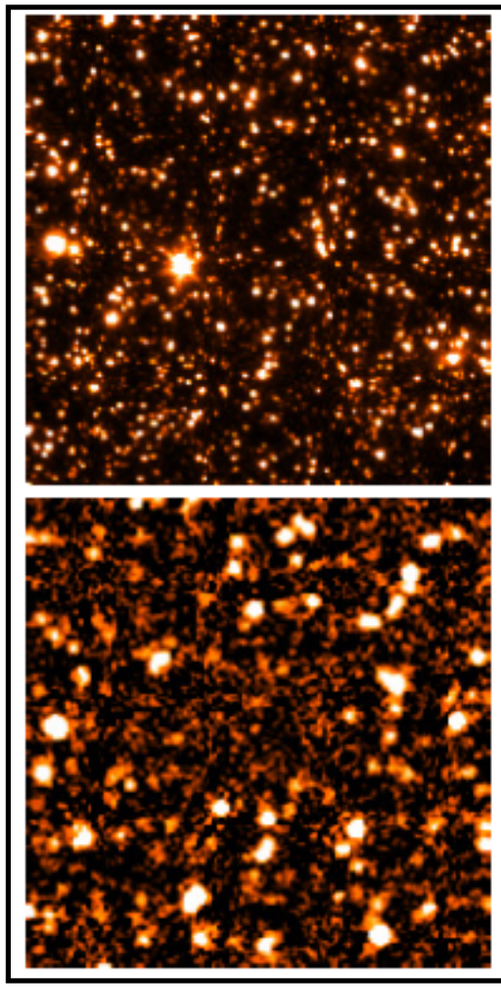
Prior source extraction in Herschel/SPIRE (confusion-limited astronomical) images (Wang et al. 2015)

Tao Wang and the ASTRODEEP consortium

Outline

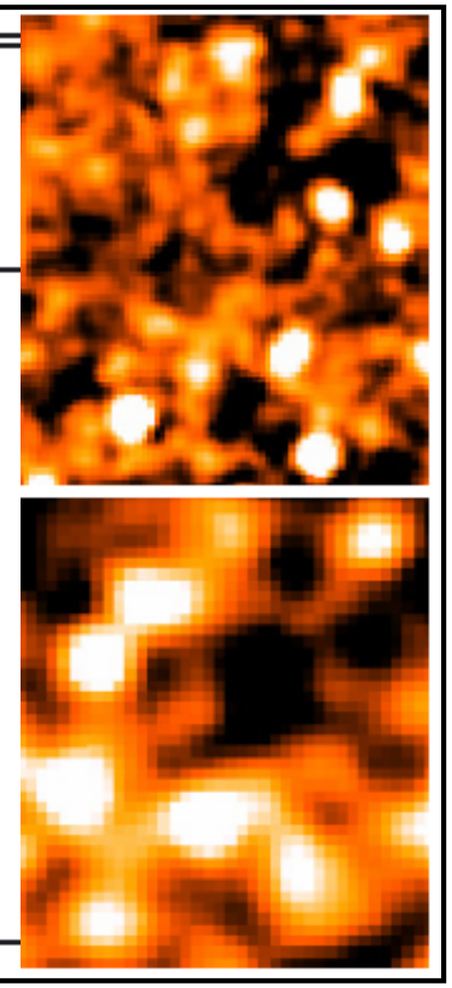
- Why a new source extraction method is needed?
- What is the optimum number of priors that should be used?
- How to accurately measure flux errors/uncertainties?
- How to improve measurements for non-clean sources?
- How to identify sources that are not in the prior list?

Why a new source extraction method is needed?



GOODS-north

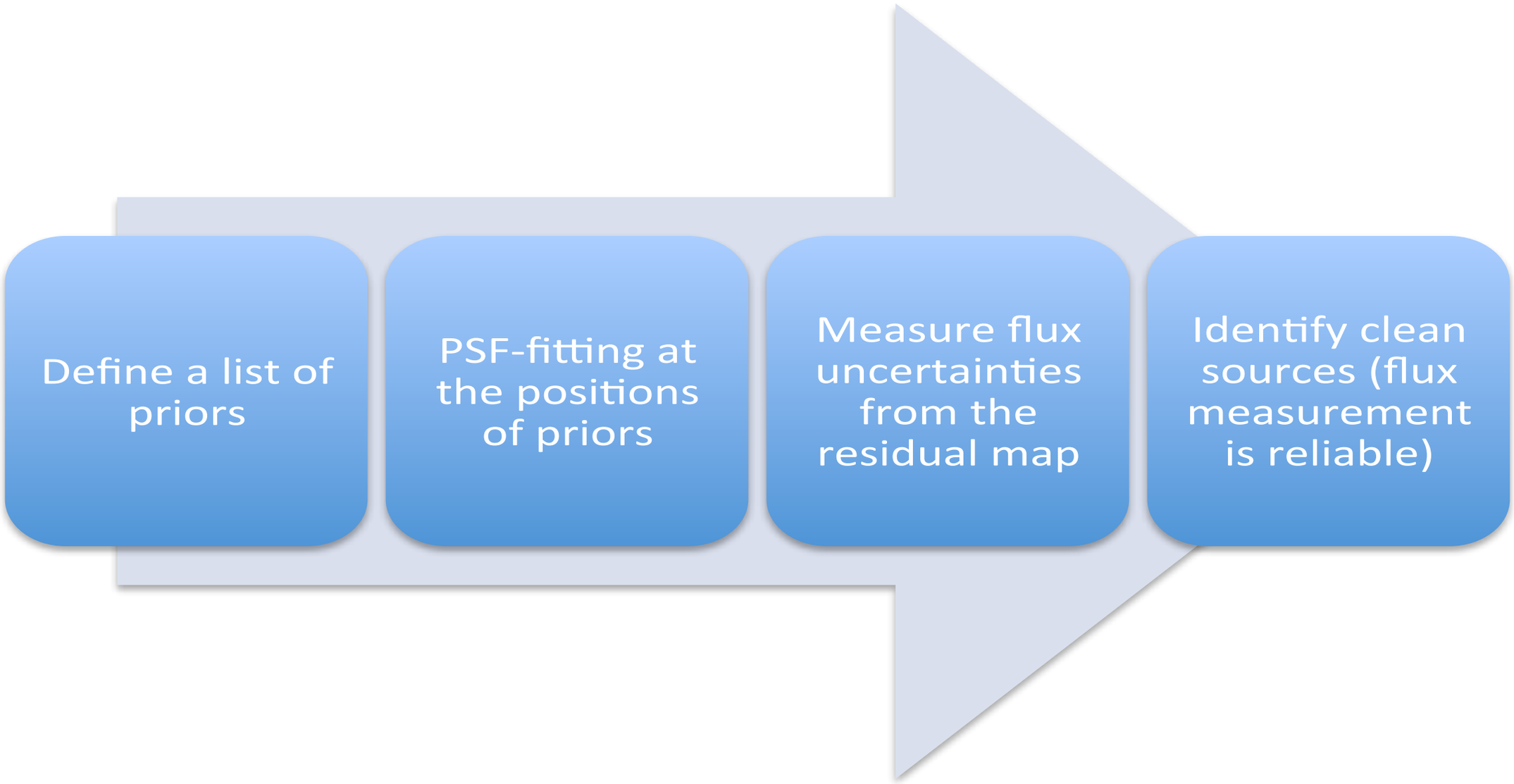
λ (μm) (1)	*FWHM* ($''$) (2)	Depth (3)	All sources Nb (4)	N_z^{spec} (5)	% z_{spec} (6)	% z_{all} (7)	Clean + z Nb (8)	% z_{sp} (9)
3.6	1.6[a]	17 μJy	24 476	3489	14	55	–	–
4.5	1.6[a]	24 μJy	19 957	3445	17	63	–	–
5.8	1.7[a]	129 μJy	8182	2648	32	76	–	–
8	2.0	150 μJy	6020	2324	39	84	–	–
16	4.0	32 μJy	1297	870	67	90	–	–
24	5.7	21 μJy	2575	1284	50	91	–	–
70	18.0	2.4 mJy	150	118	79	83	94	98
100	6.7	1.1 mJy	1095	693	63	93	959	72
160	11.0	2.7 mJy	781	517	66	94	355	77
250	18.1	5.7 mJy[b]	374	251	67	94	194	80
350	24.9	7.2 mJy[b]	173	114	66	94	91	78
500	36.6	9 mJy[b]	24	11	46	96	11	73
All	–	–	1263	776	61	89	990	72



