Constraining the dust temperature in galaxies as a function of z with PRIMA

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Talk outline

1) Why we care about dust temperature in galaxies

2) ‘Things’ that we know about dust temperature in galaxies

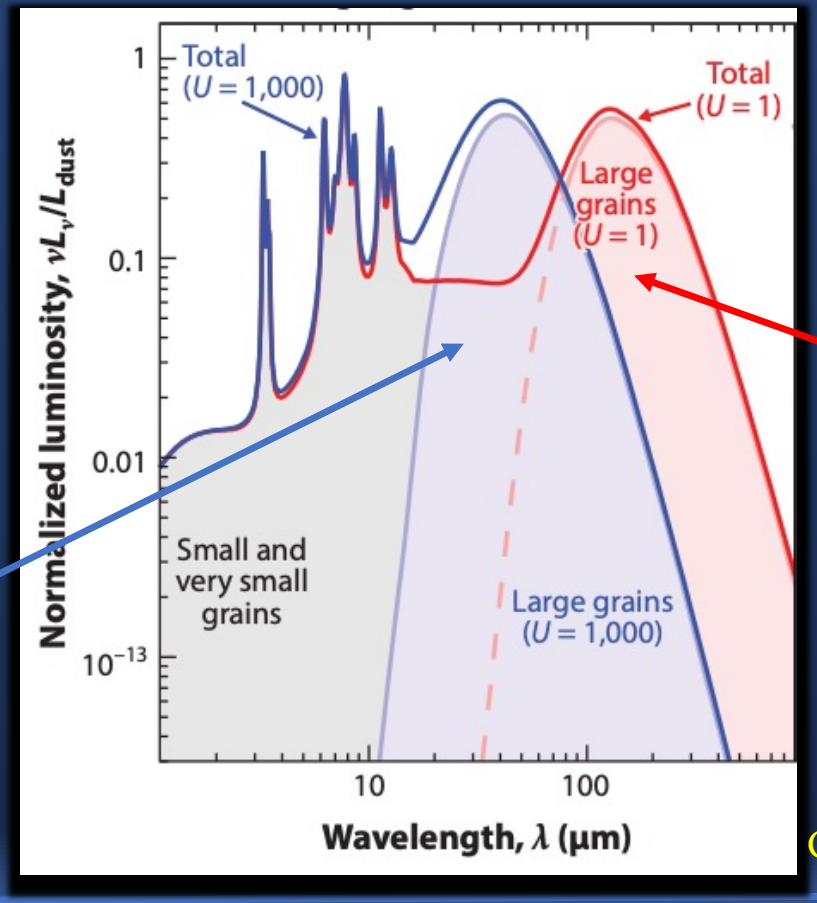
3) The role of PRIMA

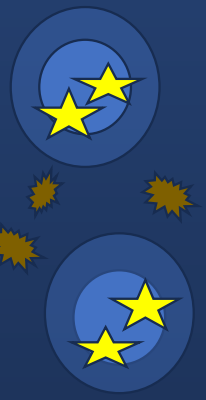
Why we care about dust temperature in galaxies

1. T dust → intensity and shape of the stellar incident radiation field

Two phase dust model
(Charlot & Fall 2000)

Birth clouds





Diffuse
ISM

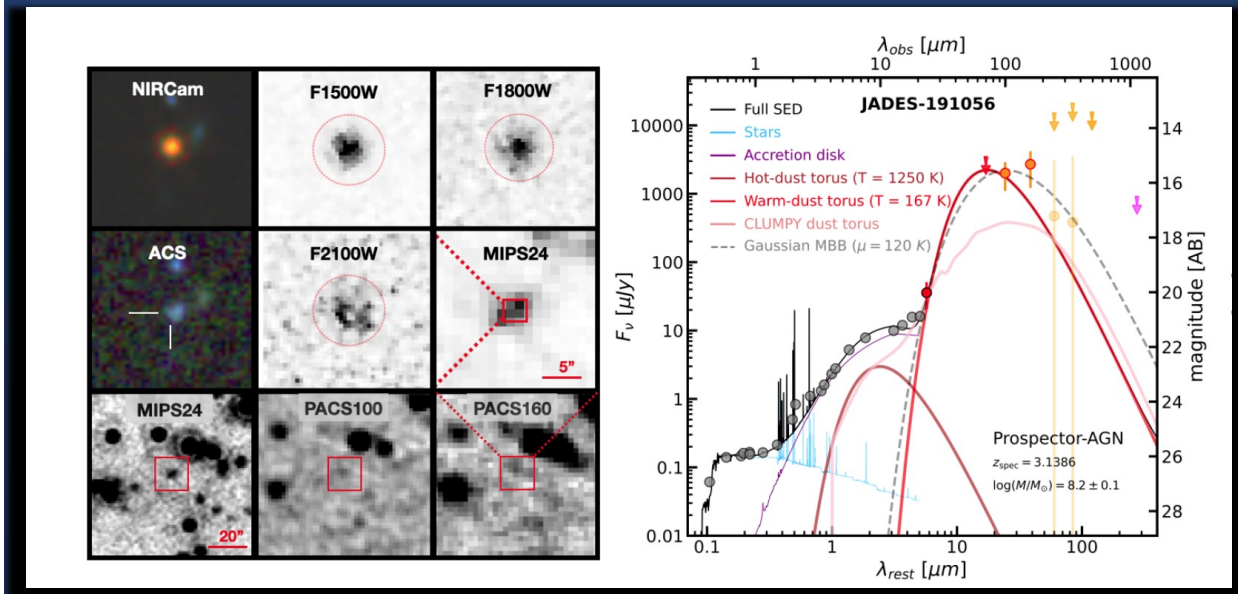
Galliano+2018

Why we care about dust temperature in galaxies

2. T dust → intensity and shape of AGN radiation field

Integrated studies JWST+SPITZER+HERSCHEL

Barro+24 (see also Andonie+2024, Pozzi+12, Gruppioni+16)



