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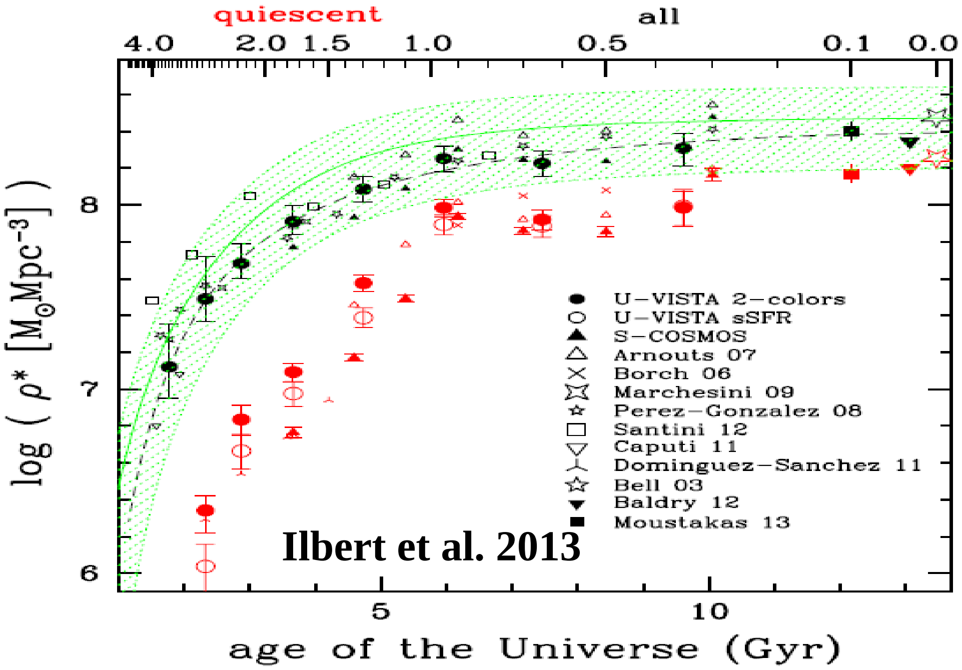
European Research Council

Evolution of the brightest & most massive galaxies since z~5

Lidia Tasca & VUDS collaboration

LAM
LABORATOIRE D'ASTROPHYSIQUE DE MARSEILLE

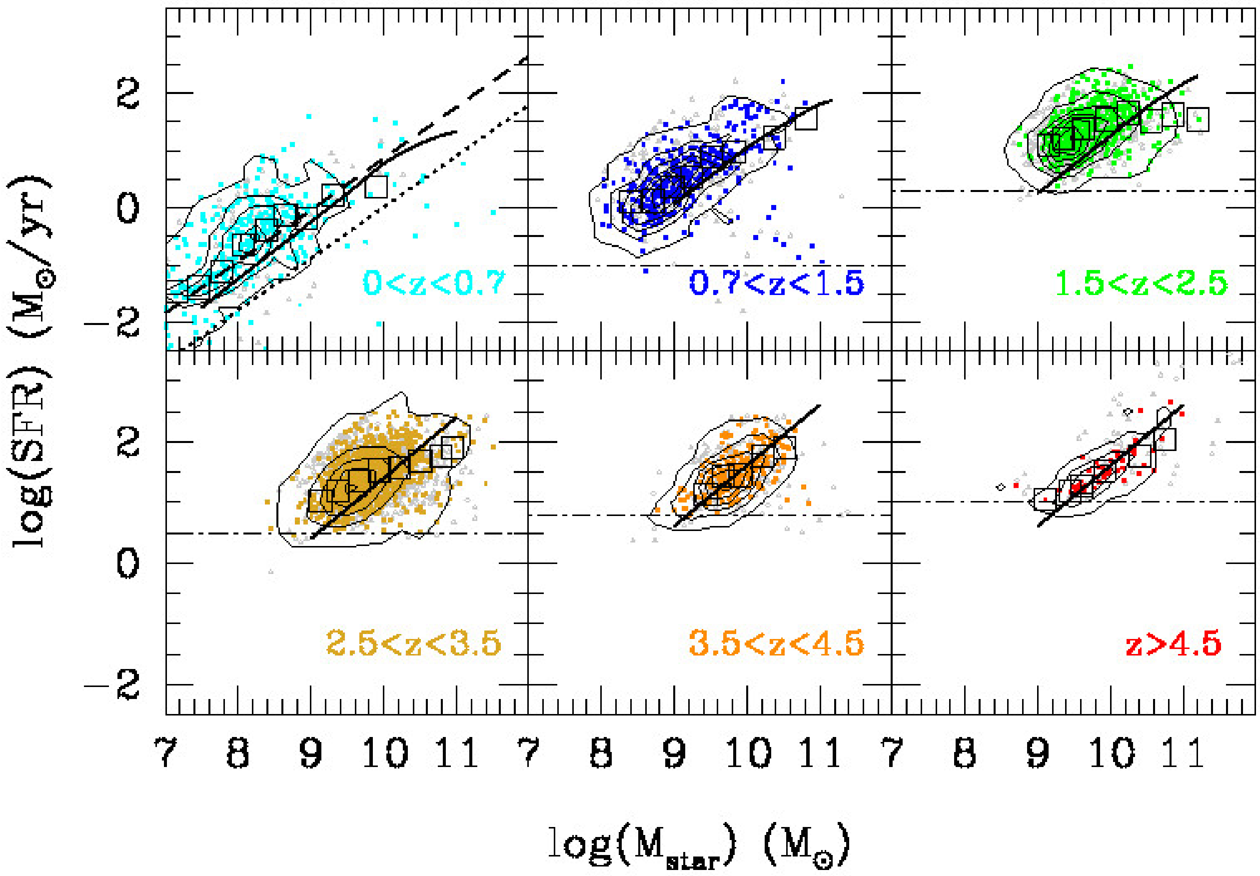
When did quenching start?



