The Euclid view on galaxy and AGN evolution

Coordinators: **Jarle Brinchman, Andrea Cimatti, David Elbaz**

PBworks: **http://euclidgawg.pbworks.com/w/page/35584490/FrontPage**

(Redmine: http://euclid.roe.ac.uk/projects/swg-coord/wiki)

>100 members

Important documents

The main repository for Euclid documents are on ESA's Livelink pages, and a
these documents for us are also available here:

- The Red Book is the one to reference in any papers dealing with Euclid
- The Euclid Management Plan is essential reading for any new members
  rules you must follow.
- The Science Requirement document (SciRD) provides an overview of th
- The Ground Data Processing Requirements Document (GDPRD) outline
- The Legacy Requirements Document (LRD) provides a complement to t

- WP 1: Physical Parameter Estimates from Photometric SEDs The go
  OU-PHZ and work with them on implementing the algorithm(s) de
- WP 2: Physical parameter estimate from spectra. This WP will comp
  metallicities, ionization diagnostics and dust attenuations. This w
  linked to WP 1.
- WP 3: Galaxy evolution in different environments. This WP should
  the full range of environments from voids through filaments to th
  (i.e. clusters). This WP should be strongly linked to OU-LE3, the cl
- WP 4: Galaxy morphology. This WP is in charge of specifying algor
  detection with Euclid data, and organisation of relevant science. Li
- WP 5: Passive galaxies. Detection and characterisation of passive g
- WP 6: Theoretical models. WP to determine what theoretical simul
  and SIM-SWG. This will be place to discuss feedback to and from
- WP 7: Galaxy & AGN evolution and lensing. This work package sho
  research. It would be expected to have strong links to SWG-WL an
  when the group is established.
- WP 8: Multi-wavelength synergies. This WP should deal with both
  electromagnetic spectrum. It should provide scientific guidance or
  science-optimised multi-wavelength analysis methods and act as
  (e.g. SKA-precursors, SPICA, X-ray missions etc). This WP is expe
- WP 9: Type 1 and 2 AGN. Methods to identify and study the evolut
  ensure that issues specific to AGNs are catered for. Links to most
- WP 10: High-z objects (z>4? and z<7) Identification and study of
  bridging the gap with SWG PU and members of this WP would be e
- WP 11: Distribution functions. Devise methods for calculation of d

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WP 1: Physical Parameter Estimates from Photometric SEDs

Aim of the WP

The goal of this WP is to contrast different methodologies for SED estimation and provide inputs to OU-PHZ and work with them on implementing the algorithm(s) deemed best.The WP should be tightly linked to OU-PHZ.

Members

Please enter your name below if you are interested in joining this WP:

- Olivier Ilbert
- Pascale Jablonka
- Lucia Pozzetti
- Thierry Contini
- Mara Salvato
- Gabriella De Lucia
- Fabio Fontanot
- Elena Zucca
- Jarle Brinchmann
- Olga Cucciati
- Micol Bolzonella
- Stéphane Paltani
- Stéphane Charlot
- Francisco Castander
- Emanuele Daddi
- Stéphanie Juneau
- Peter Capak
- Daniel Thomas
- Hervé Aussel
- Bianca Garilli
- Marco Scodeggio

Scientific questions

- Scaling laws: can theory and observations be reconciled ?
- Morphology: can we trace back the genesis of Sp/E ? Role of mergers ?
- Environment: how galaxy evolution is affected by environment effects ?
- Cosmic SFR history: what caused the rapid decline of the cosmic SFR history since z~1-2 ?
- Black holes: which process connects the growth of black holes and stars in order to end up with $M_{BH} \sim M_{bulge}/1000$?
- Mass function: models predict an overabundance of moderately massive galaxies as compared to observations, is this also true at high z ?

The scientific power of Euclid for the study of the cosmic evolution of galaxies and AGN

* VIS spatial resolution → morphology, mergers, dynamical instabilities (0.16")
* NIR spectroscopy → Hα, Hβ : SFR, dust extinction
  → [OIII]/Hβ vs [NII]/Hα : AGN
  → [OII], [OIII], Hβ : metallicities (R_{23})
* deep NIR imaging → Stellar masses
* wide fields → 2 pt correlation fct : DM halo masses
* → 3D density, environment (field, groups, clusters)
* → rare objects :
  - luminous SF objects statistics x 100 vs JWST
  - >4x10^{11} Msun at z>1.8 (1gal./sq.deg !!!)
* depth (L*-2 mag @ z<2) → large dynamics on luminosity function
* → assembly of red sequence up to z~2 (instead of 1)

Scaling laws
can theory and observations be reconciled ?

