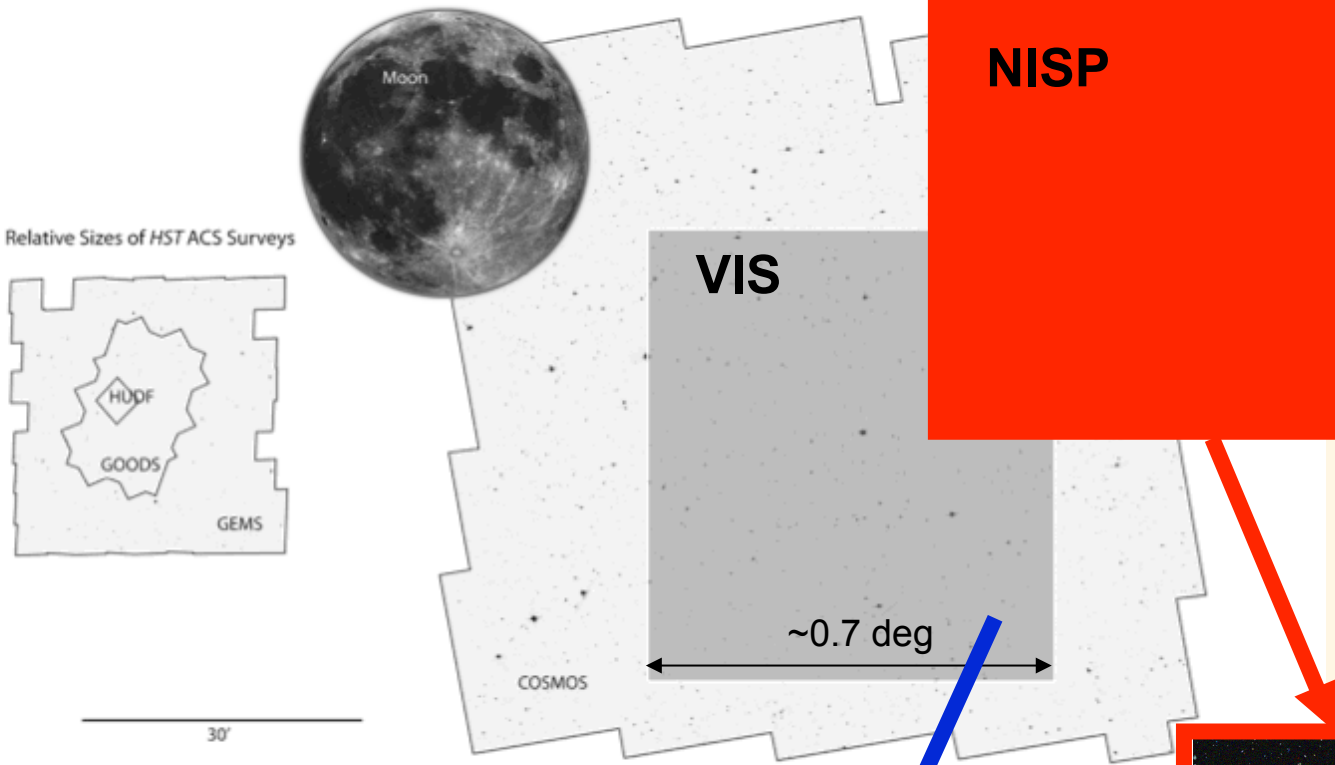
Euclid SWG-GA

Legacy Science on Galaxy & AGN evolution

WP	Lead	Country
1 Phys.param. from SEDs	Lucia Pozzetti	I
2 Phys.param. from spectra	Giovanni Cresci	I
3 Environment	Manuela Magliocchetti	I
4 Morphology	Pierre-Alain Duc / Chris Conselice	F UK
5 Passive galaxies	Andrea Cimatti	I
6 Theoretical models	Gabriela de Lucia	I
7 Lensing	Steve Serjeant	UK
8 Multi-band synergies	Hervé Aussel	F
9 AGNs	Stéphanie Juneau	F
10 High-z (2<z<7)	Emanuele Daddi	F
11 Distrib. funct.	Elena Zucca	I

Coordinators:
Jarle Brinchmann,
Andrea Cimatti,
David Elbaz

2 pilars of SWG-GA: morphology & spectral information



z, L, M*, SFR

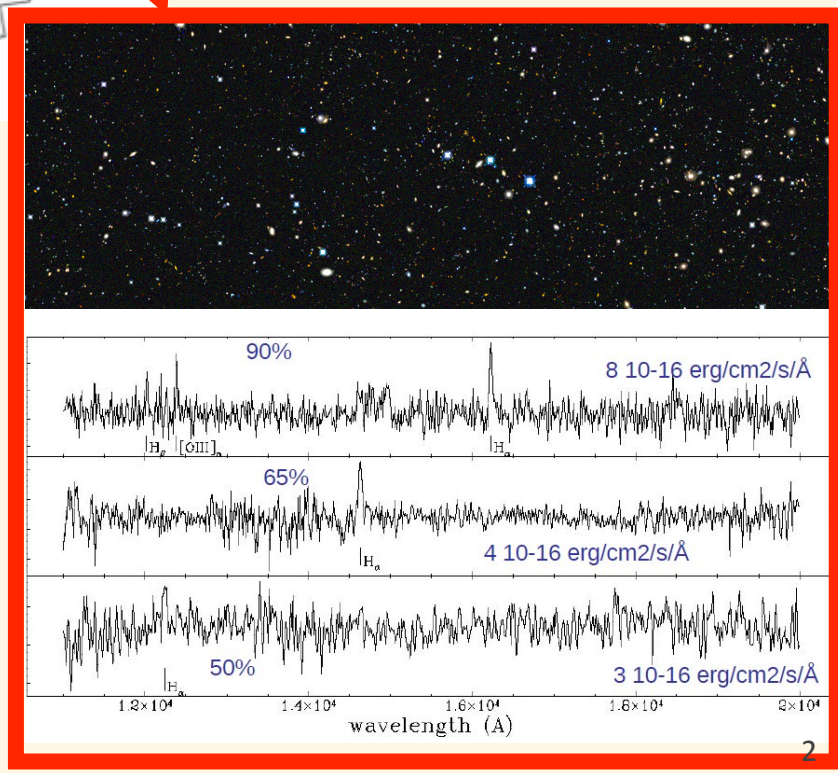
↑

Y, J, H **imaging**, 0.3" pix, AB=24

Slitless **spectroscopy**

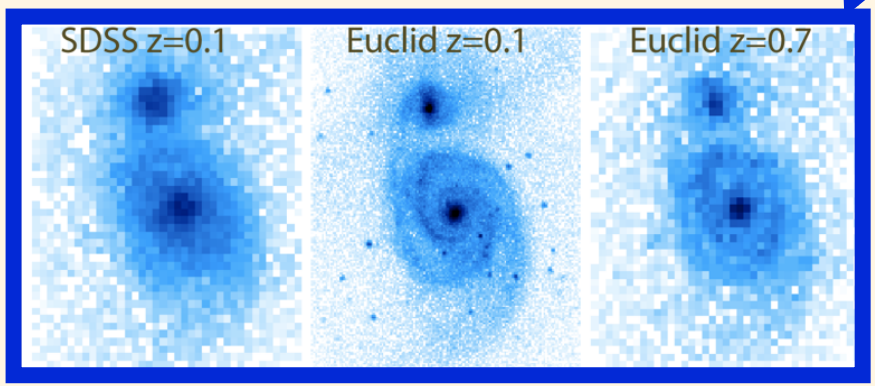
1.1 – 2 μm, R~300

$F>3x10^{-16}$ ergs cm^{-2} s^{-1}, $H_{AB}<19.5$



High-resolution imaging (0.1" pixel)

RIZ filter (0.55-0.92 μm), AB=24.5



SDSS -1.5 Gyr

Euclid -6.5 Gyr

Challenge :
Favor the scientific objectives where Euclid is unique

- morphologies of millions of galaxies
  → **"morphogenesis" vs quenching of star-formation**
  → **AGN hosts**
  → **role of environment**
  → **origin of thin disks (vs flat disks predicted by theory),…**

- universal relationships, "scaling laws" have been found for galaxies: **fundamental plane, SFR-M* main sequence, Schmidt-Kennicutt relation, mass – metallicity relation**
  effects of AGNs, environment, mergers appear as second order effects with respect to "mass"
  → **large statistics only can allow one to study 2nd order effects**
  → **galaxy-galaxy lensing on M* bins should provide the link to Mhalo !**