Evolution of the SFR-M_* relation

Progenitors of z~2
Compact Massive Quiescent galaxies

SFR-M_* relation up to z~5



High-M turn-off at z<3.5. → effect of SF quenching in a downsizing pattern

Quenching processes not fully active at z>3.5

Tasca et al. 2015

Search for progenitors of z~2 Compact, Massive Quiescent galaxies

- Identifying the physical mechanisms driving the bi-modality observed in the Local Universe, is one of the main open issues in the study of galaxy formation

- Identifying/characterising the possible progenitors at $2<z<5$ of z~2 massive compact quiescent galaxies is one way forward

- Can massive star forming galaxies with any morphology be the progenitors of the compact passive ones? Should they be compact themselves?

- The VIMOS Ultra Deep Survey (VUDS) offers a unique dataset for looking at the high-z Universe because of spectra, multi-λ data & high-resolution HST imaging

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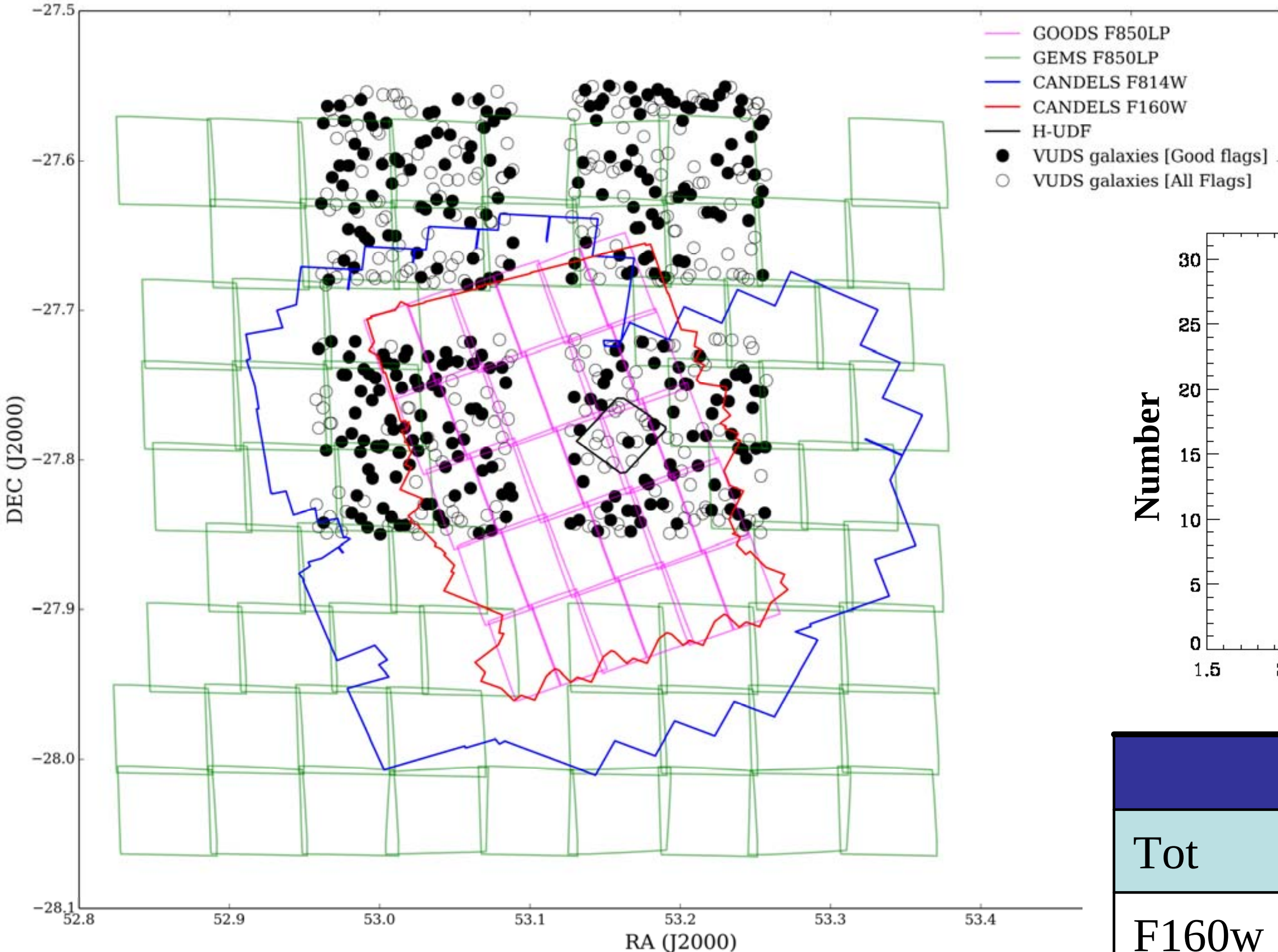
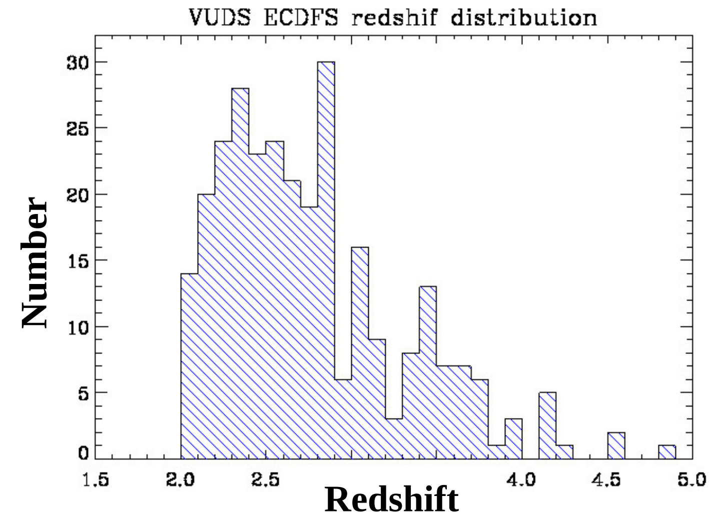
ECDFS





