

# EARLY GALAXY QUENCHING IN THE UNIVERSE

FRANCESCO VALENTINO (ESO, DAWN)



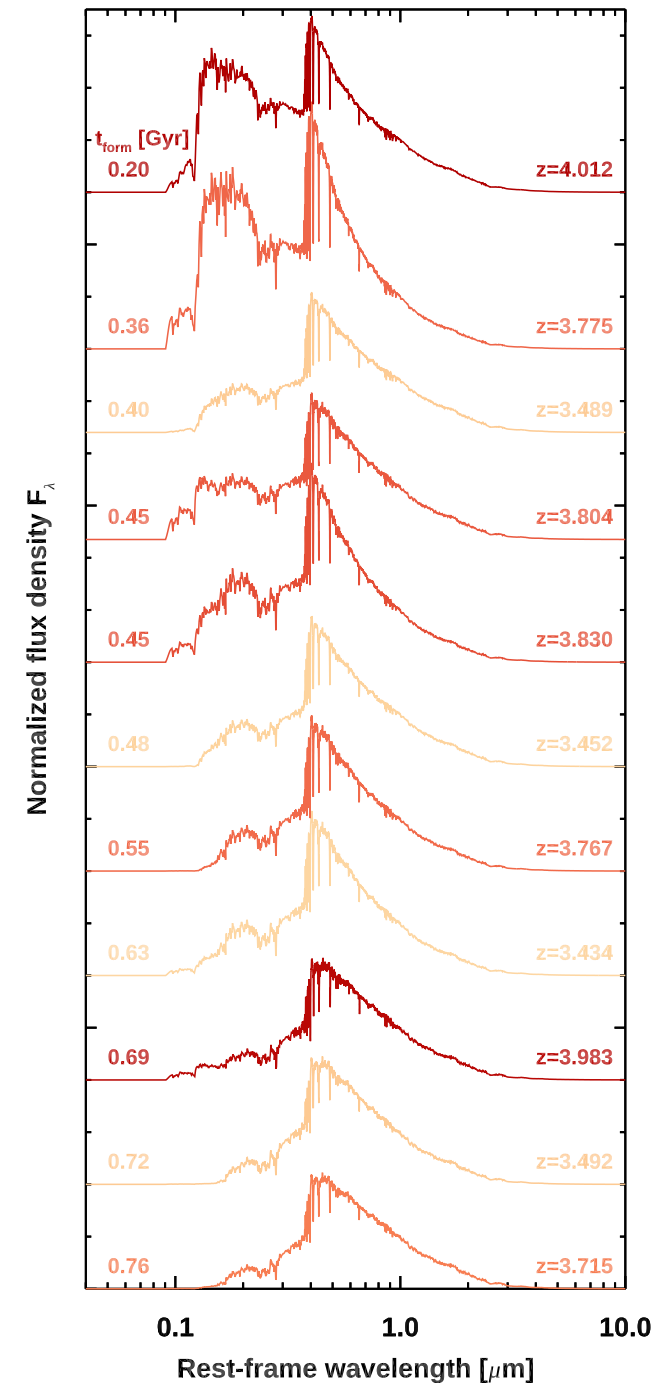
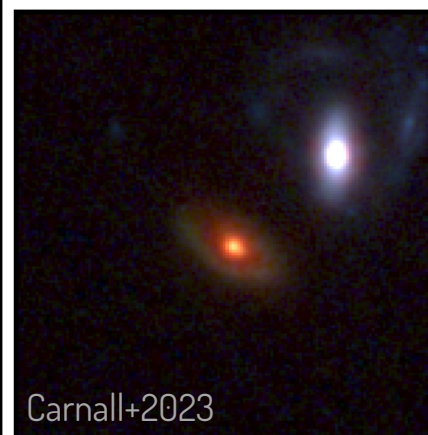
WHAT'S IN A NAME?

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Quenched, passive, (mini-)quenching,  
quiescent, post-starburst, E(K)+A,  
rejuvenated:  
common lexicon that tries to capture a  
nuanced (non-bimodal) population

Somewhat problematic already at low  
redshift – worse at large distances

**How can we effectively select** (insert your  
favorite class of) **galaxies at high redshift?**



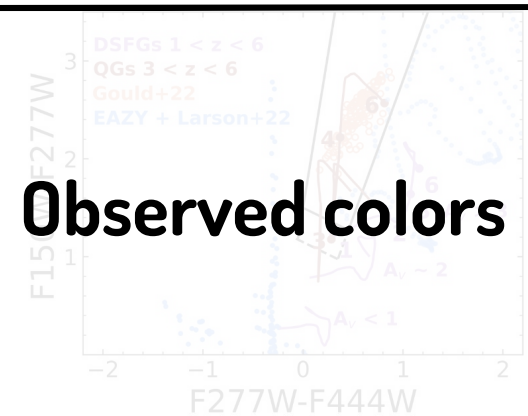
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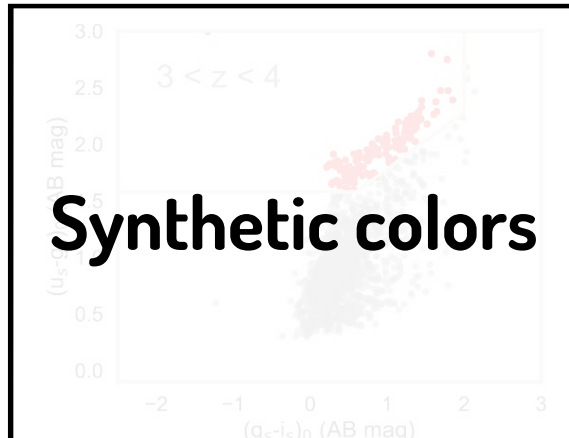
Recent focus on tailored selections – partially overlapping (but how much? Are we all on the same page?)

Daddi+05  
Williams+09  
Arnouts+13  
Schreiber+18  
Belli+19  
Leja+19  
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Lovell+23  
Antwi-Danso+23  
Gould+23  
Long+23