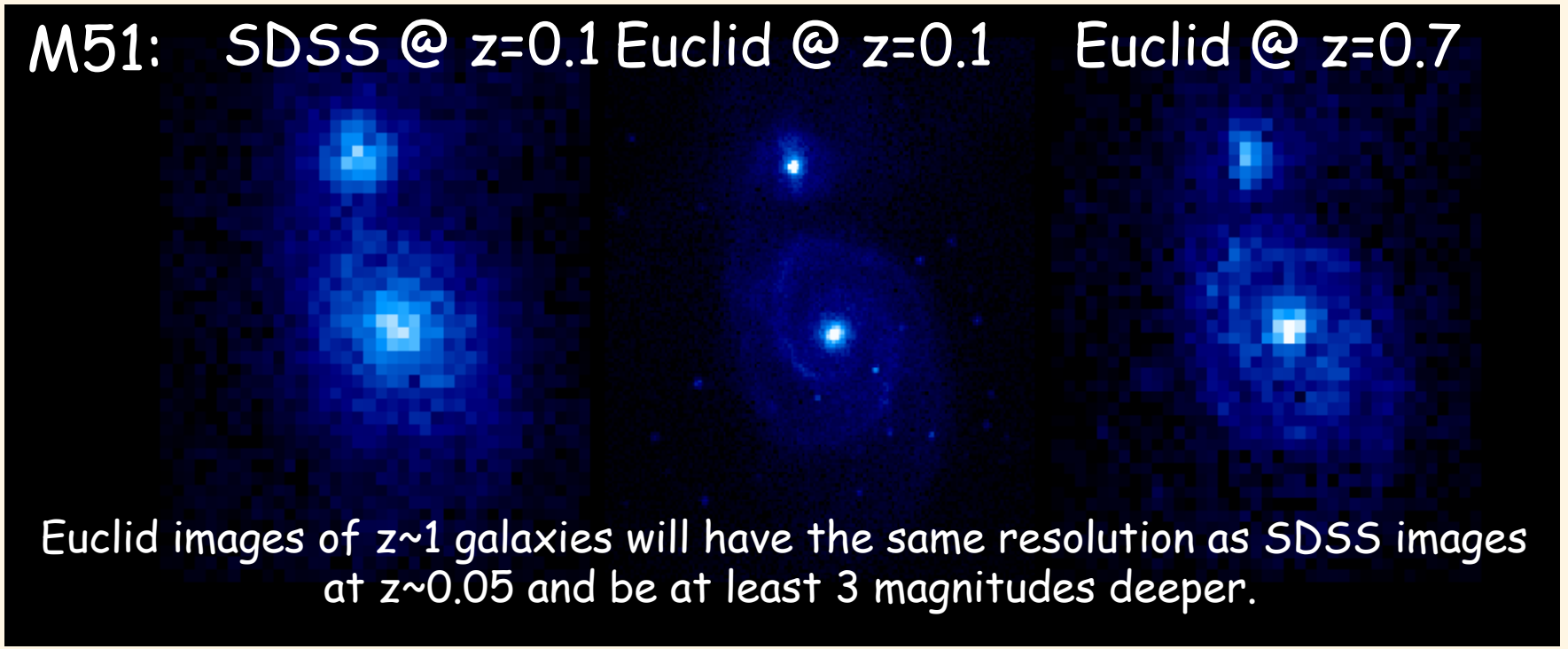
- rare objects : **very high-z galaxies, QSOs, very massive galaxies**

- **low surface brightness** signatures of past merger history, ISM

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)



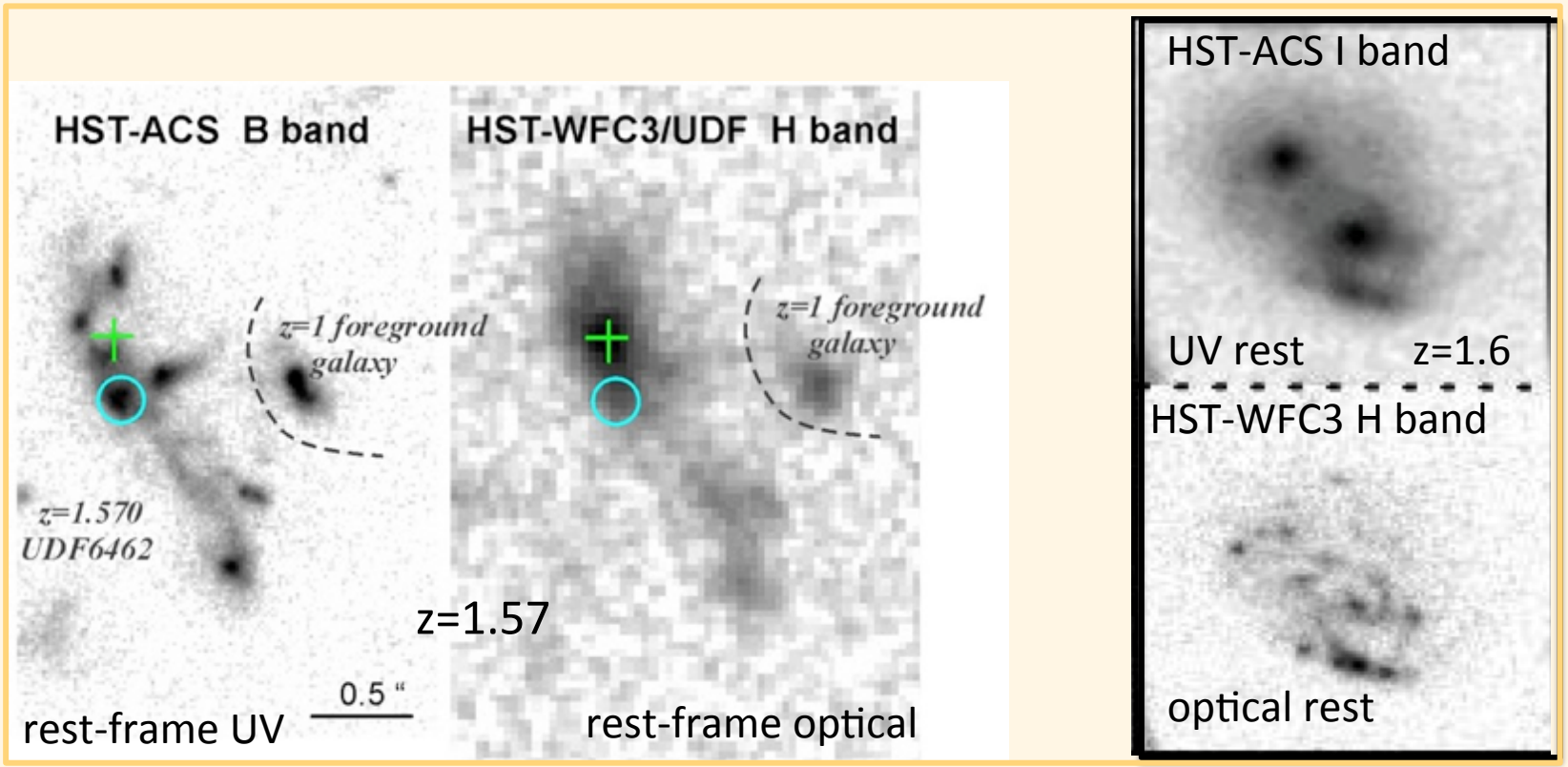
→ Cf talks Lidia Tasca, Marc Huertas-Company, Pierre-Alain Duc

- VIS: one single visual very broad band

What is the impact on morphological classification?

- NIR: several filters, but worse spatial resolution

Will they be useful for distant (z>2) galaxies?



Identifying relevant parameters for morphological classification

- Eye classification à la Galaxy zoo?

  150 000 persons have classified 50 million galaxies

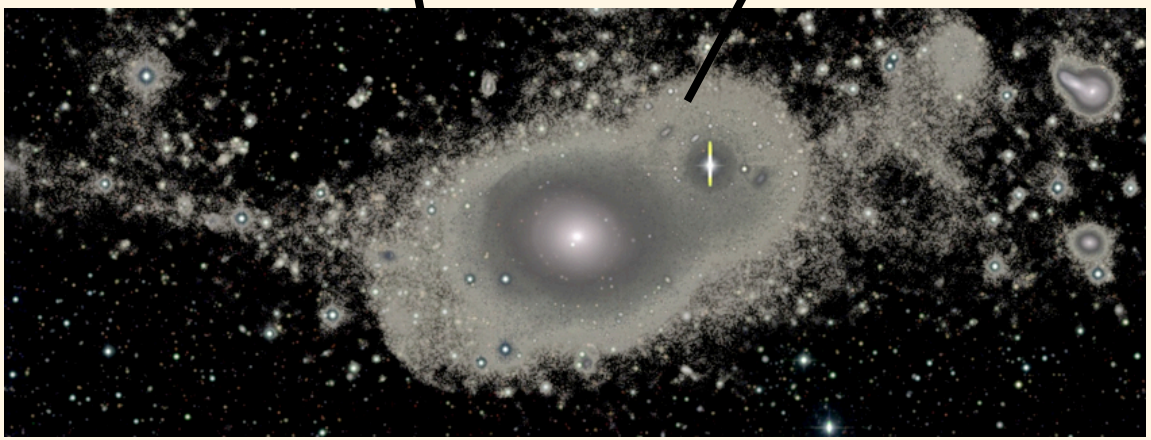
→ Cf talk Marc Huertas-Company: machine learning

SDSS: an E

MegaCam: a spiral!

SDSS: a fully relaxed ETG

MegaCam: a major merger remnant!



MATLAS/Atlas3D survey: Duc et al., 2013

- Classification depends on limiting surface brightness even in the nearby Universe !

What will be the limiting surface brightness of Euclid?

