

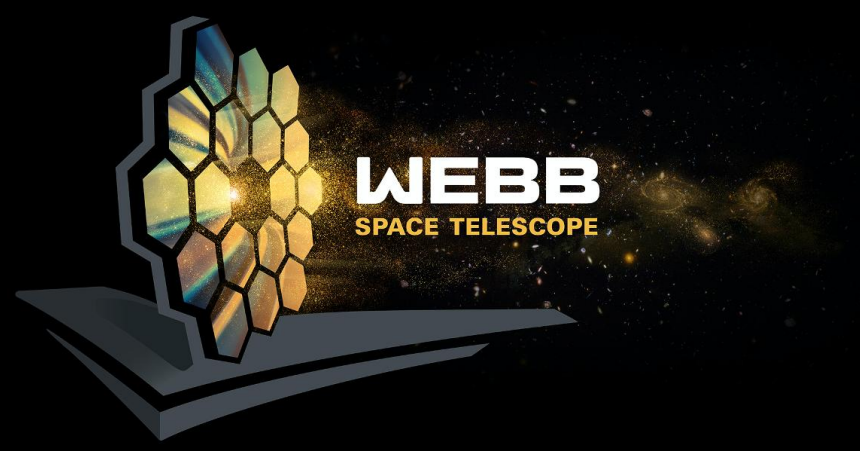
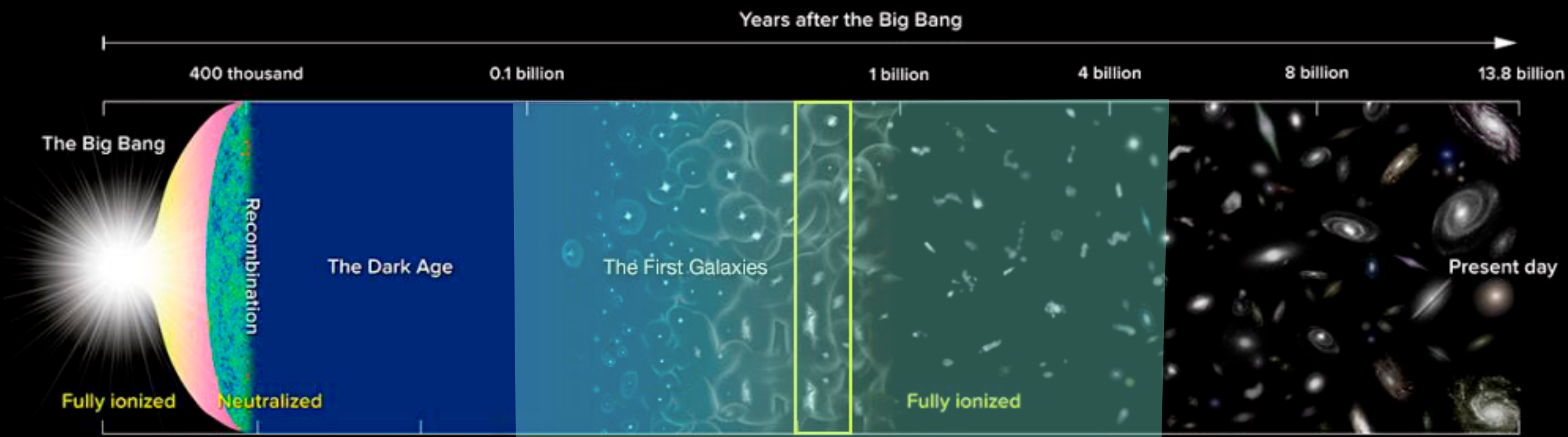


