

SCUBA-2 Large eXtragalactic Survey: First results

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What are Submillimetre Galaxies (SMGs)?

- First discovered by SCUBA 25 years ago (Smail et al. 1997; Hughes et al. 1998; Barger et al. 1998; Holland et al. 1999)
- Number density peaks at $z \sim 2$ (e.g. Chapman et al. 2005, Pope et al. 2005; Simpson et al. 2015)
- Massive (Swinbank et al. 2004; Hainline et al. 2011; Michalowski et al. 2012)
- Gas-rich (Greve et al. 2005; Engel et al. 2010; Carilli et al. 2010; Bothwell et al. 2013)
- Star-formation rates 100-1000 solar masses per year (e.g. Magnelli et al. 2012)
- Candidate population for the progenitors of massive elliptical galaxies today

Why 'Submillimetre' galaxies?

- Dusty Star-Forming Galaxies
- Approximately 20% of SMGs are not detected at optical/near-infrared wavelengths
- UV light from young massive stars absorbed by dust and re-emitted in far-infrared
- Redshifted far-infrared observed at submillimetre wavelengths
- Negative k-correction in the submm (Blain & Longair 1993) - allows for a nearly uniform luminosity selection function for a flux limited survey for dusty galaxies out to $z \sim 10$.

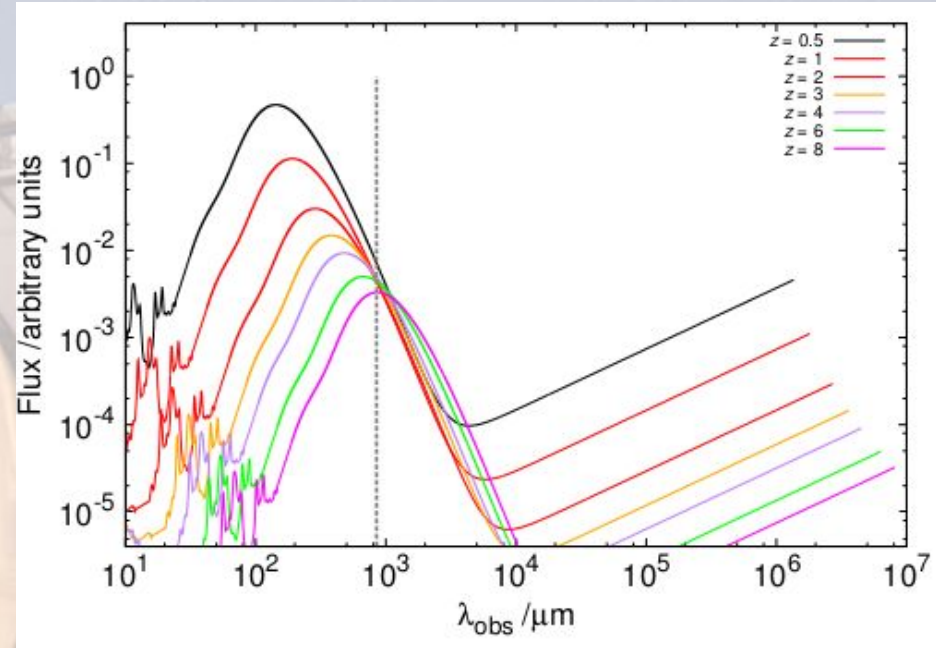


Figure from Thomson (2013)

What is the SCUBA-2 Large eXtragalactic Survey?

- JCMT Large Program; PIs James Geach (UK) and Yoichi Tamura (Japan)
- Wide survey extragalactic survey at 850 μ m with an area of 10 sq degrees
- Moderate depth with target sensitivity 1-sigma = 2mJy
- Split over two deep fields covered by the the Subaru/Hyper Suprime-Cam (HSC) Survey:
 - XMM-LSS (~ 7 sq degrees)
 - E-COSMOS (~3 sq degrees)

