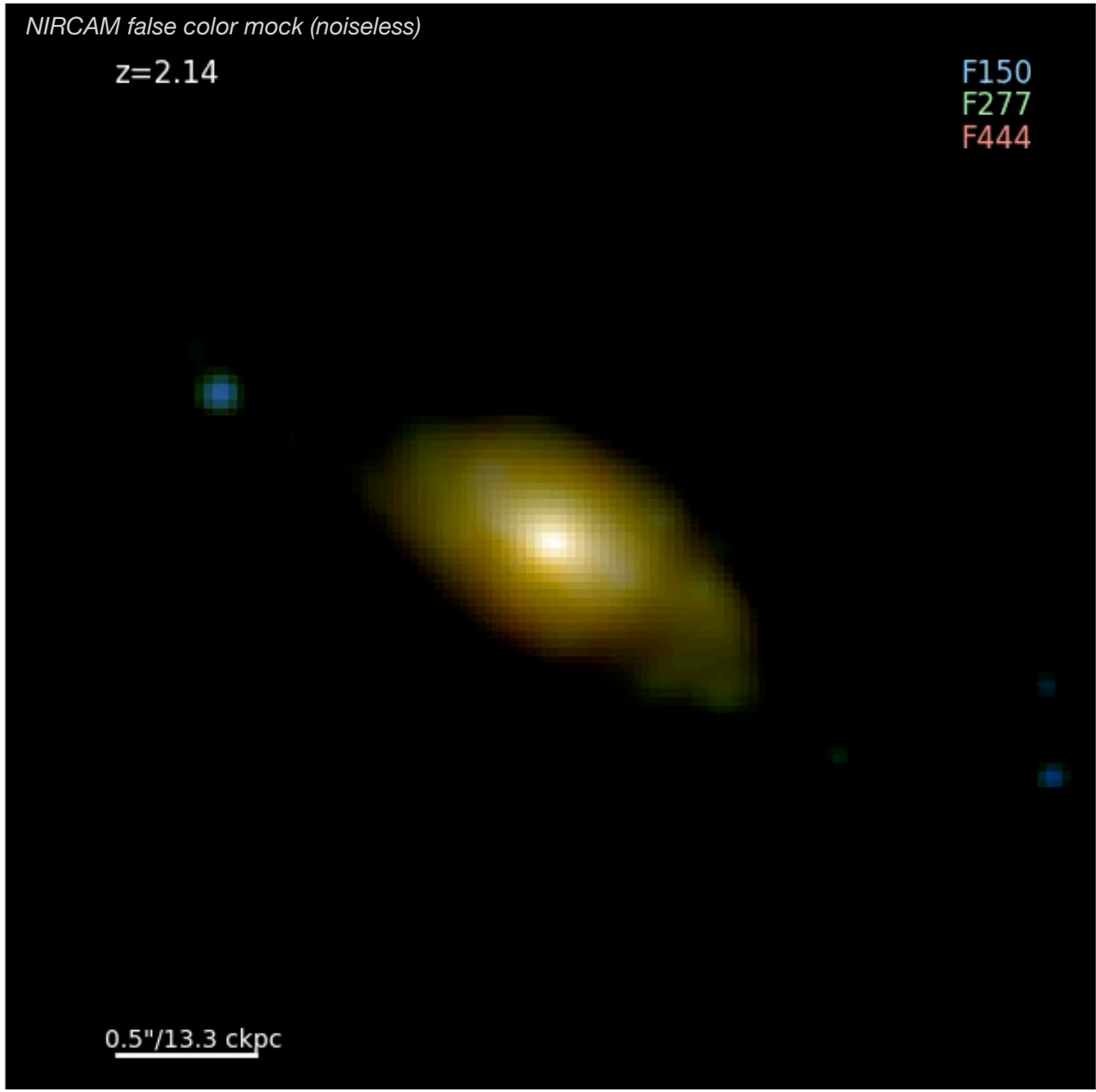
Can simulations quench enough early massive galaxies?



