(plus powderday)

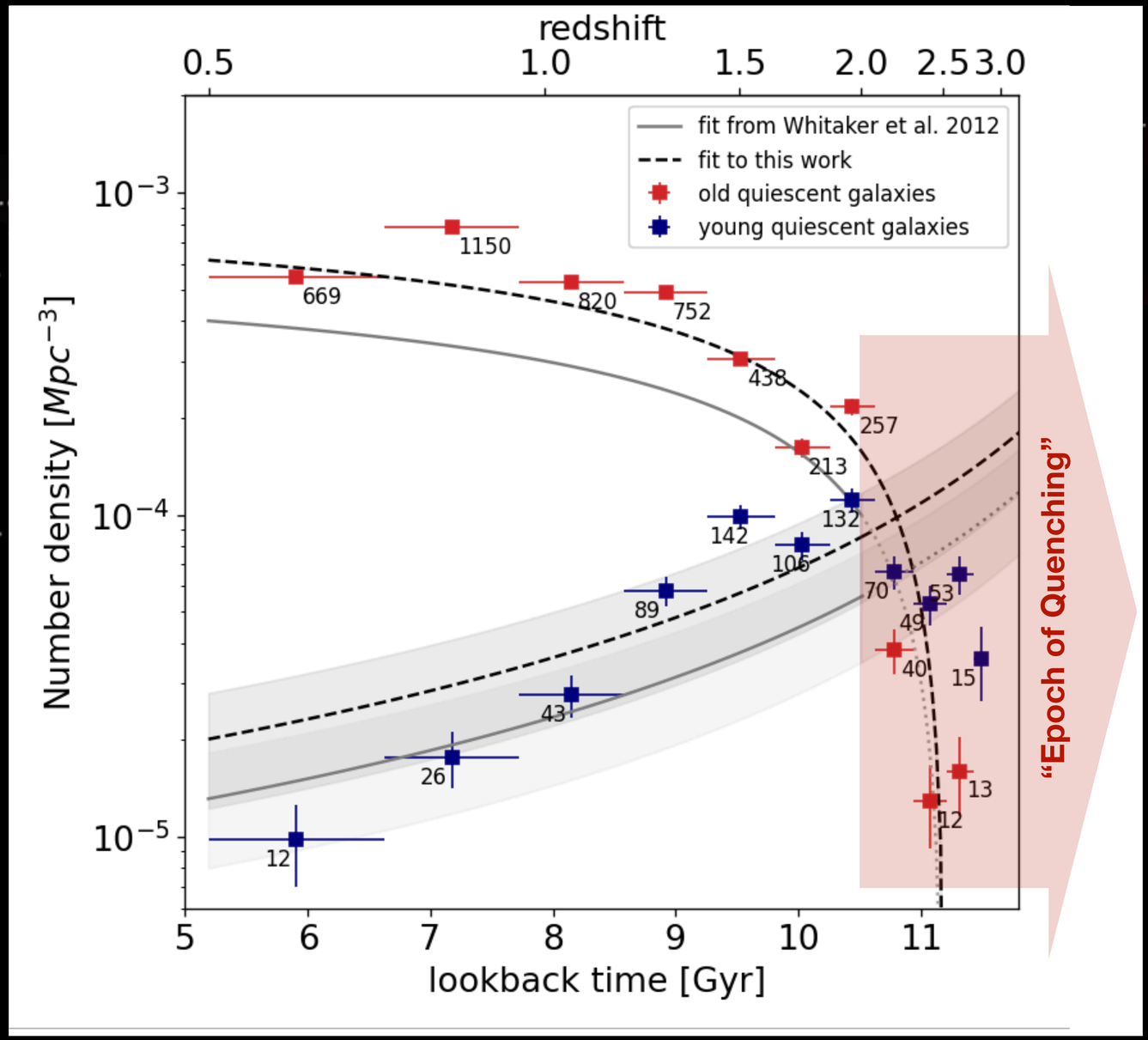
SIMBA^ PREDICTS EXOTIC MOLECULAR GAS-TO-DUST RATIOS IN *Quiescent* GALAXIES

Kate Whitaker

DAWN

UNIVERSITY OF MASSACHUSETTS AMHERST 1863

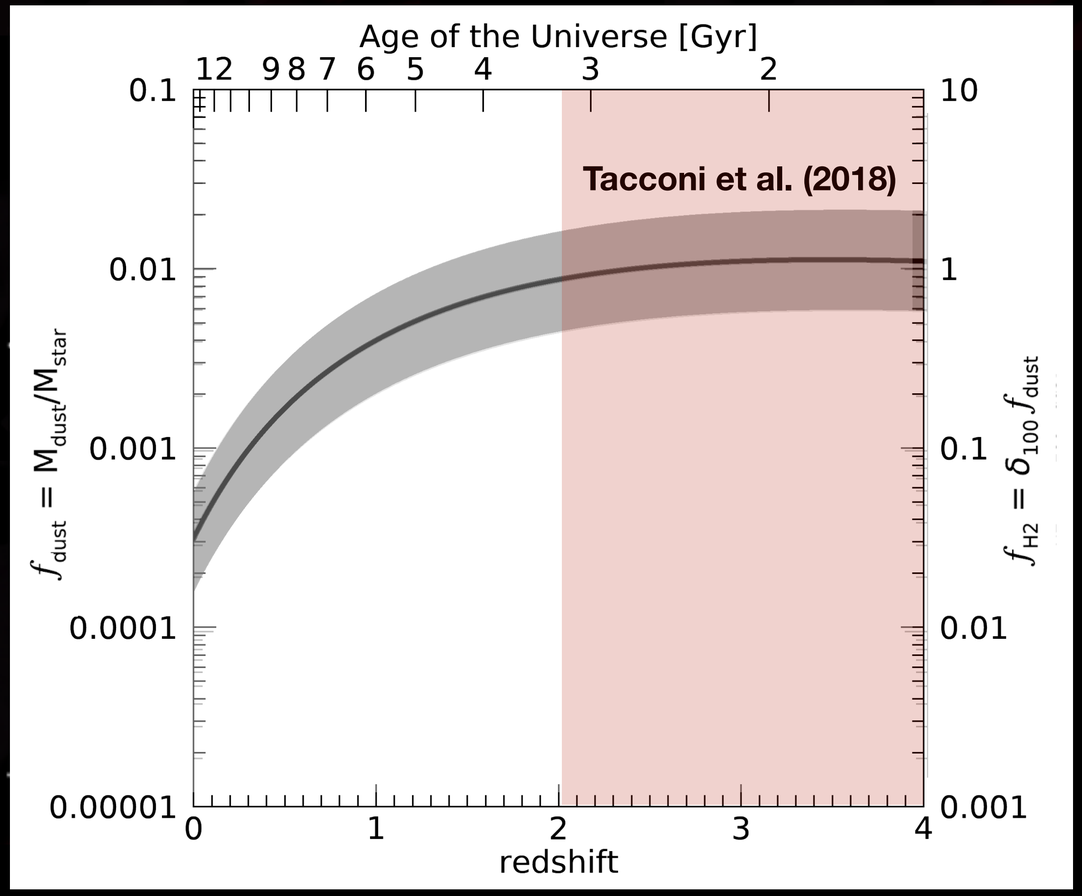
Maike Clausen et al. (in prep)
3D-DASH (PI: Momcheva)

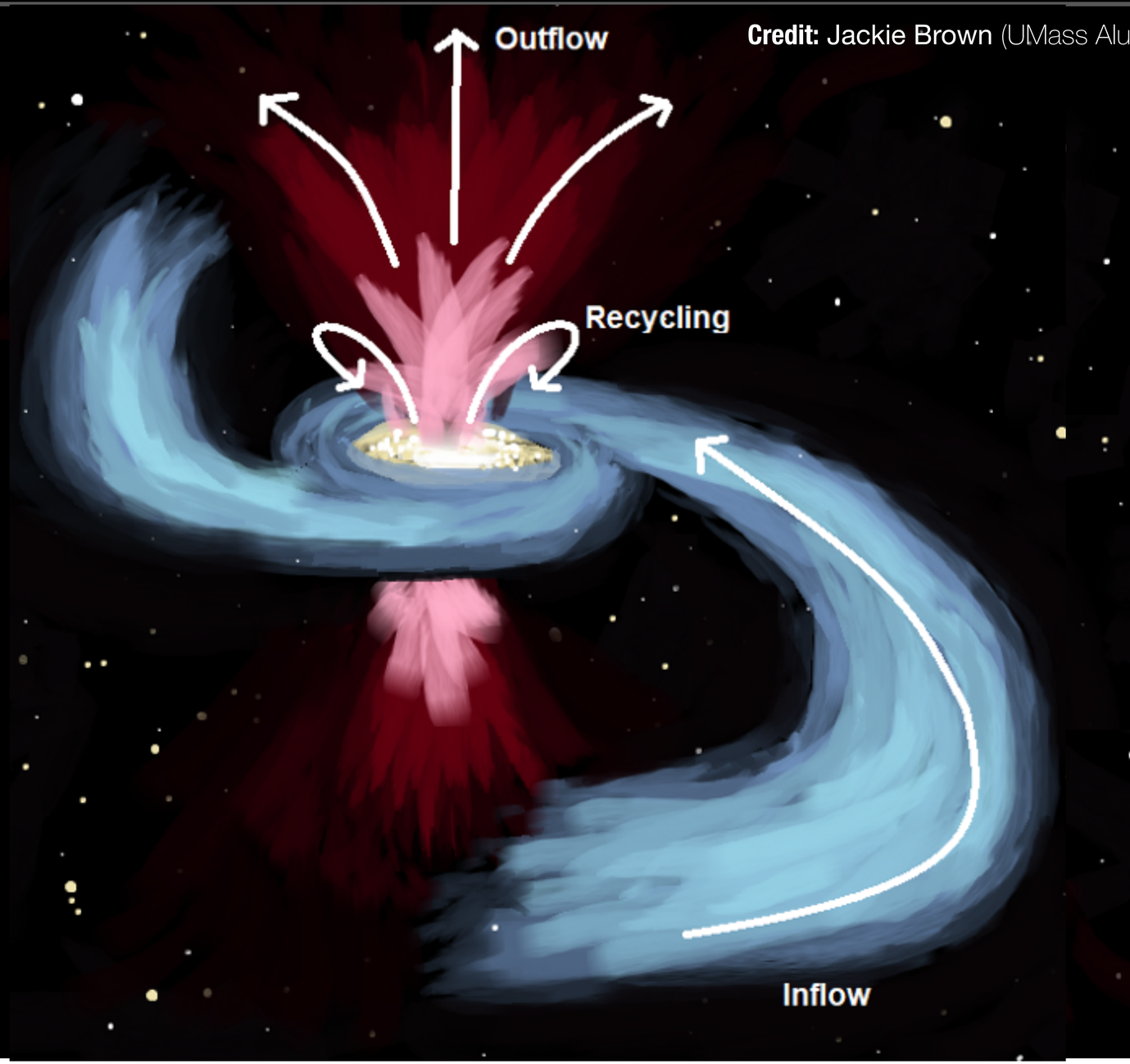


THIS TALK:

1. constraining the quiescent **cold gas fractions**
2. Recent **JWST** work

How much cold gas are *quiescent* galaxies harboring?





Credit: Jackie Brown (UMass Alum)

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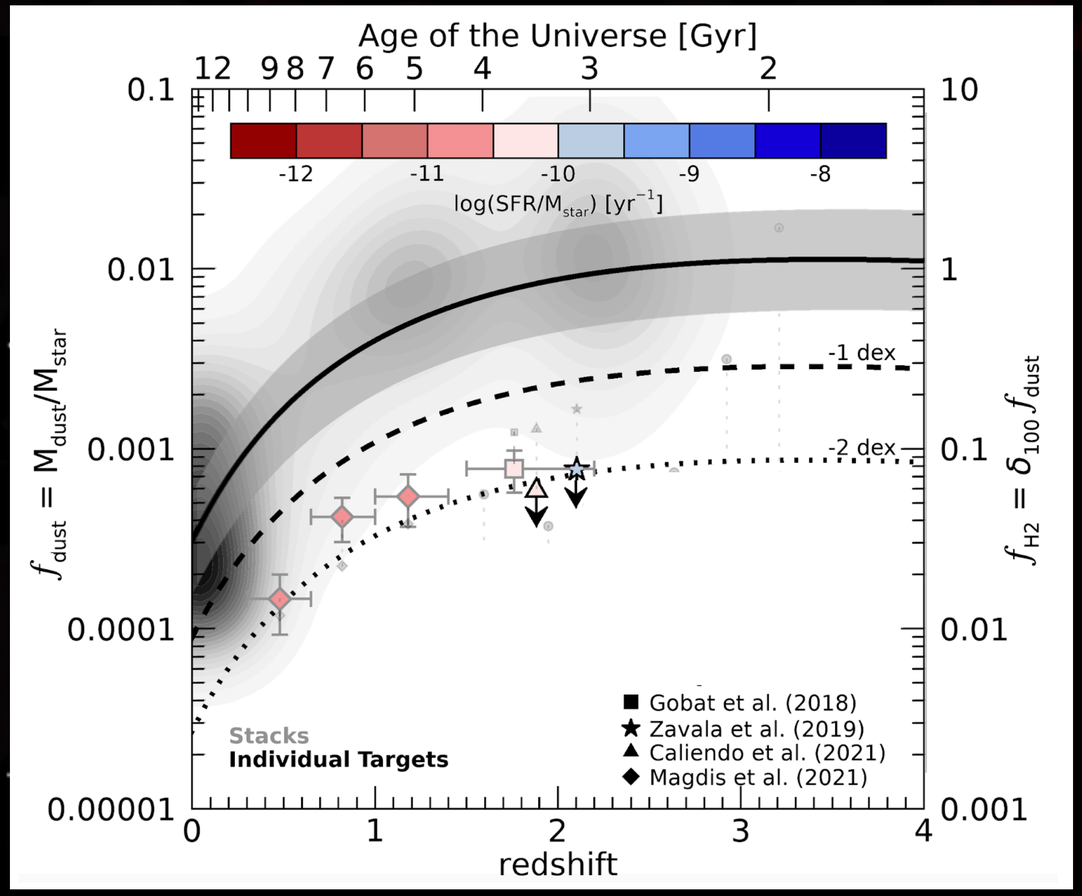