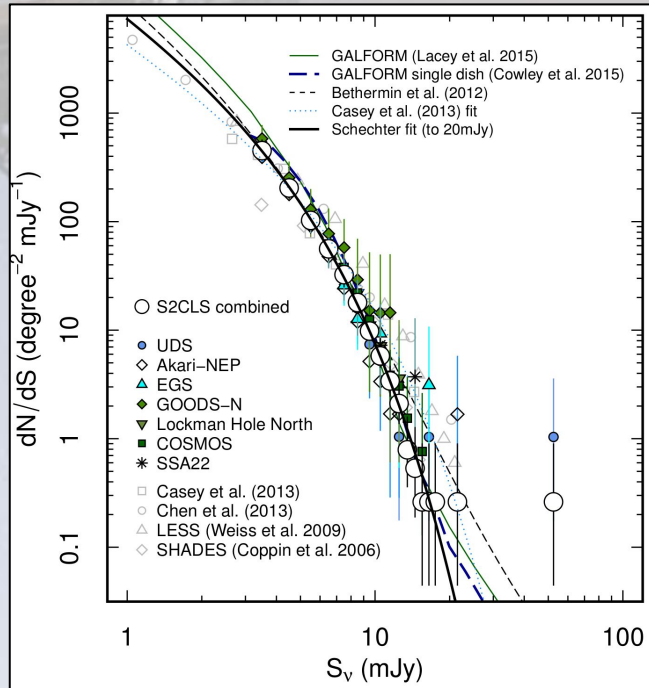
Current status

E-COSMOS observations are ongoing

XMM-LSS observations completed with 170 hours of observations

- Target area mapped to completion
- Actual sensitivity 1-sigma ~ 5mJy

Science Drivers: Probing the bright end of the 850um number counts



S2CLS (Geach et al., 2017):

- Upturn in 850um counts at 10mJy due to galactic sources of 850um emission and gravitationally lensed sources
- Only 3 > 20mJy sources detected
- Provide valuable constraints for galaxy formation models

The wide area of S2LXS allows us to detect larger numbers of rare, bright SMGs and to place tighter constraints on the bright-end of the 850um number counts.

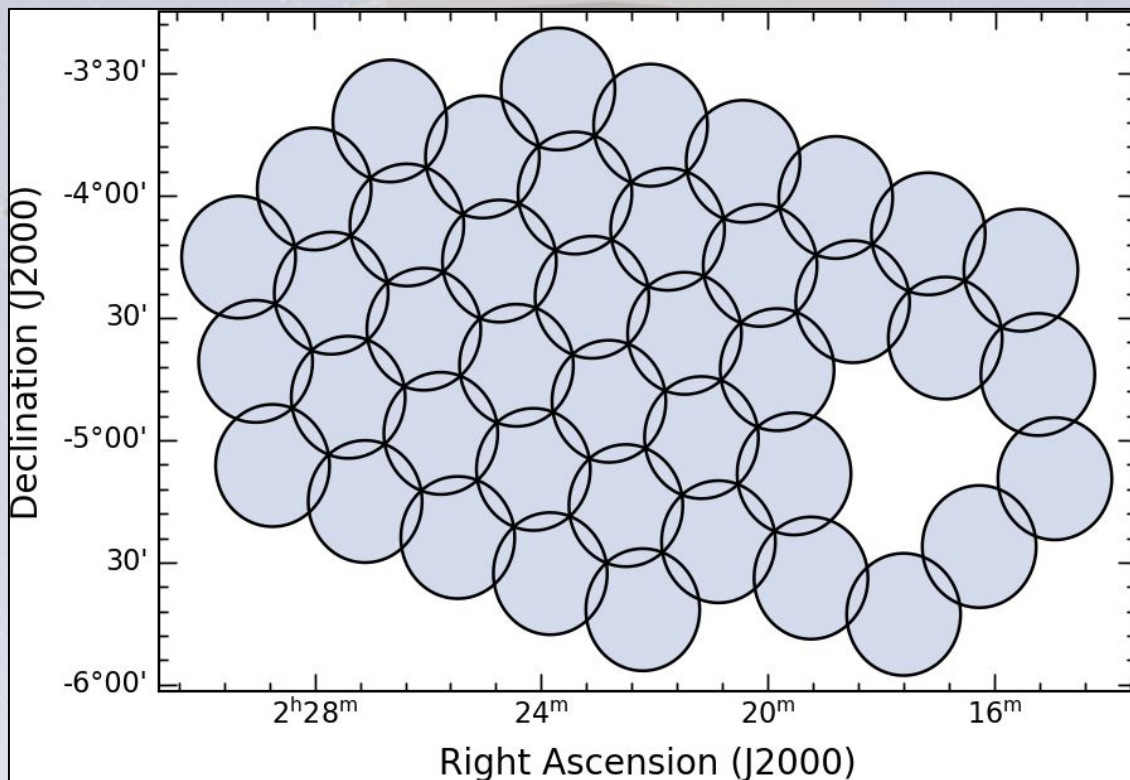
Figure reproduced from Geach et al., 2017

Science Drivers: Unveiling a distant population of SMGs

- *Herschel* SPIRE band (250um/350um/500um) preferentially select galaxies at $z < 4$
- At 850um SCUBA-2 is more sensitive at $z > 4$ so S2LXS is ideally placed to detect high redshift SMGs.
- Sources not detected in *Herschel* bands (SPIRE dropouts) but detected in S2LXS are expected to be at $z > 4$.

