Measuring Star-Formation Histories at z~2 with a Semi-Resolved Approach

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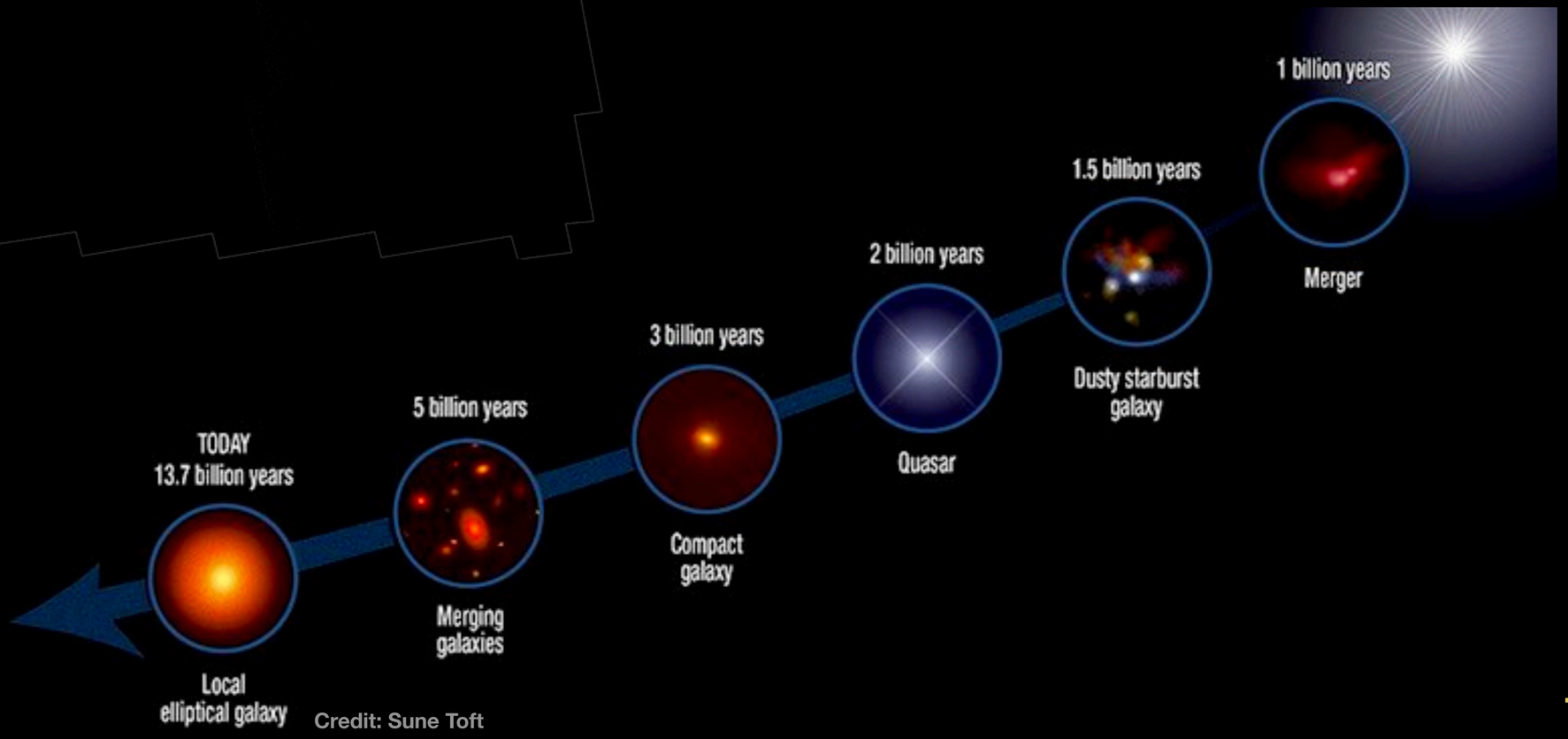
UMass Amherst, DAWN-IRES Senior Scholar/Cosmic Dawn Center
@secutler on Twitter

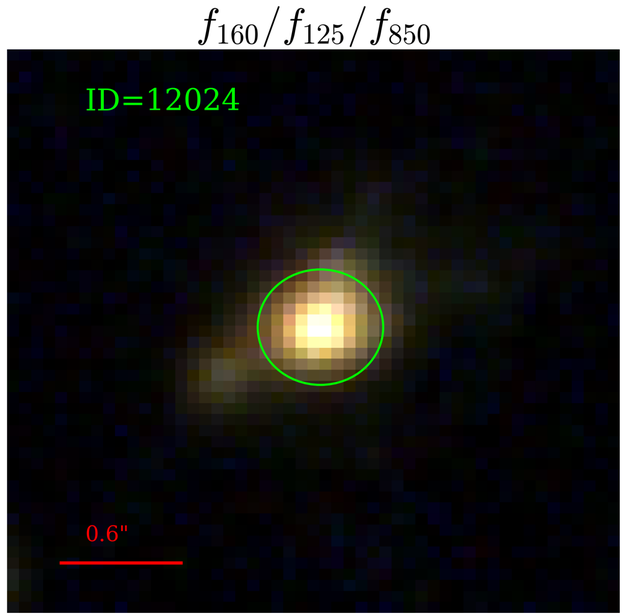
Credit: Iva Momcheva, 3D-DASH Team

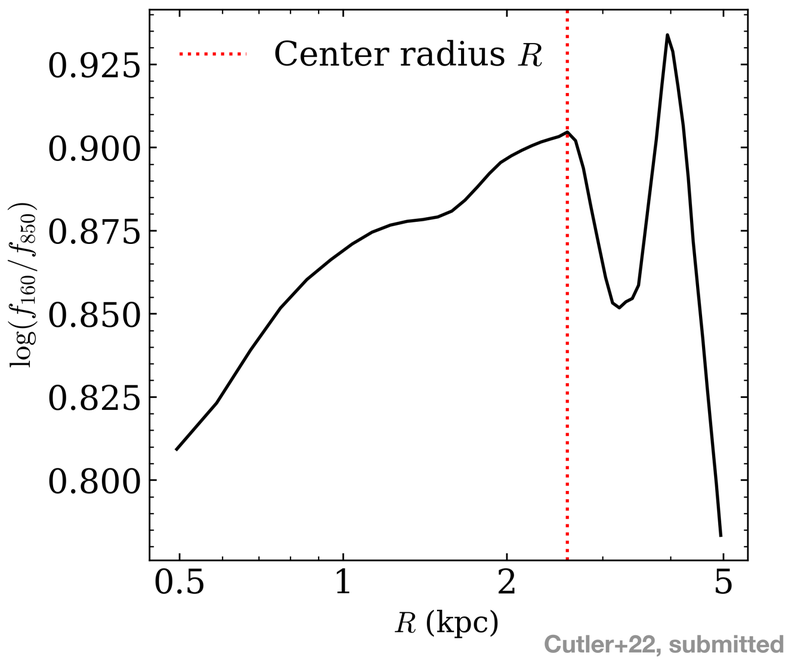


Credit: Sune Toft

Semi-resolved Prospector SEDs of star-forming galaxies

Does SFH differ between galactic centers and outskirts?





Cutler+22, submitted

Semi-resolved Prospector SEDs of star-forming galaxies

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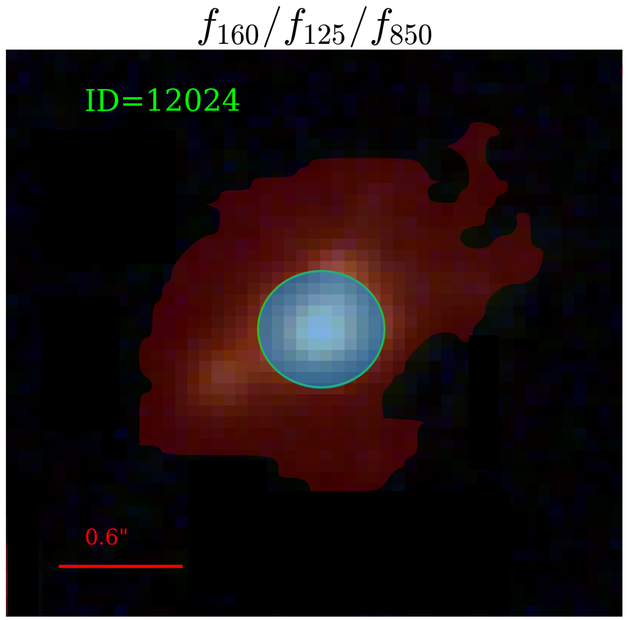
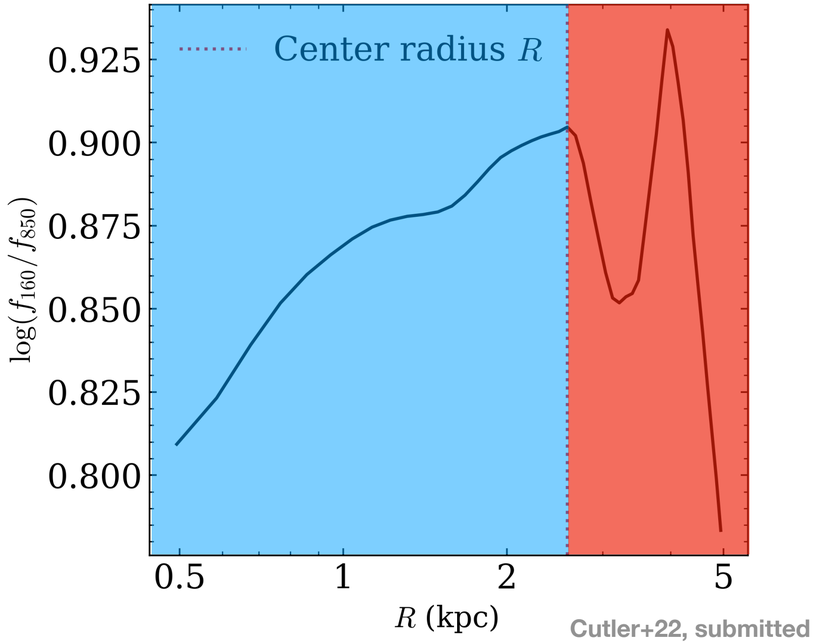
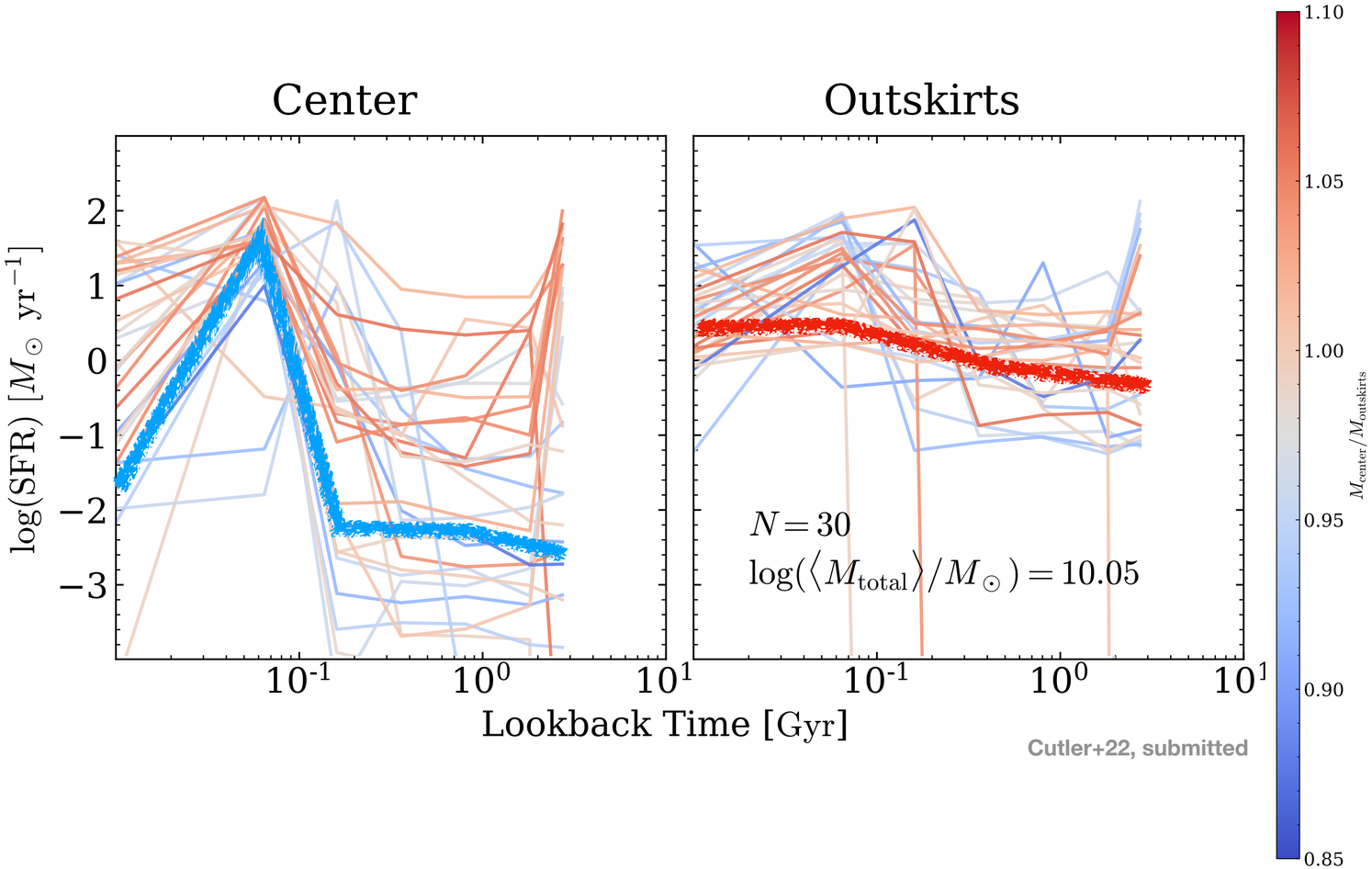




