STUDIES

SCUBA-2 Ultra Deep Imaging EAO Survey

Wei-Hao Wang (王 為豪, ASIAA)
and STUDIES Team

Outline

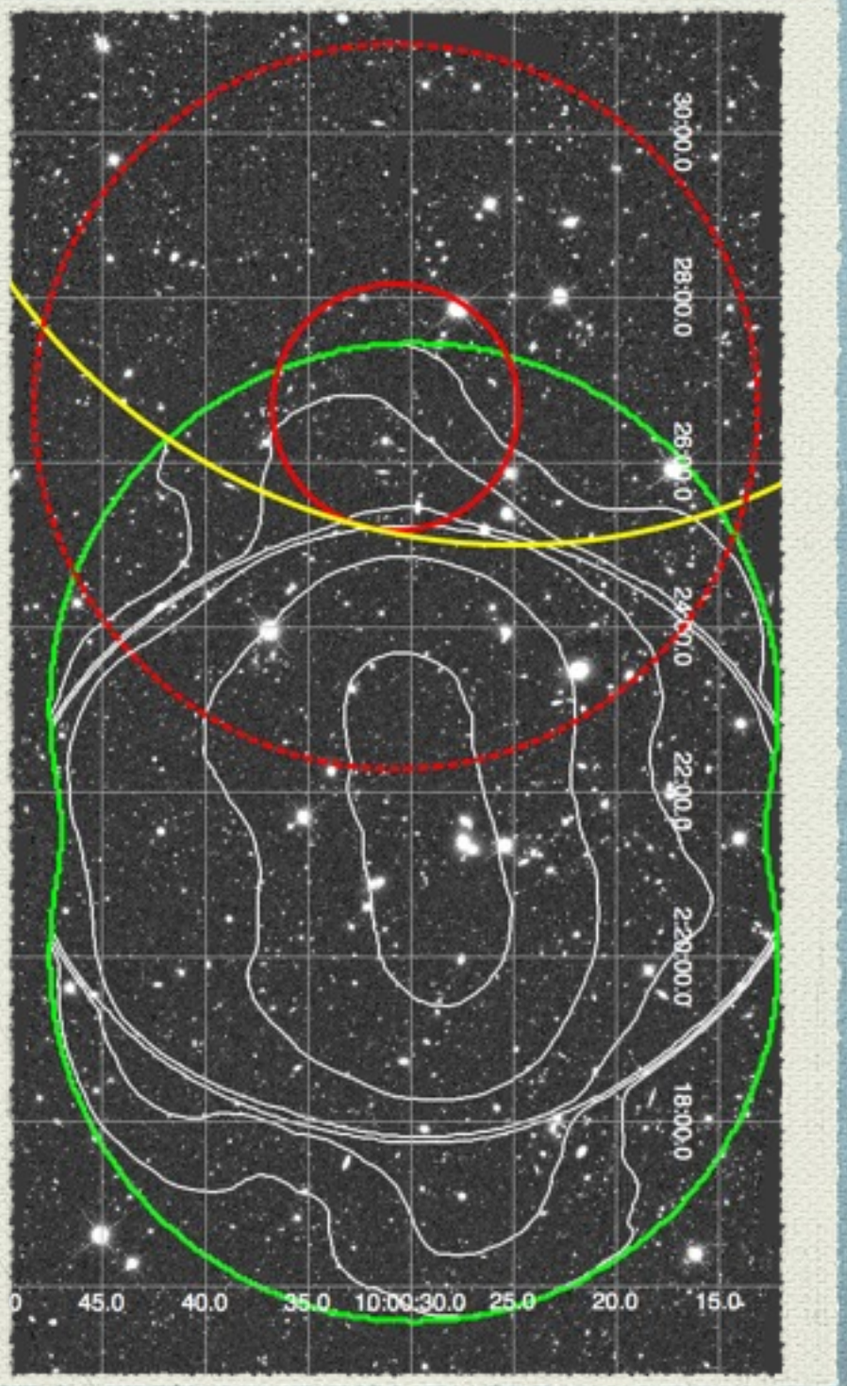
- Survey description
- Scientific background
- Science cases
- The STUDIES team