Finding the First Galaxies Behind the Lensing Cluster Abell 2744

Bingjie Wang

Pennsylvania State University



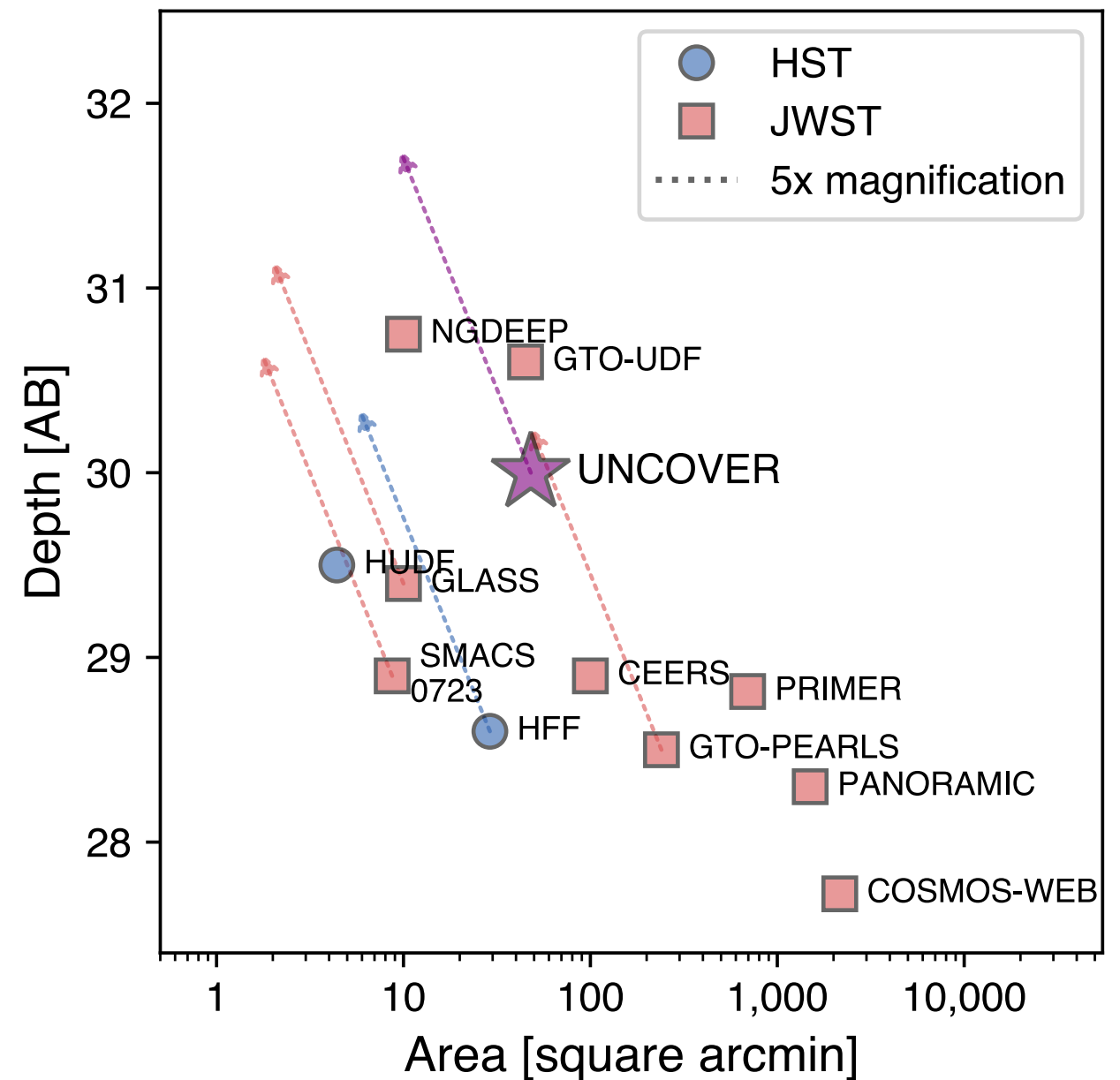
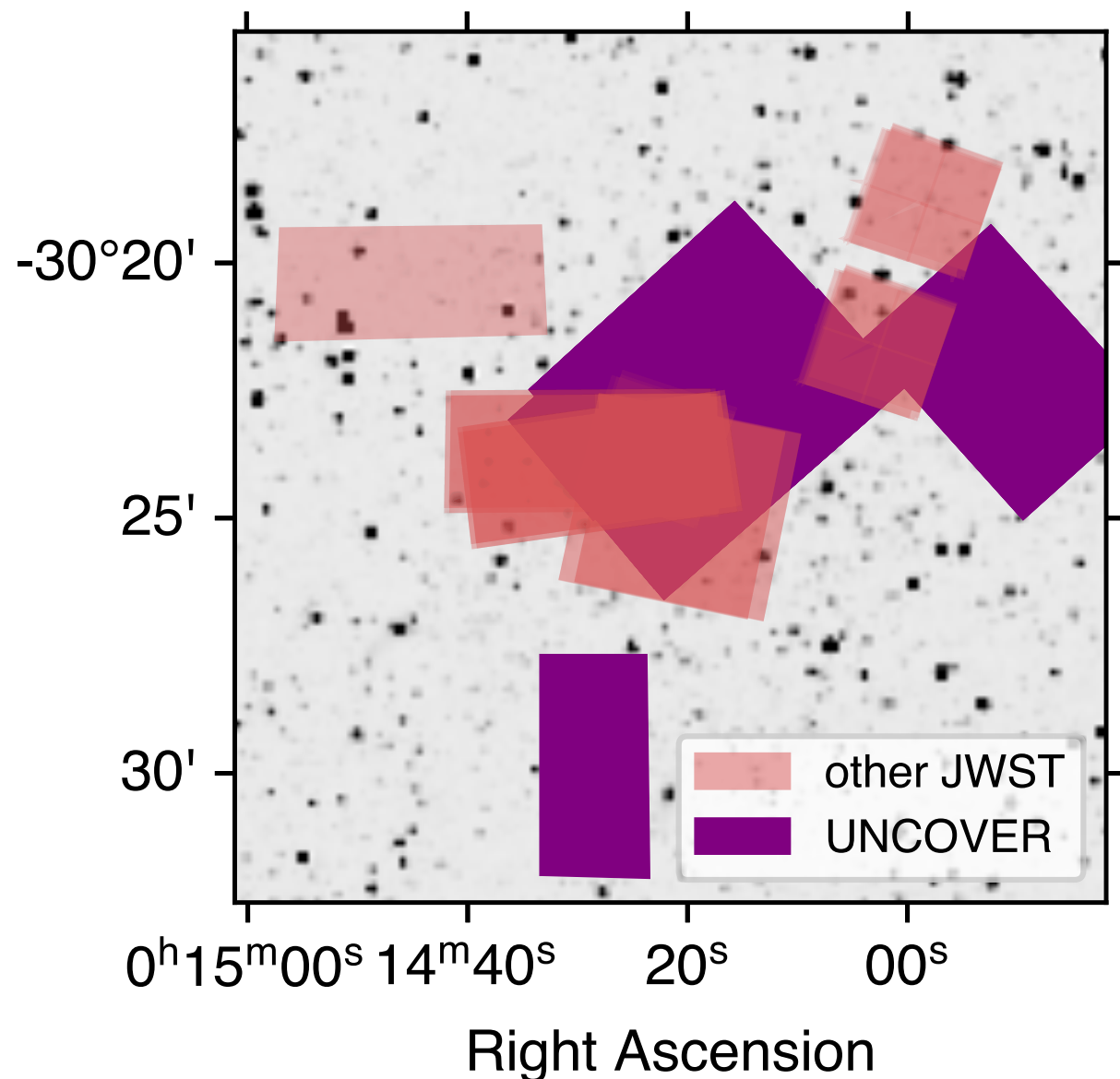