	z>4	3<z<4	2<z<3
Tot	30	123	306
F160w	12	49	101
F814w	9	46	145
F850lp	9	29	60

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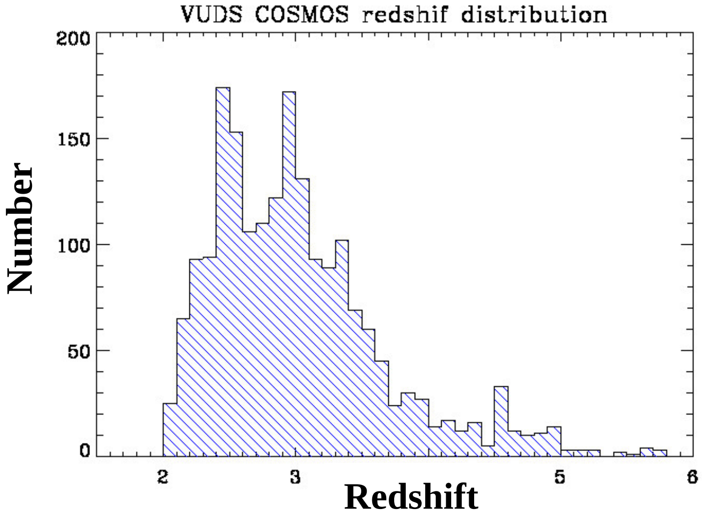
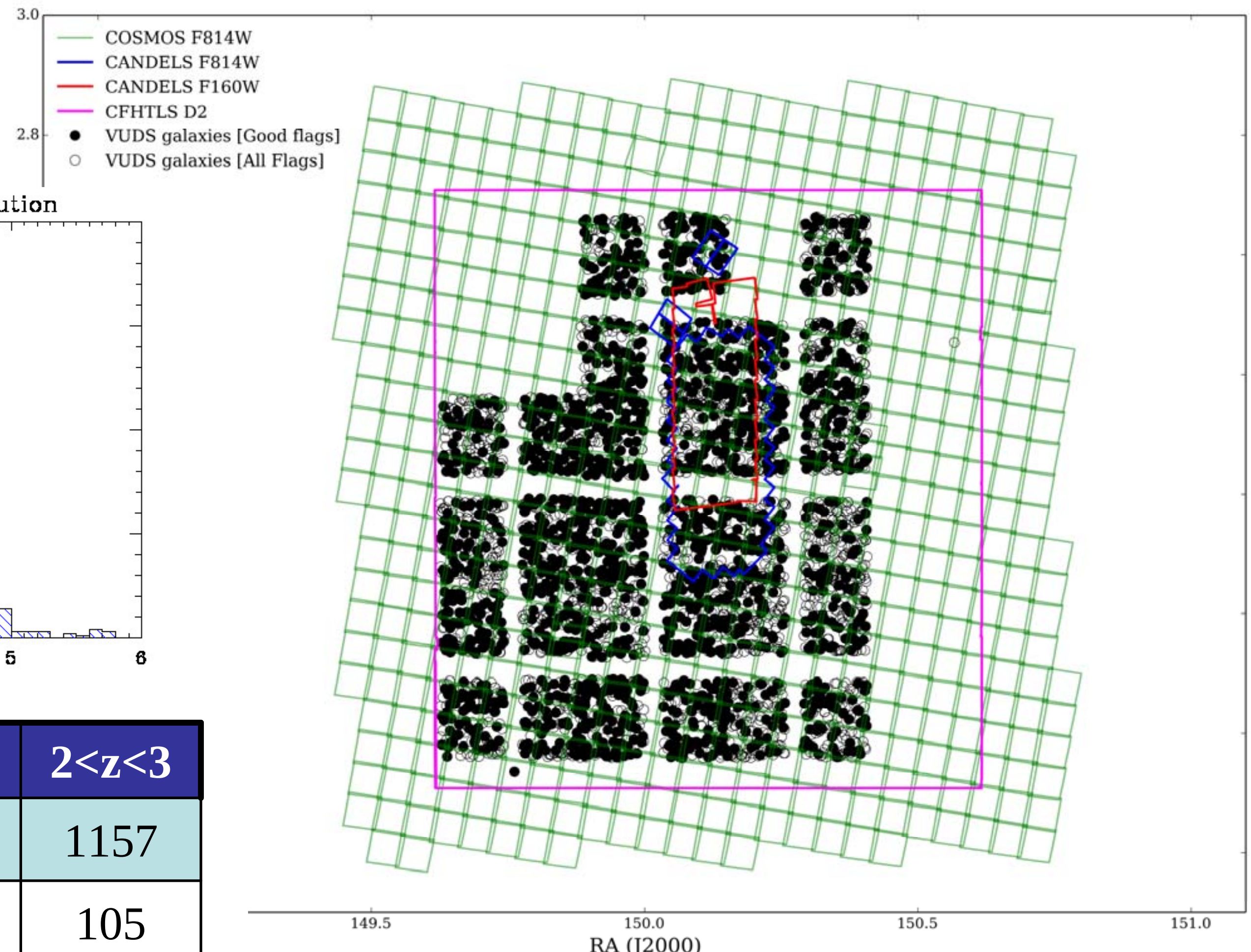
COSMOS