STUDIES in a nutshell

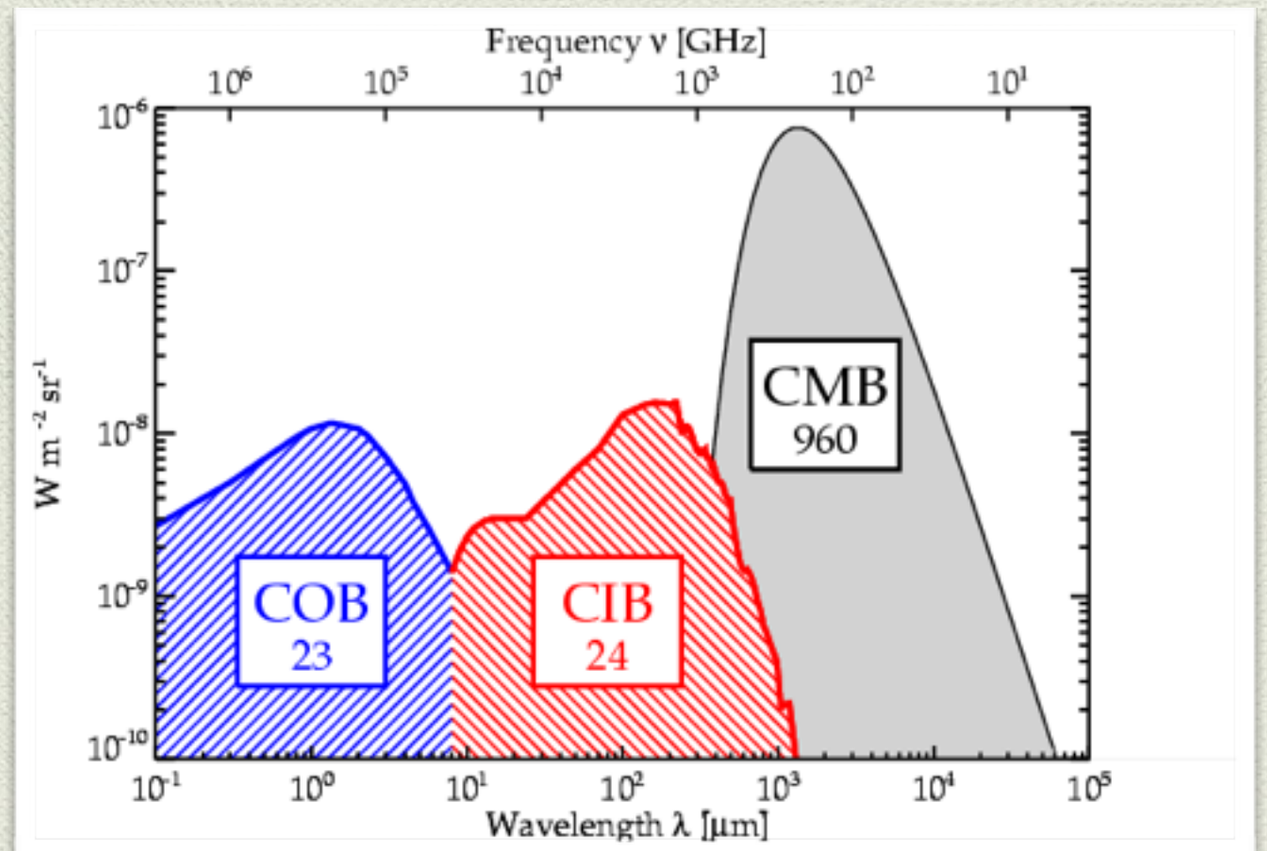
- One of the seven EAO JCMT Large Programs.
- A confusion limited SCUBA-2 450 μm map, deepest ever far-IR sensitivity limit.

Survey Description

- Pointing center: 10:00:30.7, +02:26:40.0 (center of COSMOS, norther edge of the CANDELS region)
- 330 hr of observations under the best submillimeter weather of Maunakea.
- single Daisy pointing ($D = 3''$ ultradeep core, $D = 10''$ deep outer region)
- $\sigma_{450\mu m} < 0.6$ mJy in the ultradeep core, $\sigma_{450\mu m} \lesssim 1$ mJy full map.
- Execution period: 2015–2019



Scientific Background



Dole et al. (2006)

- The optical and IR backgrounds have comparable strengths.
- Half of the activities (star formation + black hole accretion) in the universe are hidden in dust.

Great Observatories Origins Deep survey-North (GOODS-N)

Hubble Deep Field (HDF)

