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Properties of dusty massive galaxies at low and high redshifts

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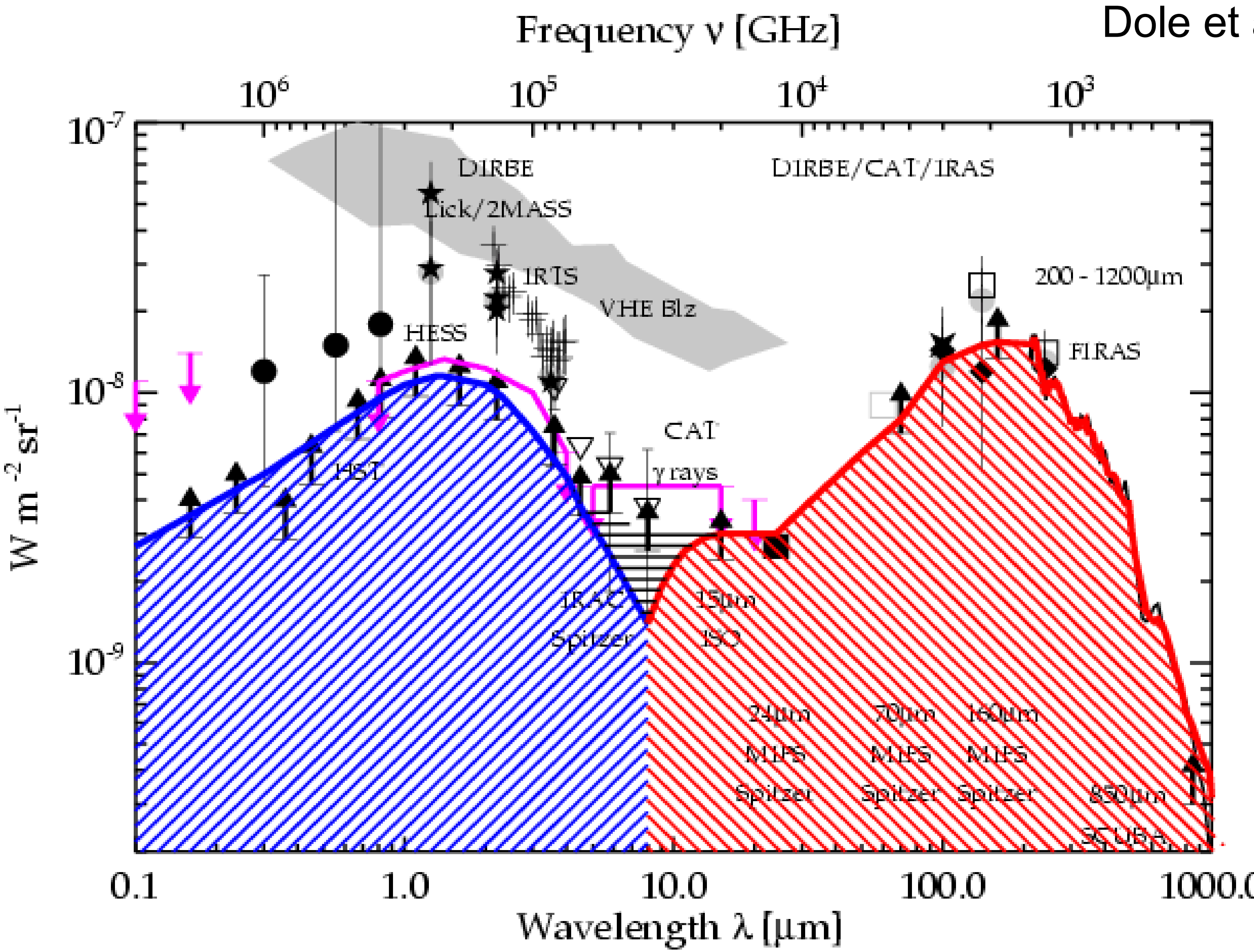
Rowlands et al. (2014a, 2014b)

Collaborators: Loretta Dunne, Steve Maddox, Alfonso Aragon-Salamanca, Simon Dye, Elisabete da Cunha, Haley Gomez, Dan Smith + Herschel ATLAS consortium

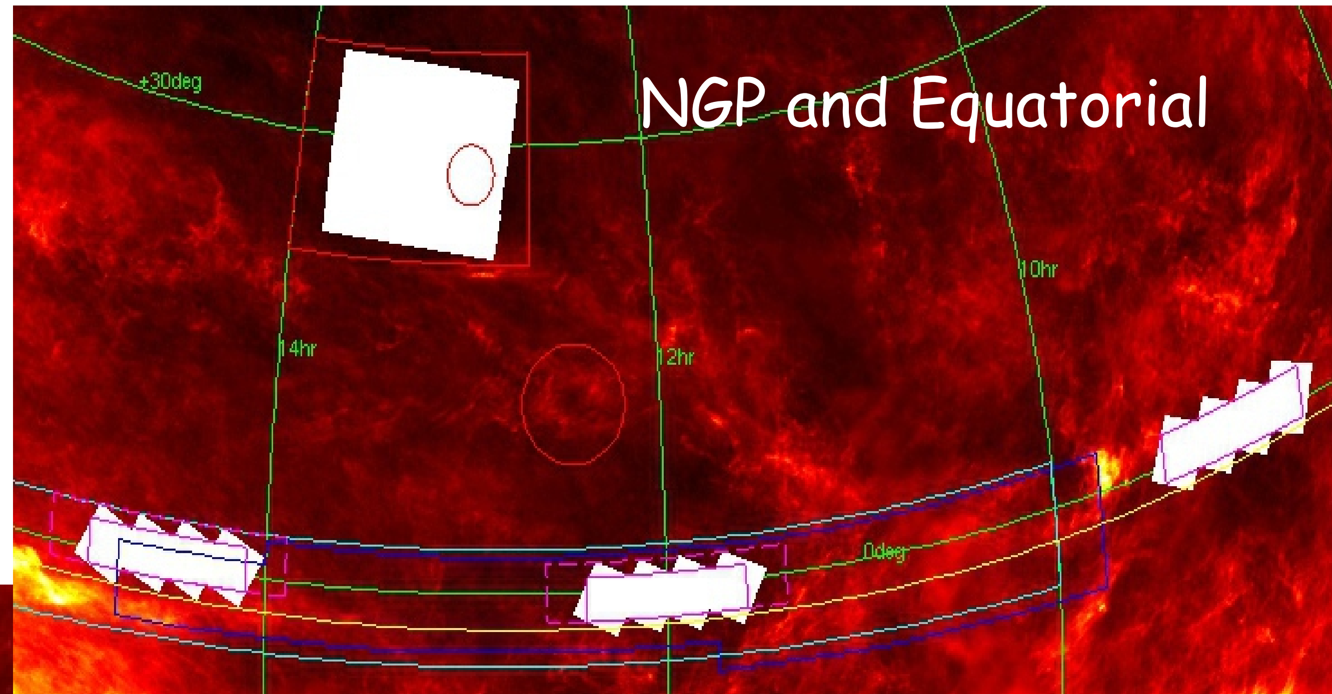
Half of all starlight is absorbed by dust