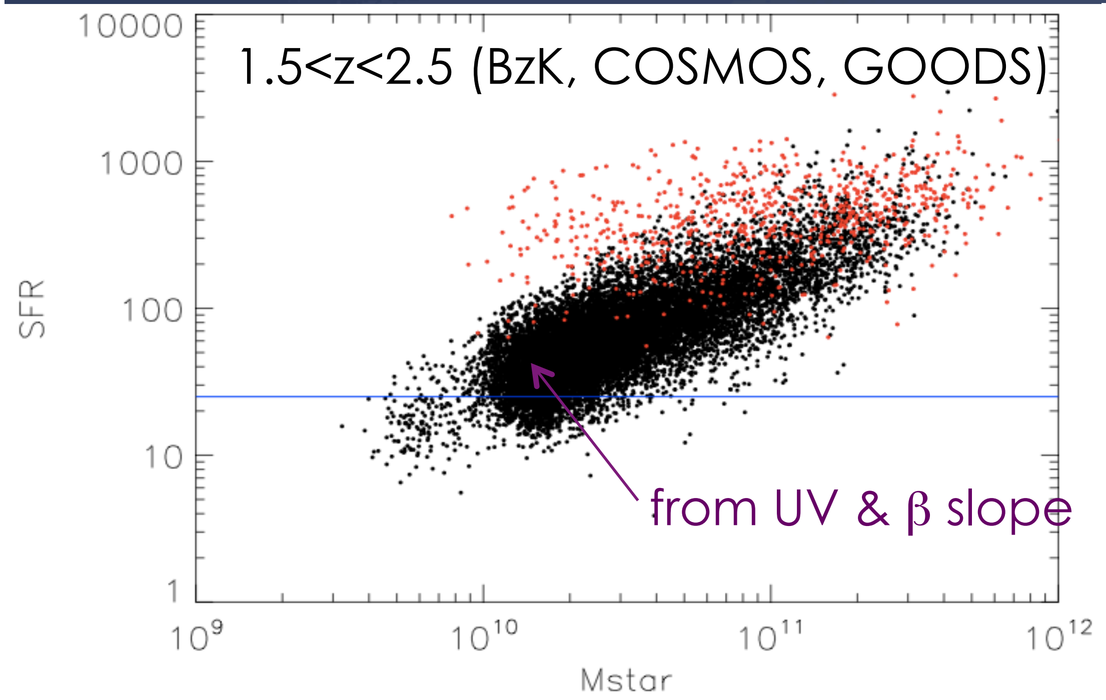
Slope, width, normalization, redshift evolution of SFR – M* relation depend on its origin, role of feedback (e.g. larger width at low masses for SN).

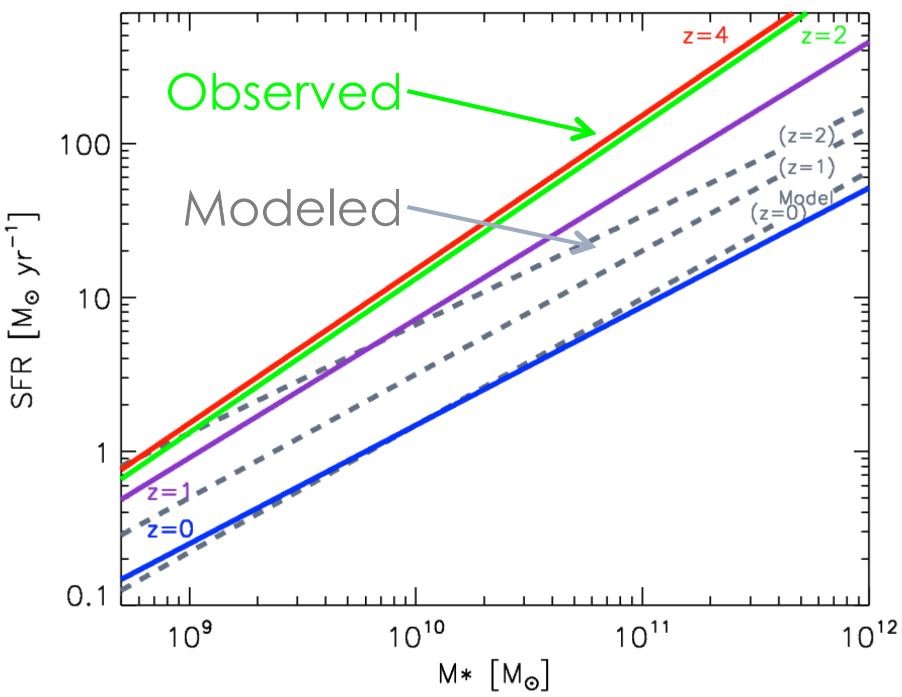
+ 3rd dimension: metallicity (FMR= fundamental mass relation)