Herschel SPIRE: 250 µm, 350 µm, 500 µm

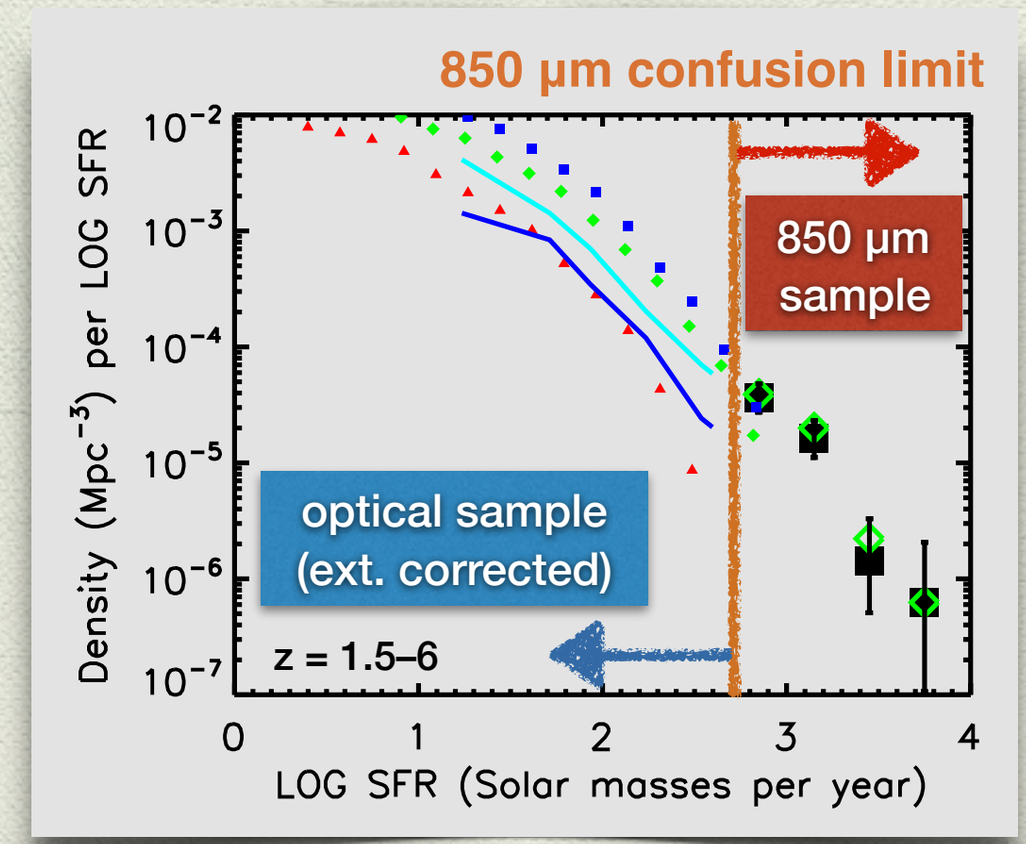
250 µm, 350 µm, 500 µm

Ks, IRAC Ch1+2, IRAC ch3+4

Effect of Confusion

- Single-dish survey instruments are all limited by confusion, and can only detect the brightest galaxies.
- Deepest SCUBA-2 850 μm surveys can only resolve < 30% of the background.
- Deepest Herschel 250-500 μm surveys can only resolve ~15% of the background.
- The majority of the far-IR background comes from faint objects below the confusion limits.
- Lensing surveys can detect fainter sources, with smaller sample sizes and uncertainties in lensing amplification correction.

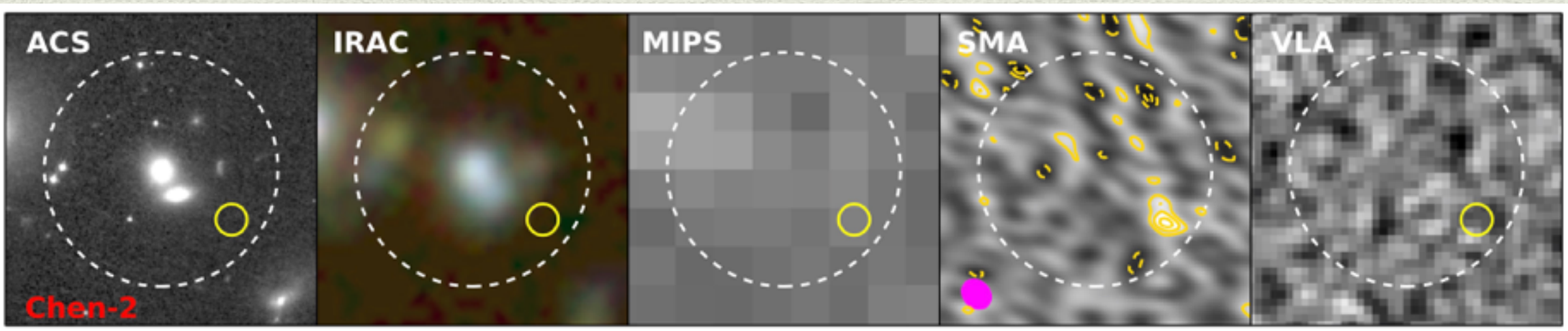
Why Care about Faint Objects?