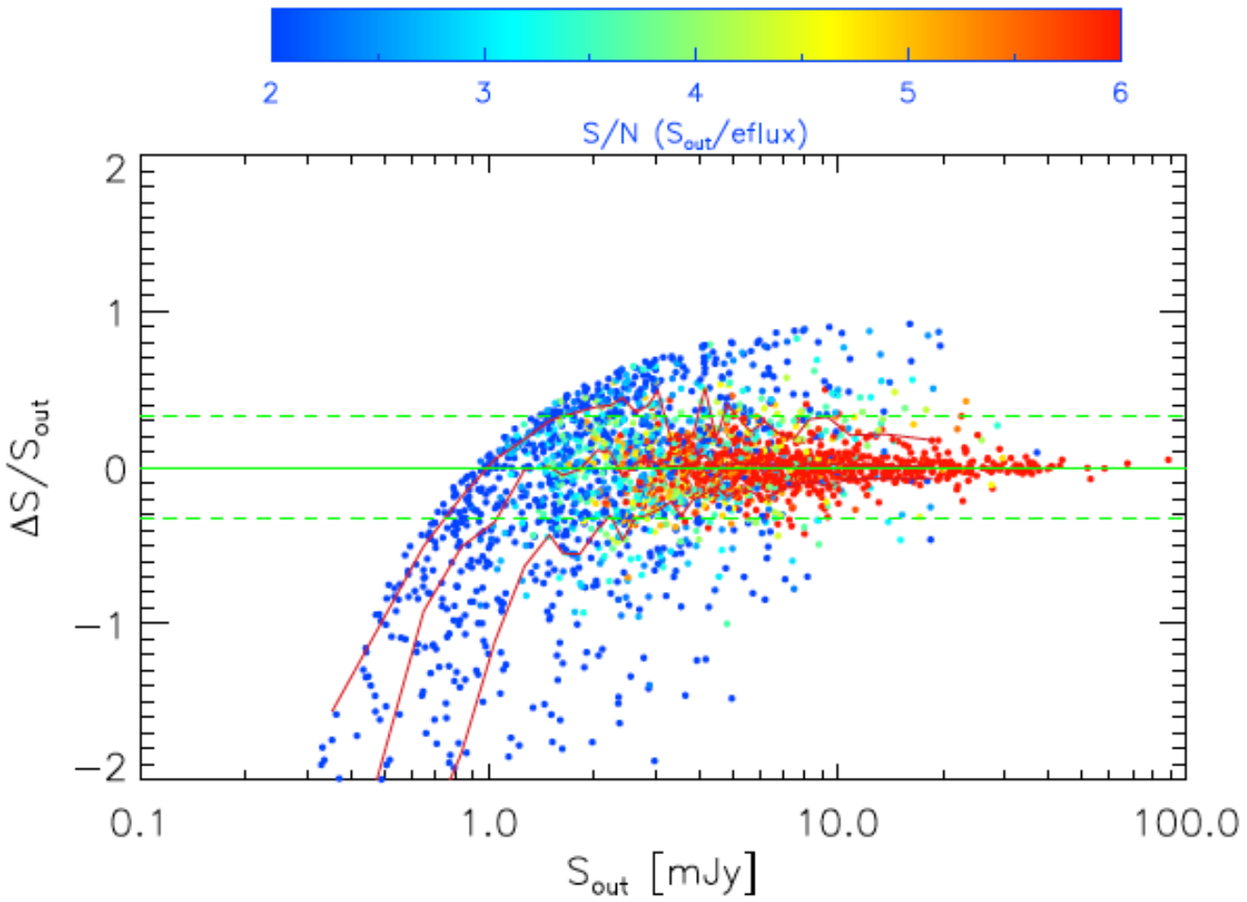
Elbaz et al. (2011)

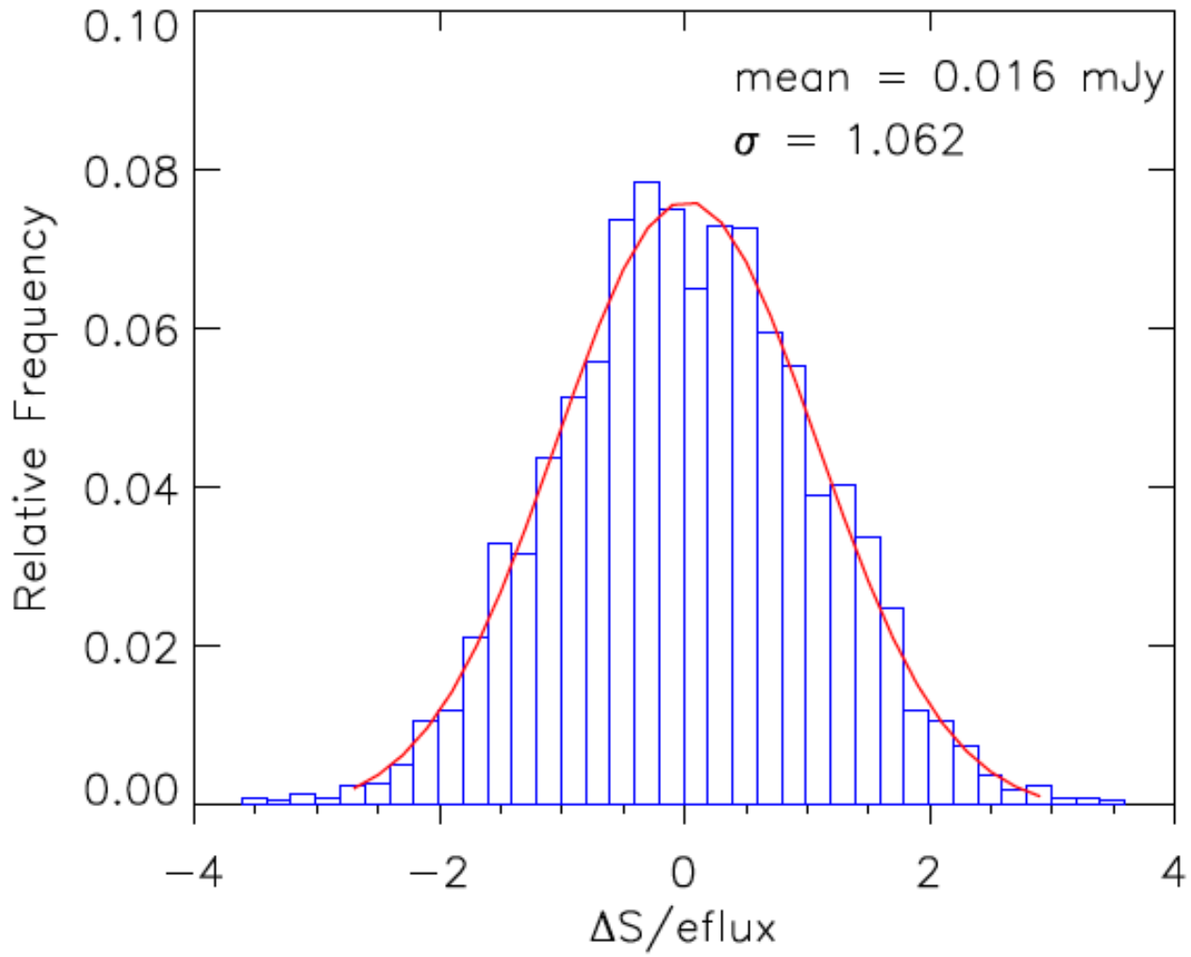
Why a new source extraction method is needed?

Previous standard source extraction procedure:

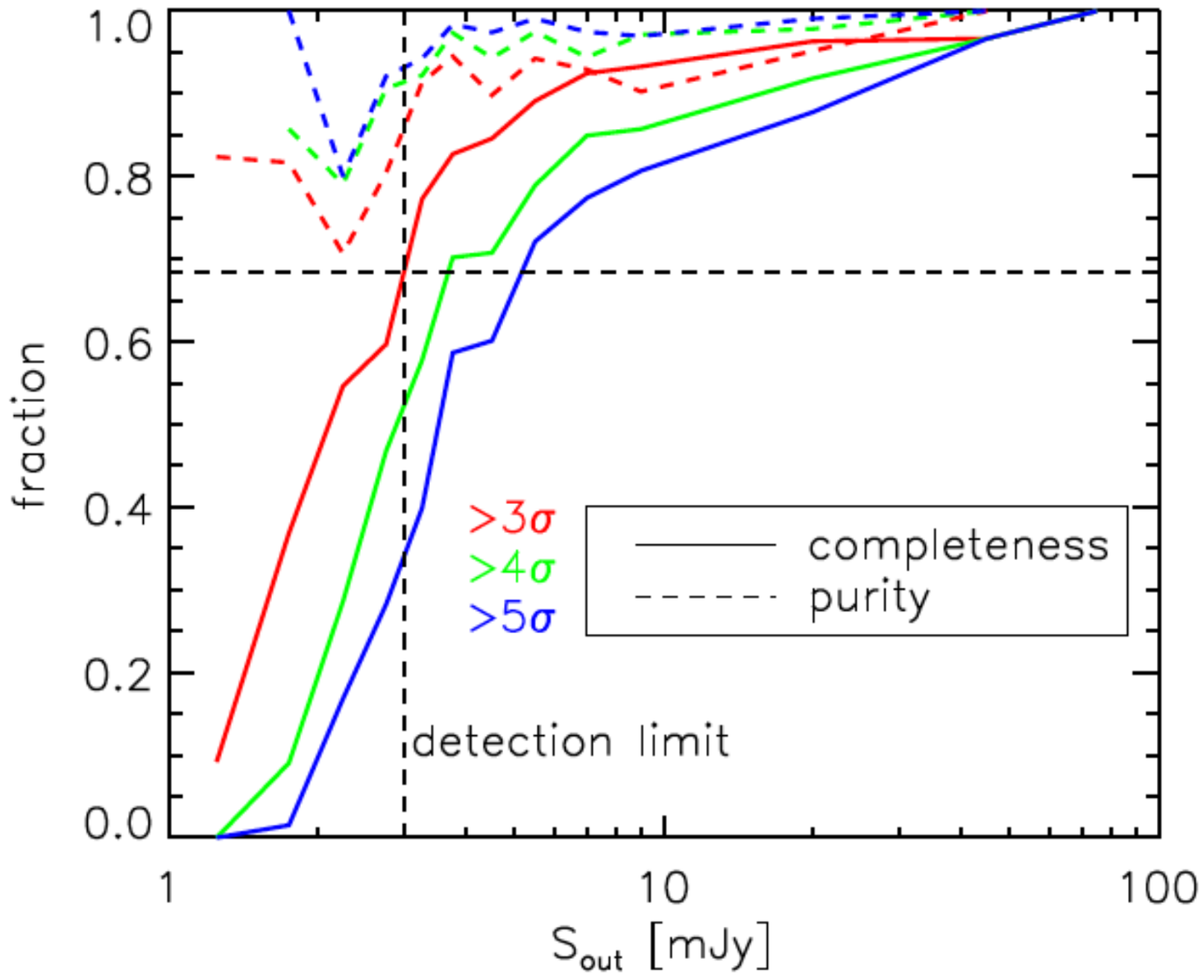


measure flux uncertainties with covariance matrix

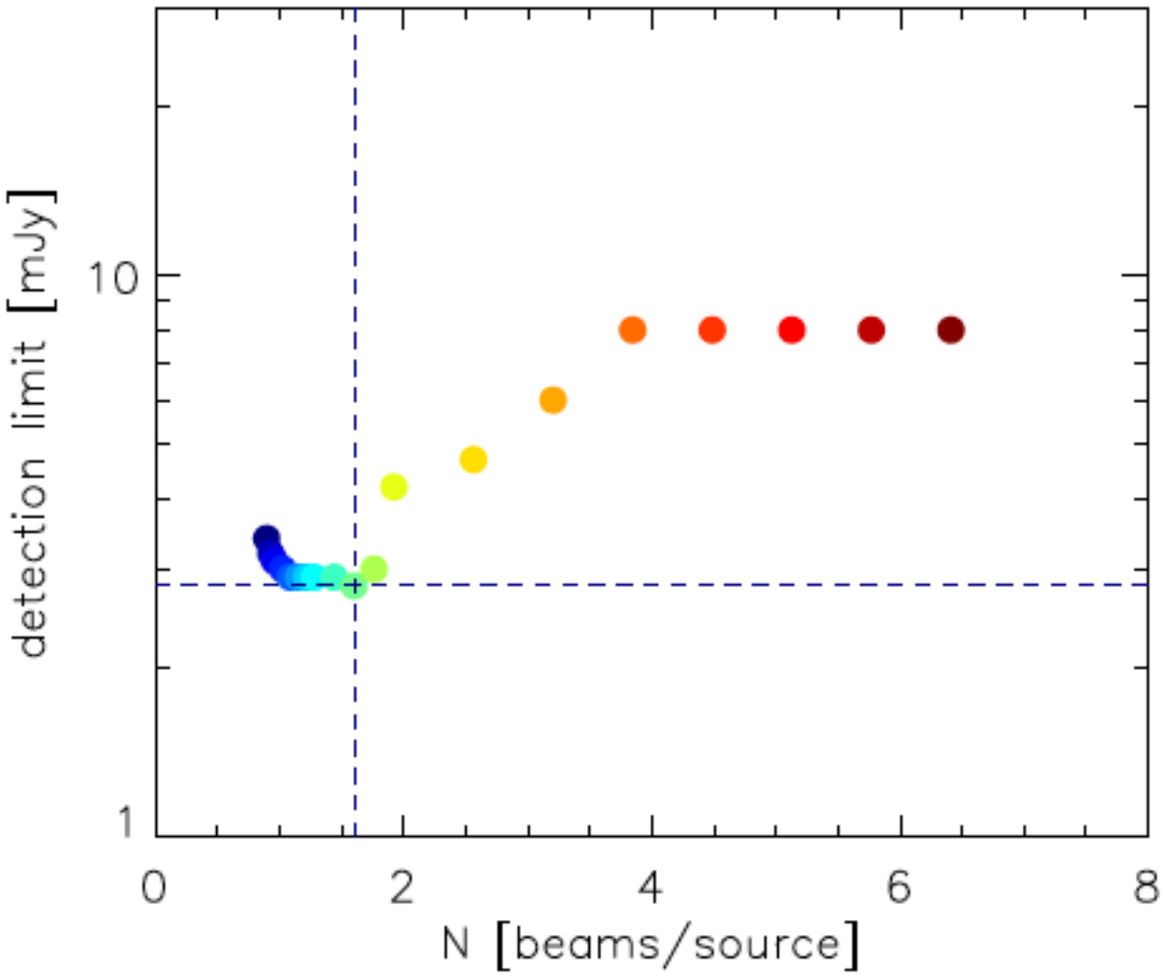


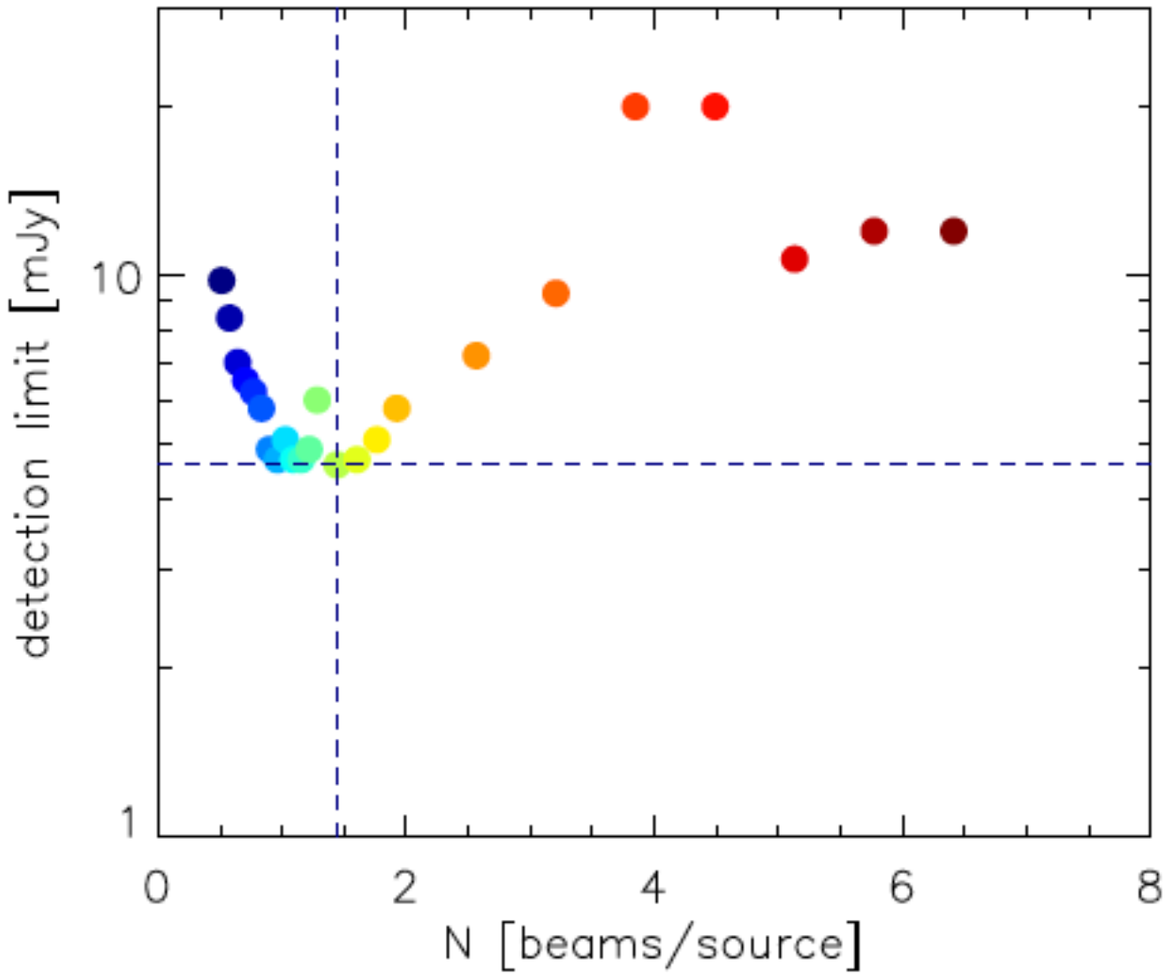


The optimum number of priors

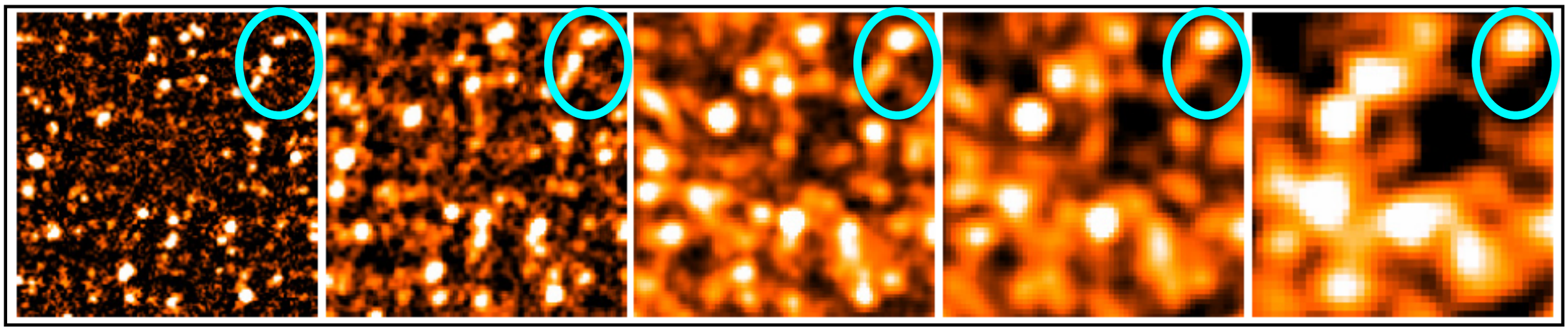


The optimum number of priors





Improve photometry accuracy of “non-clean” sources by “freezing” faint sources