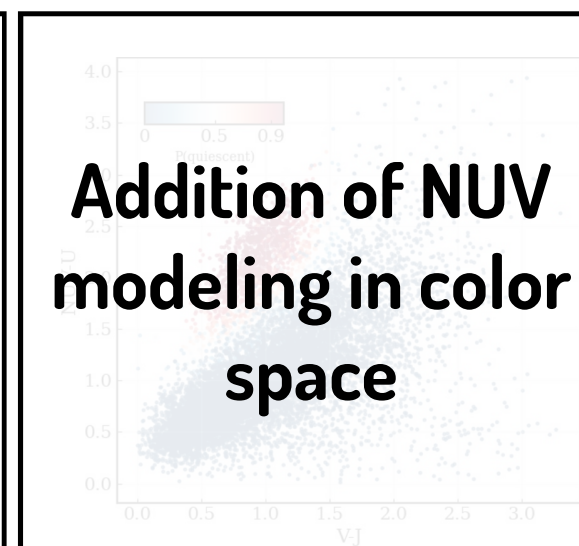
## Observed colors



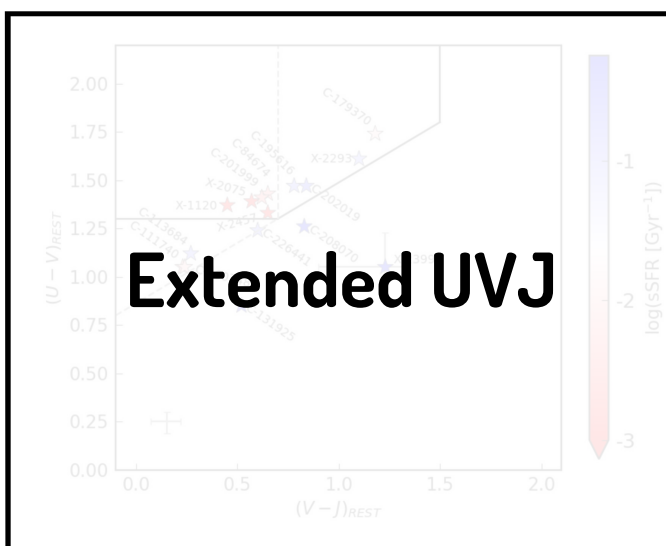
## Synthetic colors



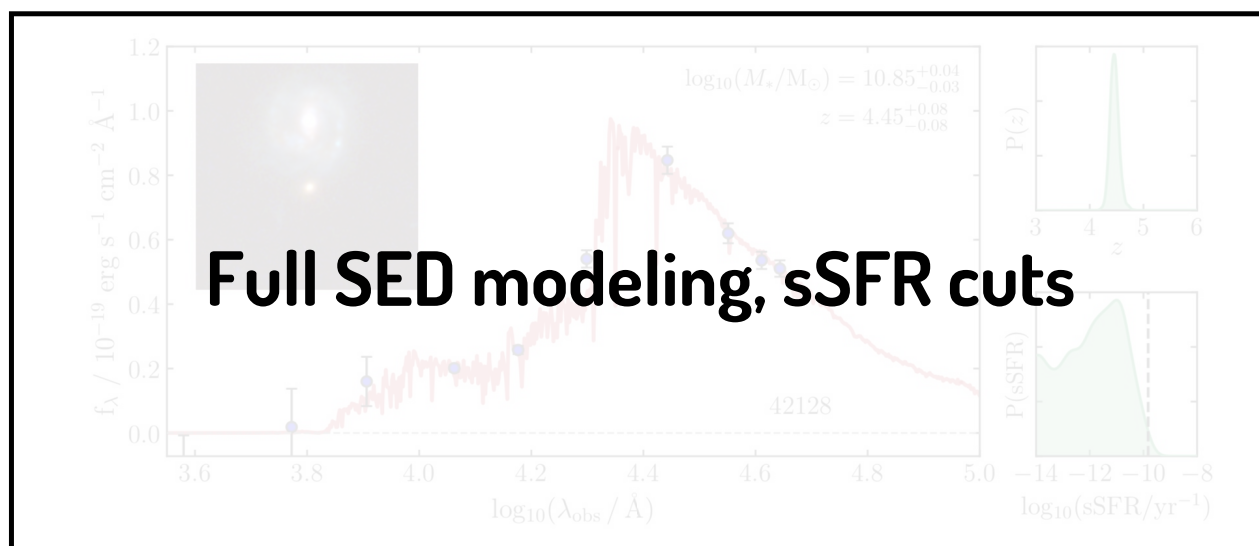
## Addition of NUV modeling in color space



## Extended UVJ



## Full SED modeling, sSFR cuts

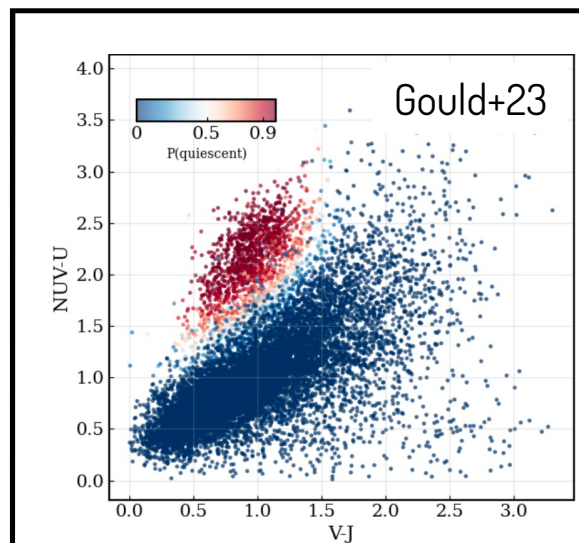
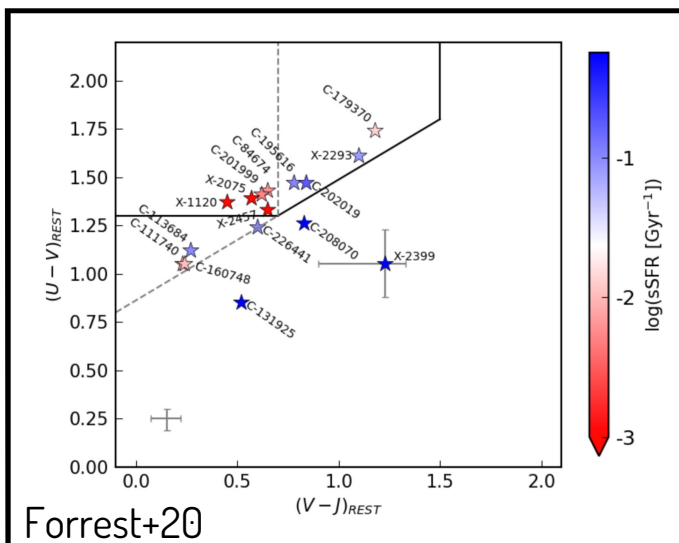
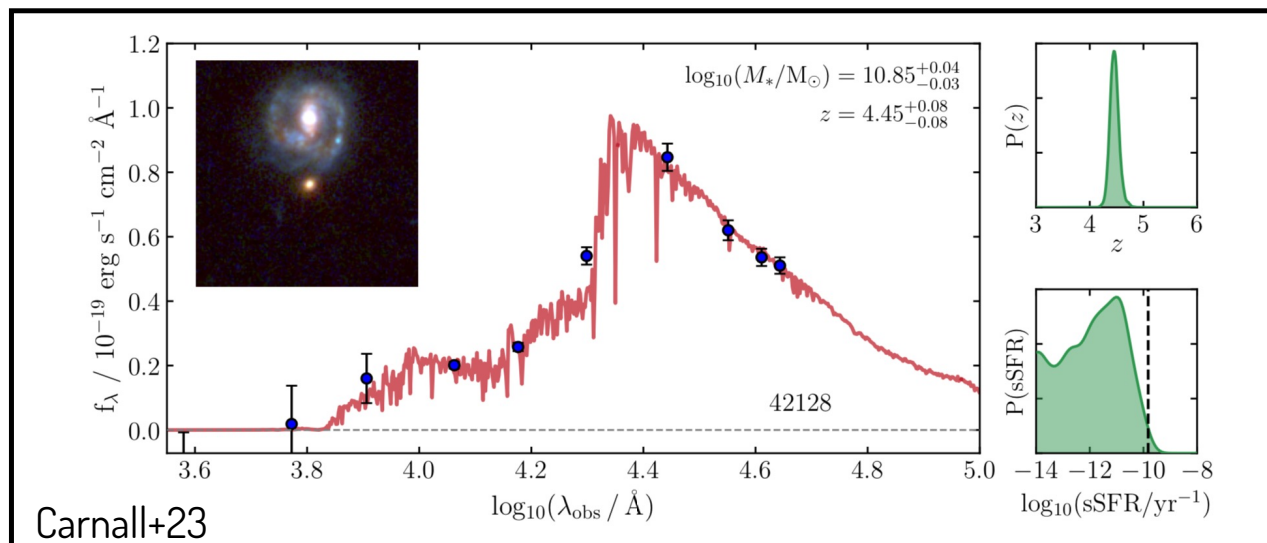
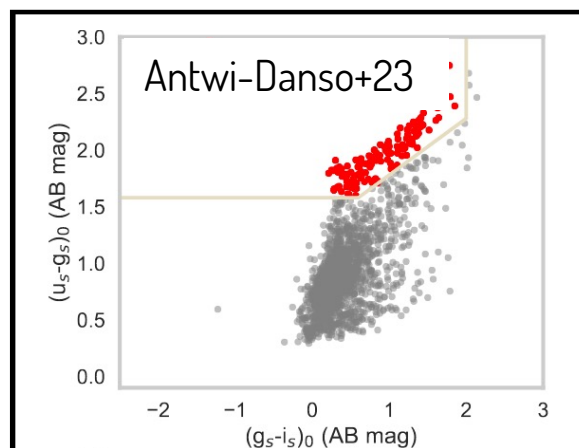
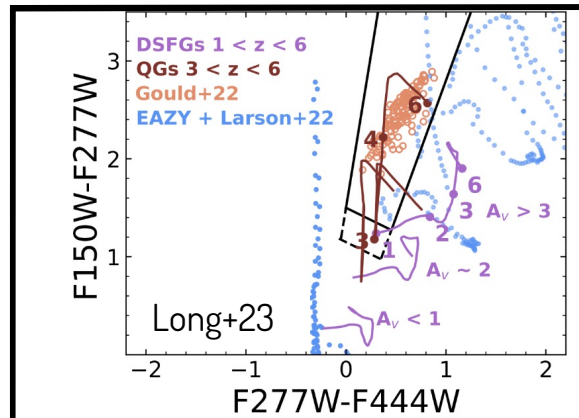


