850µm Survey of the Chandra Deep Field South

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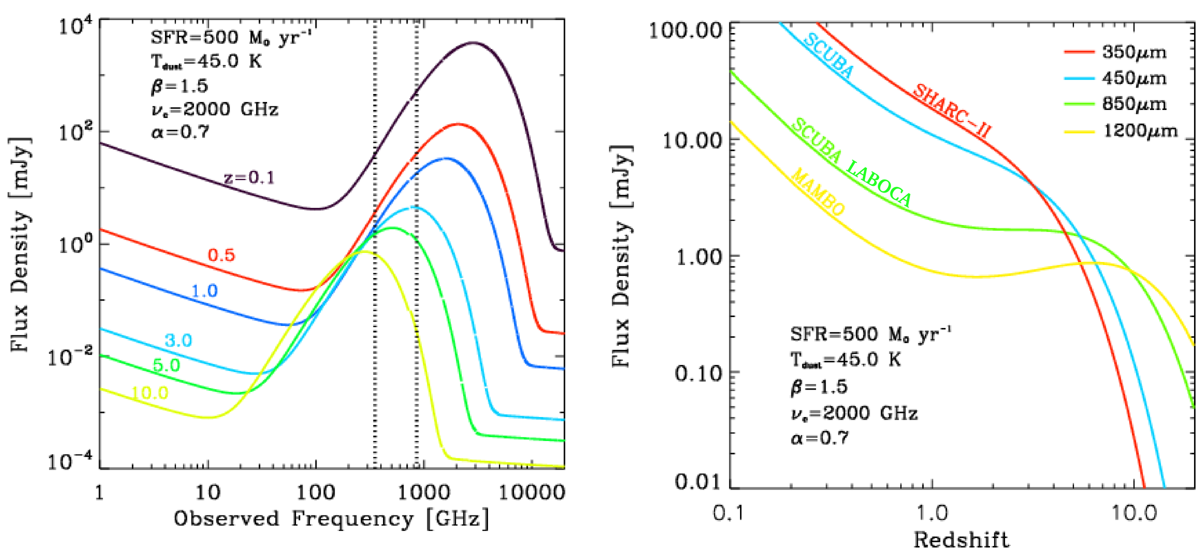
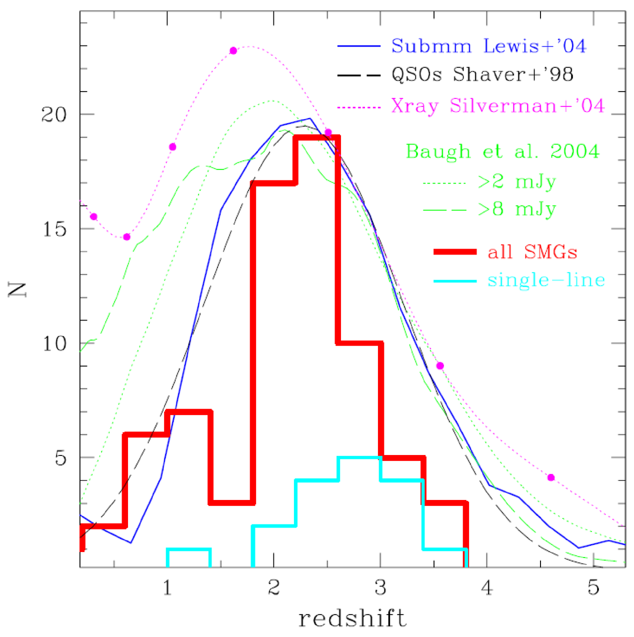
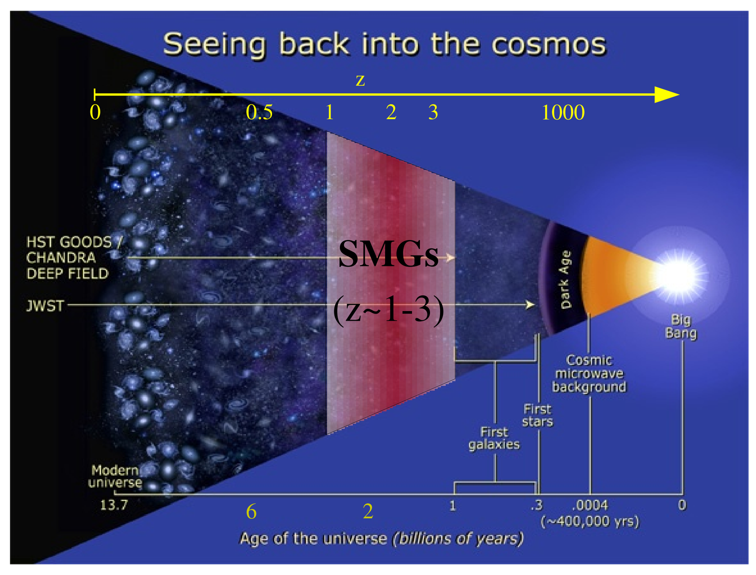
A Negative K-Correction



