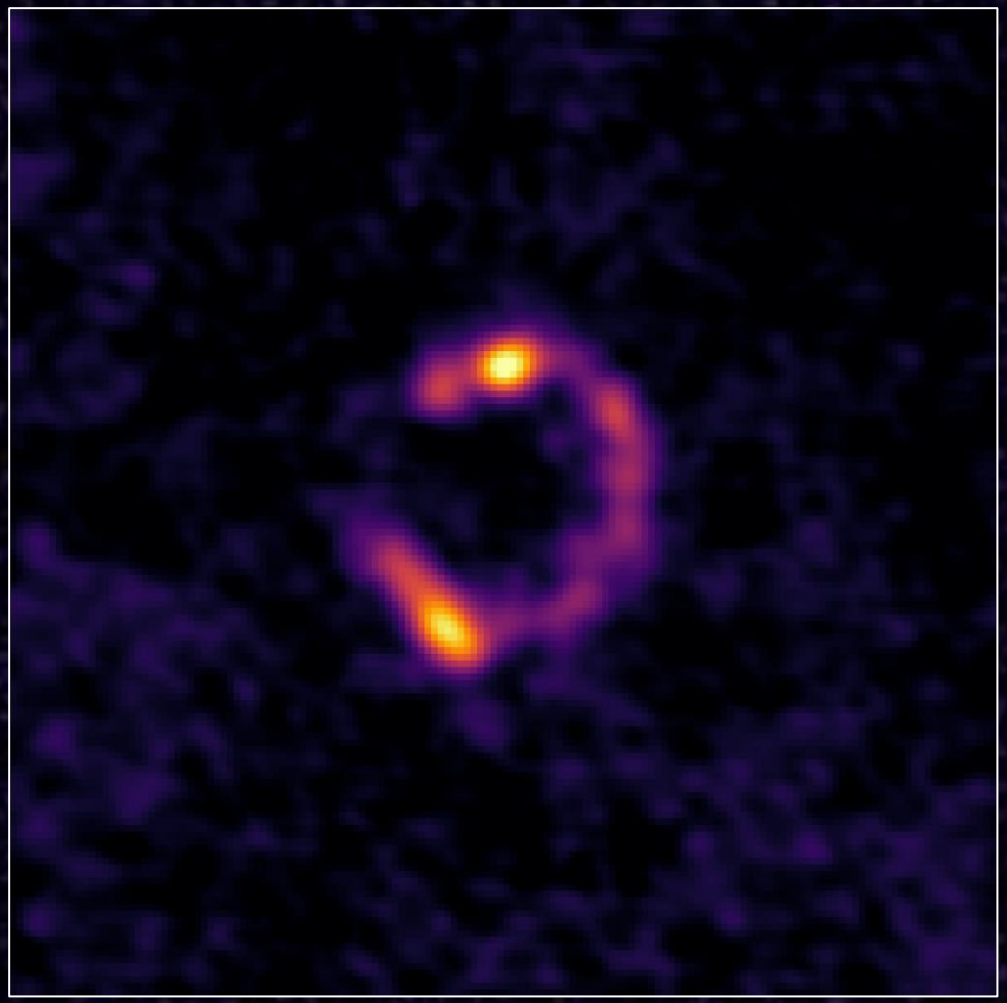
Dust Emissivity Indices in Dusty Star Forming Galaxies



