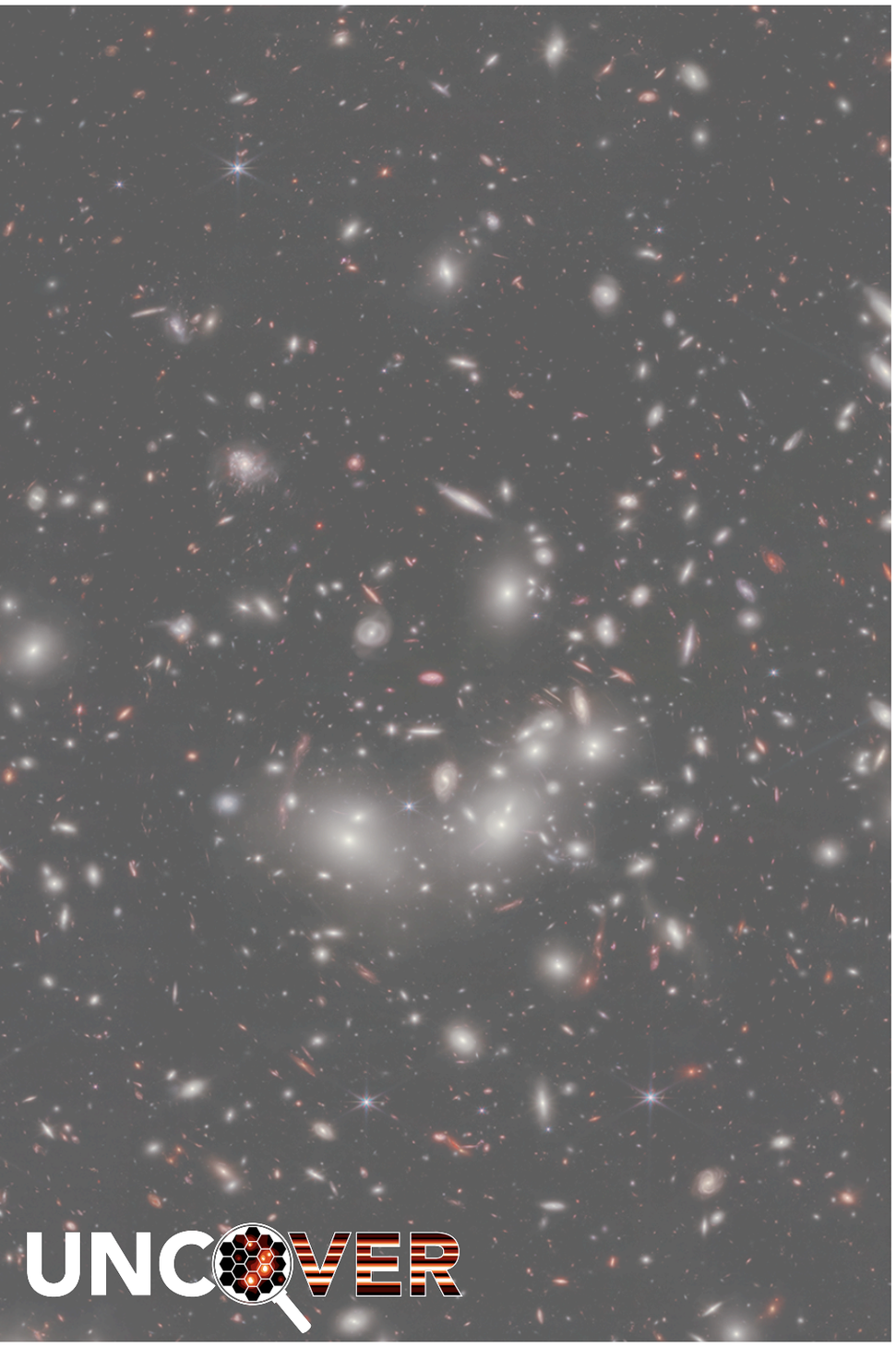
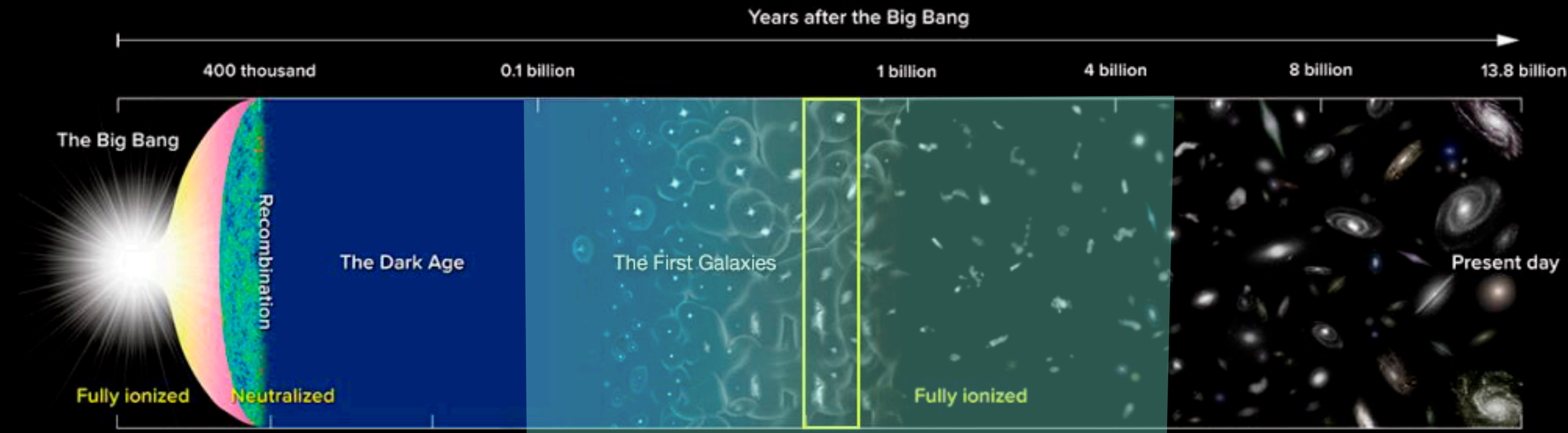