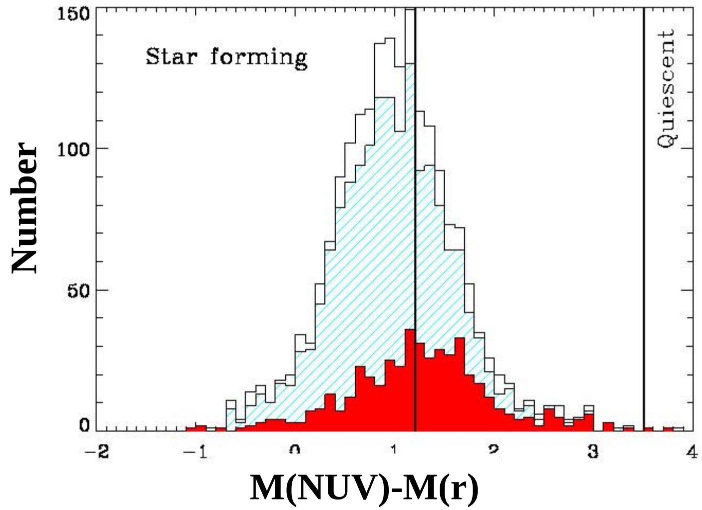


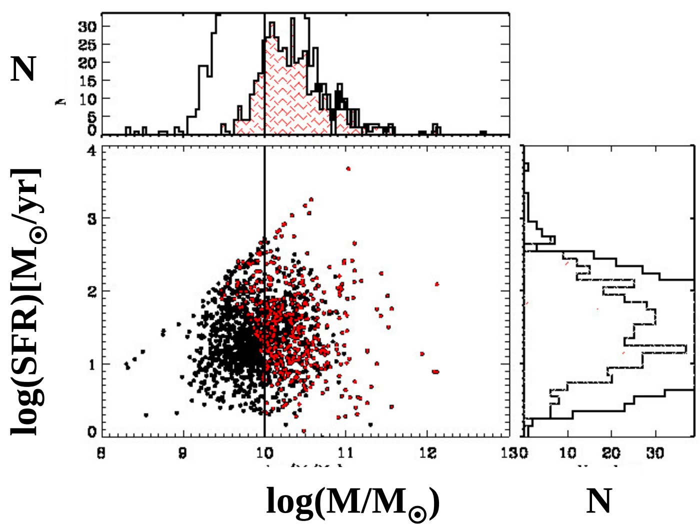


	z>4	3<z<4	2<z<3
Tot	174	704	1157
F160w	18	71	105
F814w	9	43	81
F814w	147	590	971

Finding progenitors at 2<z<5

(I) finding when galaxies become passive





We predict the sSFR and the final stellar mass of the galaxies once they have quenched.

The quenching phase is modeled with a decreasing exponential function $\exp^{-t/\tau}$.