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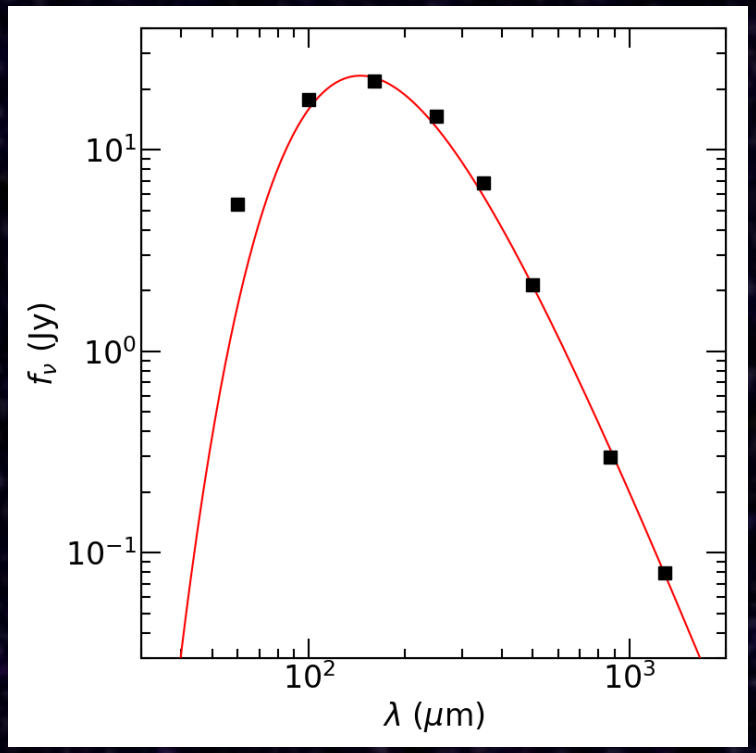
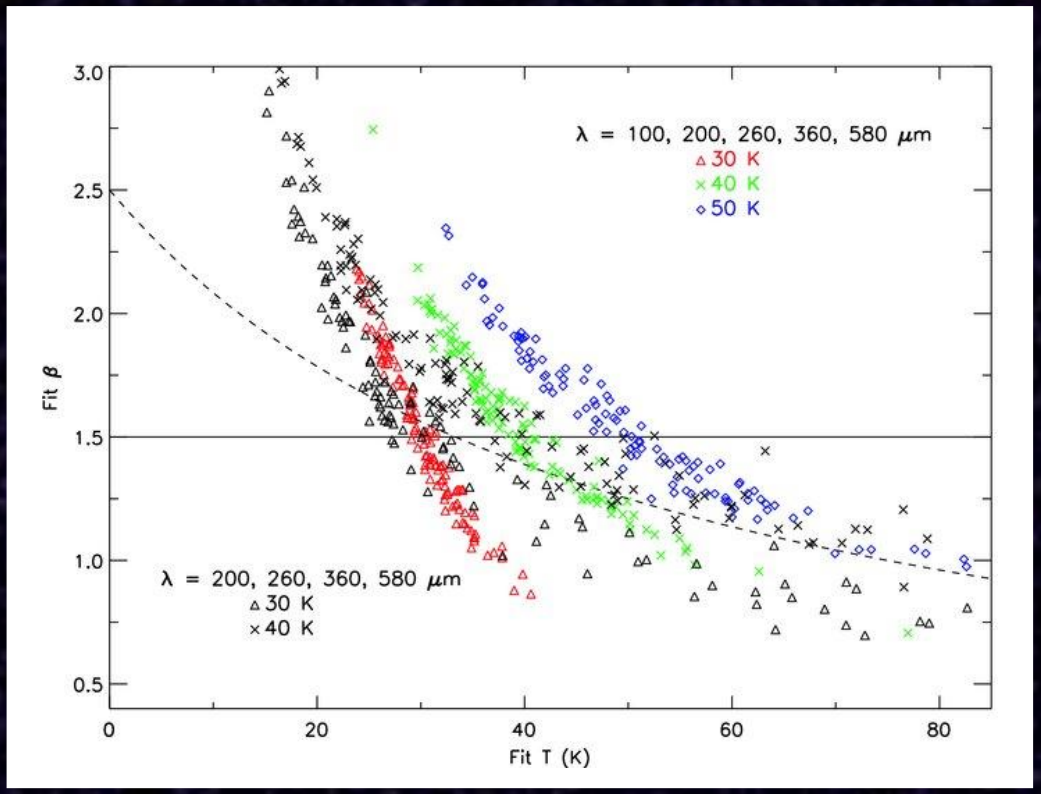
The far-infrared to submillimetre dust emission seen from other galaxies is a function of the dust mass, the dust temperature, and the emissivity function (usually described as scaling like the power law $\kappa_0 \nu^{\beta}$ or $\kappa_0 \lambda^{-\beta}$).