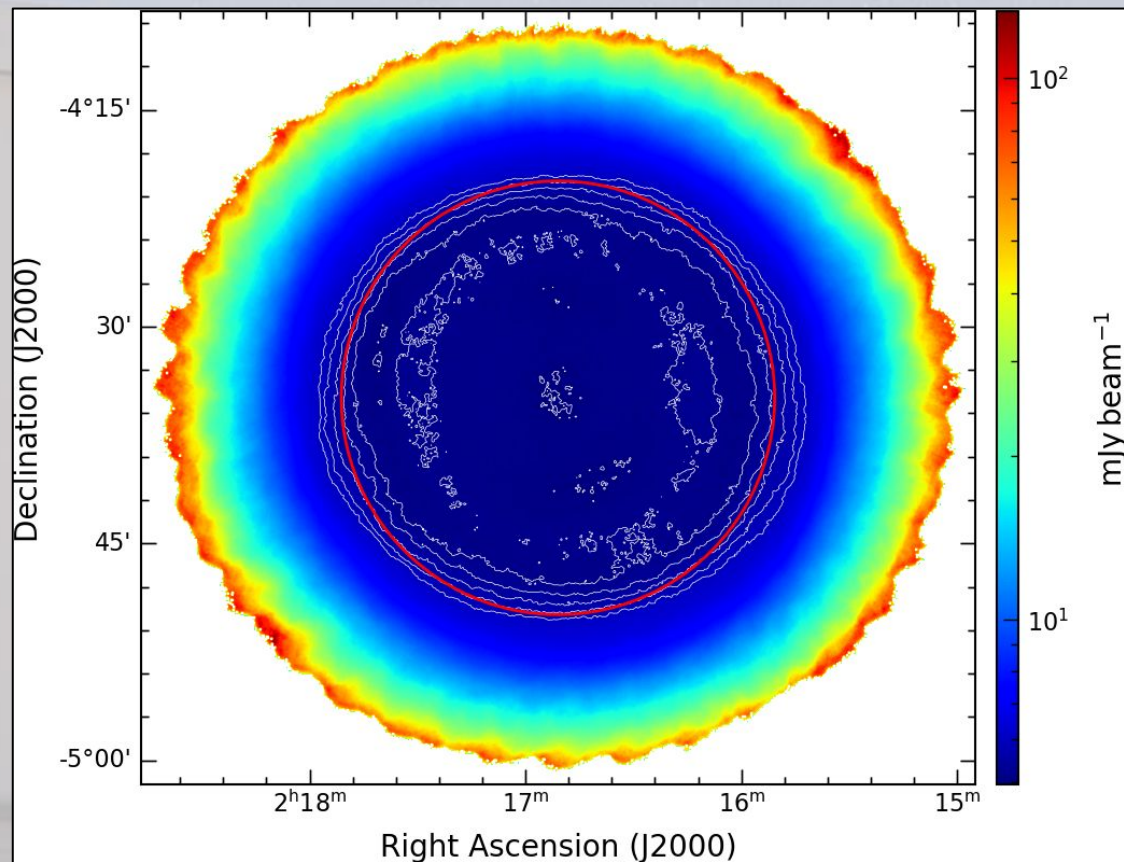
The wide area of S2LXS allows us to detect dust emission from intrinsically rare, $z > 4$ objects at 850um, which may be undetected in *Herschel* bands.