See Barchiesi talk

Why we care about dust temperature in galaxies

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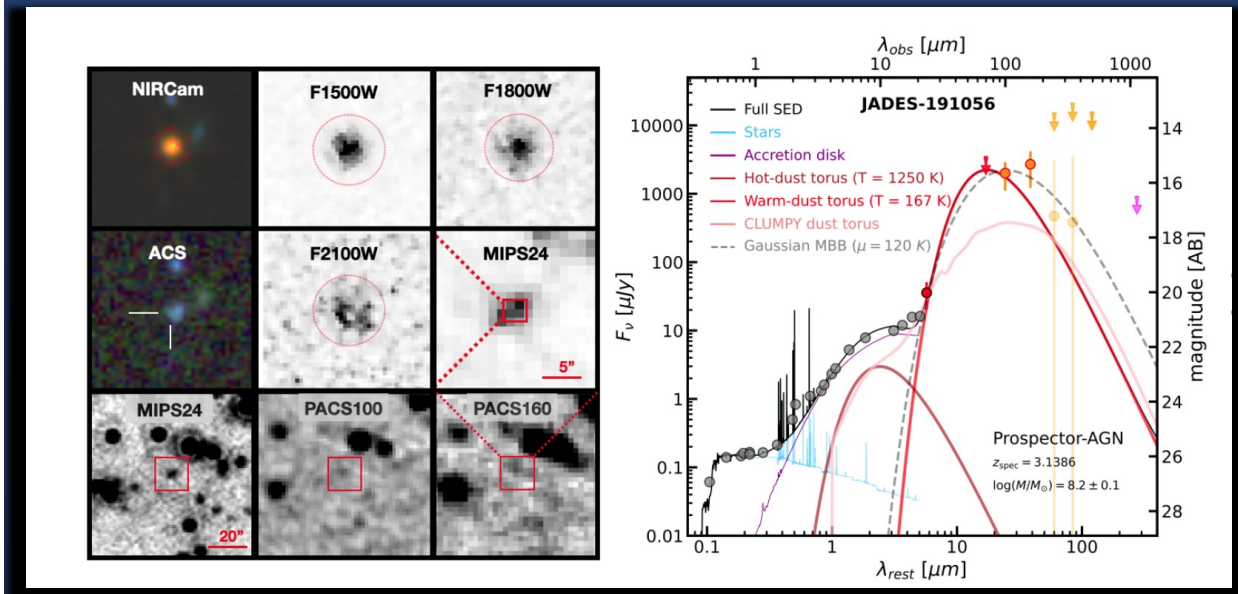
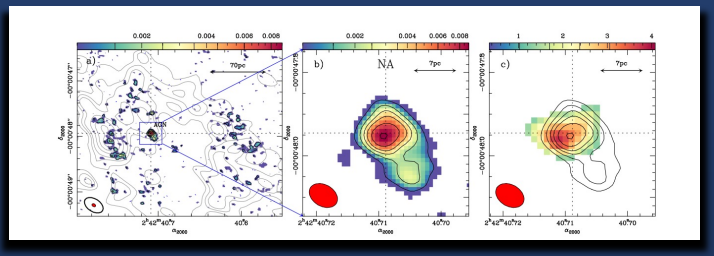
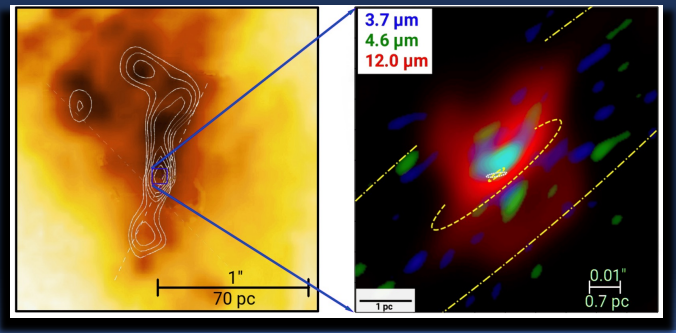