Joe Lewis, SNO 25/11/25

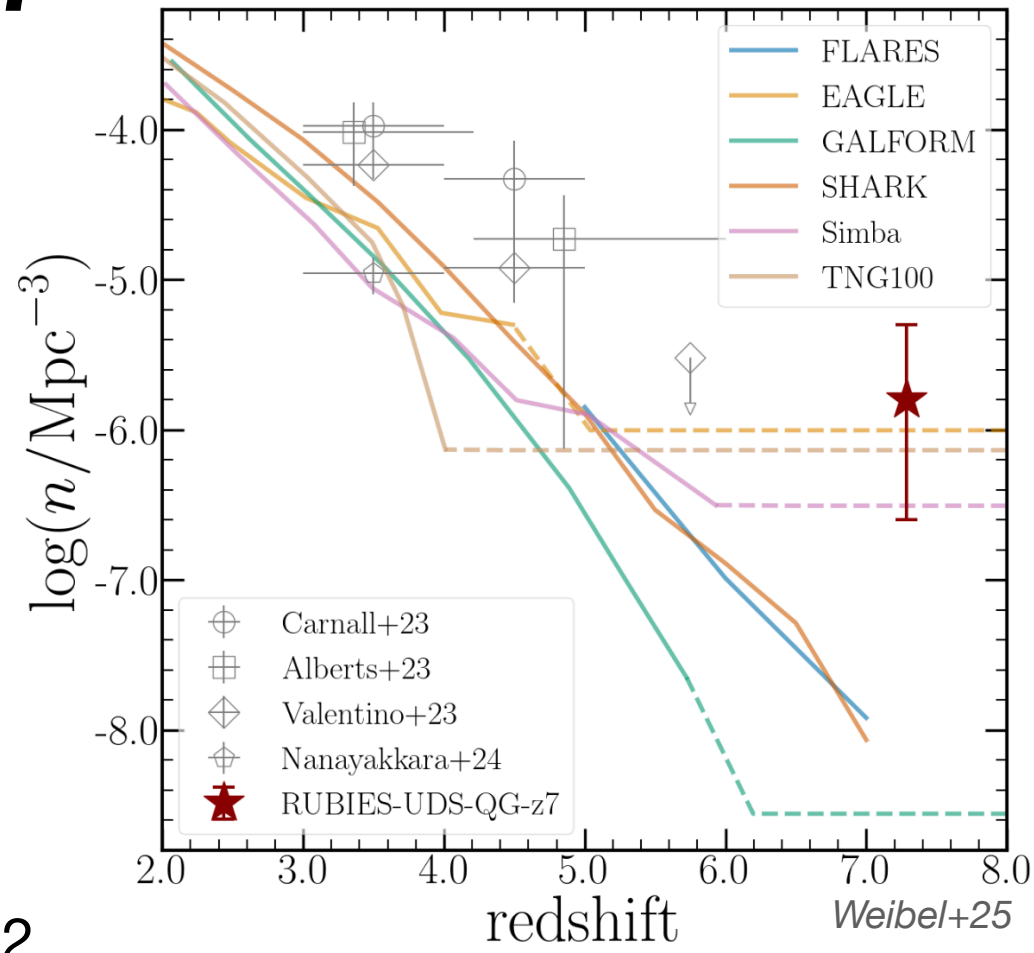
Surprises from JWST

III- Quiescent galaxies at z=7

Simulations struggle to reproduce observed high-z quenching

New quiescent galaxies at dry high z *e.g. Weibel*

Quenching linked to different galaxy physics



Getting the *right* quenching statistics

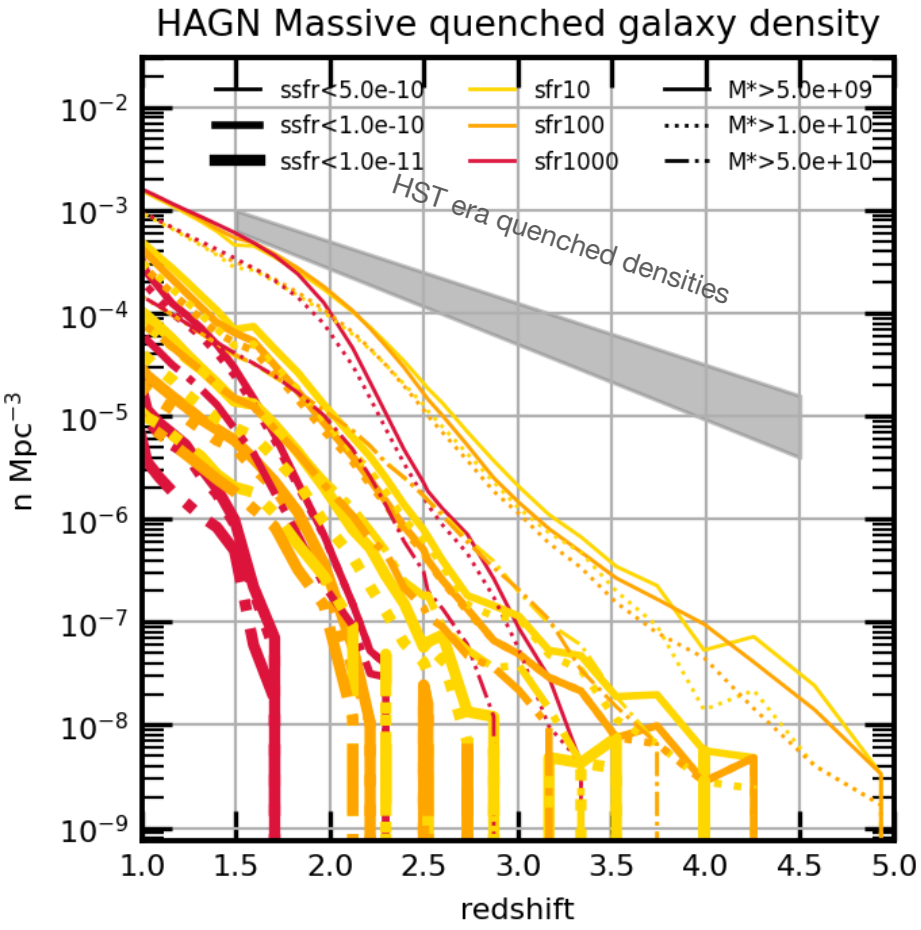
…is hard!

Very difficult to quench z>2 galaxies

Unconstrained physics at high-z (e.g. black hole formation + feedback), problems matching new UVLFs from JWST…

Do we need new modeling?

Solution involves a lot of our unknowns



Re-simulating massive quenched HAGN galaxies

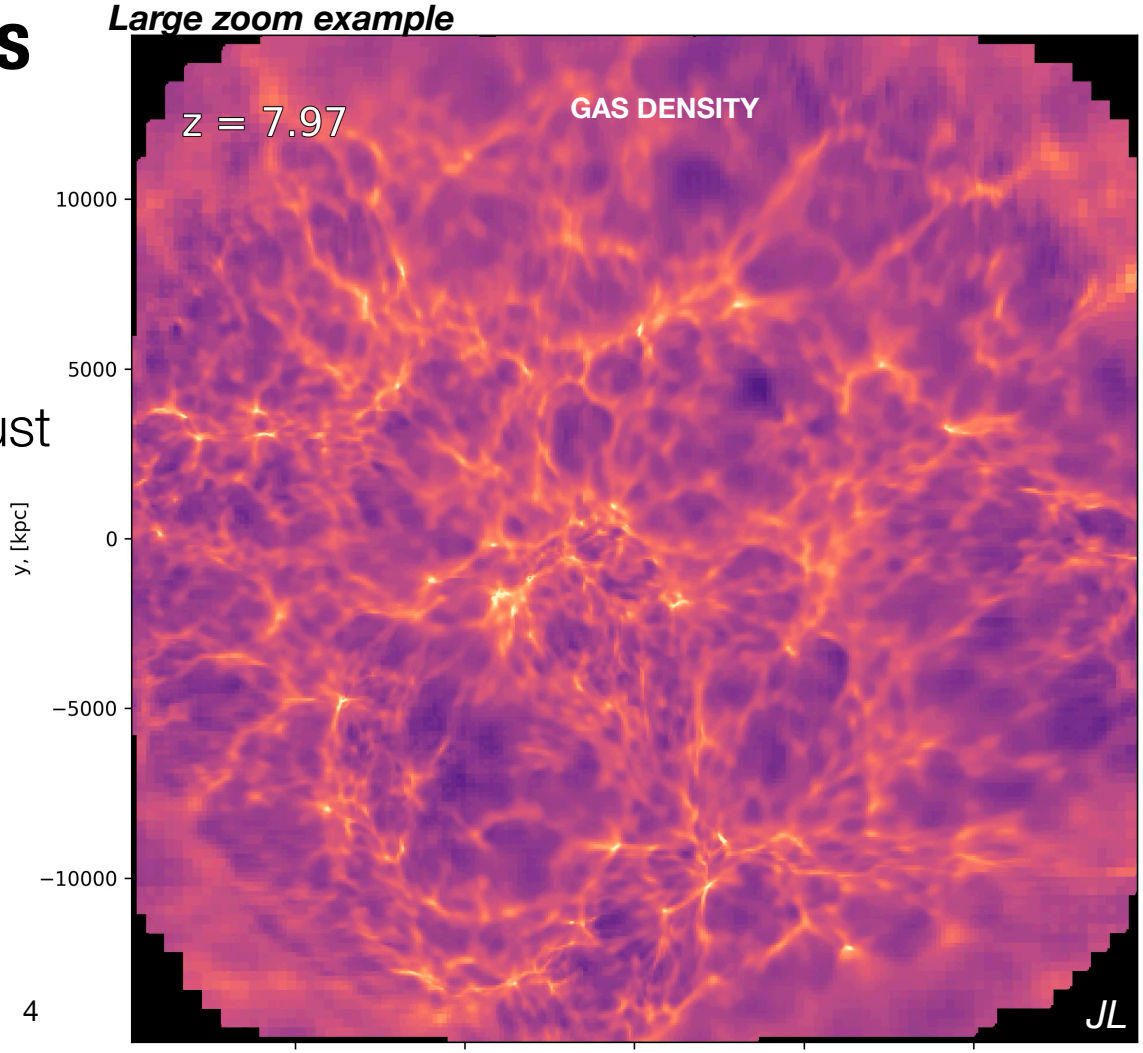
Re-simulate Horizon-AGN galaxies

1 kpc → 34 pc resolution!