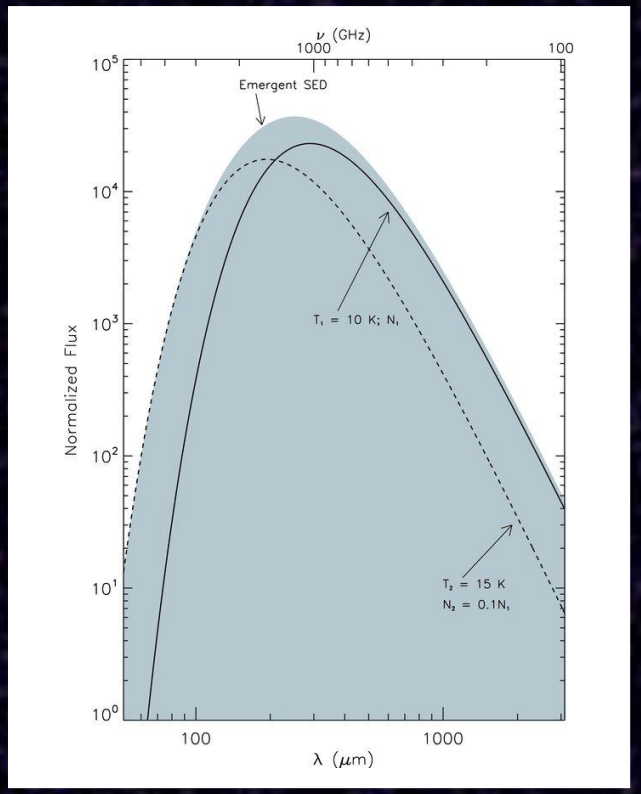
$$f_\nu(\lambda) = \frac{\kappa_0 \lambda^{-\beta} M_{dust}}{D^2} B_\nu(T)$$

People usually derive β from spectral energy distribution (SED) fitting.

However, in any SED fit involving a single modified blackbody, β and T will tend to be inversely related for multiple reasons (including blending emission from dust with different temperatures and relations caused by noise).



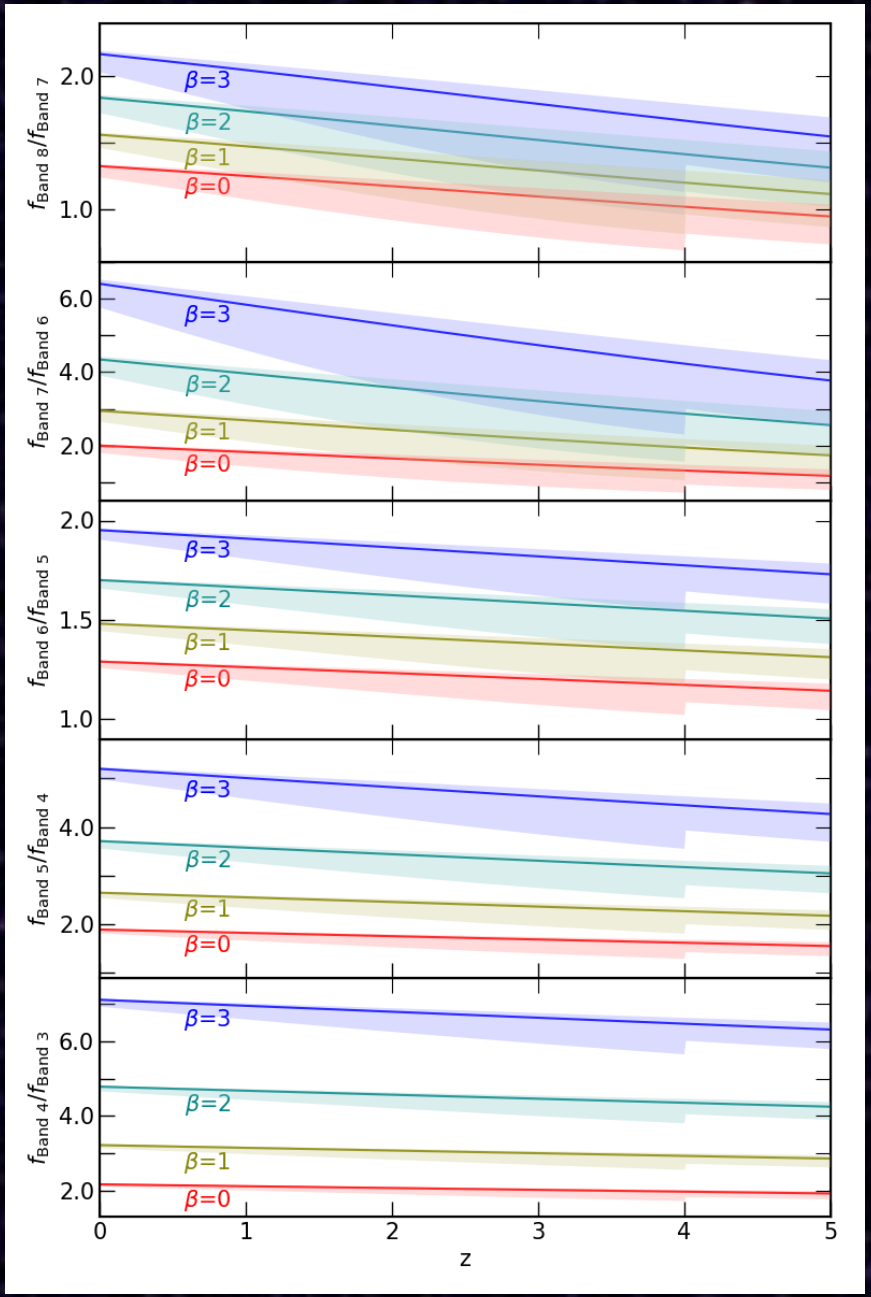
Shetty et al. (2009, ApJ, 696, 676)



