TRACING THE EVOLUTION OF DUST-OBSCURED ACTIVITY

USING SUB-MILLIMETRE GALAXY POPULATIONS

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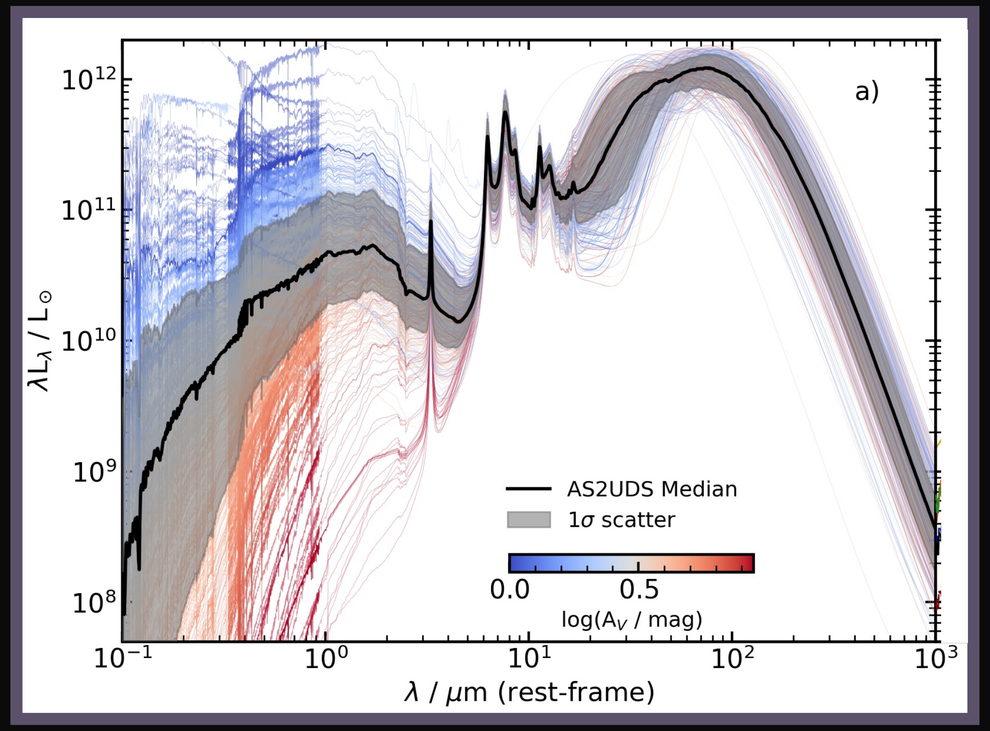
DUST-OBSCURED GALAXIES AT HIGH-Z

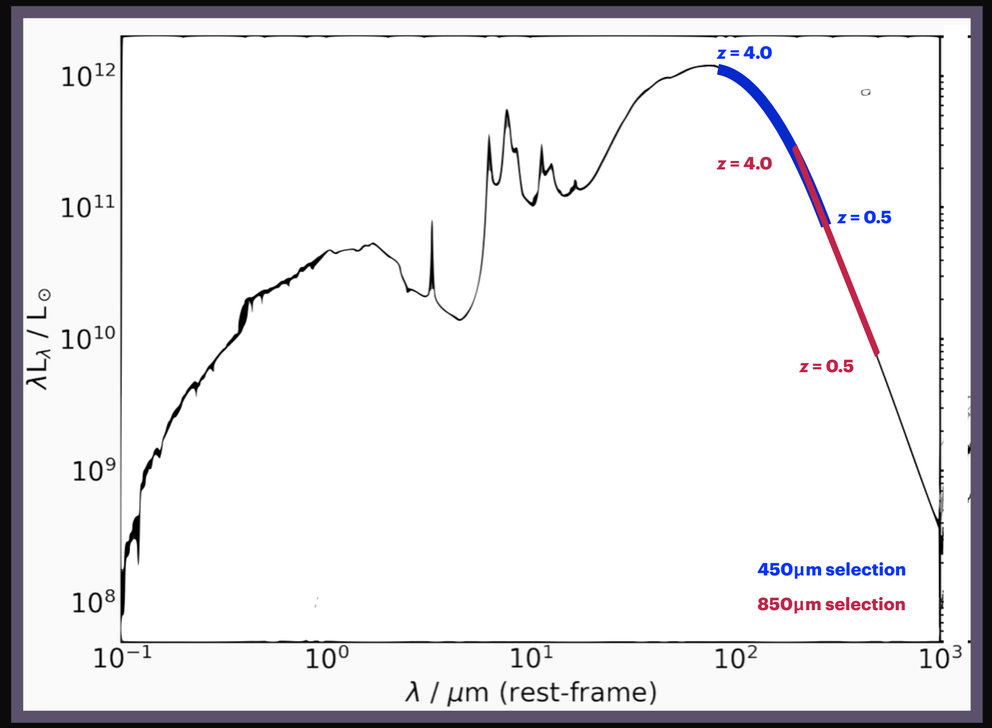
- **Significant energy density in the extragalactic background of the Universe at infrared wavelengths:**
  - **A population of dust-enshrouded galaxies**
- **In such far-IR bright galaxies:**
  - **Radiation from young massive stars is absorbed by dust grains**
  - **Then re-radiated as thermal continuum emission at far-infrared wavelengths**