SFR corrected for extinction (Hα, Hβ) for 300 000 galaxies 1.06<z<2.05 (SFR>20 $M_\odot yr^{-1}$)

and metallicities from R_{23} index ([OII], [OIII], Hβ) for 80 000 galaxies within 1.68 < z < 2.05 (peak of SFR density) with SFR>25 $M_\odot yr^{-1}$ vs SDSS 100 000 at z~0.1

$$R_{23} = \frac{F([\mathrm{OII}]\lambda 3727) + F([\mathrm{OIII}]\lambda 4959) + F([\mathrm{OIII}]\lambda 5007)}{F(\mathrm{H}\beta\lambda 4861)}$$

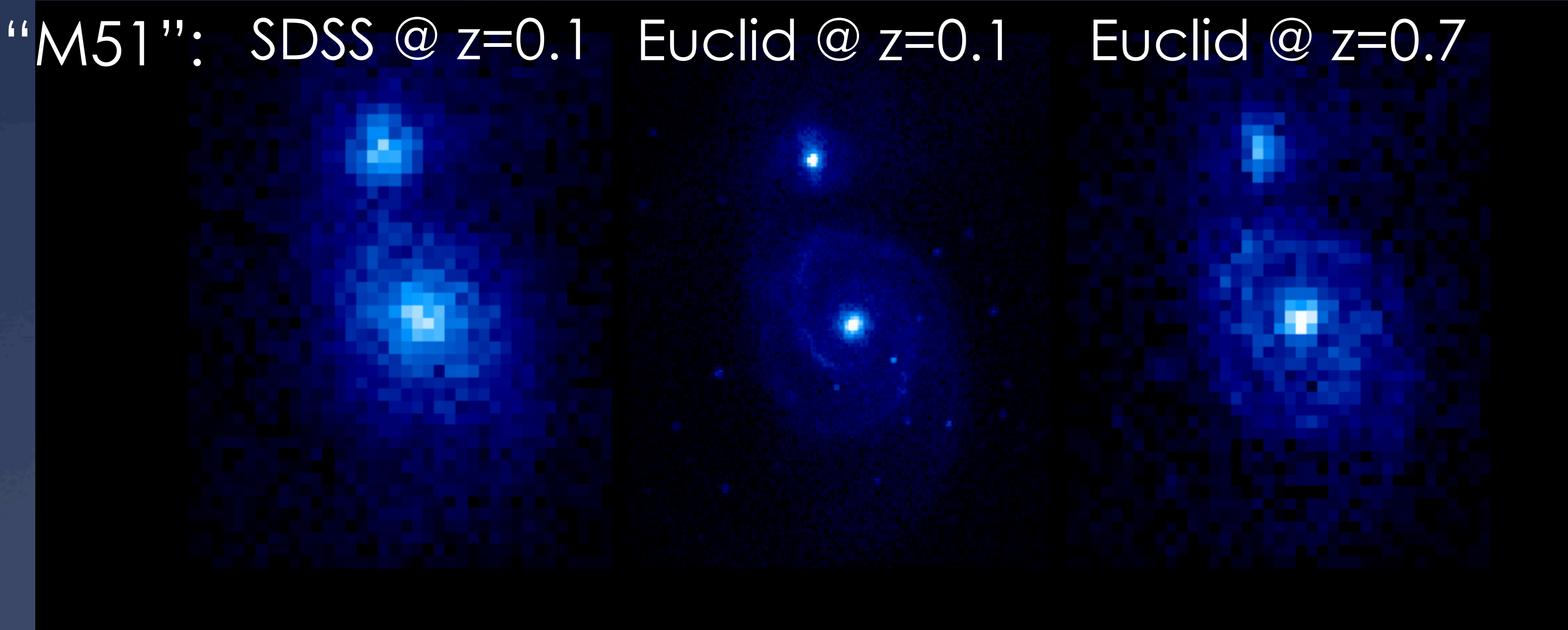




Morphologies for **2 billion galaxies**