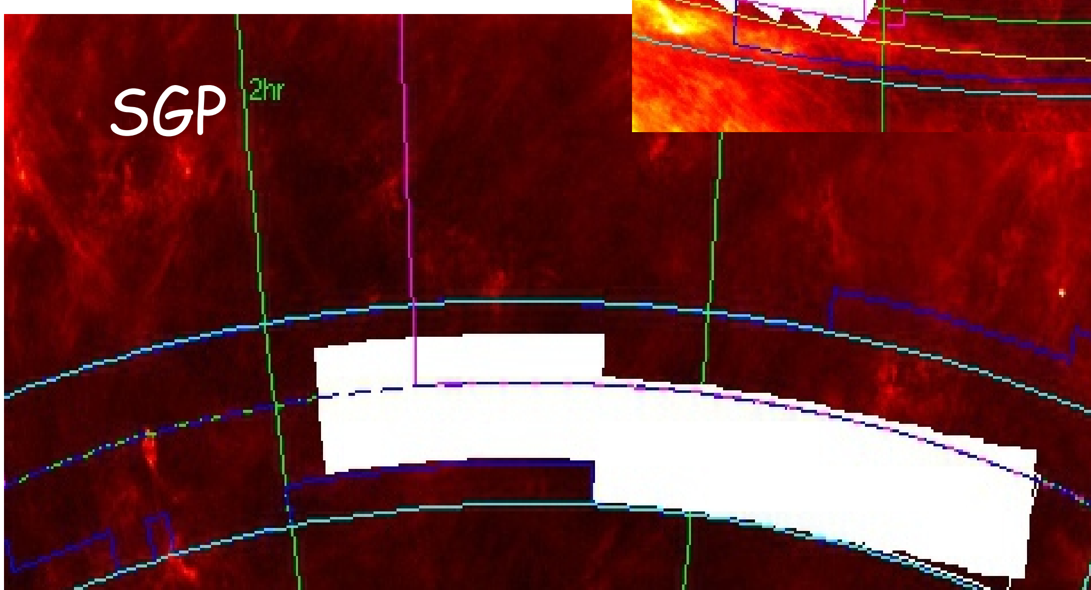
Dole et al. (2006)



Herschel ATLAS

- 300,000 sources to z~3
- Unbiased view of the dusty Universe

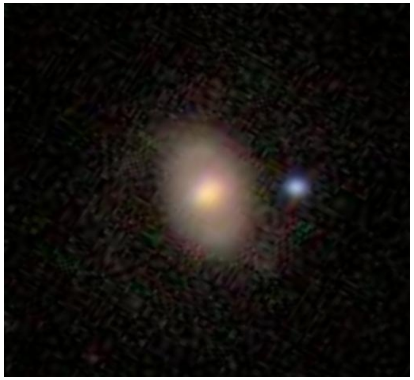




Maximum overlap with existing, planned surveys and follow up:
GALEX, 2dF, SDSS, GAMA, UKIDSS, KIDS, VIKING, PanSTARRS, DES, ASKAP, ALMA, SKA SCUBA2

Low-z dusty galaxies

- Typical star-forming spirals
- $M_* = 2.3 \times 10^{10}\ M_\odot$
- $L_{dust} = 5.6 \times 10^{10}\ L_\odot$.
- $SFR = 3.4\ M_\odot/yr$
- $M_{dust} = 9.1 \times 10^{7}\ M_\odot$



Dunne+12, Rowlands+12, Smith+12

Submillimetre galaxies

- z~2 (Chapman +05, Lapi +11, Wardlow +11)
- $M_* \sim 10^{11}\ M_\odot$
- $L_{IR} = >10^{12\text{-}13}\ L_\odot$ (ULIRGs)
- SFR 100-1000 $M_\odot$/yr
- Gas fractions ~40-50% (Tacconi +06, 08)
- Progenitors of massive local ellipticals? (e.g. Swinbank+06)

Targett+12

Sample selection

SMG sample

>3σ at 850-1100μm + Herschel data + counterparts + spec-z + optical-NIR imaging → 29 sources, z~2 (GOODS-N, GOODS-S, Lockman, COSMOS)
Magnelli+12