Finding the First Galaxies Behind the Lensing Cluster Abell 2744

Bingjie Wang

Pennsylvania State University

ELT Science in Light of JWST | 12/14/2023

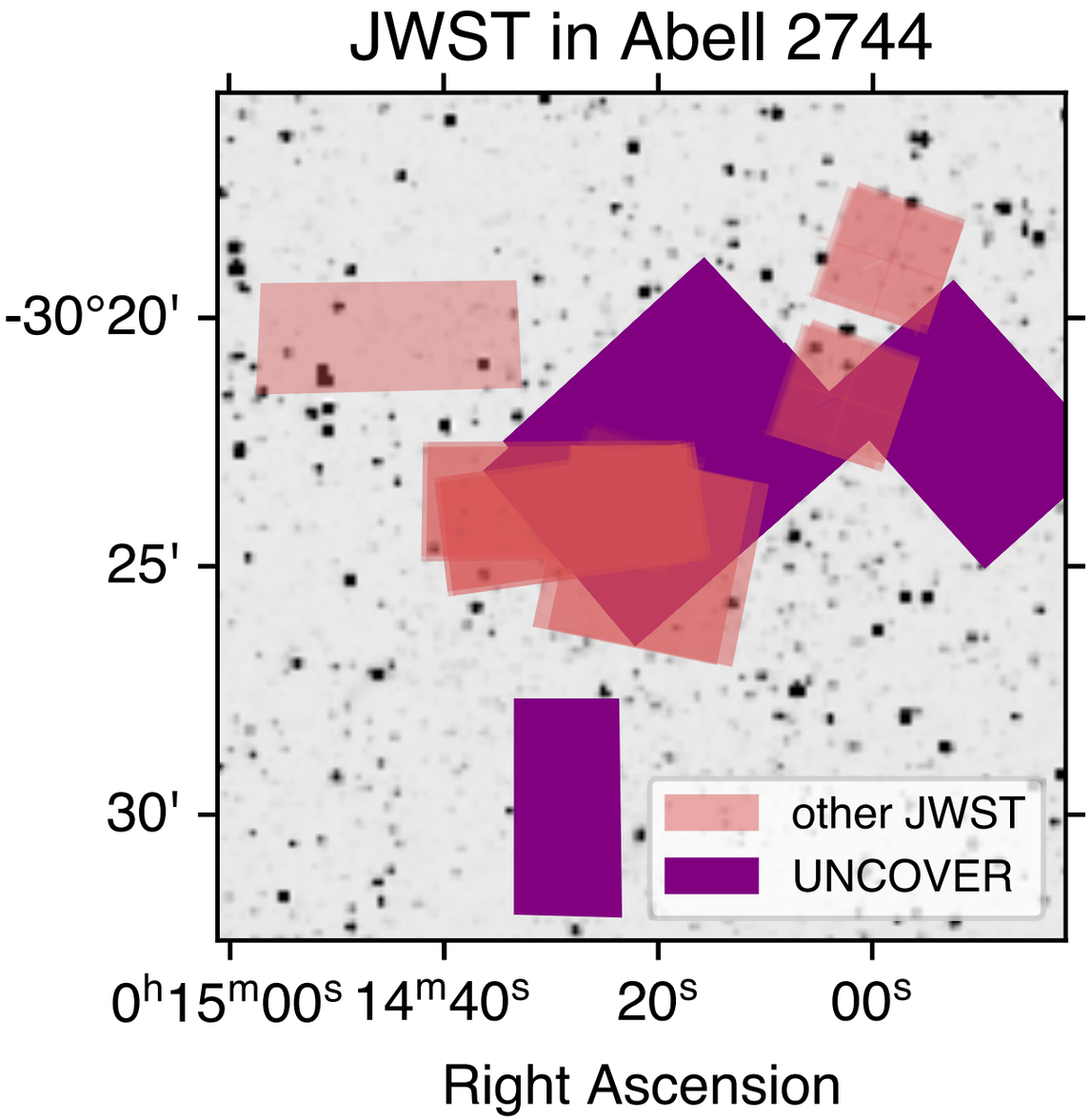


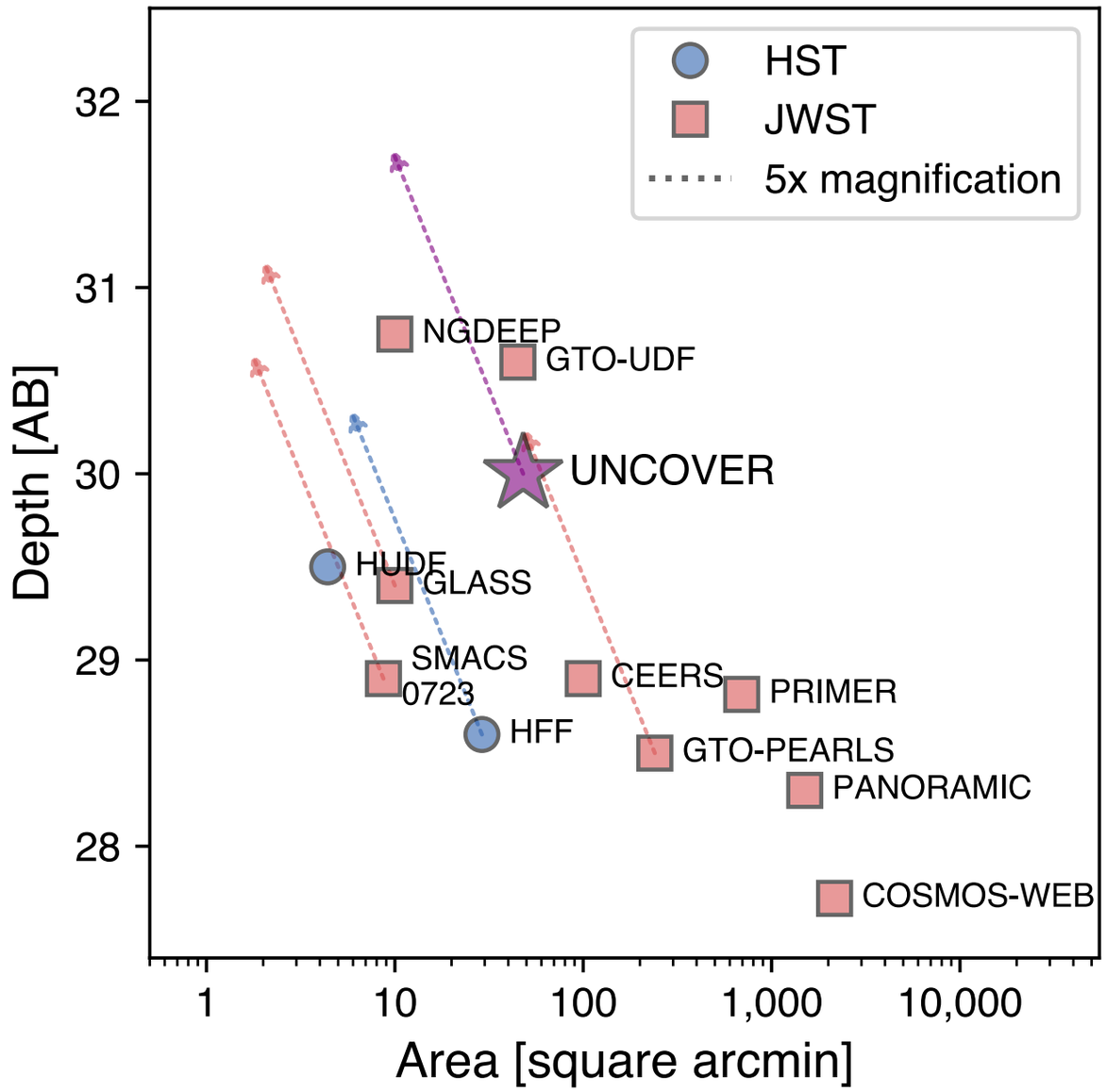
WEBB
SPACE TELESCOPE

The UNCOVER Treasury Survey

Ultradeep; aided by strong gravitational lensing

PIs: Labbe & Bezanson





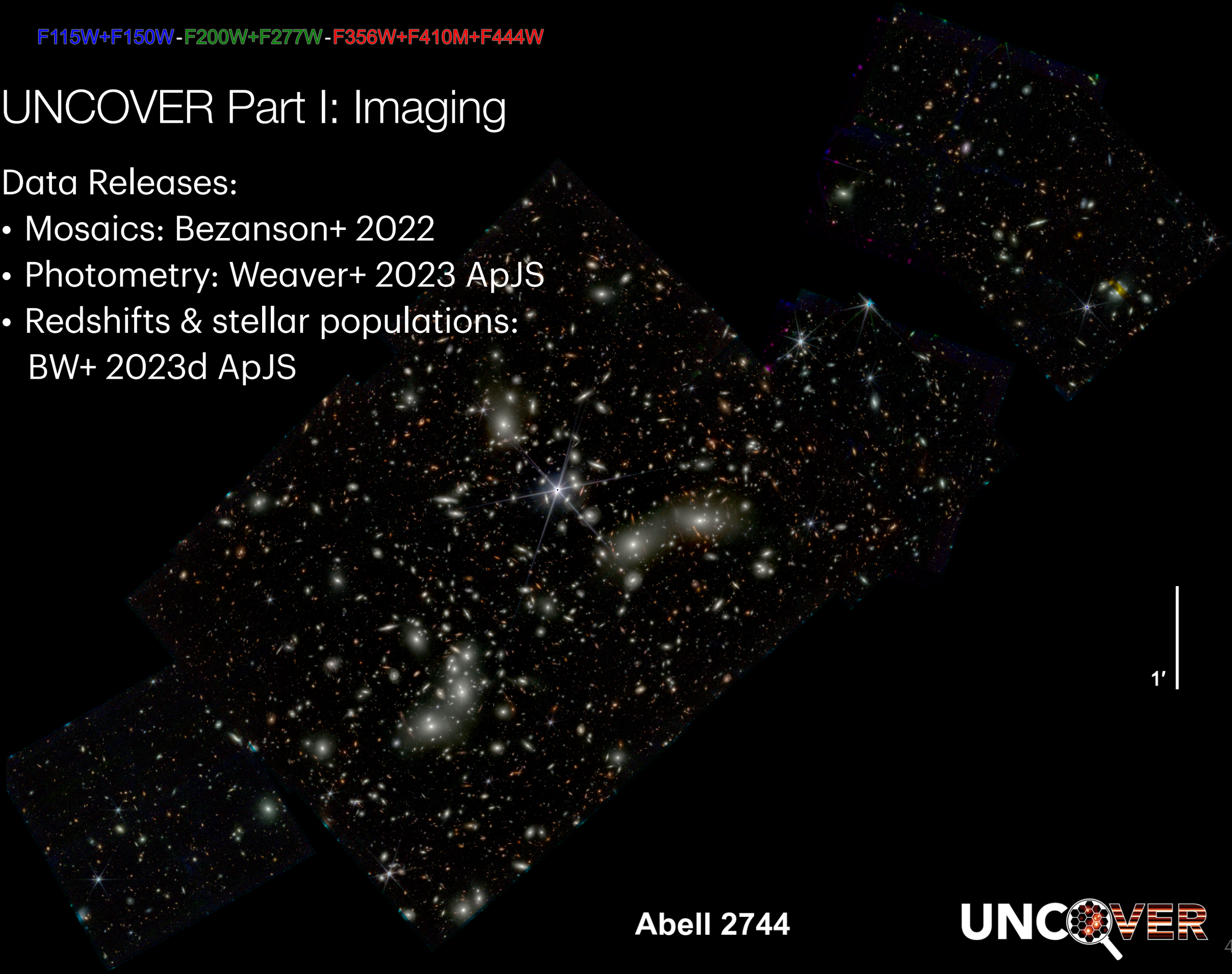
Bezanson+ (incl. BW) 2022

F115W+F150W - F200W+F277W - F356W+F410M+F444W

UNCOVER Part I: Imaging

Data Releases:

- Mosaics: Bezanson+ 2022
- Photometry: Weaver+ 2023 ApJS
- Redshifts & stellar populations: BW+ 2023d ApJS