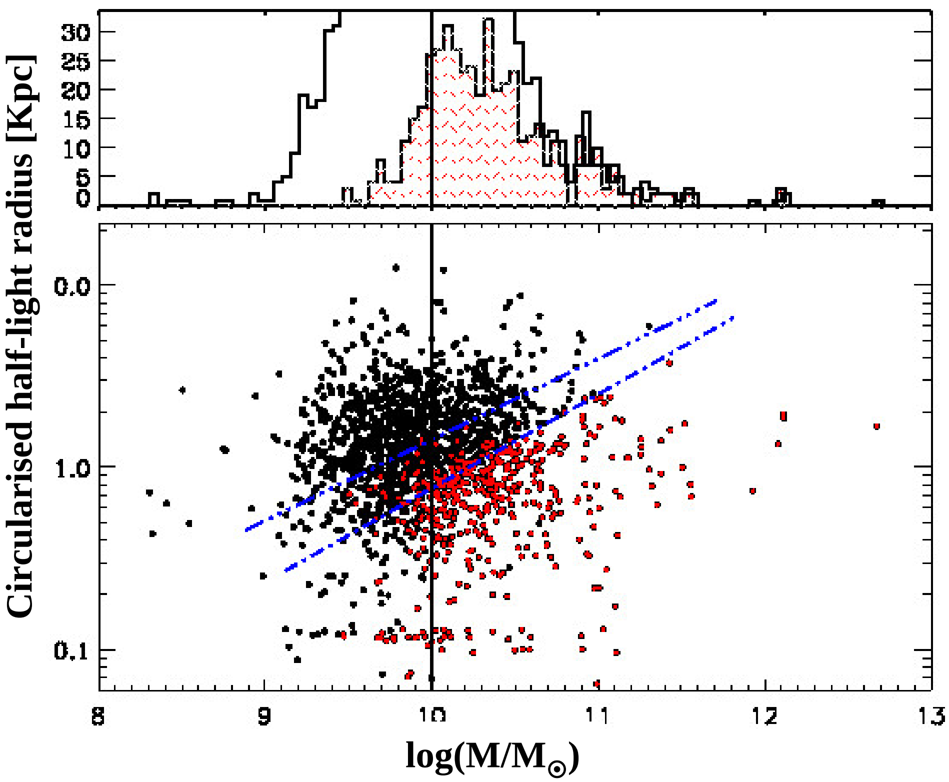
$t_q = t_{obs}$
τ=100 Myr

Passive galaxy → sSFR < -2Gyr^{-1}
Massive galaxies → logM>10 $M_\odot$

<u>Identify those which satisfy the passive criterion by z=2</u>

Finding progenitors at 2<z<5

(II) finding the compact ones



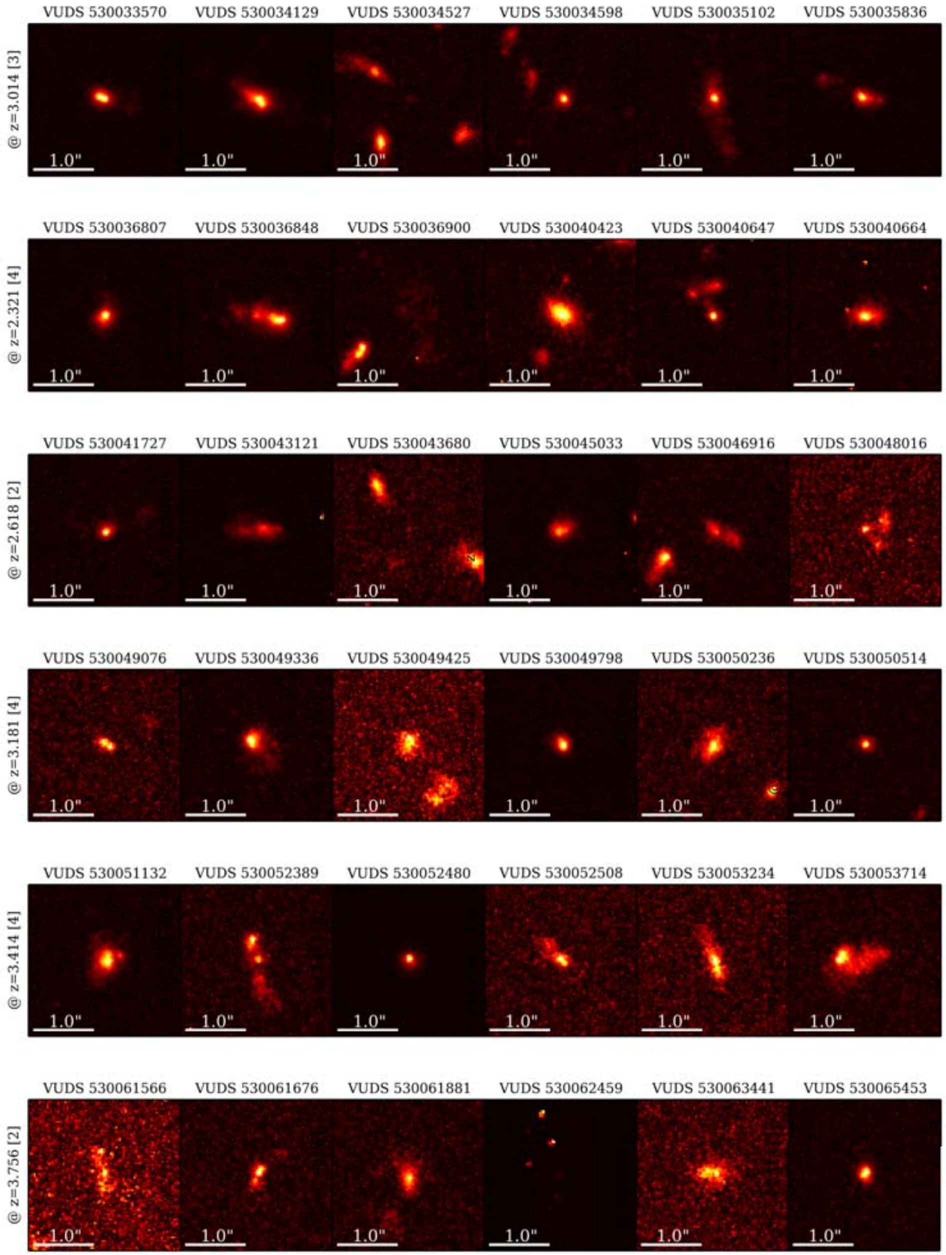
More "compact" systems are more likely to quench their SF more effectively