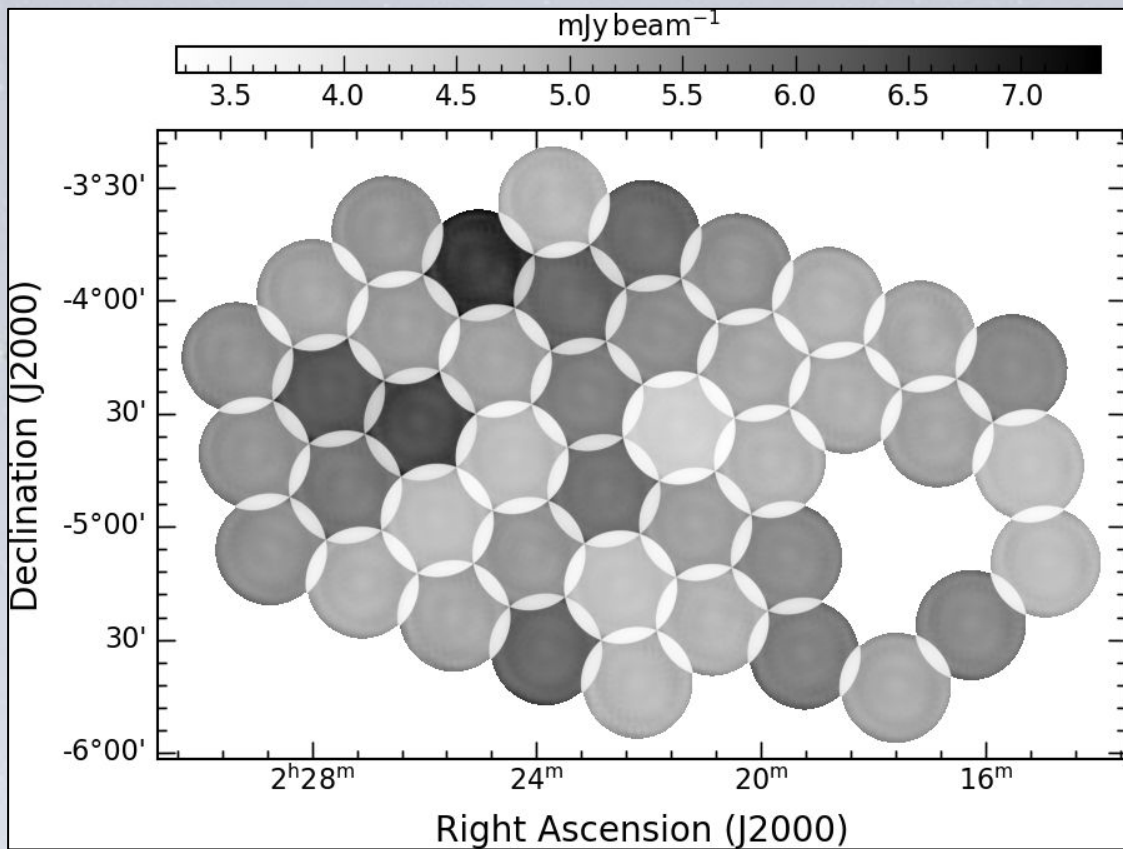
SCUBA-2 Large eXtragalactic Survey - XMM-LSS Field



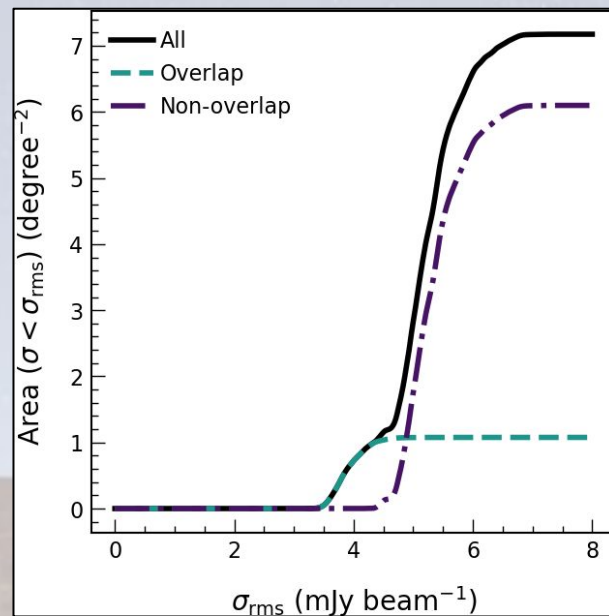
- PONG mapping strategy
- 42 hexagonally tiled PONG1800 maps
- Region corresponding to the S2CLS-UDS field (ra = 34.4542 deg, dec = -5.0986 deg) is not re-observed