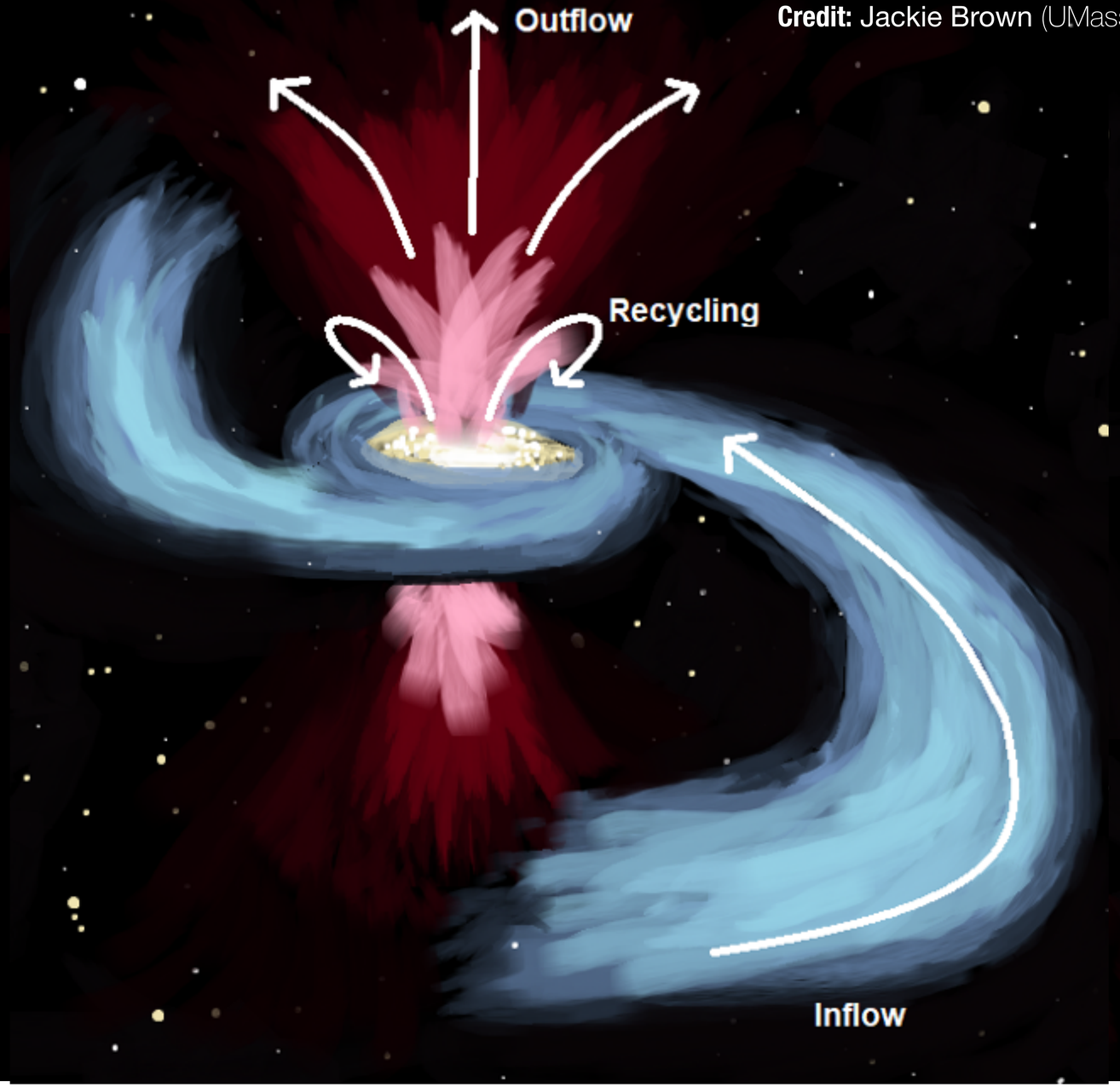

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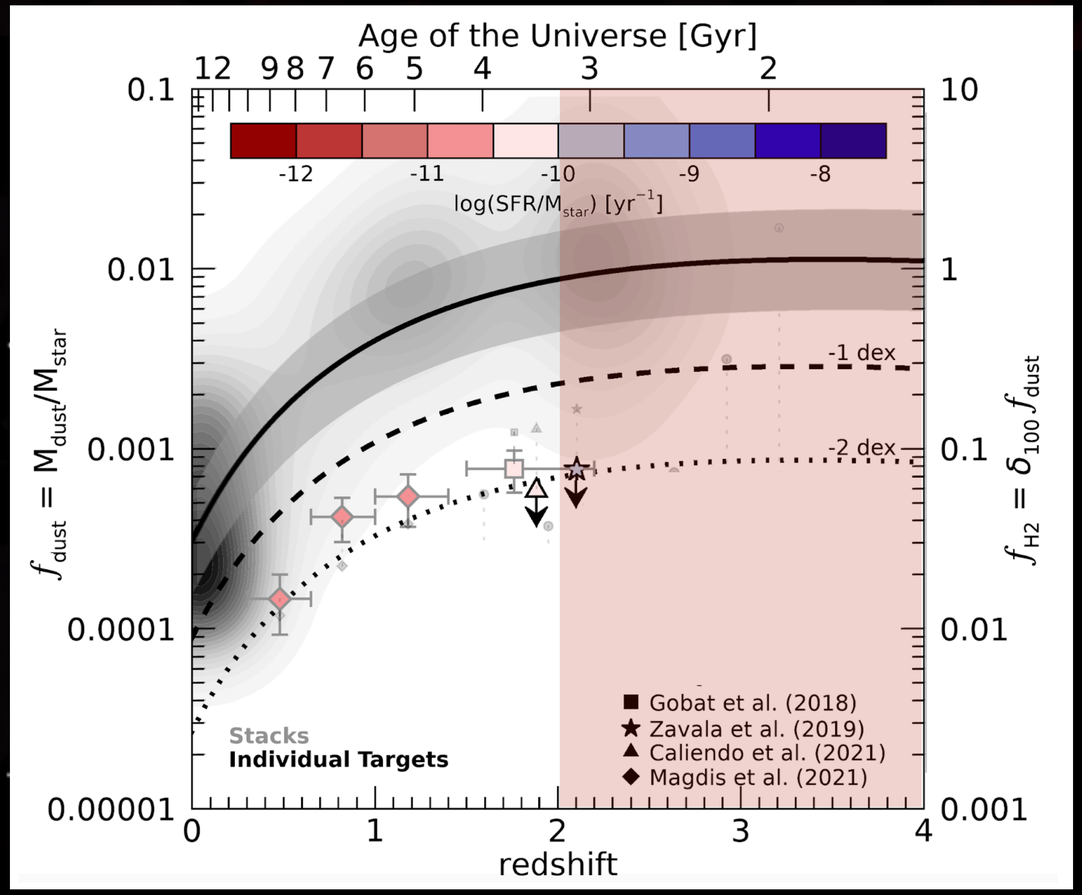
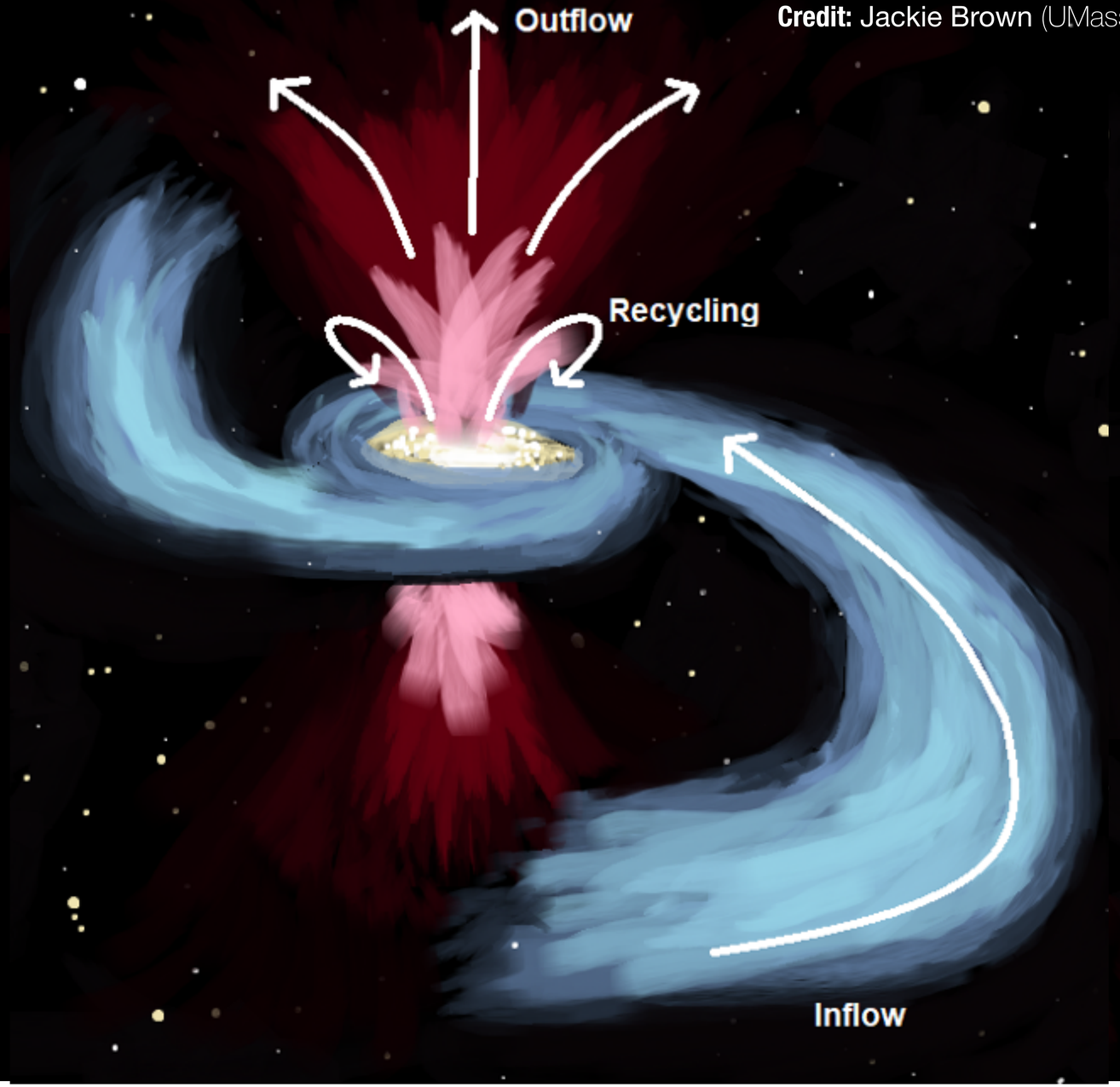
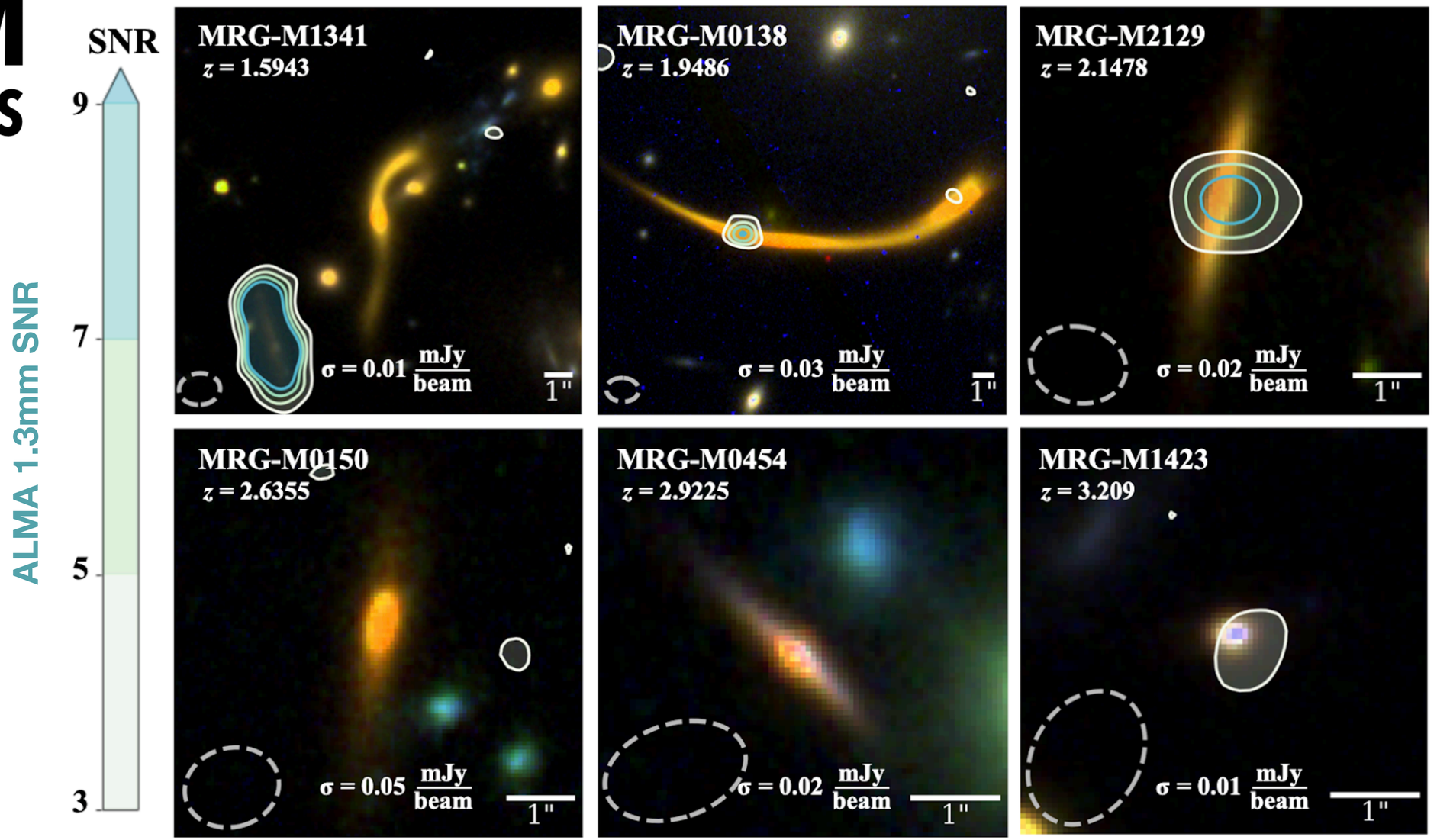