We restrict the sample to galaxies with "compact" R_{e_circ}

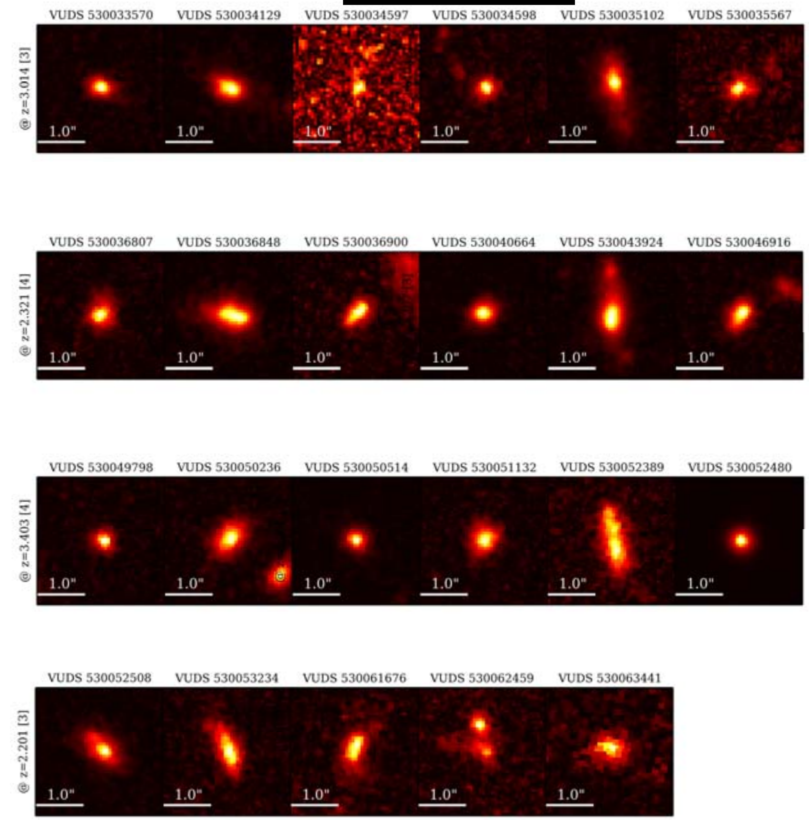
but no galaxy shape restriction

>500
possible candidates

F814w



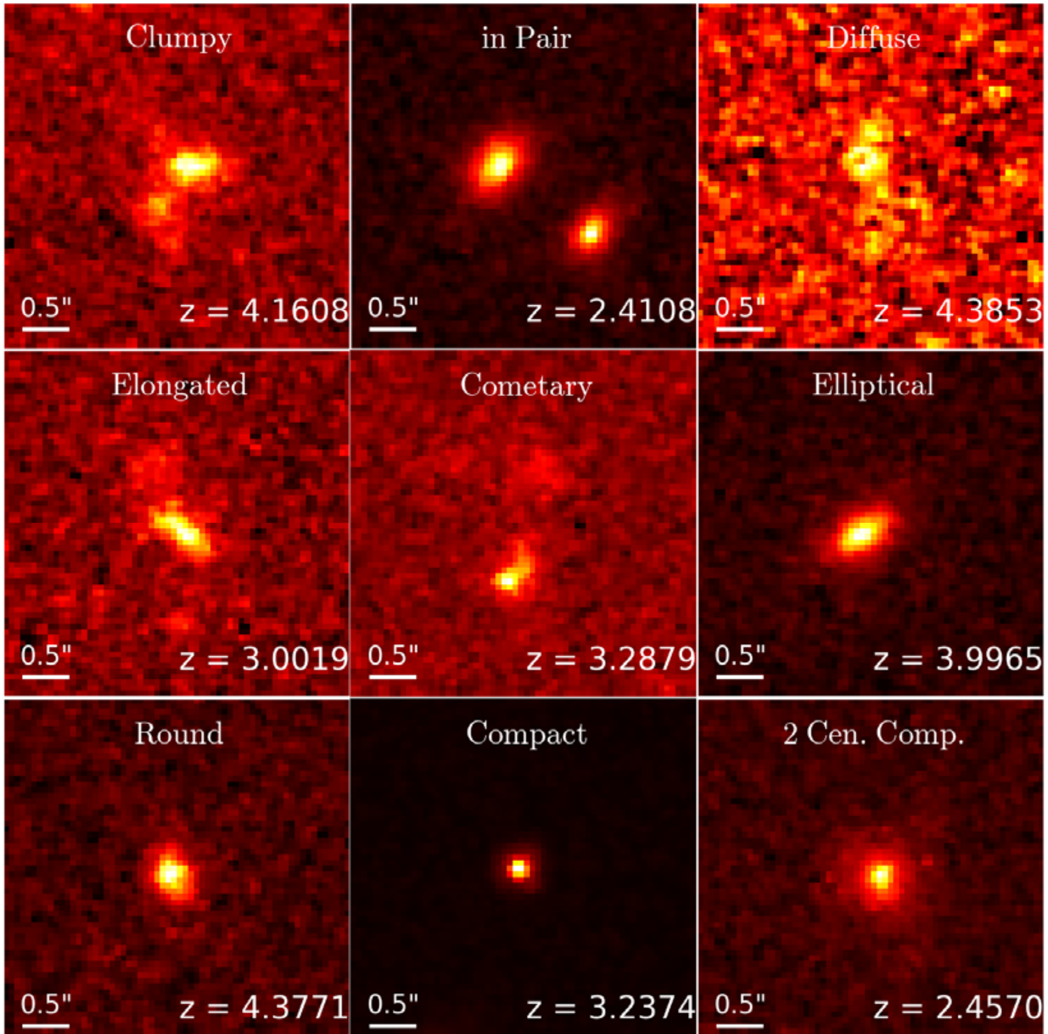
F160w



Progenitors at 2<z<5 come in a variety of morphologies

Their morphological properties are similar to the general SF population

New classification scheme



Poster 2

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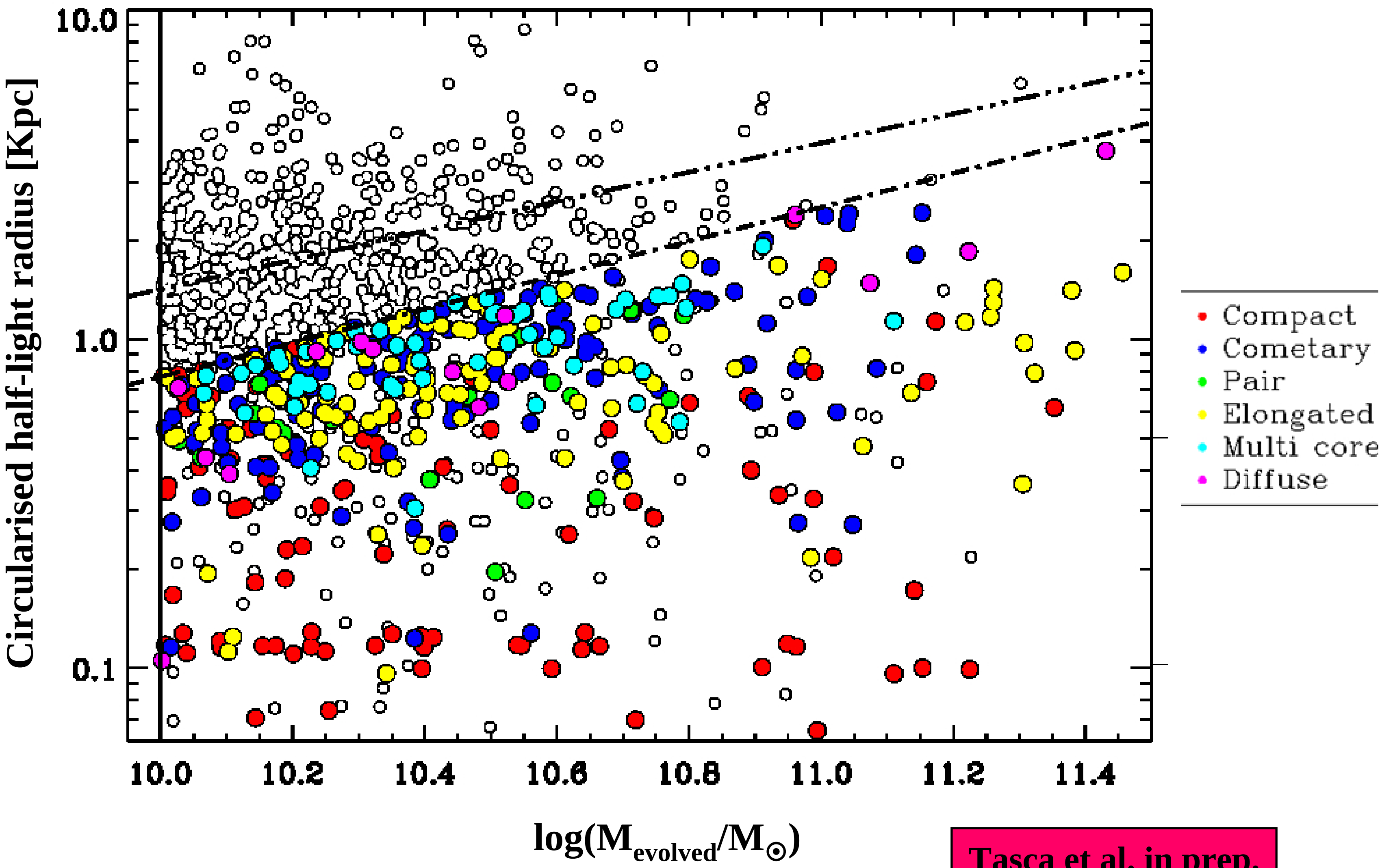
Mass-size by morphological type