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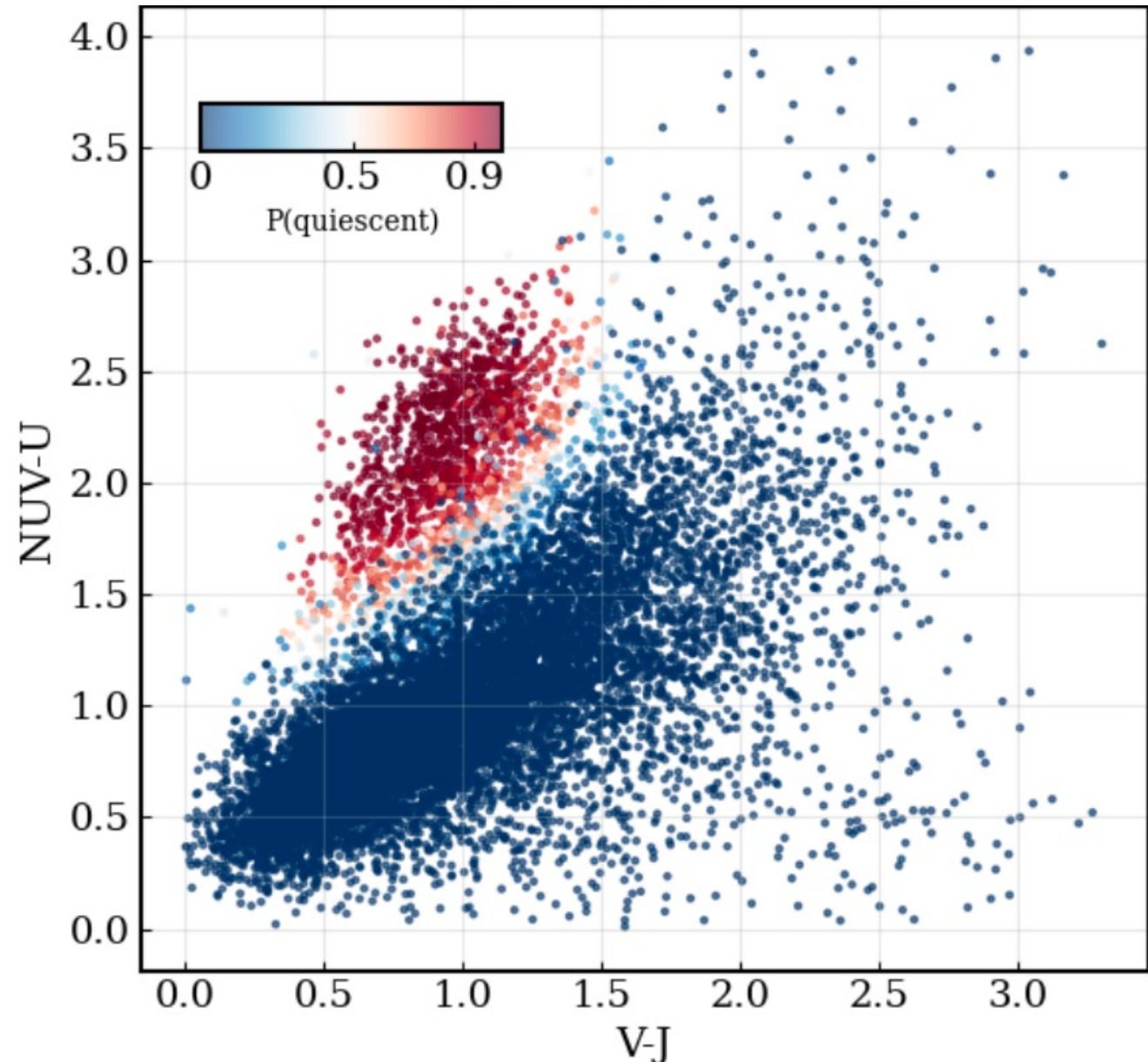
Adding a  $NUV$  band helps catch recently quenched objects (typical at high- $z$ )

**Gaussian Mixture Modeling** of the 3D color space to avoid drawing arbitrary boxes, capture the transition, and assign a “**probability of being quiescent**” to galaxies. It incorporates **uncertainties**.

Benchmarked on simulations (Lagos+18) and applied on COSMOS2020 (Weaver+22) and now JWST /NIRCam data. It outperforms  $UVJ$  at  $z>3$ .

**Code available** on github.

Gould+23, AJ, 165, 248

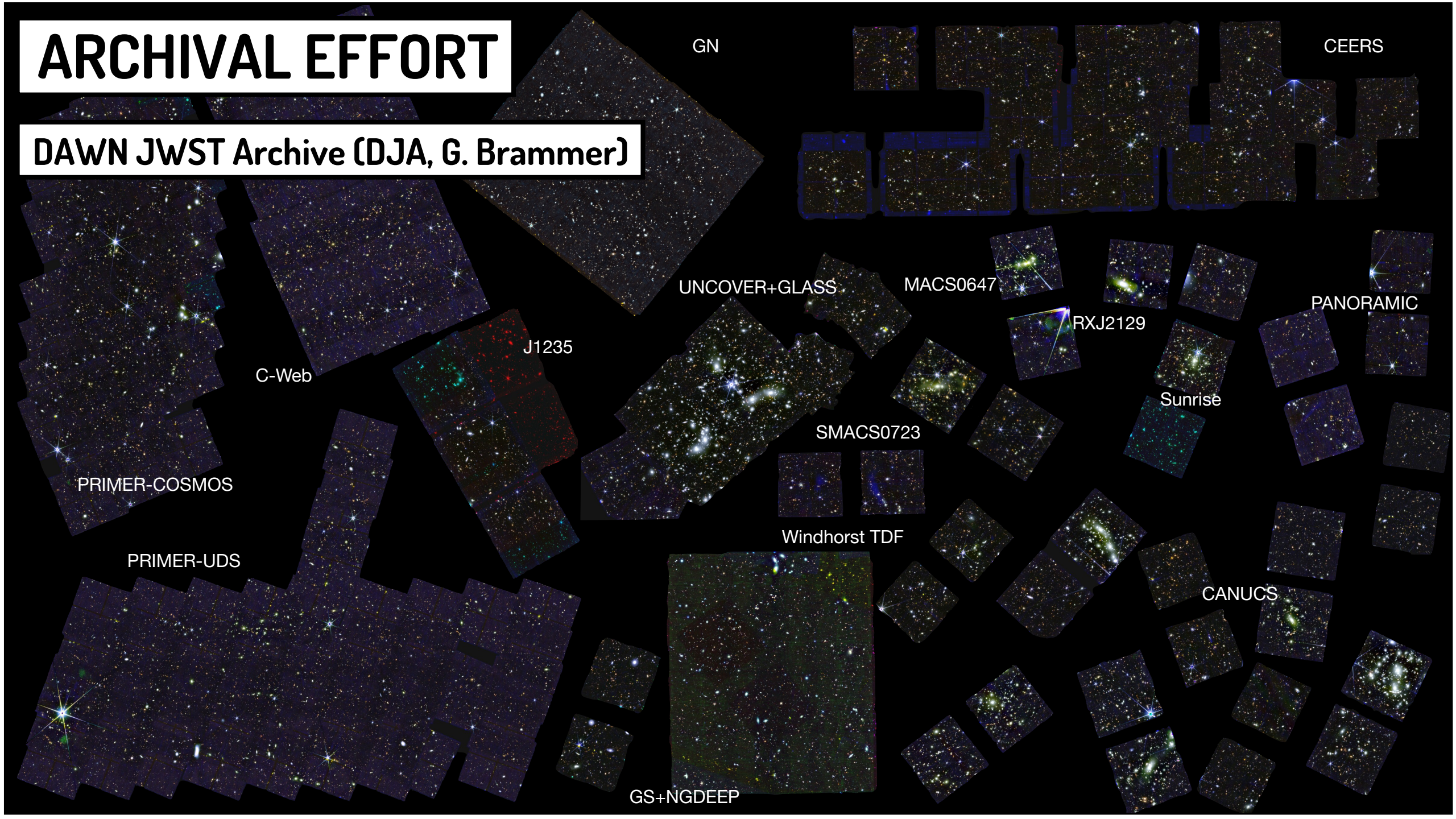


The image is a collage of various astronomical and scientific images. It includes: a large spiral galaxy in the top left; a radio telescope array in the top center; a dense field of galaxies in the top right; a diagram of concentric circles in the top right corner; a central text box with the title; a blue and orange cosmic web visualization in the middle; a merging galaxy system in the middle right; a yellow hexagonal structure, likely a telescope mirror, in the middle right; a red and white map in the bottom left; and two panels of a cosmic web visualization in the bottom center and bottom right.