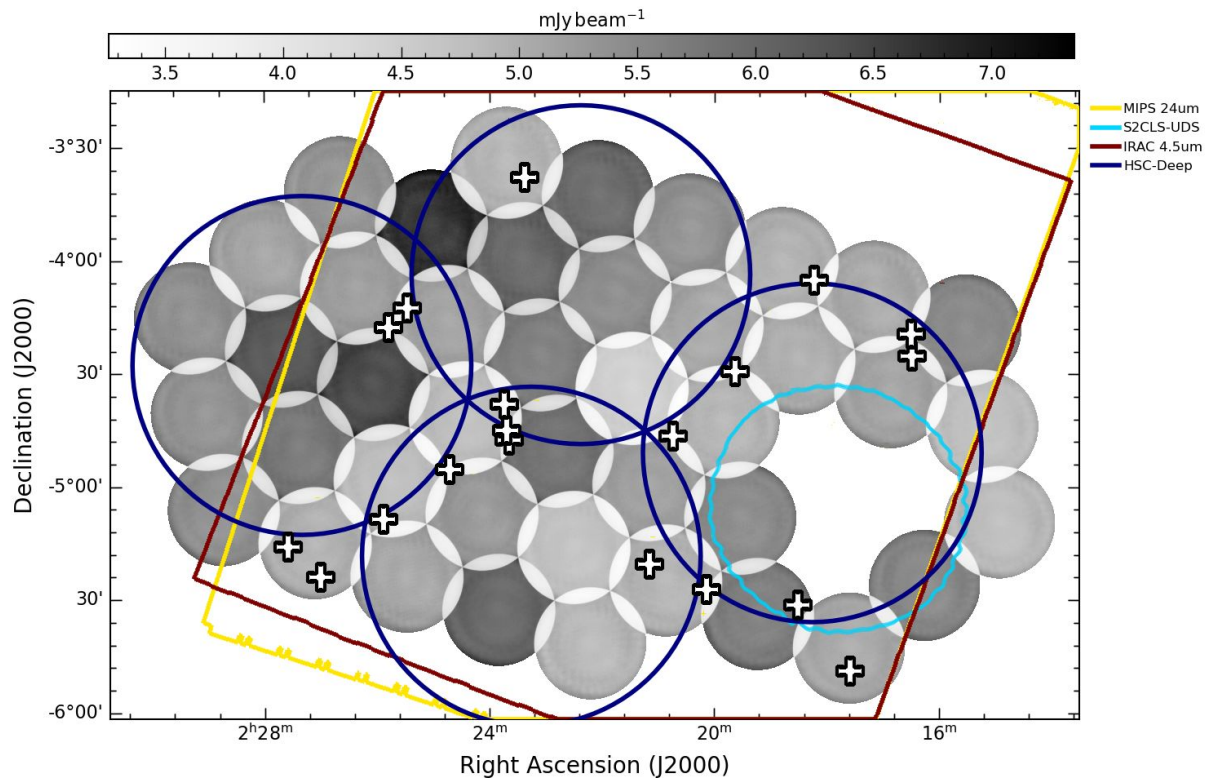
- PONG scans (5) combined with inverse variance weighting to create individual stacked PONG tiles
- PONG tiles cropped to diameter 1800'' (red circle)
- Cropping removes overscan regions which have less exposure time and higher instrumental noise.