→ Cf talk P.A. DUC

WP9: Active Galactic Nuclei

Coordinator: Stéphanie Juneau (CEA)

AGN identification

→ AGN Database useable by all other WPs

AGN studies:

- AGN triggering/feedback
- AGN obscuration
- BH masses, BH growth budget
- Connection with host galaxies
- Connection with environment

Probe of luminous objects with more sensitivity than current all-sky AGN surveys (+ get host galaxy properties!)

Improved understanding of the Black-Hole – Galaxy connection during the peak epoch of activity (z~2)

→ Cf talk S. Juneau

What is needed

Simulations to test:

- catalog techniques for OU-MER
  → Photometric uncertainty, implication on zphots,…
- morphological classification accuracy
- realistic numbers of galaxies with their accurate SFR

2 methods:

- cosmological simulations
  → complex, difficulty to reproduce SFR, thin disks,…
- emipirical simulations
  → feasible now because of the existence of scaling laws

SFR-M* main sequence, mass – size, mass – metallicity, color and morphological bimodality

EGG: the Empirical Galaxy Generator

generates realistic galaxy catalogs with broadband fluxes, morphologies and clustering
by Corentin Schreiber (paper in prep.)

Based on CANDELS deep fields
+ general galaxy trends

Presently used inside OU-MER as a preliminary tool to make simulations to test catalog techniques
→ Photometric uncertainty, implication on zphots,…

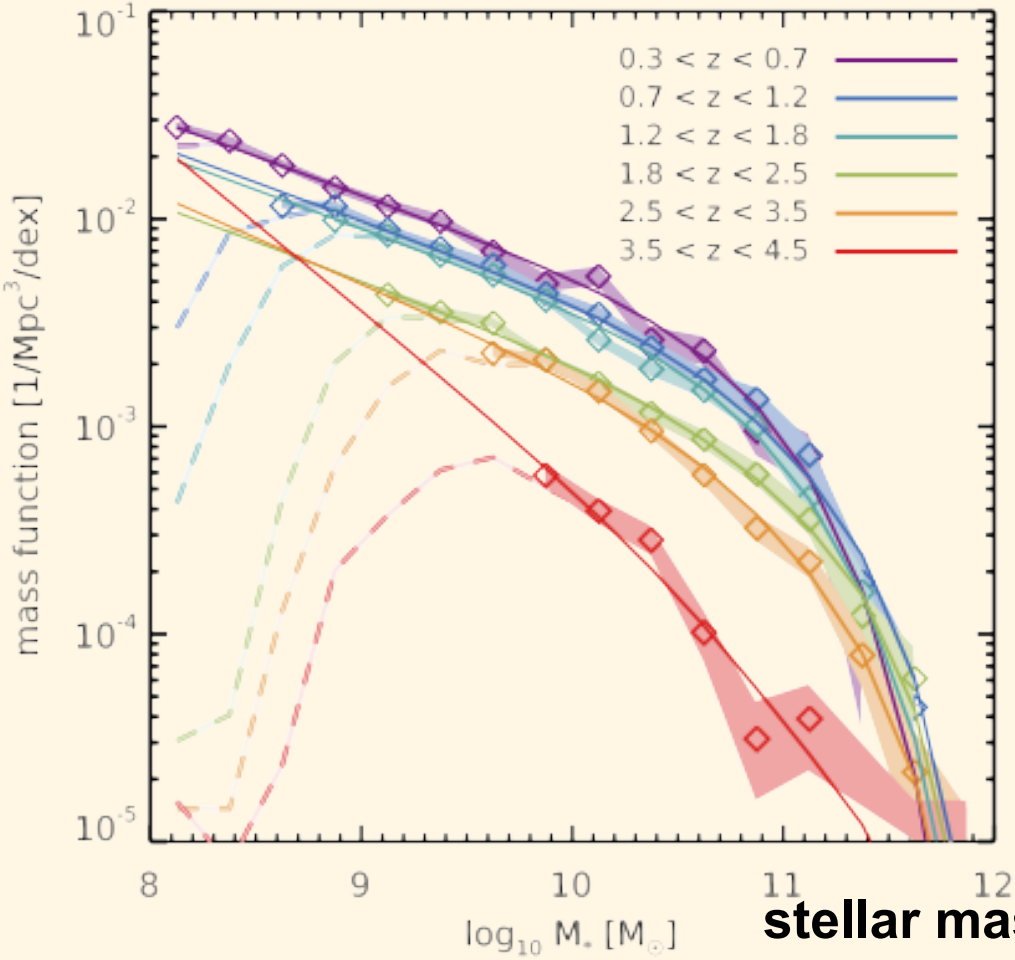
Used by astrodeep EU consortium and OU-MER
to simulate the euclid DEEP survey - here EGG is optimal given that it is calibrated on CANDELS data

EGG: start with realistic M* functions with z
→ calibrated on GOODS-S , tested on COSMOS

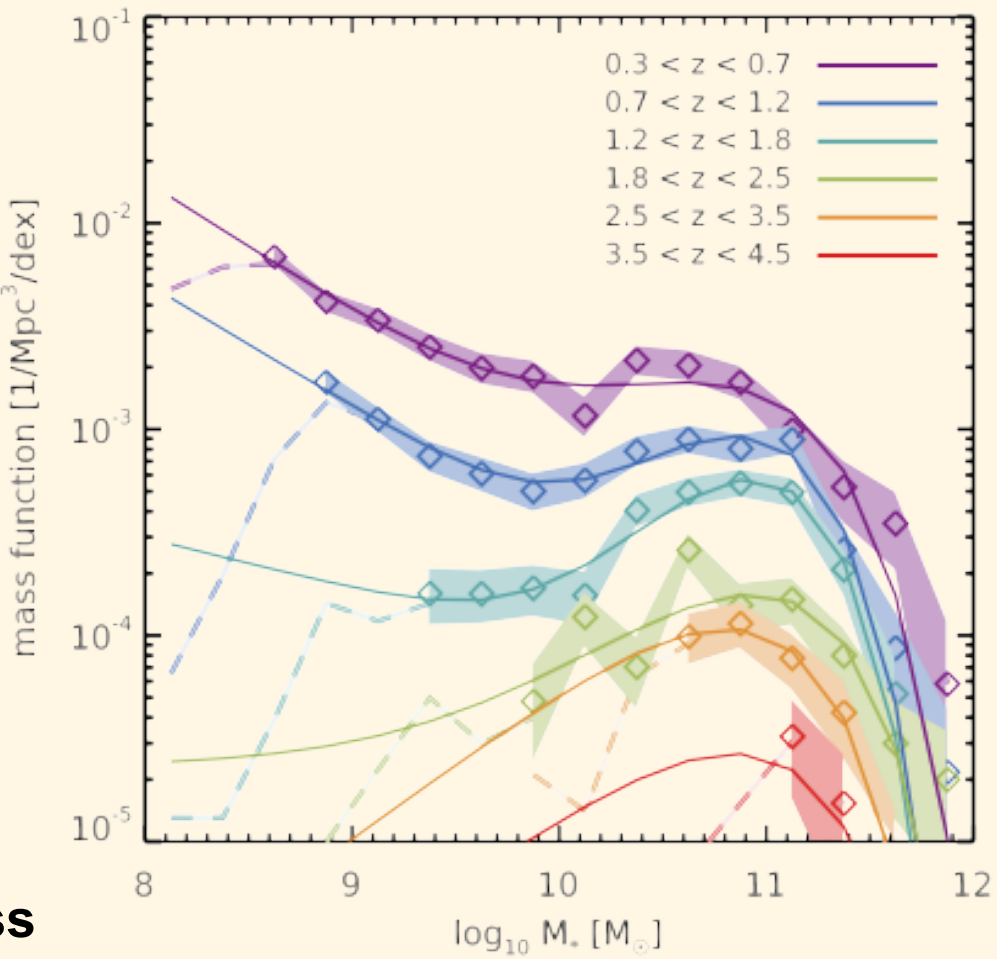
1. Mass functions of SF and passive galaxies
→ Nb galaxies / redshift / M* bin