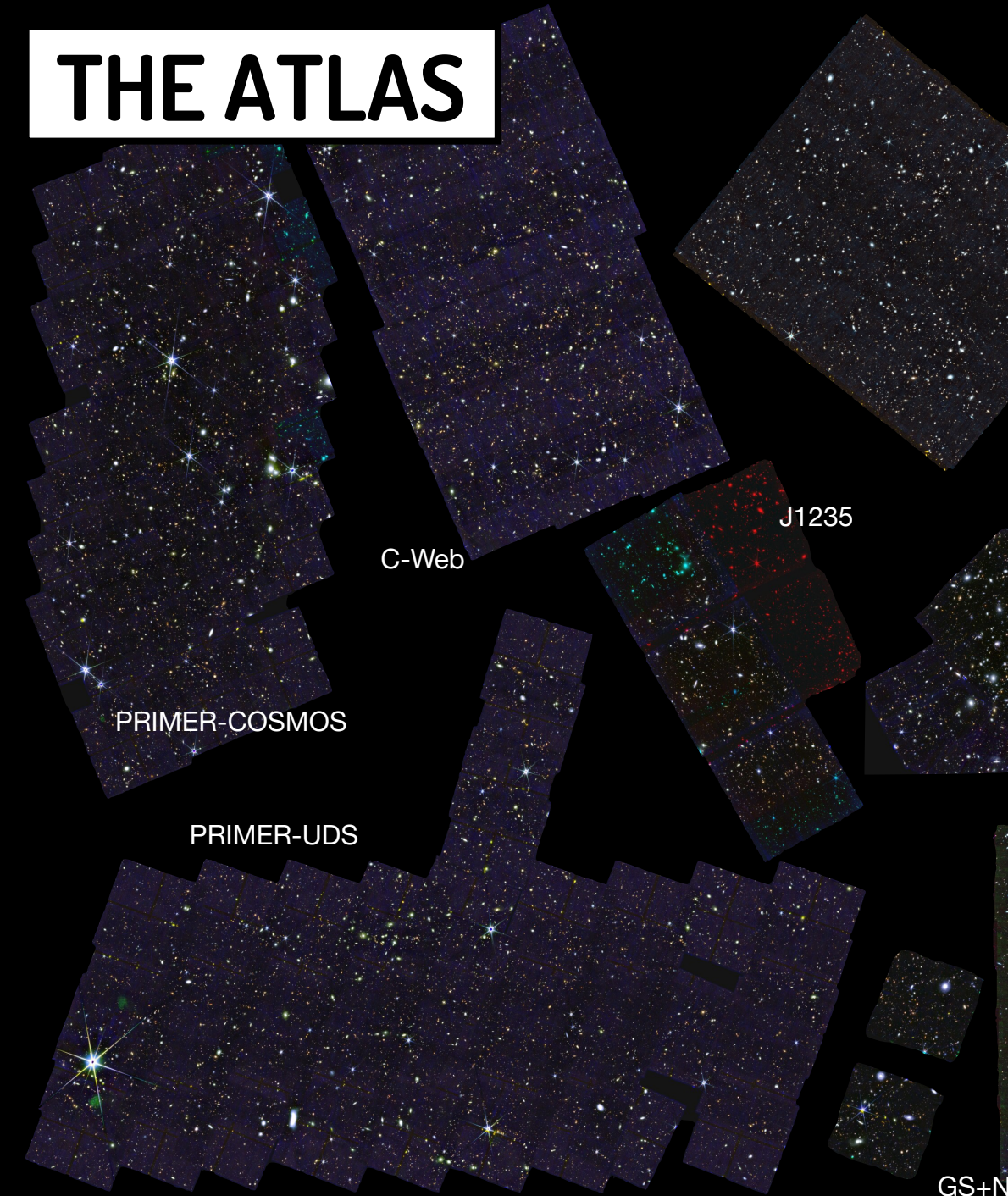
# AN ATLAS OF DISTANT QUIESCENT GALAXIES

# ARCHIVAL EFFORT

DAWN JWST Archive (DJA, G. Brammer)



# THE ATLAS



**11 public fields** with available JWST NIRCam data up to 4.4  $\mu\text{m}$  (ER0s, ERS, Commissioning fields, G0 with no proprietary time – **first 3 months**).

**Total area: ~145 sq.arcmin, ~80 QG candidates**

**The area and scattered fields are key to shrink cosmic variance**

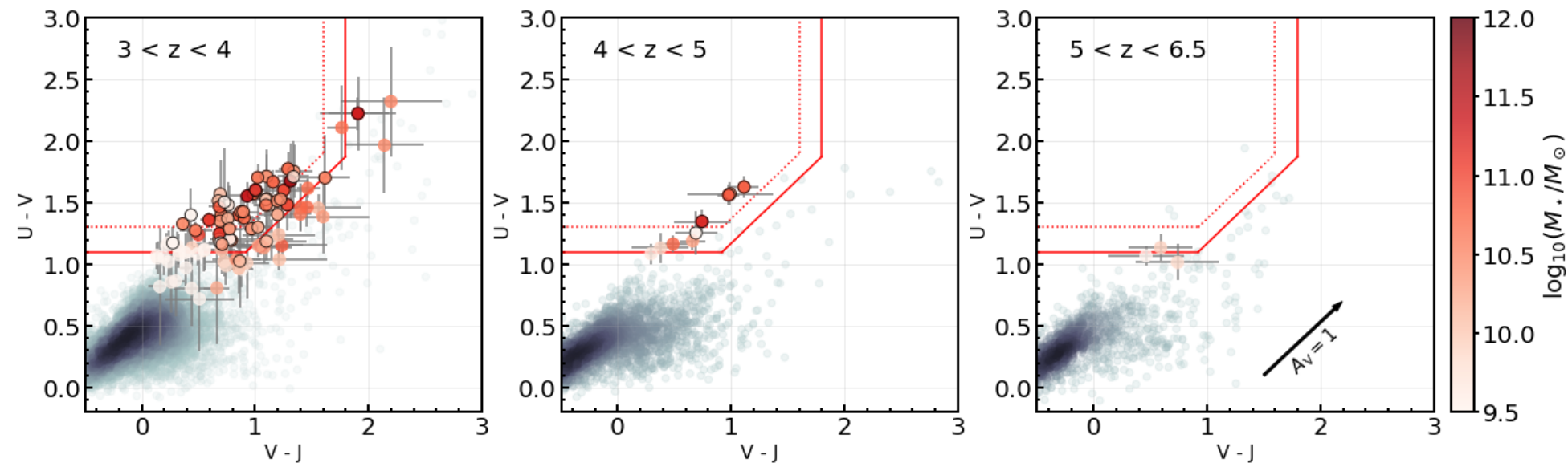
**Homogenous** JWST + HST reduction everywhere (**HST from the CHARGE archive, Kokorev+2022**)

Eazy-py modeling of the SEDs

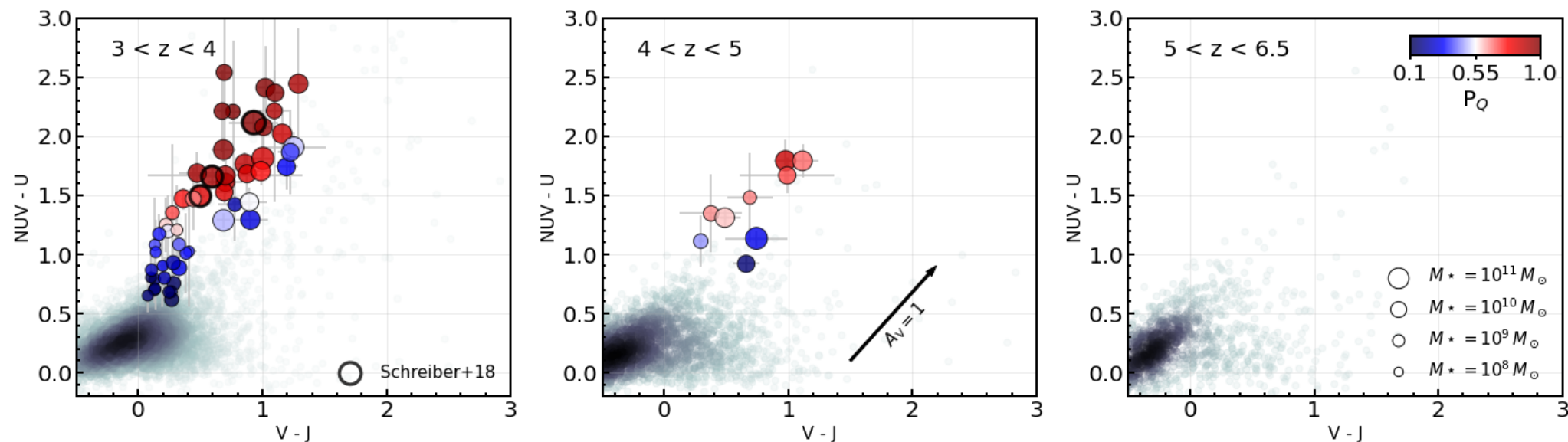
**Every high-level data product is public (mosaics, catalogs, selection)**