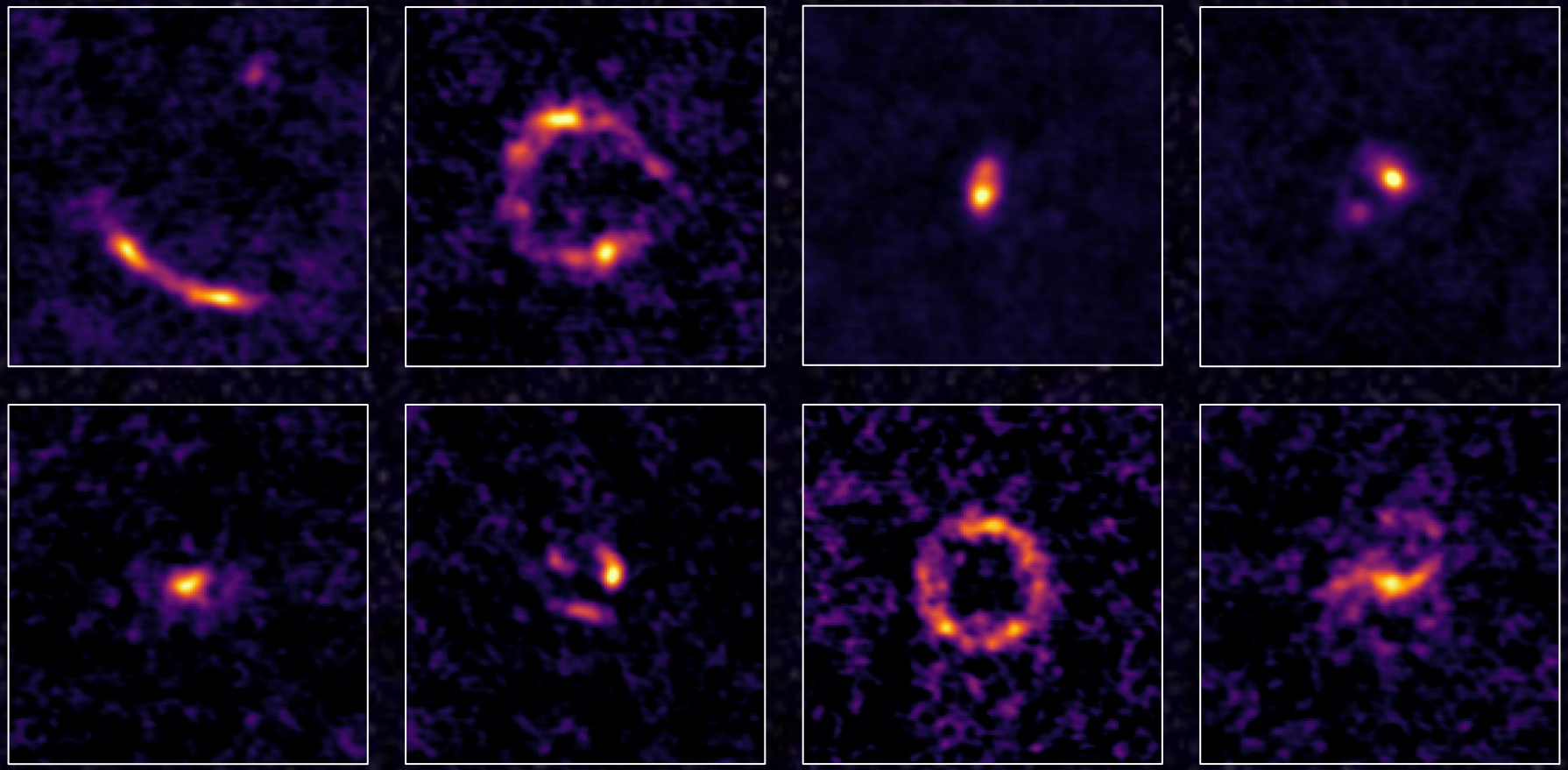
Shetty et al. (2009, ApJ, 696, 2243)