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Magnelli+12

Low redshift

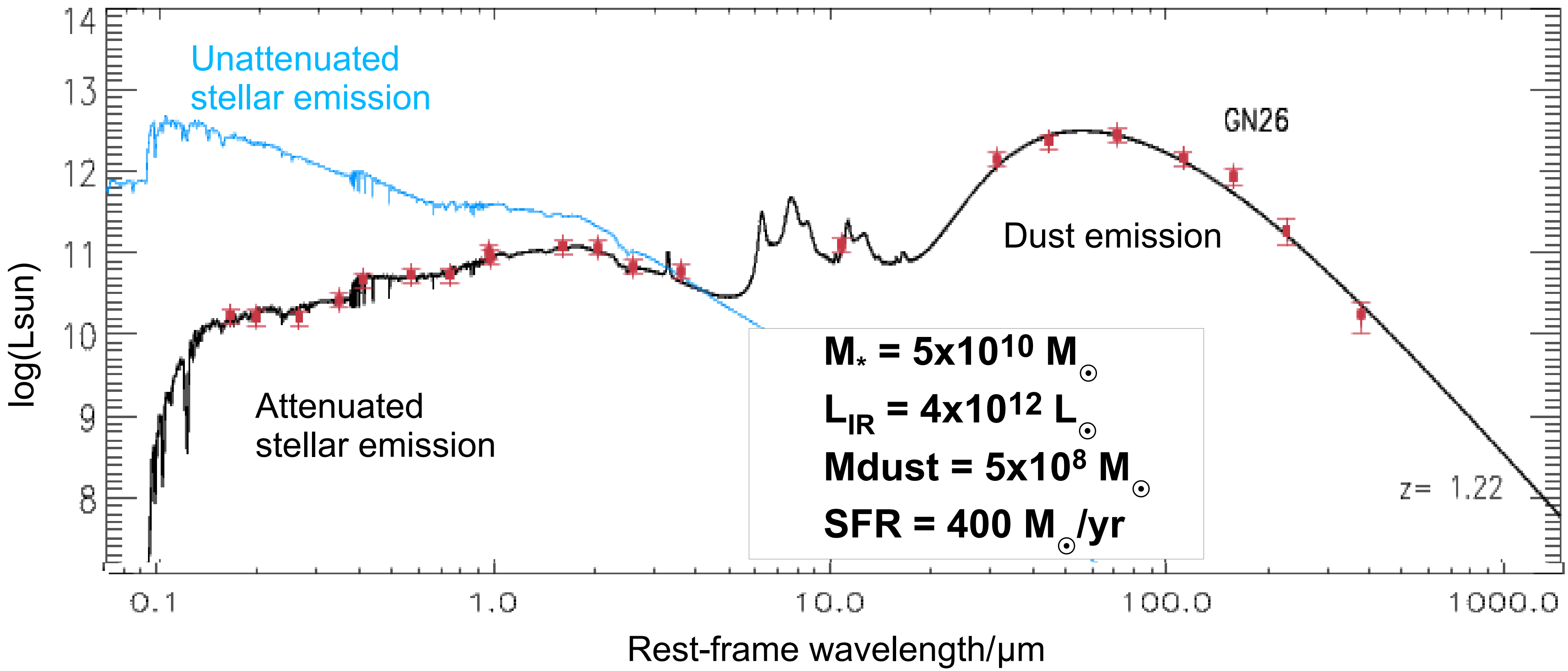
H-ATLAS: >5σ at 250μm, reliable optical counterparts + UV-K data + spec/photo-z → ~15000 sources, 0<z<0.5 (Smith+11)

Match in stellar mass to SMGs = 843 sources

SED fitting - MAGPHYS

Optical + infrared models – stochastic SFH and different dust components

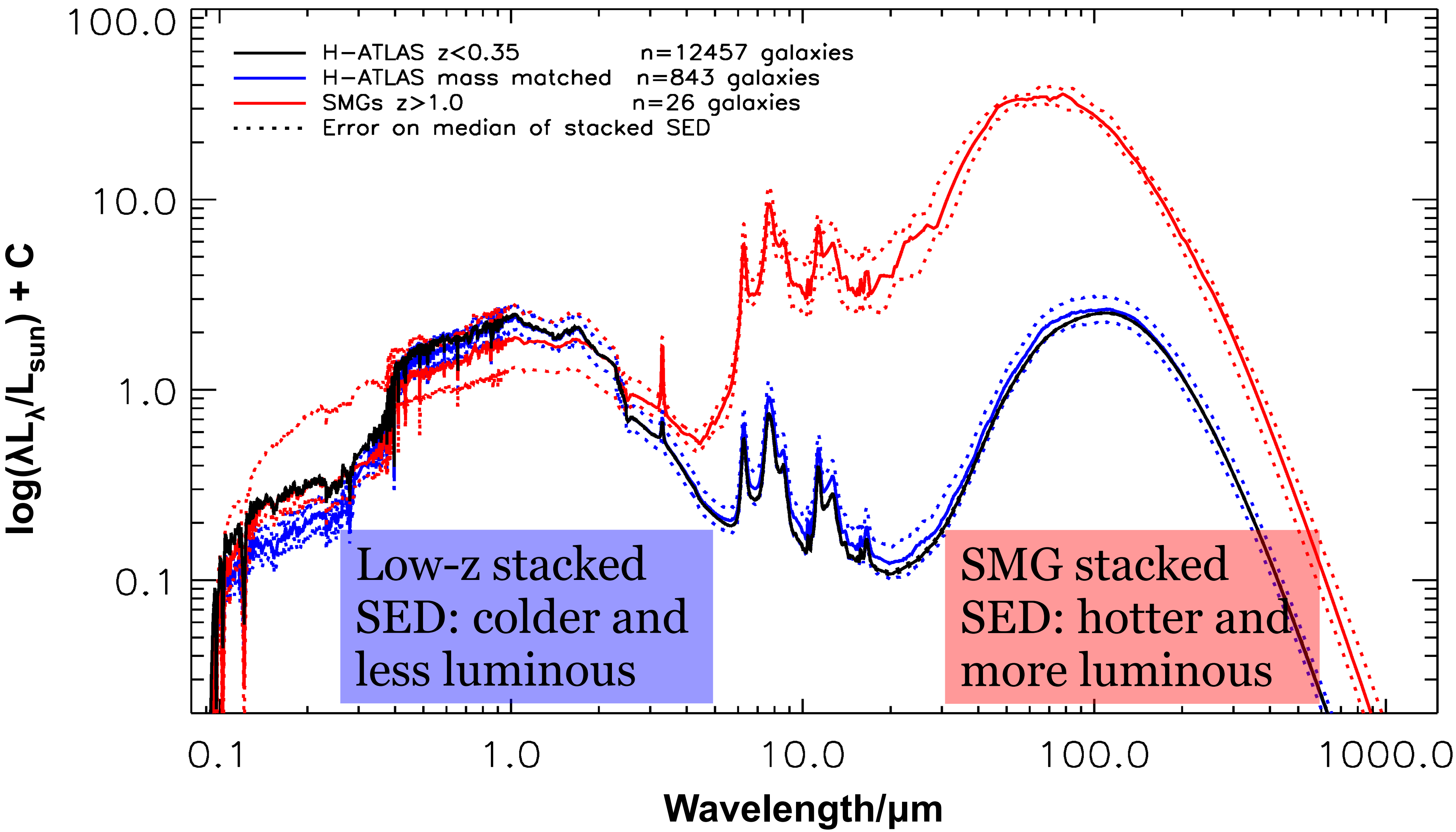
→ Balance absorbed UV energy with FIR emission