Resolved studies of NGC1068

ALMA, Garcia-Burillo+16



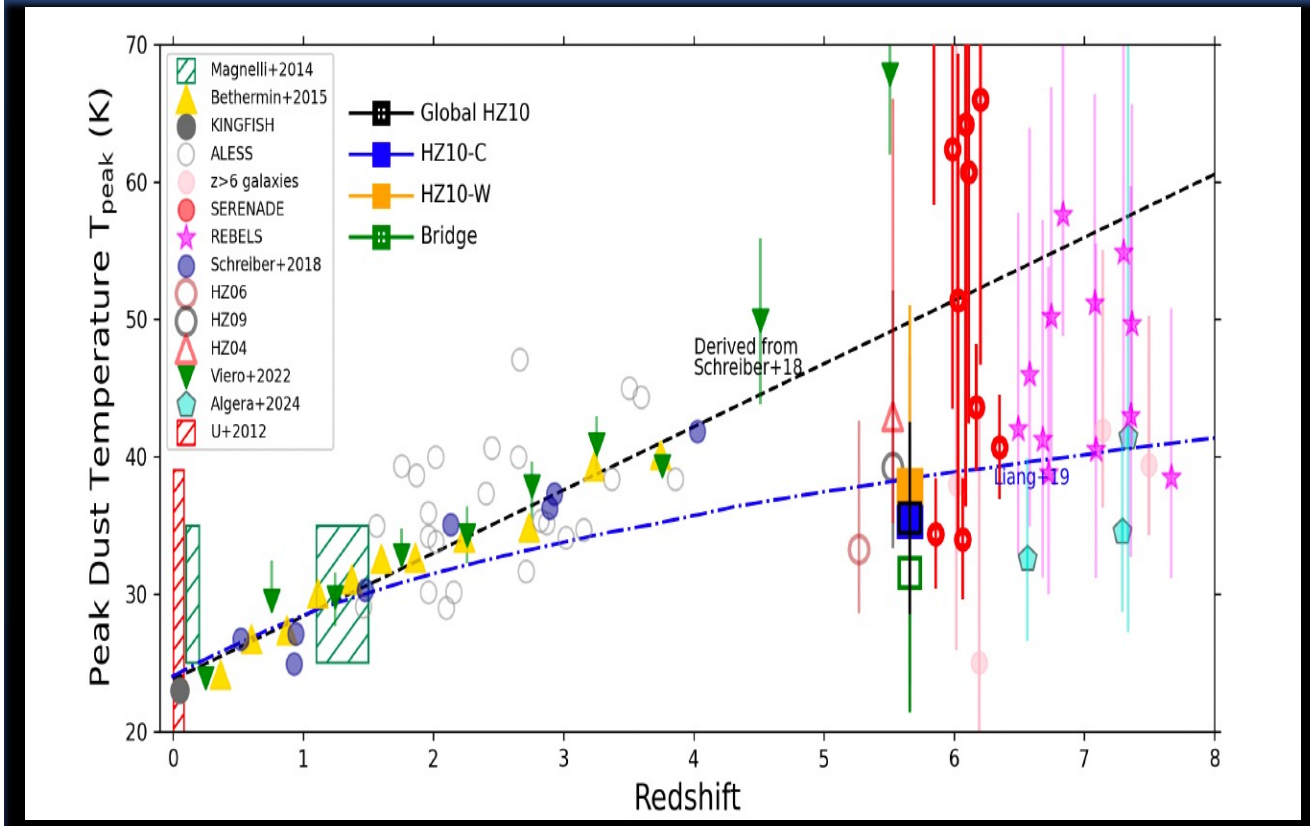
JWST, Haidar+2024



See Barchiesi talk

Things 'we know' about T_{dust} in galaxies

Evolution with z

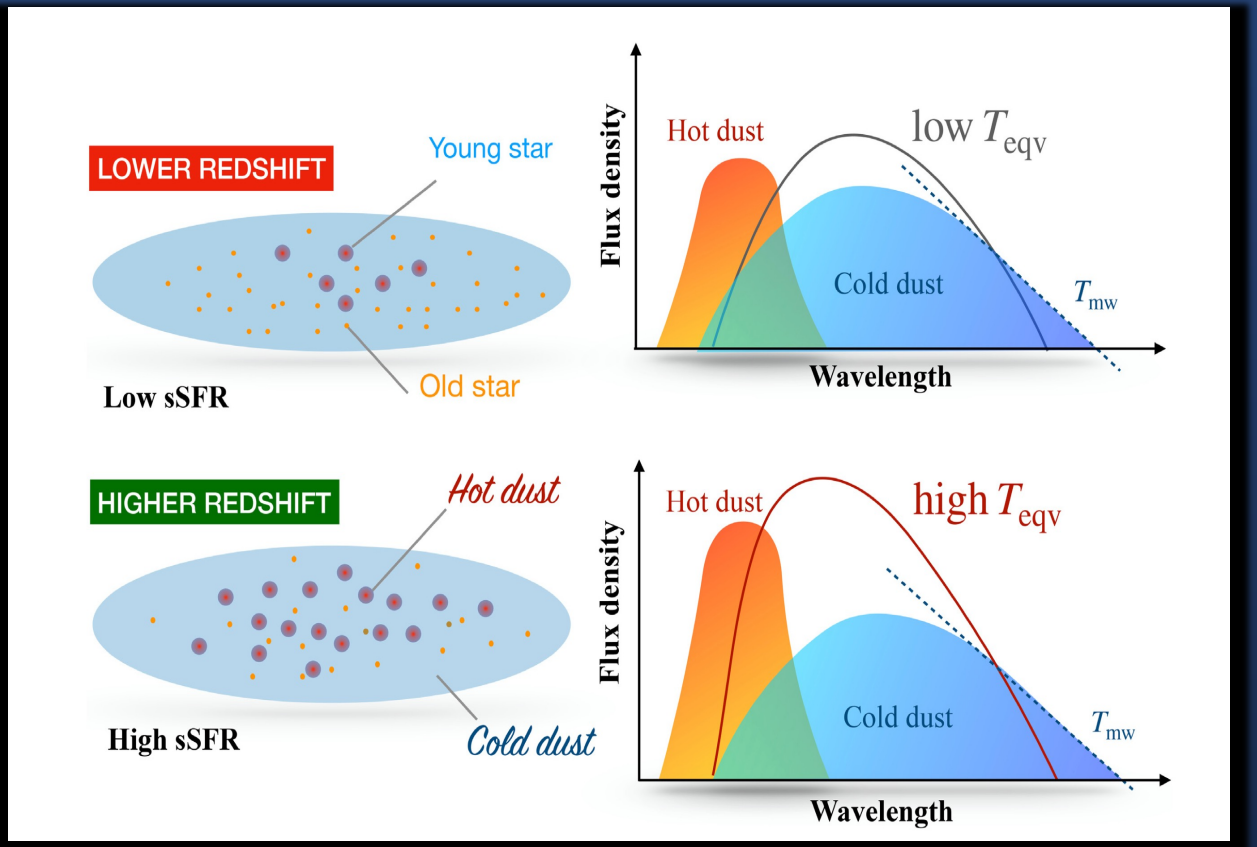


Caveats:

- Great dispersion, physical or depends on the different assumption?
- Based on galaxies selected in an inhomogeneous way
- Great limits are the number of photometric point

Villanueva+24
(see also Magnelli+13; Schreiber+18; Sommovigo+22)