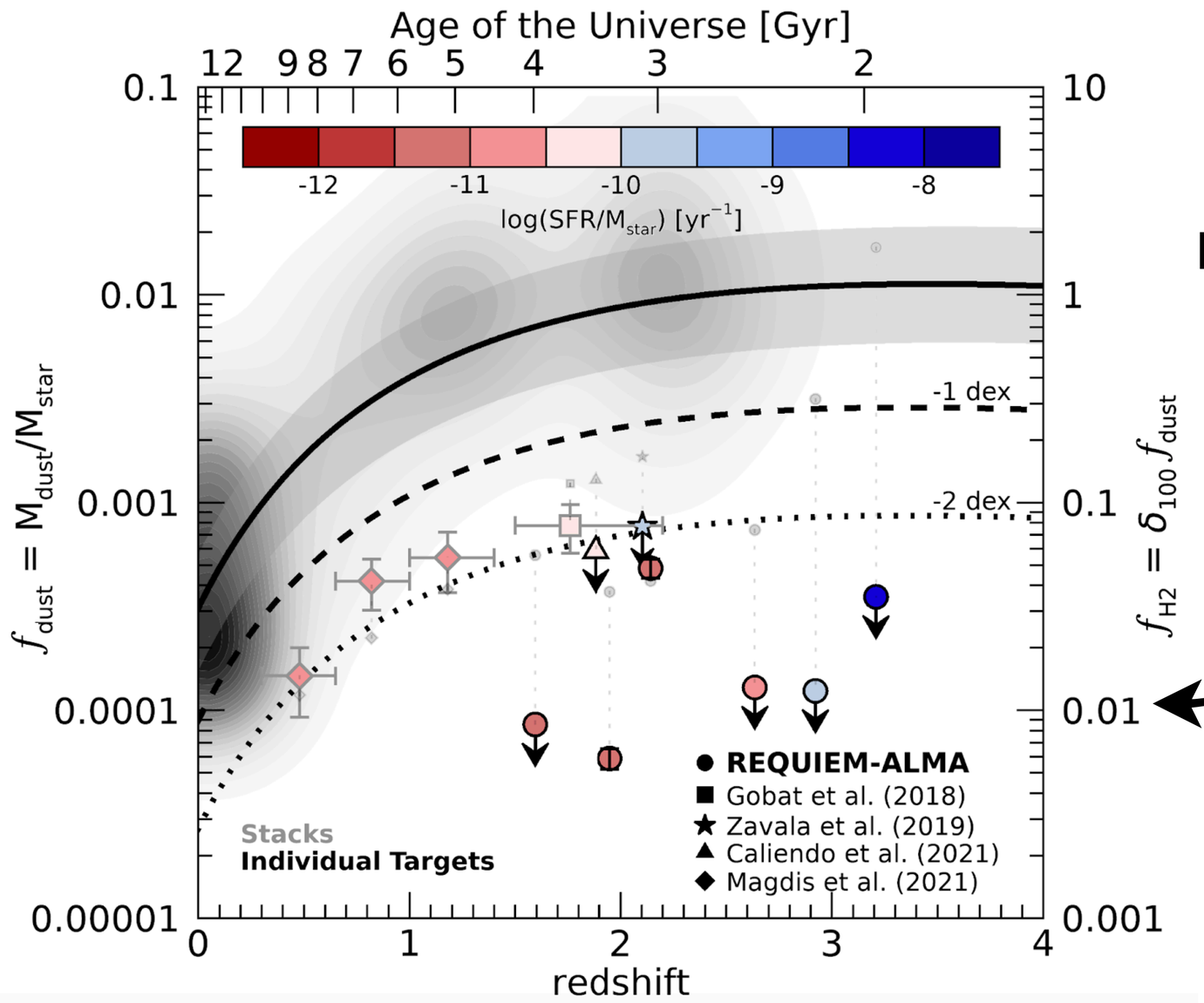
Credit: Jackie Brown (UMass Alum)

REQUIEM GALAXIES



Source Discovery Credit: Newman+15,18, Toft+17, Ebeling+18, Man+21

Whitaker et al. (2021a)

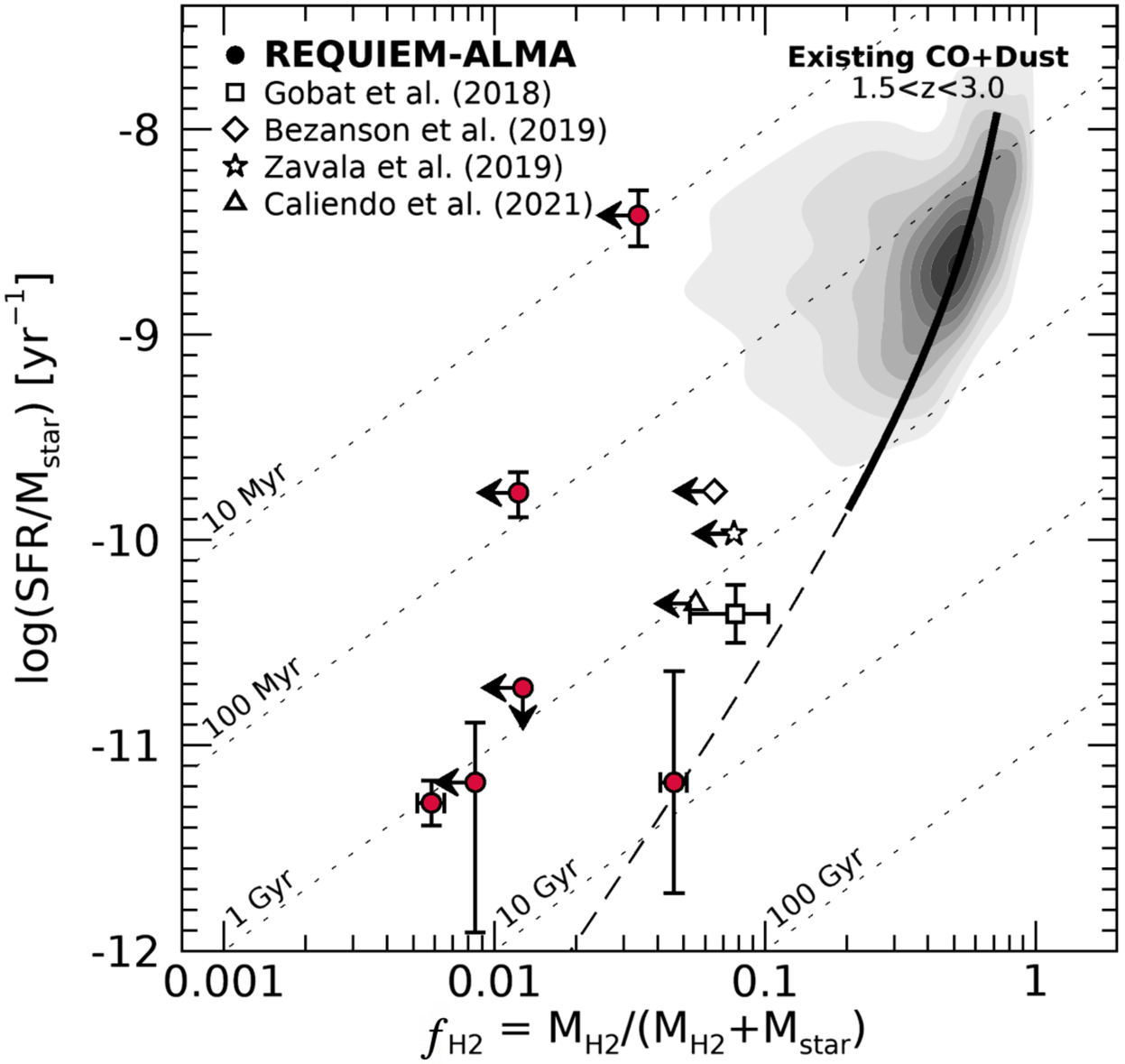


Quenched galaxies have *extremely little dust* at early times, and by proxy very little cold molecular gas.

M_{gas} < 1% M_{stars}
(M_{dust} < 0.01% M_{stars})

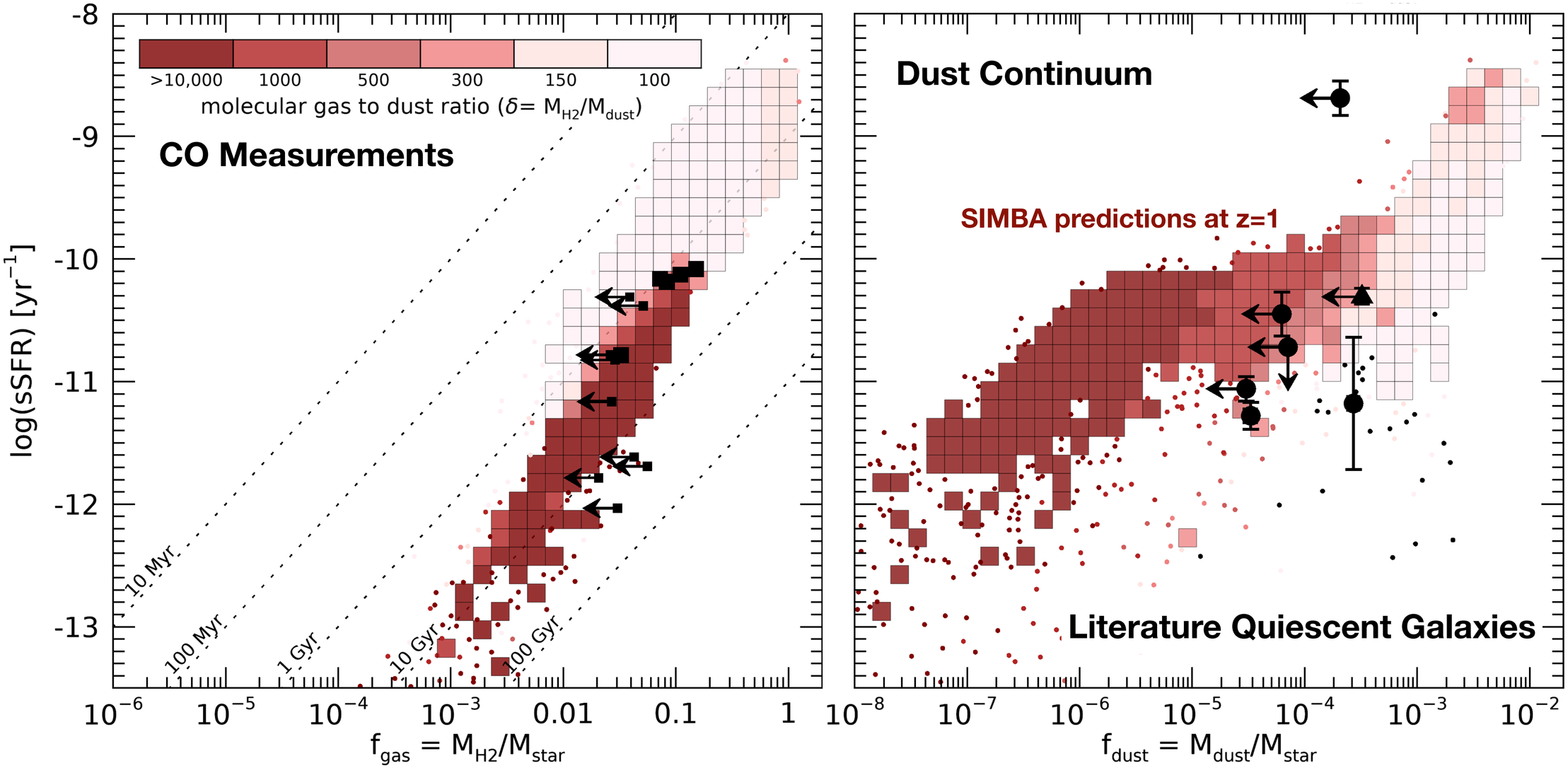
Whitaker et al. (2021a)

Implies that most early galaxies shut off star formation because their molecular gas reservoir was *rapidly depleted or removed*, and is not being replenished.