Cutler+22, submitted

Semi-resolved Prospector SEDs of star-forming galaxies

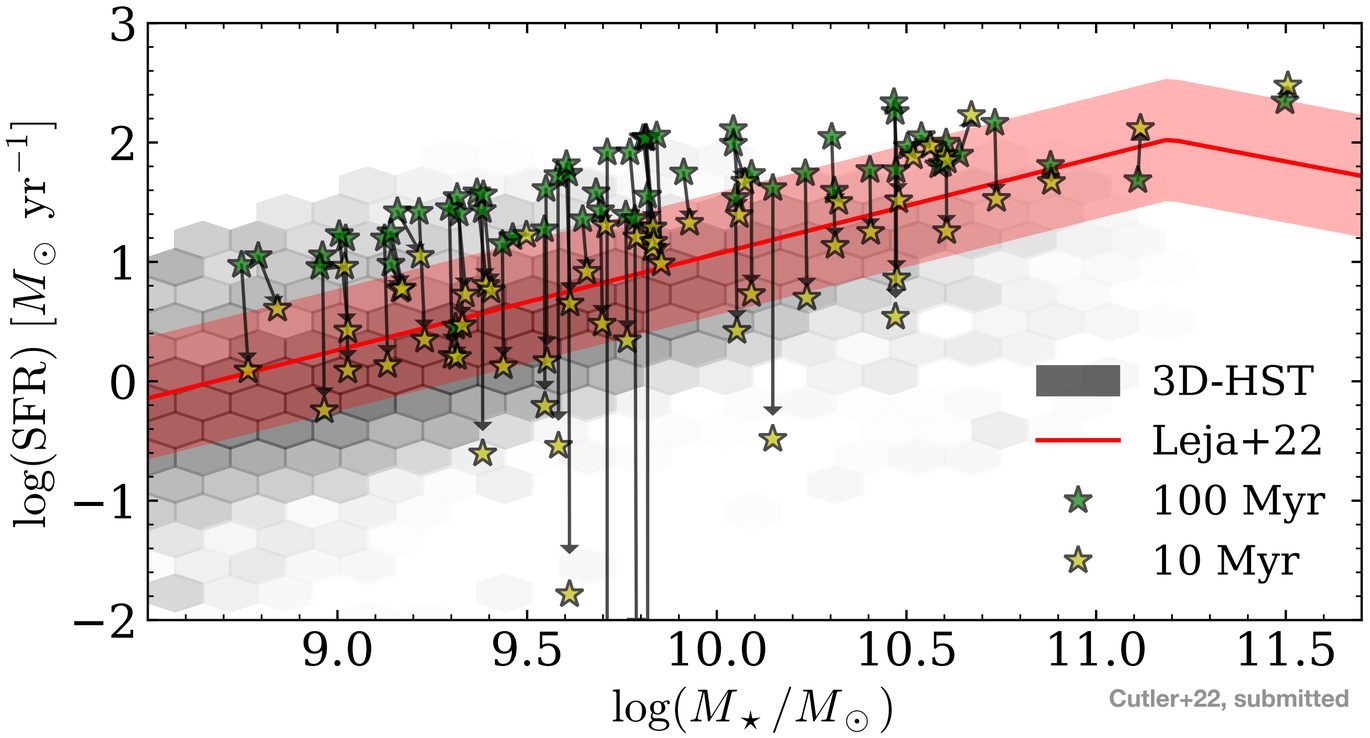
Centers of SFGs form fast and late compared to the outskirts



Cutler+22, submitted

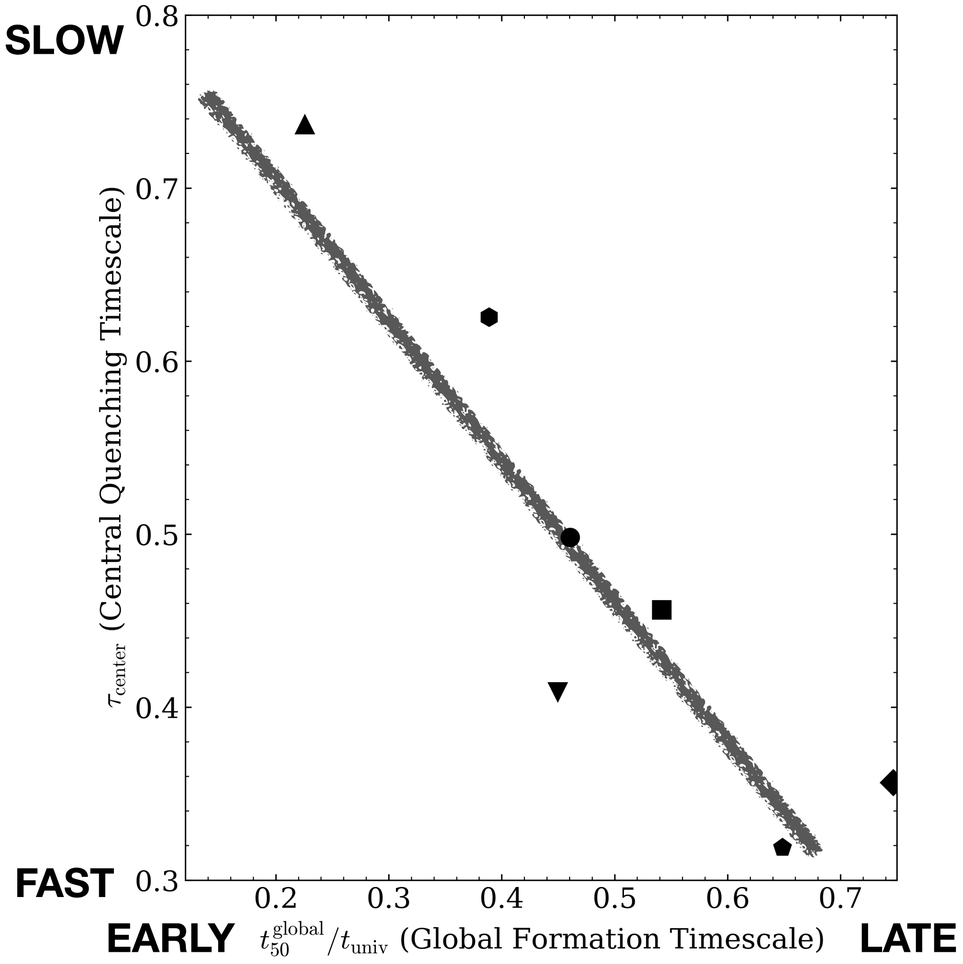
Semi-resolved Prospector SEDs of star-forming galaxies

Galaxies still on the main sequence after centers form



Timescales of quenched galaxies with color gradients

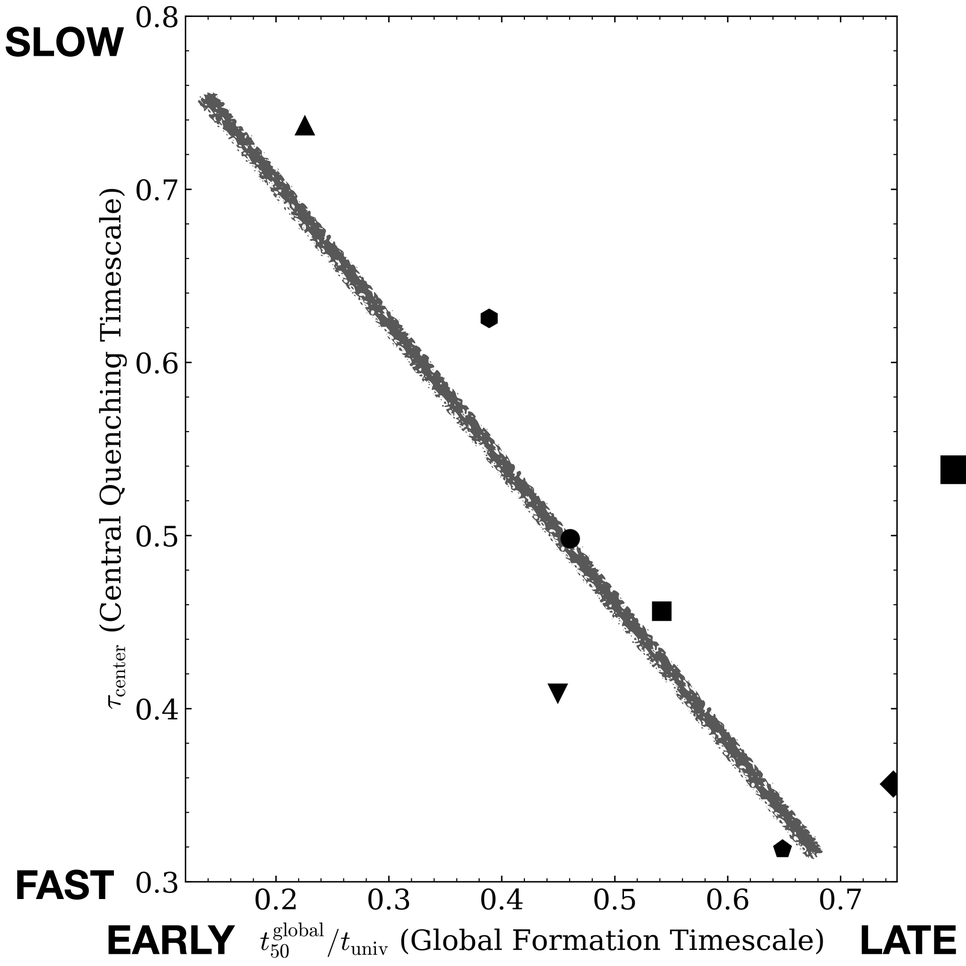
Compare (central) quenching and (global) formation timescales