For decades, people (including my PhD adviser) talked about deriving β just using the slope of the Rayleigh-Jeans SED.

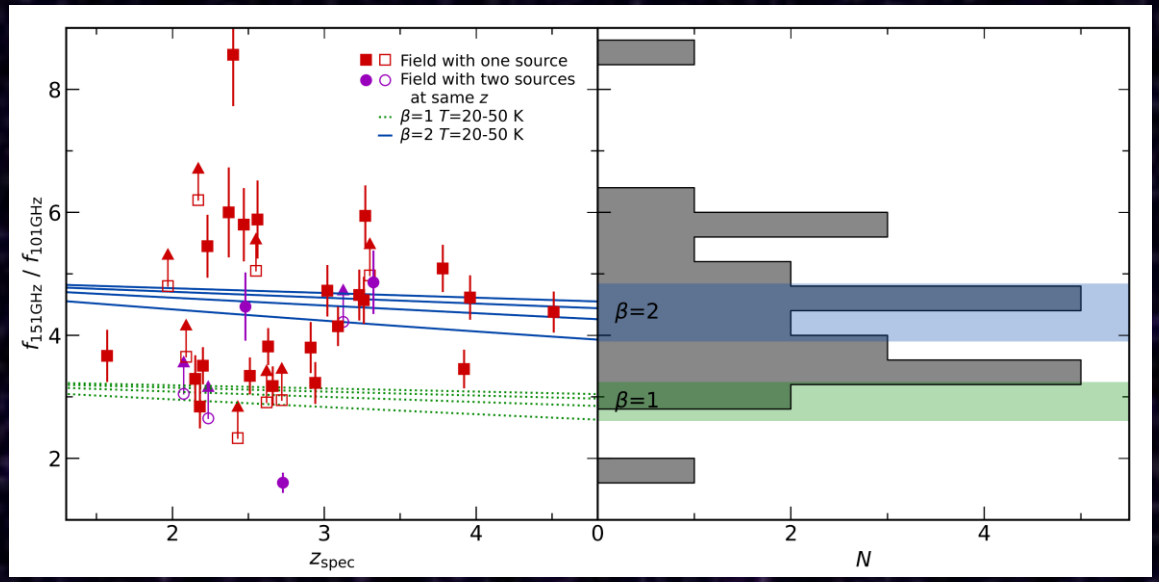
ALMA is able to do that for $1.5 < z < 4.5$ dusty star forming galaxies that have been observed in low frequency ALMA bands.