# THE ATLAS

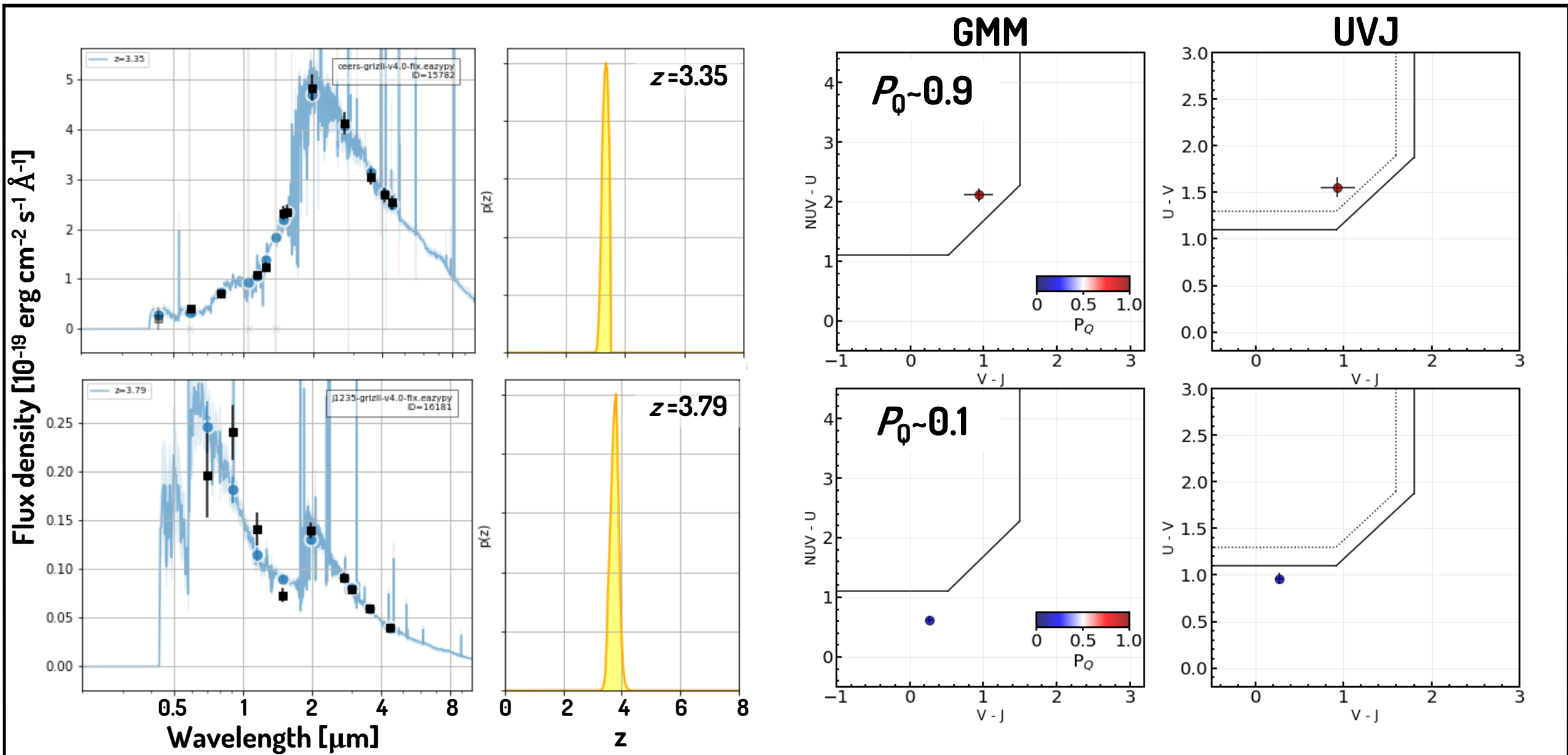
Valentino+23, ApJ, 947, 20



## Gould+23



# THE ATLAS



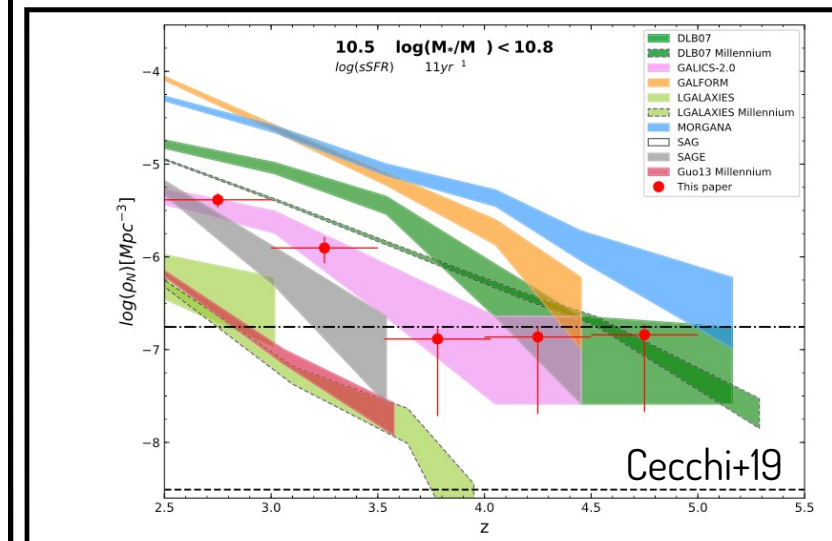
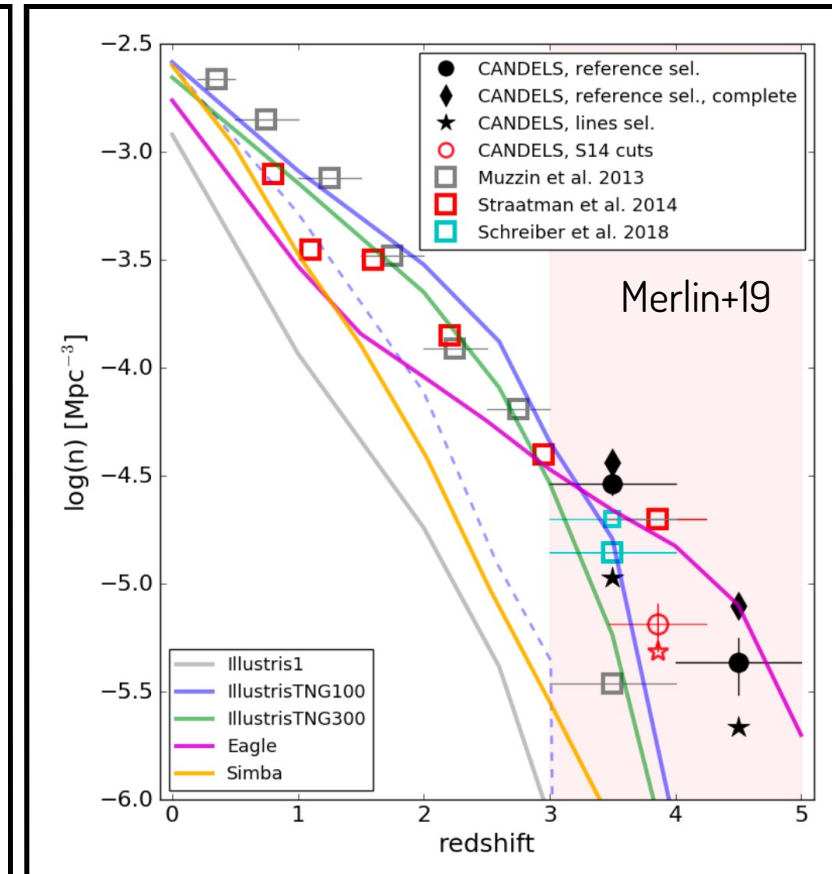