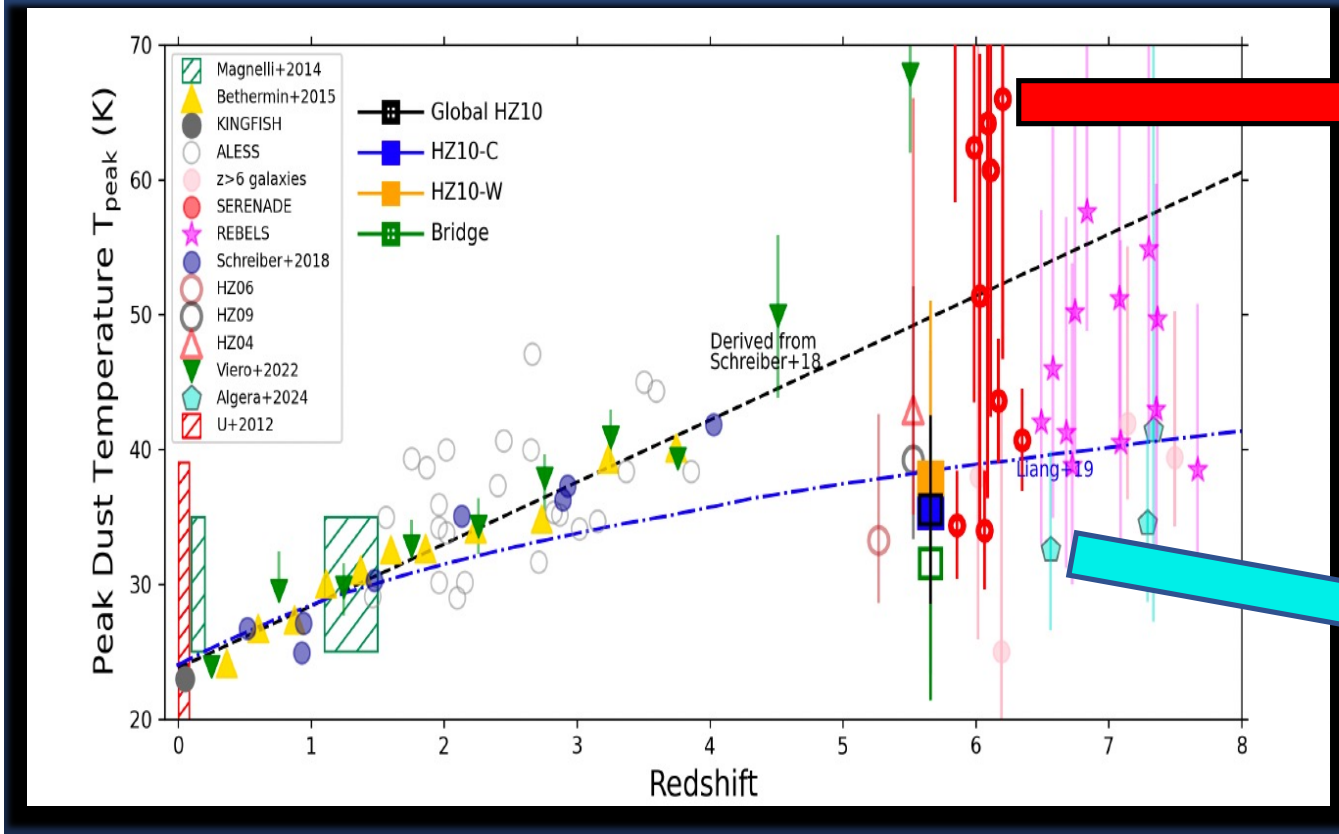
Things we know about T_{dust} in galaxies



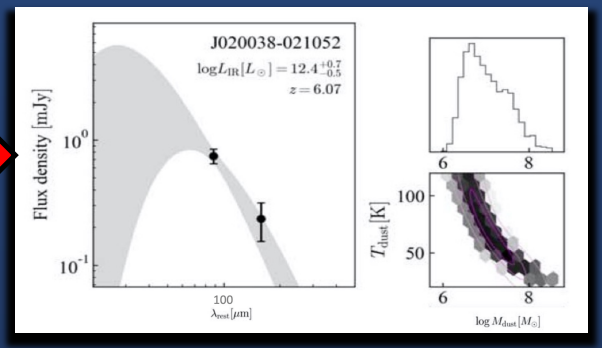
At high-z (z > 5-6) dust warm (T> 60-100 K) in the GMC is expected to dominate due to more compact GMC clouds

Liang+19 (see also Sommovigo, Ferrara+20)

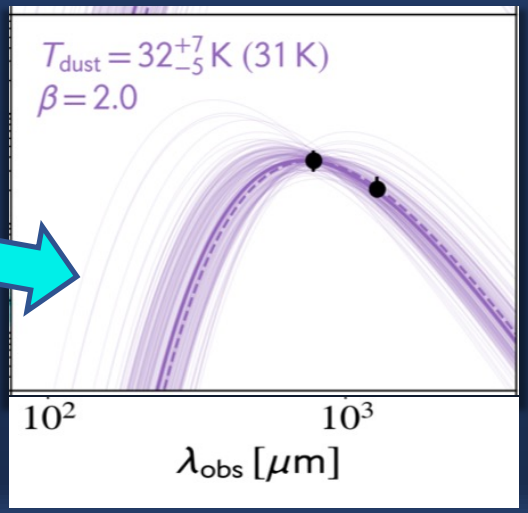
Things we know about T_{dust} in galaxies



Villanueva+24



Mitsuhashi+23



Algera+24

The key-role of PRIMA

See Traina, Pozzi et al. PRIMA special issue

SPRITZ model

Bisigello+21; Bisigello+24

✓ Phenomenological model starting from IR LF (Gruppioni+13)
✓ Star-forming galaxies, AGN, composite system, elliptical , dwarf

✓ Simulated Reference survey with PRIMAger:
1 deg^2, total integration time 1000 hr
5σ =0.09 - 0.23 mJy @ 24-230 μm

→ 44000 galaxies detected by PRIMA photometry z=0~6 (reference filter: @60μm)