High quality imaging : FWHM~0.16" → **1.3 kpc resolution** at ~all z

Euclid will resolve 1/3 of the ½-light radius of a 5×10^{10} $M_\odot$ galaxy at z~2 (3-4 kpc) (> 5-10 times better than groundbased)



Euclid images of z~1 galaxies will have the same resolution as SDSS images at z~0.05 and be at least 3 magnitudes deeper.

→ role of mergers vs cold-flow induced dynamical instabilities vs non-disturbed morphologies

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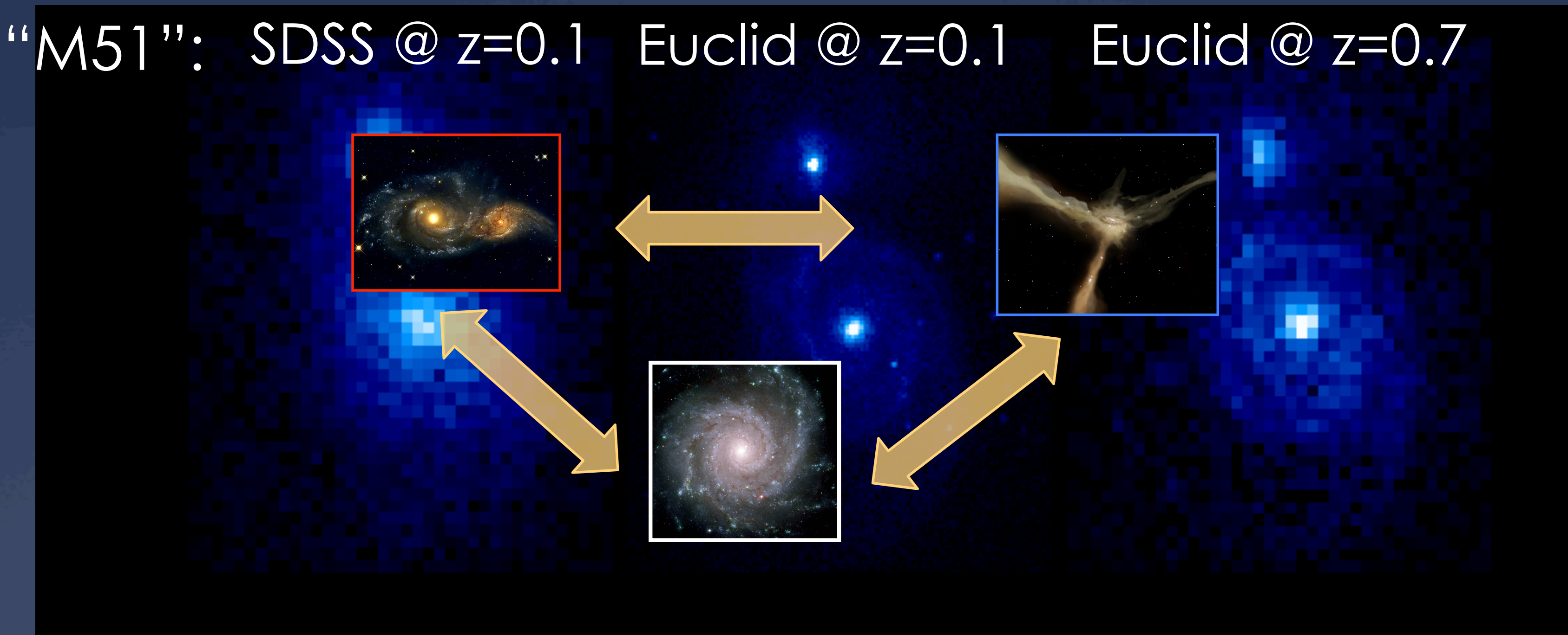