**BACK TO COUNTING**

# BACK TO COUNTING

A basic test for any selections and models:  
how many quiescent galaxies are out  
there? (Number densities)

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Whitaker+11  
Muzzin+13  
Ilbert+13  
Straatman+14  
Spitler+14  
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**Merlin+18, +19**  
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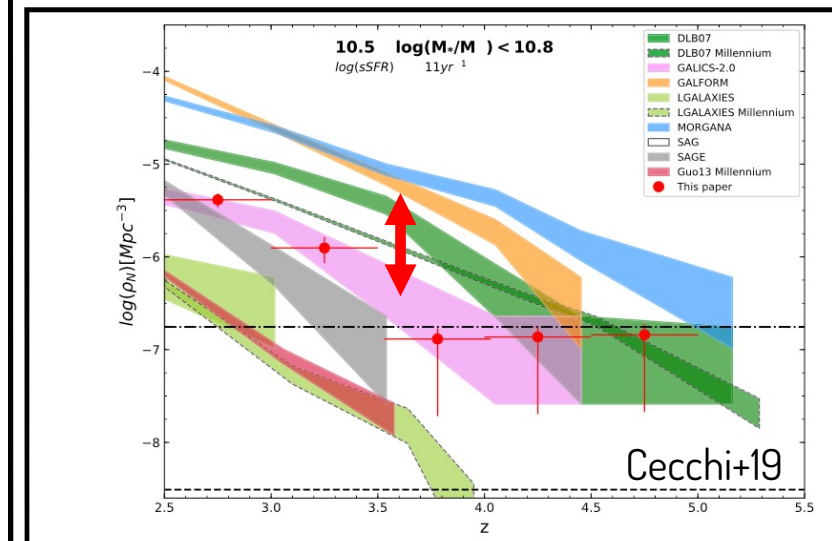
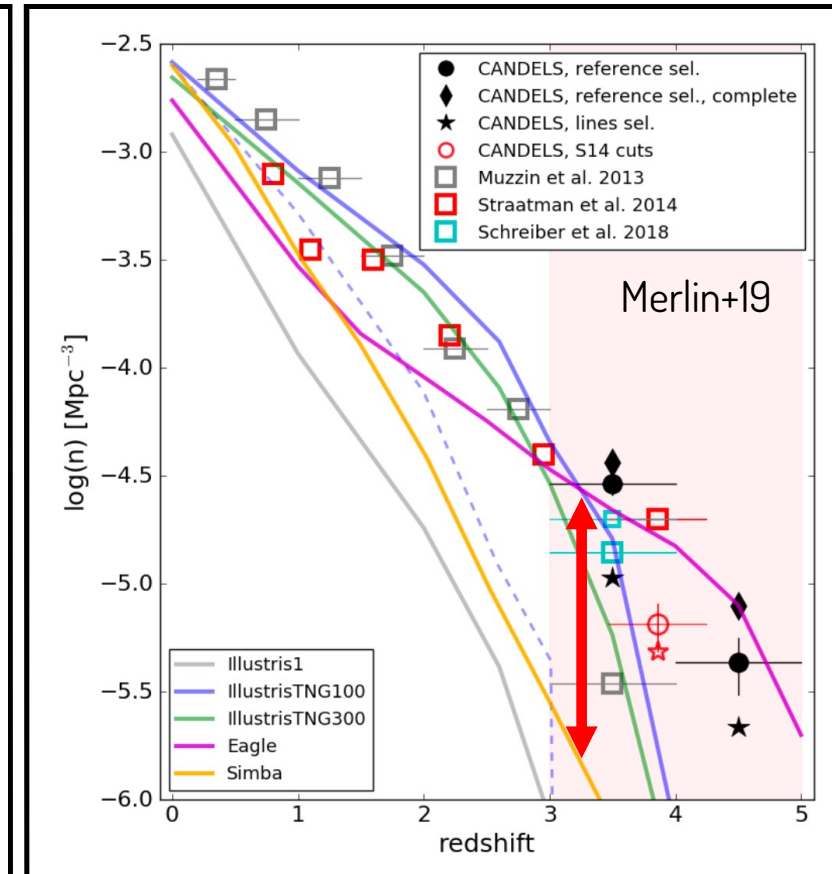


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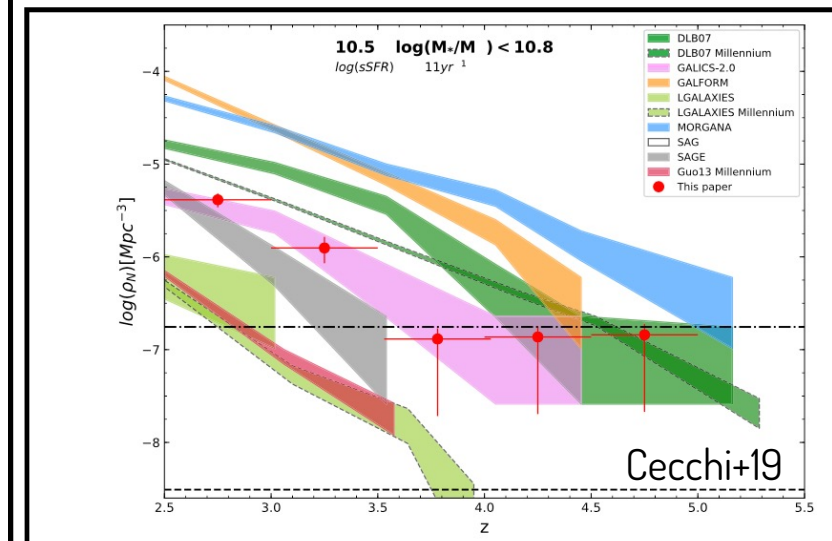
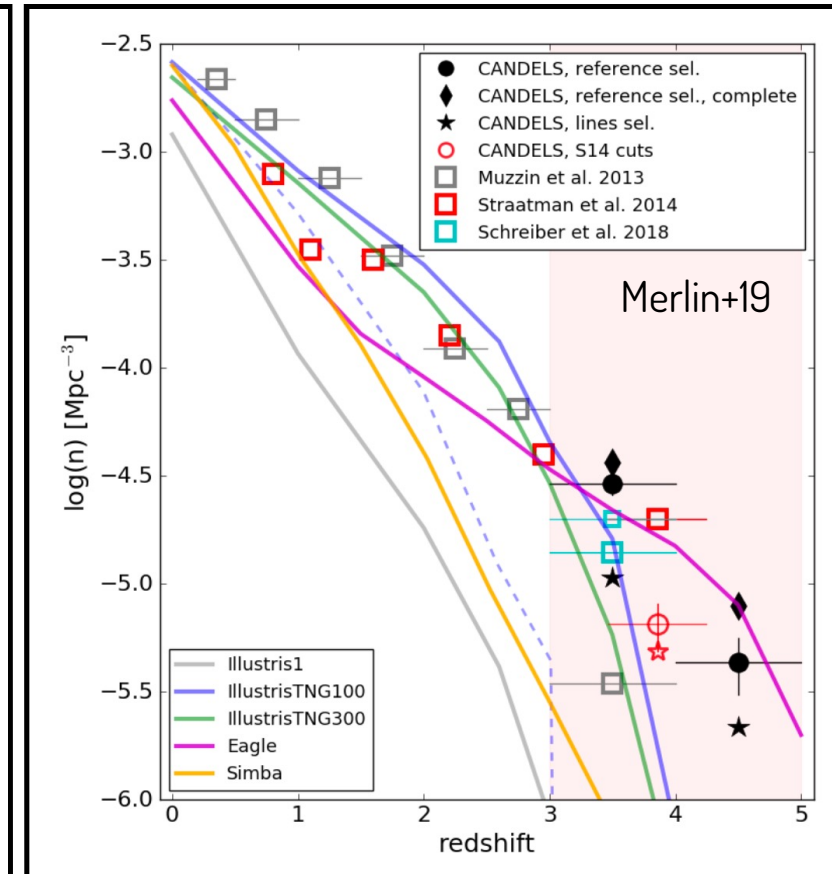
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Different selections, assumptions,  
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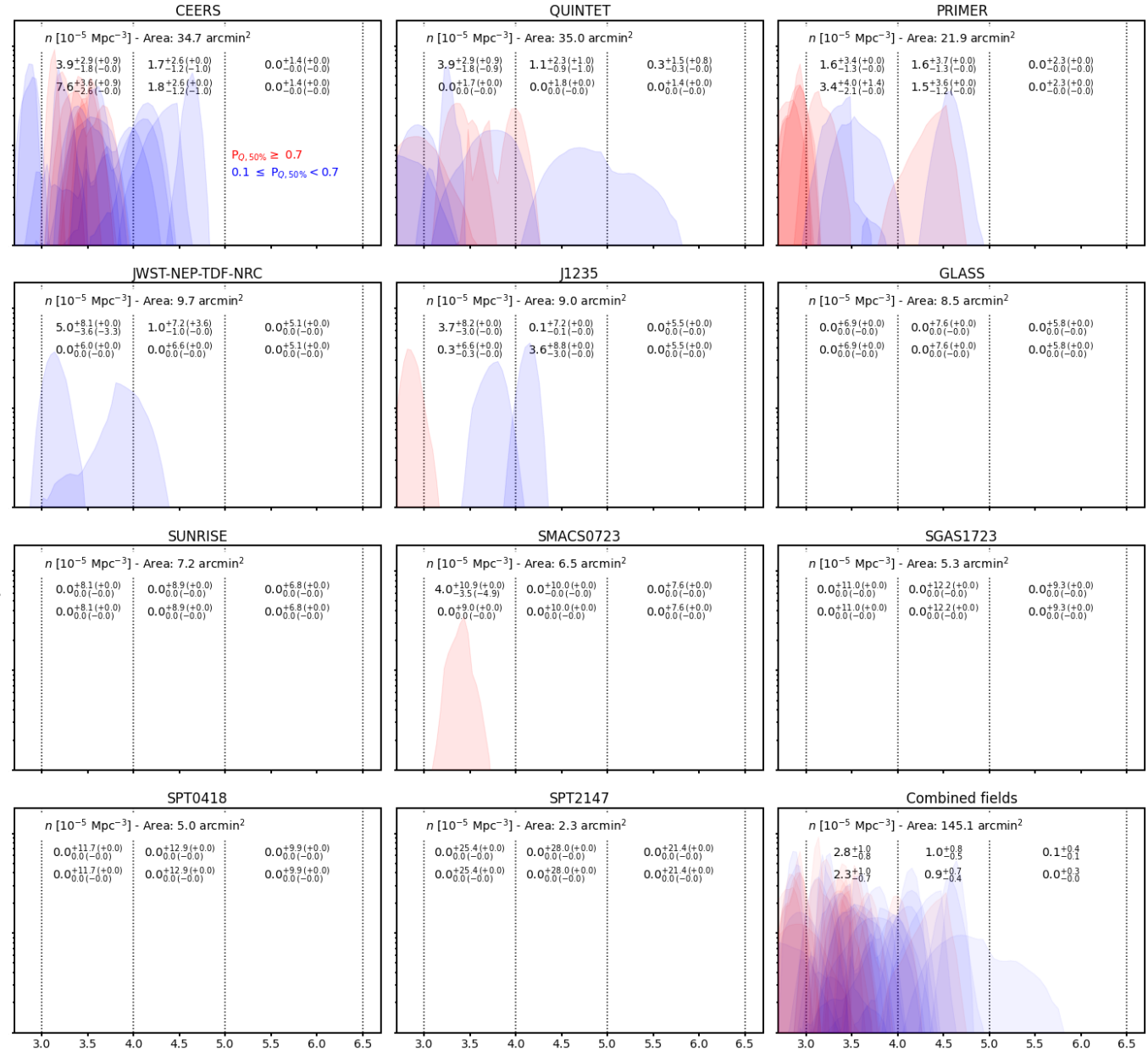
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# BACK TO COUNTING