from CANDELS H-band catalogs (H<26), UVJ separation of SF and quiescent galaxies

Star-forming population



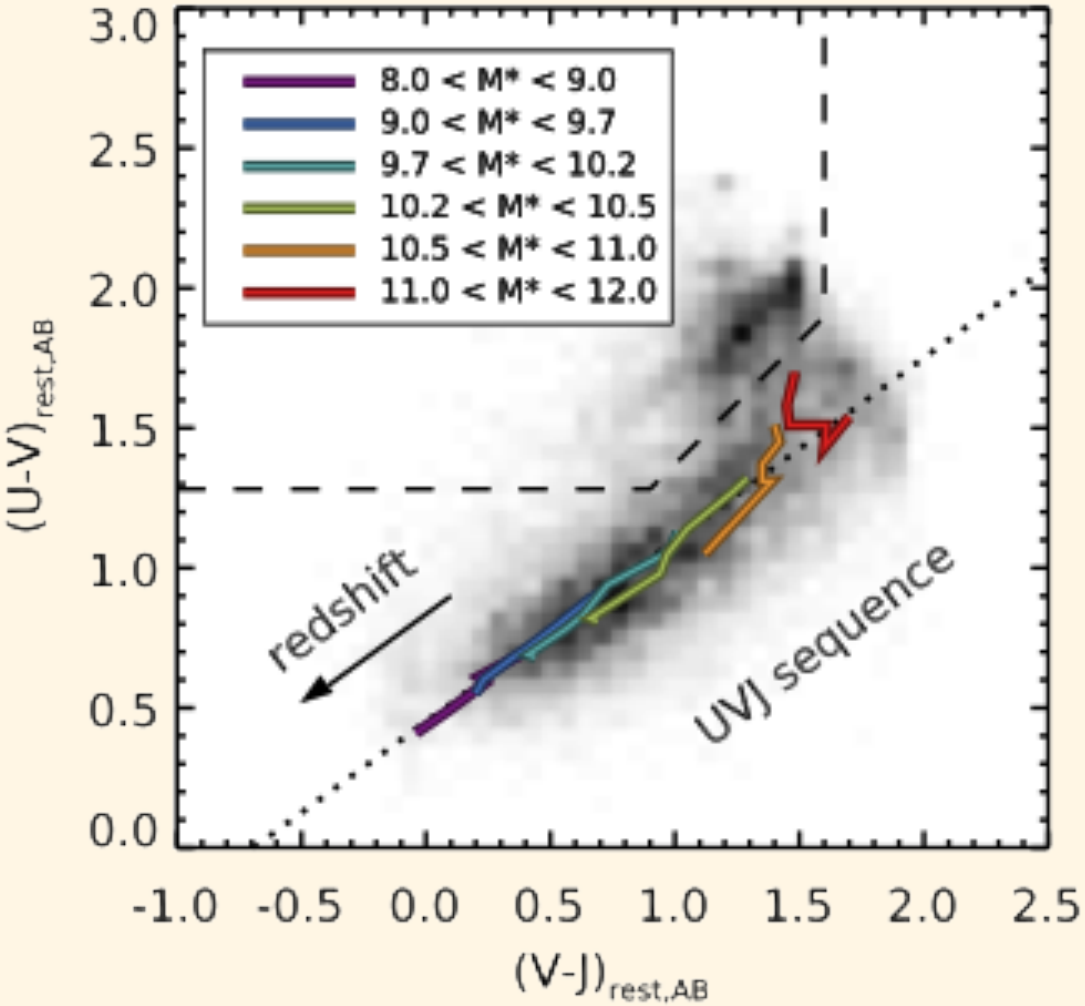
Quiescent population

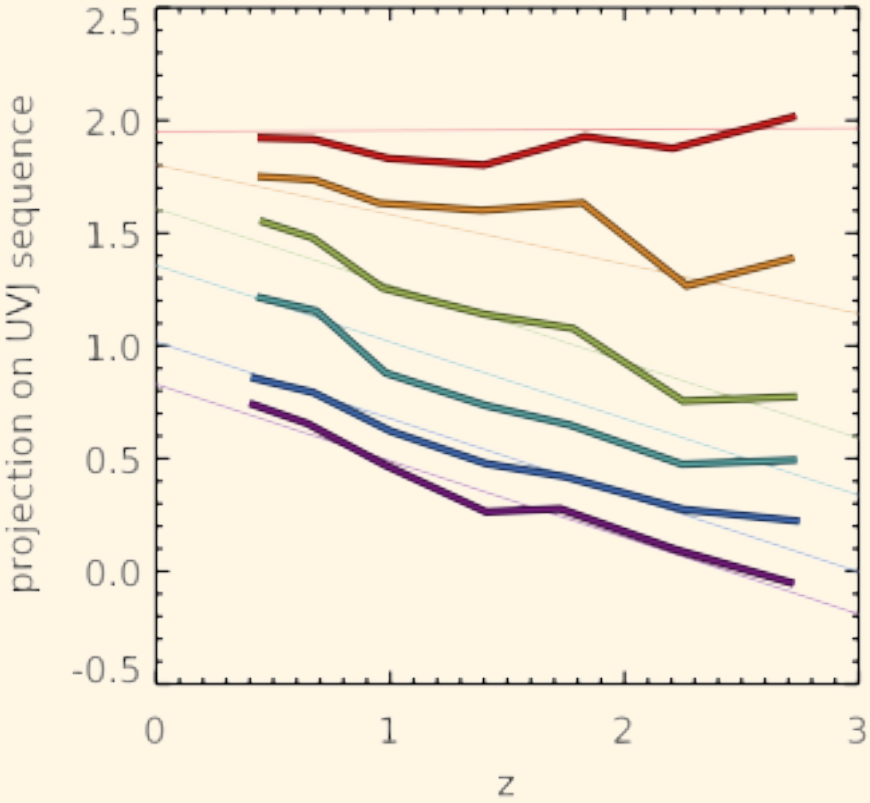


stellar mass

EGG: M*, z → UVJ color → optical – NIR SED

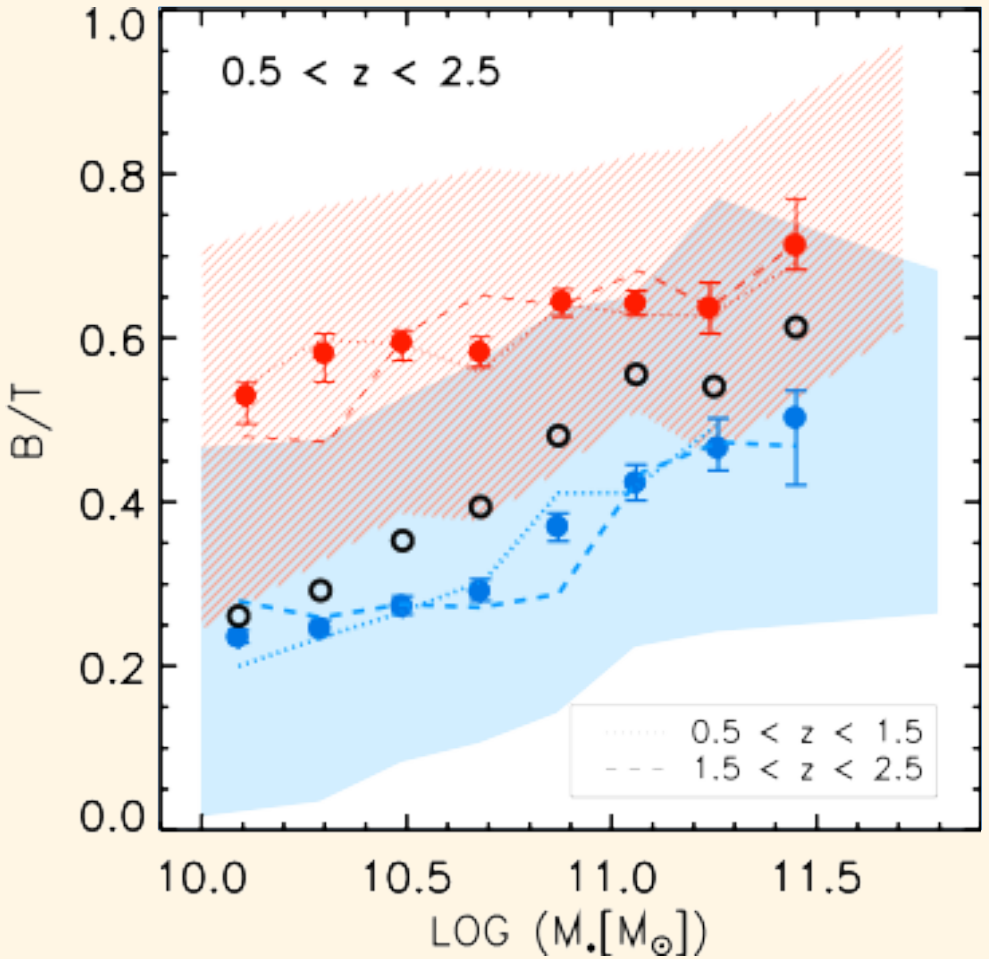
1. Mass functions of SF & passive gals → Nb galaxies/z/M* bin
2. M*, z → UVJ color
   → stacked optical-NIR SED / CANDELS galaxies
   → Fit with Bruzual & Charlot SED





EGG: M*, z, SF/Quiescent → morphology

1. Mass functions of SF & passive gals → Nb galaxies/z/M* bin
2. M*, z → UVJ color → stacked optical-NIR SED
3. Morphology (B/T, size, axis ratio, position angle θ)