A benefit of observing on the Rayleigh-Jeans side of a black- or graybody spectrum is that the falling fluxes from increasing distances are compensated by a shift to higher rest-frame frequencies at greater redshifts. This effect is shown (left) for 850µm observing of a typical luminous galaxy placed at various redshifts. As a result such a galaxy would appear equally bright at 850µm in the redshift range 0.5-8 (right), making the mm-band attractive for conducting unbiased surveys of luminous galaxies.

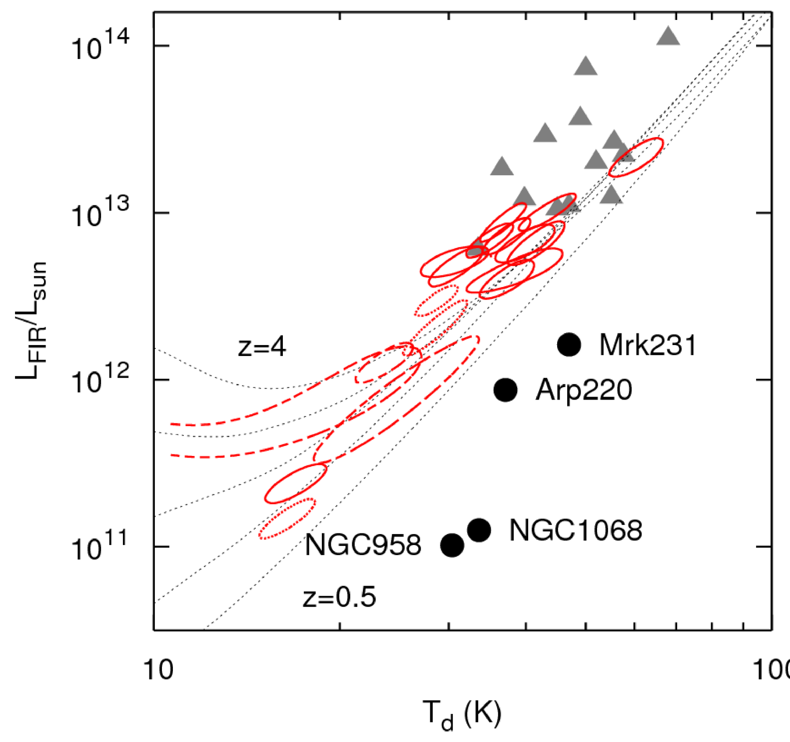
Redshift Distribution





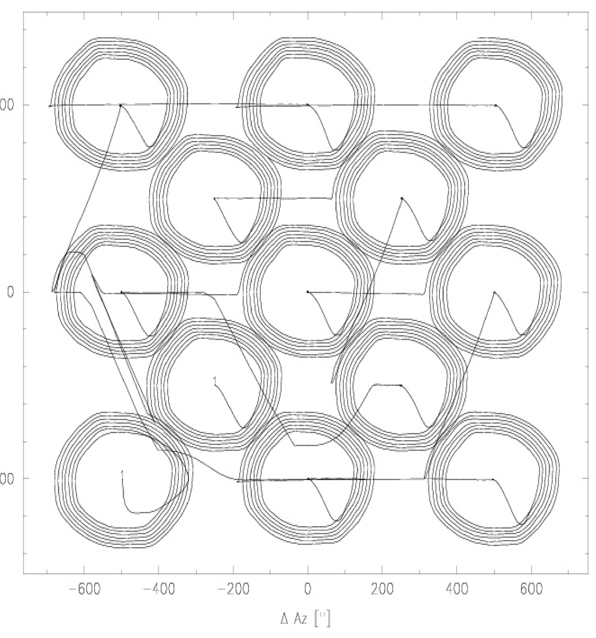
Prior studies (Chapman et al. 2005) have suggested that SMGs are clustered around a median redshift z ~ 2.4, and appear to be distributed much like other known high-z sources, like quasars (left). Thus, SMGs trace an early stage of galaxy evolution that took place in the first few billion years of the universe. Some SMGs may be at yet greater distances of z > 3, where redshift identification becomes increasingly difficult. Currently, around a third of the SMG population is at unknown redshift, an it is unclear how many of these are more distant.