$$m = \sum_{k=1}^{N_s} S_k PSF_{x_k,y_k} + \sigma + \mu,$$

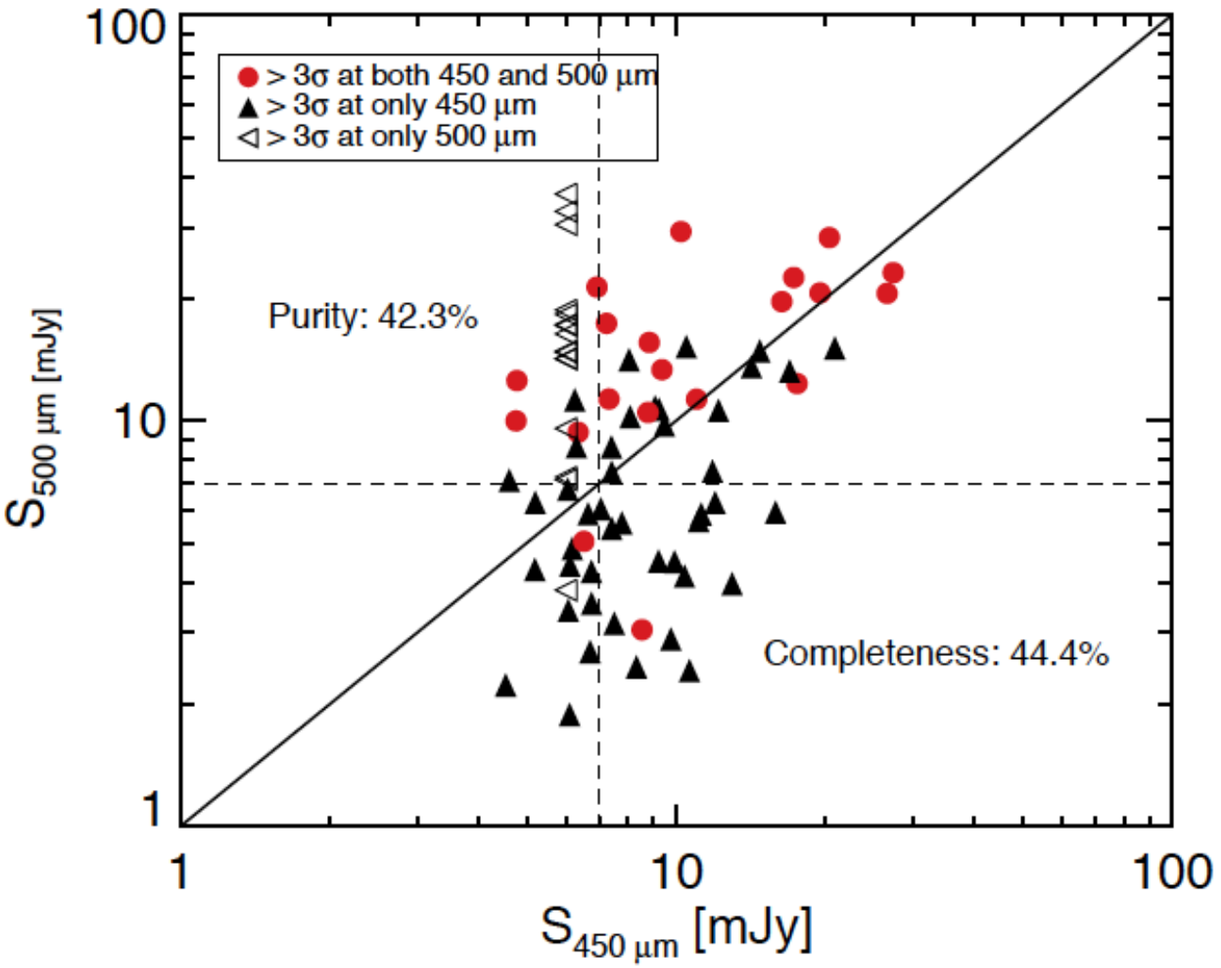
$$-log(L) = \sum_{pixels} \frac{\left(m - \sum_{i=1}^{Nsources} PSF_{x_i,y_i} \times S_i - \mu\right)^2}{2n^2} + \sum_{pixel} log\left(C(n)\right) + \sum_{i=1}^{Nsources} \eta_i (S_i - \theta_i)^2 / 2\sigma_i^2$$

predicted flux

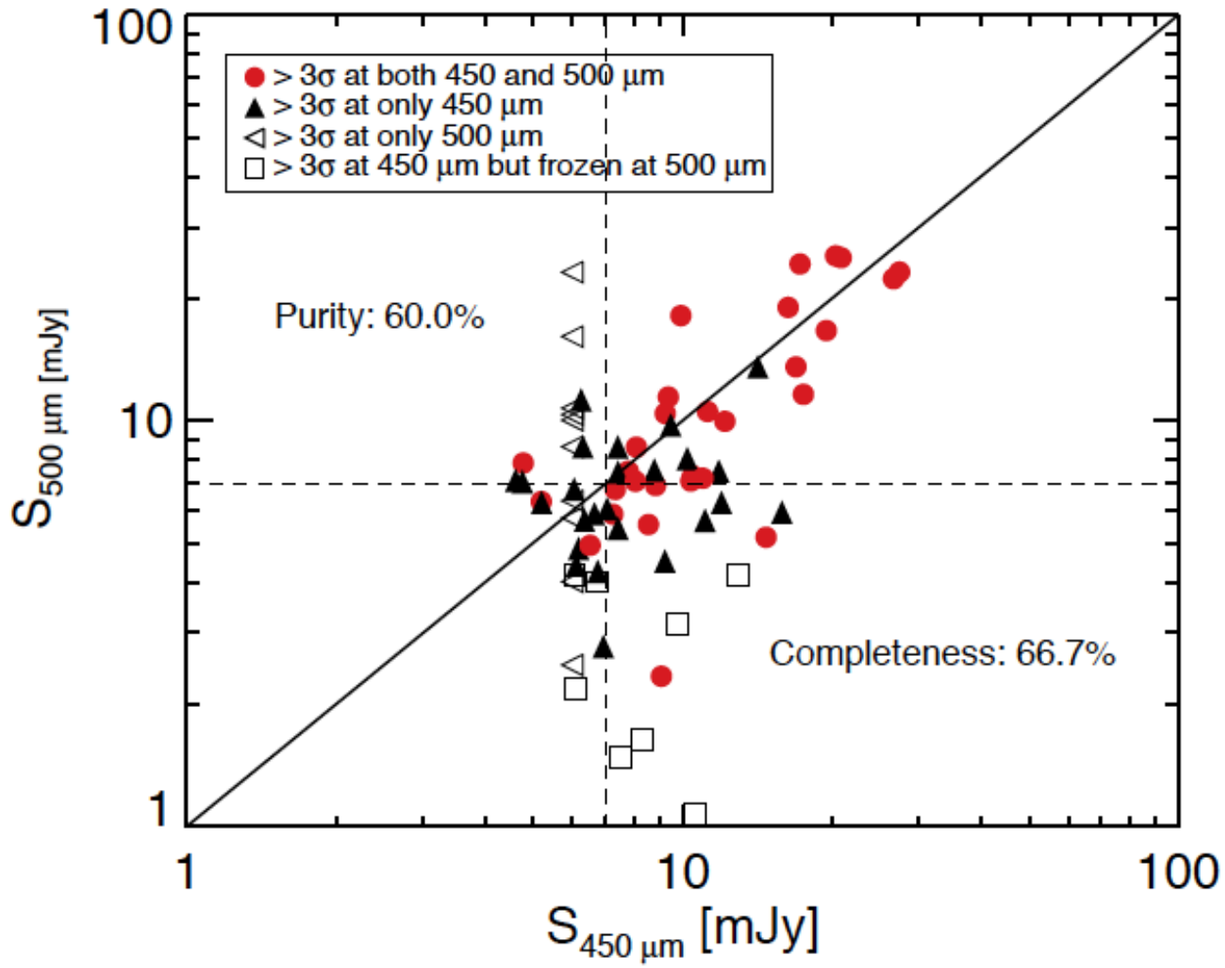
freezing flag (0,1)