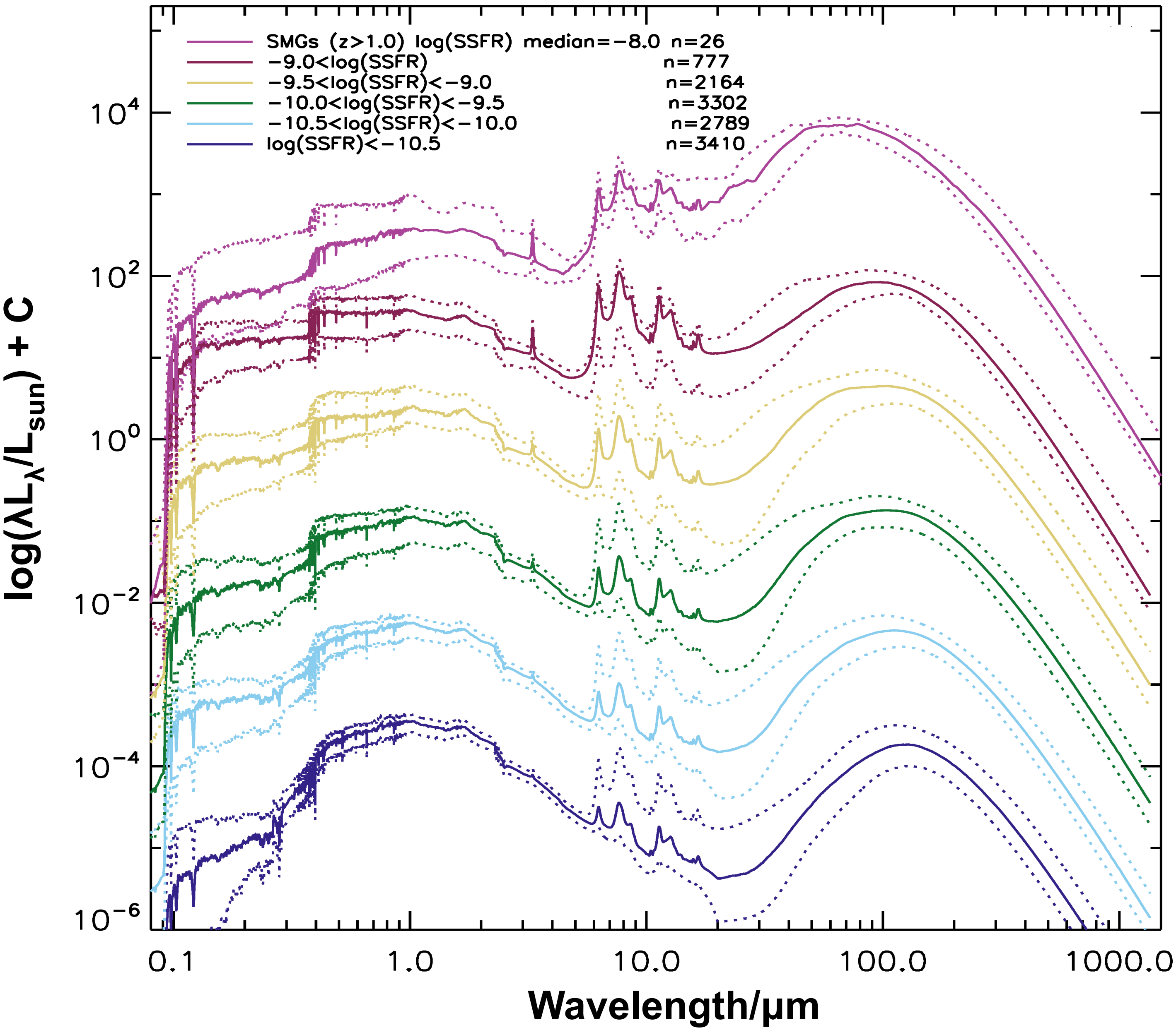
Assume: starlight absorbed by dust in birth clouds and ambient ISM is reradiated in the FIR by different dust components