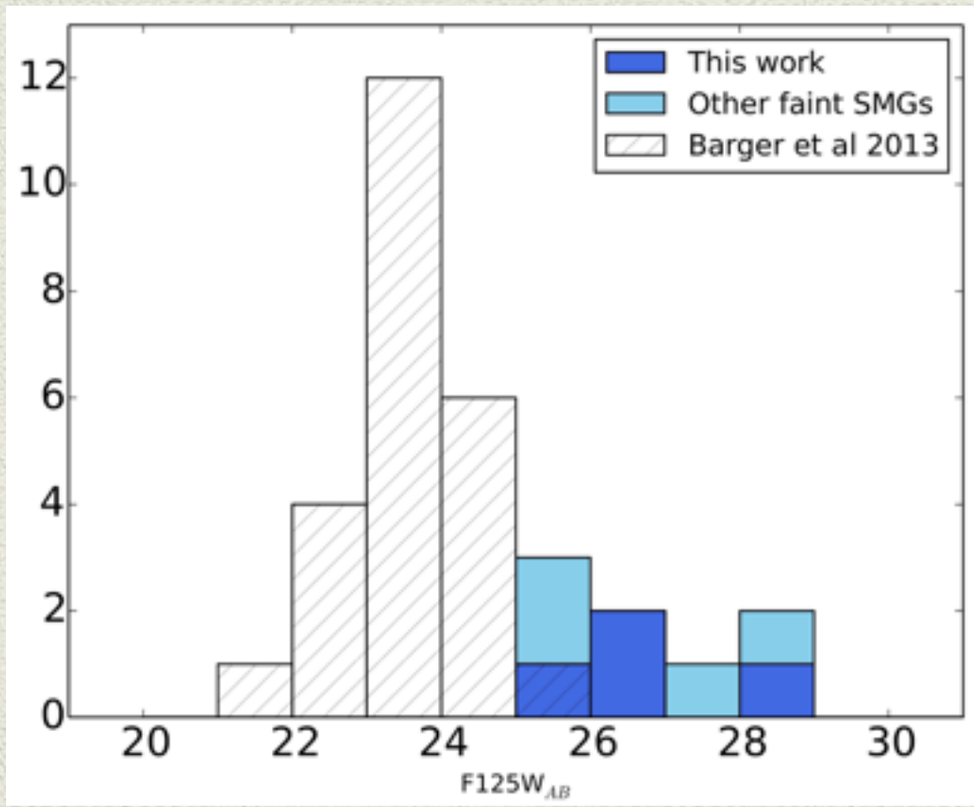
Barger et al. (2014)

- Faint submm sources are responsible for most of the obscured star formation in the universe.
- Are faint submm sources already present in the optical sample?

Are Faint Submm Sources Dusty?



Chen et al. (2014)