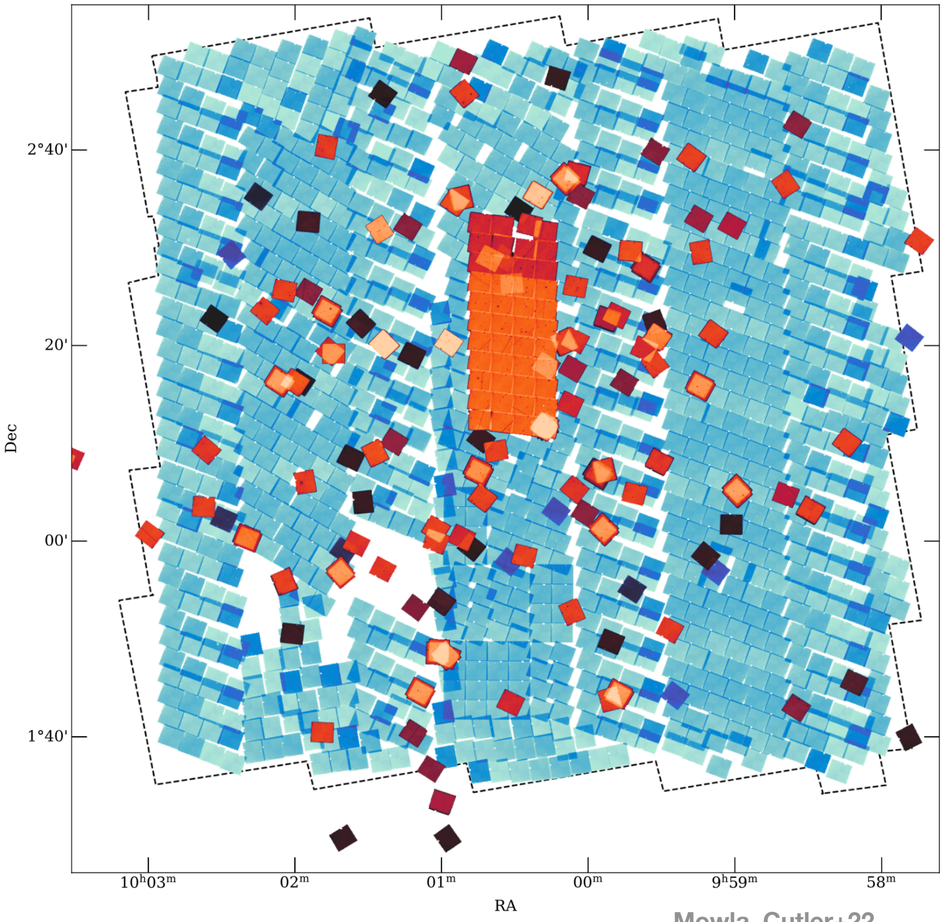
Data from REQUIEM (Akhshik+23)

Timescales of quenched galaxies with color gradients

Study timescales with a larger sample (e.g. 3D-DASH)



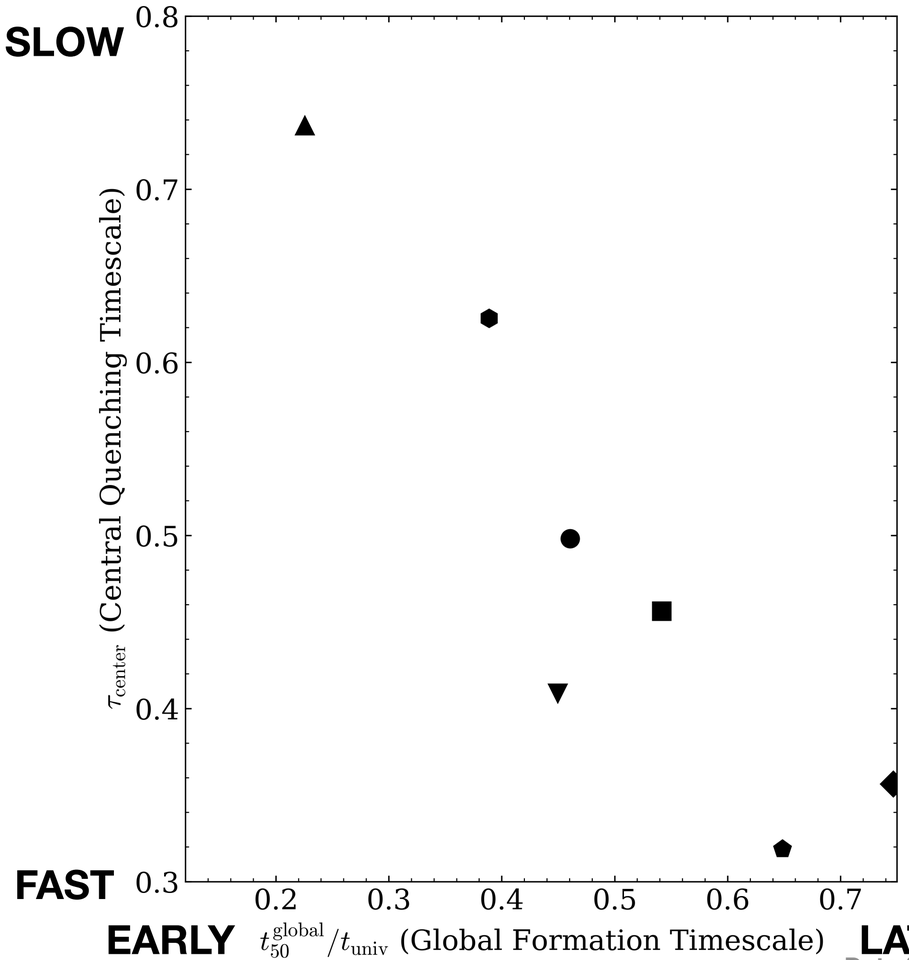
Data from REQUIEM (Akhshik+23)