Goals

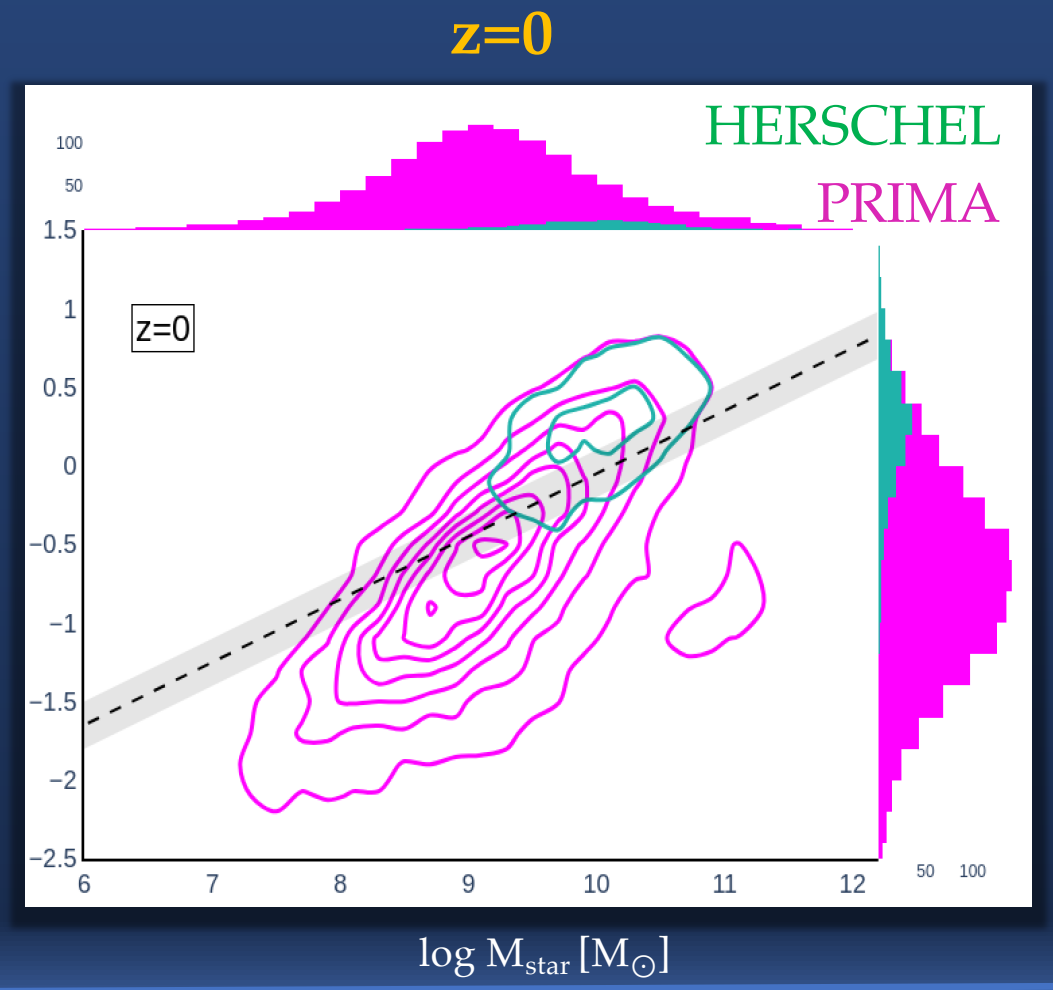
- Expected number of galaxies with a measured T_{dust} assuming only 1 component
- Examples of T_{dust} estimates assuming 2 components for brighter galaxies