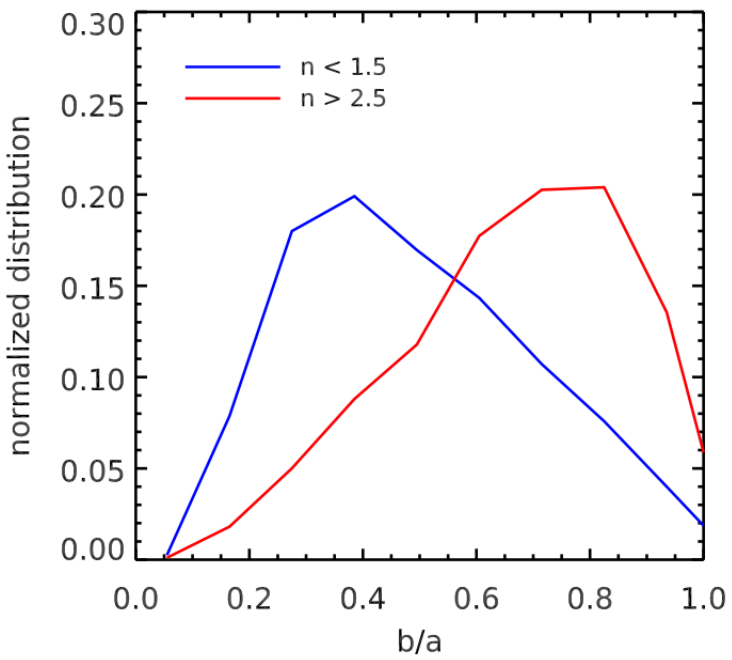
B/T decomposition on HST H<26 assuming:
bulge: n=4 Sersic
disk: n=1 Sersic

UVJ quiescent:
bulge & disk on the red cloud

UVJ star-forming:
disk on blue cloud, bulge red or blue

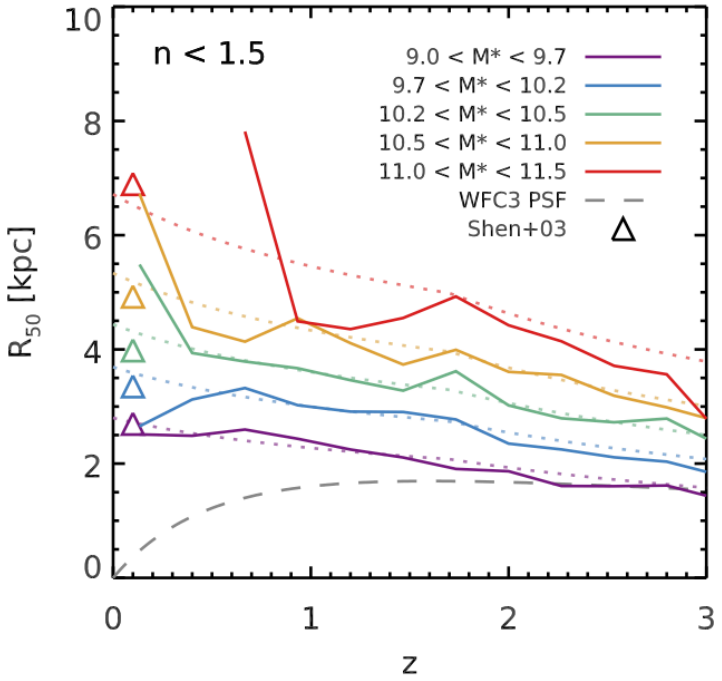
Lang et al. (2014)

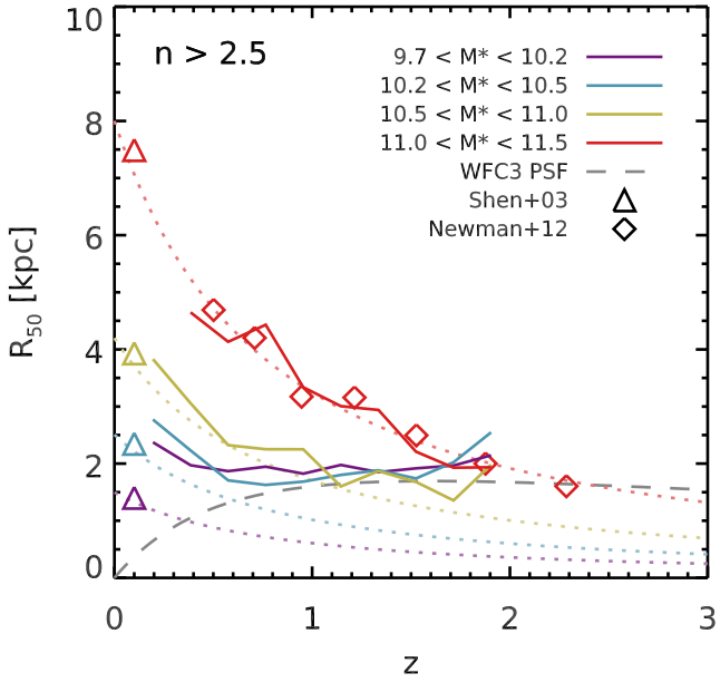
EGG: M*, z, SF/Quiescent → morphology



GOODS-S H<26 galaxies split in n<1.5 and n>2.5 populations for which we measure:

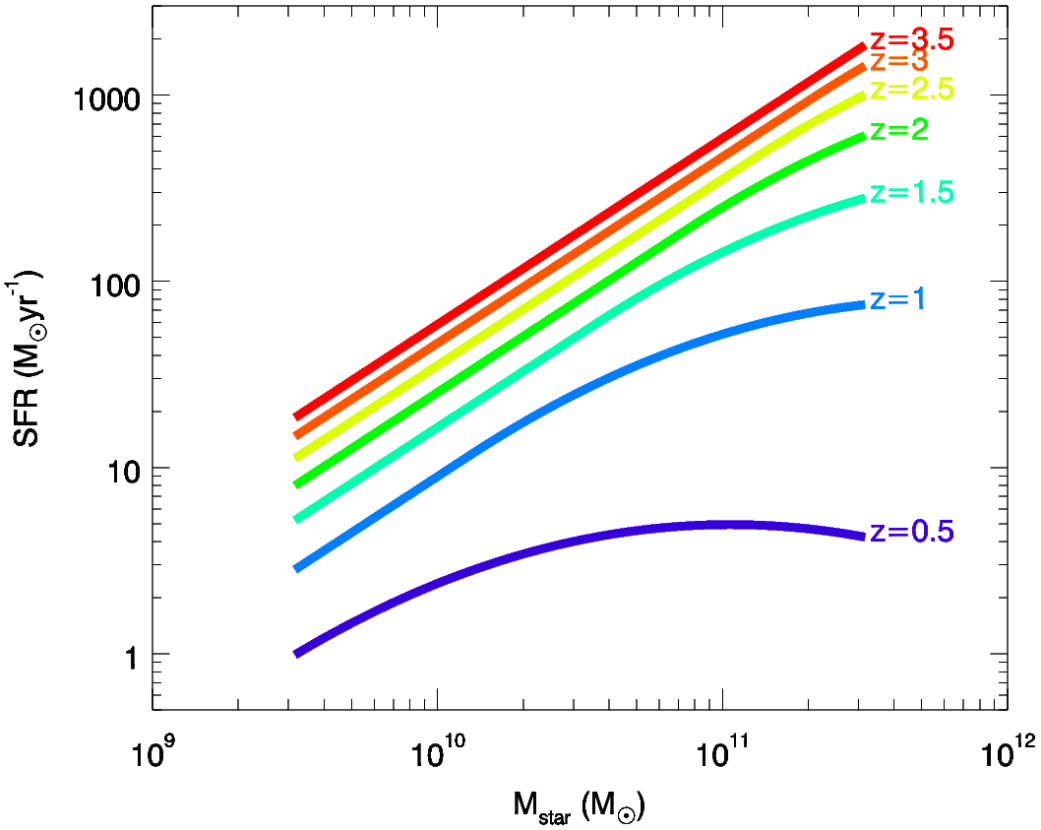
- ½-light radius vs z and M*
- axis ratio (b/a)
- position angle θ random