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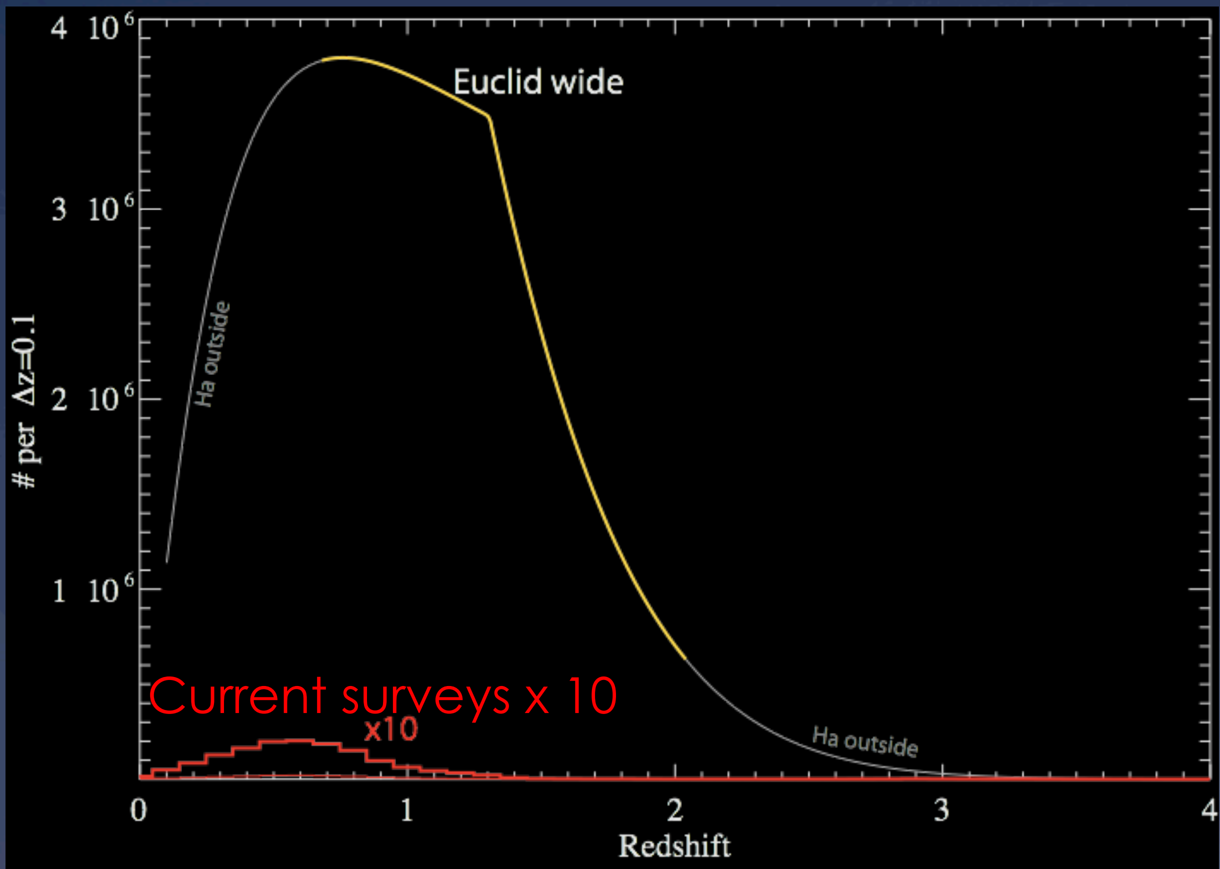
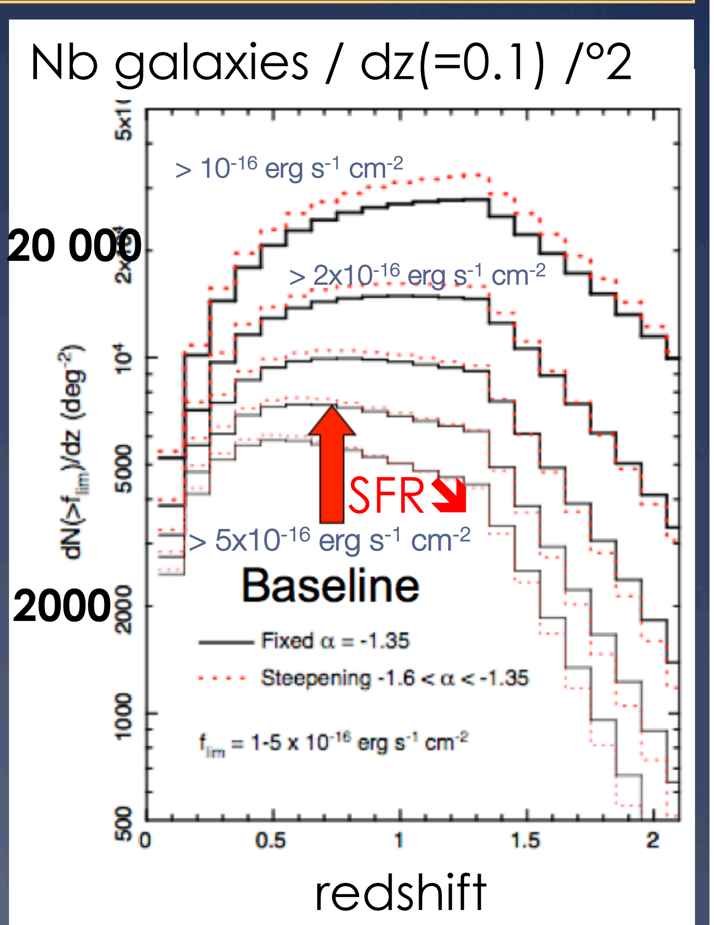
Environment : Slitless spectroscopy