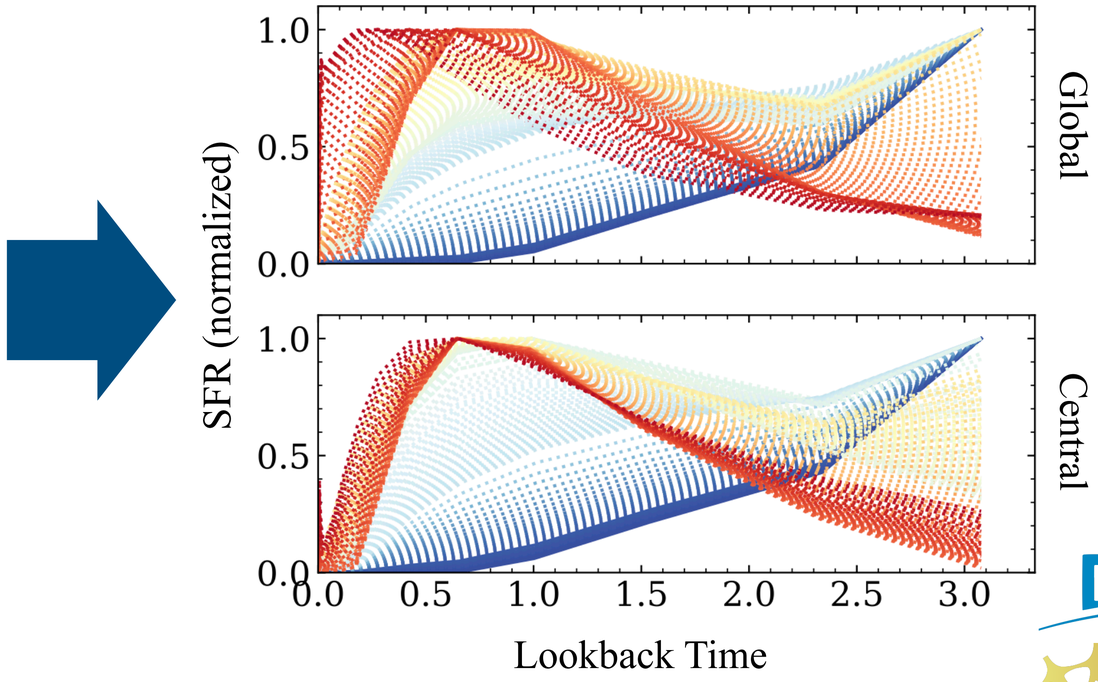


Mowla, Cutler+22

Timescales of quenched galaxies with color gradients

Use REQUIEM SFHs to create grid of model color-gradients





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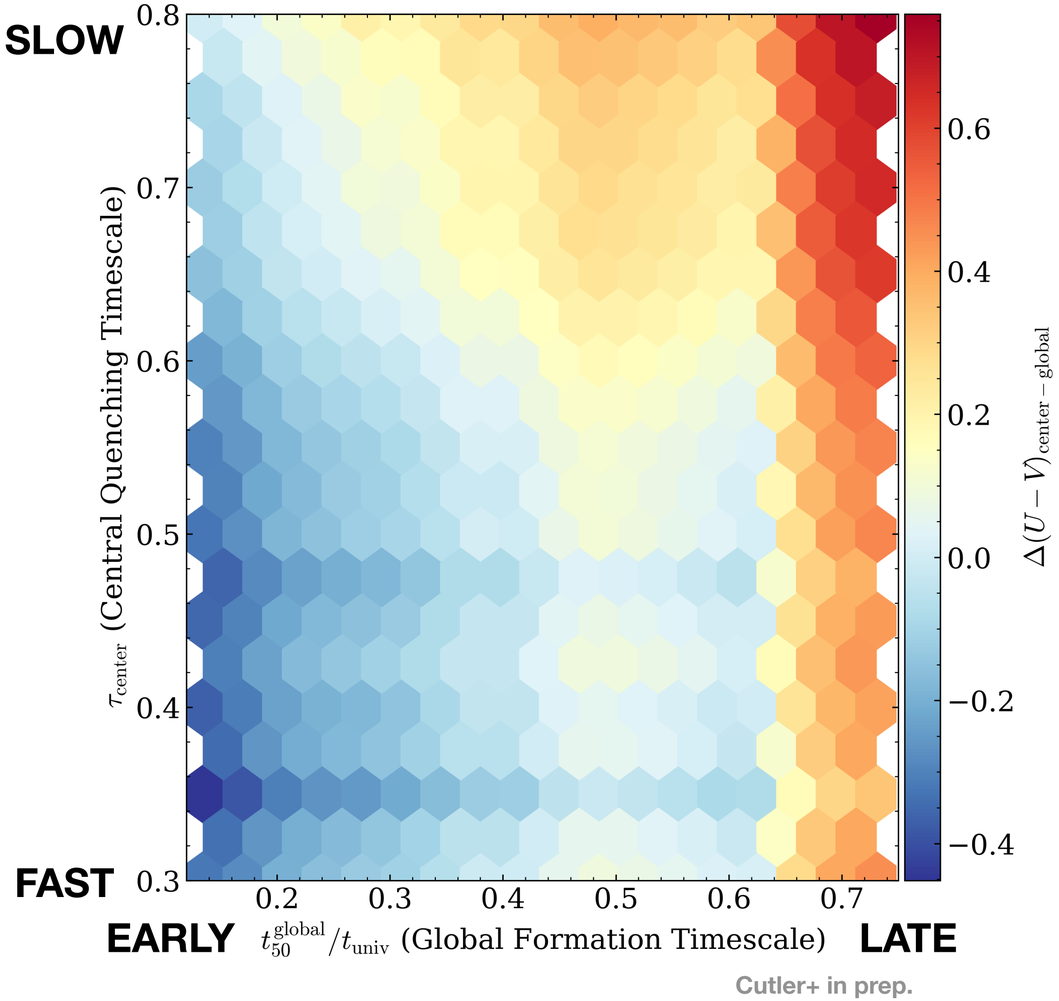
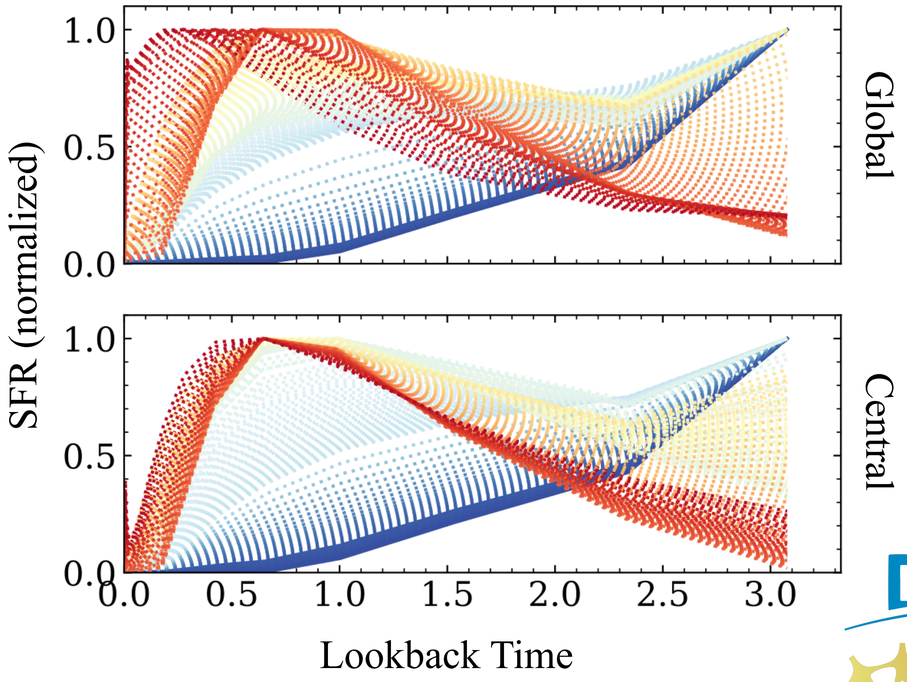
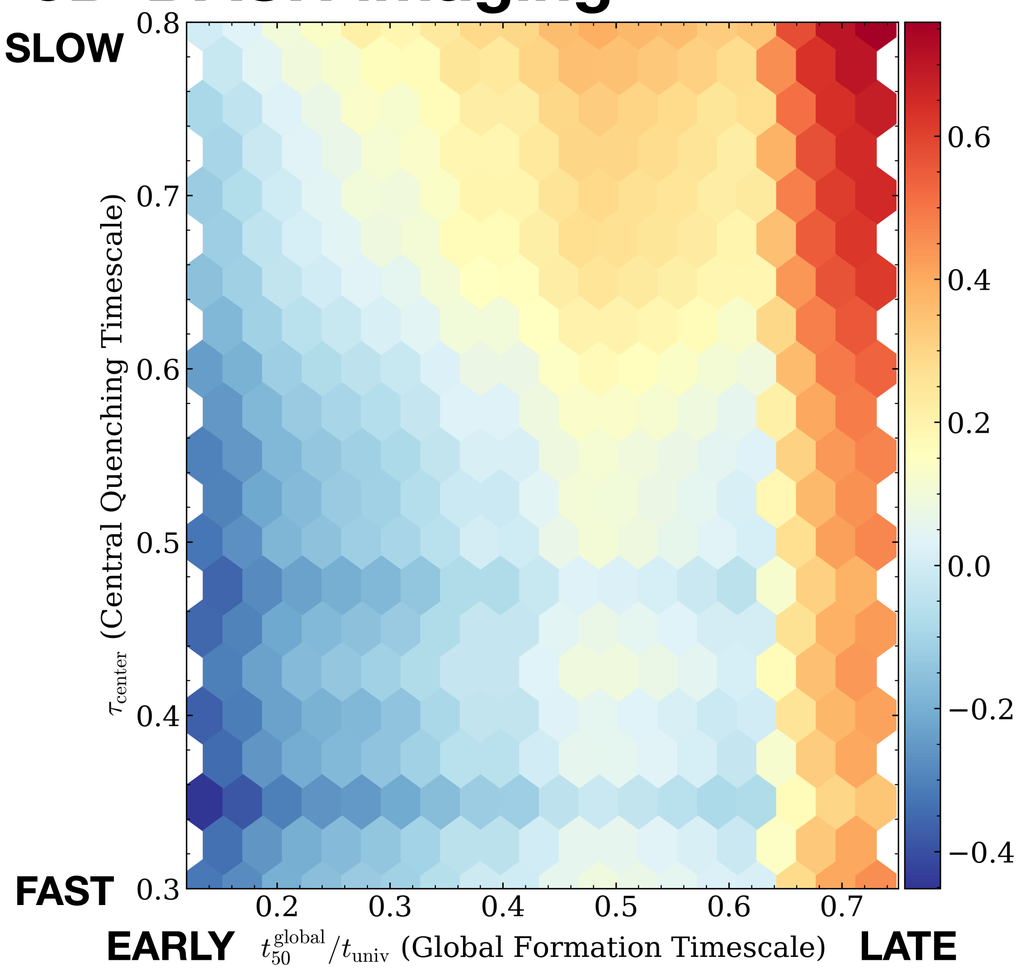


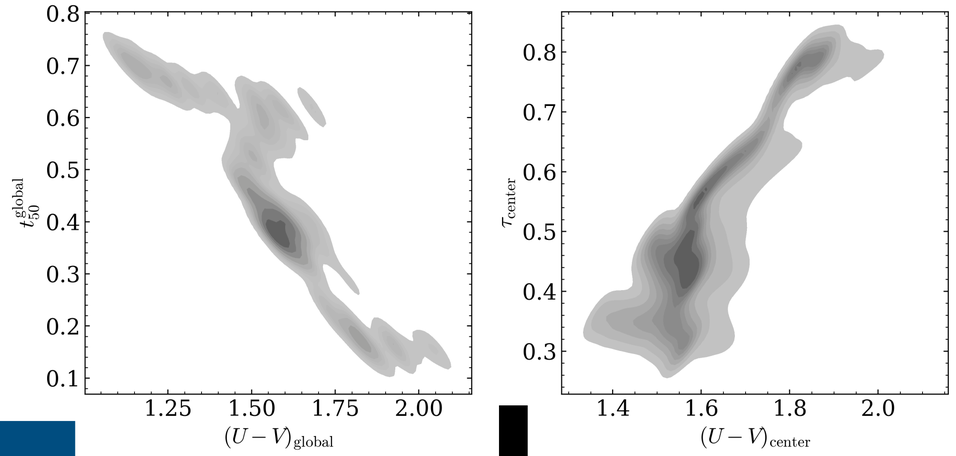


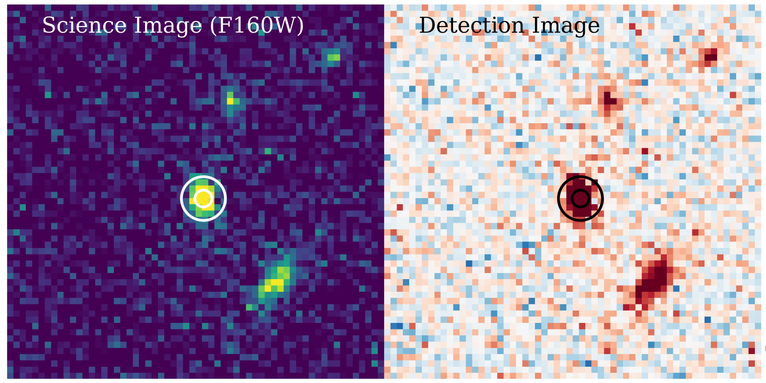
Cutler+ in prep.

Timescales of quenched galaxies with color gradients

Use observed *i-H* colors to approximate timescales of *z*~2 galaxies in 3D-DASH imaging







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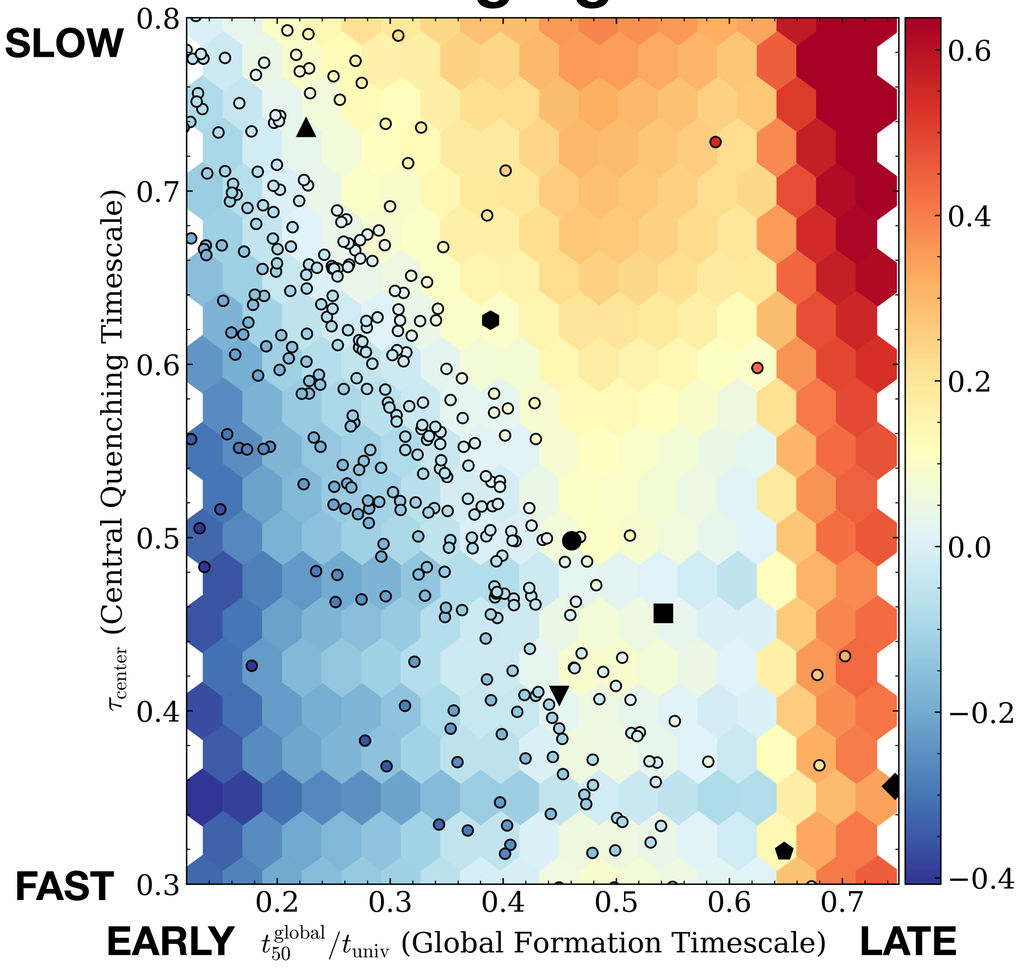
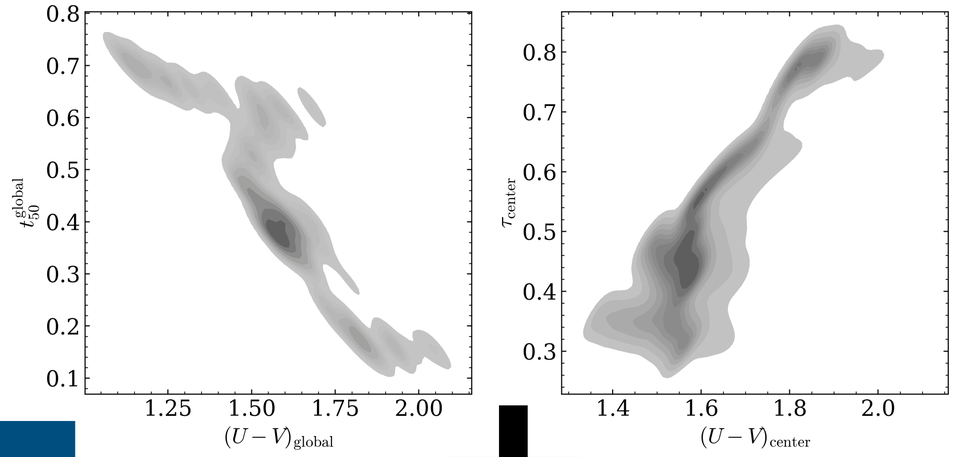
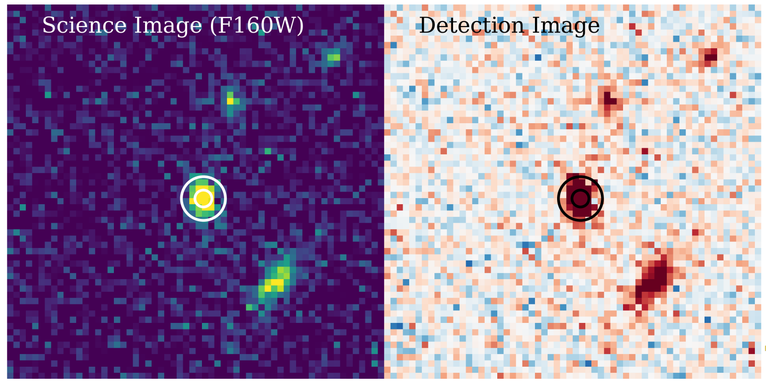






Cutler+ in prep.