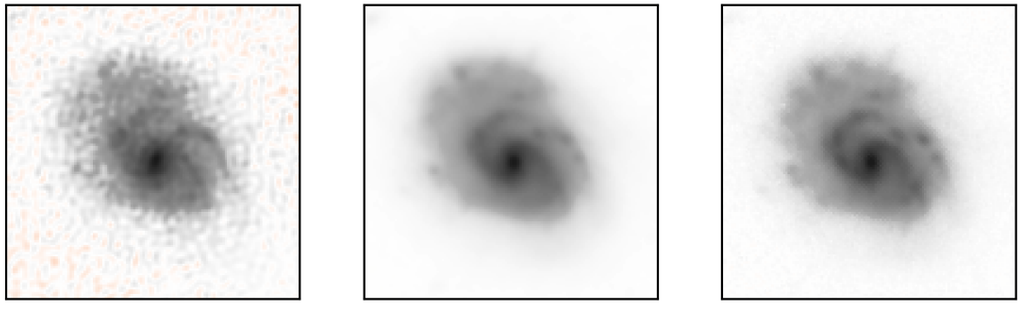


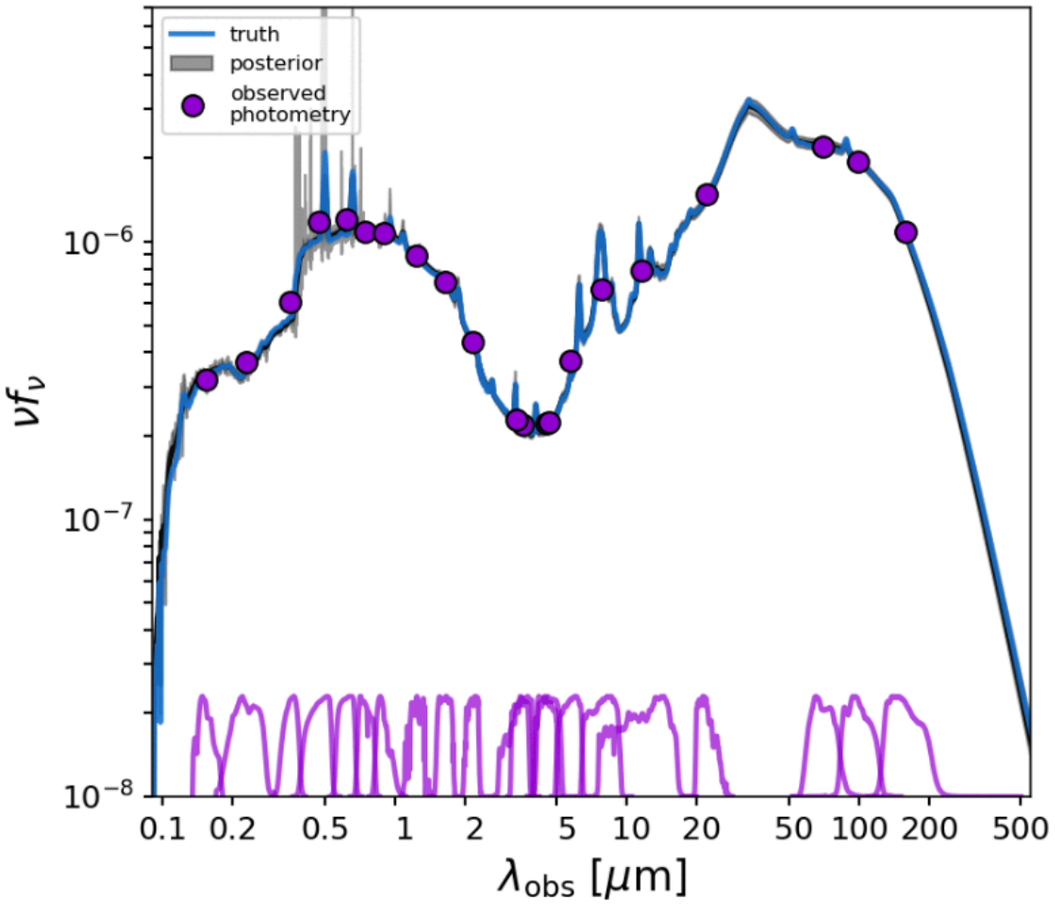
Abell 2744

UNCOVER

Observations

Spectral energy distribution; SED





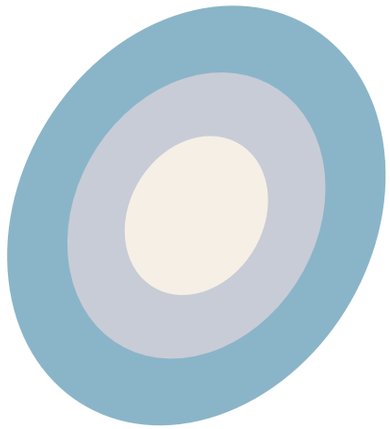
Models

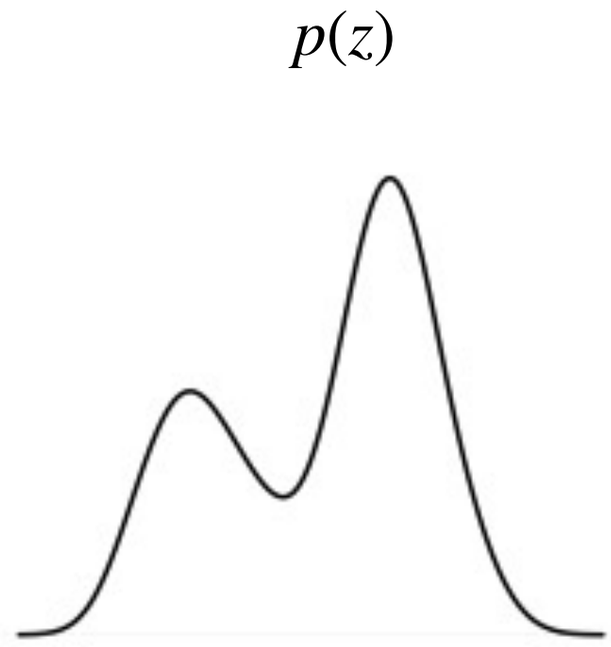
Physical properties

- Stellar mass
- Star formation history
- Dust
- Gas
- …

State-of-the-art SED modeling