da Cunha +08,10a,b

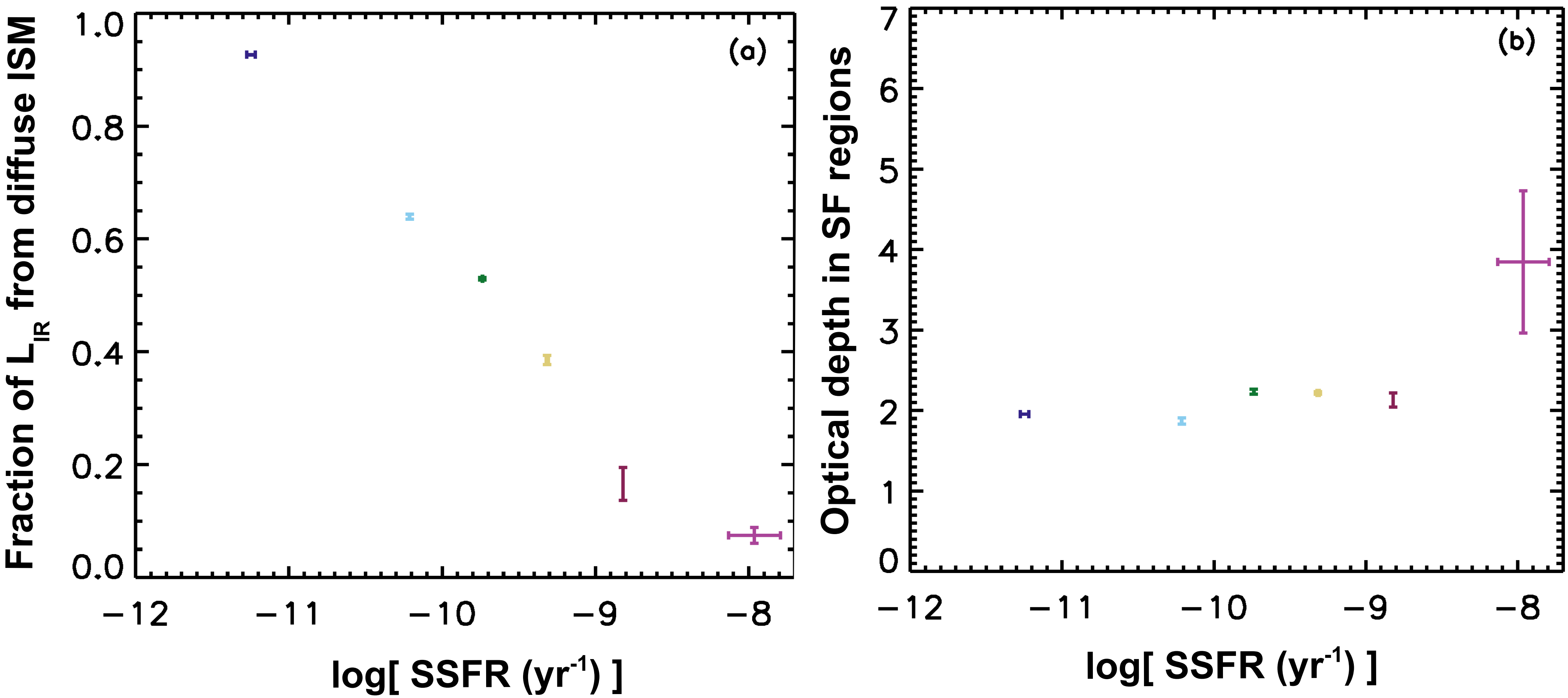
Low and high redshift SEDs



Low and high redshift SEDs

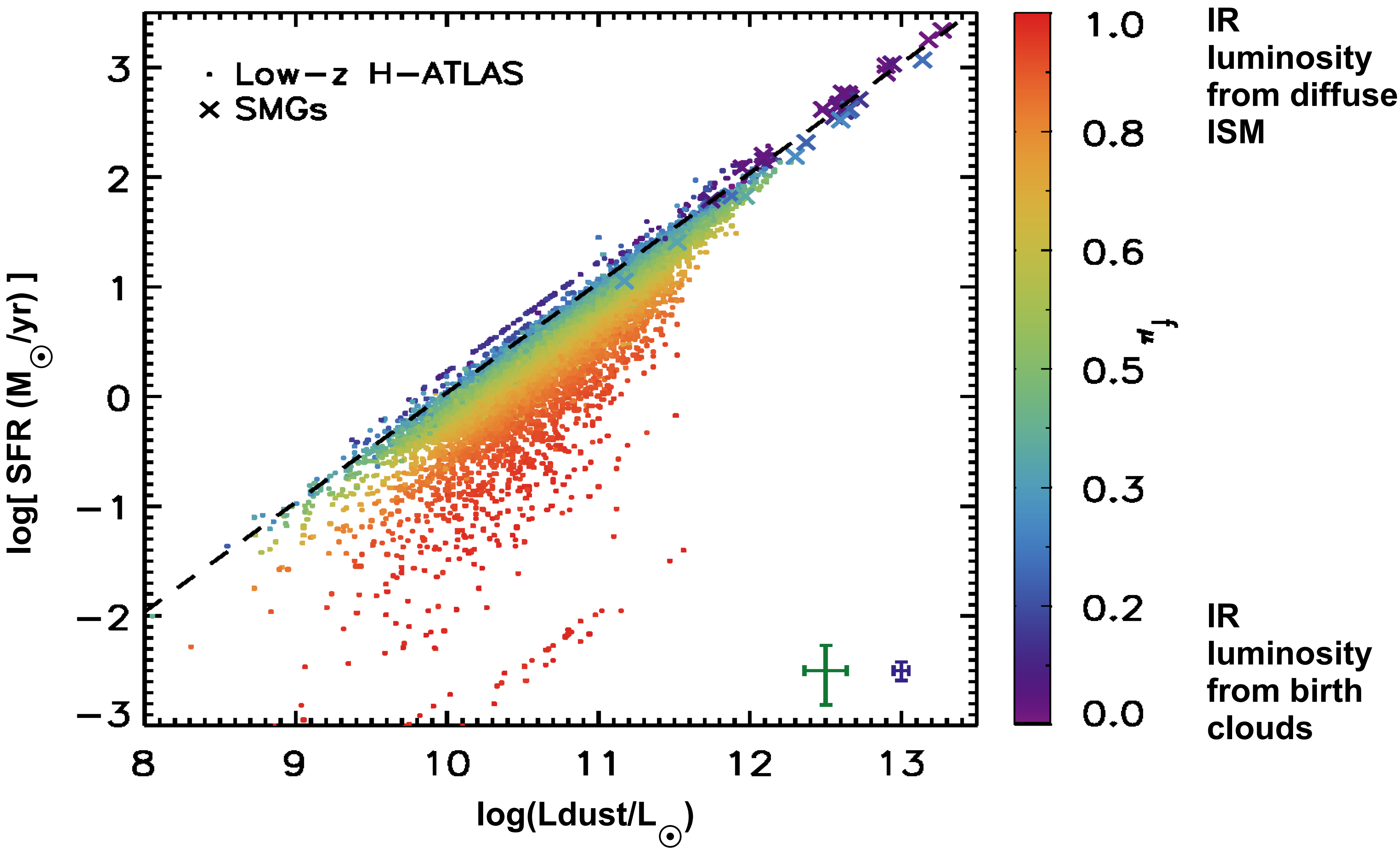