The UNCOVER Treasury Survey

Ultradeep; aided by strong gravitational lensing

PIs: Labbe & Bezanson

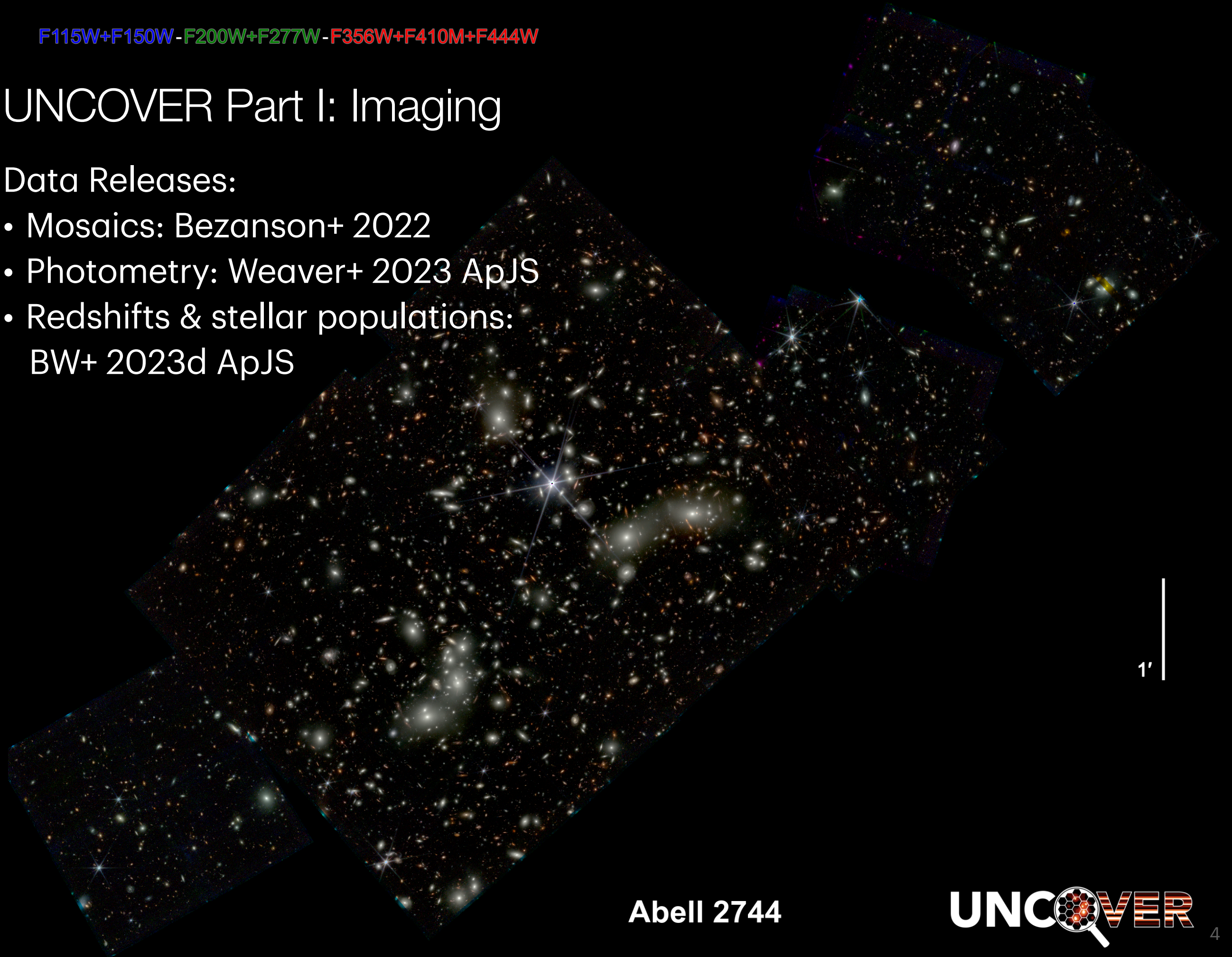
JWST in Abell 2744



UNCOVER Part I: Imaging

Data Releases:

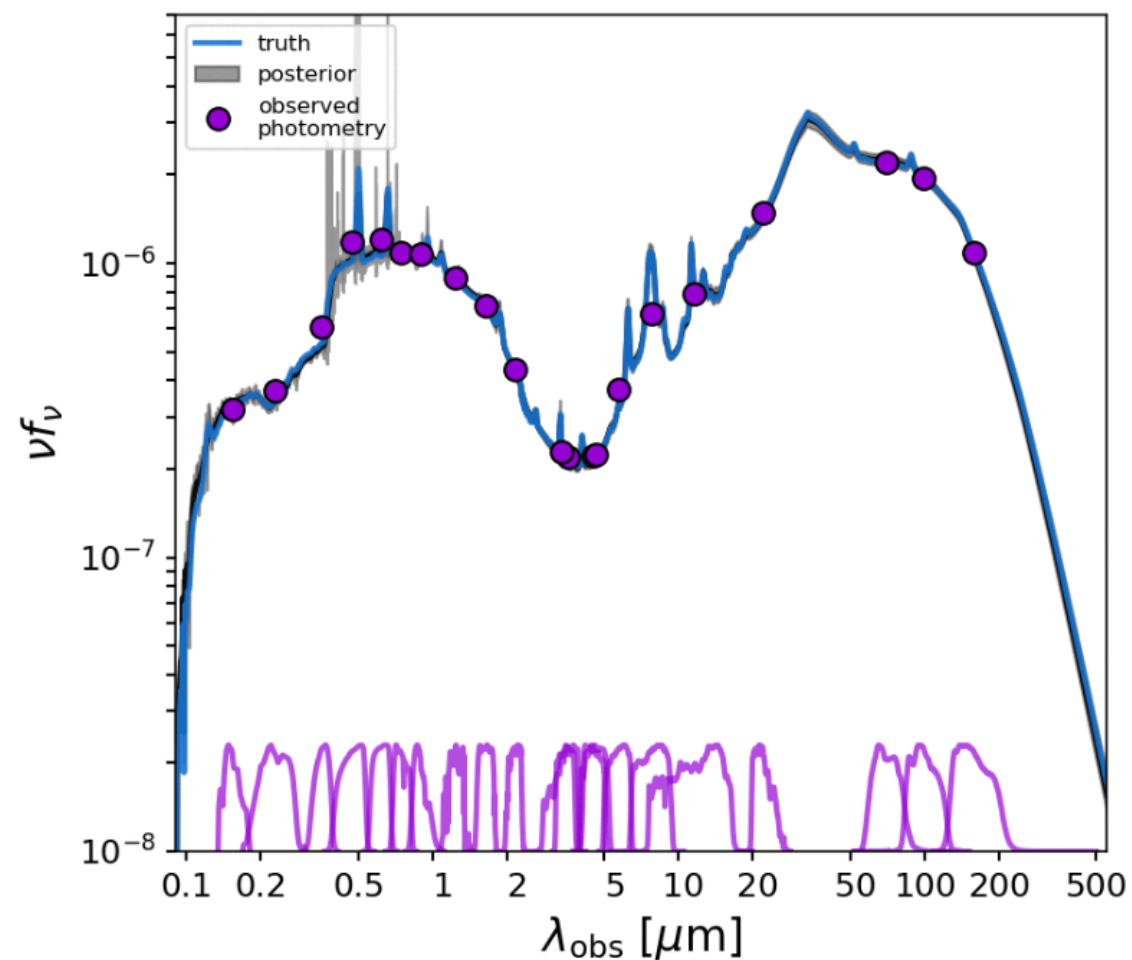
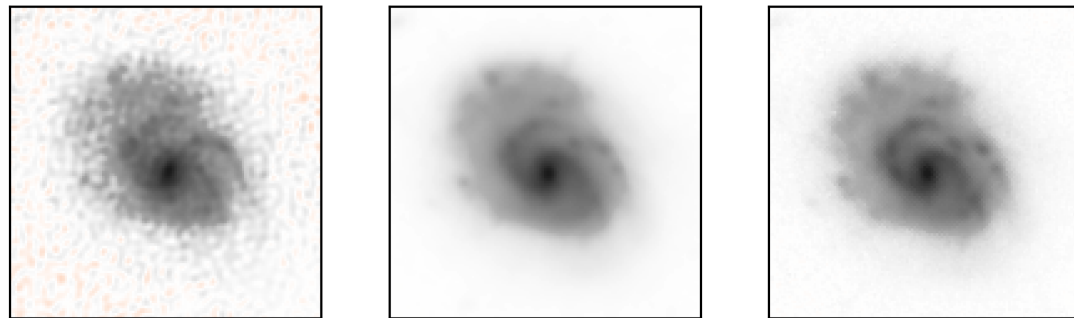
- Mosaics: Bezanson+ 2022
- Photometry: Weaver+ 2023 ApJS
- Redshifts & stellar populations:
BW+ 2023d ApJS



Abell 2744

Observations

Spectral energy distribution; SED



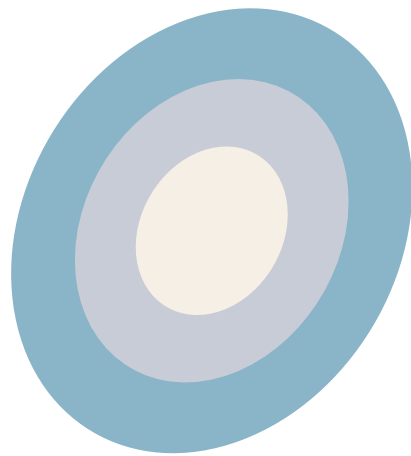
Models

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)
- ...