flux unc

Tests in real SPIRE images, and comparison with SCUBA 2 images (450 um)

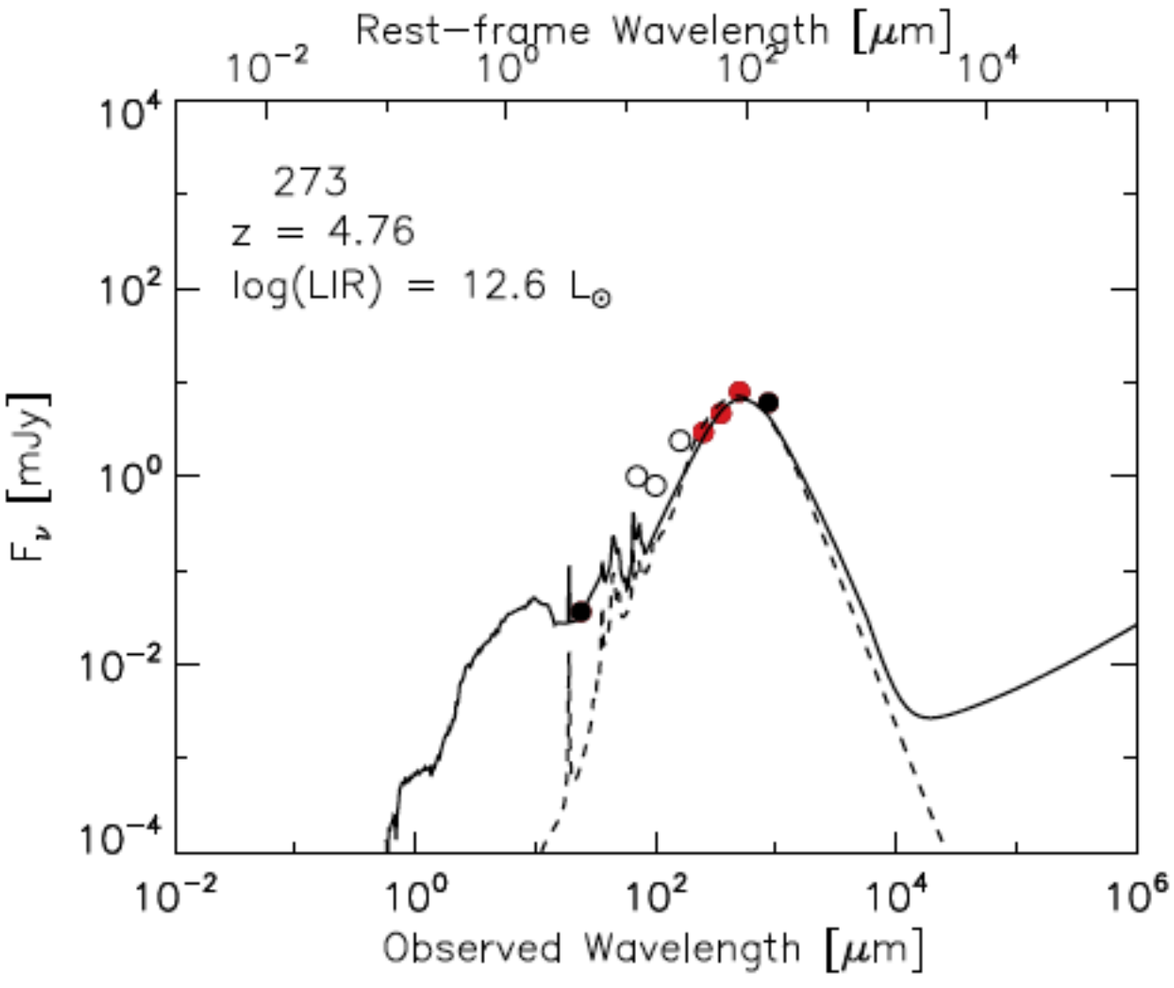


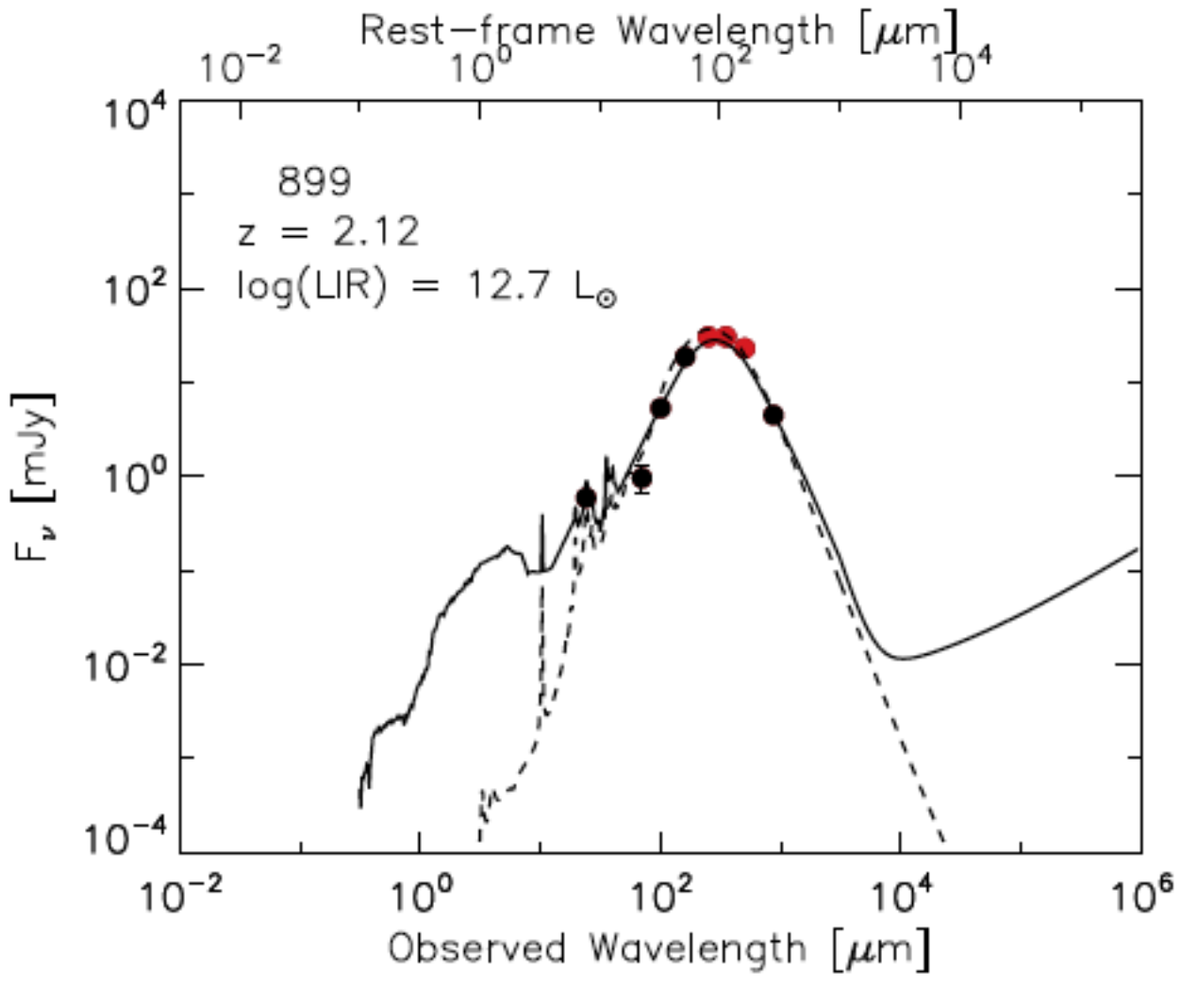
before freezing fainter sources



after freezing fainter sources

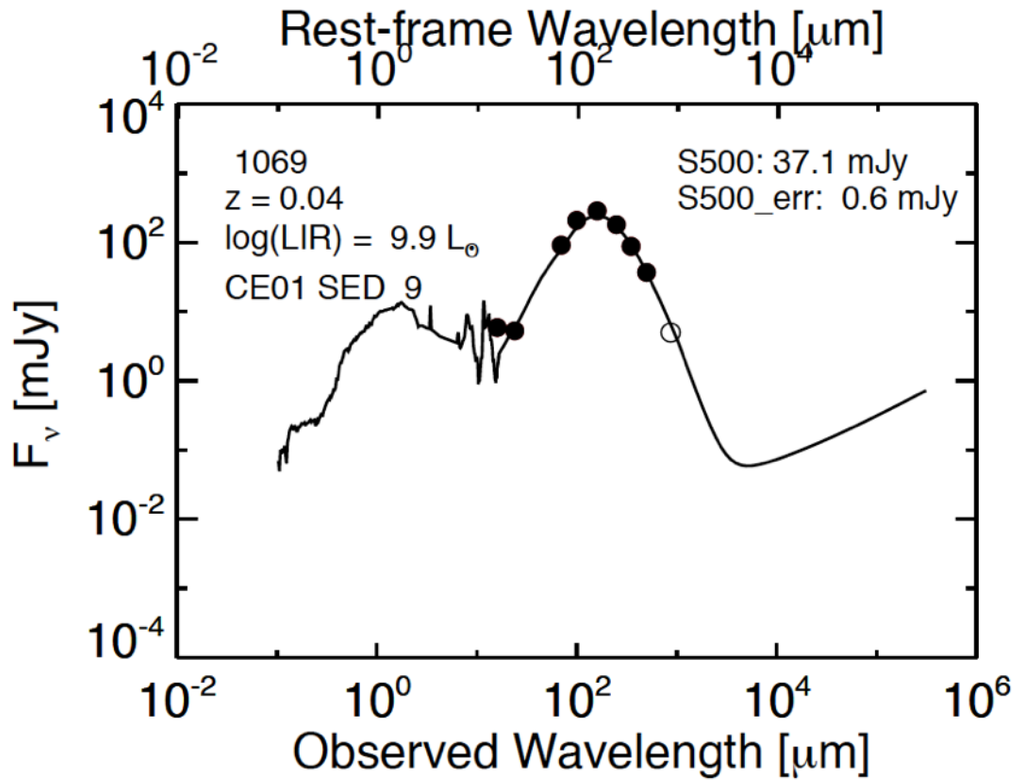
Example SEDs of sources with detections in all the three SPIRE bands