Dudzevičiūtė et al 2020

SELECTION OF DUSTY GALAXIES

- **Large-scale surveys at high-z are undertaken primarily around ~850μm-1.2mm:**
  - **Sensitive to the cool dust mass of the galaxies**
  - **Suggested that these systems are strongly dust obscured systems with high far-infrared luminosities and lying at high redshifts with huge gas reservoirs and SFRs of ~100-1000 $M_\odot yr^{-1}$.**
- **To better understand the physical properties of the whole population, selection closer to the peak of emission, has to be considered (e.g. 450μm)**



THIS STUDY

- Combination and comparison of 450-μm and 850-μm surveys for a more complete view of luminous far-infrared activity in the Universe over a wider redshift range than possible with either individual sample

- **STUDIES** (Wang et al 2017; Lim et al 2020):

  - multi-year JCMT survey, ~20 times lower confusion limit than SPIRE at 500μm.

  - deepest single-dish map at 450μm currently available, with 121 sources detected at >5σ.

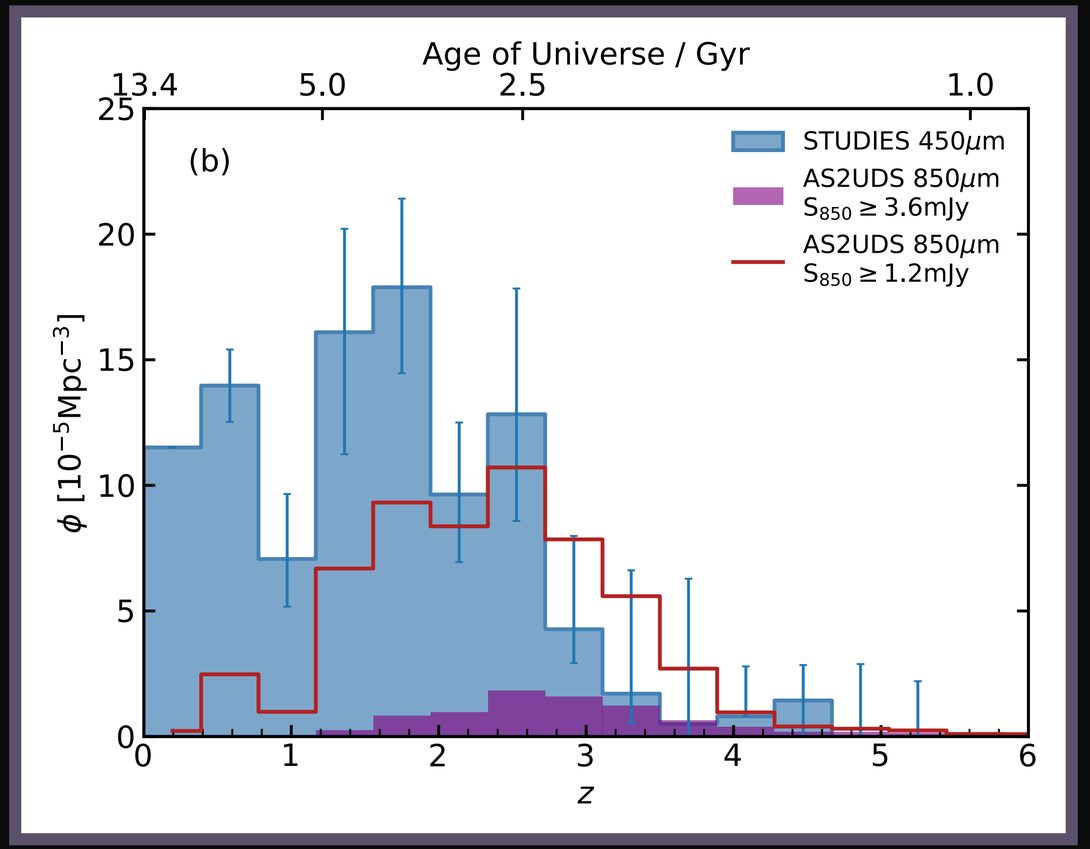
- **AS2UDS** (Stach et al 2017; Dudzevičiūtė et al 2020):