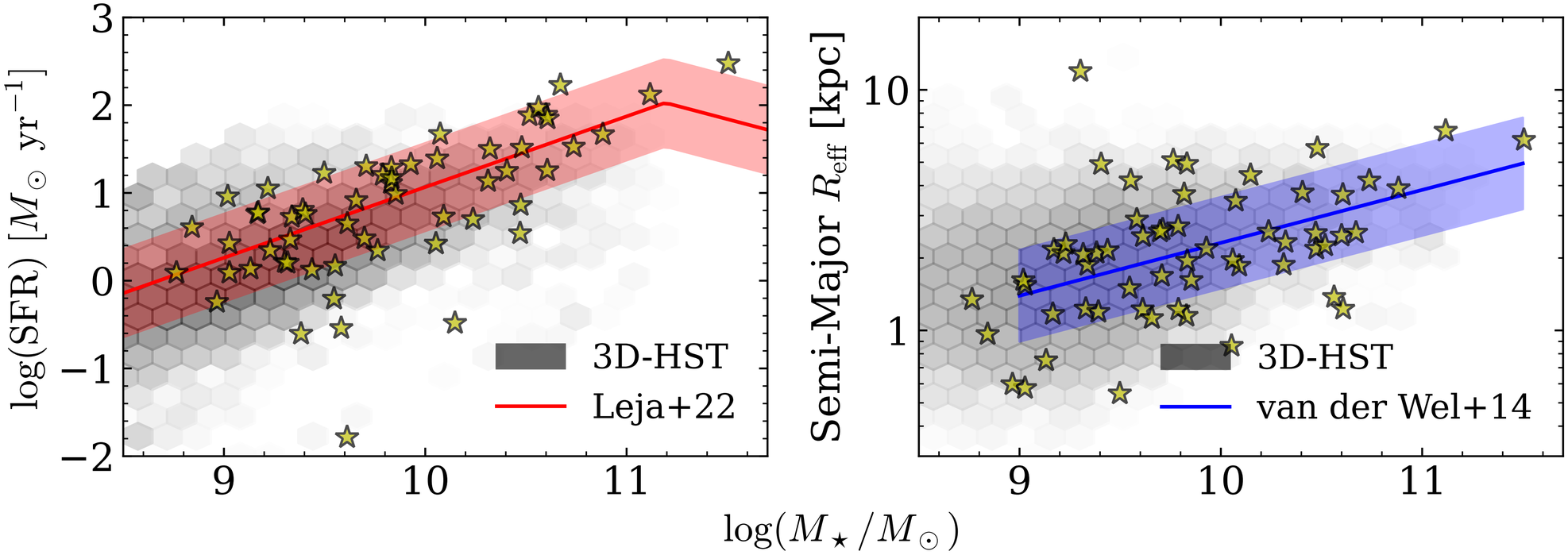
Summarizing…

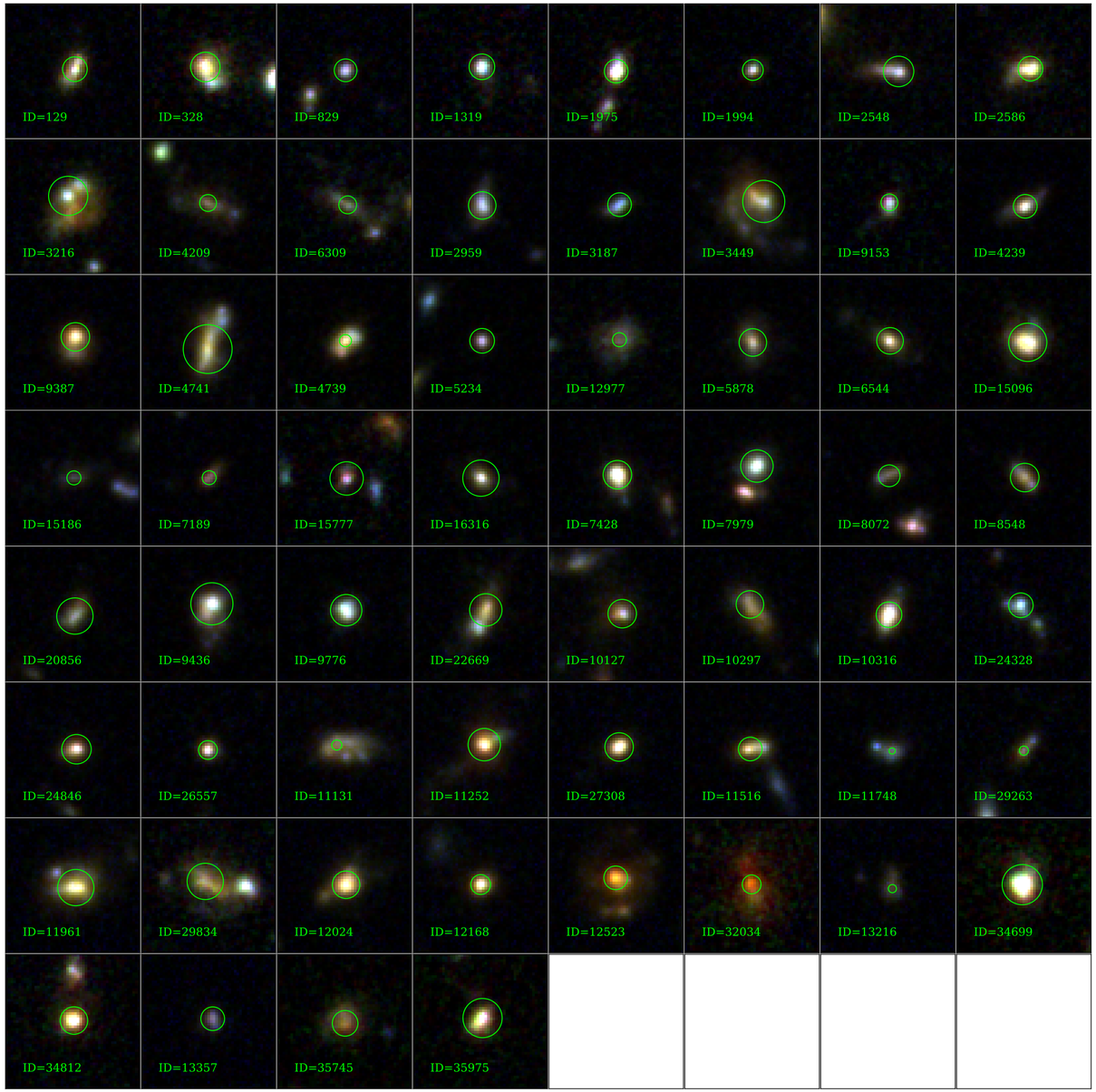
(arXiv:2208.01653)

1. **Cutler et al. 2023:** *Prospector SFHs of centers/outskirts of star-forming galaxies*
   - For logM<10.5, centers form later in a rapid burst of star-formation
   - Galaxies remain on the main sequence even after central starburst (not quenching yet)
2. **Cutler et al. in prep:** *Estimate formation & quenching timescales of quiescent galaxies*
   - Measure observed *i-H* color gradients from COSMOS/3D-DASH and predict timescales
   - Quenched 3D-DASH galaxies follow a similar trend in t_{50}-τ_{center} as REQUIEM

Contact me with any thoughts or suggestions!
secutler@umass.edu; @secutler on Twitter; samecutler.github.io

Bonus Slides!