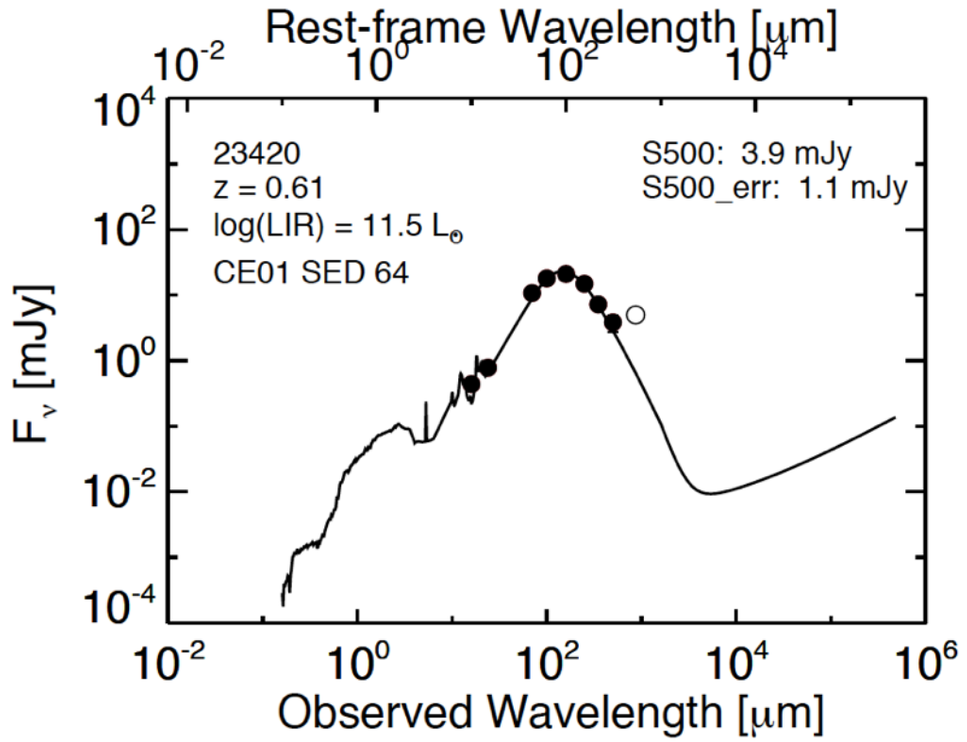


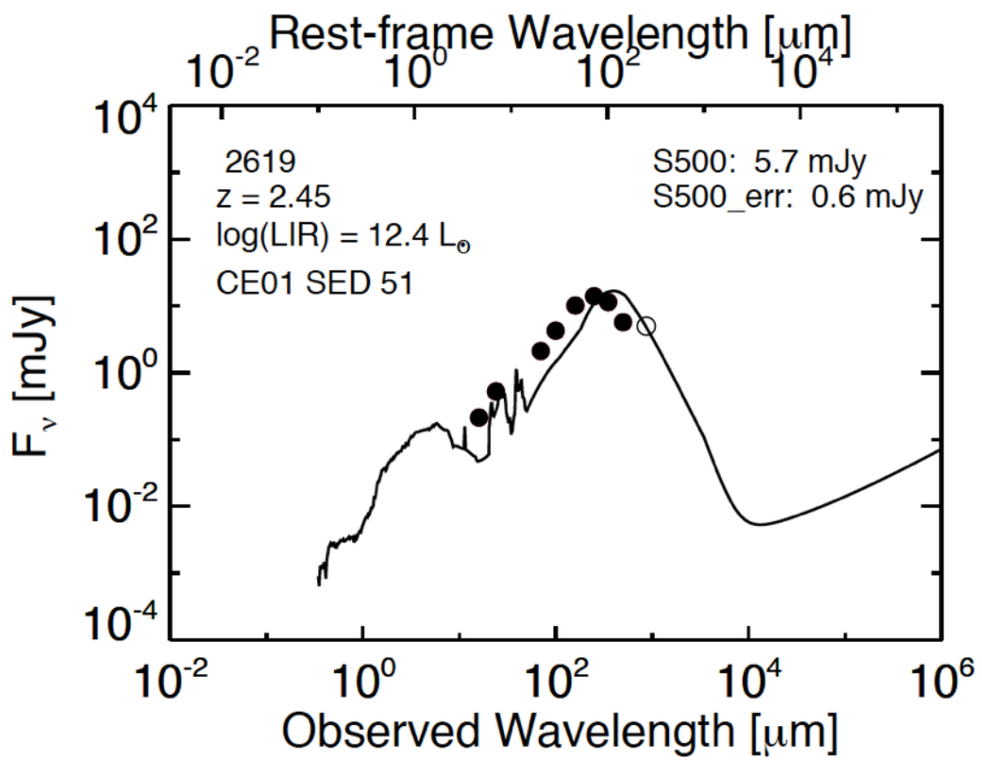


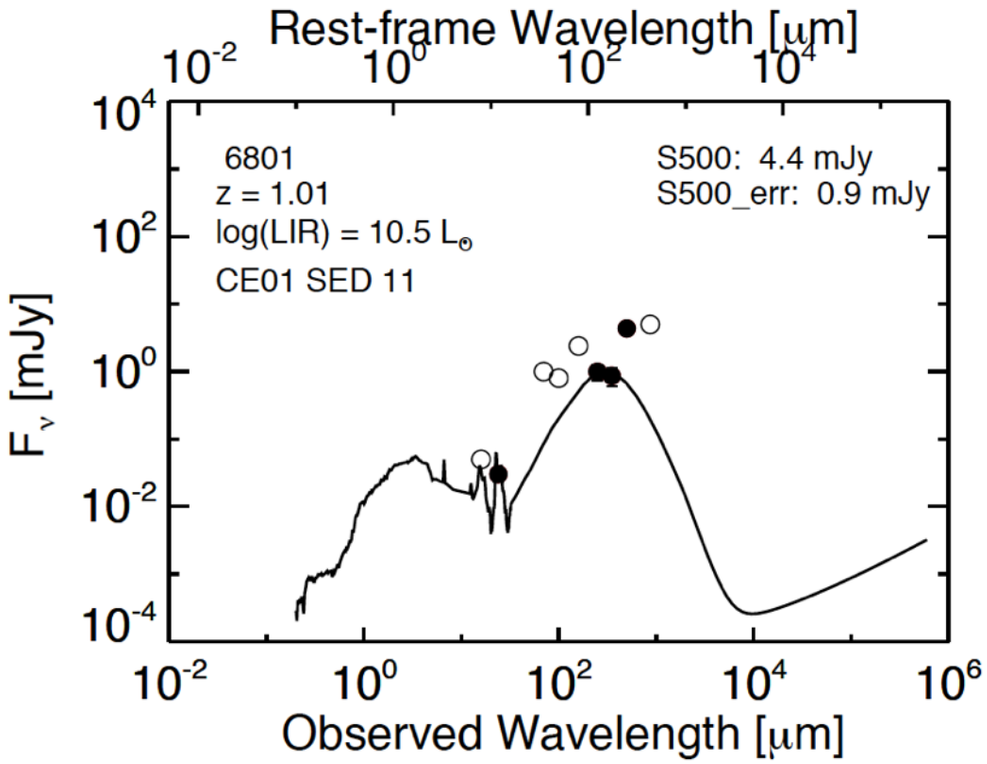
We detect **138** sources with S/N > 3, compared to ~10 in previous released catalogs, in all the three SPIRE bands in GOODS-South