EGG: M*, z, SF/Quiescent → SFR

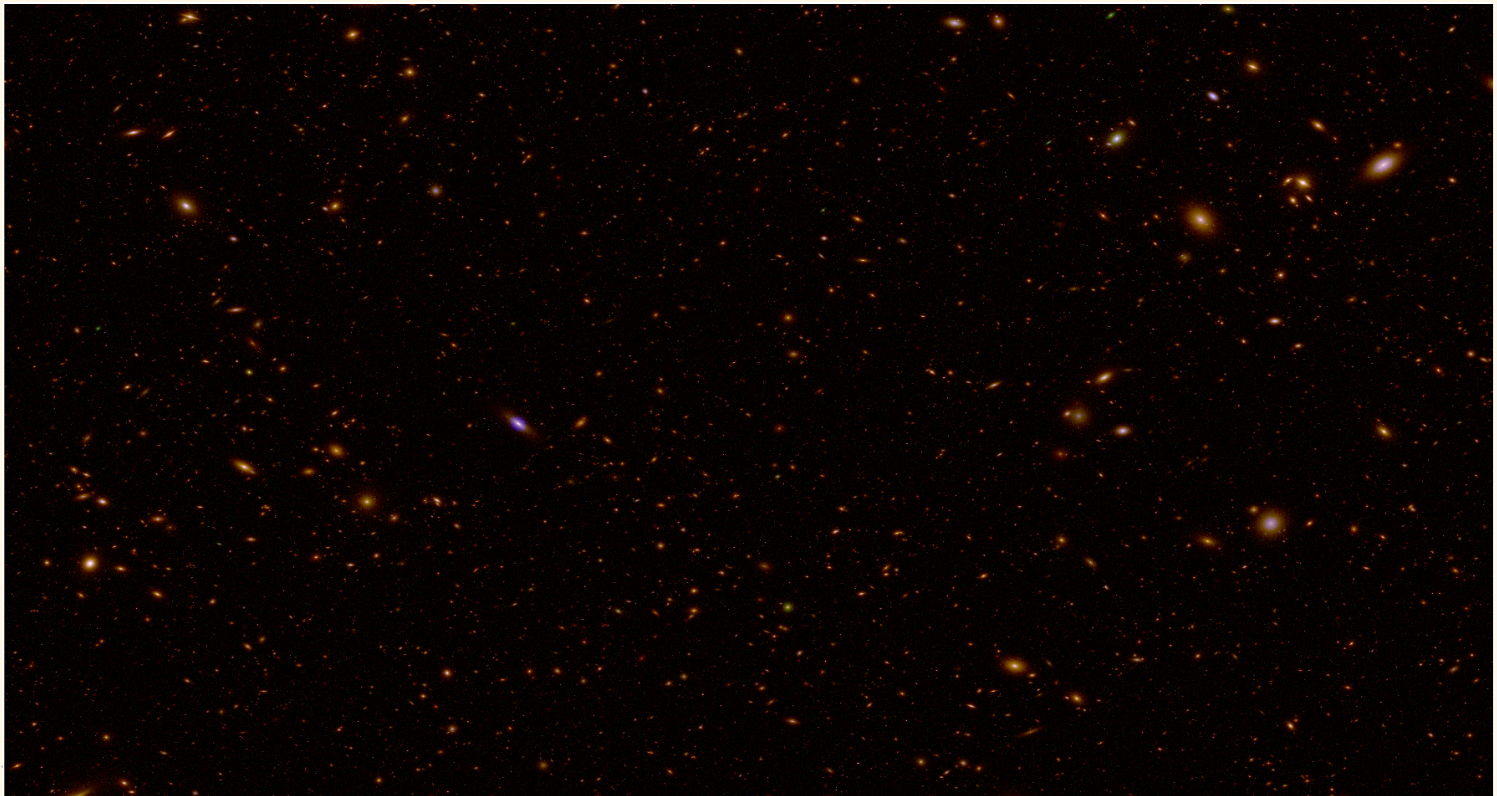
1. Mass functions of SF & passive gals → Nb galaxies/z/ M* bin
2. M*, z → UVJ color → stacked optical-NIR SED
3. Morphology (B/T, size, axis ratio, position angle θ)
4. SFR for M* & z following the SFR-M* relation + starbursts



EGG: M*, z, SF/Quiescent → clustering

1. Mass functions of SF & passive gals → Nb galaxies/z/ M* bin
2. M*, z → UVJ color → stacked optical-NIR SED
3. Morphology (B/T, size, axis ratio, position angle θ)
4. SFR for M* & z following the SFR-M* relation + starbursts
5. **Clustering:**

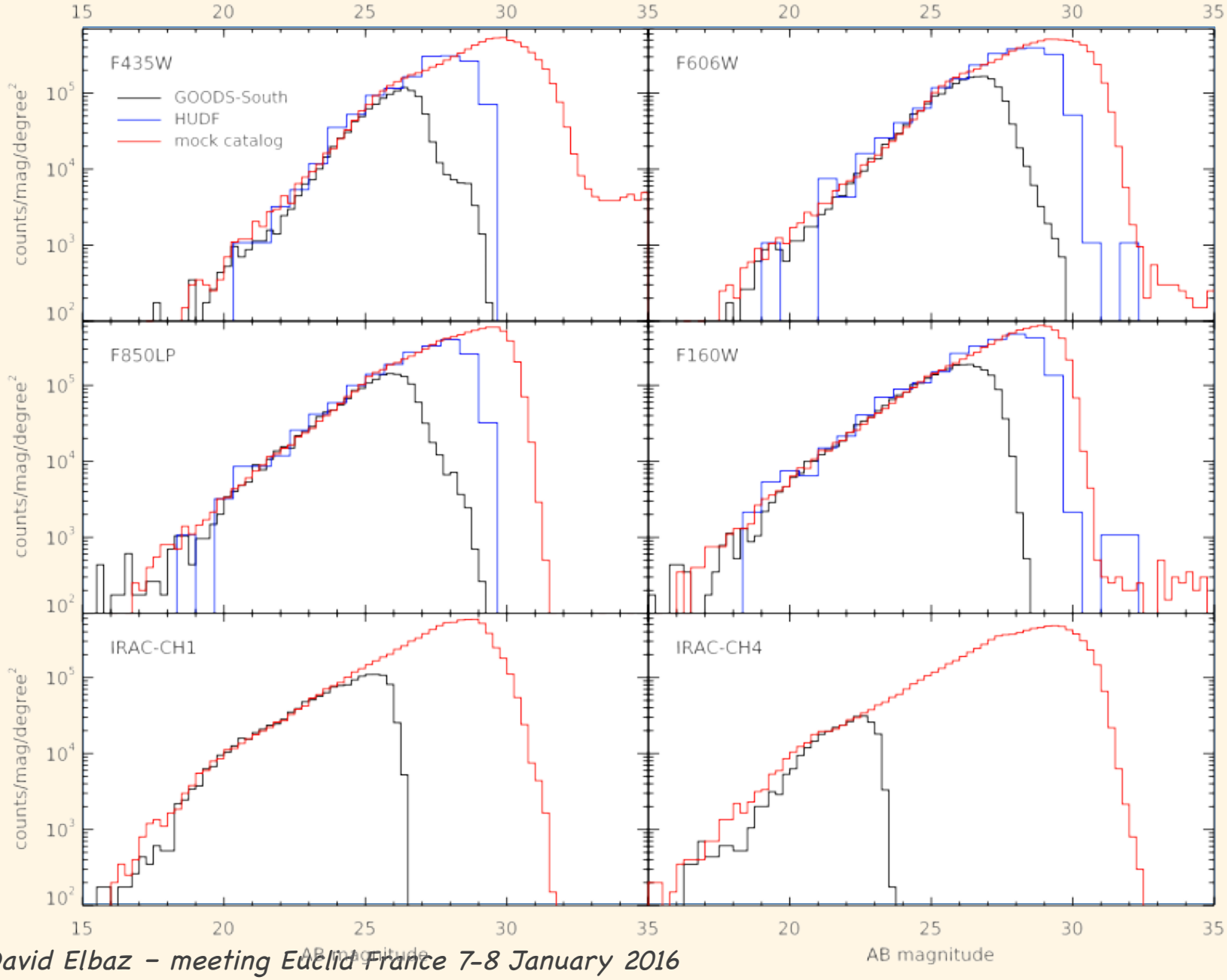
angular 2 point correlation function measured on galaxies in 2 M* & 0.25(1+z) bins
Soneira & Peebles (1978) algorithm → positions consistent with observed