log(SFR) [$M_\odot$ yr^{-1}]
3
2
1
0
−1
−2
9
10
11
3D-HST
Leja+22
Semi-Major $R_{\rm eff}$ [kpc]
10
1
9
10
11
3D-HST
van der Wel+14
log($M_\star$ / $M_\odot$)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ID=2959
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ID=12977
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ID=6544
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ID=16316
ID=7428
ID=7979
ID=8072
ID=8548
ID=20856
ID=9436
ID=9776
ID=22669
ID=10127
ID=10297
ID=10316
ID=24328
ID=24846
ID=26557
ID=11131
ID=11252
ID=27308
ID=11516
ID=11748
ID=29263
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ID=29834
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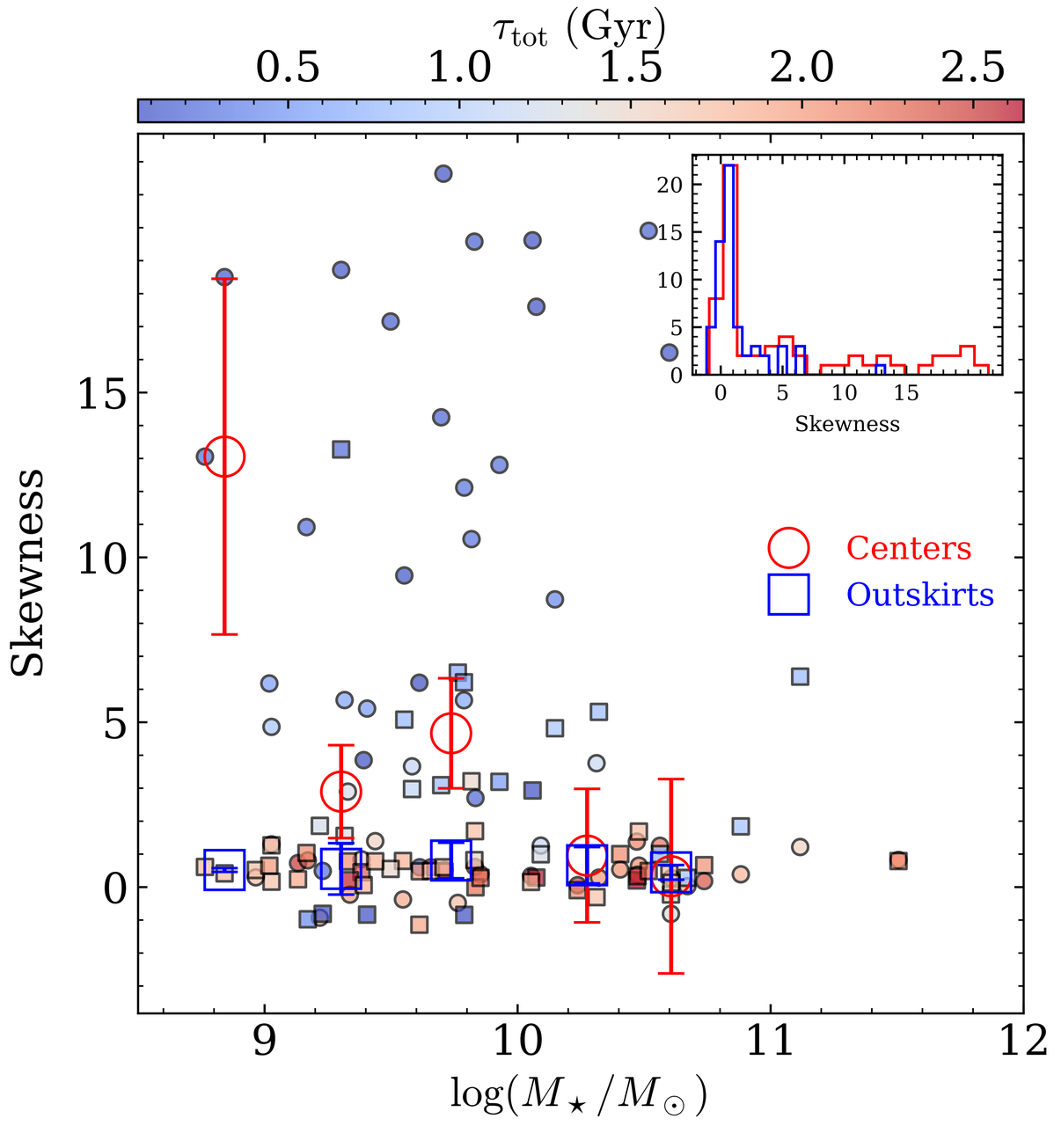
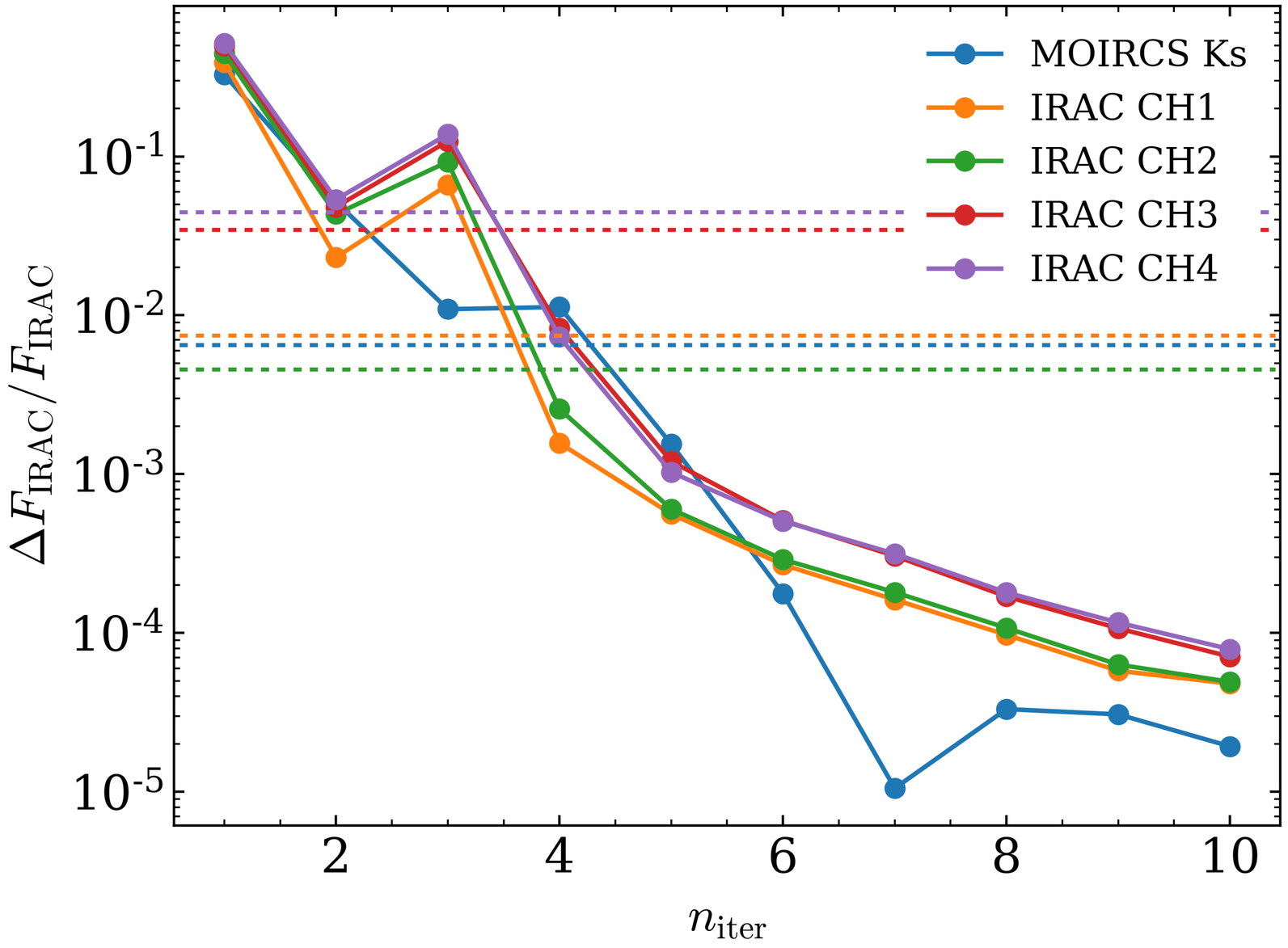
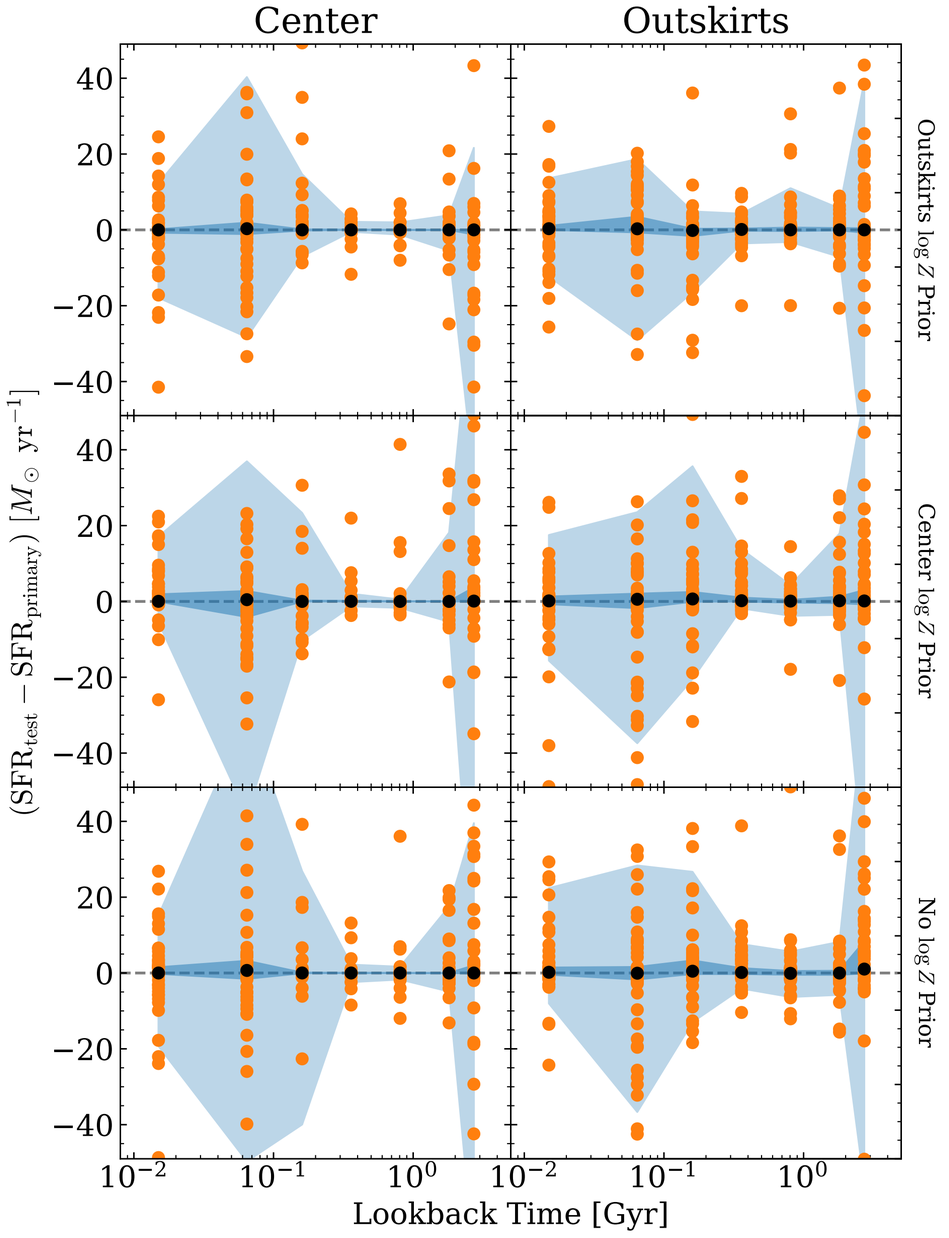
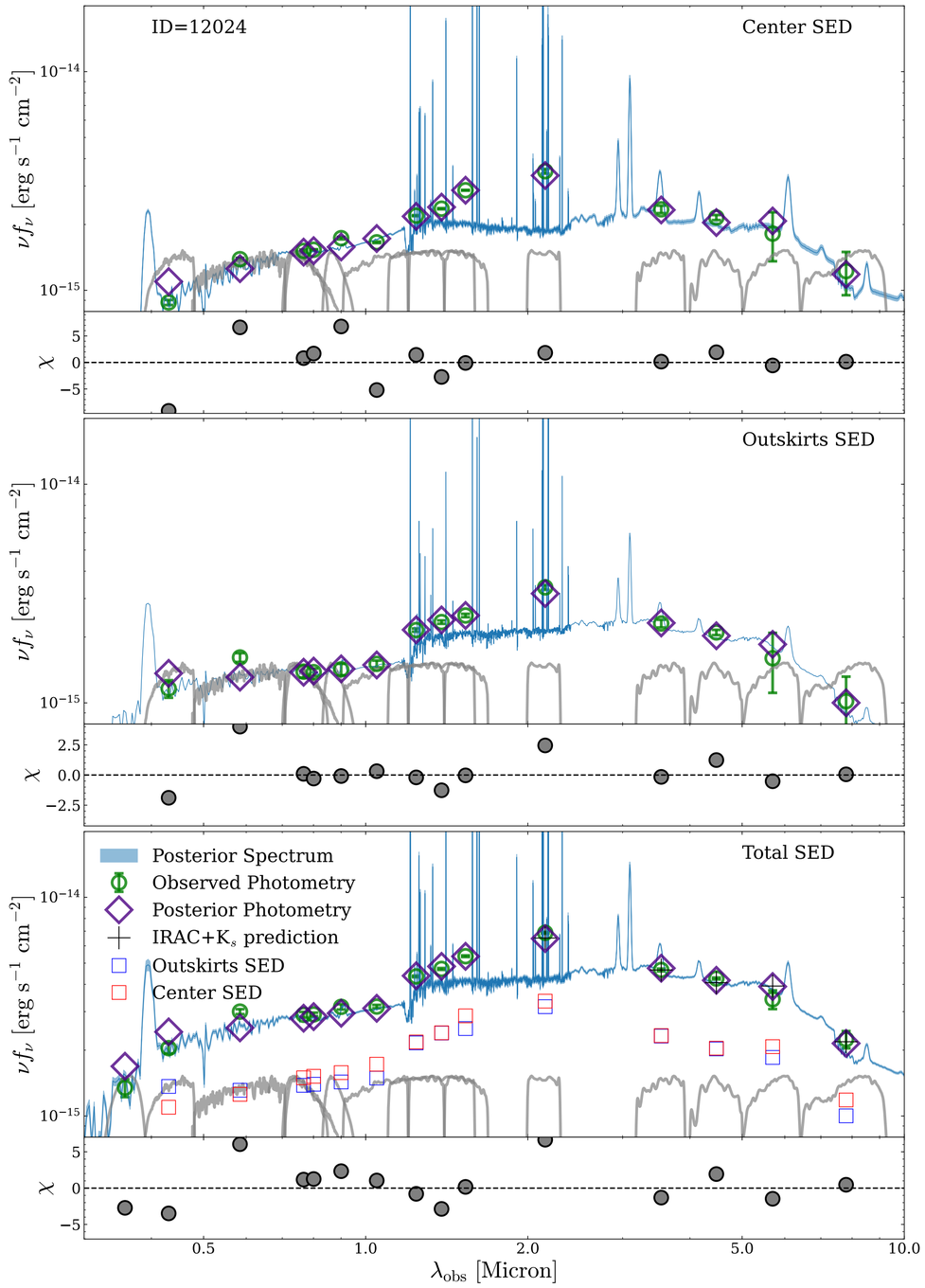
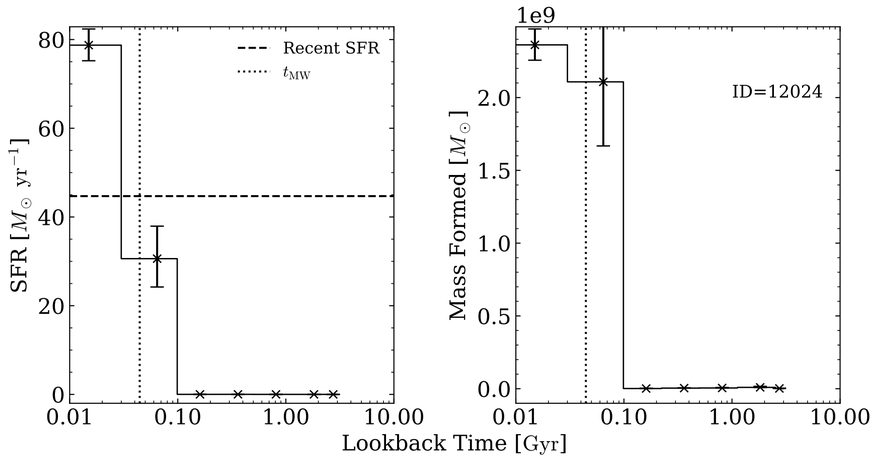