Example SEDs of non-870 um sources

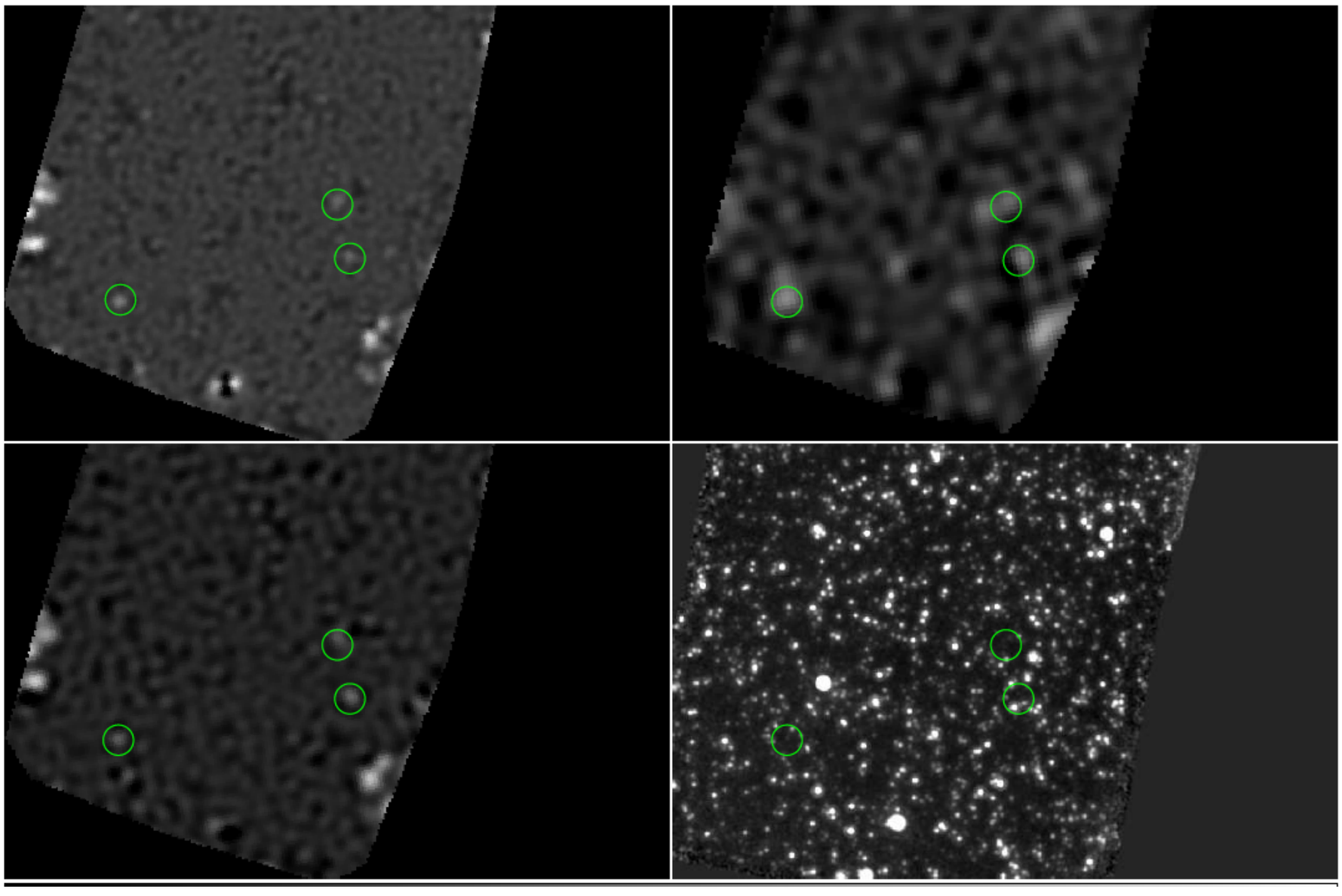






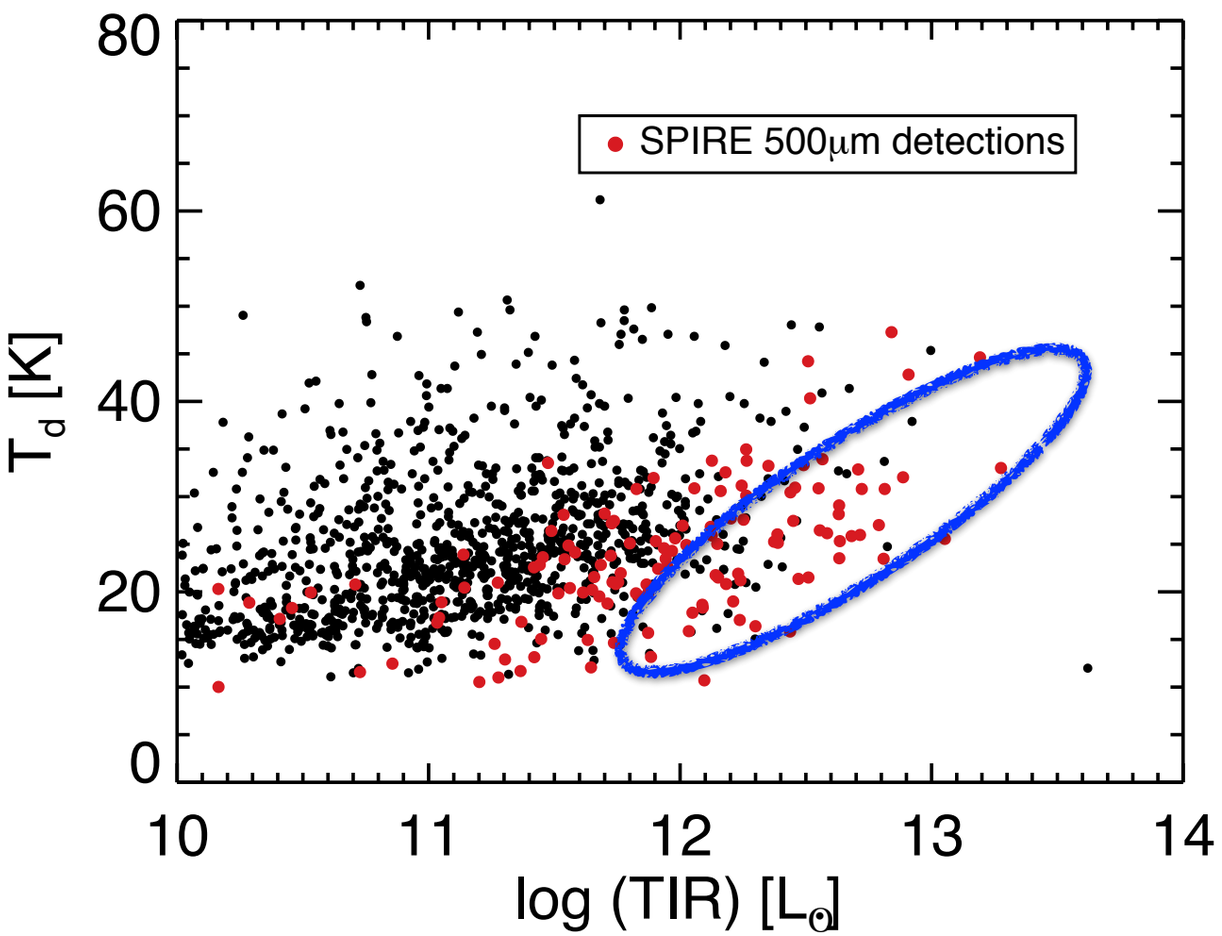


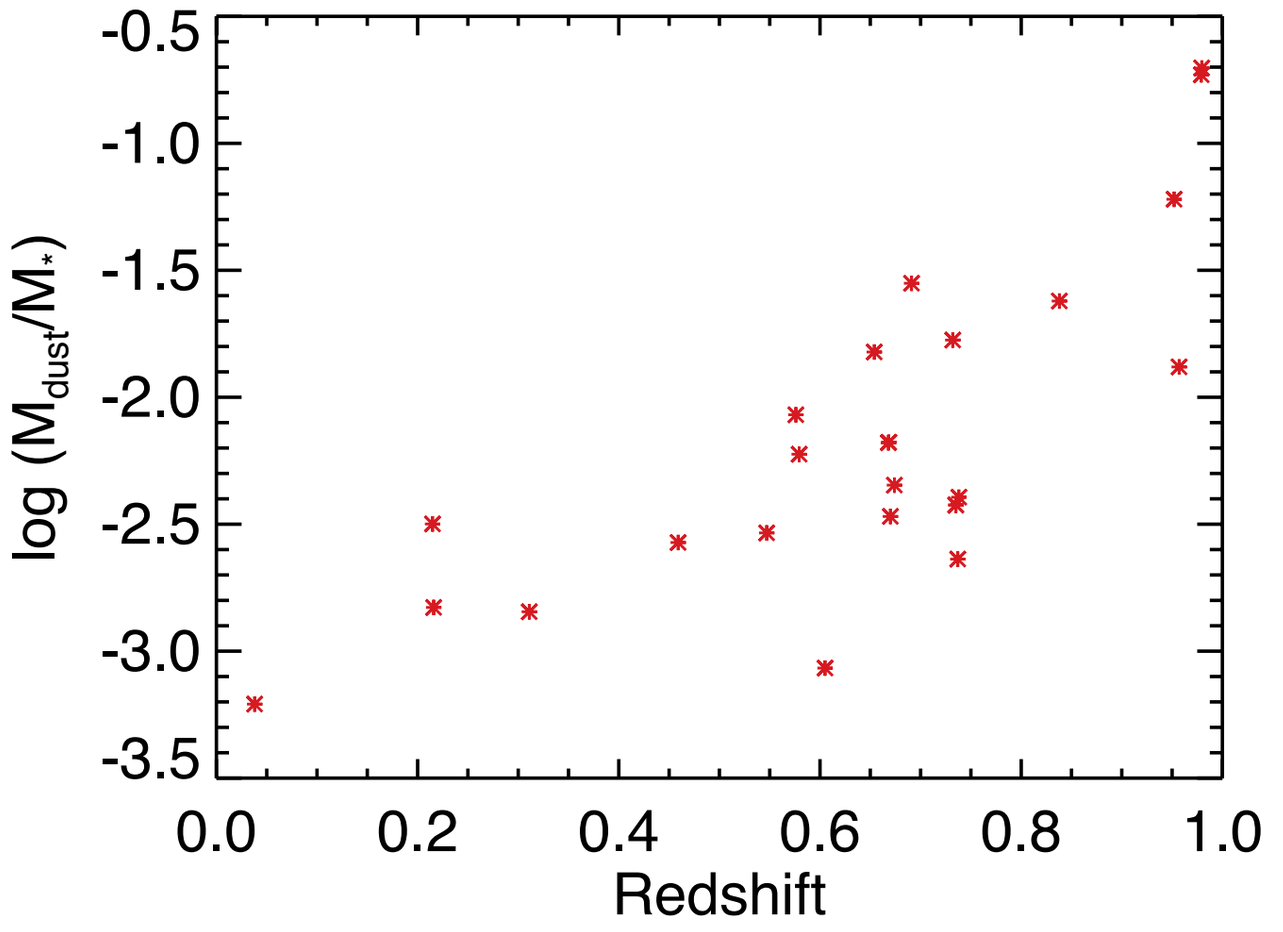
Identify sources that are missed in the prior list

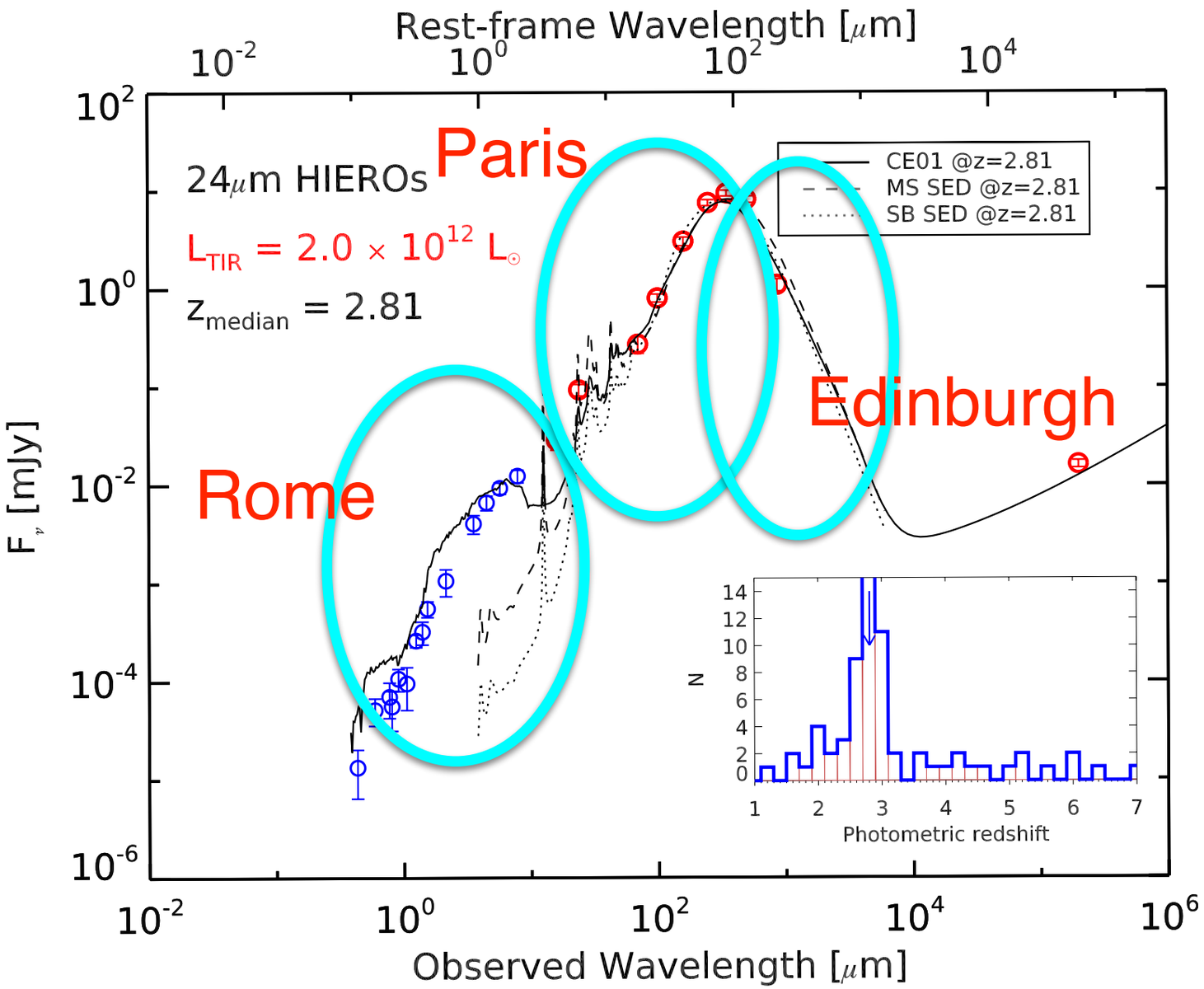


Run STARFINDER on residual images and identify sources that are missed in the prior list (mostly z>~3 sources)

Better science with Better catalogs






Rest-frame Wavelength [μm]
10^{-2}
10^{0}
10^{2}
10^{4}
10^{2}
10^{0}
10^{-2}
10^{-4}
10^{-6}
F_ν [mJy]
24μm HIEROs
$L_{TIR} = 2.0 \times 10^{12}\ L_\odot$
$z_{median} = 2.81$
Paris
Rome
Edinburgh
CE01 @z=2.81
MS SED @z=2.81
SB SED @z=2.81
N
Photometric redshift
10^{-2}
10^{0}
10^{2}
10^{4}
10^{6}
Observed Wavelength [μm]