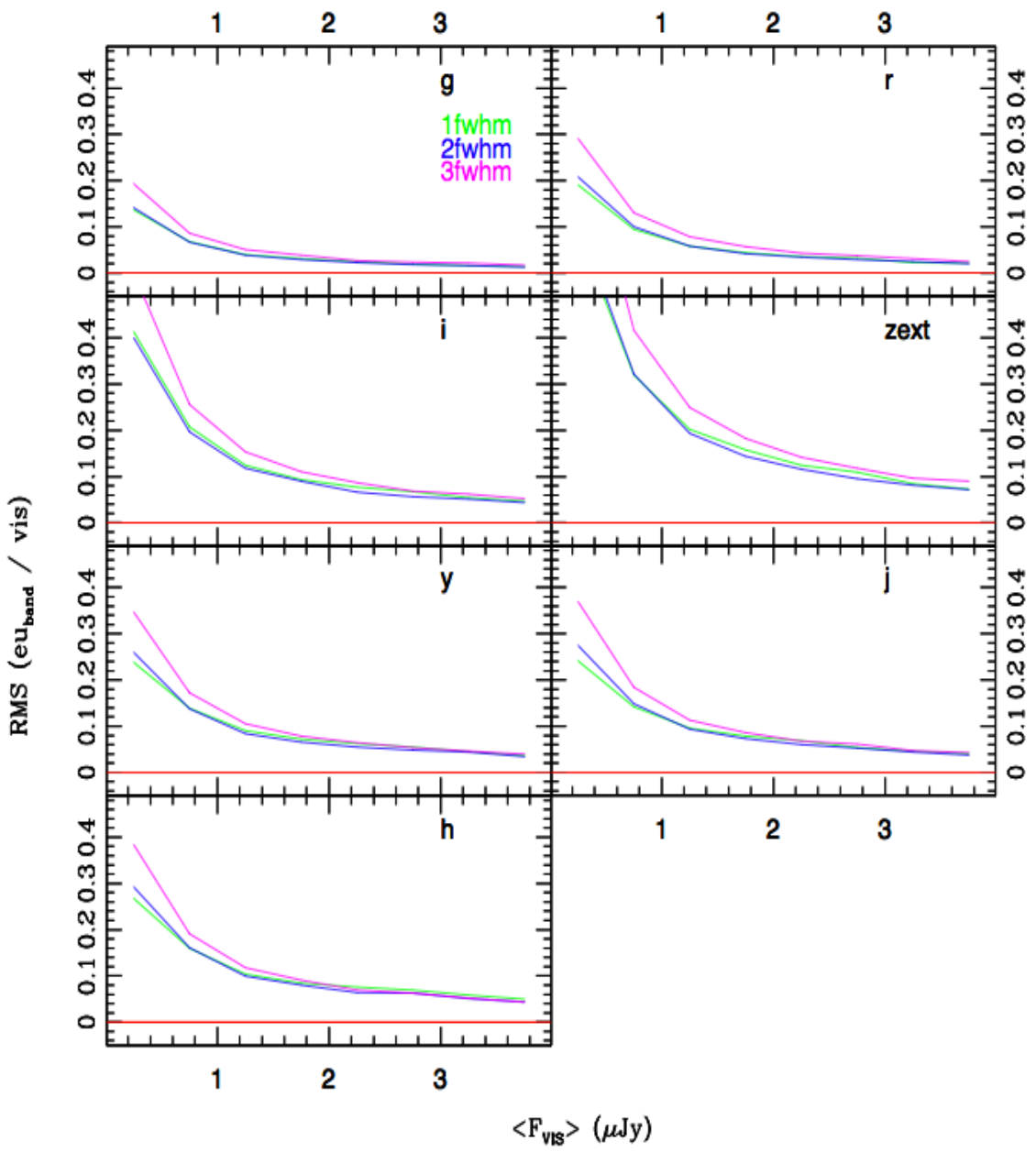
Each catalog~ 65000 objects (6500x10 realizations); 12171 high-quality spec-z. 822 AGNs.

Other Data Challenges planned :

e.g. PSF-matching and prior based photometry

2) Multiwavelength catalogue production

EUCLID “Data Challenge n.1”



Independent realizations of the “same” catalogue + CANDELS basis for comparison allow to estimate:

- “intrinsic” photometry RMS

- biases due to: varying depth, PSF-matching/ measurement, adopted detection band and parameters.

ASTRODEEP context:

- Starting point for ASTRODEEP WP6 (so far DC is EUCLID-Wide only)

- approaches to test photometry reliability on simulations

- intense code development under way:

READCAT.f90: multi-purpose, flexible code to assemble multi-band catalogs

CHECK_SEGM.f90: to fully evaluate different detection approaches.

3) Data processing

Advanced mathematical methods for image analysis:

Image decomposition/denoising
(with Daniele Ottaviani, graduate student, Dept. Mathematics Univ. Roma-1)

- “Total variation” methods to split images into “structure” and “texture” (chosing different scales).

Possibly a two step process: 1) structure= sources+background; texture=noise.
2) structure=background; texture=sources.