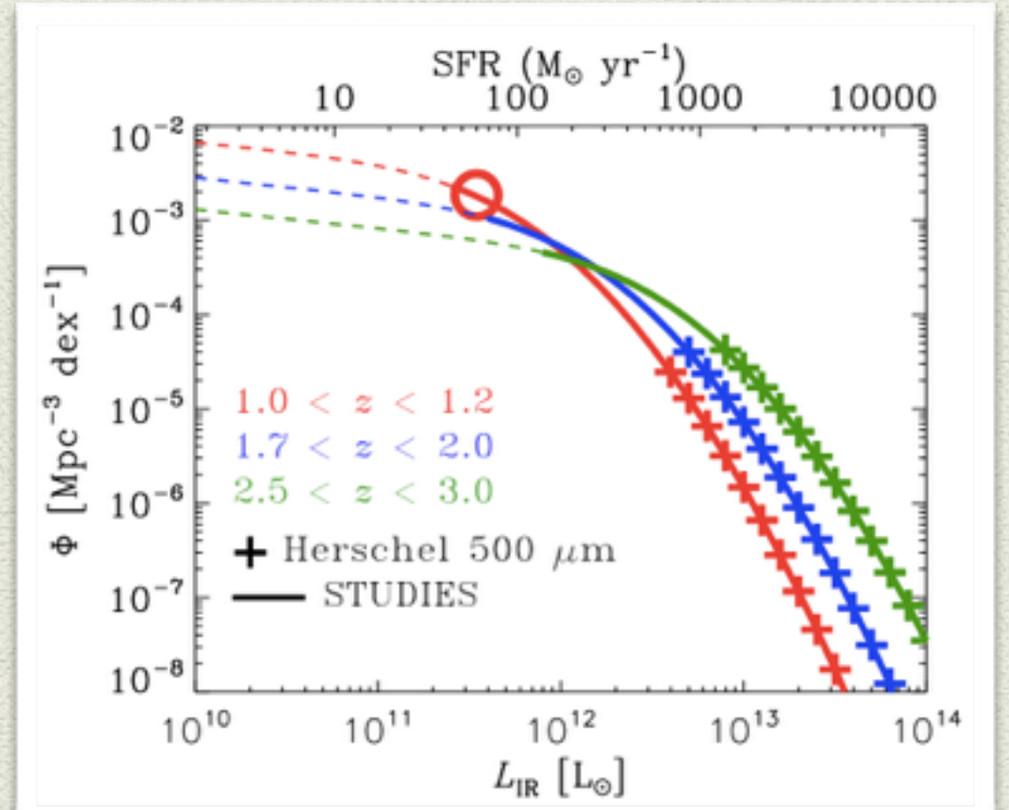


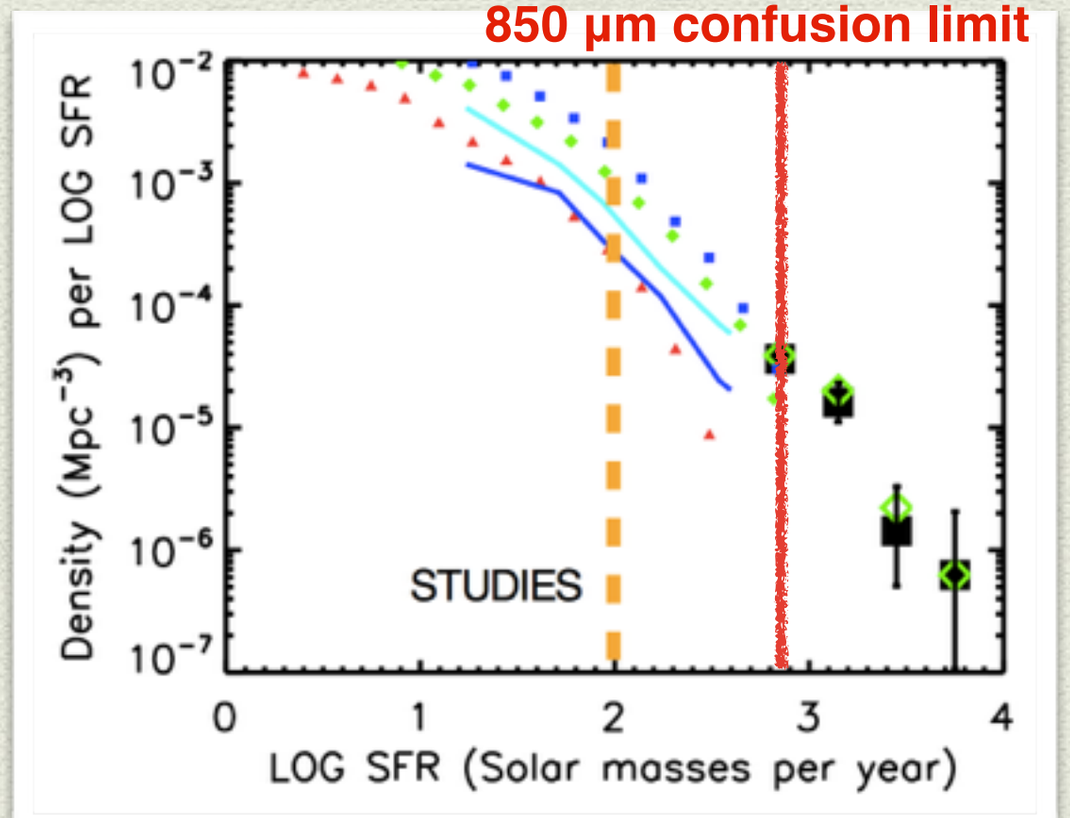
- Many lensed submm sources are extremely faint in the optical/near-IR.
- Bad news for optical people, good for us.
- Need larger samples to further investigate this.

SCUBA-2 450 μm Comes to Rescue

- SCUBA-2 is the first/only instrument that can map at 450 μm efficiently.
- Resolution much higher
  SCUBA-2 450 μm: 8″
  SCUBA-2 850 μm: 15″
  Herschel SPIRE 250-500 μm: 20″-40″
- SCUBA-2 450 μm is much less confusion limited.
- Can resolve a much fainter (denser, $\lesssim 10^5$ sources/deg^2) population if integrating for sufficiently long.