$p(z)$

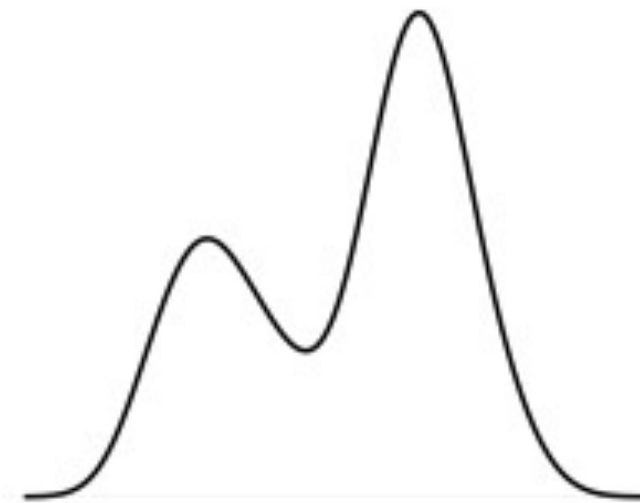
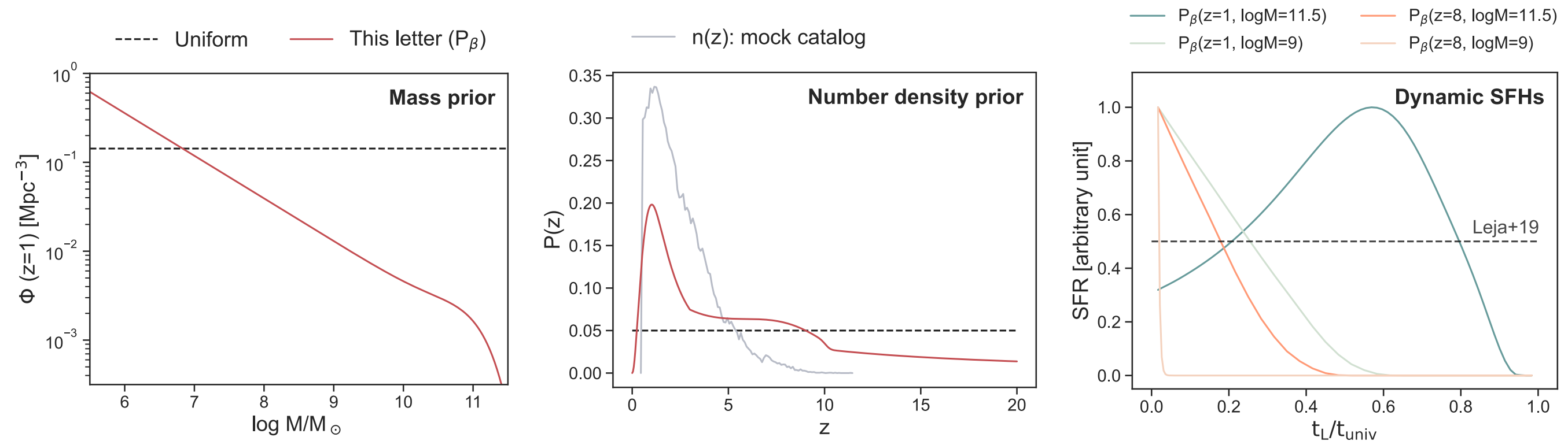