Joint probability distributions of galaxy properties ("the Bayesian revolution")





Bayesian codes for high-dimensional SED modeling

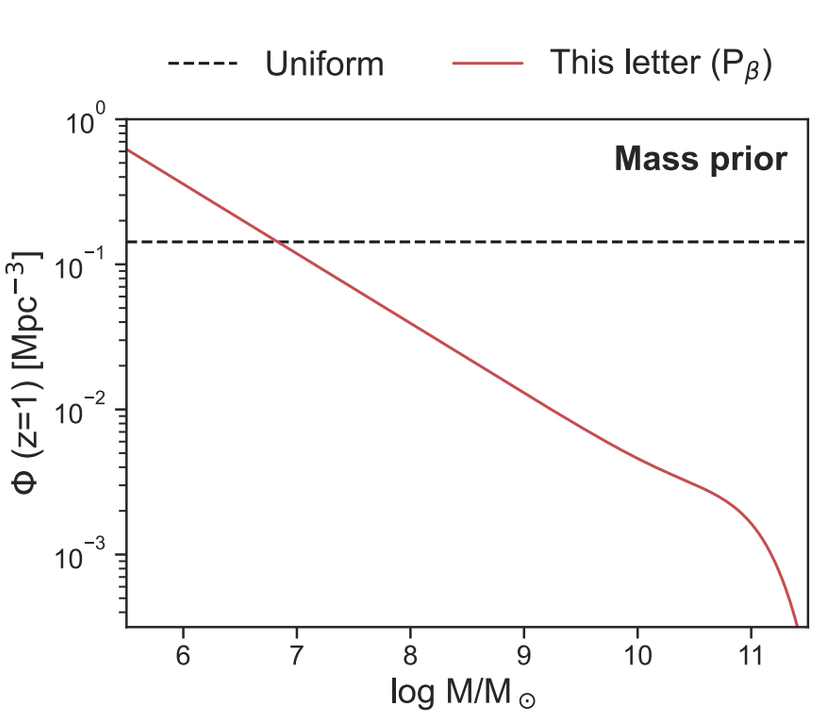
- BEAGLE (Chevallard & Charlot 16)
- BAGPIPES (Carnall+18)
- Prospector (Johnson+21)
- …

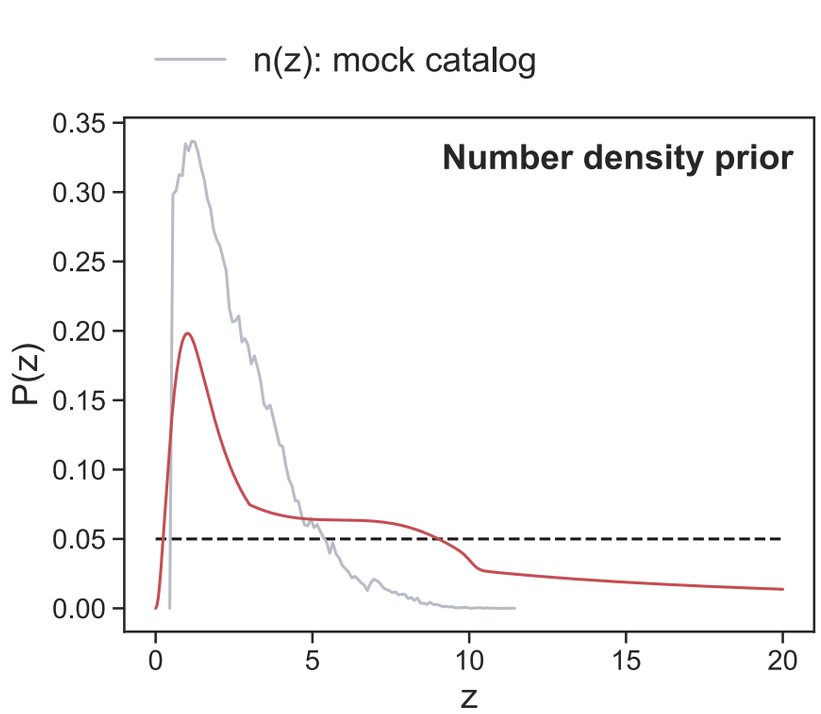
Photo-z codes

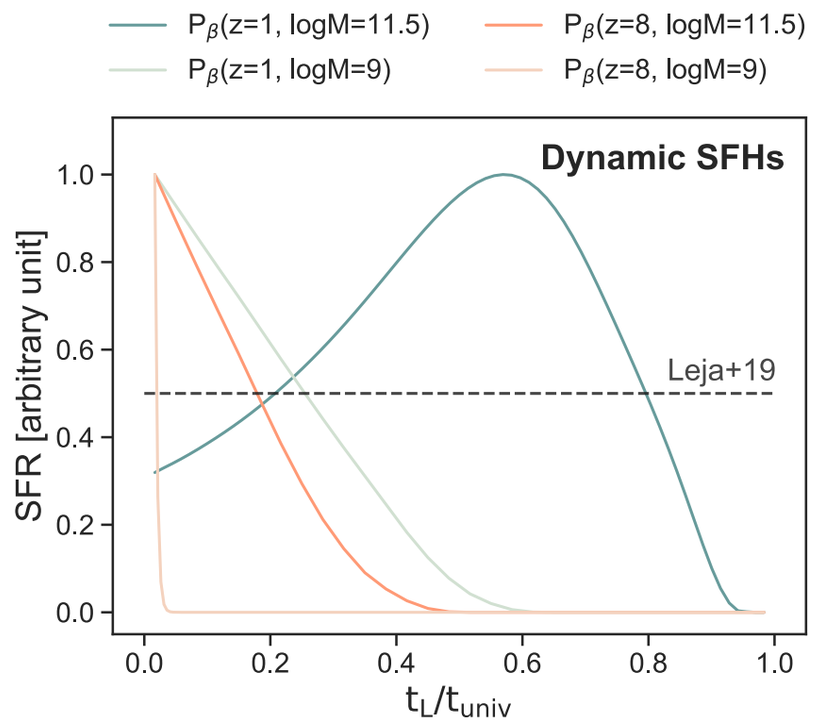
- LePhare (Arnouts+99; Ilbert+06)
- BPZ (Benítez+00)
- EAzY (Brammer+08)
- …