Luminous Galaxies



Kovács et al. 2006 have shown that SMGs (contours) tend to be characterized by dust temperatures that are similar to local starburst galaxies like Arp220. However, SMGs are much more luminous, hinting at star-formation rates unseen in the local universe. (triangles are quasars from Beelen et al. 2005).

LABOCA Observations at APEX

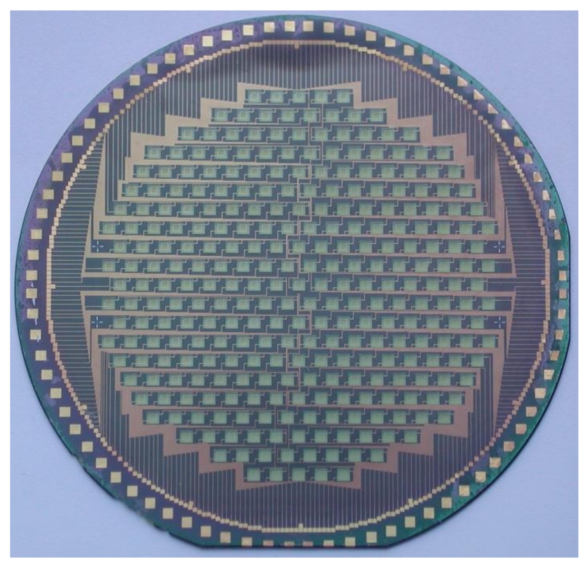


We used a "raster of spirals" pattern (above) to achieve uniform coverage over a 0.5 deg × 0.5 deg area (see below). Total power bolometer arrays, like LABOCA, require fast, cross-linked scanning patterns for optimal imaging under a bright, fluctuating atmospheric background and other instrumental noise sources. When used correctly, this technique yields images that are far superior to the traditional chopped or jiggle mapping modes.

As one of the pivotal large projects for the APEX LABOCA instrument, we are conducting a deep submm survey of the Extended CHANDRA Deep Field South (CDFS) at 850µm in collaboration with ESO. Our goal is to reach ~1 mJy/beam rms sensitivities over a quarter square-degree area. This exciting project, when complete, will give us the largest and deepest ever sub-mm continuum map of an extragalactic field. The new data will help us better understand the elusive submillimeter-selected galaxy (SMG) population. The CDFS has some of the best multi-wavelengths coverage of any deep field also, thus promising many exciting discoveries to come.

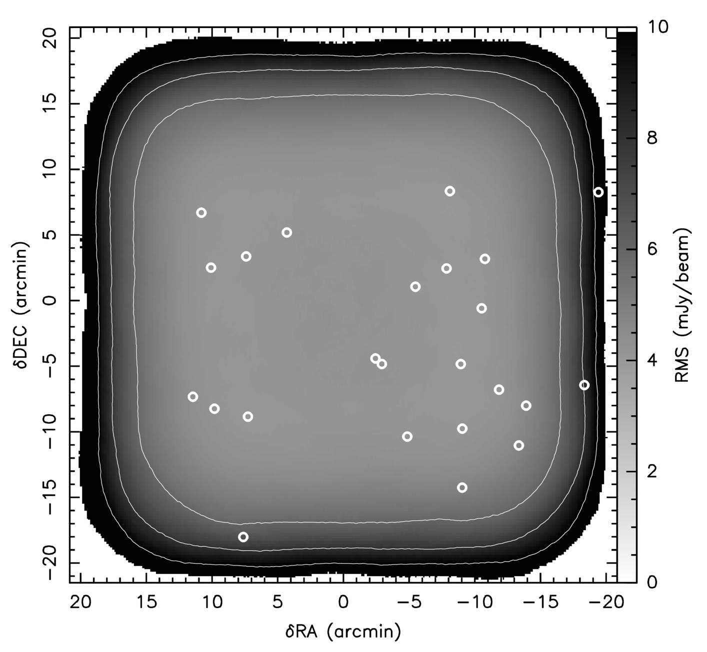
We expect to reach our target sensitivities after some 200 hours of on-source integration. Presently, we have ca. 100 hours of data reaching ~1.6 mJy/beam depths in the full targeted area.