Tasca et al. in prep.

Progenitors of massive compact passive z~2 galaxies

- They have very diverse morphologies
  - Not necessarily single component
  - But size Re_circ<1kpc implies that they are likely to evolve into a single component by z~2
- Compatible evolution scenarios
  - Secular processes – monolithic collapse - accretion:
    - More restricted set of morphologies expected: single component or multiple component (not compatible with pairs, elongated or cometary)
  - Major mergers:
    - Take ~1Gyr to merge, hence one single component by z~2
    - High major merger fraction ~20% (Tasca+14): 30% of galaxies undergo a major merger between z~4 and z~2
    - pairs / cometary / elongated / multi-component could be representatives of the different phases of a merger process
  - Minor mergers:
    - Should have a fairly high rate to produce a fast transition to single compact object by z~2
- Likely scenario: combination of several or all of the above

Formation scenarios

- Small sizes of compact star forming galaxies (potential progenitors) could be the result of strongly dissipational processes that reduce the effective radius of SFG with more extended light profile

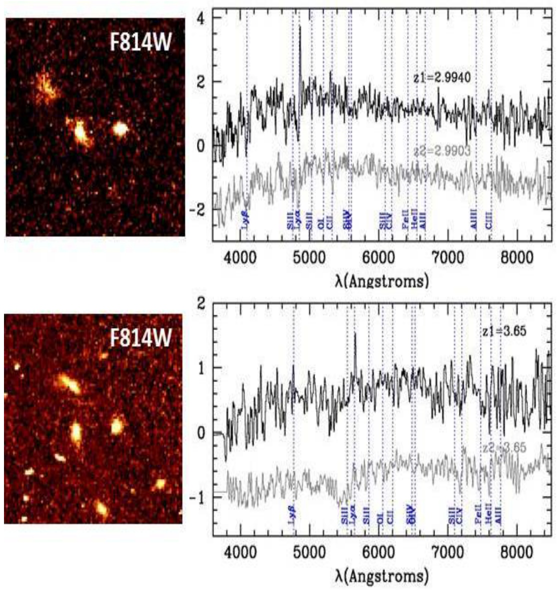
- Gas rich major mergers or disk instabilities triggered by strong gas accretion processes from the halo are plausible mechanisms

- SAM make predictions about which galaxies are likely to experience significant structural transformations

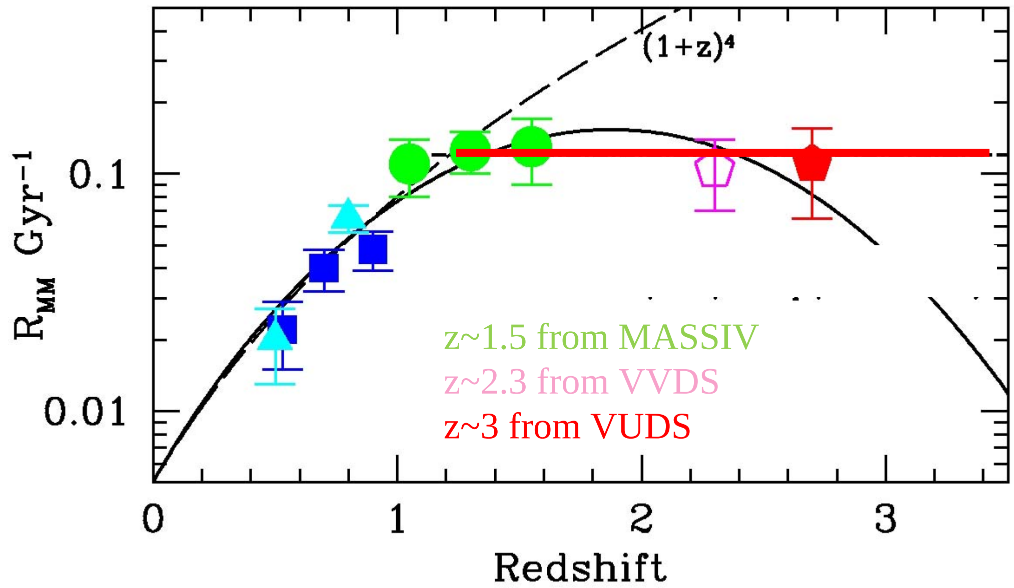
Direct evidence for the mechanisms responsible for the formation of compact SFG remains to be found

Galaxy Merger Rate History since z~3 from spectroscopic pairs

Le Févre et al. in prep.