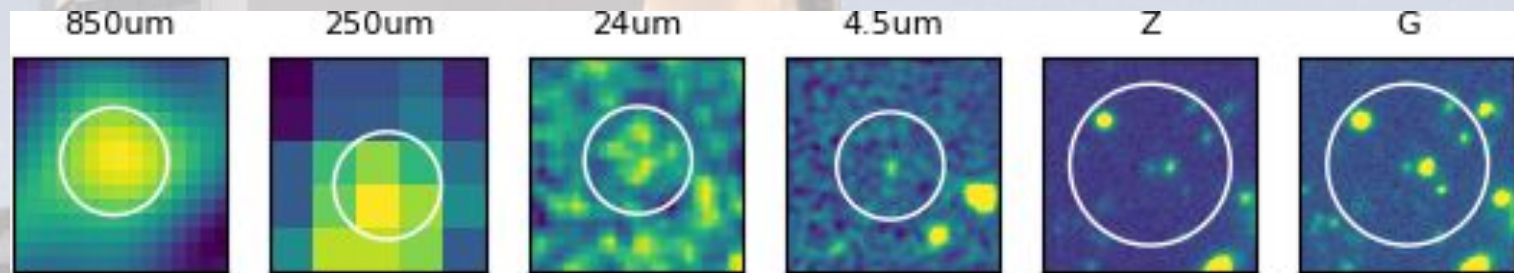
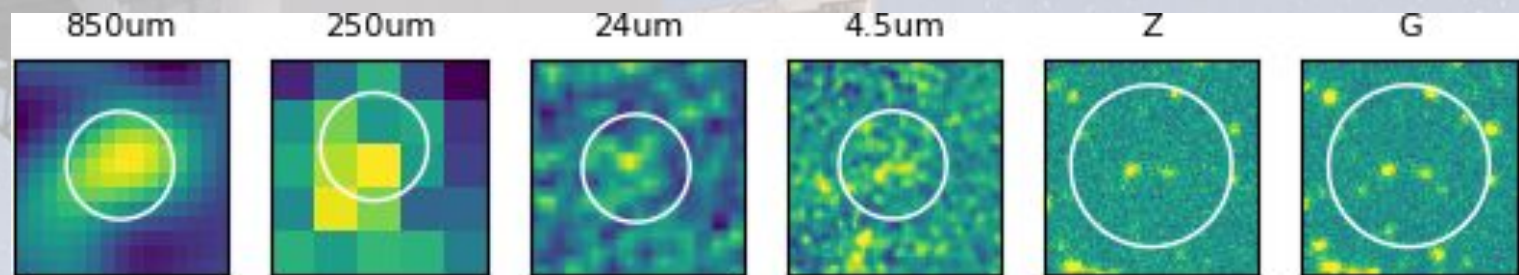
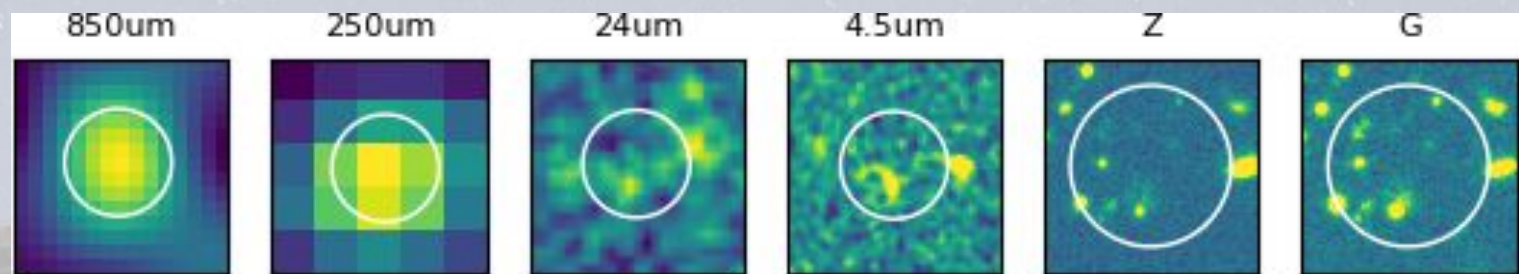


- PONG tiles combined with inverse variance weighting to create the S2LXS XMM-LSS mosaic. Area ~ 7 sq degrees.
- Median sensitivity 1-sigma $\sim 5\text{mJy}$.
- Median sensitivity in overlap regions 1-sigma $\sim 4\text{mJy}$.