Prospector-β: new galaxy evolution priors

BW+ 2023a ApJL







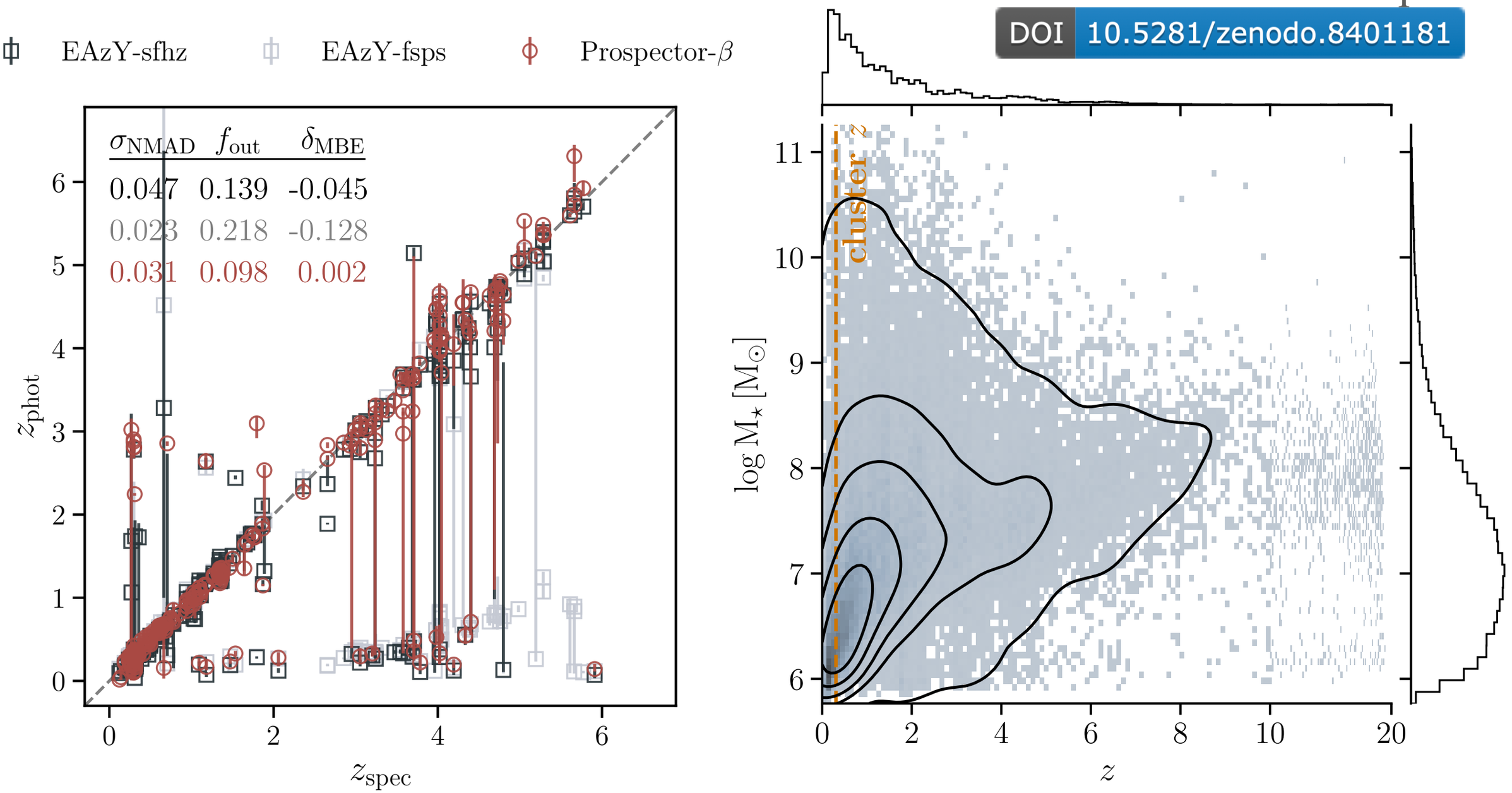
Intended for fitting galaxy photometry where z is unknown