LABOCA is a mapping machine....



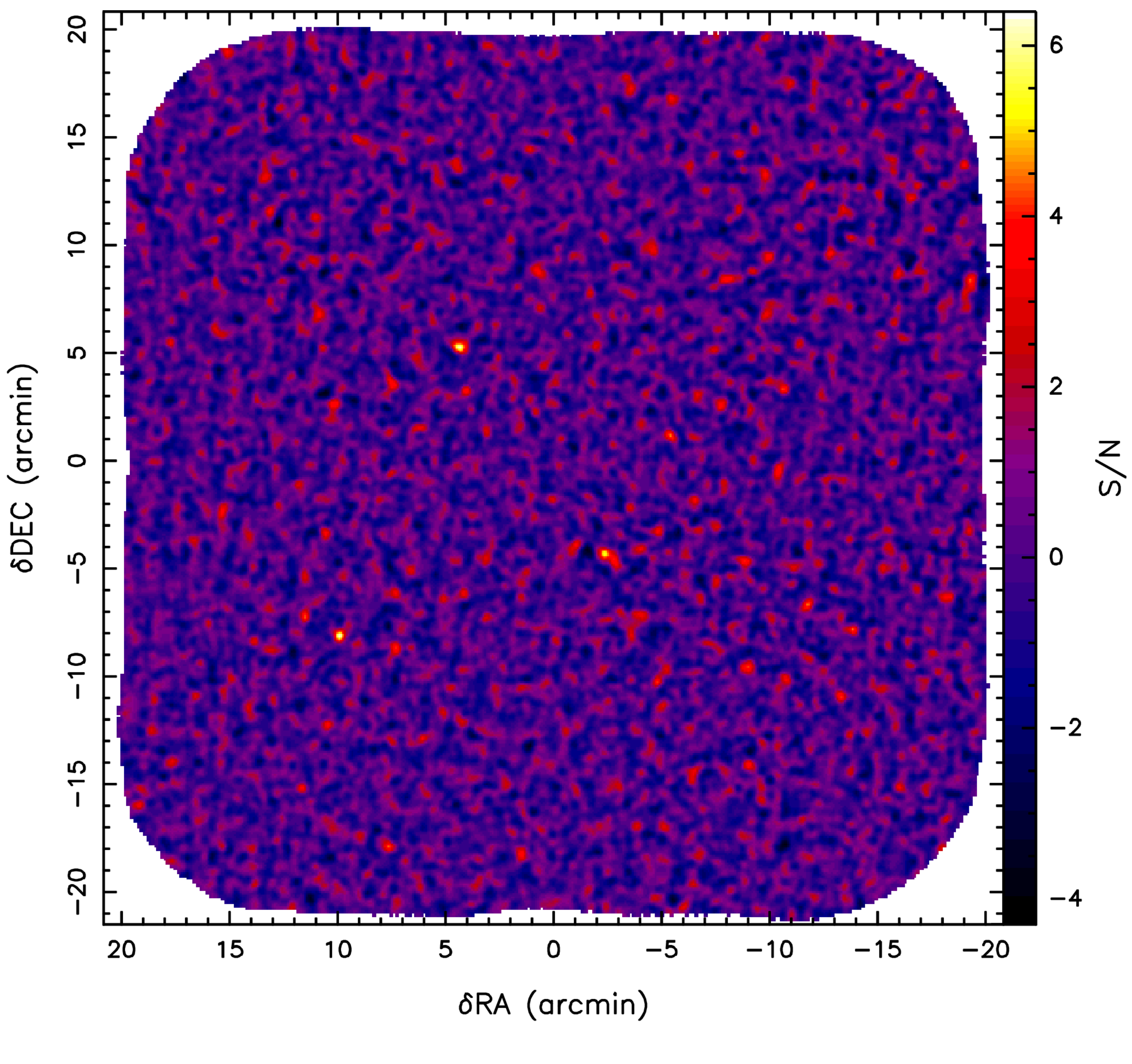
LABOCA (E. Kreysa & G. Siringo) with its 295 pixels is the ideal instruments for sensitive mapping of large fields (shown is a picture of the detector array above). It is capable of downintegrating approximately 10 times faster than the highly successful SCUBA instrument, and thus promises to yield spectacular scientific results.