Blue: F435W
Green: F850LP
Red: F160W

Resulting number counts from B to IRAC

compared to GOODS-South & HUDF



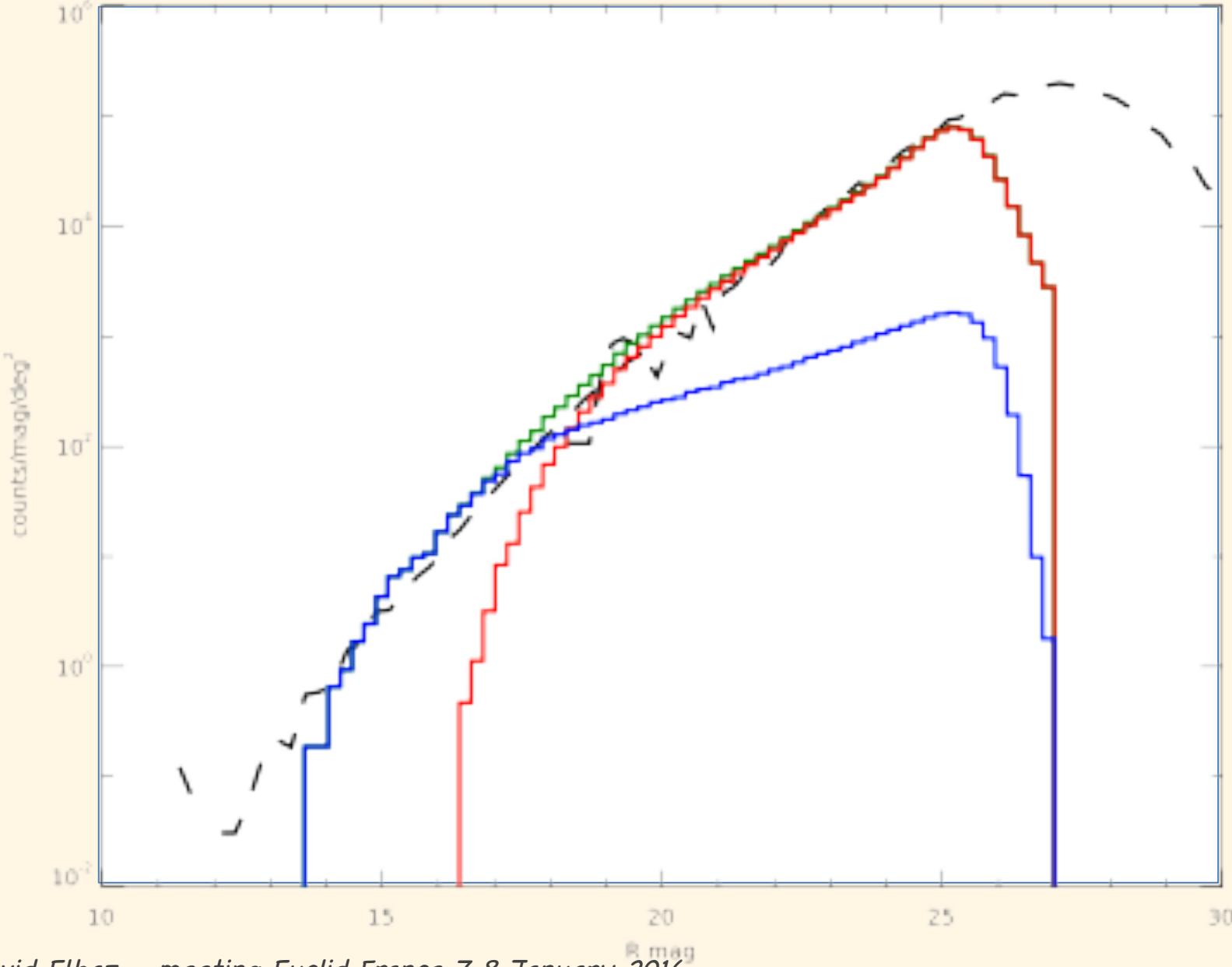
GOODS-S

HUDF

simulation

Resulting number counts from B to IRAC

compared to GOODS-South (faint end) + GAMA/SDSS (bright end)



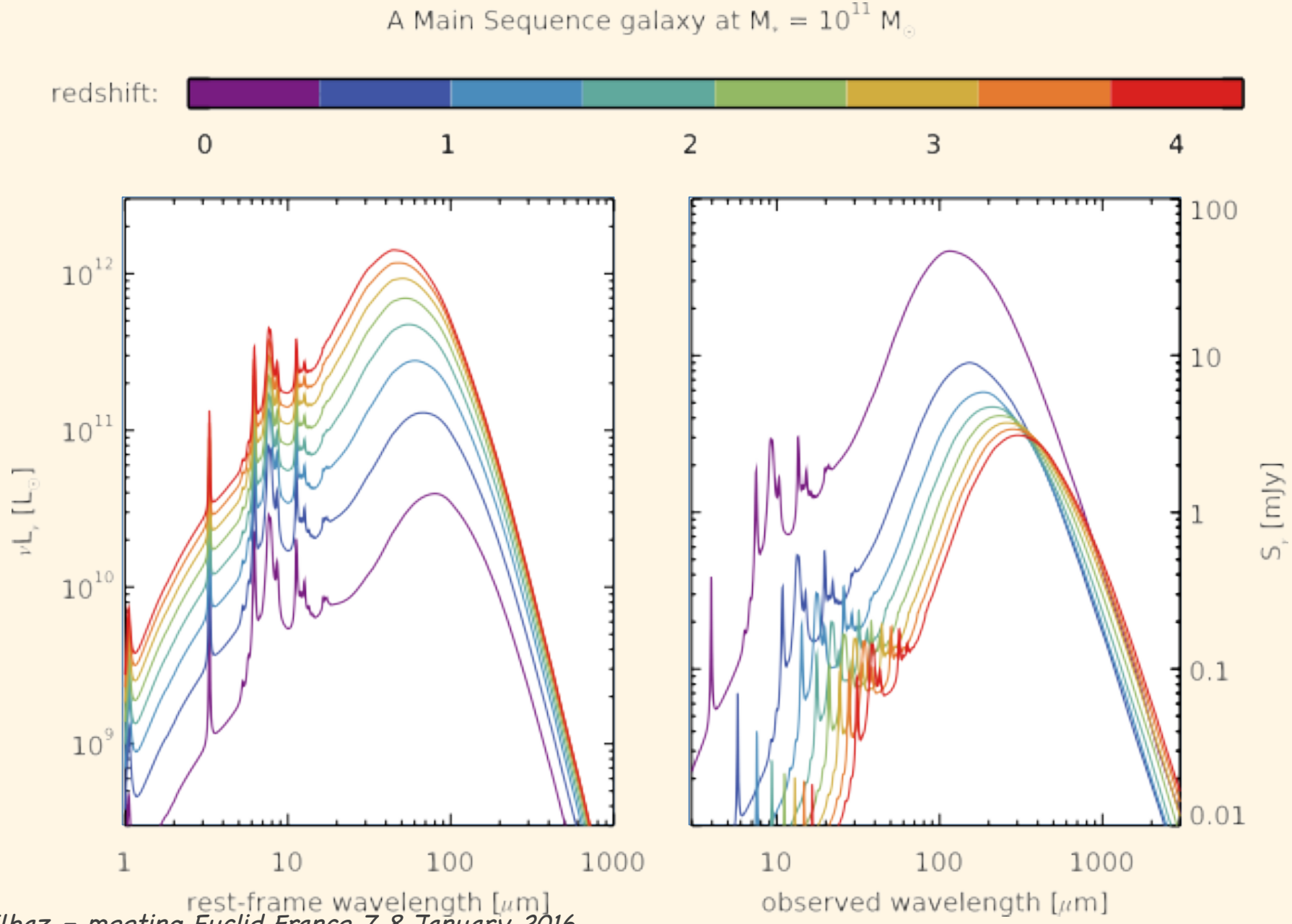
GOODS+GAMA

simulation (z>0.2)

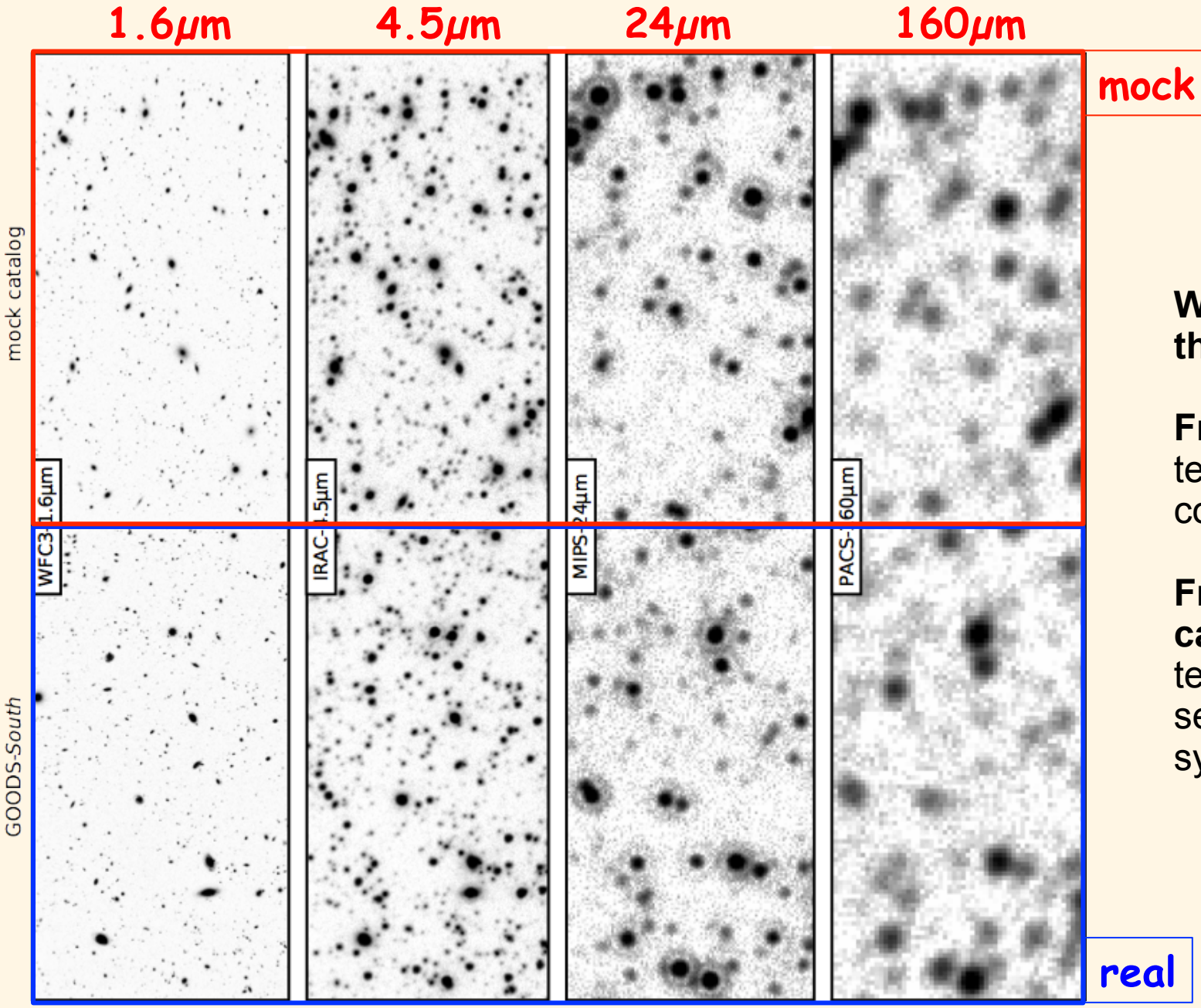
simulation (z<0.2)