Photo-z codes

- 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

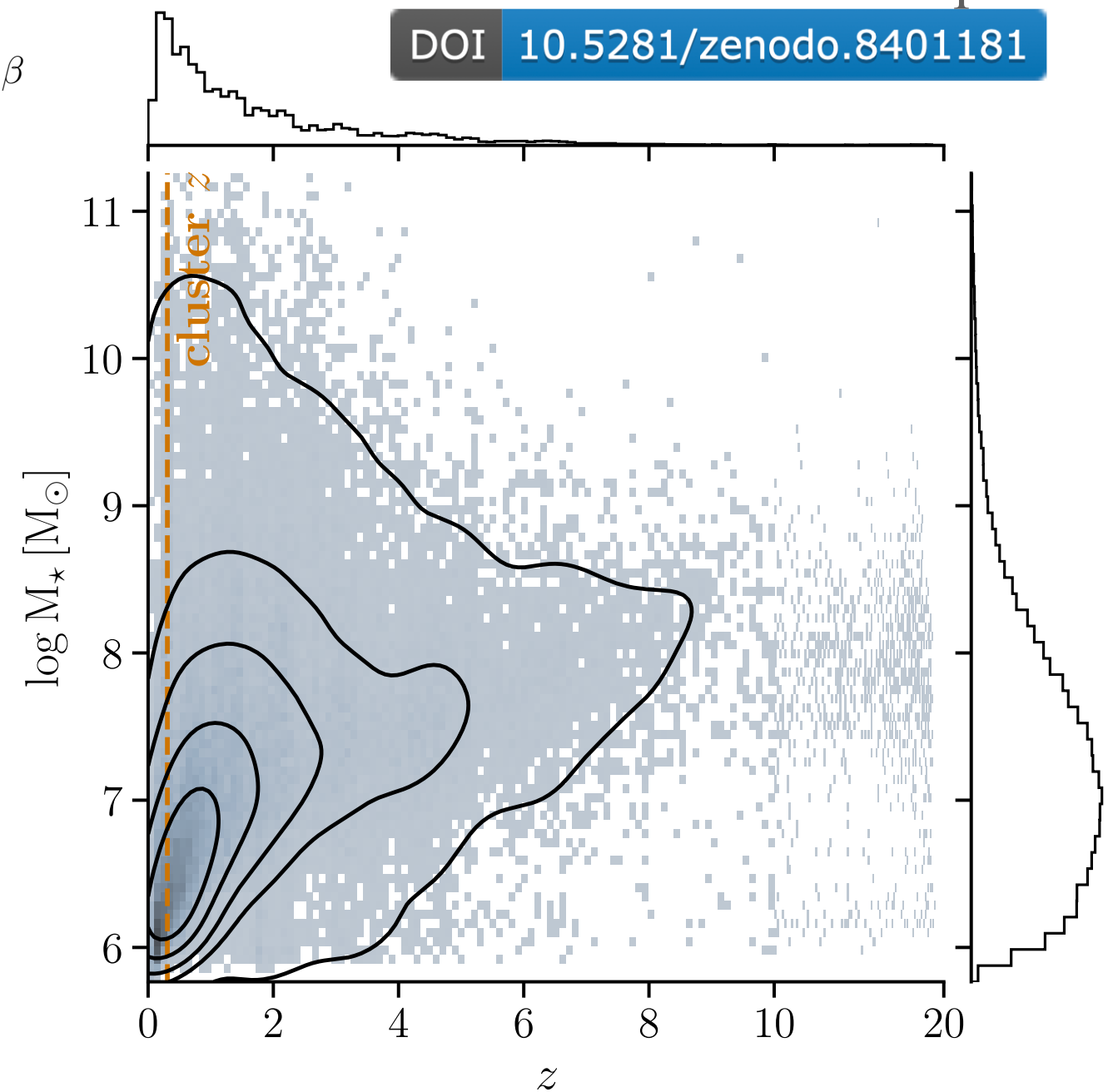
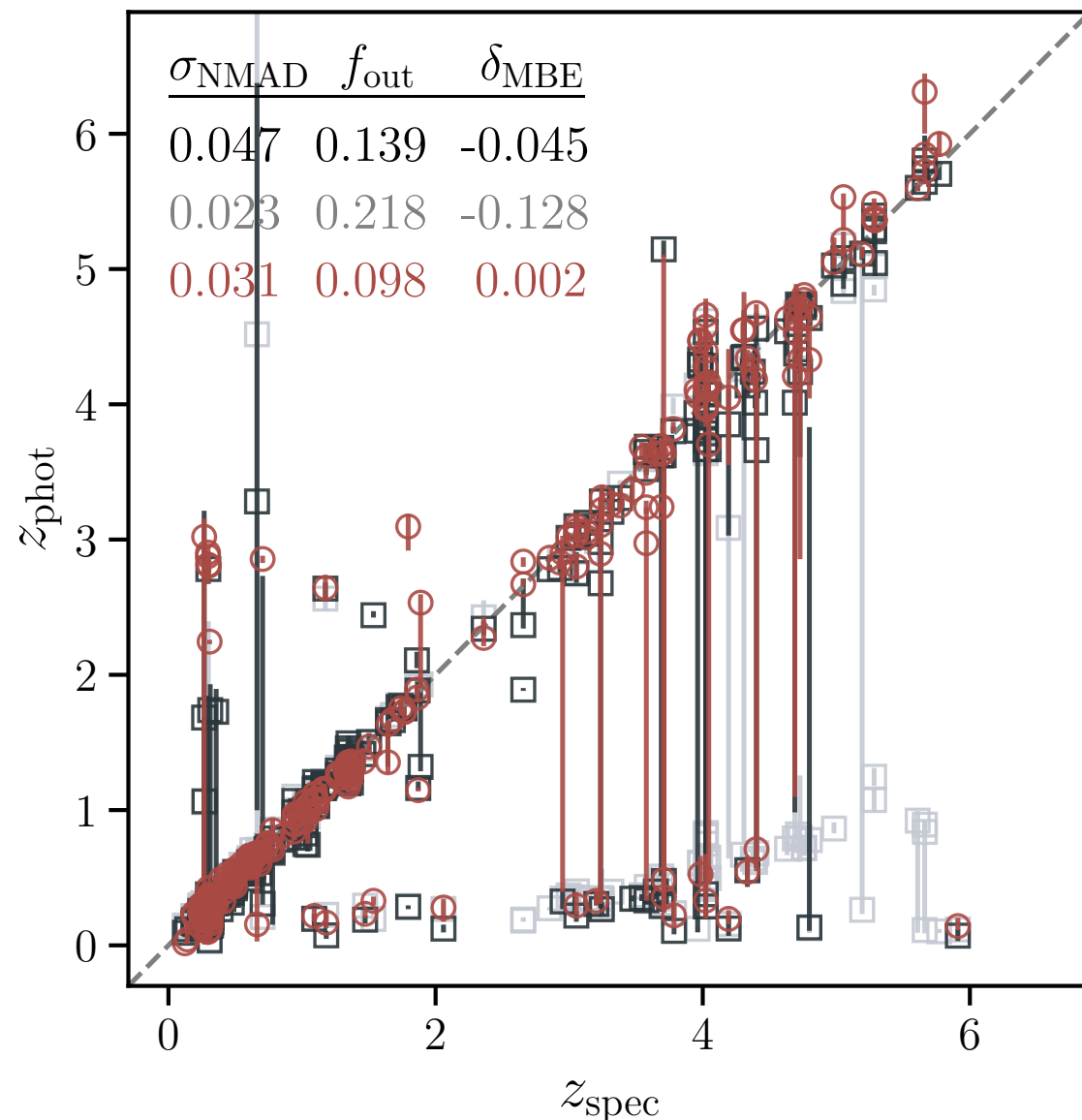
Publicly available as a part of Prospector 

UNCOVER Redshift & Stellar Population Catalog

BW+ 2023d ApJS

DOI [10.5281/zenodo.8401181](https://doi.org/10.5281/zenodo.8401181)