$\tau_{\rm tot}$ (Gyr)
0.5
1.0
1.5
2.0
2.5
Skewness
15
10
5
0
9
10
11
12
$\log(M_\star/M_\odot)$
Centers
Outskirts
20
15
10
5
0
0
5
10
15
Skewness


MOIRCS Ks
IRAC CH1
IRAC CH2
IRAC CH3
IRAC CH4
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
$\Delta F_{\rm IRAC}/F_{\rm IRAC}$
2
4
6
8
10
$n_{\rm iter}$

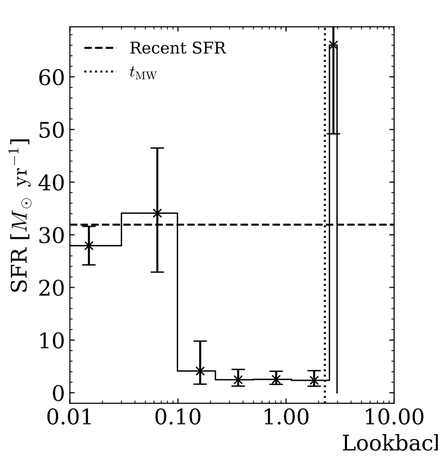

Center
Outskirts
Outskirts log Z Prior
Center log Z Prior
No log Z Prior
(SFR$_{\rm test}$ − SFR$_{\rm primary}$) [$M_\odot$ yr^{-1}]
Lookback Time [Gyr]
40
20
0
−20
−40
10^{-2}
10^{-1}
10^{0}

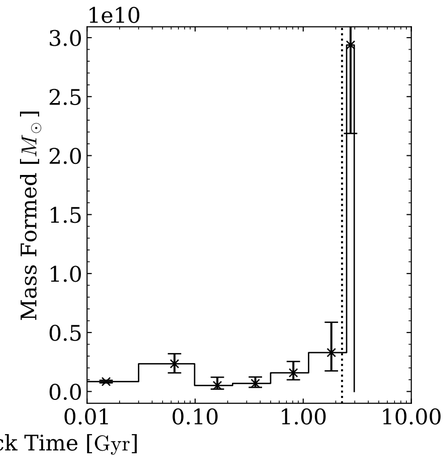

ID=12024
Center SED
Outskirts SED
Total SED
Posterior Spectrum
Observed Photometry
Posterior Photometry
IRAC+K$_s$ prediction
Outskirts SED
Center SED
νf_ν [erg s^{-1} cm^{-2}]
χ
$\lambda_{\rm obs}$ [Micron]