Plugging dust emission

using stacks of Herschel & Spitzer images in CANDELS (Schreiber + 2015)



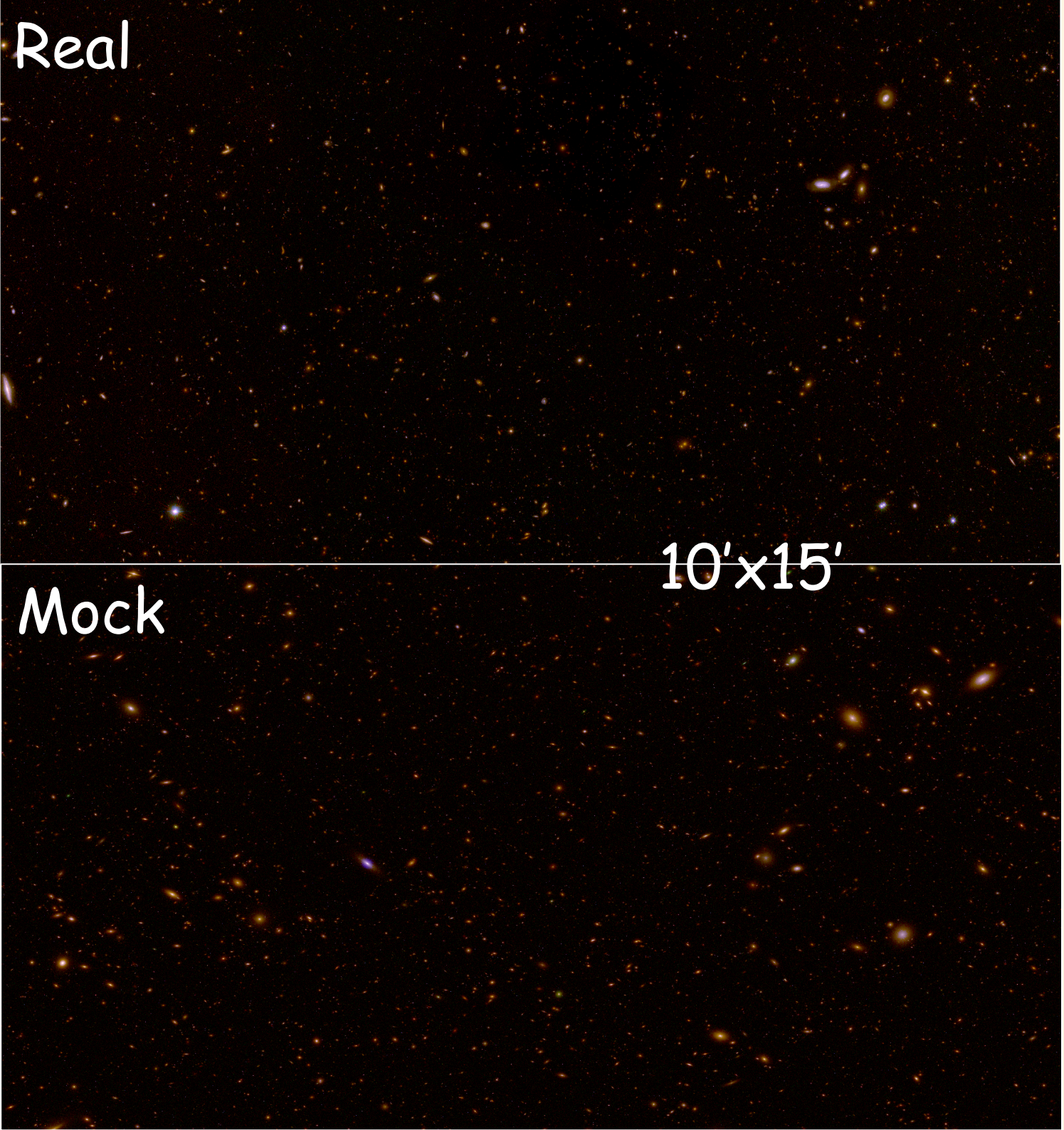
Simulated GOODS-S images



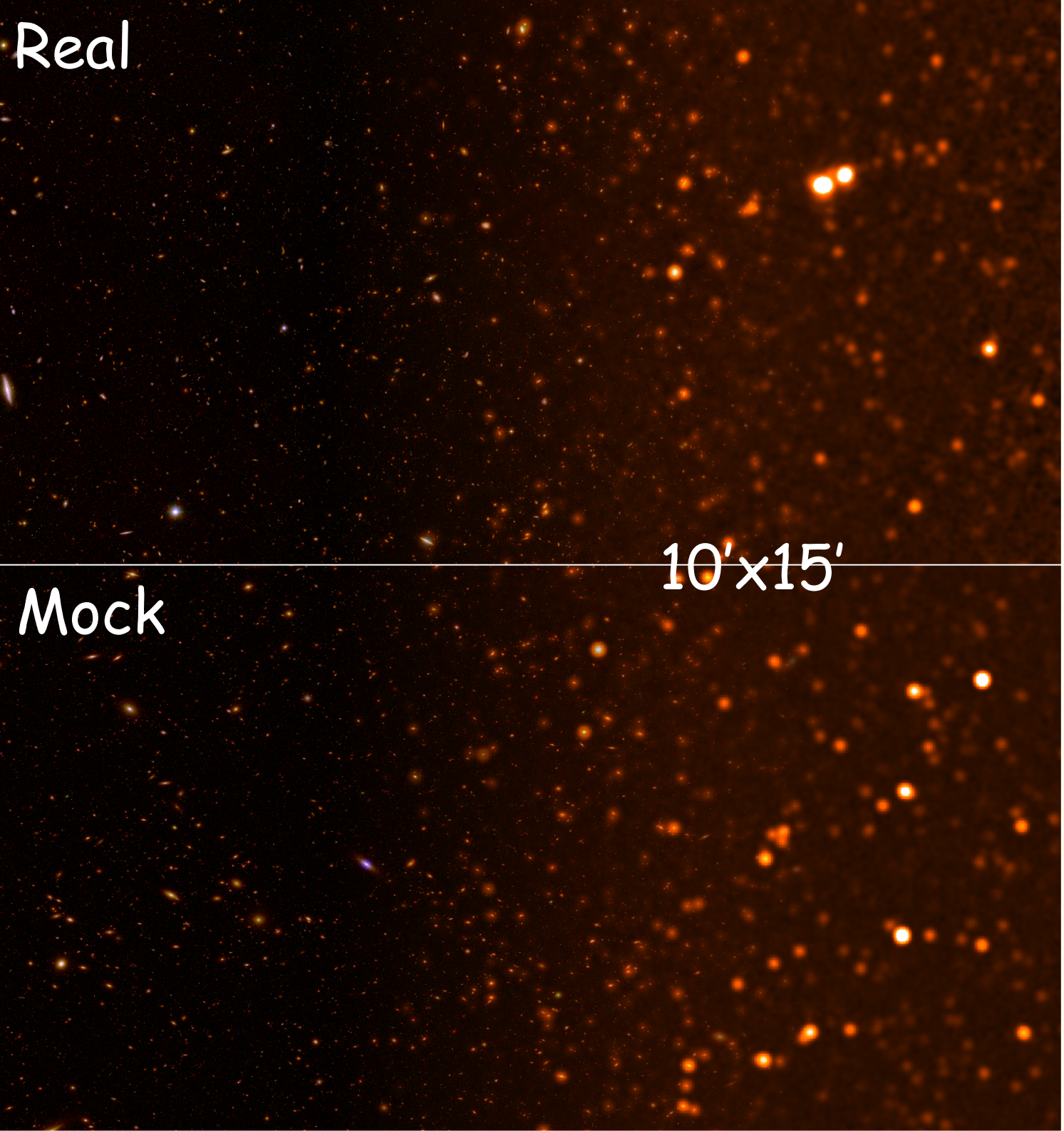
What can you do with these simulations?

From images:
test source extraction codes.

From extracted catalogs:
test photo-z codes, search and quantify systematics, etc...



Blue: F435W
Green: F850LP
Red: F160W



Blue: F435W
Green: F850LP
Red: F160W

EGG: the Empirical Galaxy Generator

To be done: include stars

Advantages:
- fast as compared to cosmological simulations
- can generate any field size
- realistic

Paper TBS, code + catalogs + images free access

Can be tuned to your needs

You can choose:
- the position of the field on the sky
- the area of the field (must be a square)
- the depth to reach (either in terms of flux or stellar mass)
- the photometric bands for the simulated fluxes

For advanced usage:
- disable stellar or dust SED component
- input your own redshift, masses, positions and SF/quiescent classification
- output the full (high resolution) SED for each galaxy