⊞ EAzY-sfhz ⊞ EAzY-fsps ⊞ Prospector- β

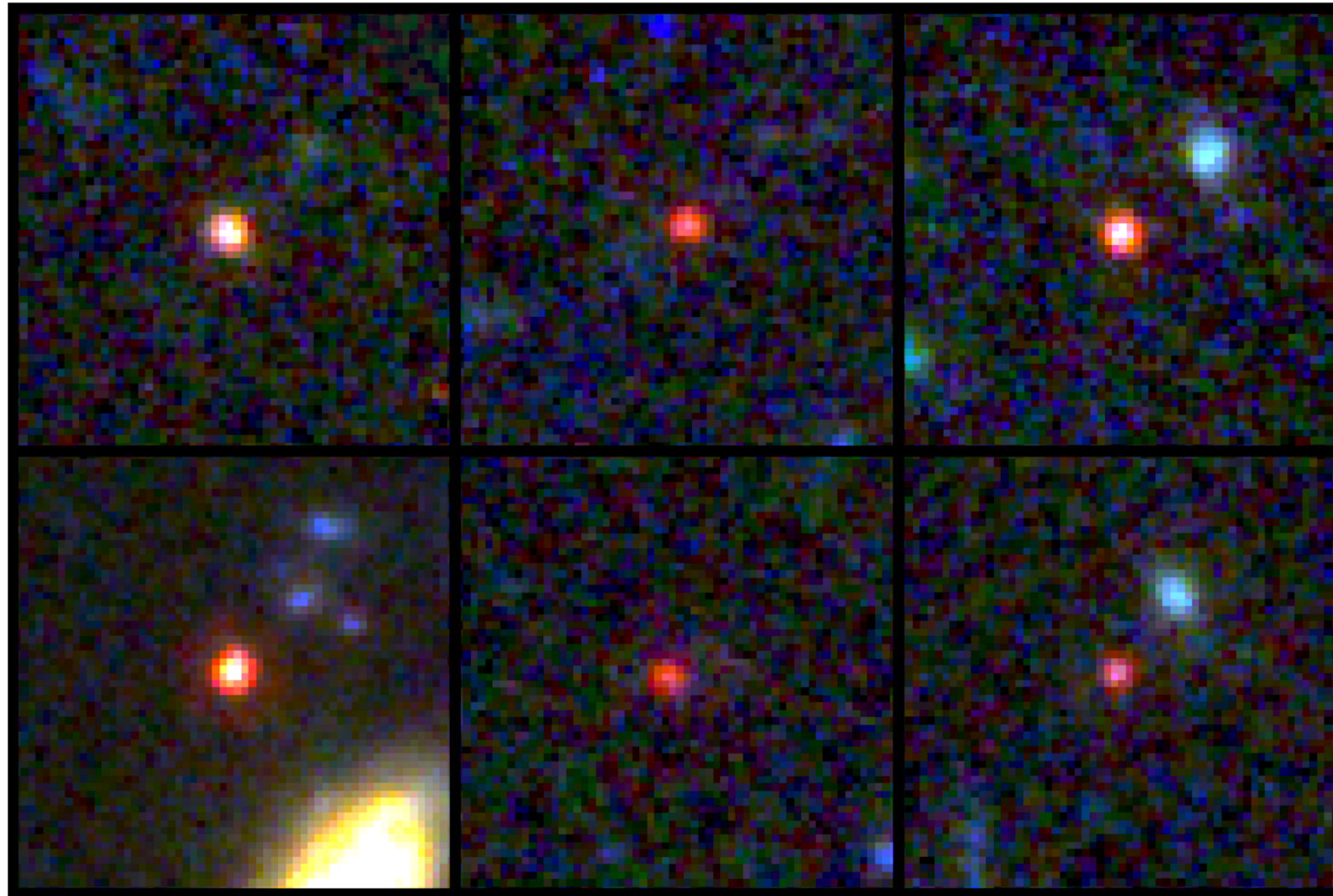


$\gtrsim 60\text{k}$ objects; all parameters jointly inferred using Prospector- β

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

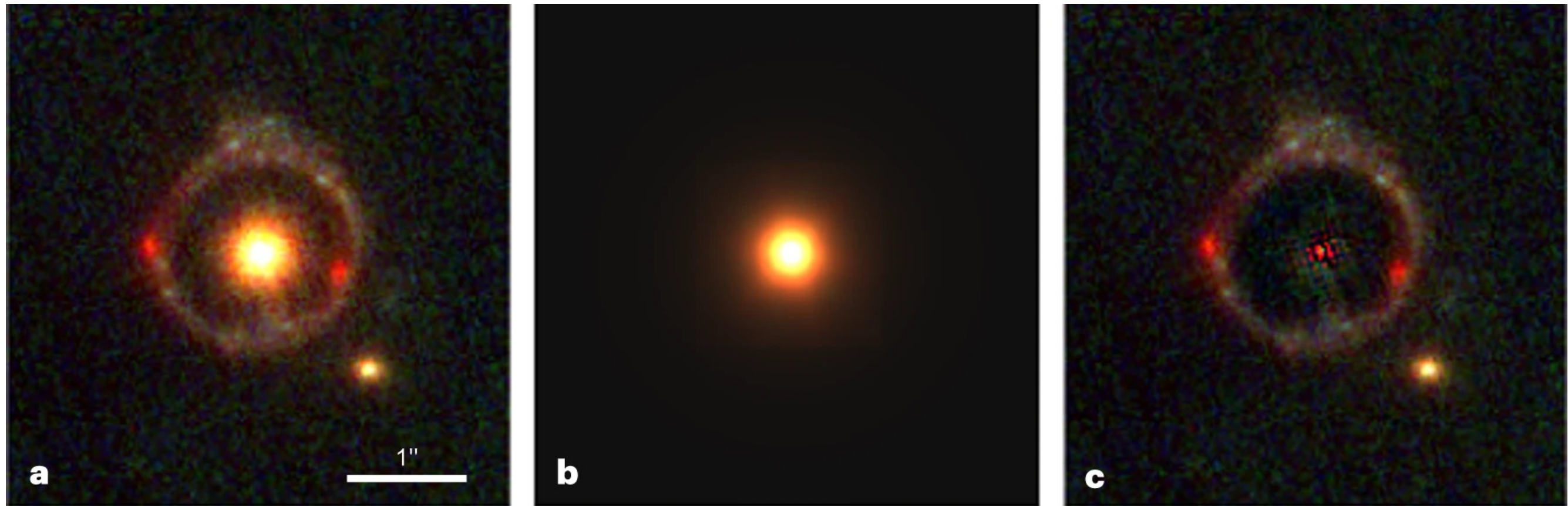


Red, candidate massive galaxies at $z \sim 8$, dubbed “universe breakers”