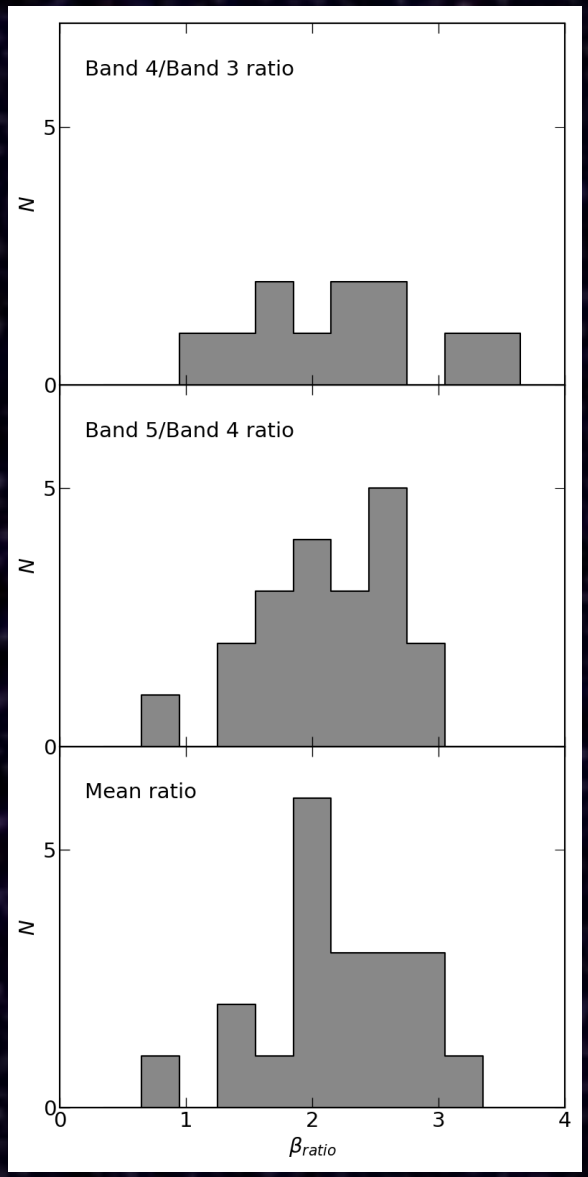
I have been working with multiple other collaborators on samples of gravitational lens candidates originally identified through surveys with the Herschel Space Observatory.



The first analyses have yielded β values of 2.0-2.4. However, the work on this is ongoing.