Publicly available as a part of Prospector

UNCOVER Redshift & Stellar Population Catalog

BW+ 2023d ApJS

DOI 10.5281/zenodo.8401181

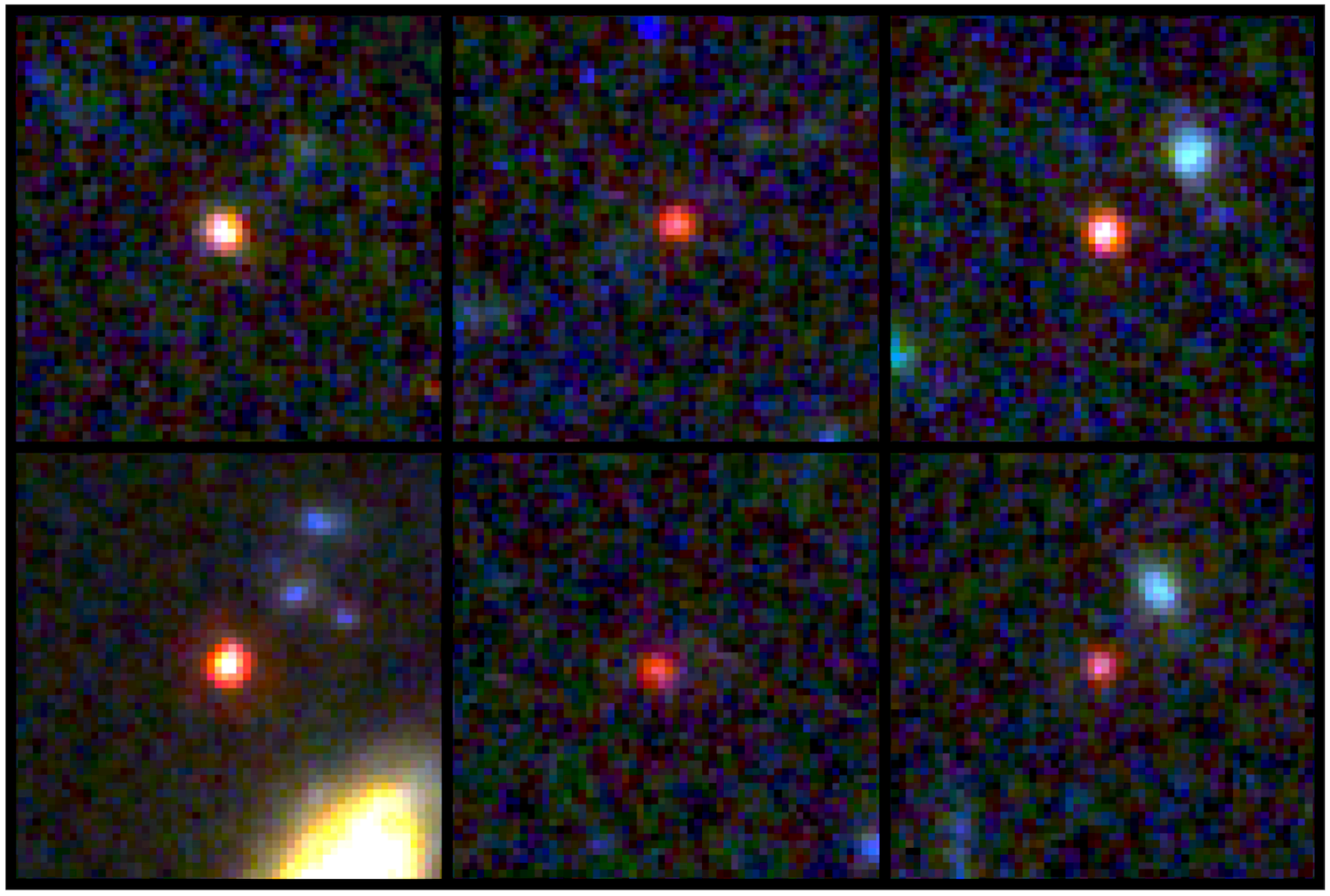


≳ 60k objects; all parameters jointly inferred using Prospector-β

Contains redshifts, stellar masses, metallicities, ages, SFRs, contributions from dust, gas, and mid-IR AGN, and rest-frame colors.

Prospector-β: applications on JWST data

Labbe+ (incl. BW) 2023 Nature



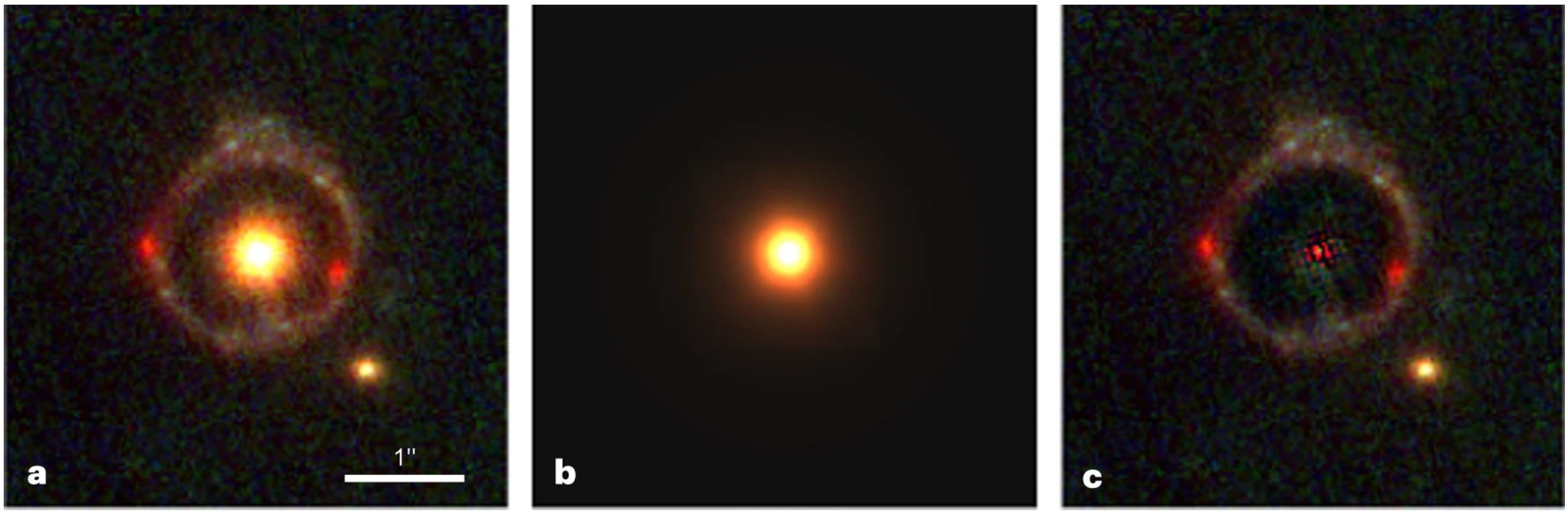
Red, candidate massive galaxies at $z \sim 8$, dubbed “universe breakers”

- Unexpectedly massive if they are galaxies (c.f. Greene+23, Kocevski+23)

- To be followed up with JWST/NIRSpec (PIs Nelson & Labbe)

Prospector-β: applications on JWST data

van Dokkum, Brammer, BW+ 2023 Nat Ast



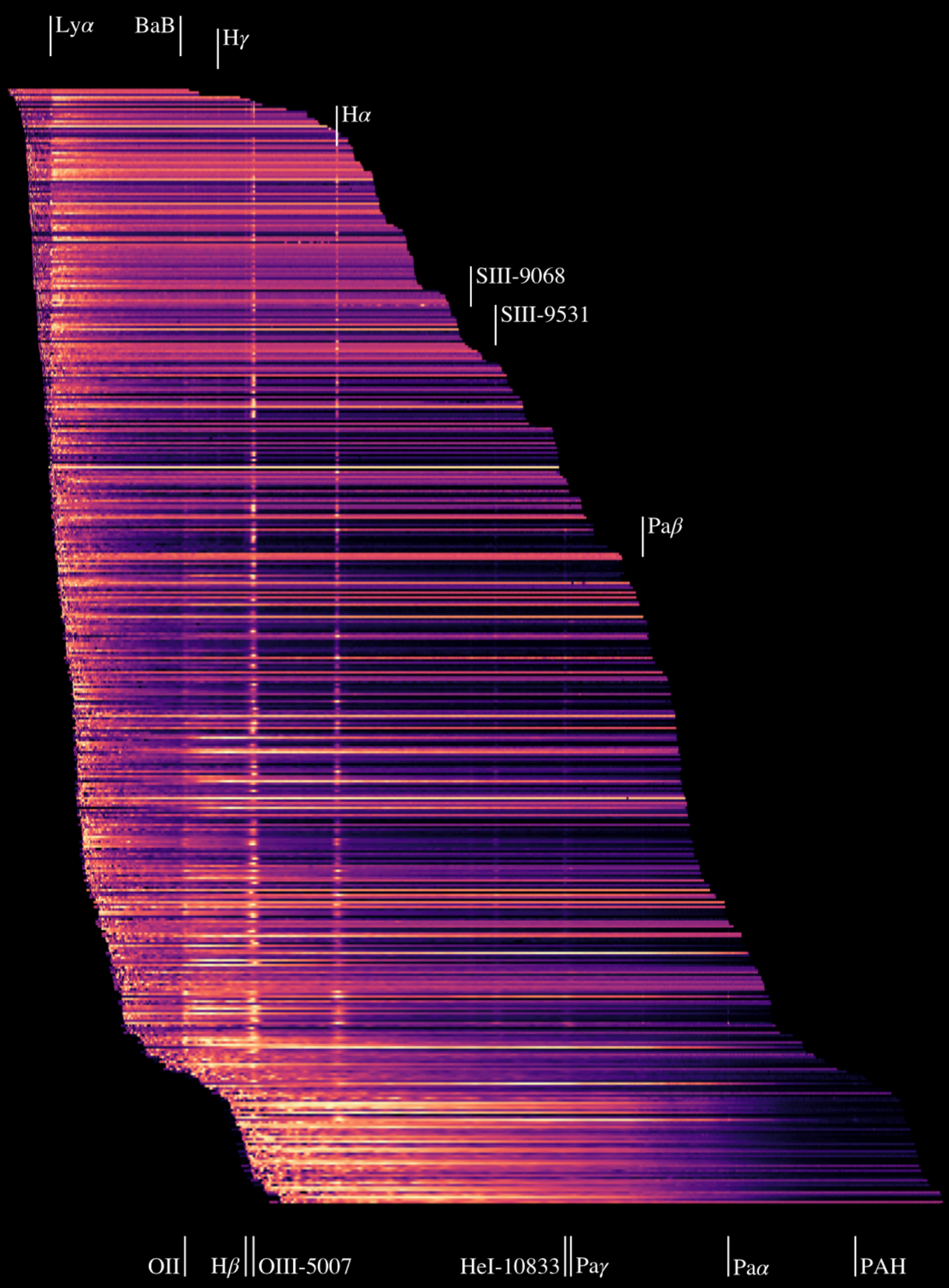
The highest redshift lens; enclosed is a compact, massive, quiescent galaxy