  - largest available ALMA-identified 850-μm-selected SMG sample (707 galaxies)

REDSHIFT DISTRIBUTIONS

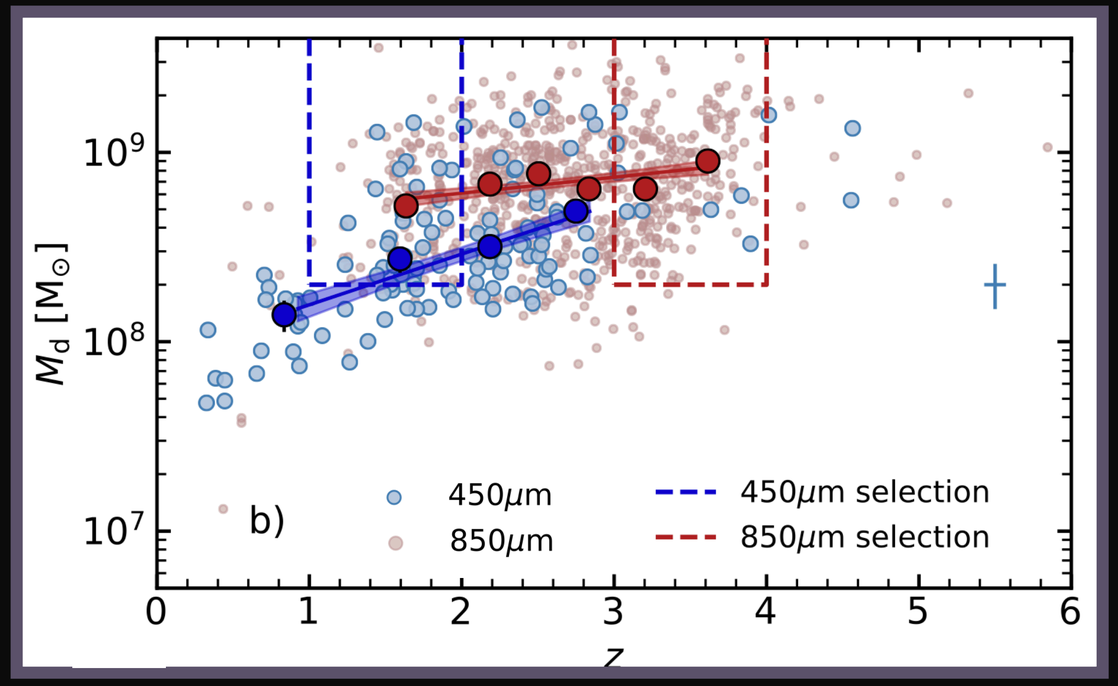
- **450μm population has significantly lower median redshift:**
  - $z = 1.85 \pm 0.12$ **(450μm population)**
  - $z = 2.61 \pm 0.08$ **(850μm population)**
- **450-μm population has higher space density up to a redshift of $z = 2$, but a similar space density at $z = 2–3$**

➡ **LIRGs are the main obscured population at z~1-2, while ULIRGs dominate at higher redshifts.**