- 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

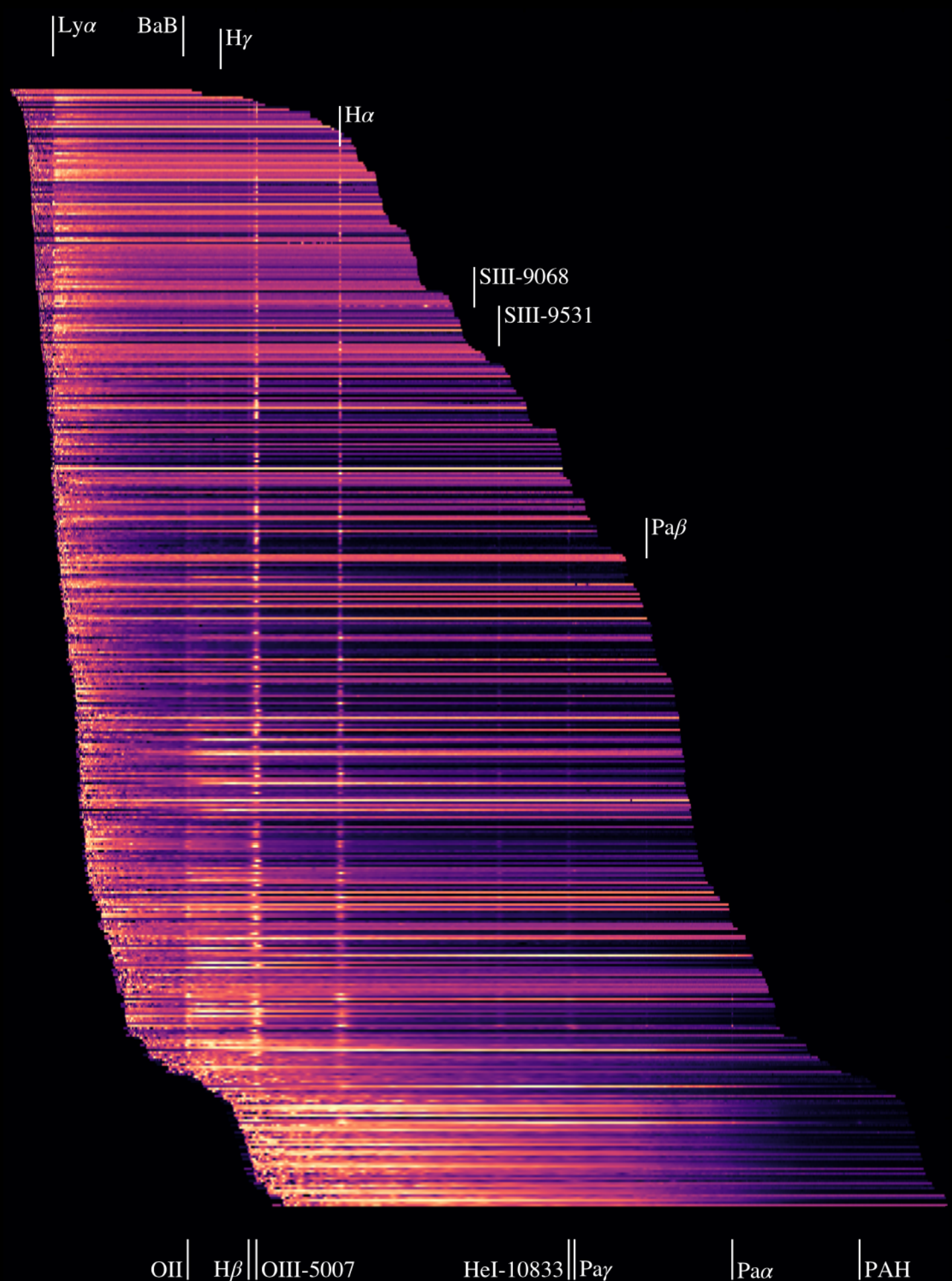
van Dokkum, Brammer, BW+ 2023 Nat Ast



The highest redshift lens; enclosed is a compact, massive, quiescent galaxy
Total mass > stellar mass + dark matter mass

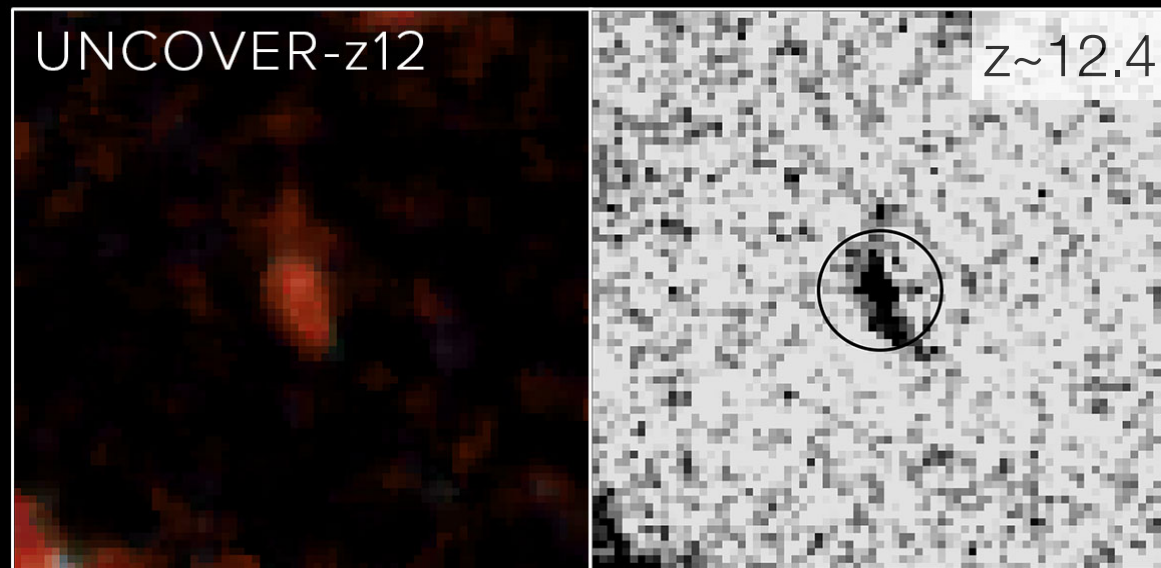
UNCOVER Part II: Spectroscopy

- 2 — 17hr integrations
- 7 MSA masks

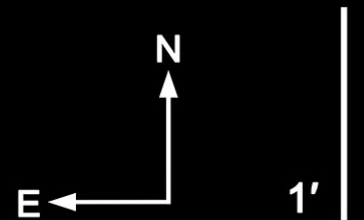
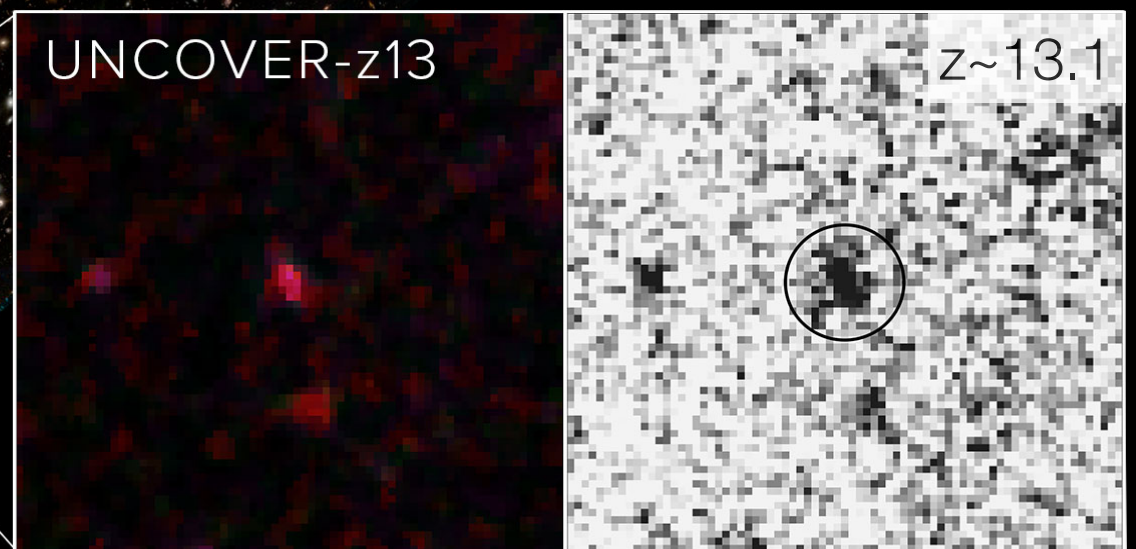


