TRACING THE EVOLUTION OF DUST-OBSCURED ACTIVITY USING SUB-MILLIMETRE GALAXY POPULATIONS

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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
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-\textmu m and 850-\textmu m 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 500\textmu m.

- deepest single-dish map at 450\textmu m currently available, with 121 sources detected at >5\sigma.

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

- largest available ALMA-identified 850-\textmu m-selected SMG sample (707 galaxies)
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 $z \sim 1-2$, while ULIRGs dominate at higher redshifts.
WAVELENGTH MATCHED SAMPLE

- Rest-frame wavelength (~180\,\mu m) matched sample:
  - 450\,\mu m at z=1-2
  - 850\,\mu m at z=3-4
  - Dust mass above $2 \times 10^8 \, M_\odot$

To probe the evolution of a uniform sample of dusty star-forming galaxies spanning the cosmic noon era.
Lower dust mass, far-IR luminosity than equivalent measures of the $z \sim 3.5$ population.

Significantly lower dust attenuation compared to $z \sim 3.5$ 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
Dusty galaxies selected at the same rest-frame wavelength have a similar dust mass density at $z \sim 1.5$ and $z \sim 3.5$.

Total dust mass density at $z \sim 1.5$ is roughly three times higher compared to $z \sim 3.5$.

Dust content of galaxies is governed by variation in gas content and dust destruction timescale.
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 $z\sim1-2$, 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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