Whitaker et al. (2021a)

Do quiescent galaxies have exotic molecular gas-to-dust ratios?



Whitaker, Narayanan et al. (2021b)

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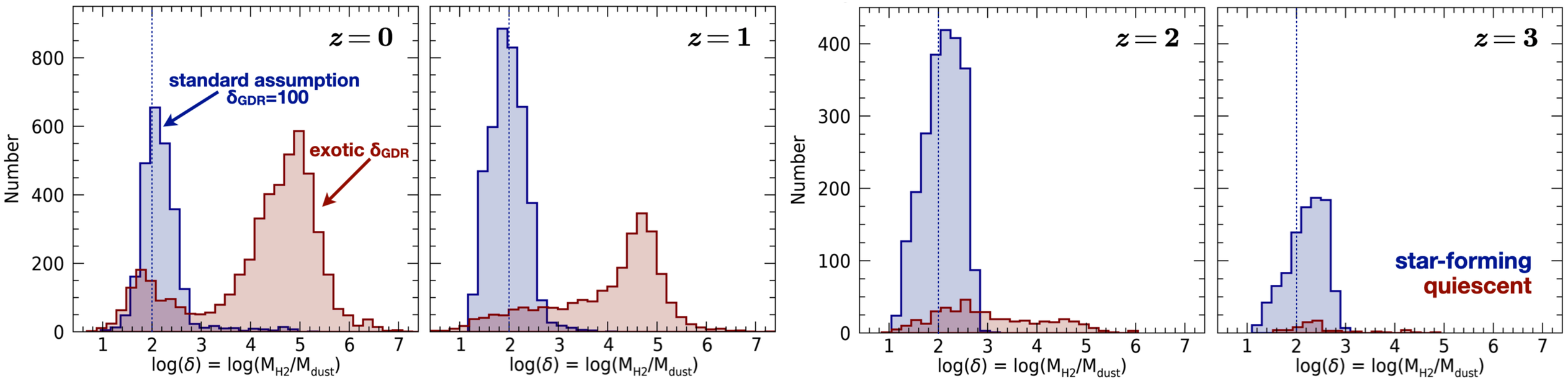

(1) **Dust formation stops** via star formation processes

(2) **Dust then destroyed** by SN shocks and thermal sputtering.

(3) **Dust growth rate not sufficient** to overcome the loss of >3 orders of magnitude in M_{dust} to return to normal δ_{GDR} values despite having high metallicity.

Whitaker, Narayanan et al. (2021b)

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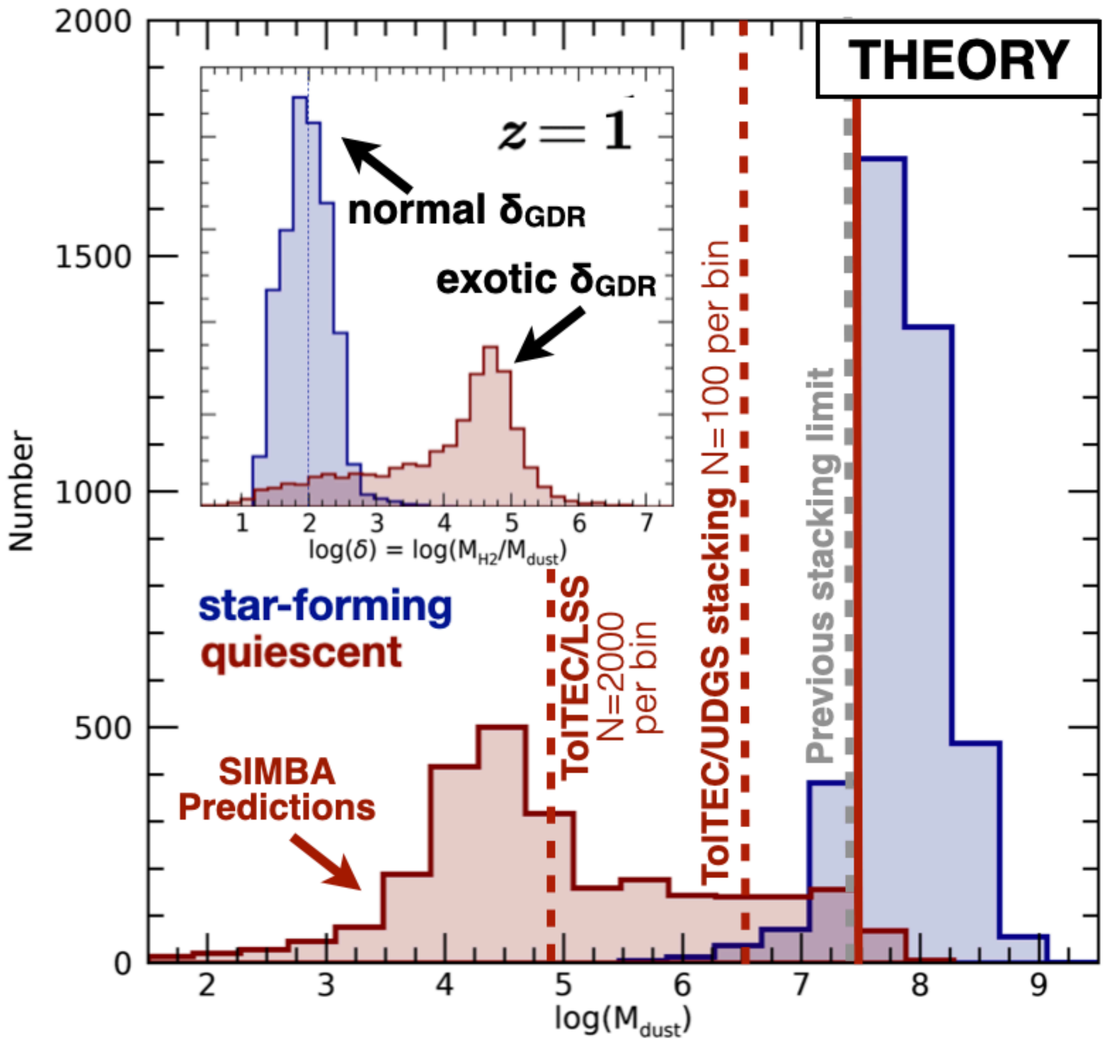
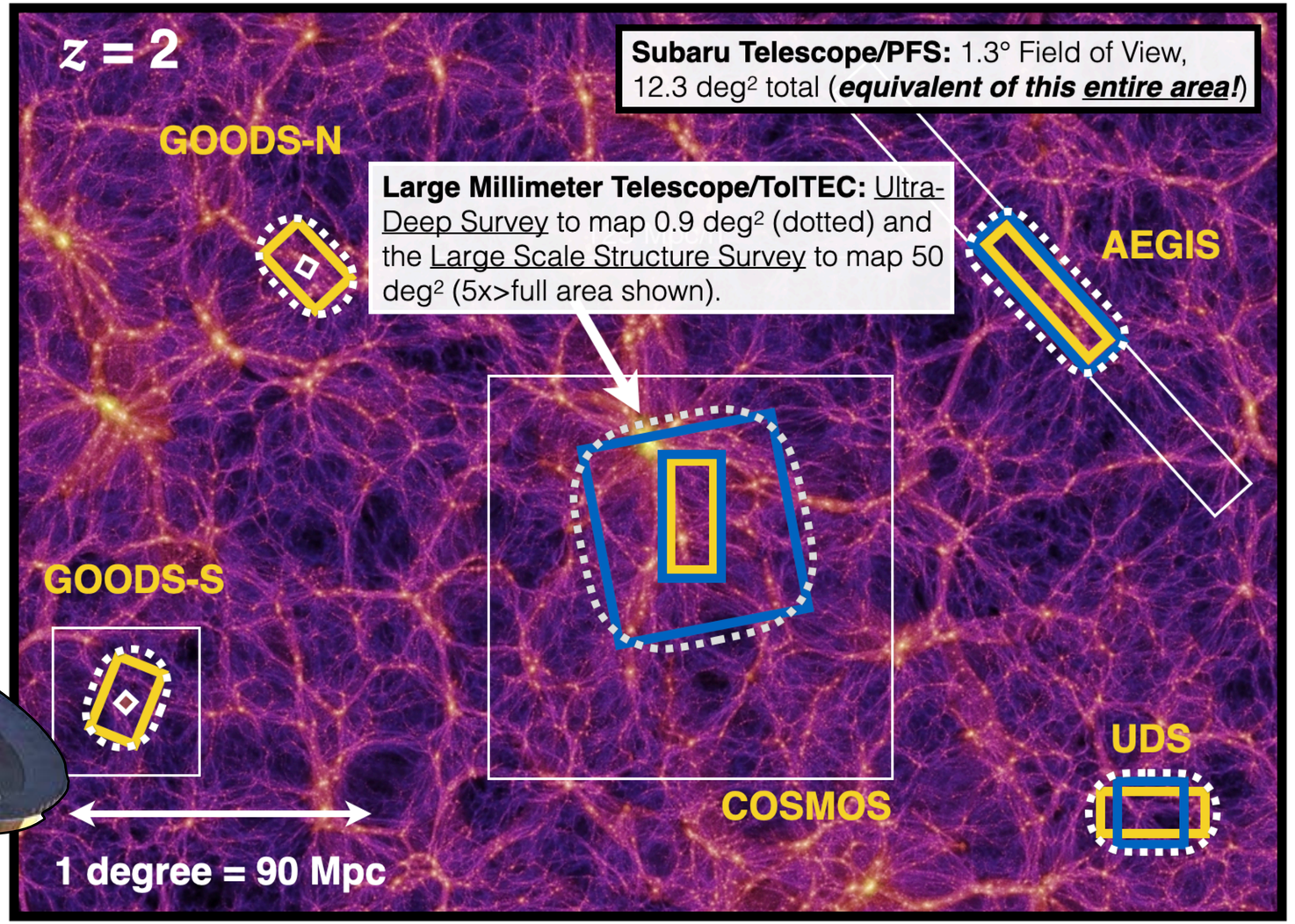
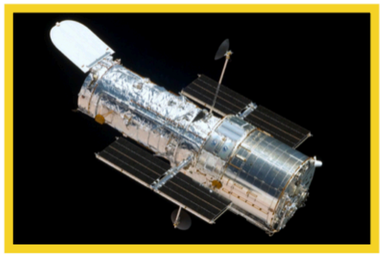
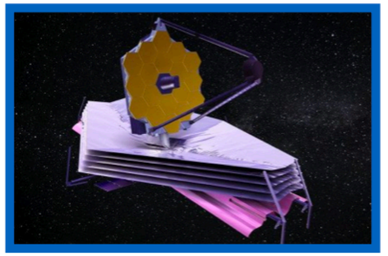
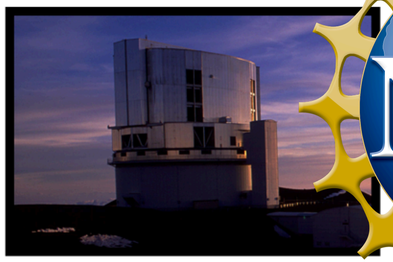


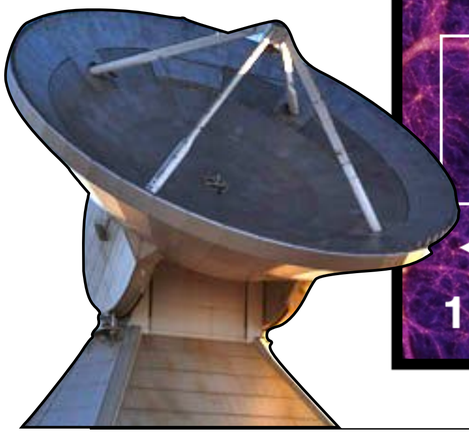
FUTURE PROSPECTS: *Stacking LMT/TolTEC and SIMBA Mock Dust Images*