Center SFH

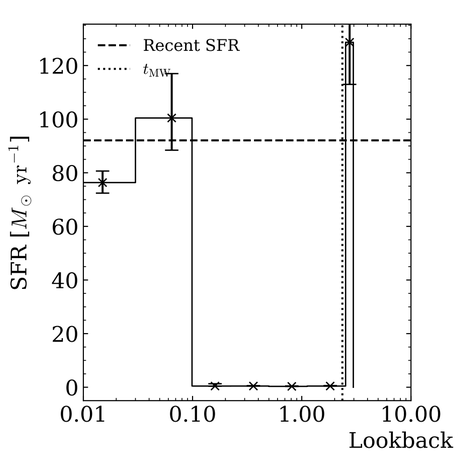


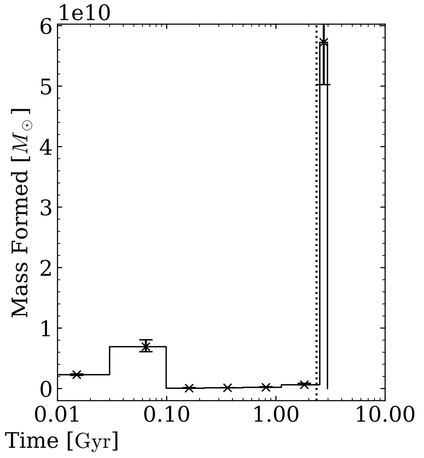
Outskirts SFH



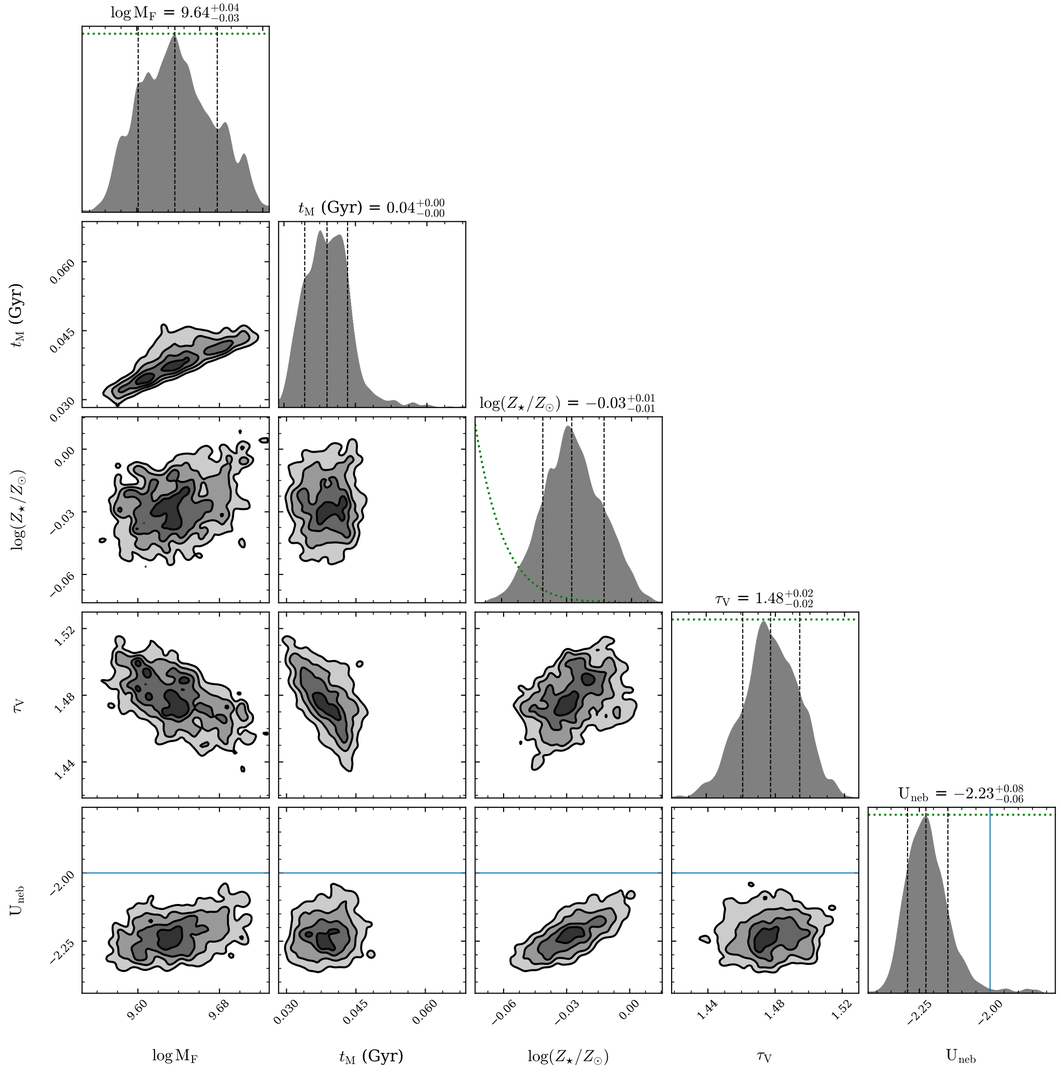


Total SFH

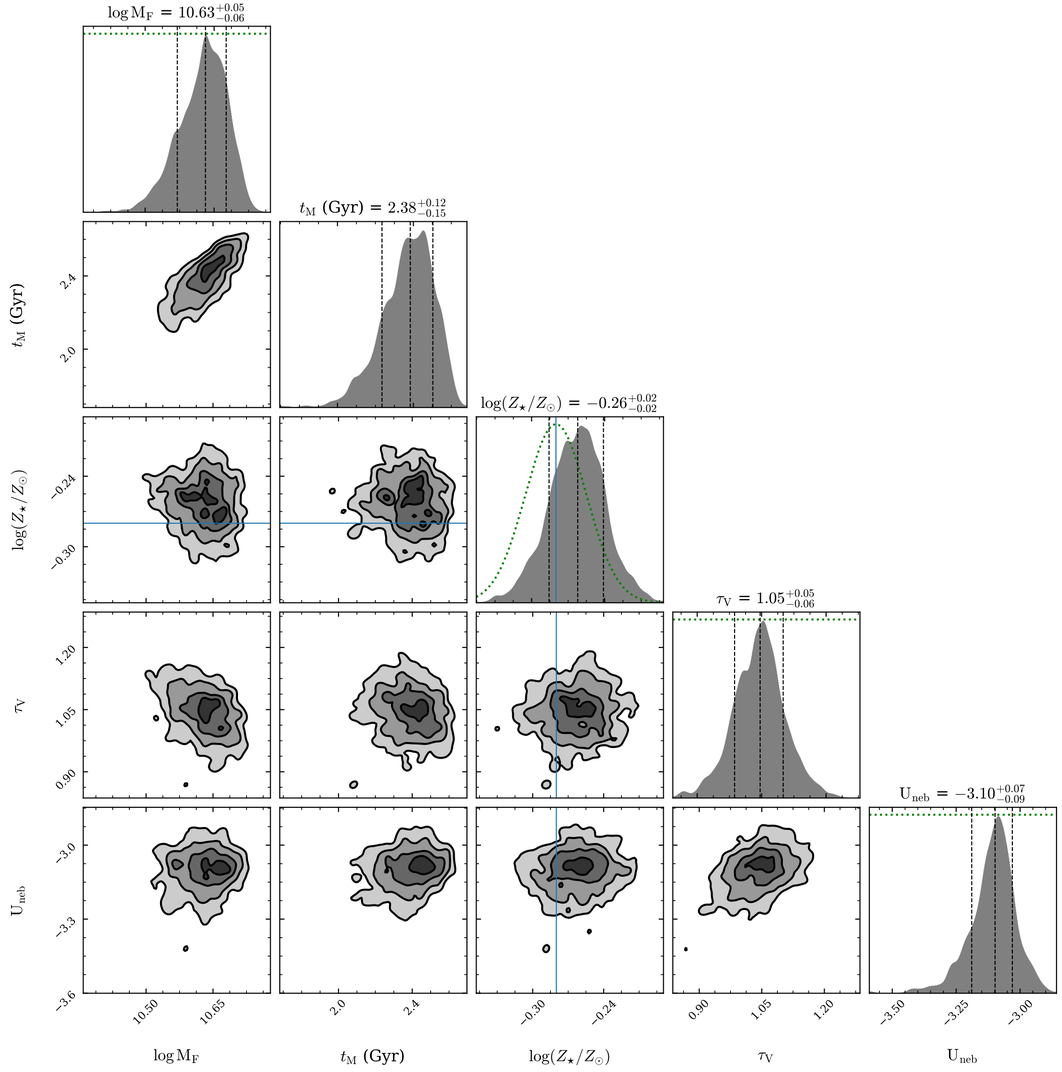




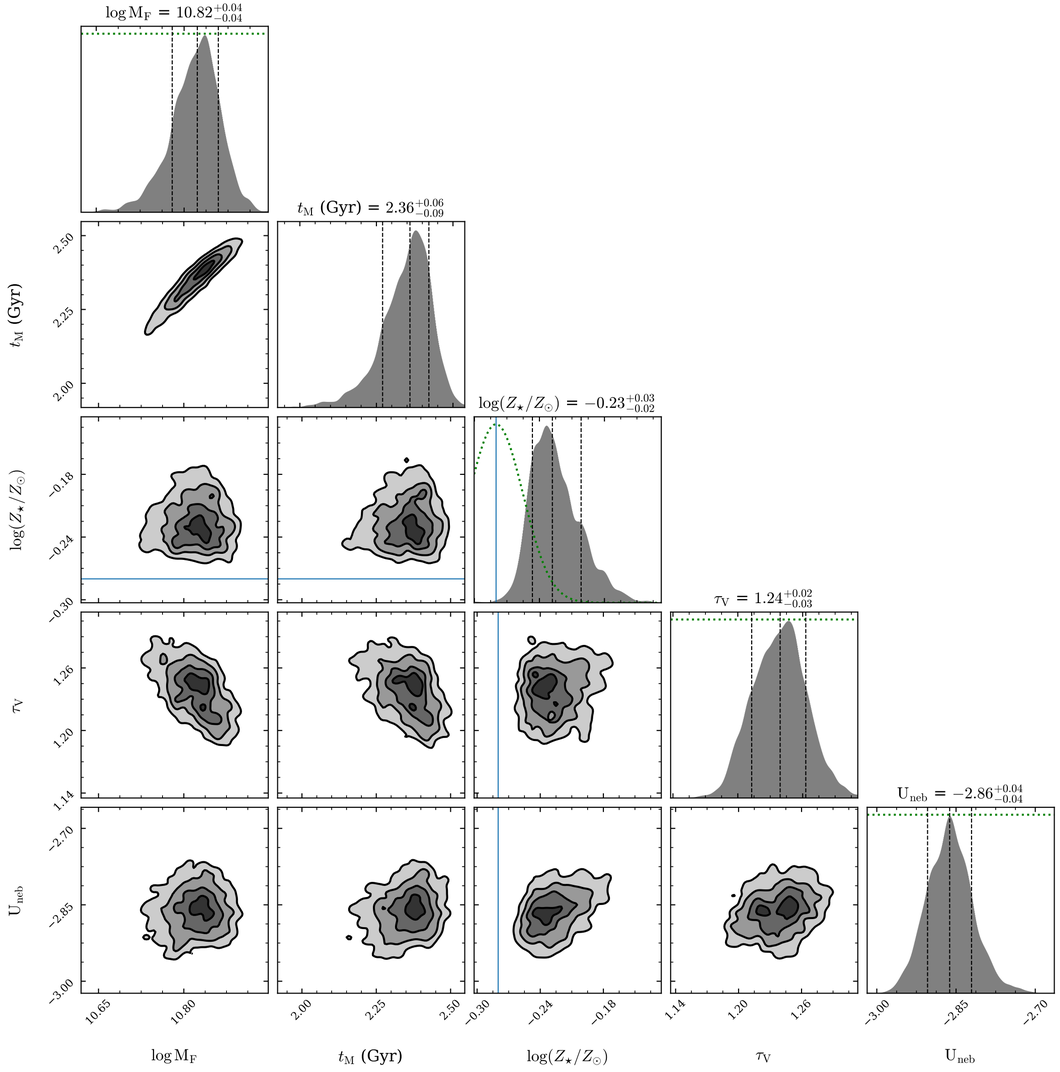
Center Covariance (ID=12024)



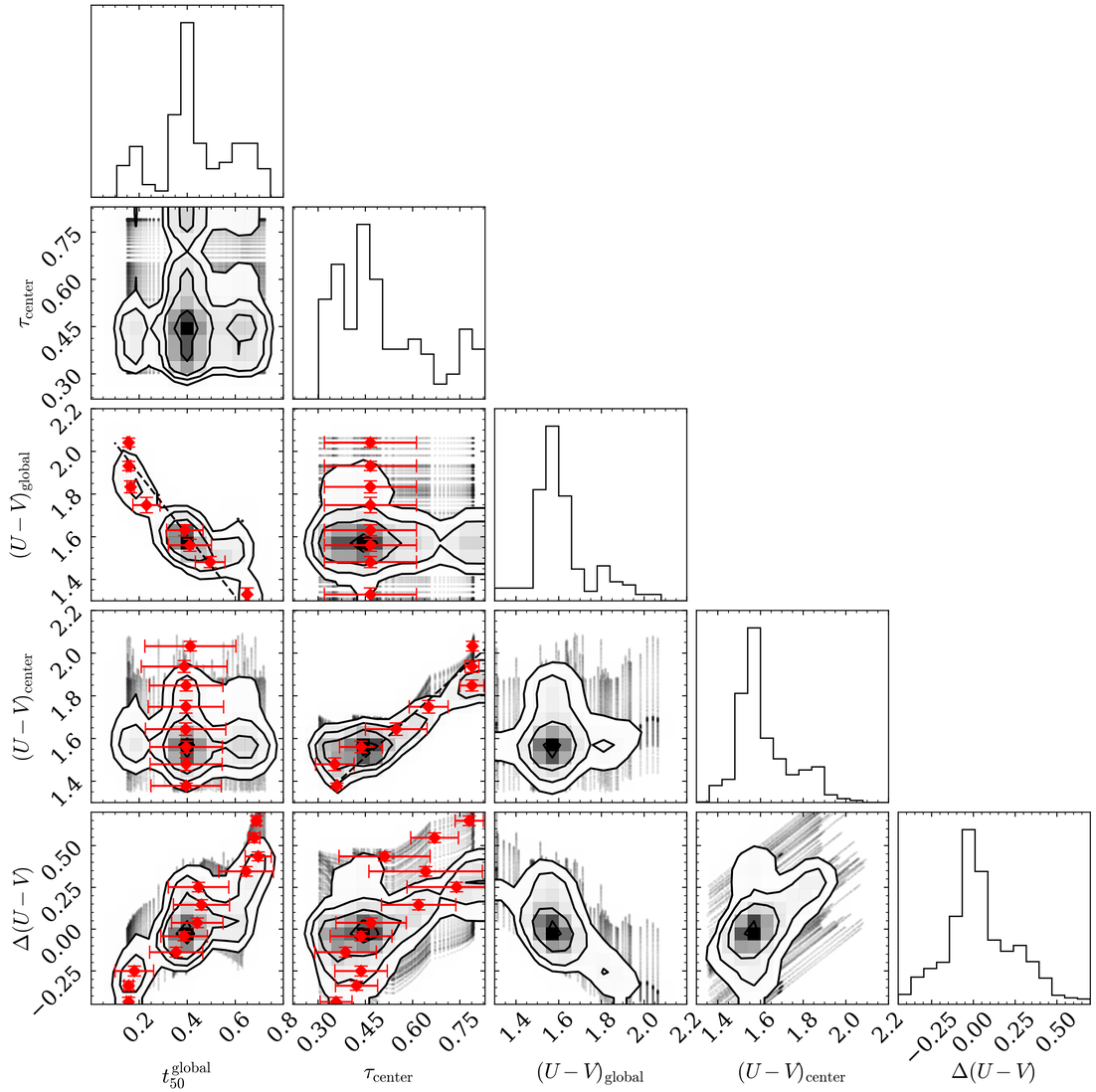
Outskirts Covariance (ID=12024)

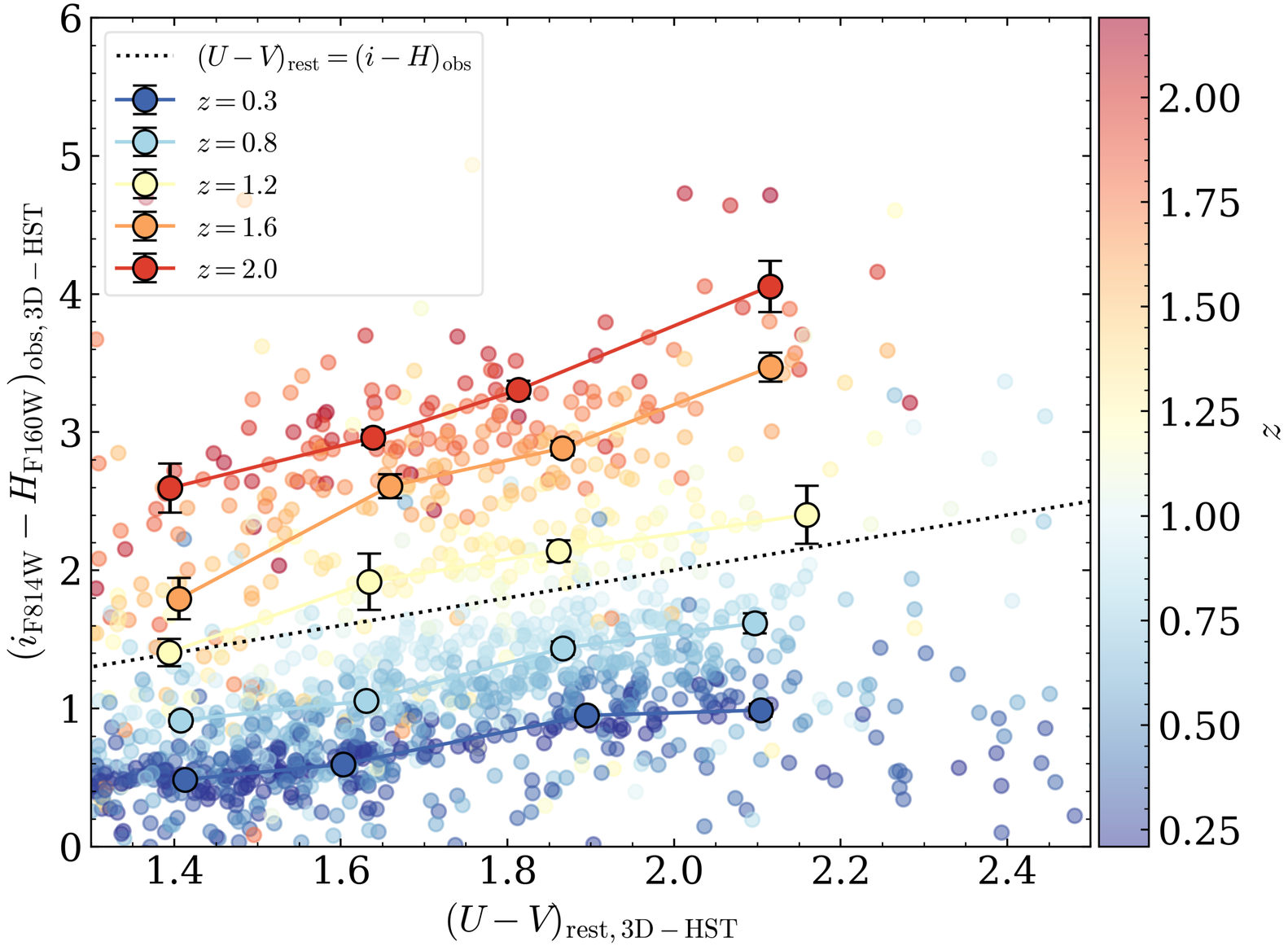


Total Covariance (ID=12024)



DAWN


t_{50}^{global}
τ_{center}
$(U-V)_{\mathrm{global}}$
$(U-V)_{\mathrm{center}}$
$\Delta(U-V)$


$(U-V)_{\rm rest} = (i-H)_{\rm obs}$
$z = 0.3$
$z = 0.8$
$z = 1.2$
$z = 1.6$
$z = 2.0$
$(i_{\rm F814W} - H_{\rm F160W})_{\rm obs,\,3D-HST}$
$(U-V)_{\rm rest,\,3D-HST}$
z
0
1
2
3
4
5
6
1.4
1.6
1.8
2.0
2.2
2.4
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00

DAWN