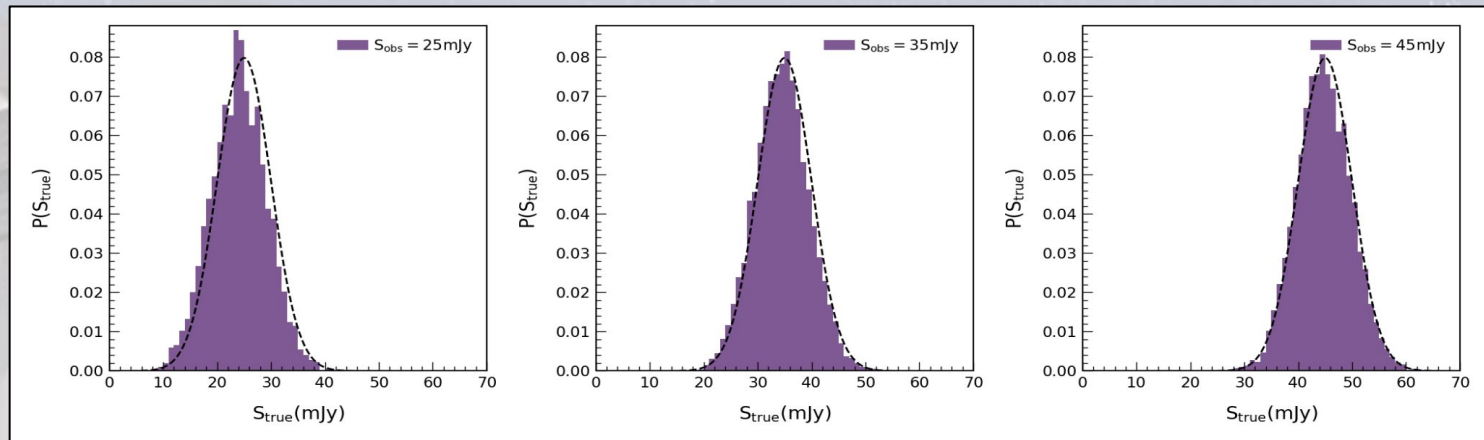


- Formal detection threshold for S2LXS XMM-LSS > 5 sigma.
- At >5 sigma the false detection rate is $\sim 15\%$.
- Detect 19 sources at > 5 sigma (white crosses) with flux densities > 19 mJy.

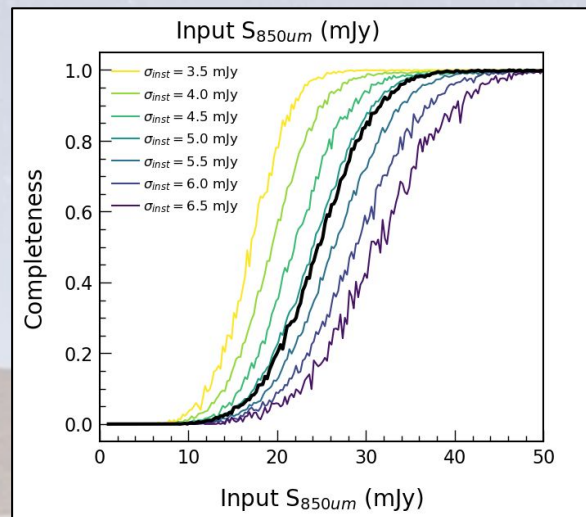
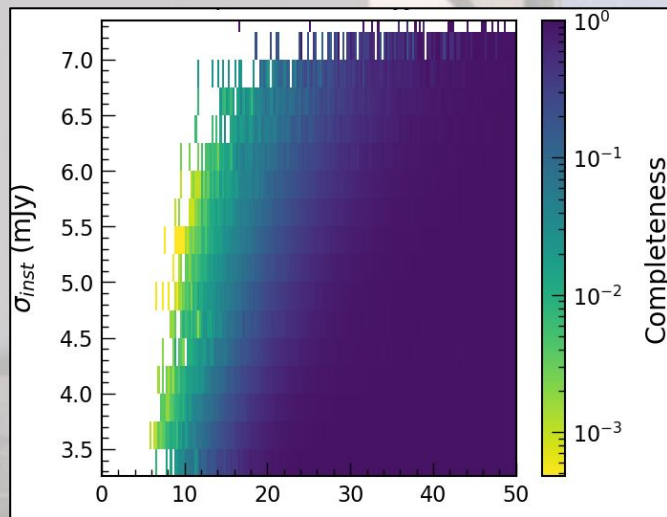