Expected sources with measured T_{dust}

- At least 2 PRIMA points
- Herschel flux limits in COSMOS

$N_{PRIMA} \sim 8 \times N_{HERSCHEL}$

PRIMA up to SFR ~ 0.01 $M_\odot$ / yr

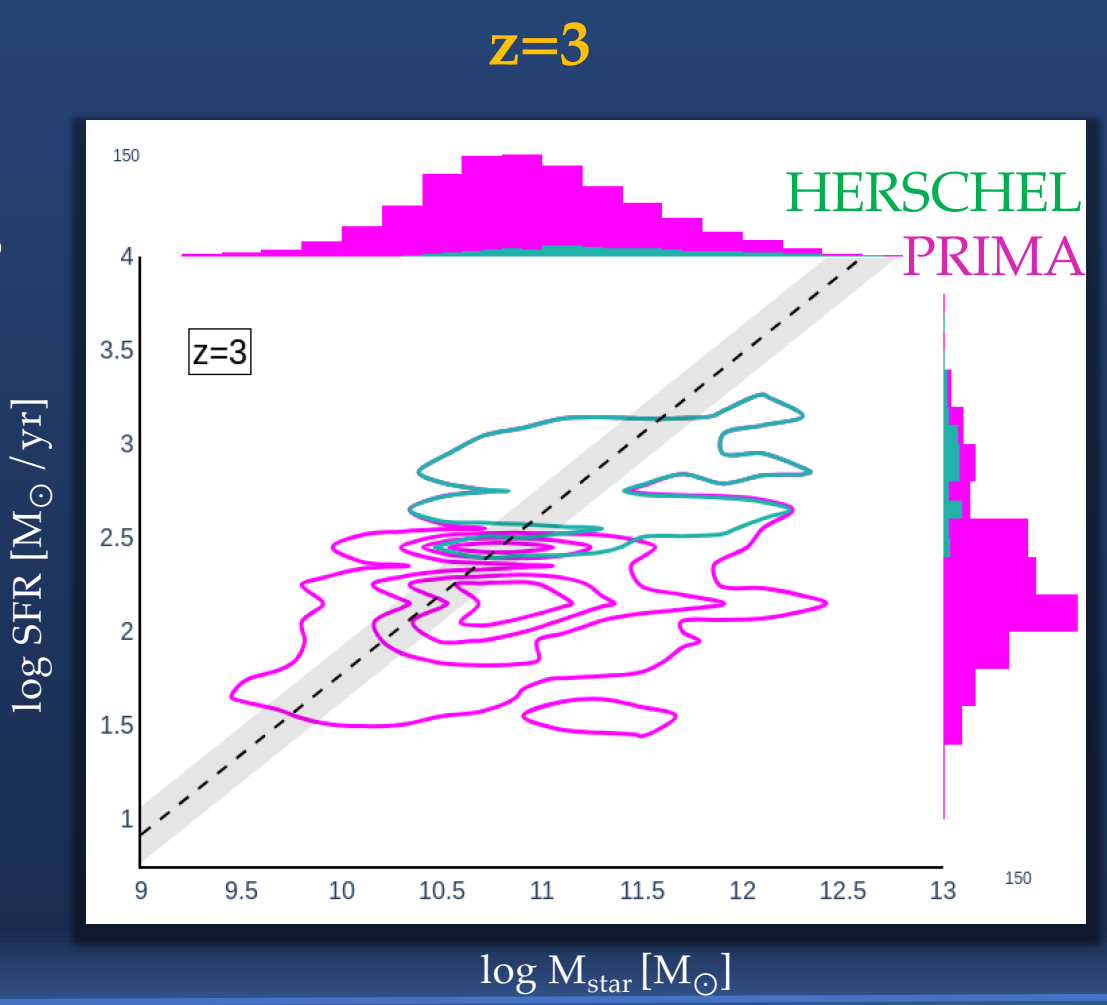


Expected sources with measured T_{dust}

- At least 1 PRIMA point +sub-mm/mm detection
- Herschel flux limits in COSMOS

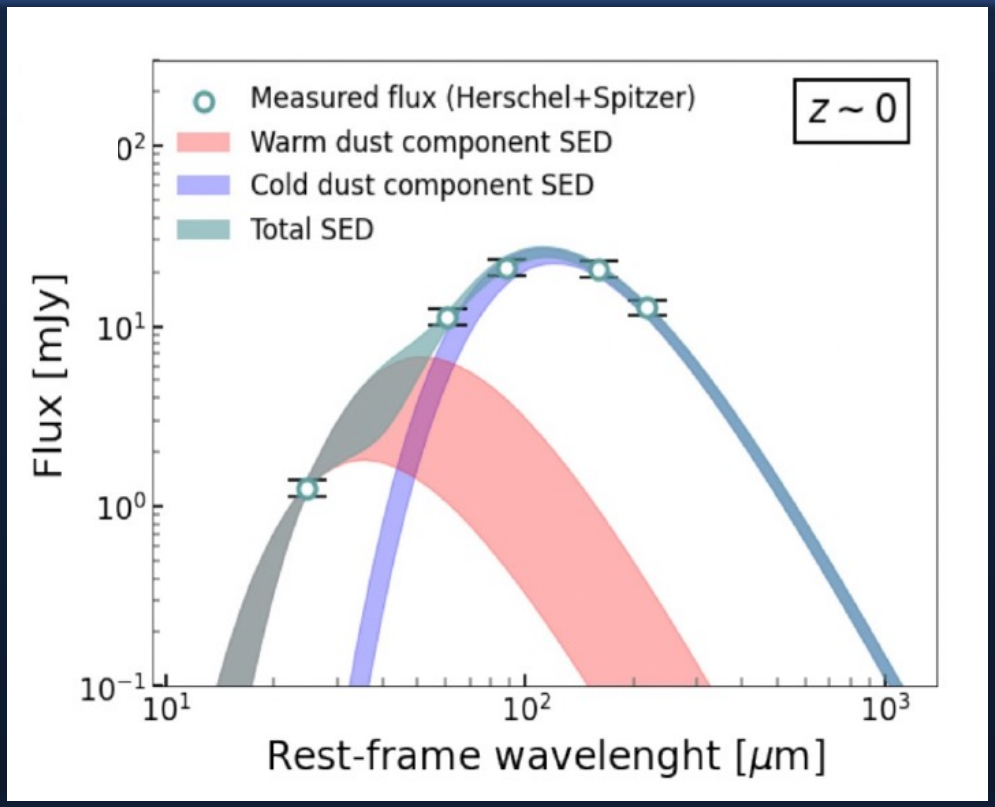
$N_{PRIMA} \sim 5 \times N_{HERSCHEL}$

PRIMA up to SFR ~ 30 $M_\odot$ /yr