Targets: 1e12< M_{halo} <1e13 $M_{\odot}$

NewHorizon like physics with YD+24 dust

Variations on stellar & AGN physics



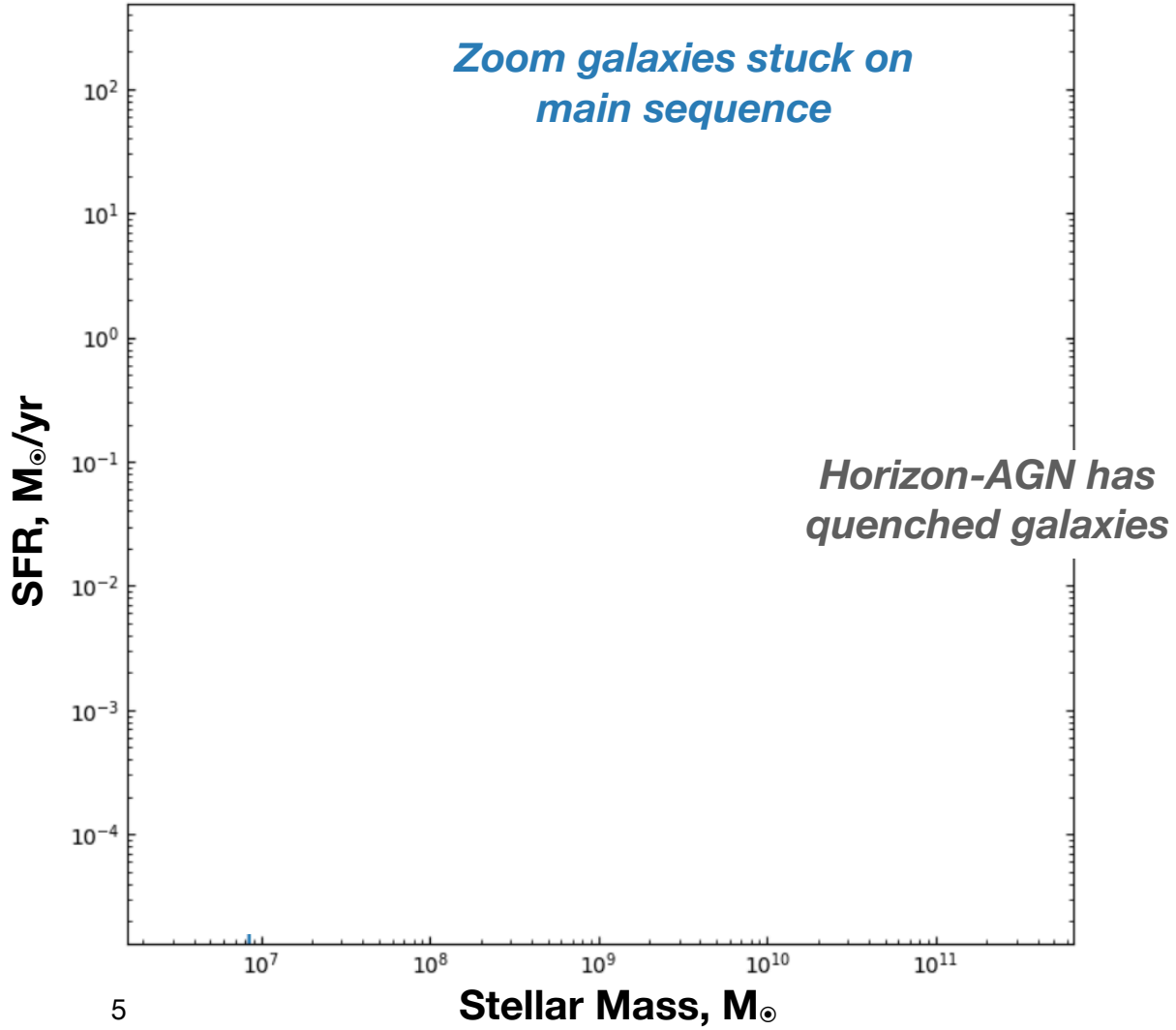
Re-simulating massive quenched HAGN galaxies

Do the zooms quench?

Horizon-AGN galaxies do quench

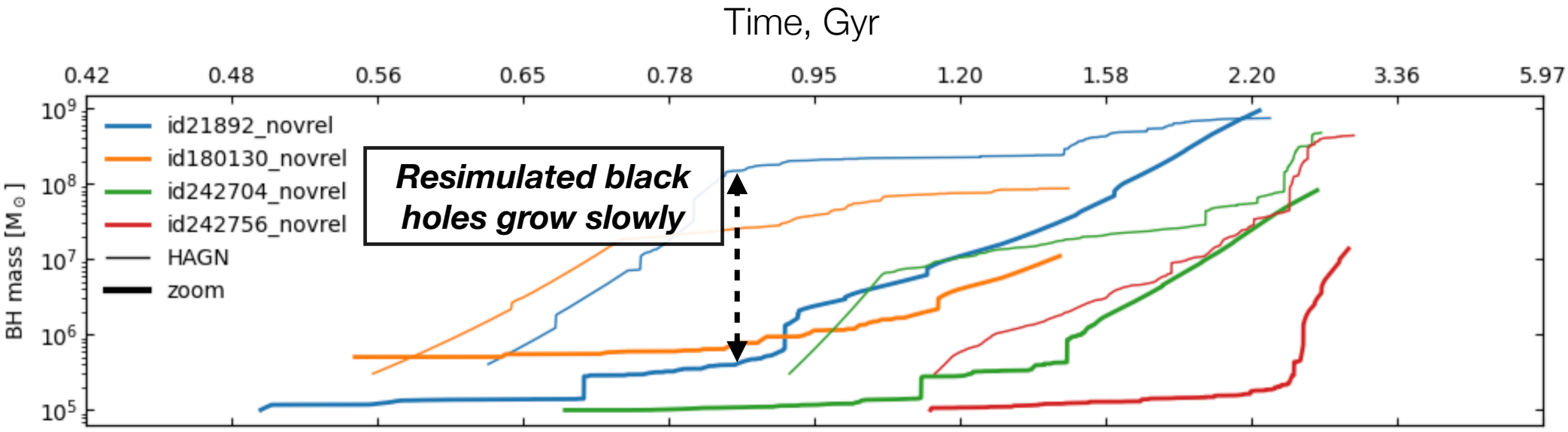
But fewer than in observations…

Resimulations have no red or quenched galaxies at z=2!



Re-simulating massive quenched HAGN galaxies

Surprises and growing black holes



Problem with the model?