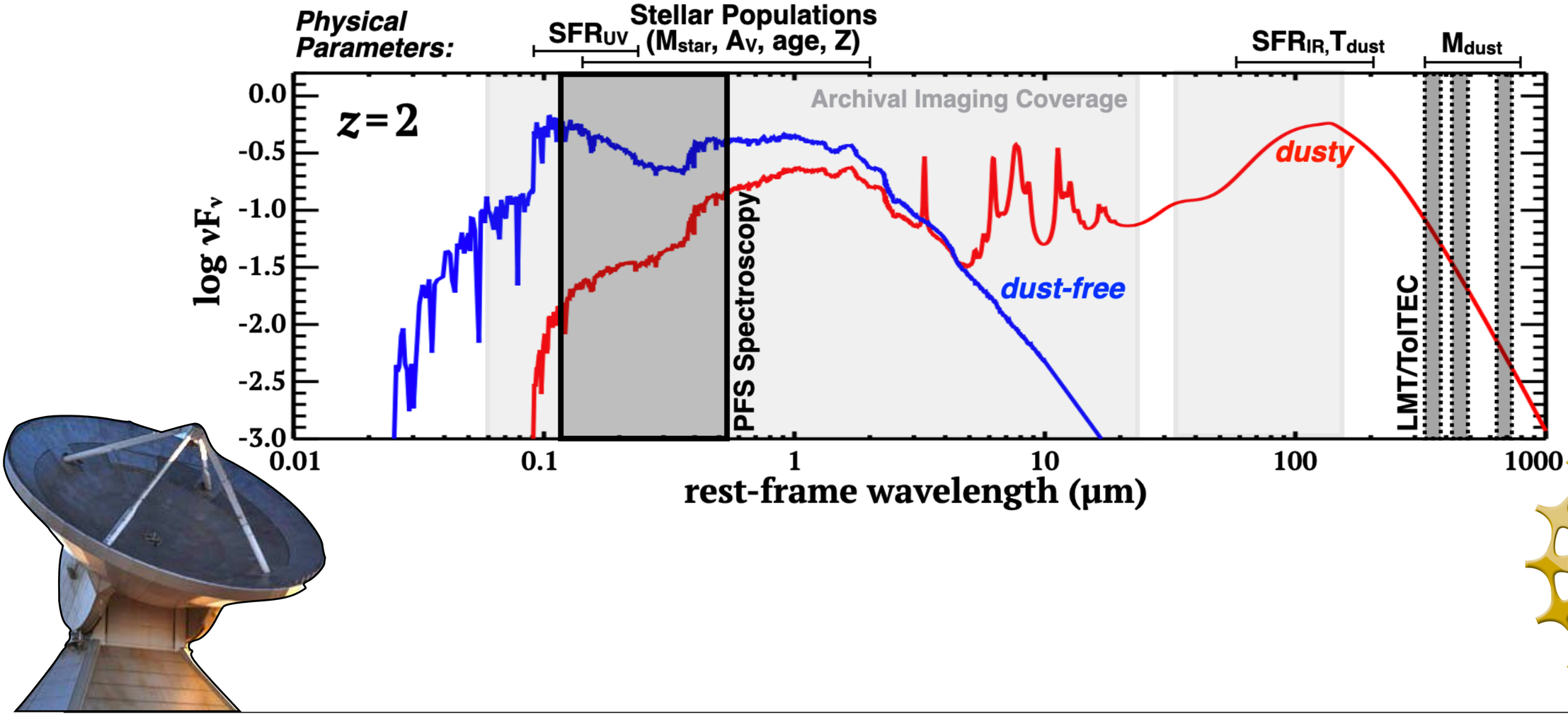




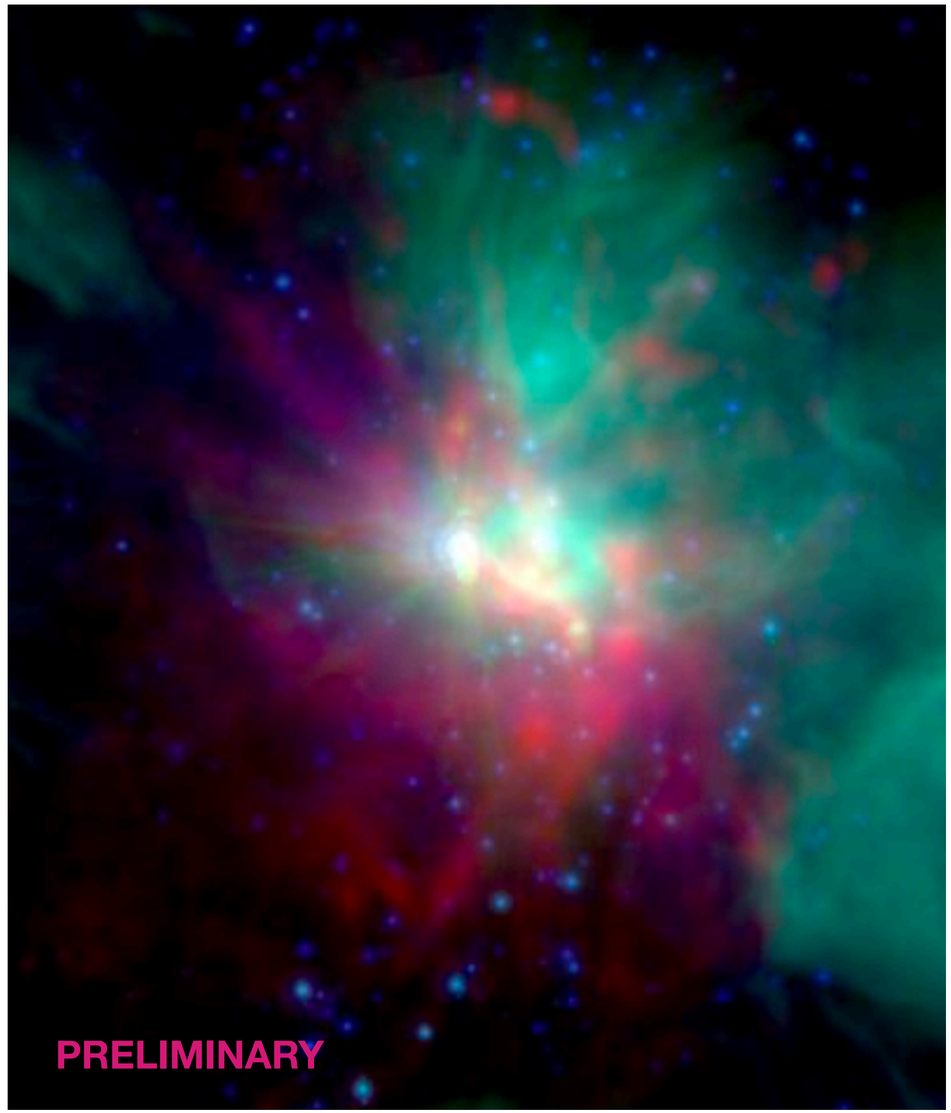




FUTURE PROSPECTS: *Stacking LMT/TolTEC and SIMBA Mock Dust Images*



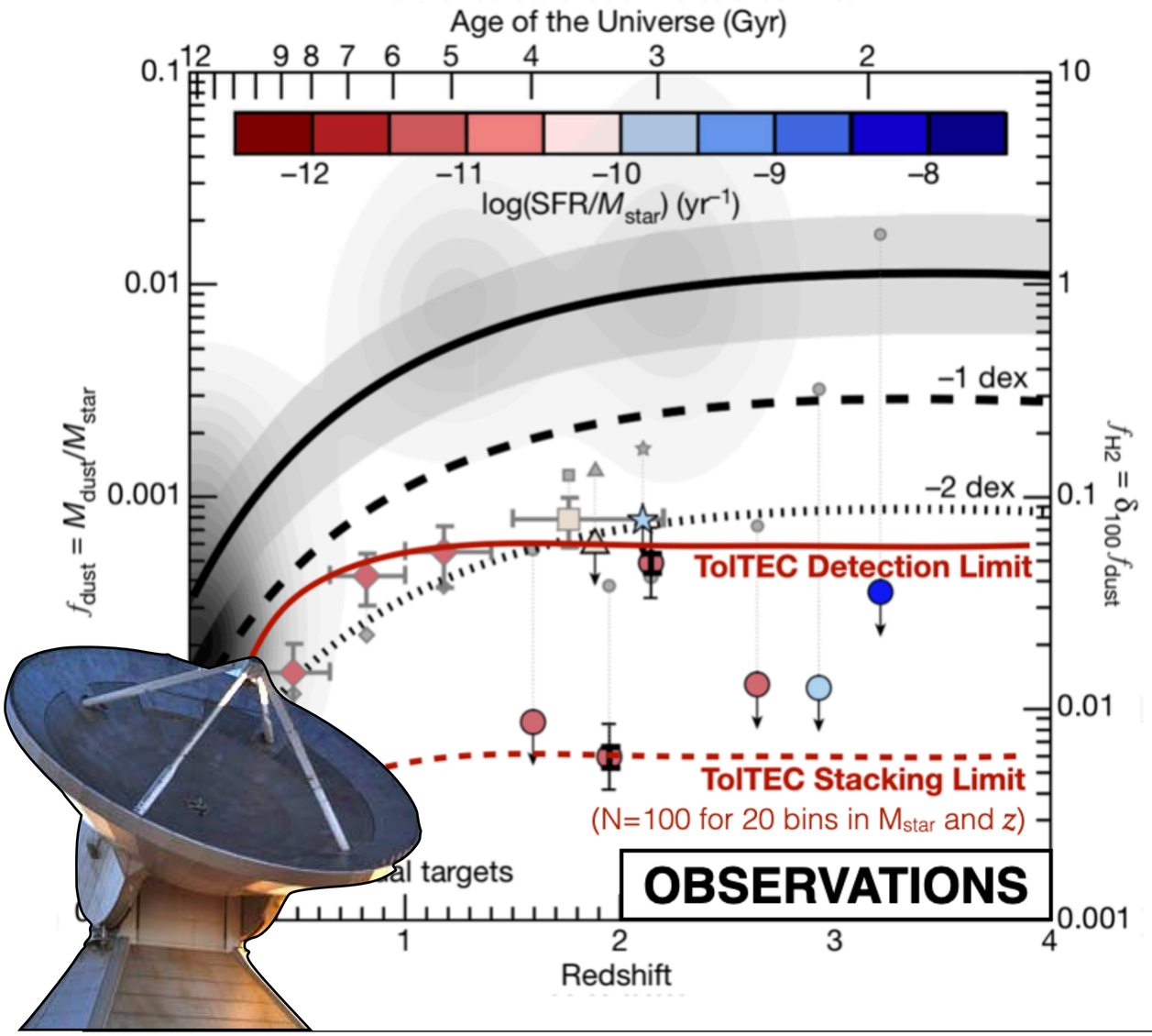
LMT/TolTEC First Light!

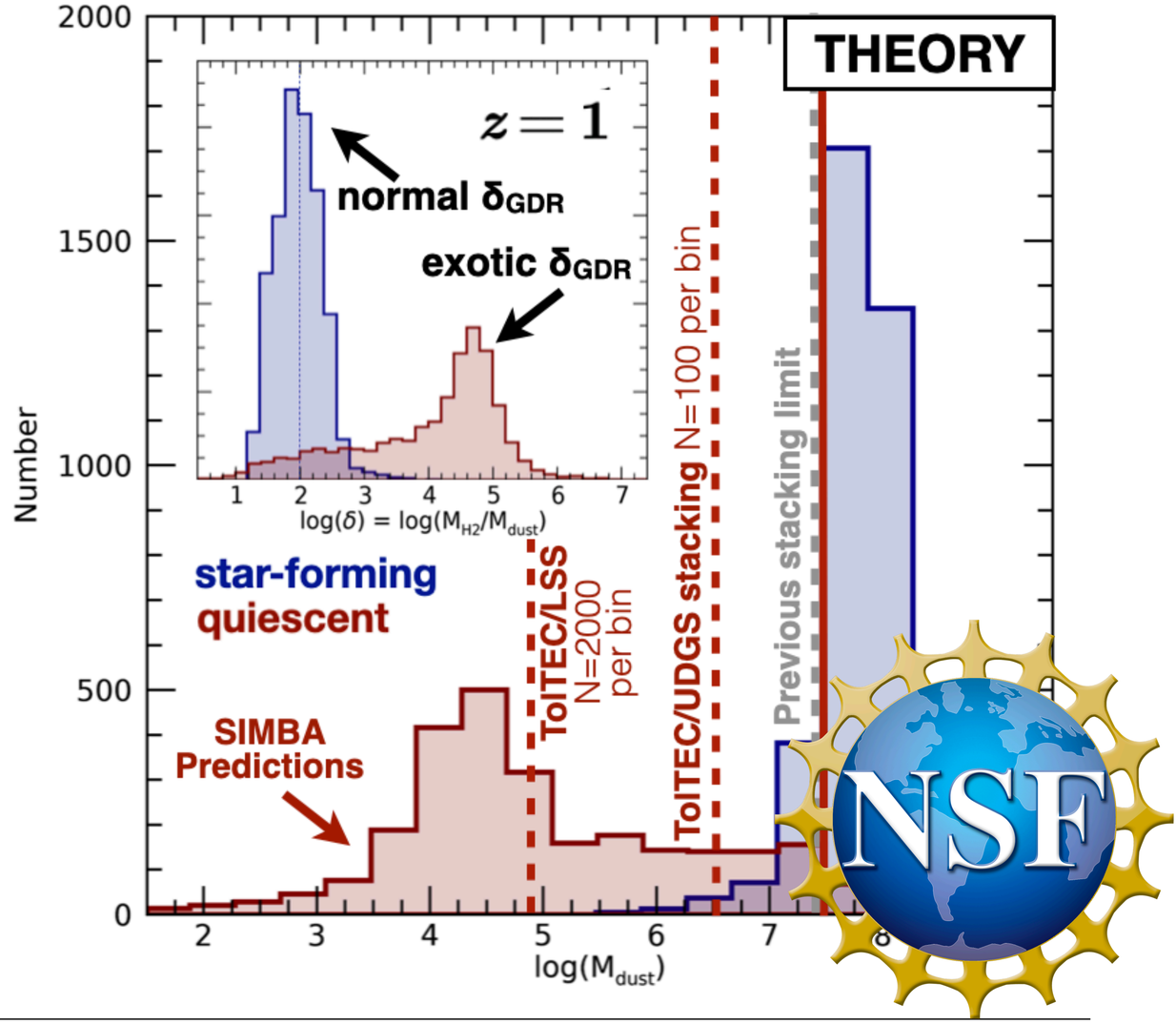


MAELSTROM
Embedded Stellar Cluster

Spitzer 3.6: Recent Forming Stars
Spitzer 8.0: PAH emission (hotter)
TolTEC 1.1mm: Cold Dust