WAVELENGTH MATCHED SAMPLE

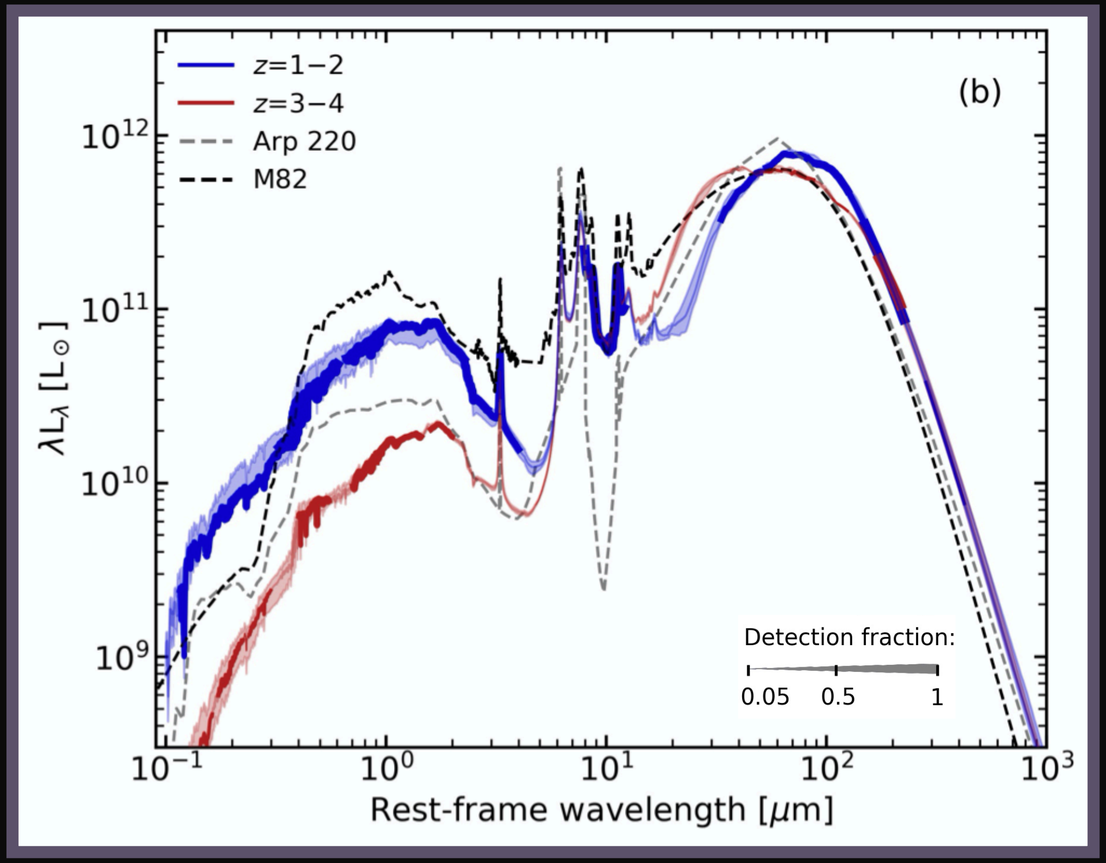
- **Rest-frame wavelength (~180μm) matched sample:**
  - **450μm at z=1-2**
  - **850μm at z=3-4**
  - **Dust mass above 2 x 10^8 M⊙**



➡ **To probe the evolution of a uniform sample of dusty star-forming galaxies spanning the cosmic noon era.**

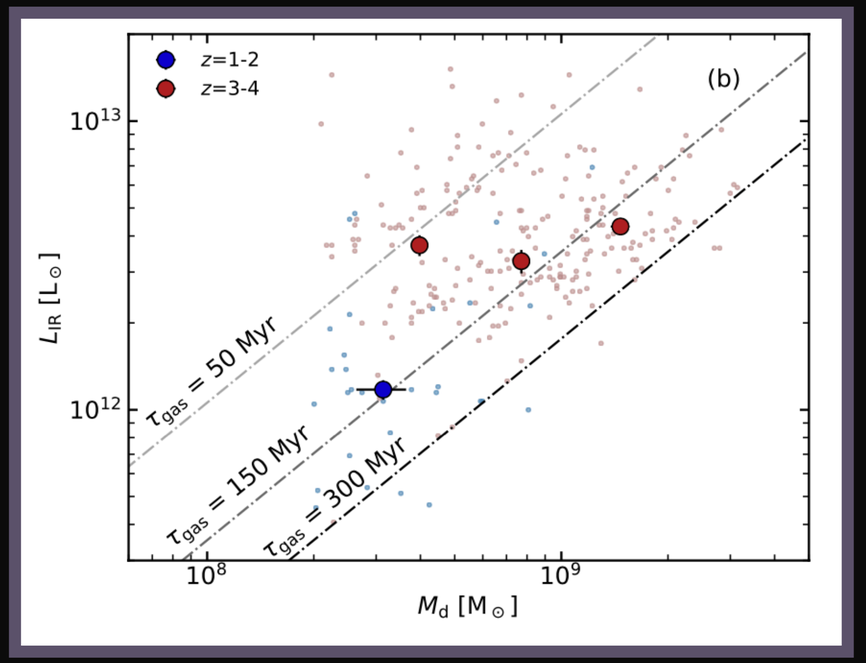
PROPERTIES OF DUSTY GALAXIES

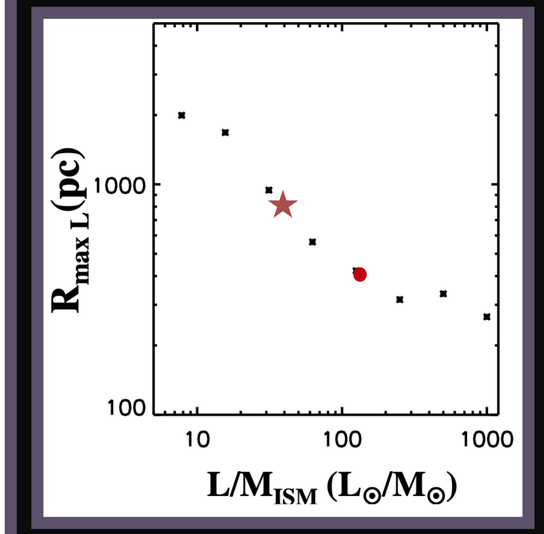
- Lower dust mass, far-IR luminosity than equivalent measures of the *z*~3.5 population.
- Significantly lower dust attenuation compared to *z*~3.5 sample.
  - Opposite to expected trend?