AGN Feedback

e.g. More effective coupling?, Farcy+25

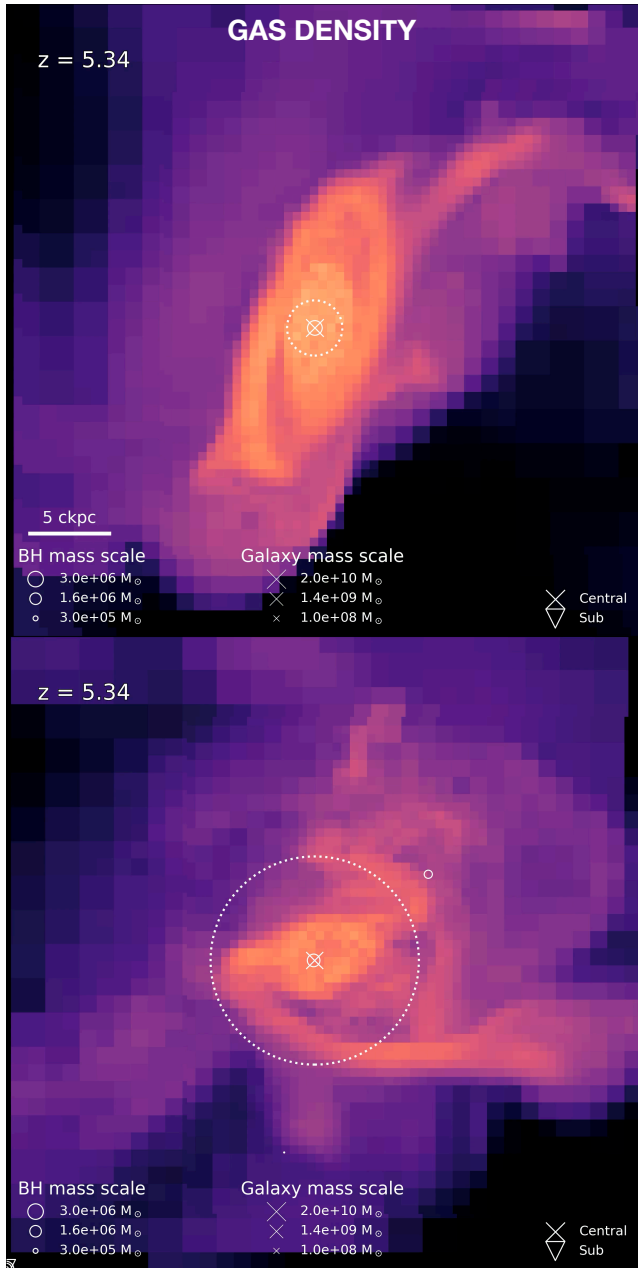
My work

BH Accretion

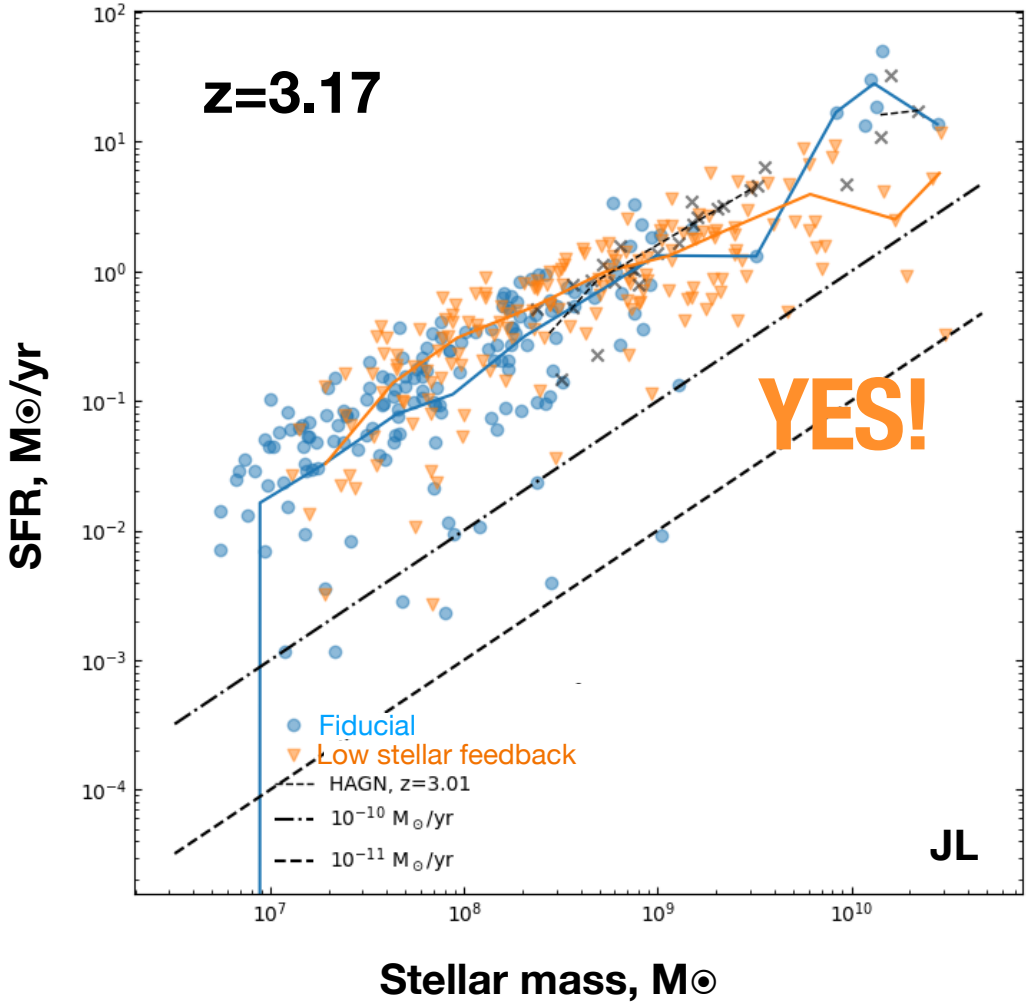
e.g. Torque limited accretion, Angles-Alcazar+17

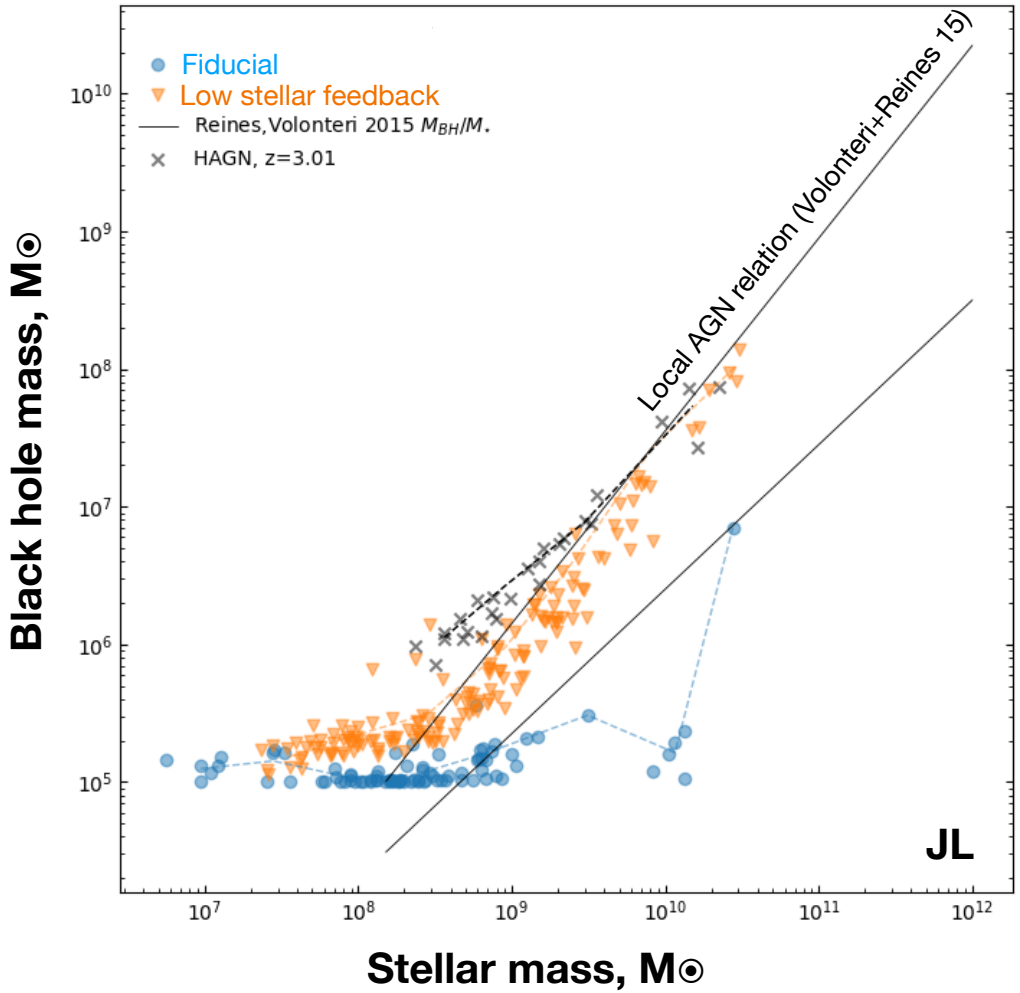
Star formation and feedback?

e.g. Weaker stellar feedback



Let's throw in the kitchen sink… Can I quench?