FUTURE PROSPECTS: *Stacking LMT/TolTEC and SIMBA Mock Dust Images*





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

UMass Amherst cohort within

PRIMER

NIRCam Photometric Catalogs

Sam Cutler

Yingjie Cheng

Aubrey Medrano

PI: Dunlop

UDS

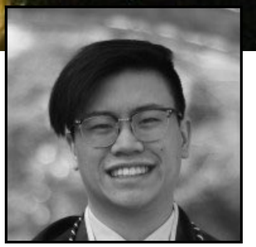
COSMOS


PRIMER
PI: Dunlop

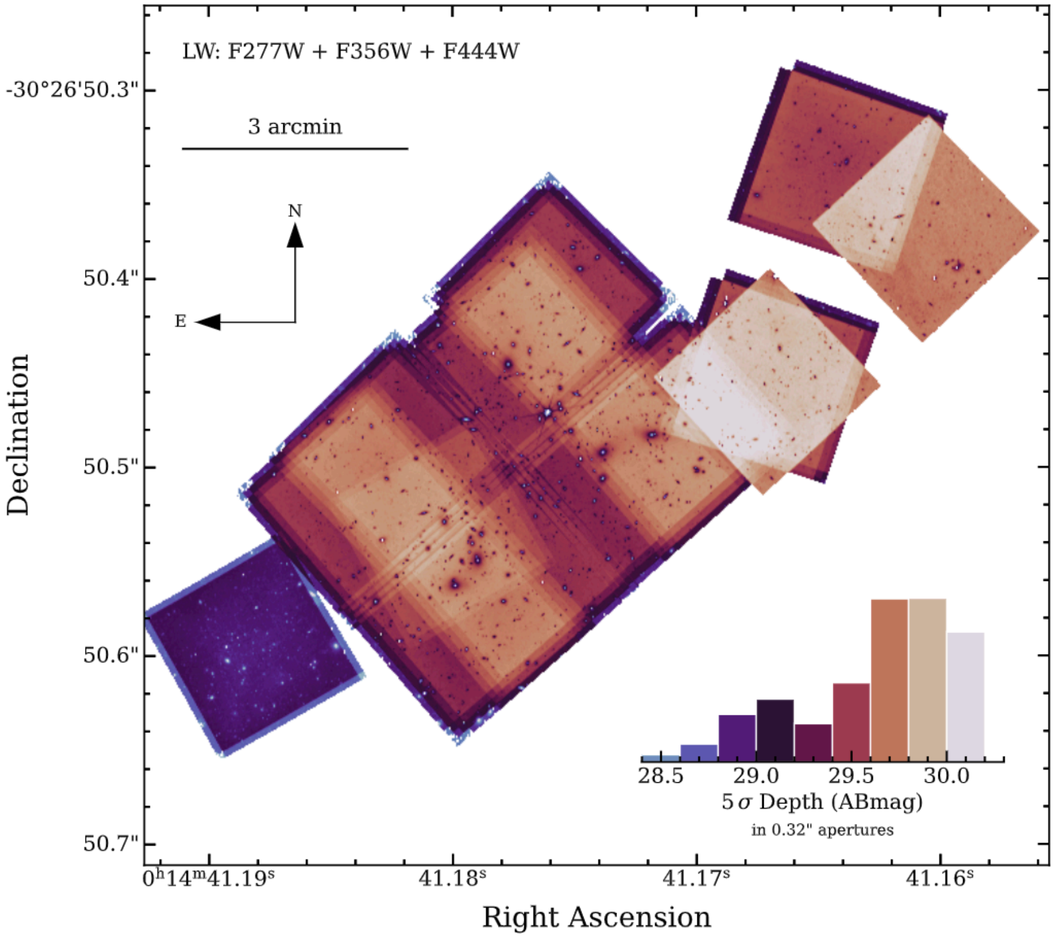
UNCOVER Part I

Includes UNCOVER (GO-2561),
GLASS (ERS-1324), and DDT-2756

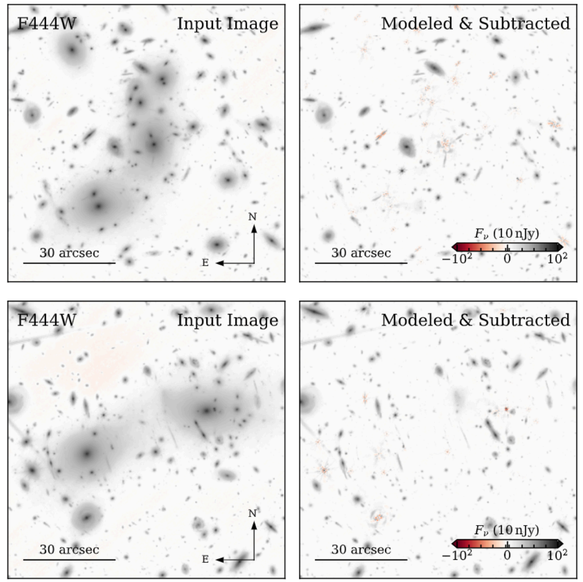


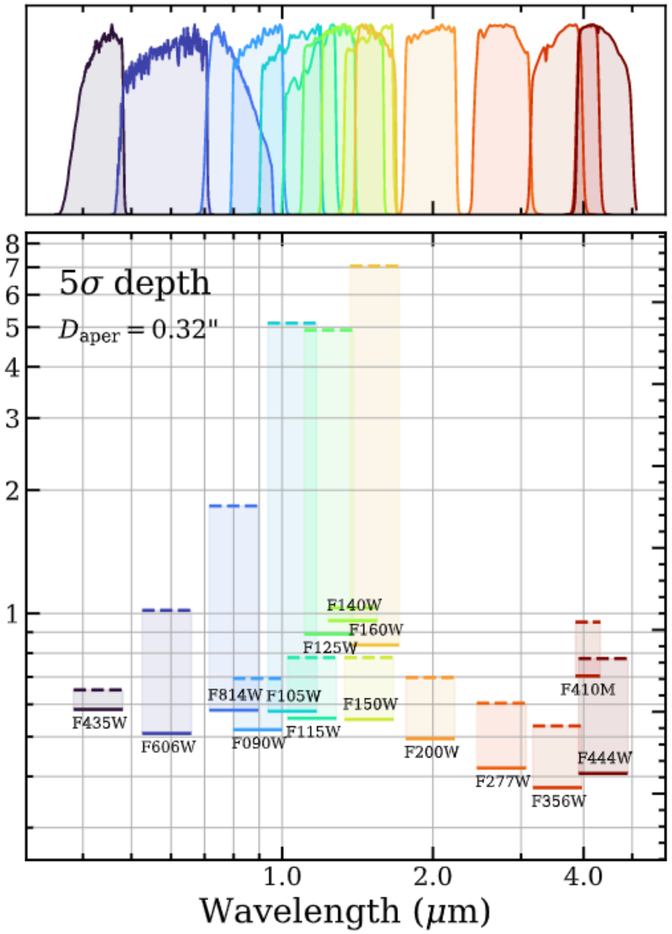



Weaver, Cutler, Pan, Whitaker et al. (2023)



- **15 filters (7 HST + 8 JWST)**
- **F277W+F356W+F444W Detection**
- **PSF matched to F444W**
- **bCG/ICL light modeled out**
- **50k objects**



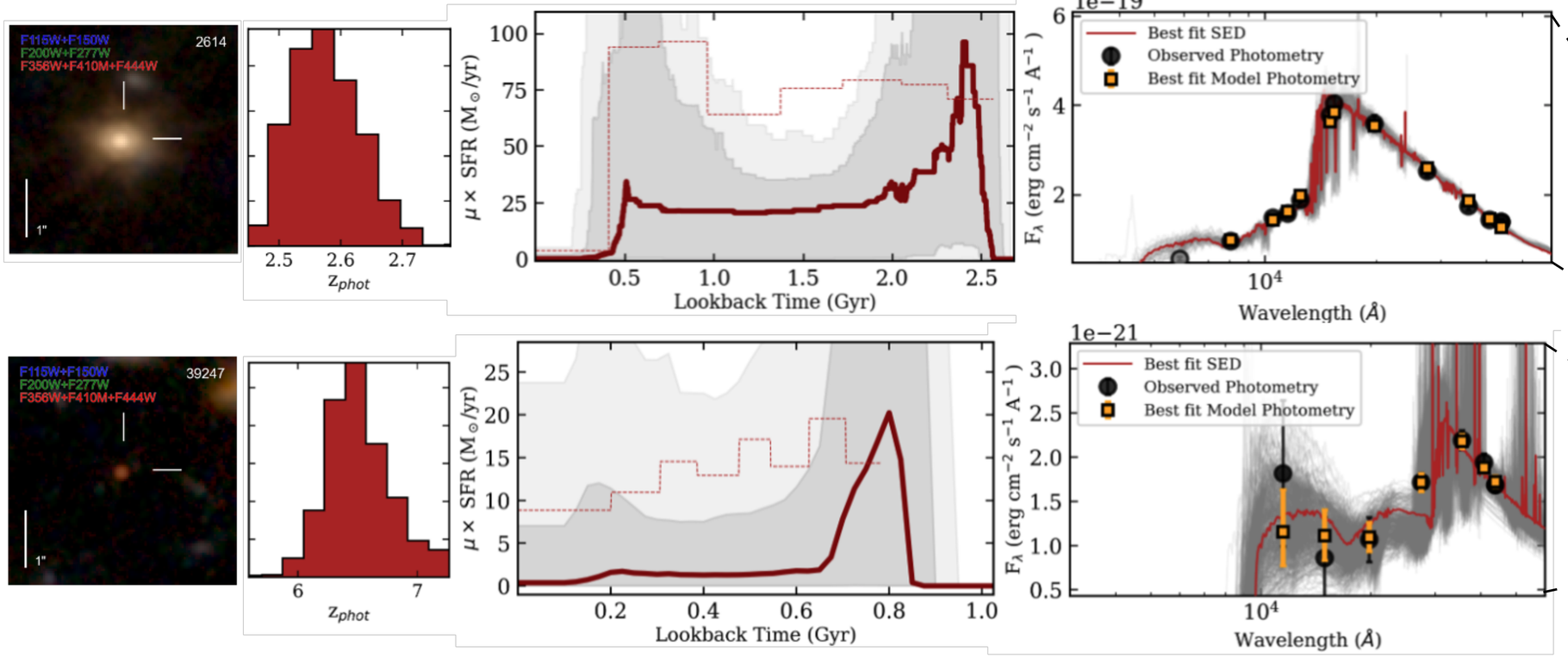


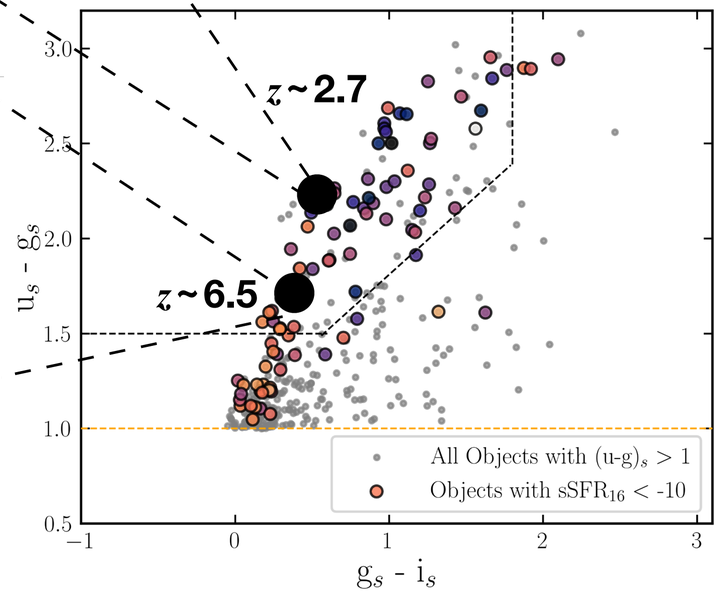
UNCOVER Quiescent Candidates at $z>3$

Examples of Candidates:
Top – z~2.7 galaxy with a recent quenching episode
Bottom - z~6.5 galaxy with Balmer break

Adopting a continuity flexible SFH to capture recent quenching episodes following ***Suess et al. (2022b)***