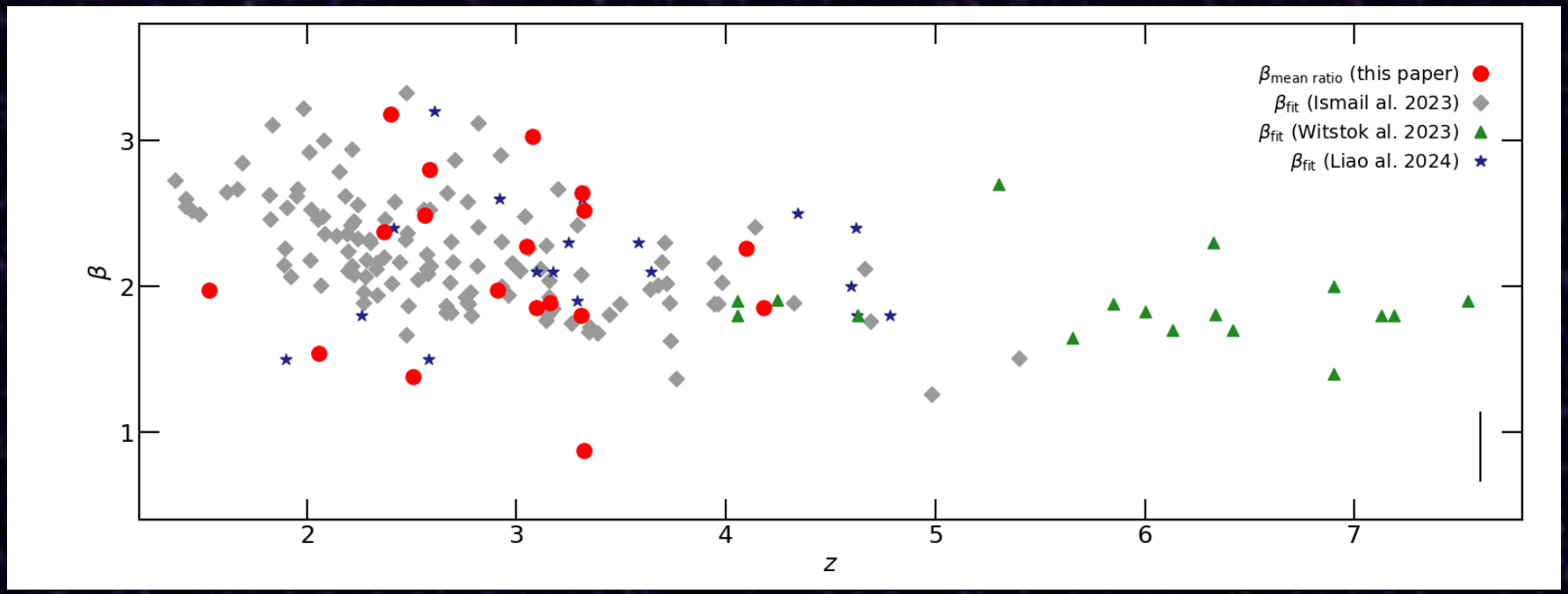


Bendo et al. (2023, MNRAS, 522, 2995)



Bendo et al. (2025, MNRAS, 540, 1560)

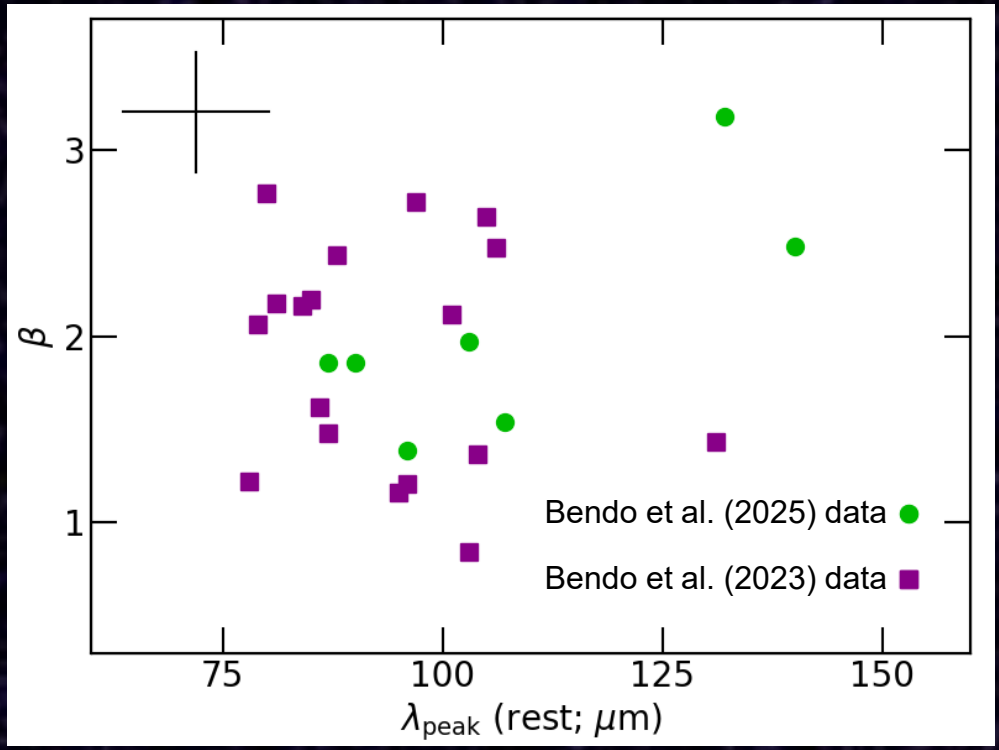
No relation has been seen between β and redshift from this analysis or analyses with other data.



Bendo et al. (2025, MNRAS, 540, 1560)

Critically, the peak wavelength in the dust SED (a model-independent metric for T) is uncorrelated with β.

This contradicts most other research results, which depend on SED fitting and are therefore likely to be biased towards deriving an anticorrelation between β and T.



This research is currently ongoing with a much larger sample. Additional work is going to be done on SED fitting.