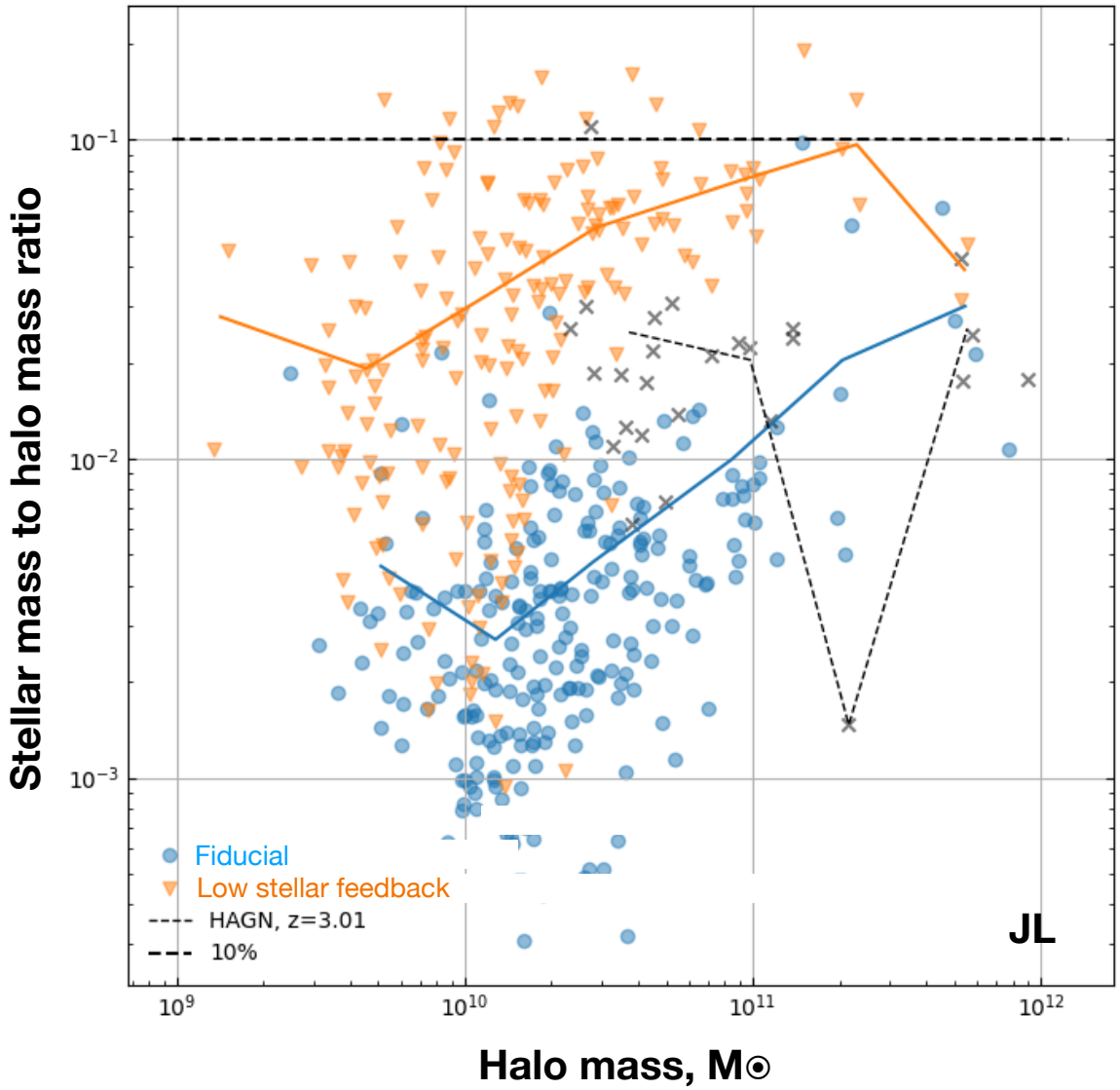


But at what cost?

Too much star formation

Gentler feedback sources?

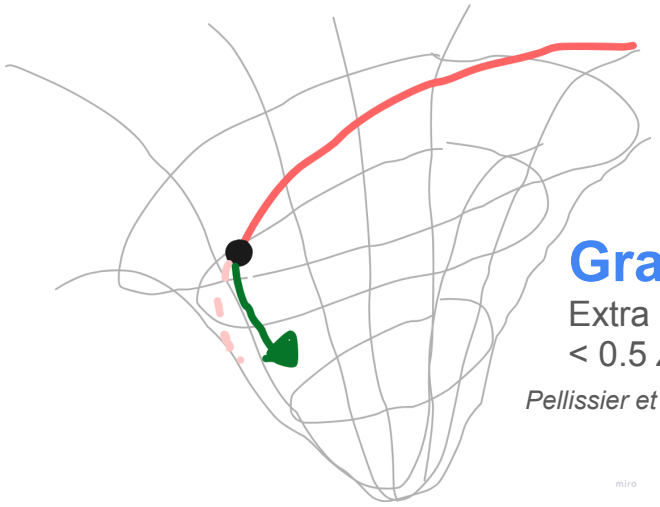
…Stay tuned !



Work by Arturo Nunez-Castineyra

Problem with the numerics?

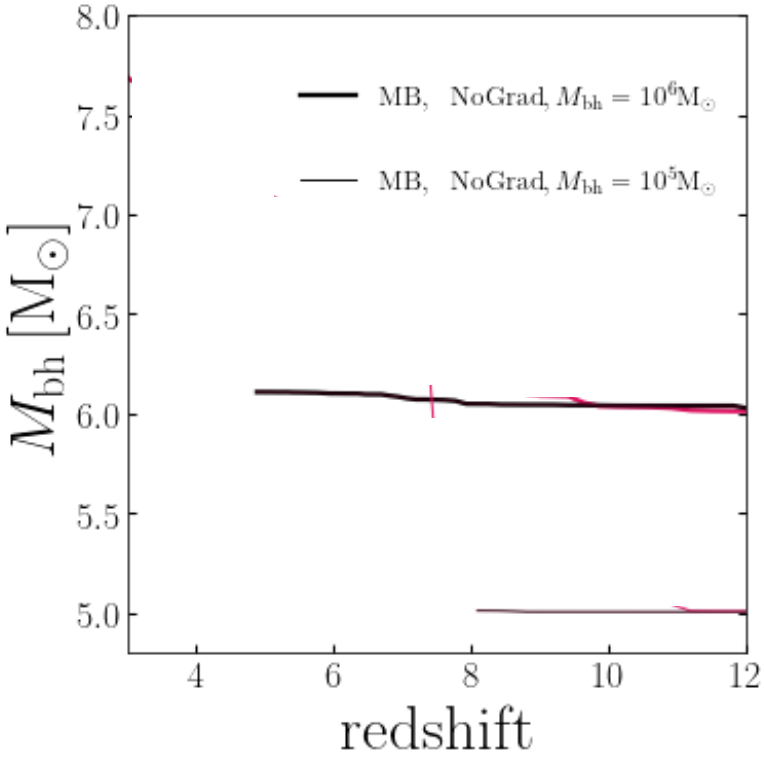
Forcing the black hole into dense clumps



Gradient descent:

Extra sink displacement
< 0.5 Δx towards the local potential well.