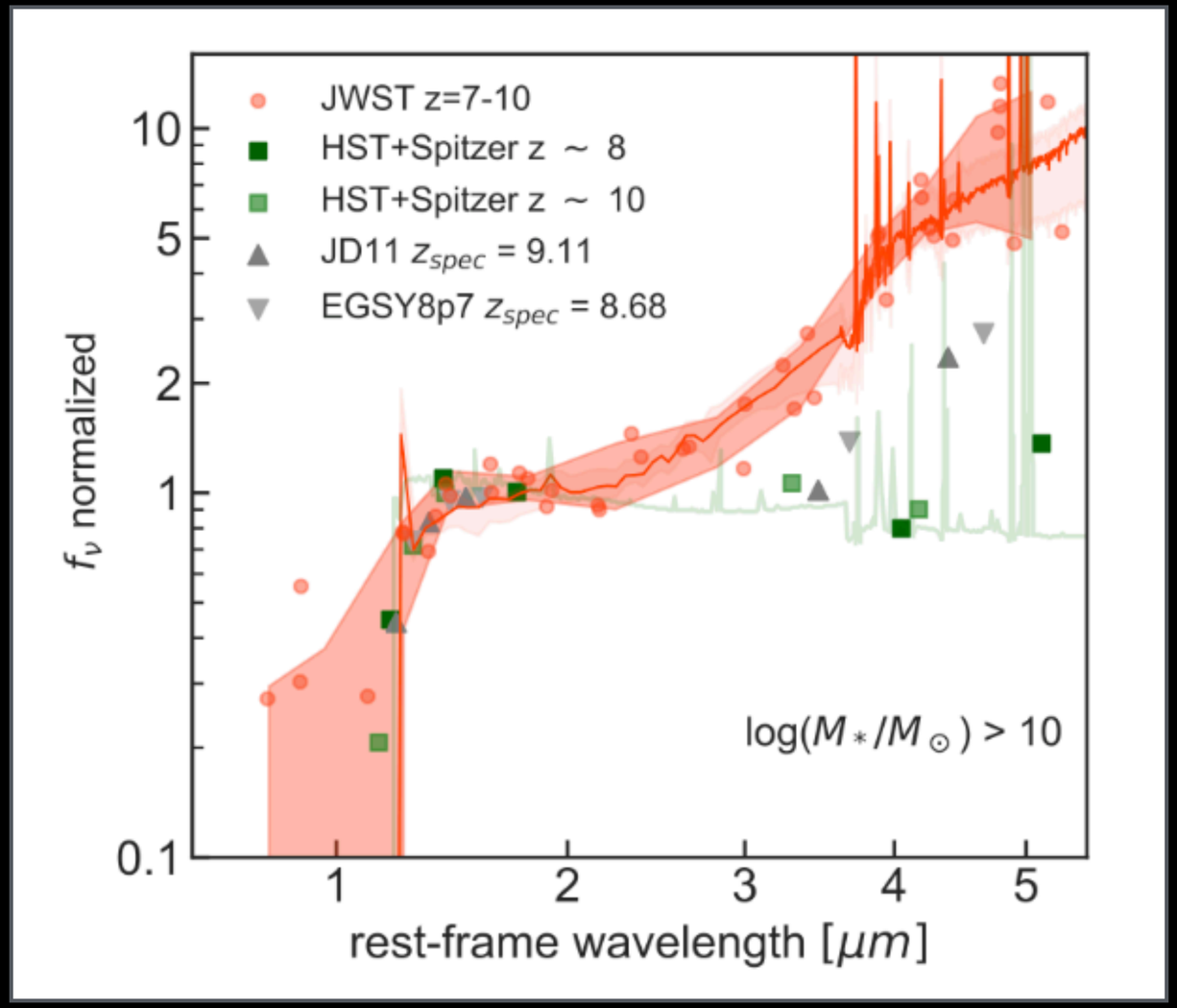
Gourav Khullar et al. (in prep)



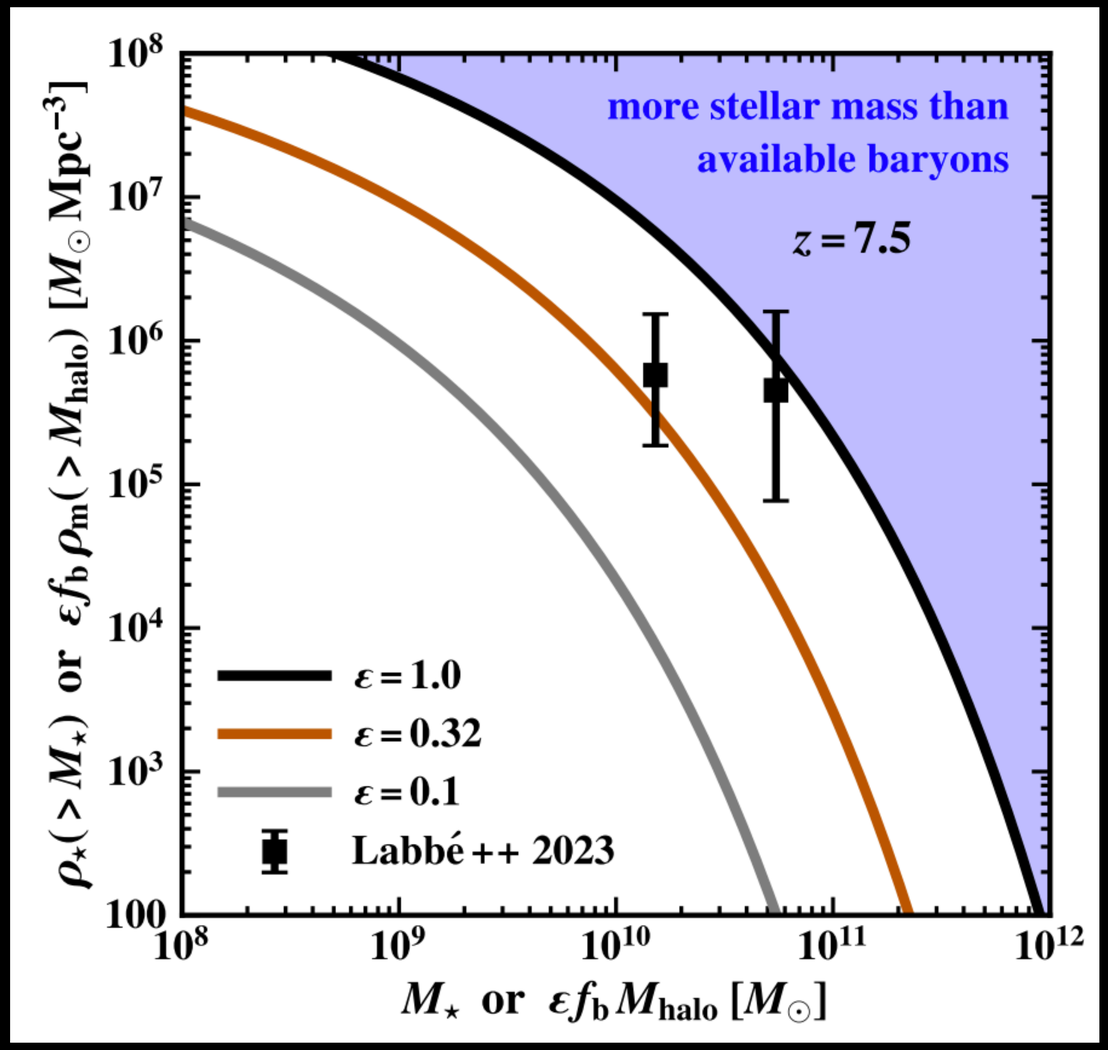


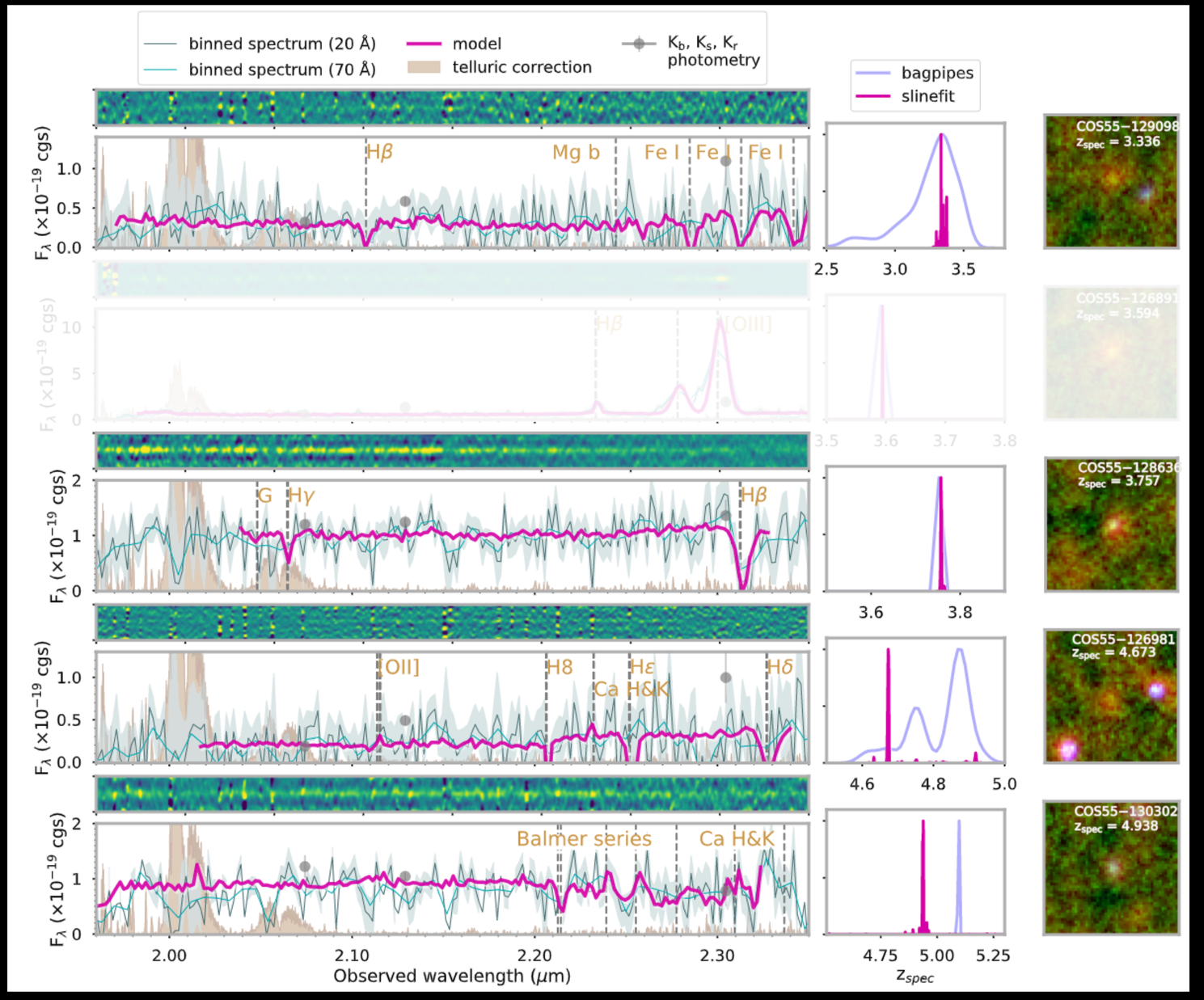
Legend:
SFH: MAP SFH (dotted red), Median SFH (solid red), 1sigma (dark grey) and 2sigma (light grey) SFH constraints
SED: MAP SED (solid red), SED uncertainties (1 sigma, grey), observed photometry (black), best fit model photometry (orange)

Labbé et al. (2023)