STUDIES:
The First Confusion Limited 450 μm Survey





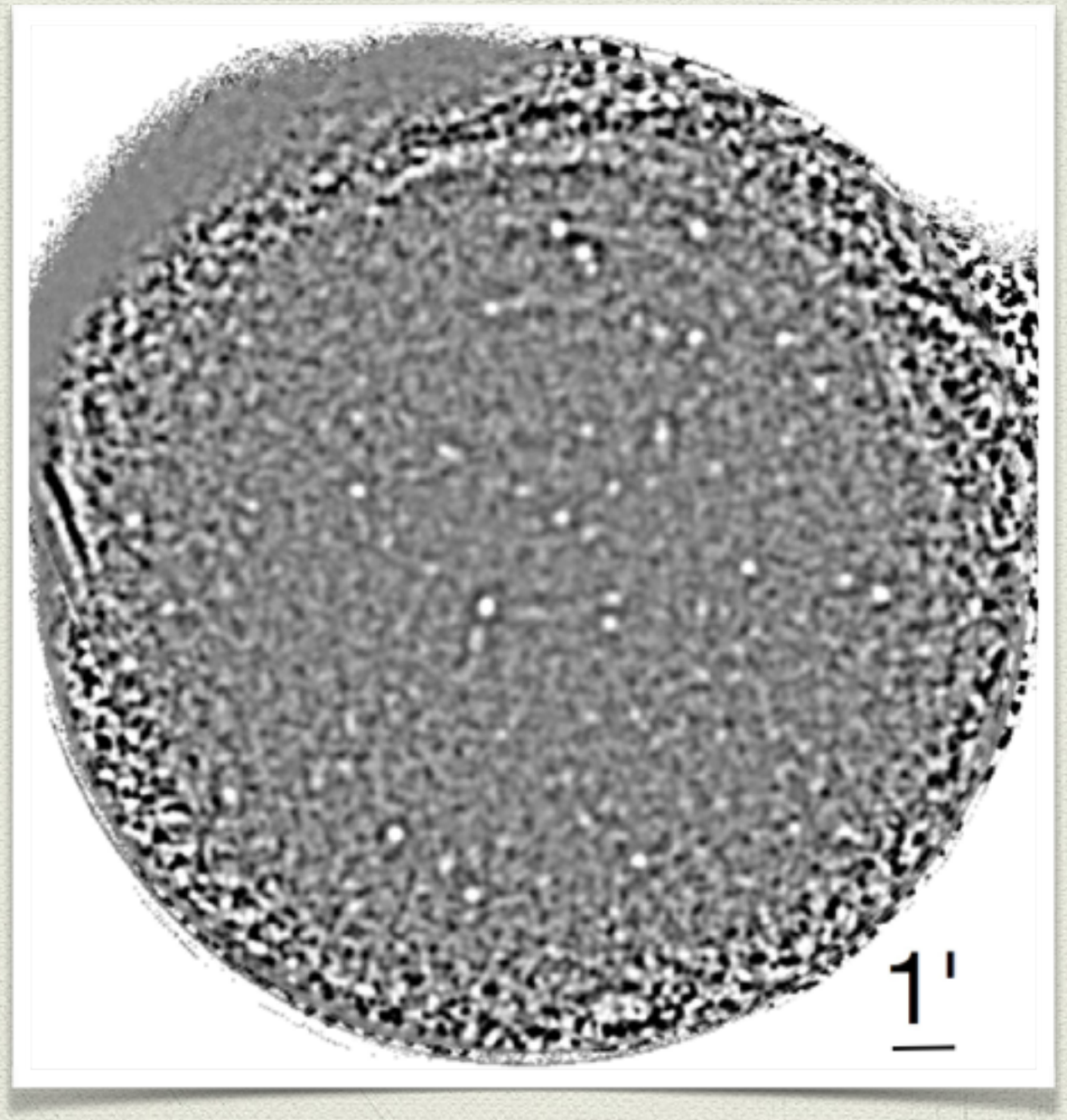
- STUDIES will detect the most typical members in the dusty galaxy population, key star formers in the history of the universe.
- STUDIES will significantly overlap, for the first time, with the SFR range probed by optical surveys.