Pellissier et al. 2023



Problems with the comparisons to observations?

Observational biases

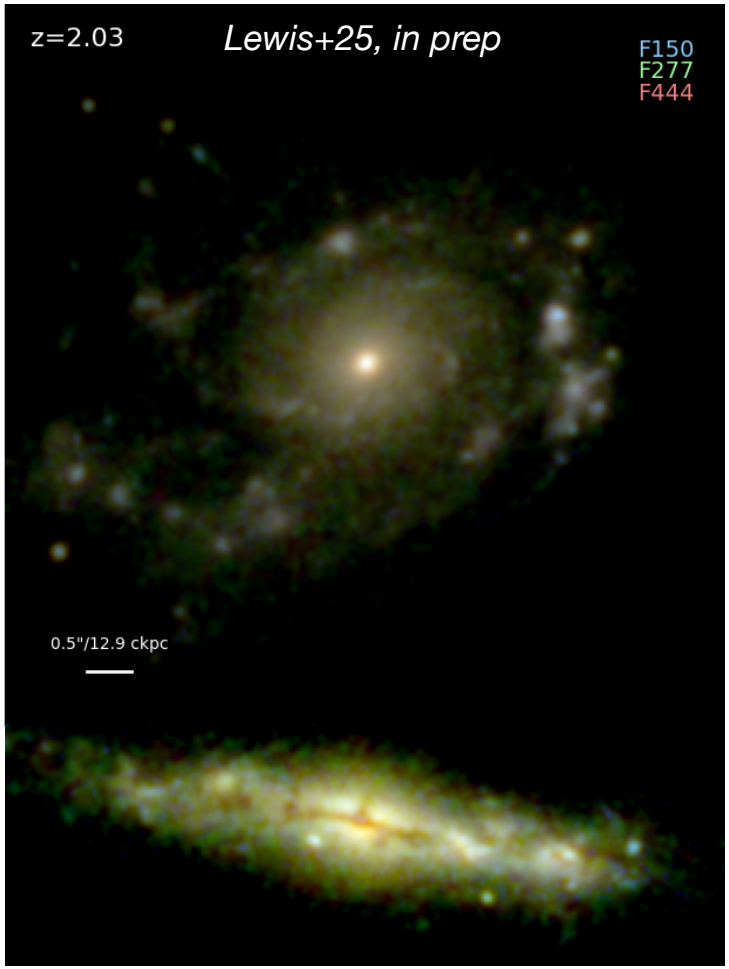
How do UV-J cuts and photometric sSFR cuts perform?

What if star formation is in faint features?
Could we miss it?

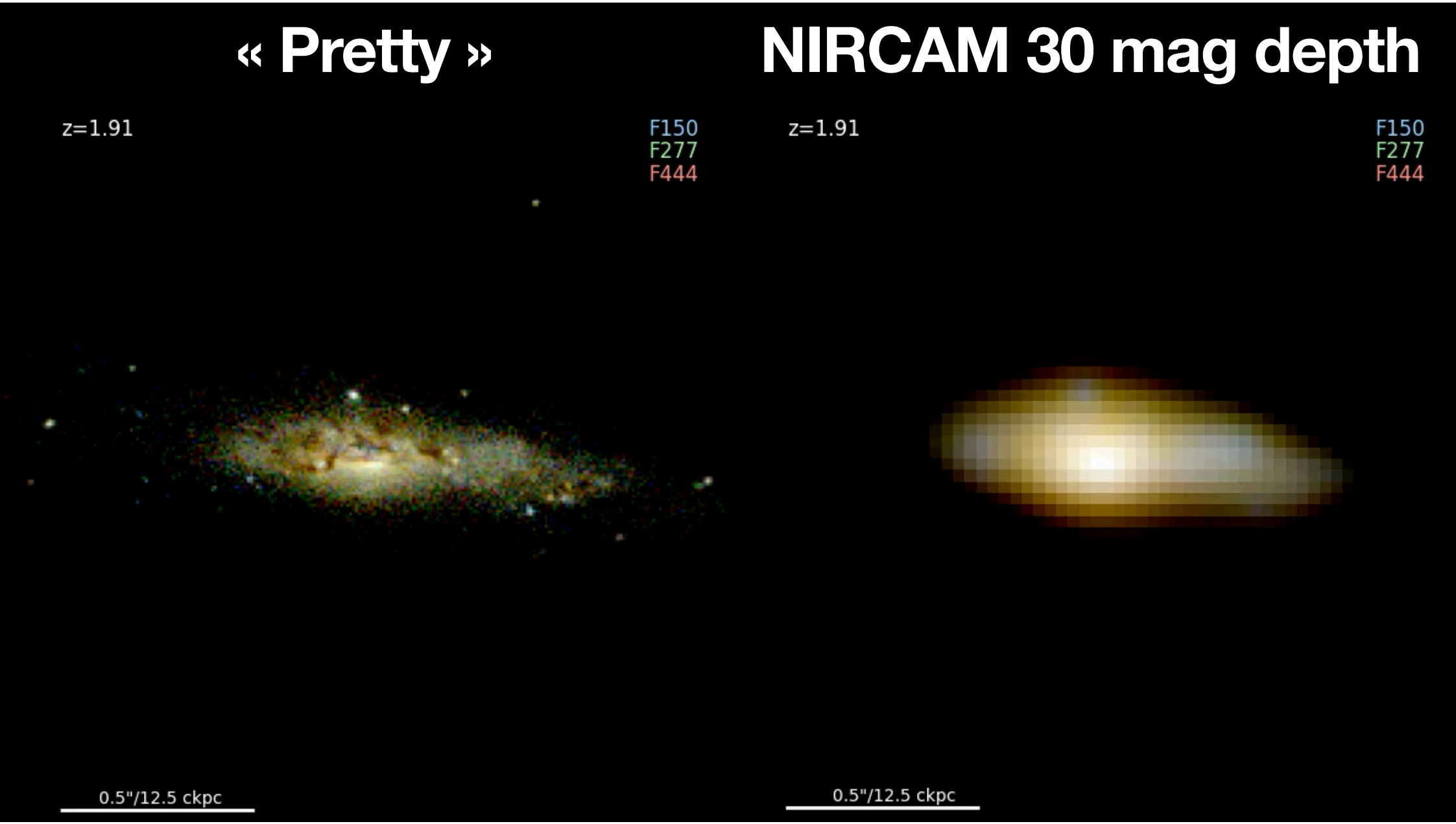
Mock observations of my simulations with RASCAS (MD+20)