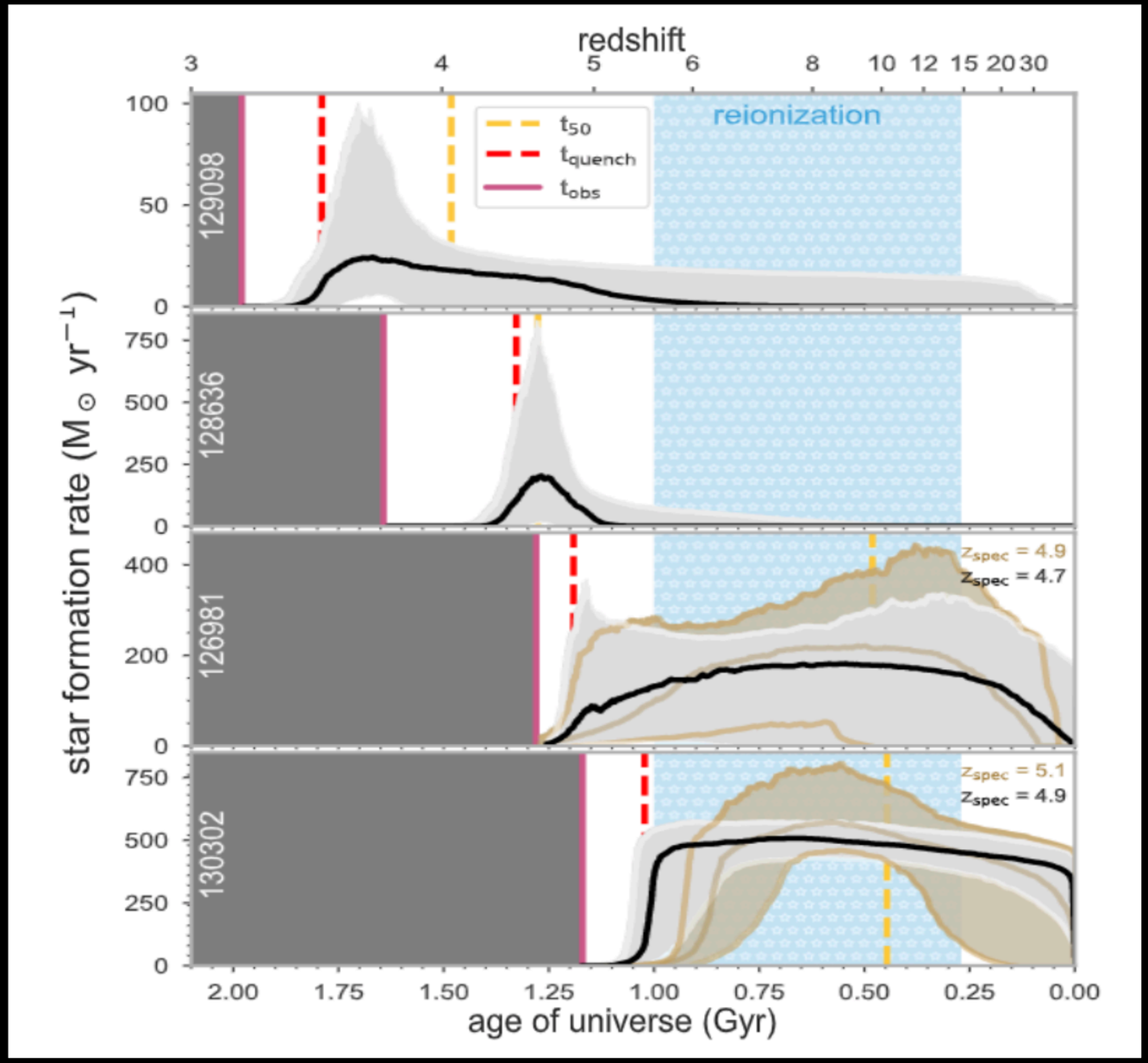


Boylan-Kolchin et al. (2023)





Jacqueline Antwi-Danso
et al. (in prep)



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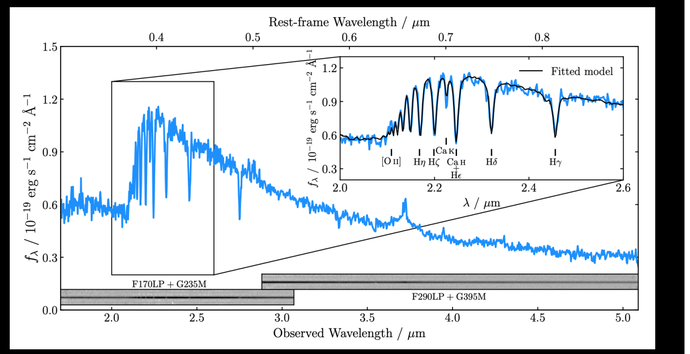
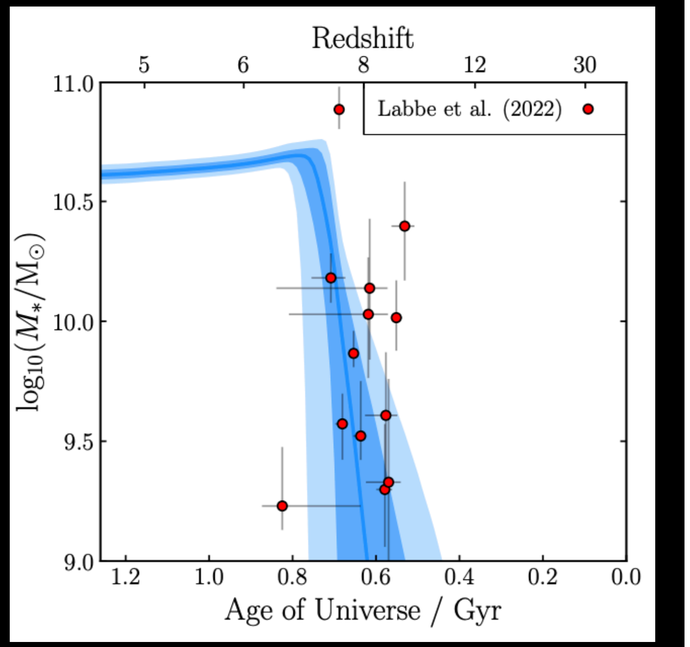
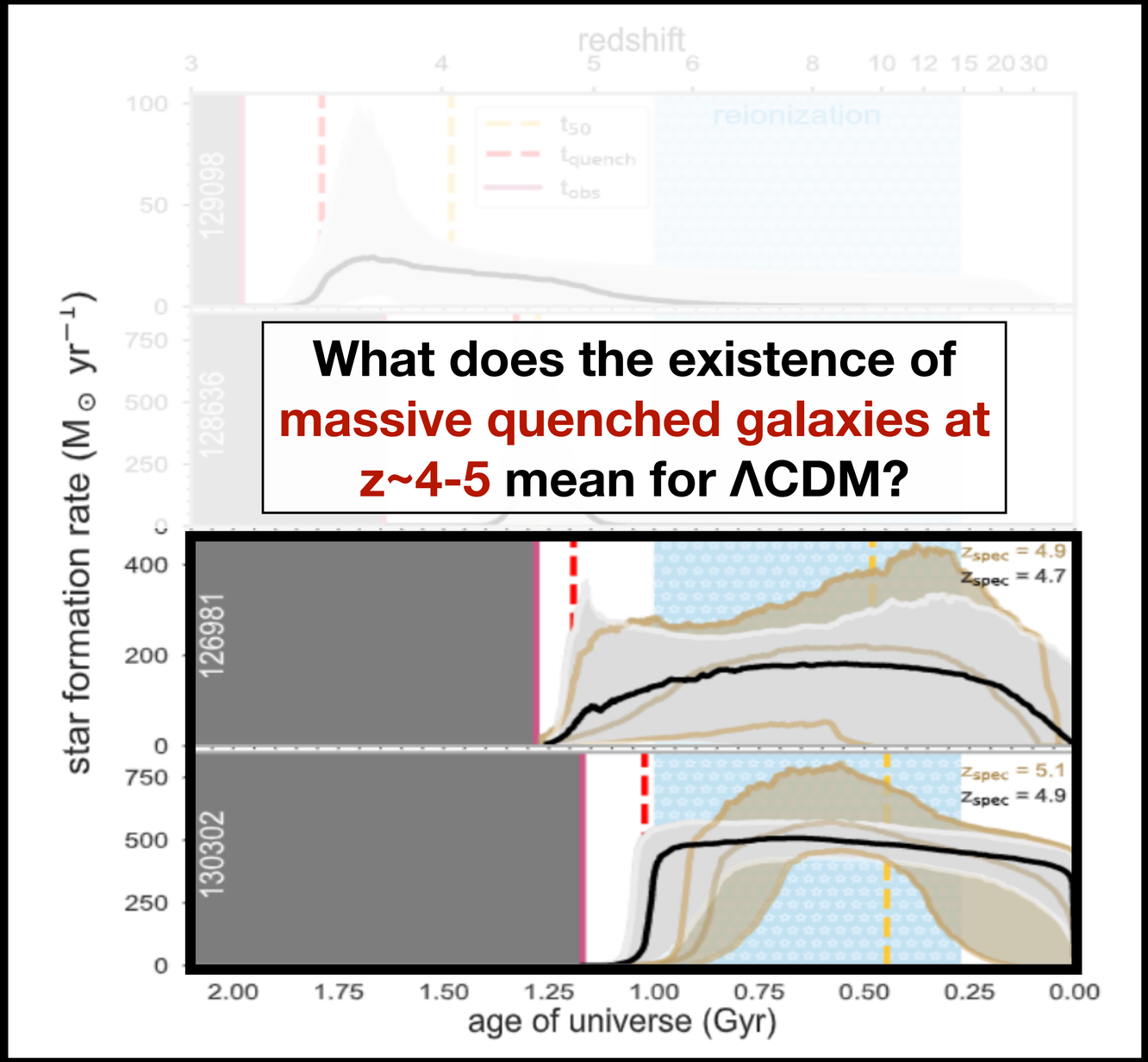




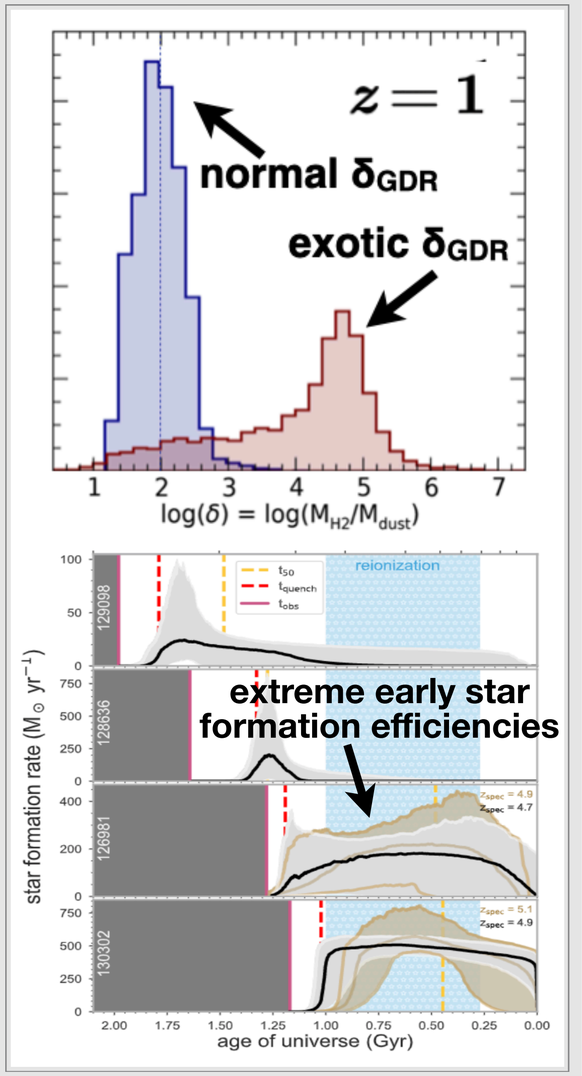
Carnall et al. (2023b)



Some highlights...

Quiescent galaxies at z~2 have extremely low inferred gas fractions

Or do they? **This is surprising and contradicts our current view at high redshifts from stacking analyses. Simulation predictions and stacking results stand in tension. We need to understand the molecular gas to dust mass ratios better…**

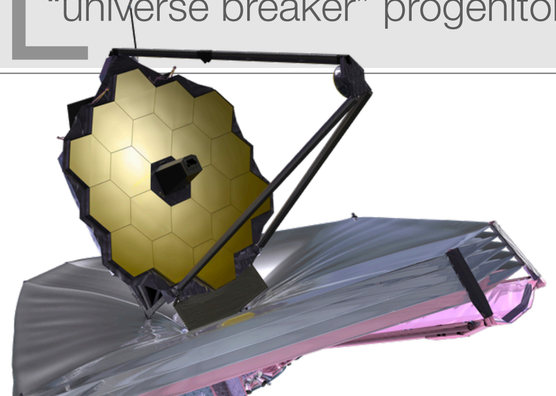


Results from the JWST Treasury Programs

UNCOVER released images (Bezanson+23), lens models (Furtak+23), photometric catalogs (Weaver+23) and soon SPS modeling (Wang+23). Stay tuned for paper led by Gourav Khullar presenting a large sample of high redshift quenched candidates. Also stay tuned for results from PRIMER with a team working at UMass Amherst.

Tension in Early Galaxy Formation Models

Spectroscopic confirmation of quiescent galaxies at z~4.5-5 challenge formation models, requiring 98% star formation efficiency; at face value, they are consistent with “universe breaker” progenitors but more high-quality (JWST!) spectroscopy is needed.



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Assistant Professor, UMass Amherst

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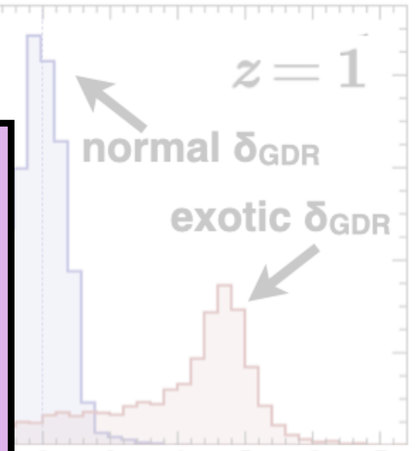
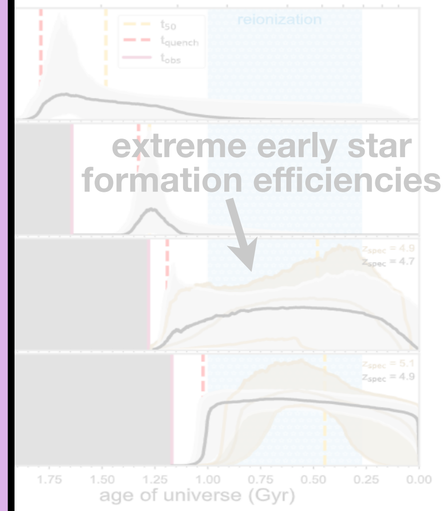
DAWN

Danmarks Grundforskningsfond
Danish National Research Foundation





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