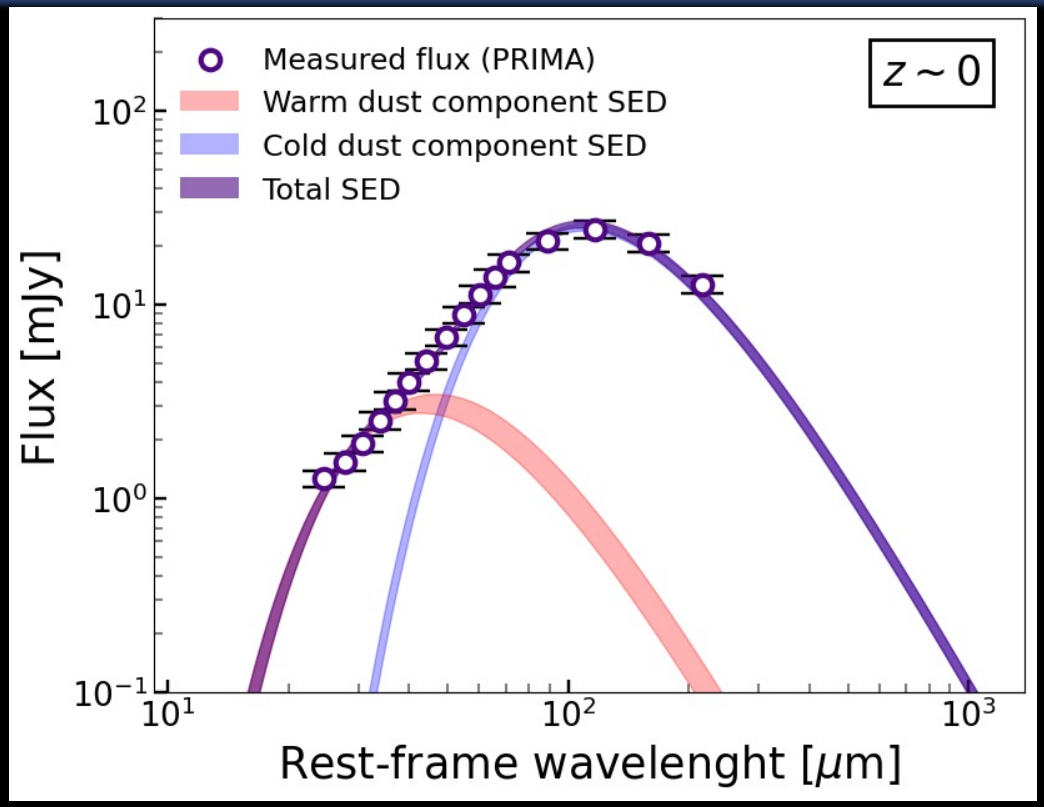


Simulated z ~ 0 galaxy

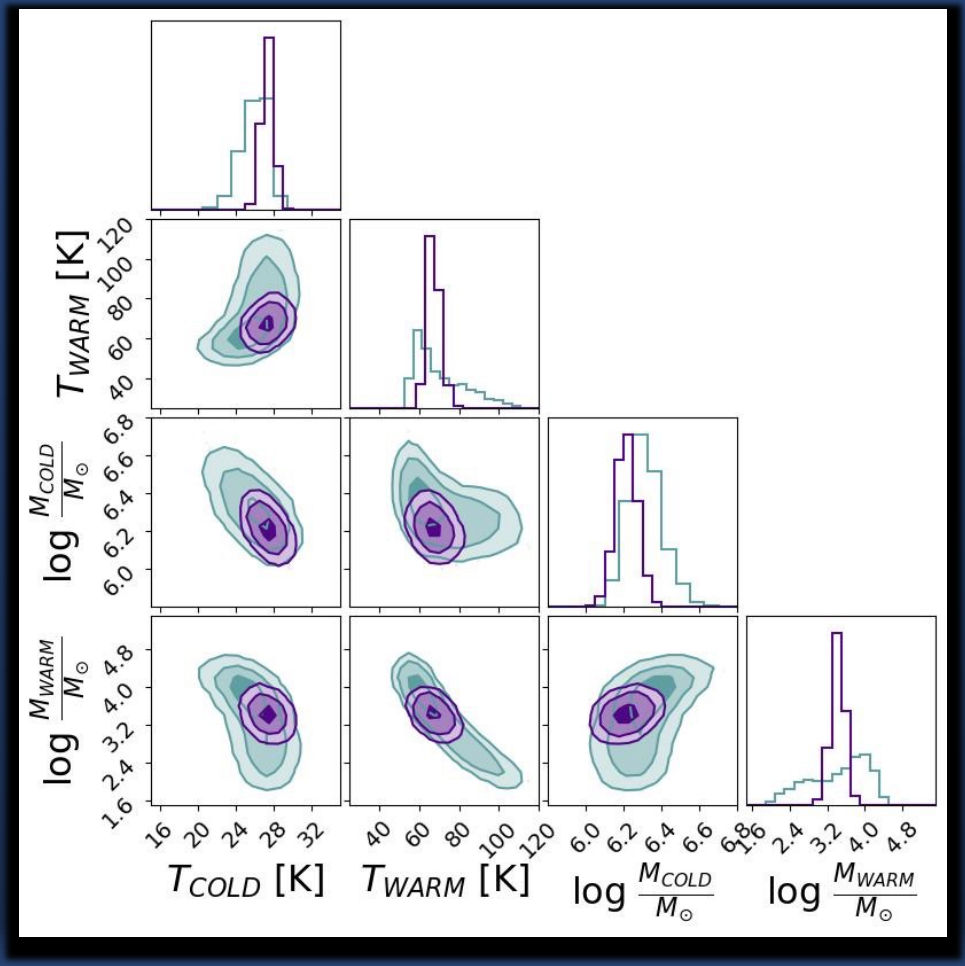
Pre-PRIMA



PRIMA



Simulated z ~ 0 galaxy



Pre-PRIMA

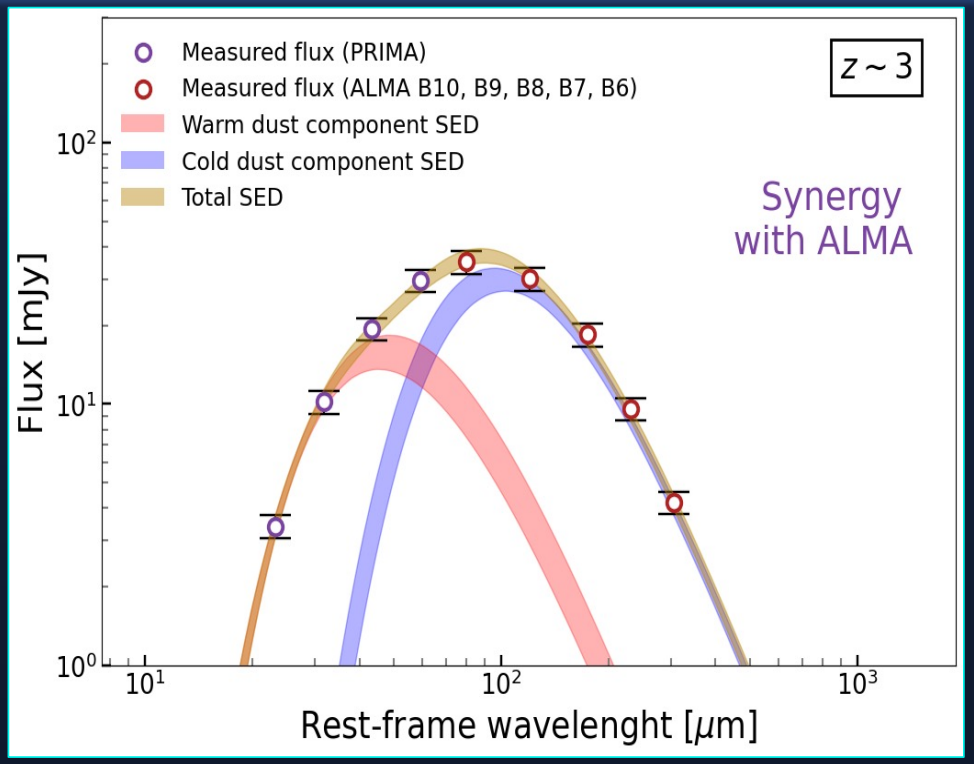
PRIMA

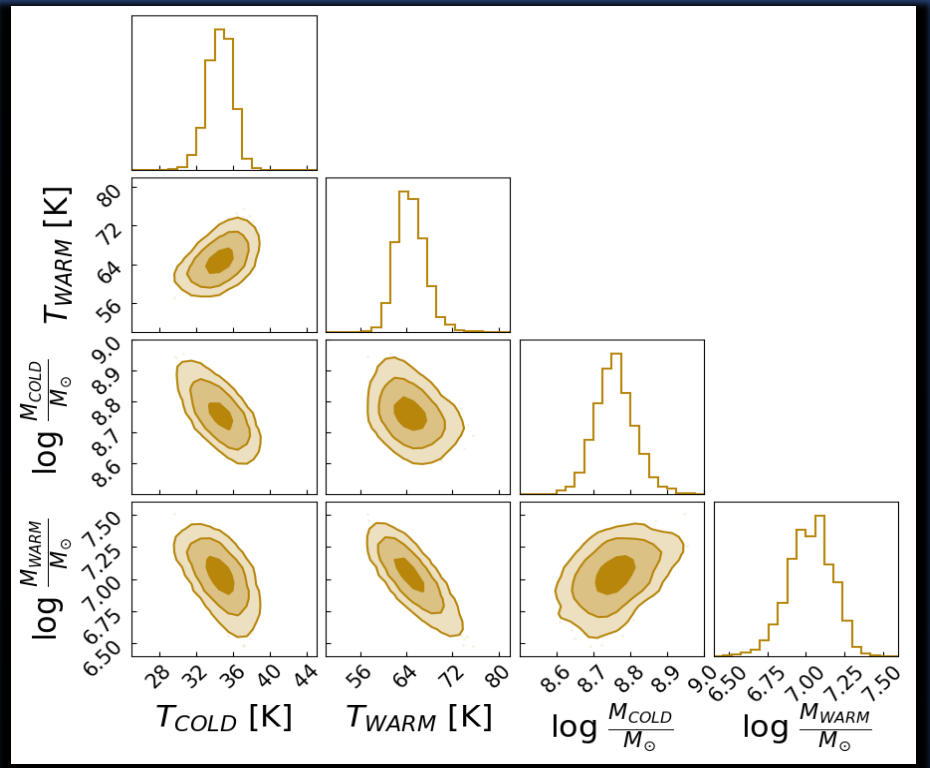
$$\Delta T_{cold} \rightarrow \frac{\Delta T_{cold}}{2}$$

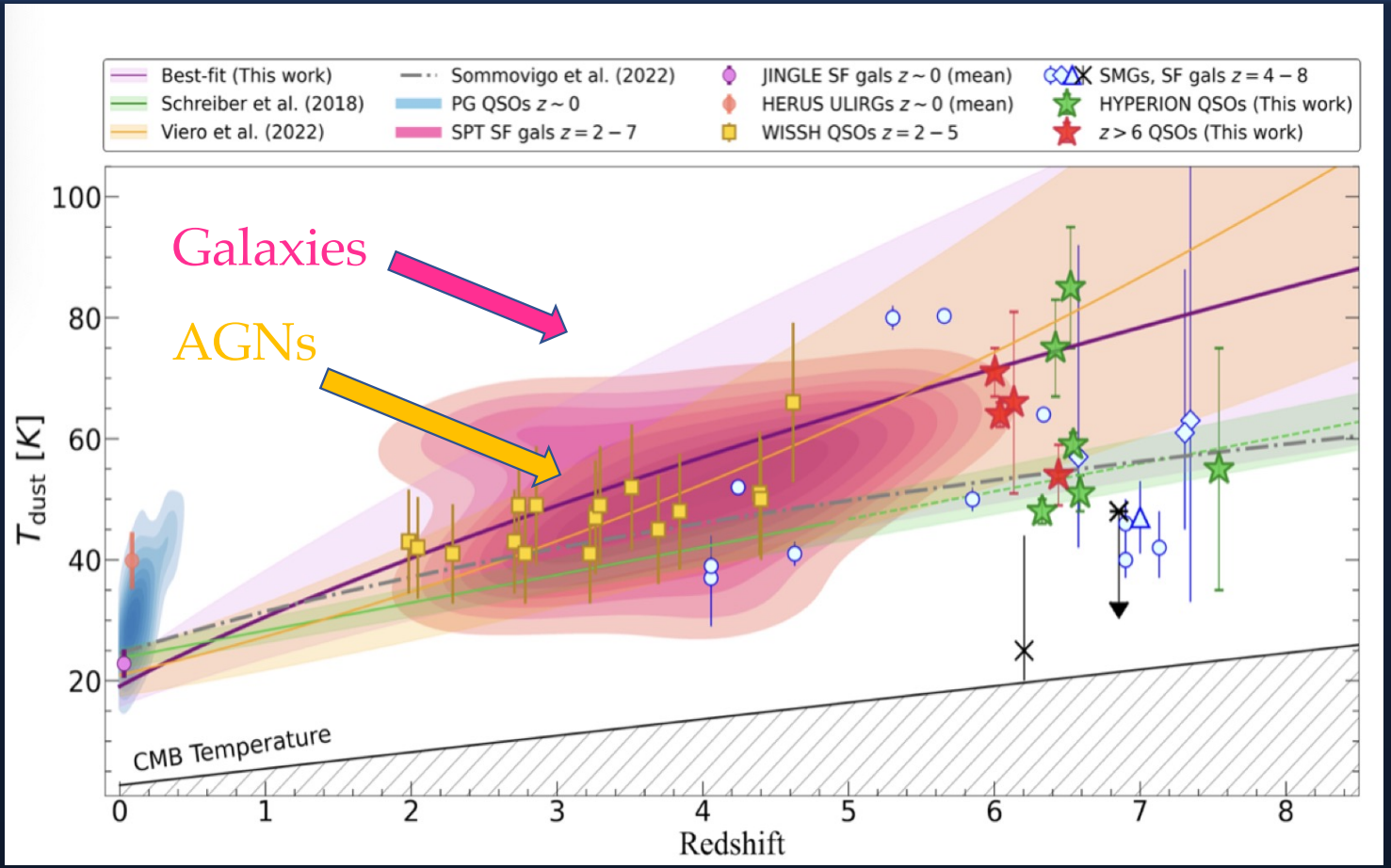
$$\Delta T_{warm} \rightarrow \frac{\Delta T_{warm}}{10}$$

Simulated z~3 galaxy

PRIMA + synergy sub-mm facilities (i.e. ALMA)







Is the dust temperature in AGN the same as in star-forming galaxies?

2 dust components key to give an answer

Tripodi+24

Conclusions

1) PRIMAger reference cosmological survey : 1deg^2, 1000 h

2) Simulated galaxies / AGN with SPRITZ model

→ T_{dust} for 1 dust component for 1 dex fainter sources (in SFR) in comparison to pre-PRIMA missions from z~0 up to z~5

→ T_{dust} for 2 dust components for the brighter galaxies (z > 1.5 key synergy with sub-mm/mm facilities)