Corrections

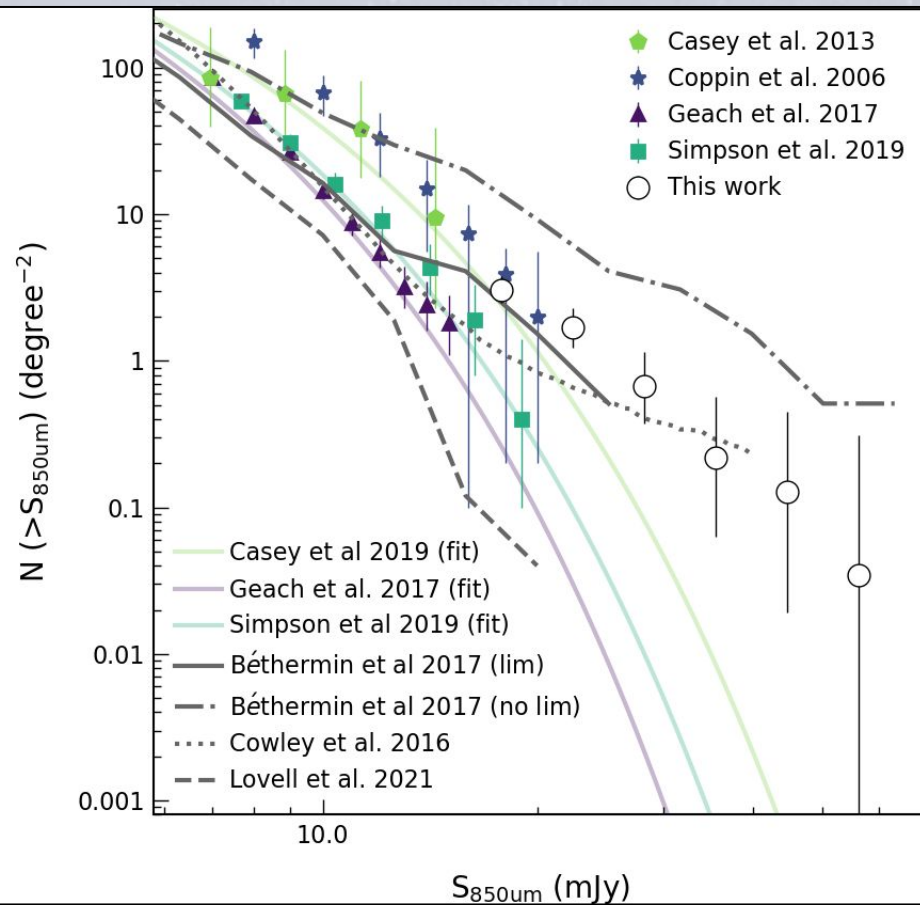
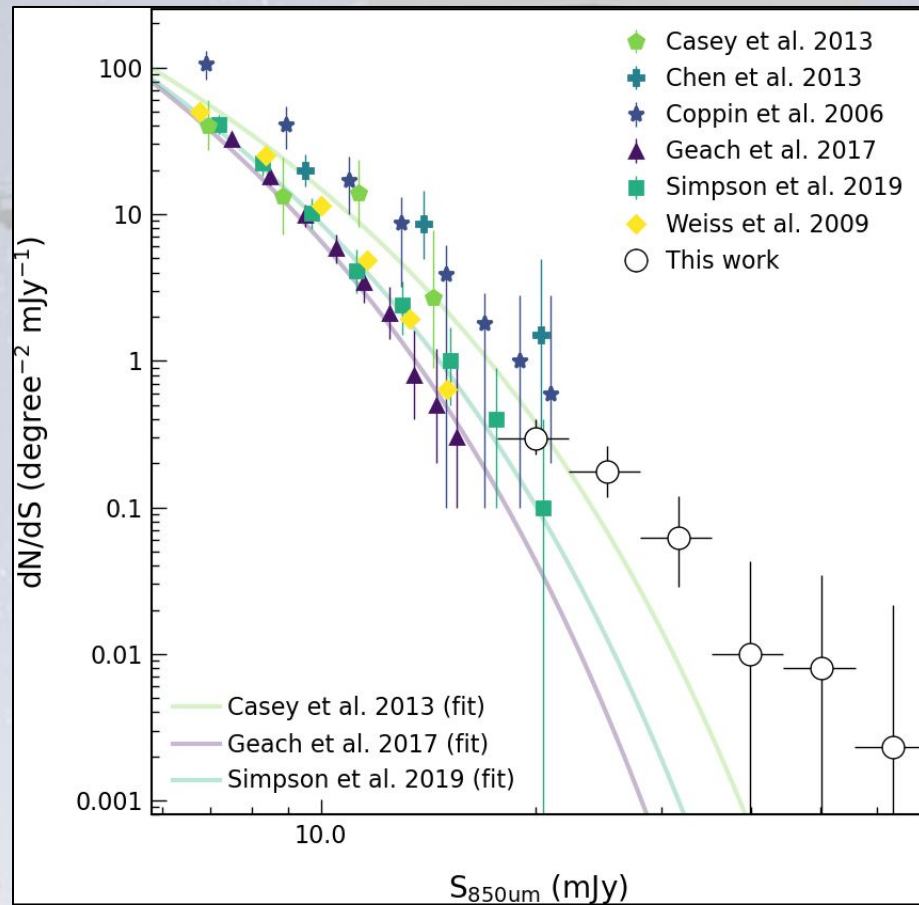
Flux Boosting



Completeness



Measurement of 850um number counts



Next steps

- Test number counts corrections - initial results are promising
- Identify counterparts to the 19 sources in our 5 sigma catalogue
- Explore the nature of these $>20\text{mJy}$ sources - local/lensed?

Candidate 850 μm riser ($S_{850} > S_{500}$) & potential 'G' band dropout.