With proper PSFs, resolution and noise

SE++ detections + LePhare photometry

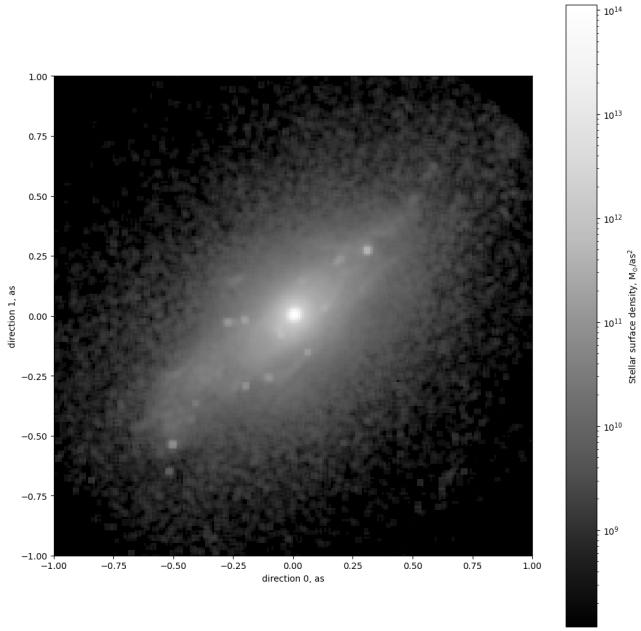


False color NIRCAM image of a z=2 spiral from my simulations

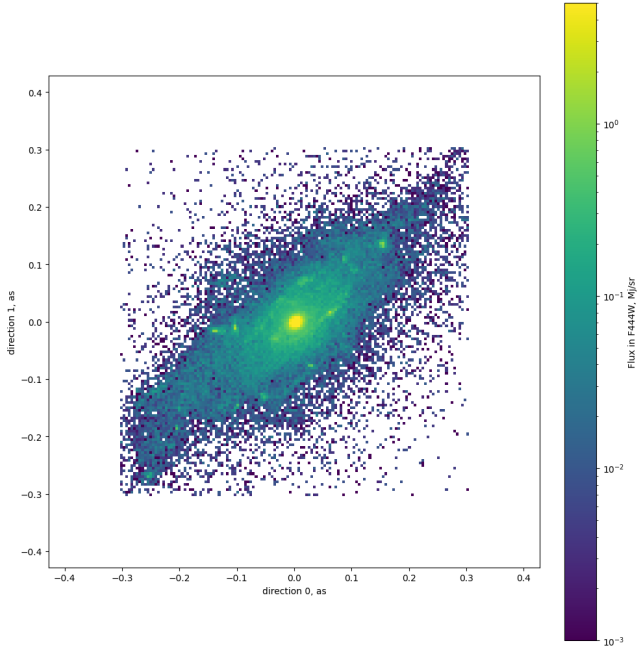

« Pretty »
NIRCAM 30 mag depth
z=1.91
F150
F277
F444
0.5"/12.5 ckpc
z=1.91
F150
F277
F444
0.5"/12.5 ckpc