JWST/NIRSpec confirmation of $z > 12$ galaxies

BW+ 2023c ApJL



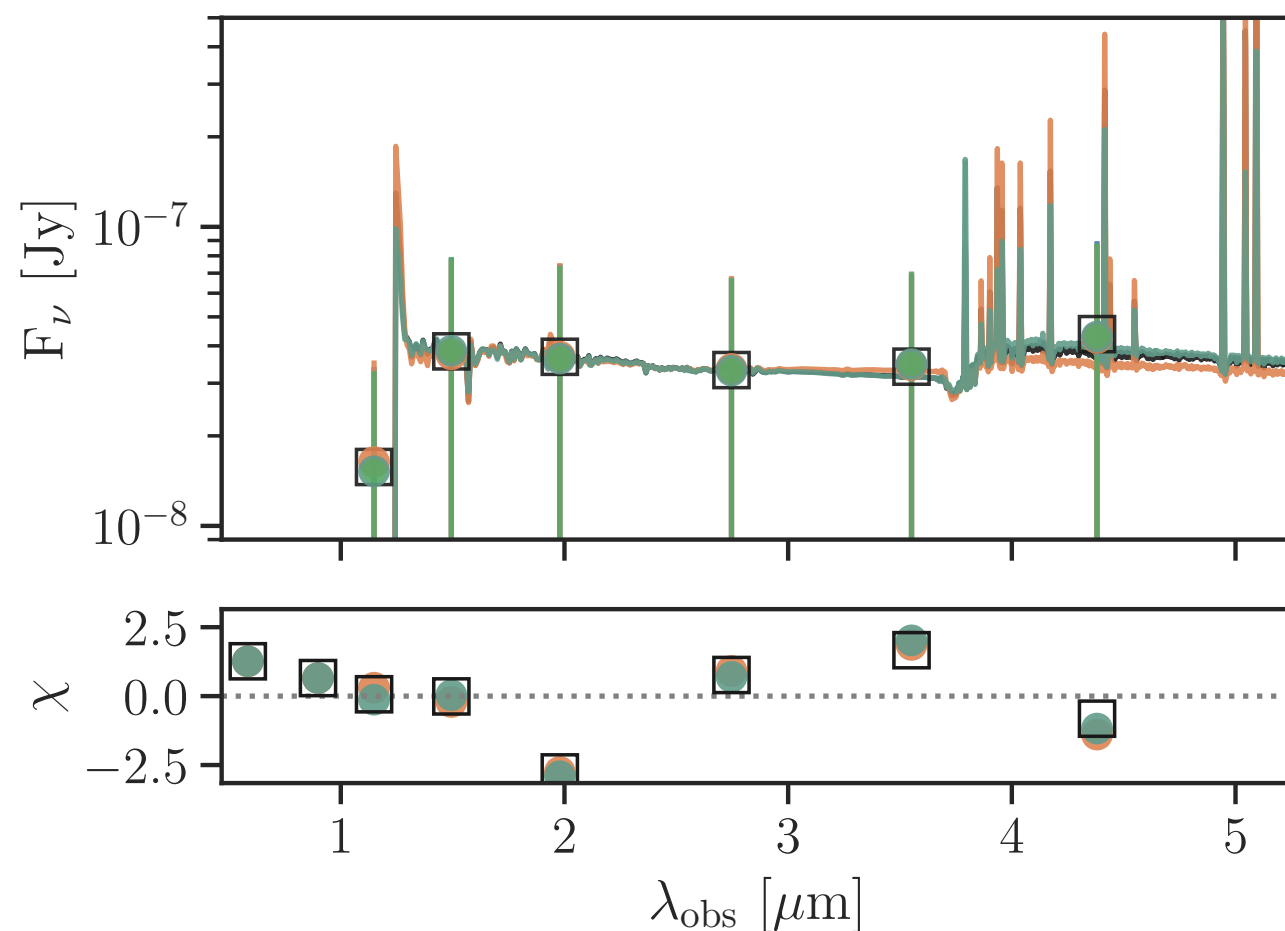
- $\sim 300 - 400$ pc in size, notably larger than the JADES $z > 10$ galaxies (Curtis-Lake+ 23; Robertson+ 23)



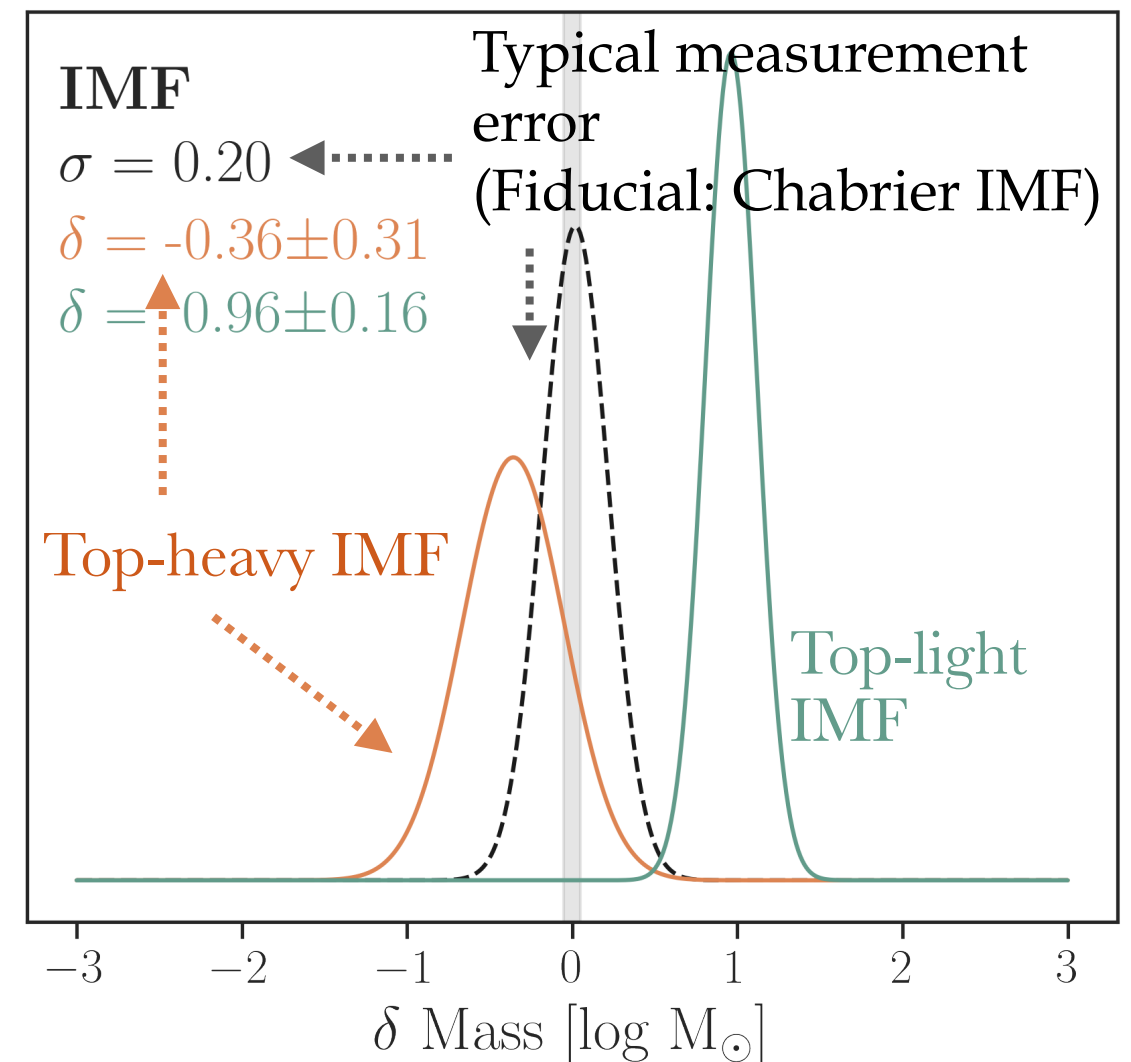
Systematics in SED fitting & ELT outlook

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 >>

- formal reported uncertainties
- scatter from using different SED fitting codes (Pacifici+ 2023)