relative roles of (**SFR, M*, environment) in galaxy mass assembly**

50 million redshifts (completeness >45%)
> 3×10^{-16} erg s^{-1} cm^{-2}

~10^6 per Δz=0.1 in z spectroscopic
(>10^7 with phot-z's)
>> SDSS : ~10^6 spectra **in total**
→ Euclid= 1 SDSS / Δz=0.1





narrow bins of mass, type, SFR and environment
→ main mechanisms of galaxy mass assembly

Euclid in context

SFR History

∗ 3D-HST: 248 orbits of HST grism over 600 sq.arcmin, PSF FWHM 0.13"
on well studied "CANDELS" fields (GOODS-S, UDS, EGS, COSMOS)
→10 000 redshifts at $z>1$, SFR>1.5 $M_\odot yr^{-1}$ at $z=1$ and 15 $M_\odot yr^{-1}$ at $z=2$

→JWST/NIRSPEC will increase the depth but on known targets !

vs Euclid: 300 000 galaxies $1.06<z<2.05$ (SFR>20 $M_\odot yr^{-1}$) in DEEP and 1 million in WIDE → sharpness on Hα LF with 0.4% precision down to 0.1L* at $z=1.5$ (faint end slope and SFR density with precision <1% !)
⇒ will allow us to constrain the multi-parameter physics causing the redshift evolution, unique access to the way SFR change with mass and redshift

Morphology

∗ HST: few hundred galaxies at $z>1$
vs Euclid
x 10 000 for galaxies with a z_{spec} !
x 500 000 for galaxies with a z_{phot} !
⇒ ability to measure merger rate up to z~6 instead of z~1
⇒ + merger / AGN connection

AGN

⇒BPT AGN selection [OIII]/Hβ vs [NII]/Hα) for bright enough galaxies where the separation of [NII] vs Hα is feasible ($F(H\alpha)>10^{-15}$ $erg.s^{-1}cm^{-2}$) else MEx (Juneau +11)

Euclid legacy in numbers

What	Euclid	Before Euclid
Galaxies at 1<z<3 with good mass estimates	$\sim 2 \times 10^8$	$\sim 5 \times 10^6$
Massive galaxies (1<z<3) w/ spectra	~few x 10^3	~few tens
Hα emitters/metal abundance in z~2-3	$\sim 4 \times 10^7 / 10^4$	$\sim 10^4 / \sim 10^2$?
Galaxies in massive clusters at z>1	$\sim 2 \times 10^4$	$\sim 10^3$?
Type 2 AGN (0.7<z<2)	$\sim 10^4$	$< 10^3$
Dwarf galaxies	$\sim 10^5$	
T_{eff} ~400K Y dwarfs	~few 10^2	<10
Strongly lensed galaxy-scale lenses	~300,000	~10-100
z > 8 QSOs	~30	None