Total mass > stellar mass + dark matter mass

also see Mercier+ 2023

UNCOVER Part II: Spectroscopy

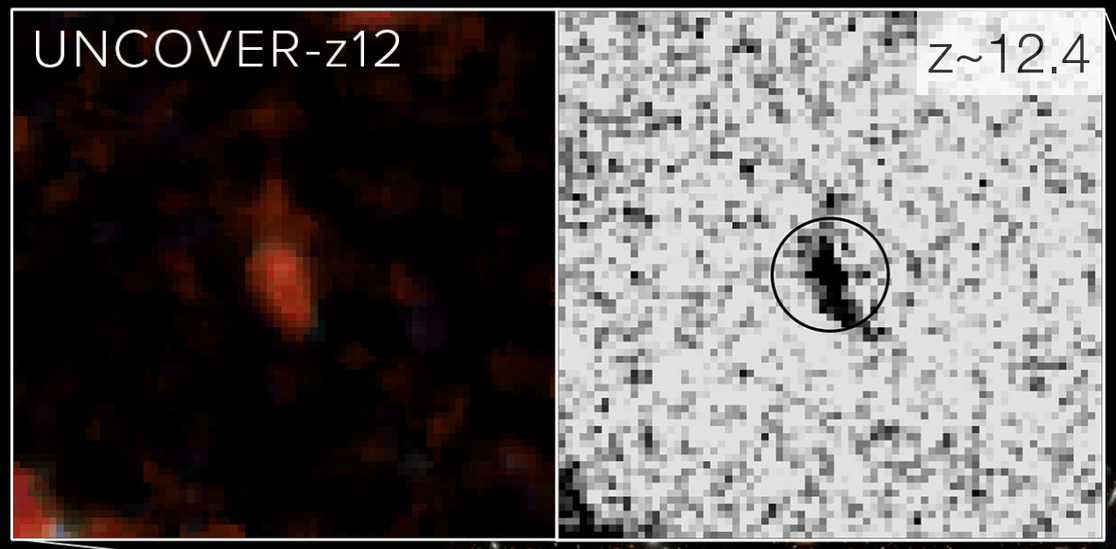
- 2 — 17hr integrations
- 7 MSA masks

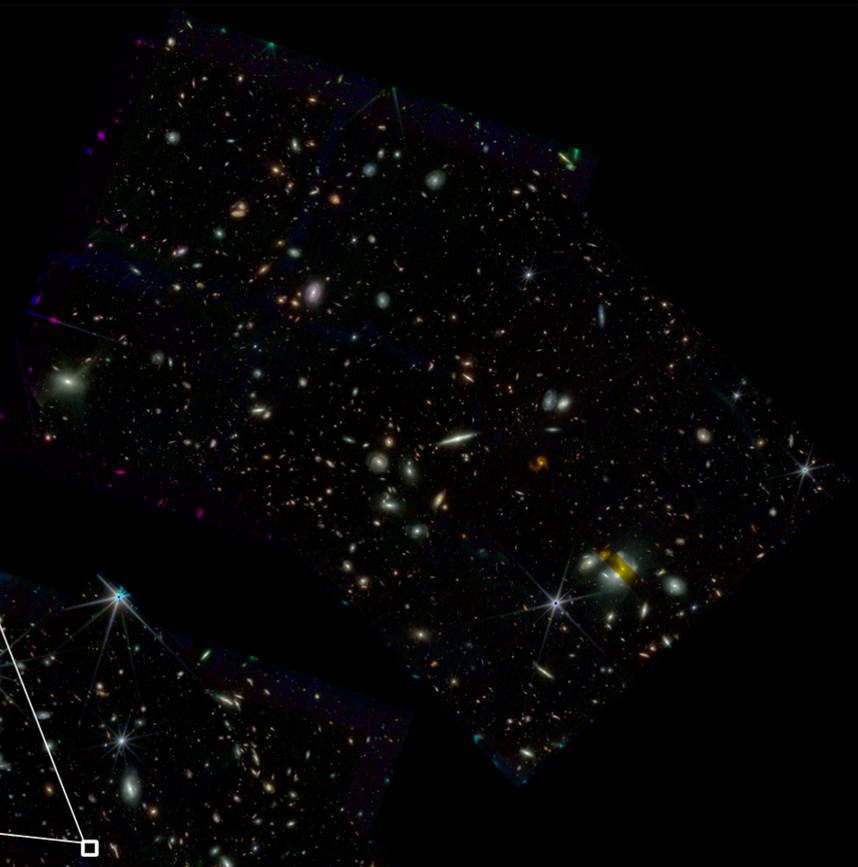


Price+ (incl. BW) in prep

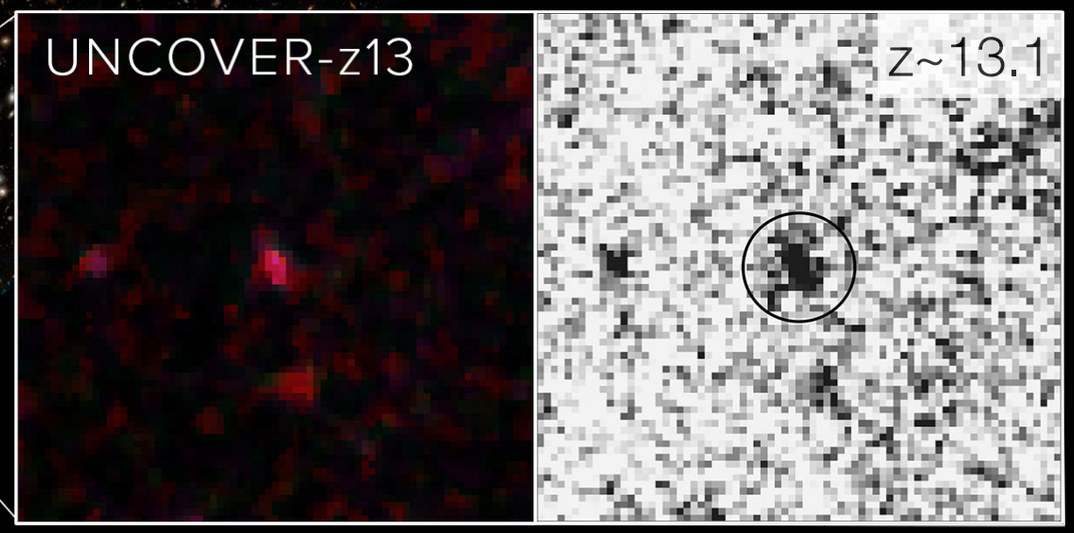
JWST/NIRSpec confirmation of $z > 12$ galaxies