Low and high redshift SEDs

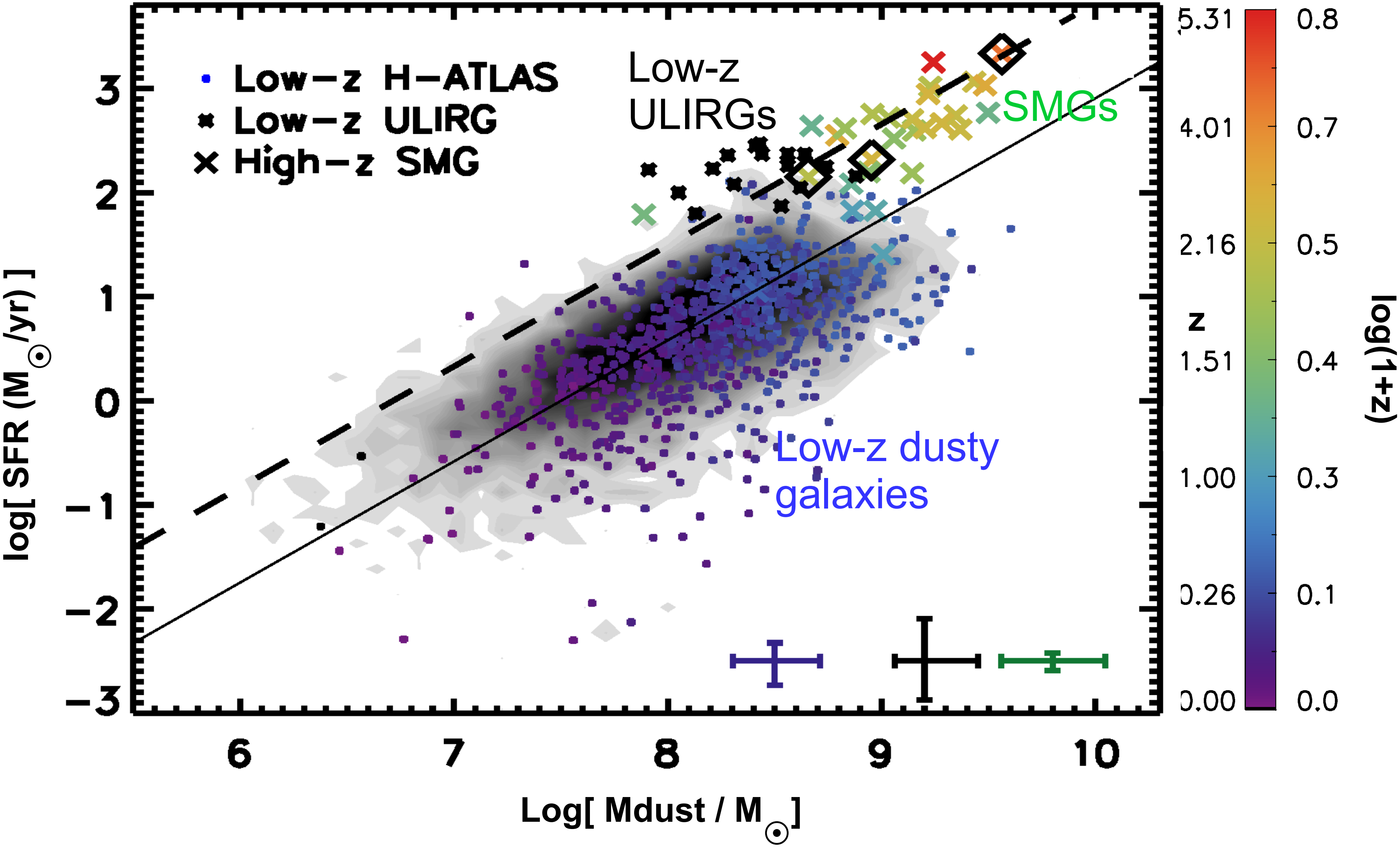


Change in SED shape - physical difference in the structure of birth clouds in SMGs.