$\frac{dp(z)}{dz}$



(GMM:  $P_0 > 0.7$  /  $0.1 < P_0 < 0.7$ )

Photometric redshift

Valentino+23

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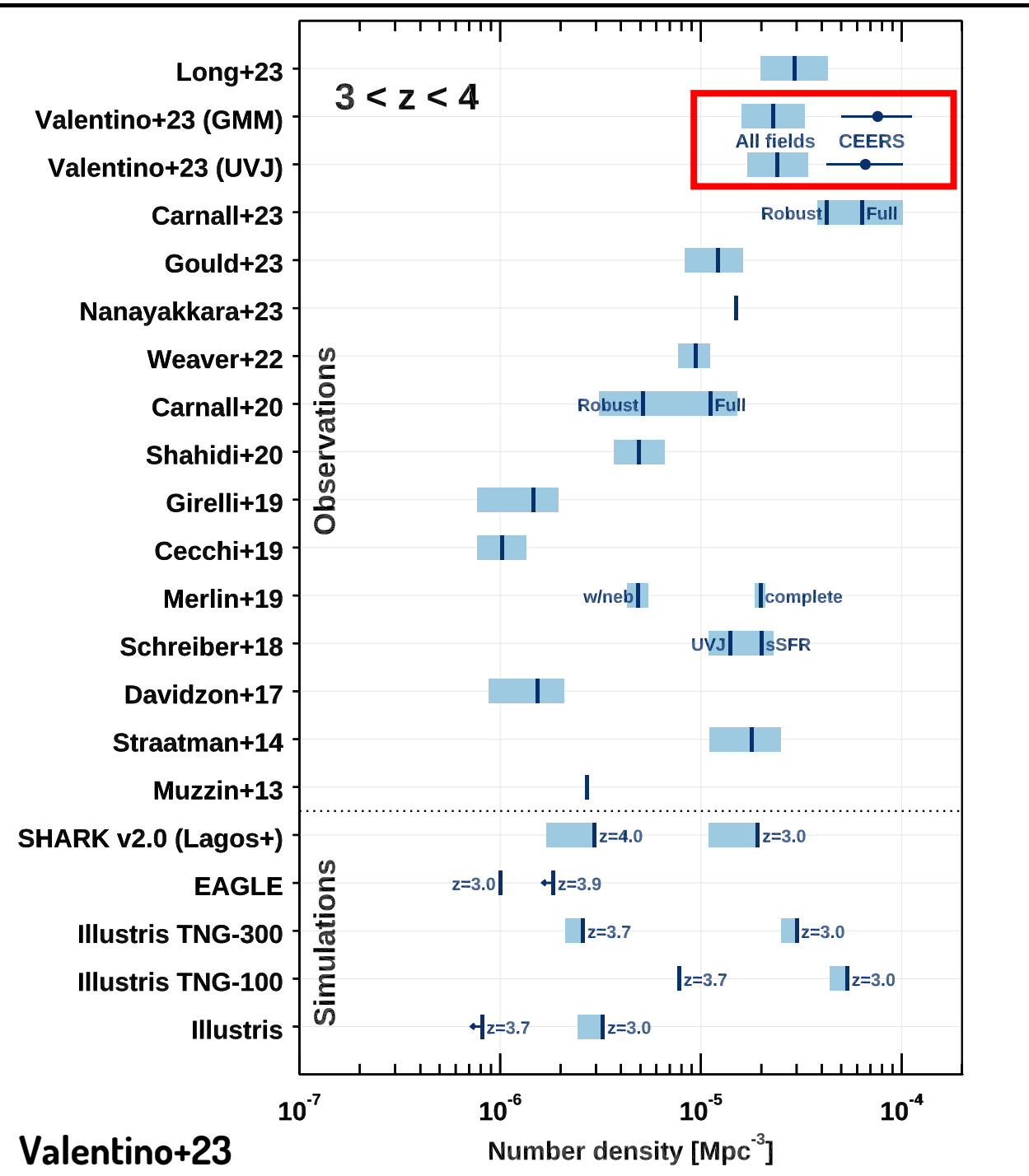
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**Are we reaching an agreement? How?**