BW+ 2023c ApJL





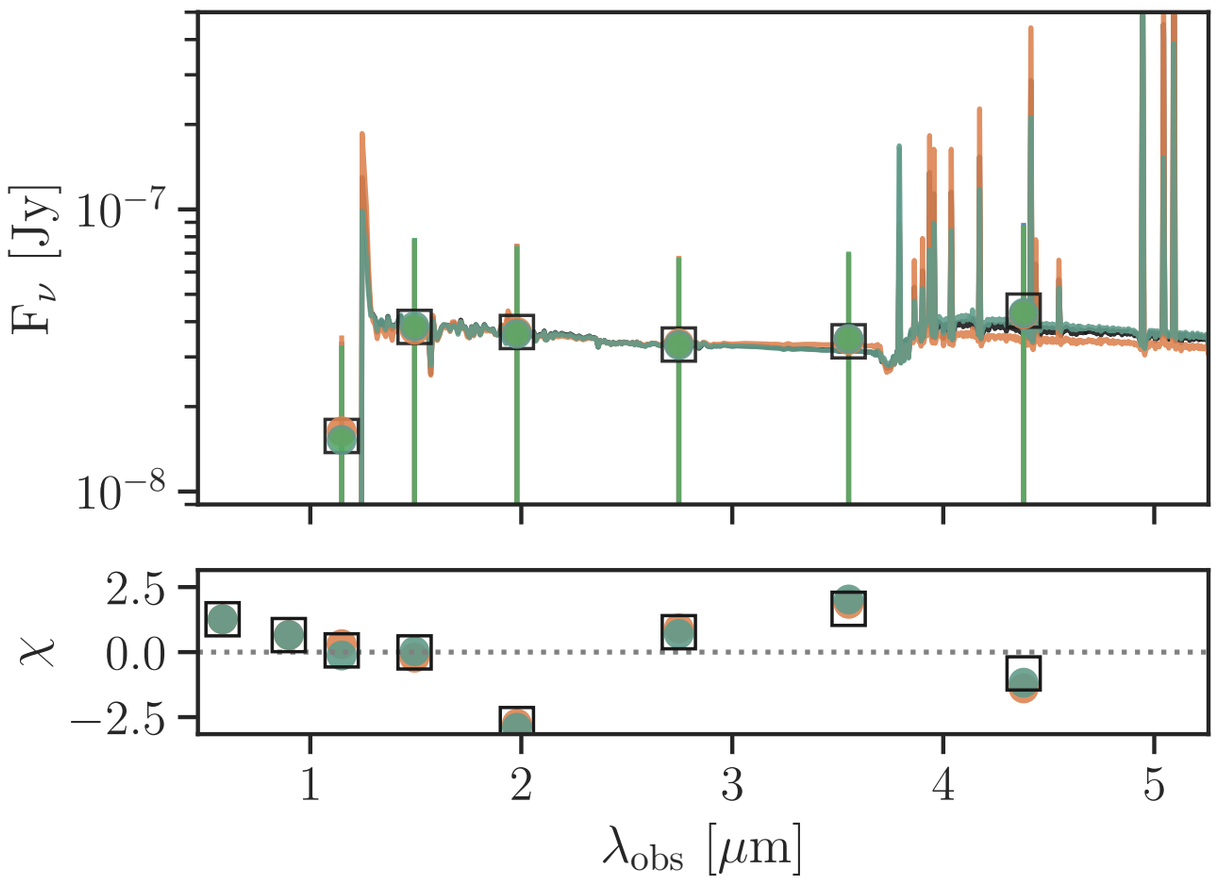
- ~ 300 - 400 pc in size, notably larger than the JADES $z > 10$ galaxies (Curtis-Lake+ 23; Robertson+ 23)

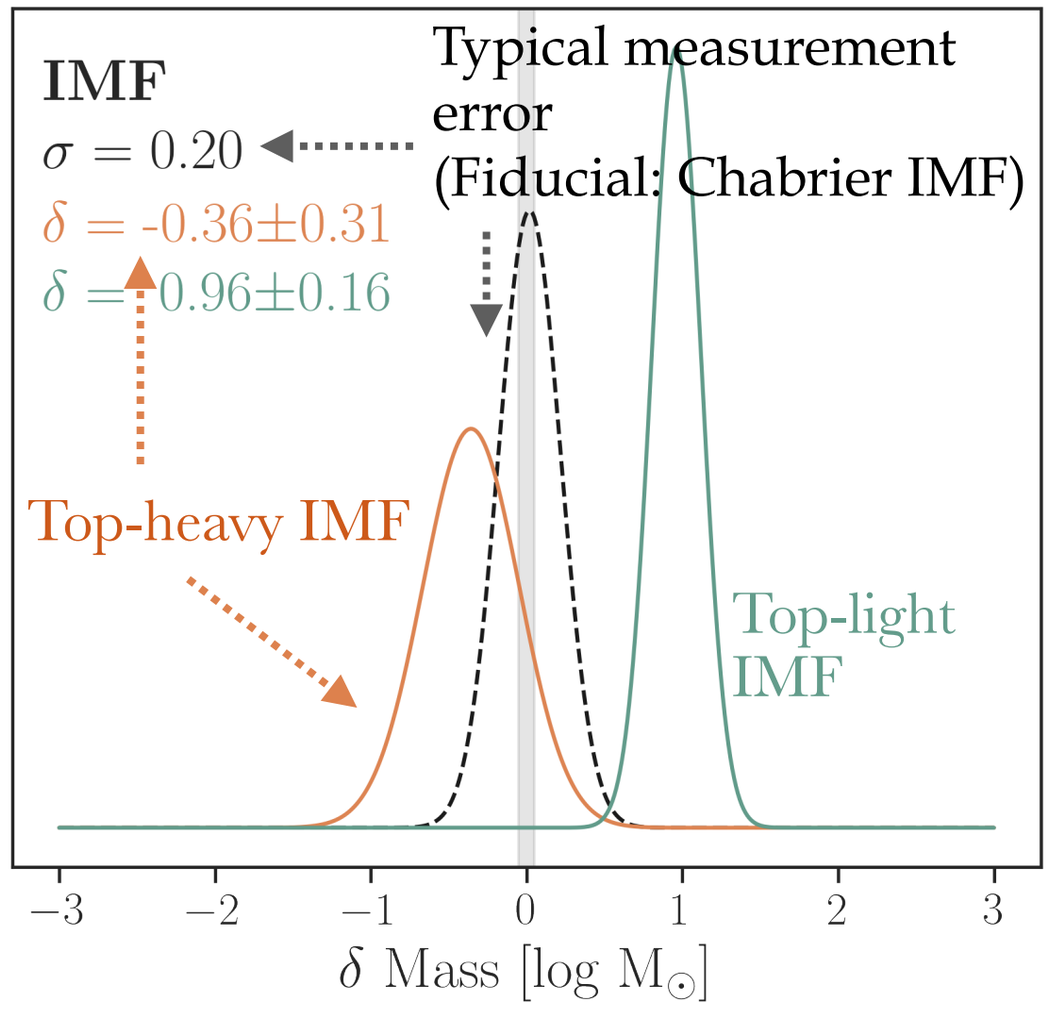


Systematics in SED fitting & ELT outlook

BW+ 2023e sub. to ApJ

The known unknowns: burstiness of SFH, the IMF, and nebular physics





I. Photometric data are too degenerate to distinguish between the models

II. Systematics can >>

i. formal reported uncertainties

ii. scatter from using different SED fitting codes (Pacifici+ 2023)