Pipeline

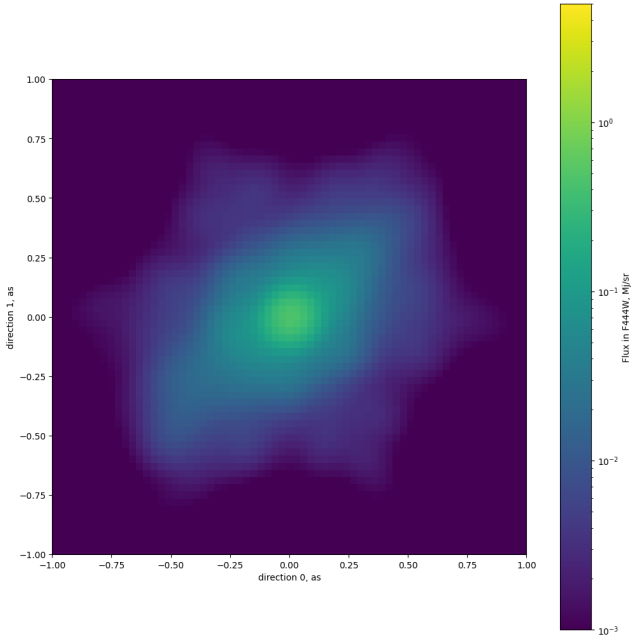
Simulation



Rascas

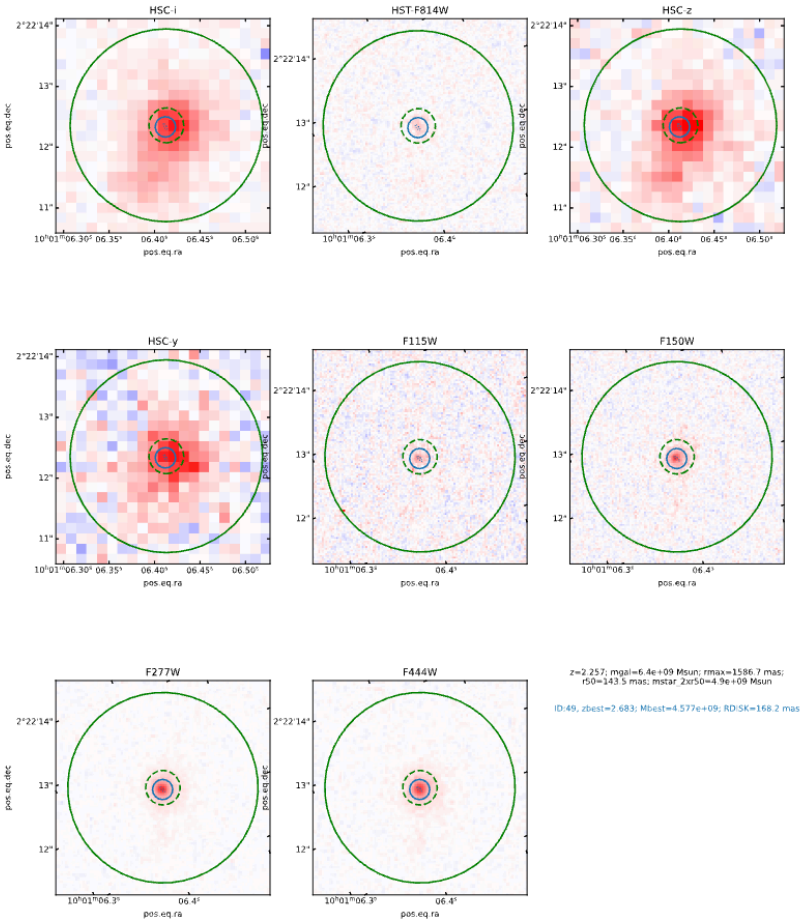


Mock

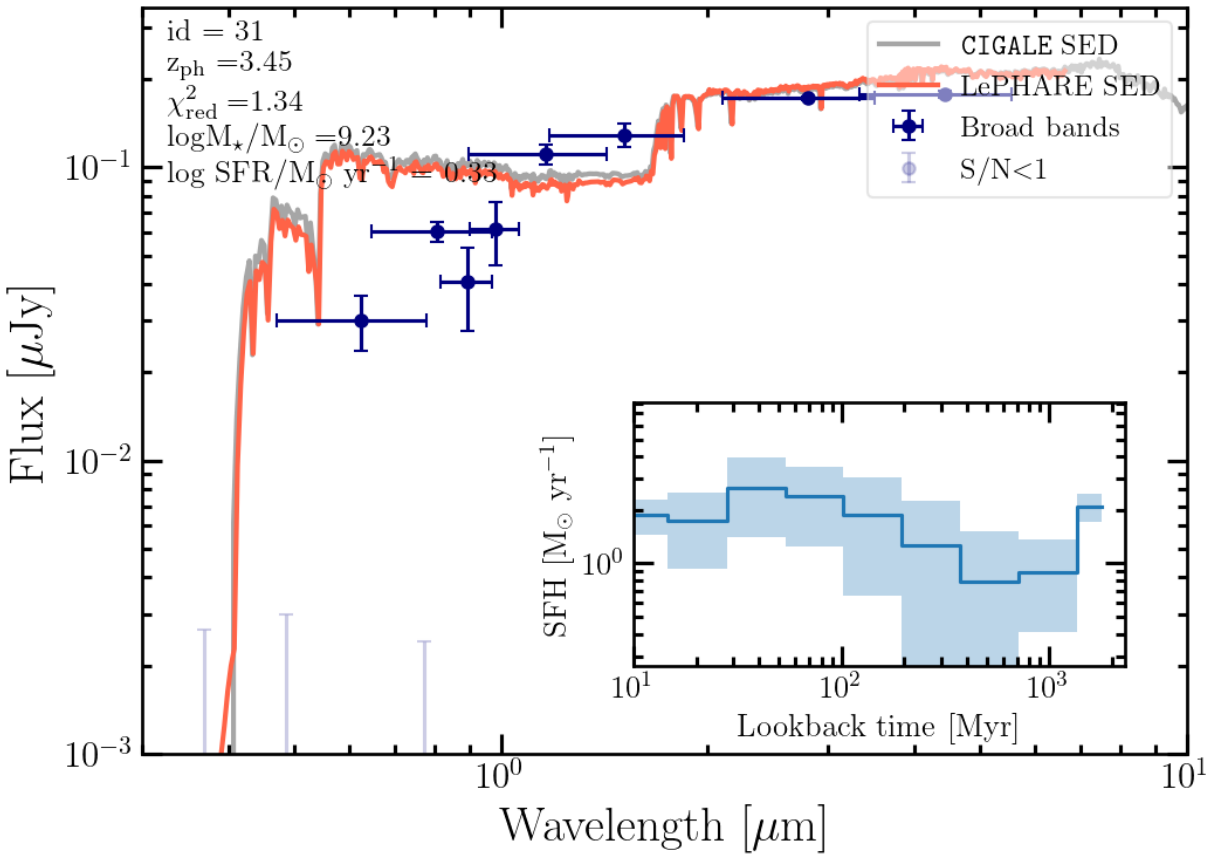


Pipeline

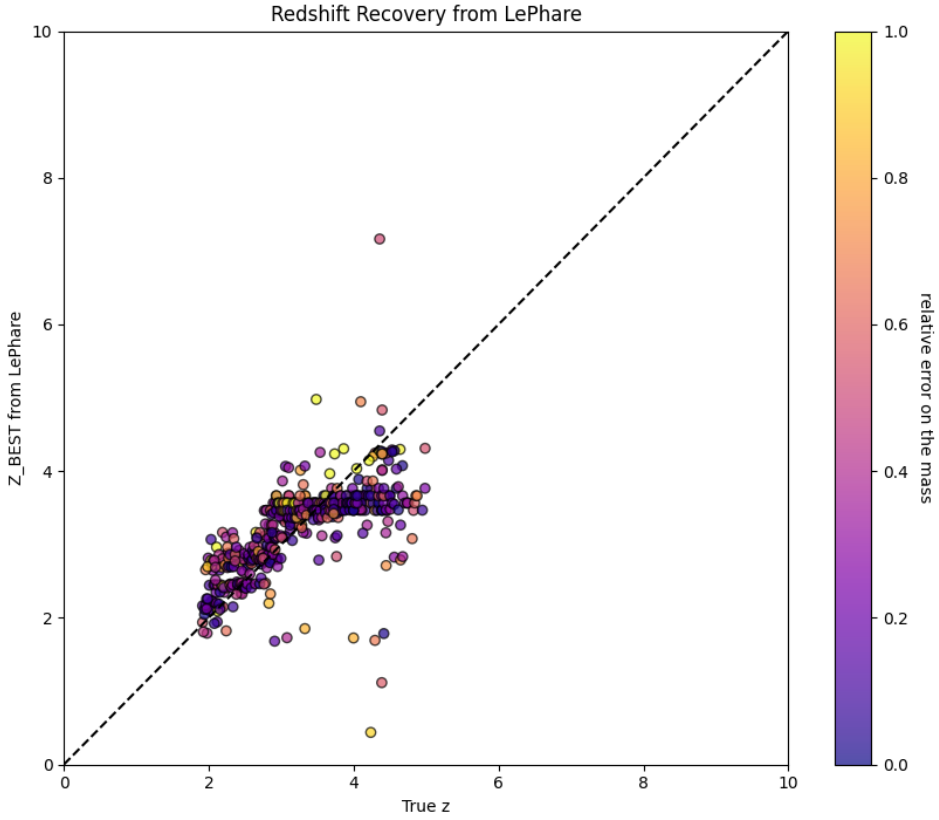
Flats with real noise

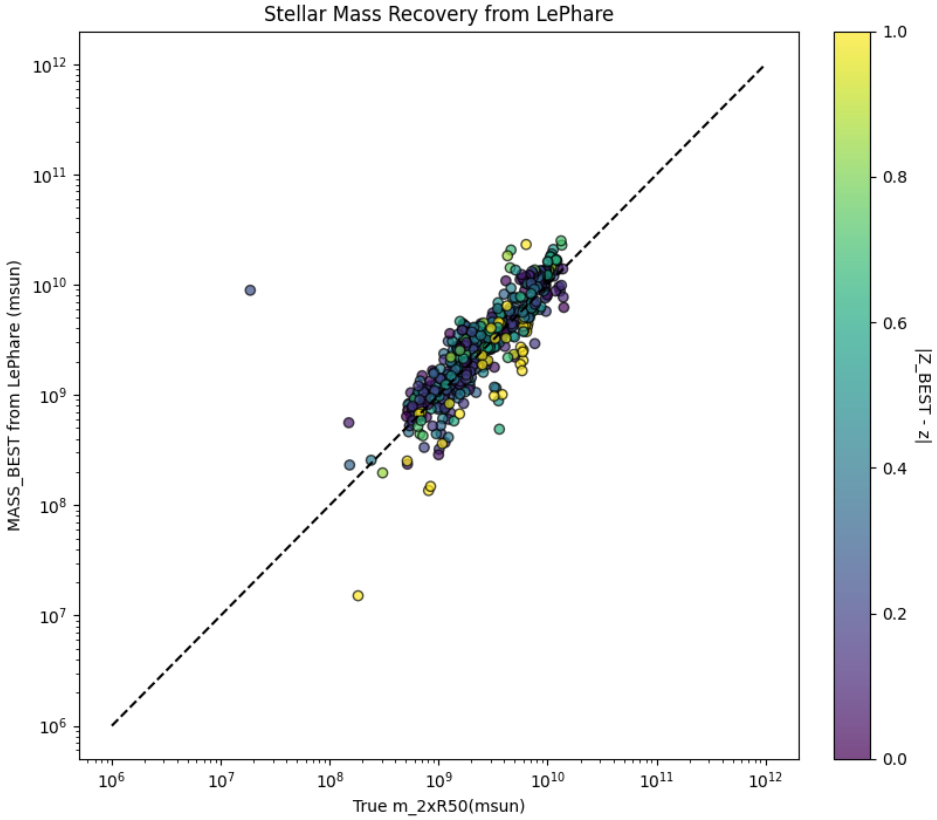


Lephare/Cigale



Pipeline


Redshift Recovery from LePhare
Z_BEST from LePhare
True z
relative error on the mass
0
2
4
6
8
10
0.0
0.2
0.4
0.6
0.8
1.0


Stellar Mass Recovery from LePhare
MASS_BEST from LePhare (msun)
True m_2xR50(msun)
|Z_BEST - z|
10^6
10^7
10^8
10^9
10^{10}
10^{11}
10^{12}
0.0
0.2
0.4
0.6
0.8
1.0