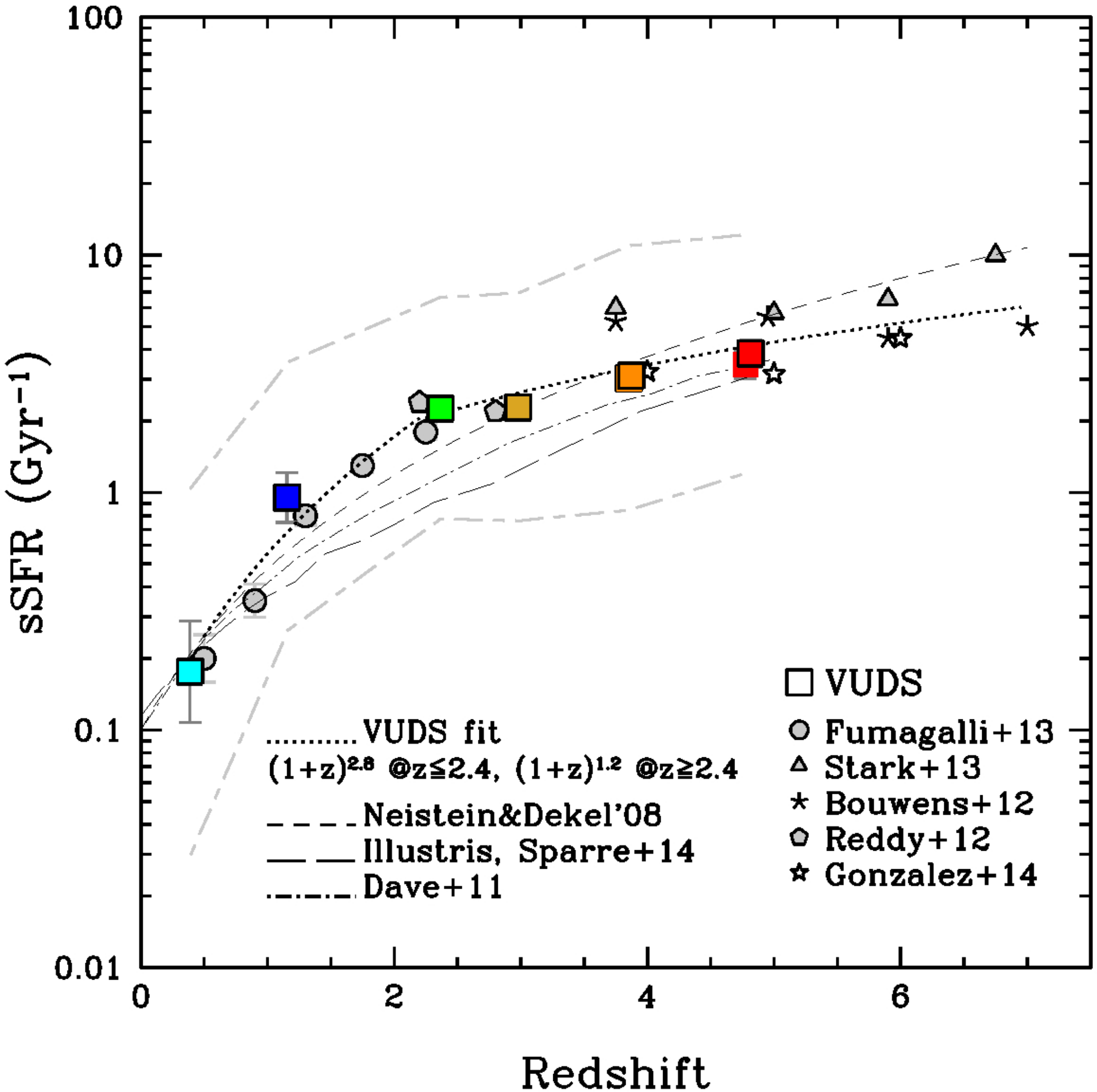
Tasca et al. 2014b



Peak in major merger rate at z~1.5-2 ?

Integrating the GMRH indicates that 60% of the mass of galaxies at z=0 has been assembled by mergers

sSFR evolution since z~5



The sSFR evolution does not follow a pure accretion driven galaxy mass growth.

Need to combine with merger processes.

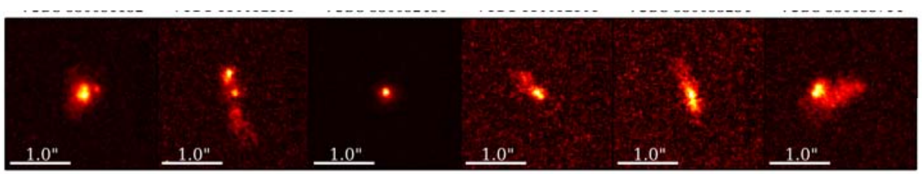
Tasca et al. 2015

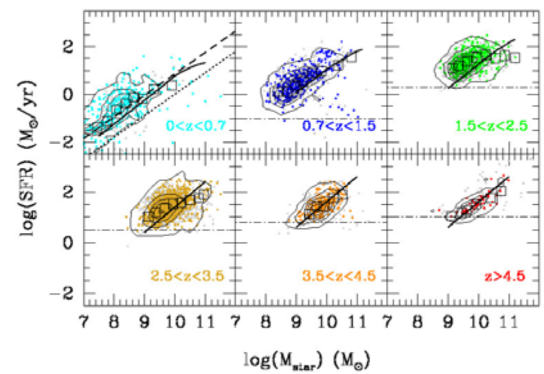
Conclusion & future

VUDS allows an unbiased and homogeneous study of the high-redshift universe & to look for the inset of quenching

Turn-off of the SFR-M relation at the highest-mass end up to z~3.5

Identification of progenitors of compact z~2 massive quiescent galaxies showing a wide range of morphological properties
Next : follow their morphological evolution since z~5





Various evolutionary processes likely at play:
Monolithic collapse; Major mergers: Gas rich minor mergers
Next : follow their evolution in semi-analytical models

Thank you for your attention

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