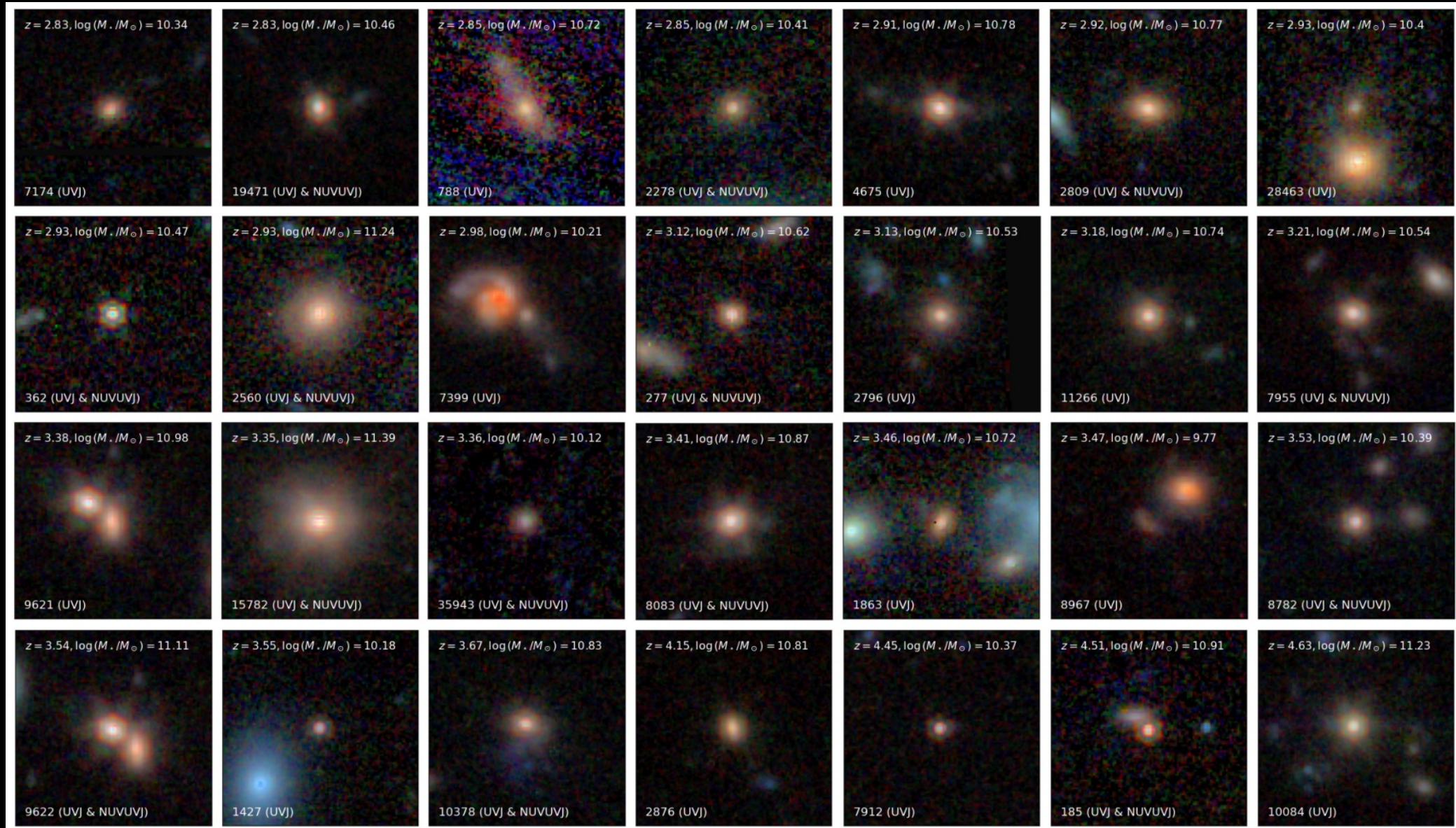




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Ito, Valentino+23 arXiv:2307.06994



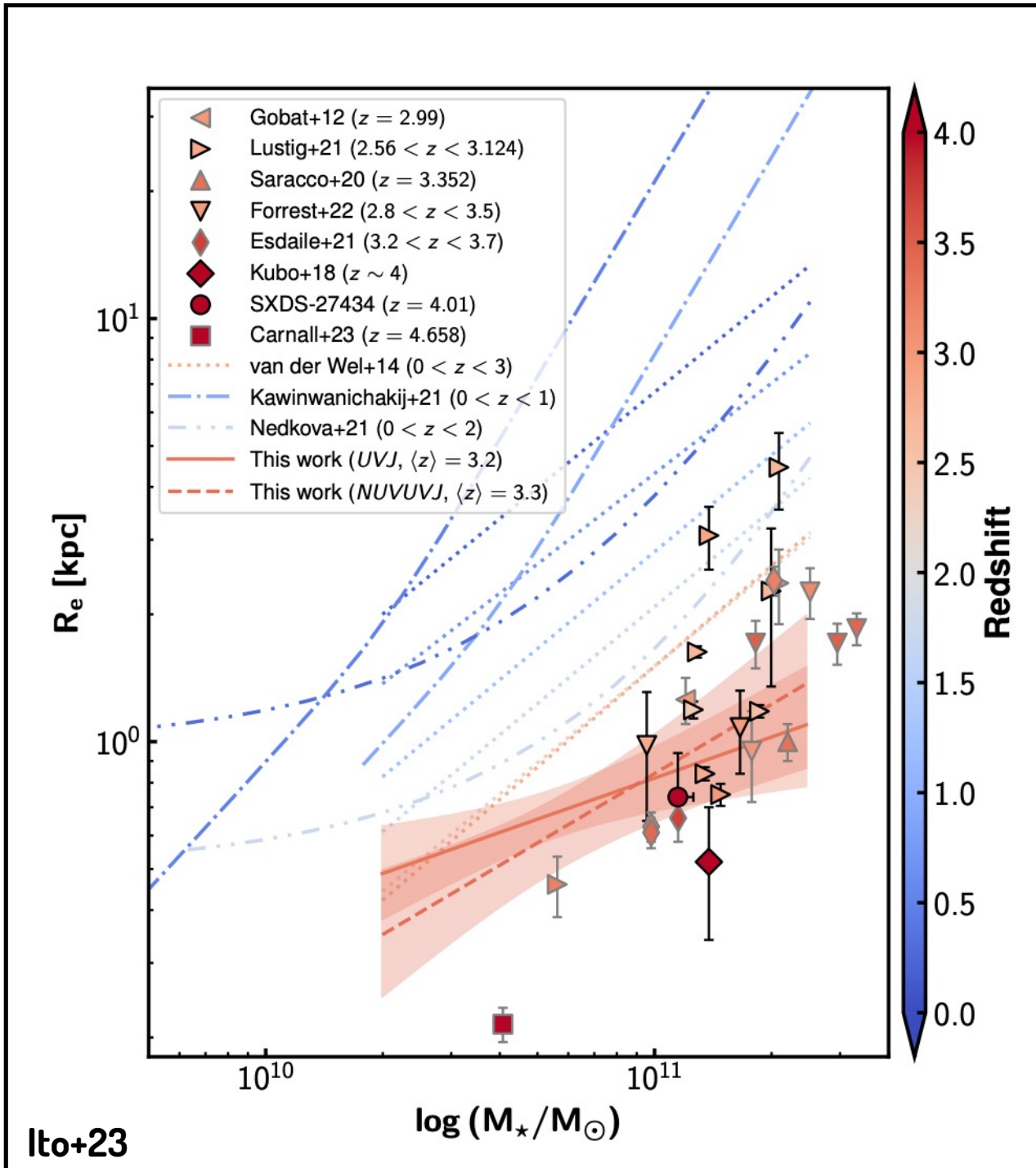
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UV to optical rest-frame size measurements across JWST bands – to correct for a mild negative gradient

## Evolving mass-size relation at $z \sim 3-5$

(consistent with the extrapolation of lower redshift measurements,  $\sim$ constant slope)

Typically spheroid-like shapes and profiles, but hints of lower Sérsic indices and lower axis ratios at high redshifts (and transitional objects).



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A new **quantitative selection** of candidate quiescent galaxies  
(Gould+23, AJ, 165, 248)

An atlas of distant quiescent galaxy candidates (Valentino+23, ApJ, 947, 20)

Photometric studies: **number counts at higher redshifts, lower masses**

**Sizes, shapes, profiles!** They keep evolving at  $z \sim 3-5$ , more disk objects at high redshift (Ito+23, arXiv:2307.06994)

**Cycle 2, ~50 hour NIRSpec follow-up** to determine the physical properties of quiescent galaxies at different post-quenching epochs

**Proof of concept of a (now available!) full-fledged photometric and spectroscopic JWST archive (DAWN JWST Archive)**



# DAWN JWST ARCHIVE



# G. Brammer et al., DAWN



RA Dec

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