Science Cases of STUDIES

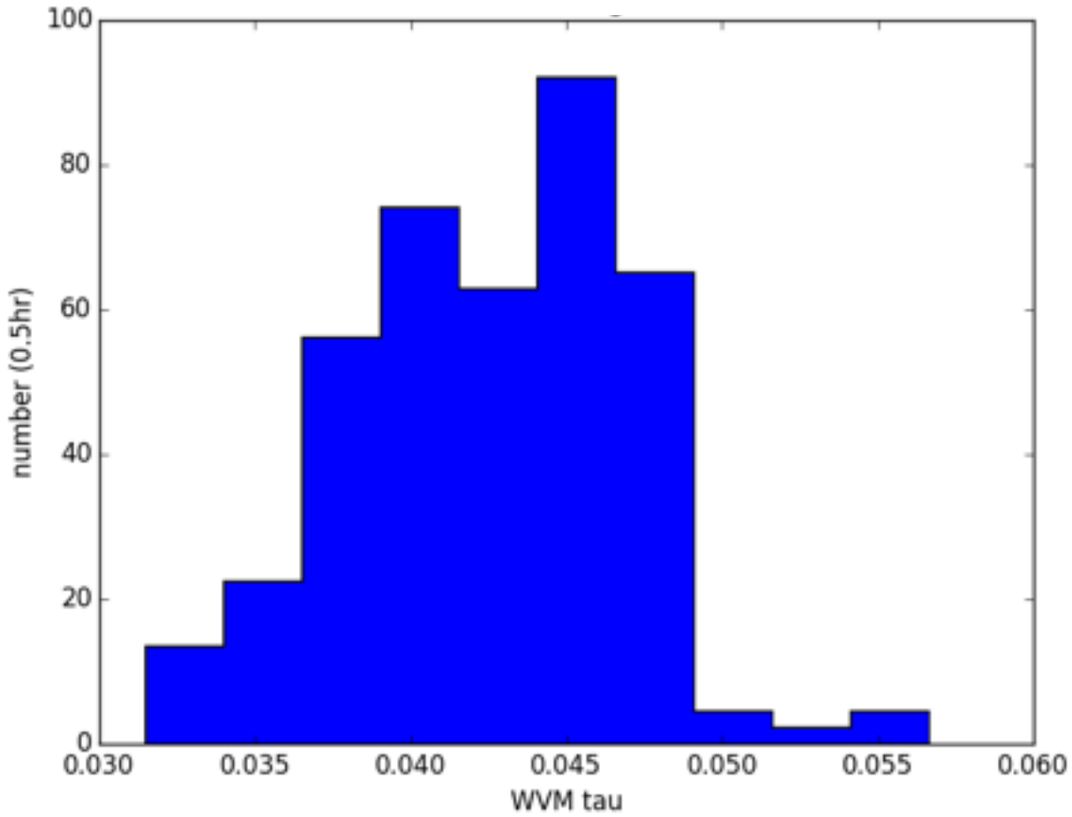
- Basic statistical properties: number counts, redshift distribution, luminosity functions…
- Nature of faint dusty star forming galaxies: disk vs merger (via morphology with HST or ALMA images), AGN fraction…
- Far-IR properties of optically selected galaxies: obscured vs unobscured star formation, nature of extinction in the rest-frame UV…
- Far-IR color selection of high-z objects
- Star formation and accretion history of the universe

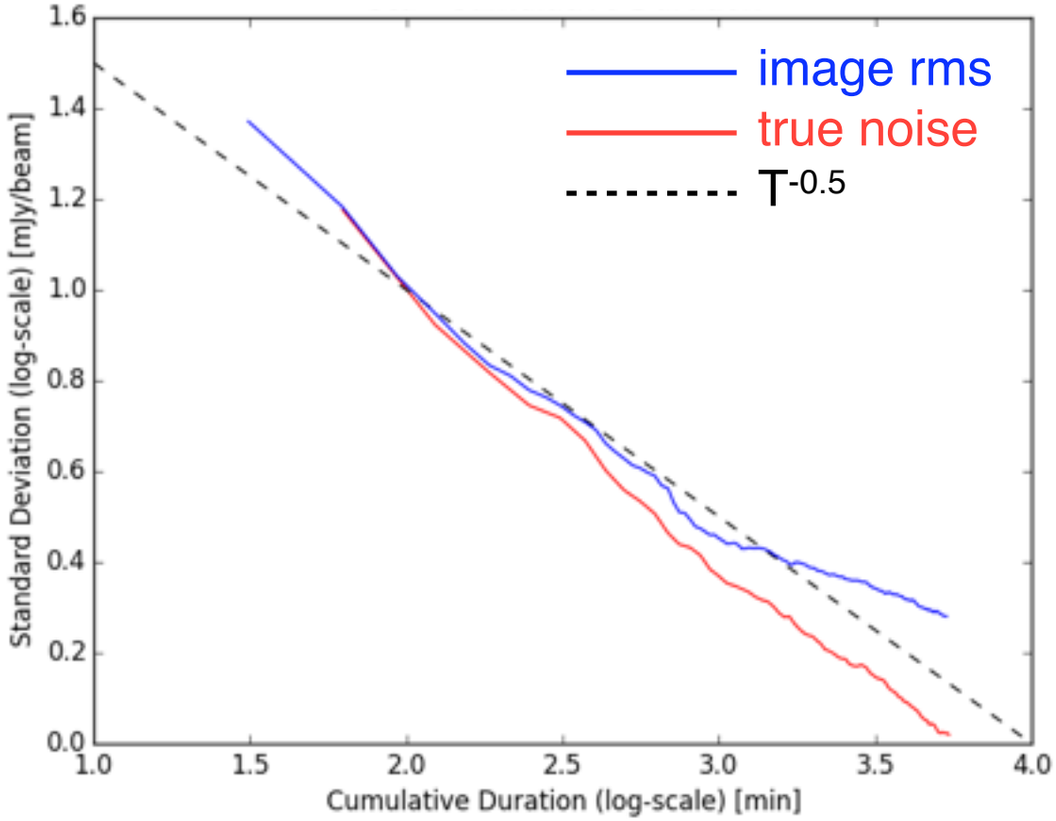
Current Progress

- 110.5 hr of observations executed (33% complete)
- rms noise of 1.0 mJy at the map center.
- noise consistent with prediction of SCUBA-2 ITC for band-1 weather.