DUST EMISSION REGIONS

- Using an optically-thick model (Scoville 2013), we suggest z~1.5 population has lower dust density:
  - z~1.5: comparable inferred dust emission radii (~0.8 kpc), but lower dust mass

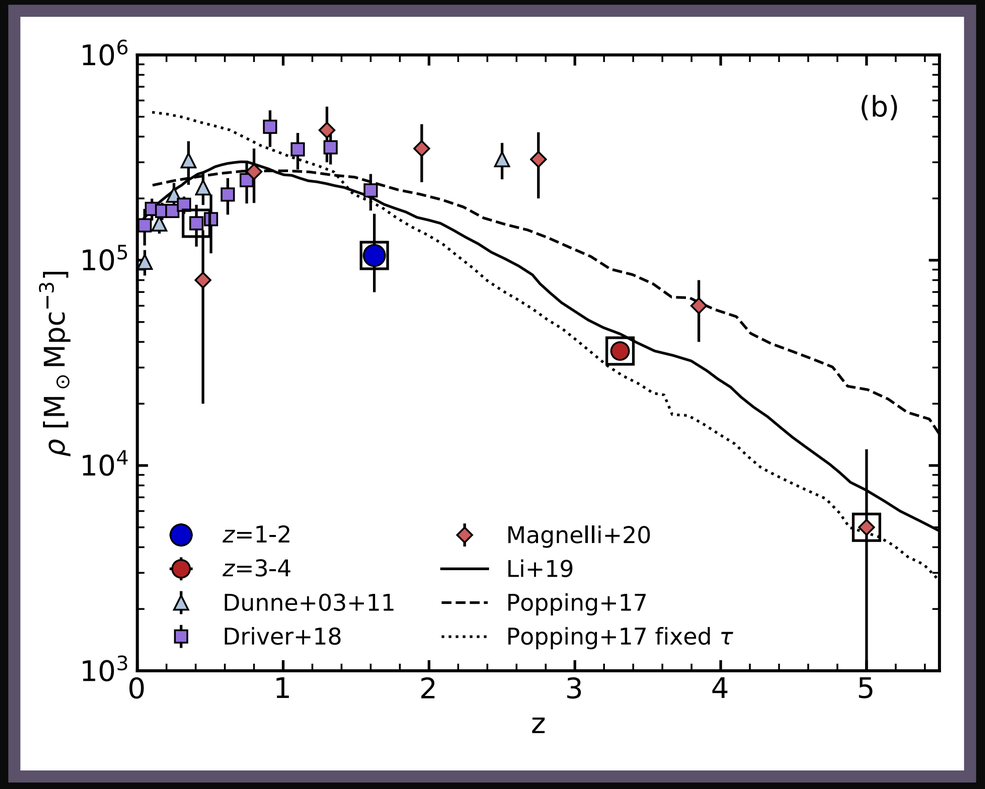




➡ Dust density appears to be a key parameter leading to the lower dust attenuation in SMGs seen at z~1.5

TOTAL DUST MASS DENSITY

- Dusty galaxies selected at the same rest-frame wavelength have a similar dust mass density at *z*~1.5 and *z*~3.5.
- **Total** dust mass density at *z*~1.5 is roughly three times higher compared to *z*~3.5.
- Dust content of galaxies is governed by variation in gas content and dust destruction timescale.



SUMMARY

- Aim of the study: to investigate the evolution of a uniform sample of dusty star-forming galaxies spanning the cosmic noon era.

  ➡ LIRGs are the main obscured population at z~1-2, while ULIRGs dominate at higher redshifts.

  ➡ Higher redshift sources have higher dust densities:

  - Their dust continuum sizes are roughly half of those for lower-redshift population (at a given dust mass).

  ➡ For the first time, wavelength matched sample at *z*=1-2 and *z*=3-4, to assess the evolution with redshift in physical properties of far- infrared-selected samples

  - Dust content of galaxies is governed by variation in gas content and dust destruction timescale.

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