Tracing SFR with infrared luminosity



Comparing dust mass and SFR



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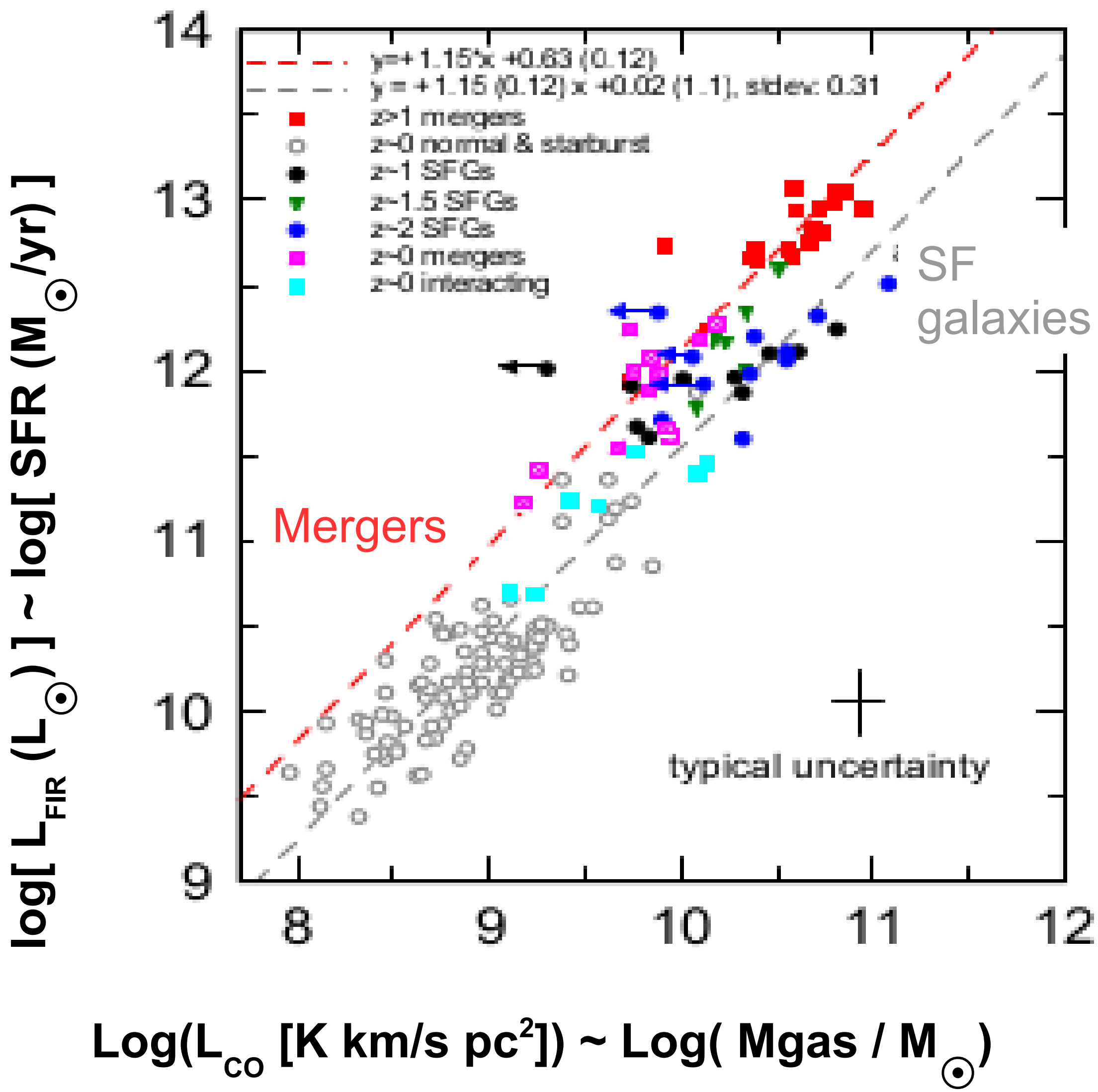
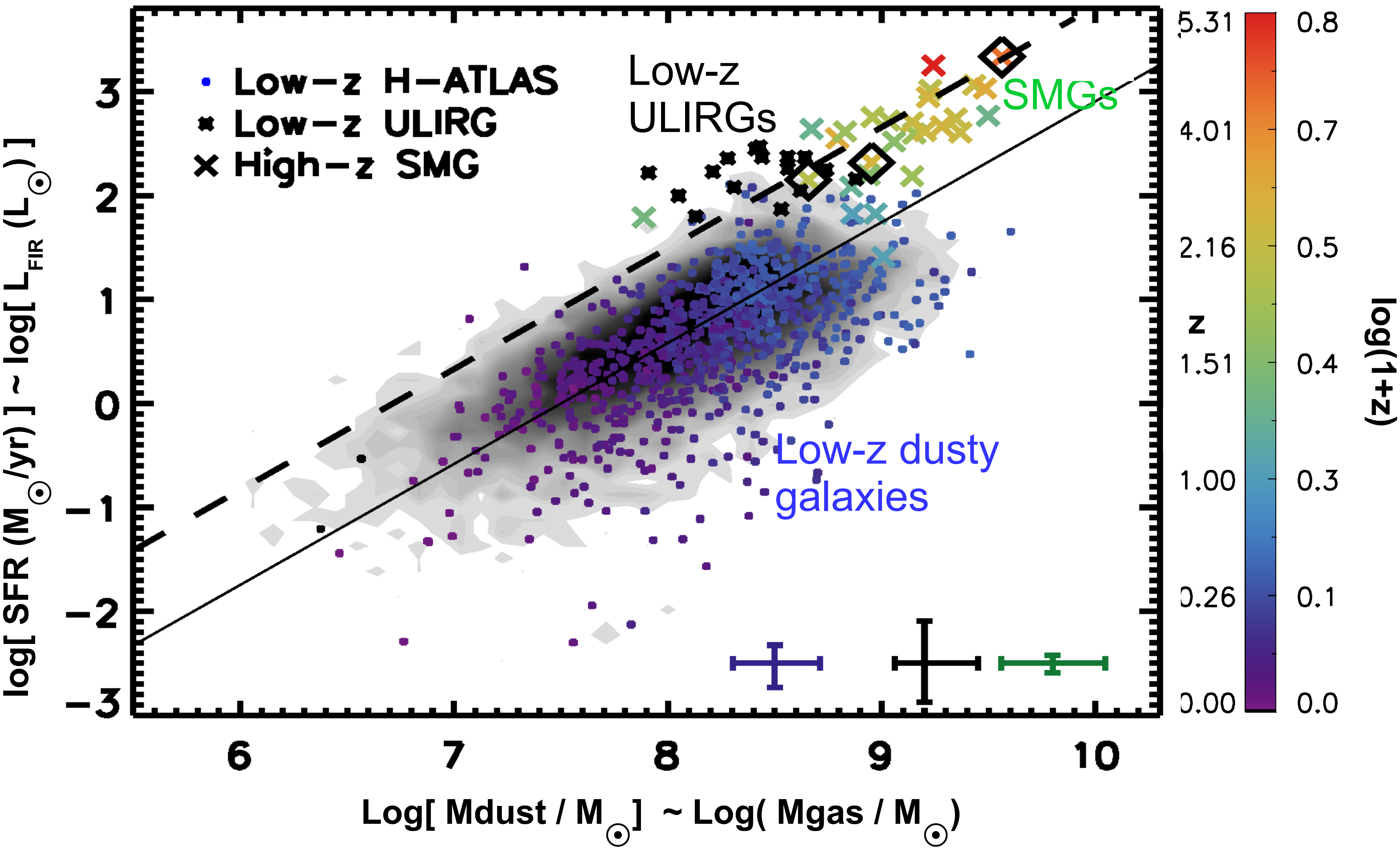
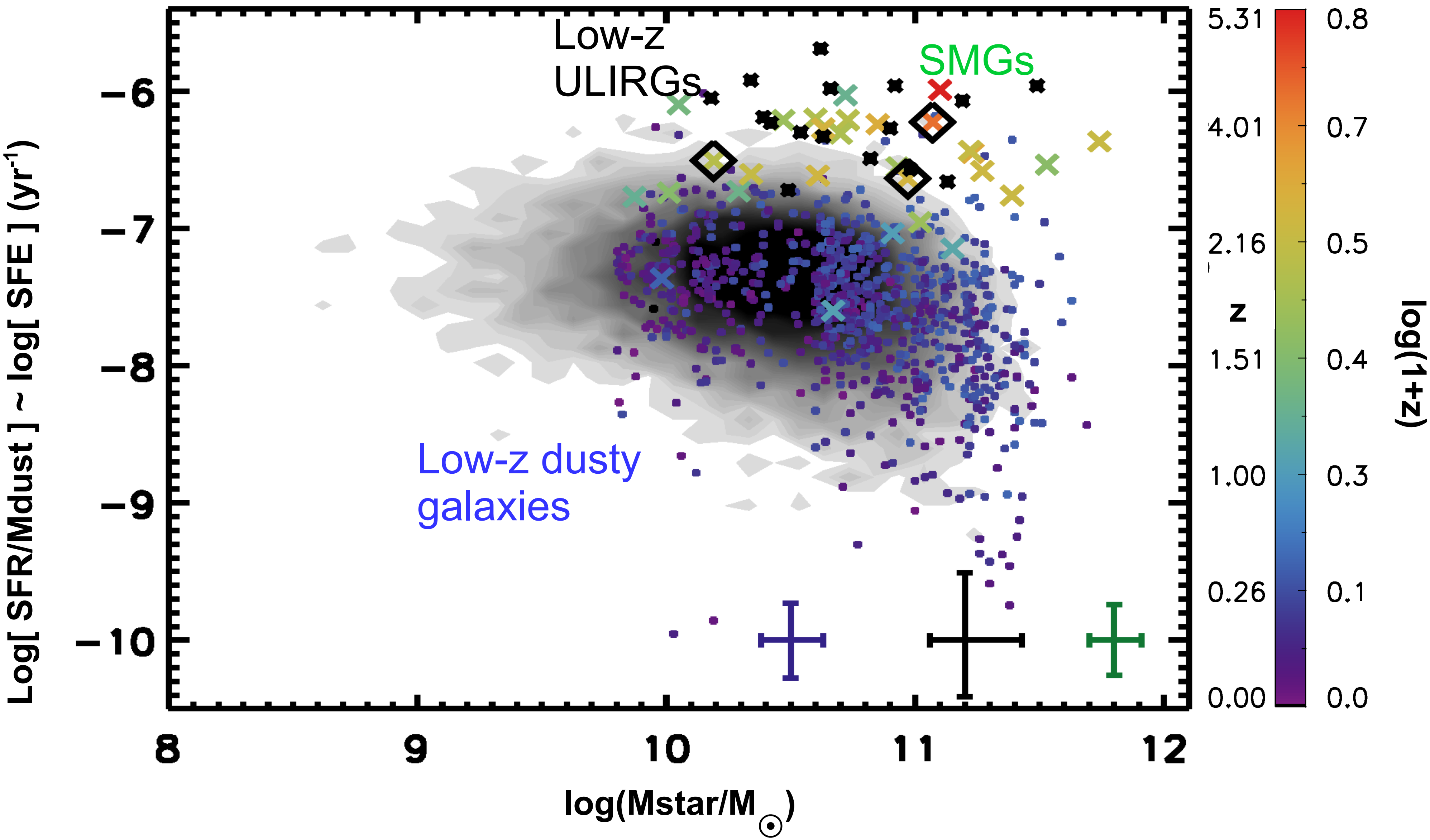


Genzel+10,
also Daddi+10.

Comparing dust mass and SFR



Star-formation efficiency



Conclusions

- SMGs have warmer effective dust temperatures consistent with their high SFRs.
- At the same dust mass SMGs are offset towards a higher SFR compared to the low redshift H-ATLAS galaxies.
- SMGs are undergoing a more efficient mode of star formation.
- Dust mass is as good a tracer of molecular gas as L'_{CO}.

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