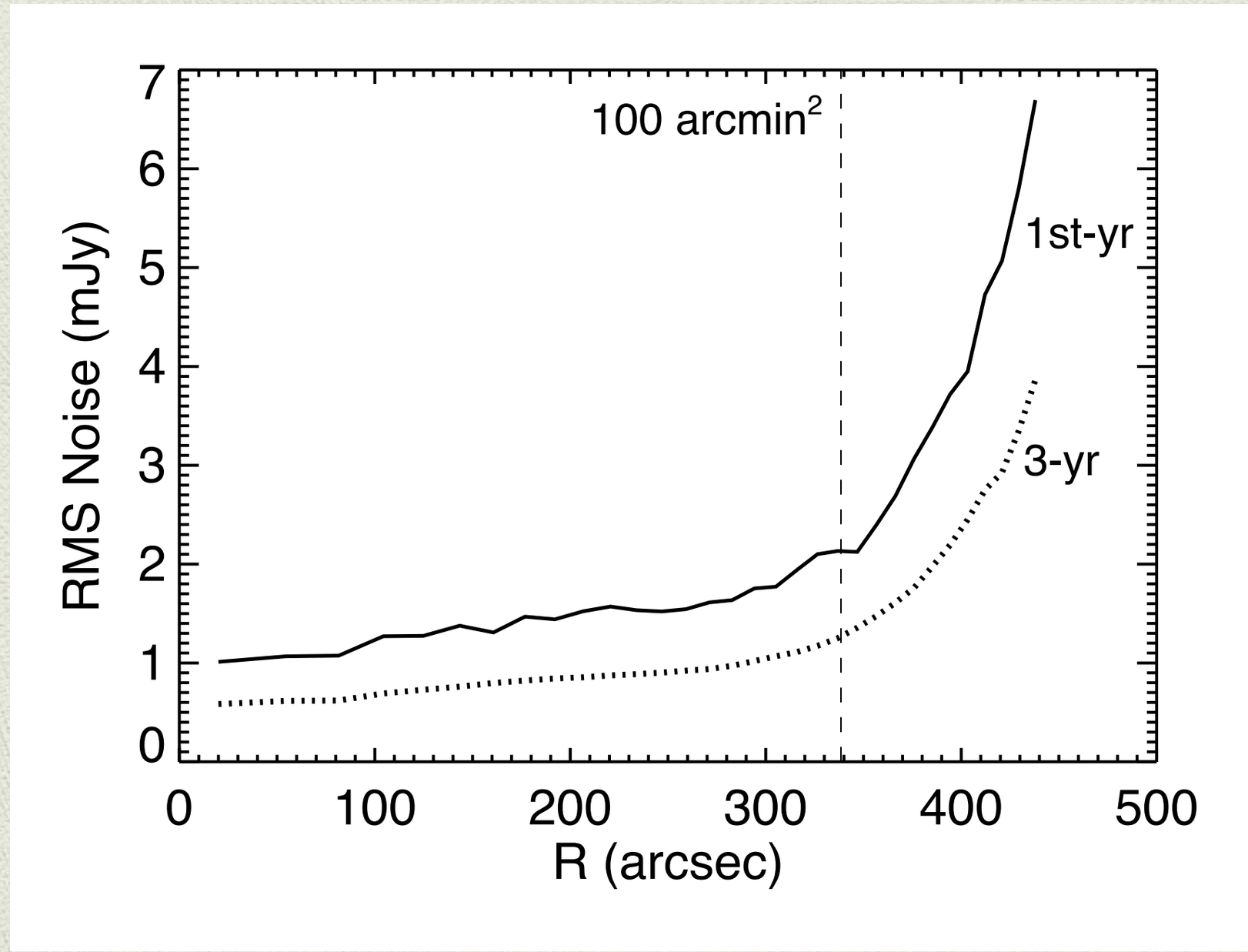
Data Quality





thanks to the El Niño!

Sensitivity



The STUDIES Team

- project coordinators:
  CA – Scott Chapman
  CN – Xianzhong Zheng
  JP – Tadayuki Kodama
  KR – Hyunjin Shim
  UK – Ian Smail
  TW – Wei-Hao Wang
- 97 members:
  CA: 4
  CN: 19
  KR: 10
  JP: 15
  UK: 39
  TW: 10