850μm Selected Sources



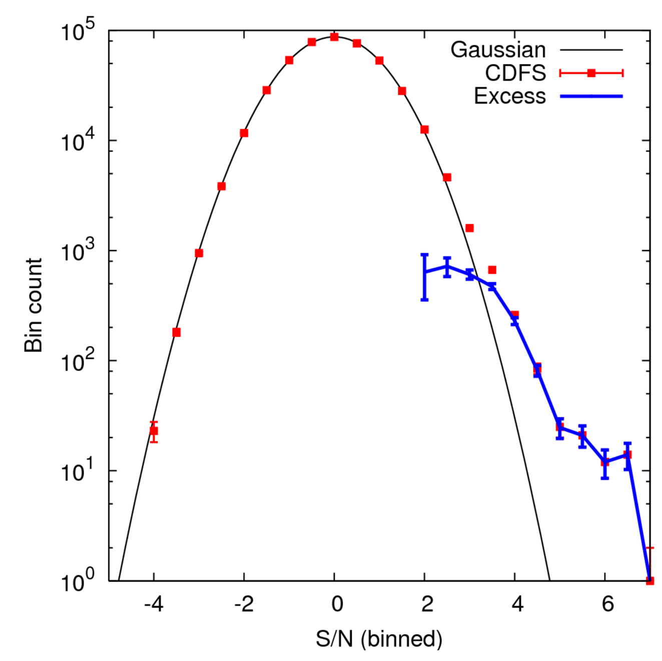
The noise map (above) with the positions of the sources extracted (see source list below) indicated as circles. Contours are shown at 2, 4, and 6 mJy/beam rms levels. Upon completion of the project, we hope to reach ~1 mJy/beam sensitivities in the same area, making our survey deeper and covering a larger area than any preceding deep submm survey.

ID	RA (J2000.0)	DEC (J2000.0)	S(850 μm) (mJy/beam)	S/N
1	03:32:49.36	-27:42:47.4	10.7 ± 1.6	6.72
2	03:33:14.35	-27:56:12.8	10.7 ± 1.6	6.71
3	03:32:18.87	-27:52:23.2	9.0 ± 1.6	5.51
4	03:31:26.96	-27:55:58.2	8.0 ± 1.8	4.54
5	03:31:36.29	-27:54:45.3	7.2 ± 1.6	4.48
6	03:33:04.46	-28:05:59.6	11.5 ± 2.6	4.46
7	03:31:48.93	-27:57:43.9	7.0 ± 1.6	4.43
8	03:32:05.13	-27:46:55.2	7.0 ± 1.6	4.41
9	03:33:21.77	-27:55:18.1	7.3 ± 1.7	4.39
10	03:31:02.24	-27:39:41.5	17.7 ± 4.1	4.36
11	03:31:41.24	-27:44:47.6	6.9 ± 1.6	4.32
12	03:32:16.67	-27:52:48.7	6.8 ± 1.6	4.23
13	03:32:07.88	-27:58:20.4	6.8 ± 1.6	4.21
14	03:33:03.36	-27:44:36.7	6.6 ± 1.6	4.16
15	03:31:42.34	-27:48:33.6	6.5 ± 1.6	4.15
16	03:33:15.45	-27:45:27.7	6.5 ± 1.6	4.13
17	03:33:18.74	-27:41:16.3	6.5 ± 1.6	4.09
18	03:31:53.32	-27:39:37.9	6.4 ± 1.6	4.09
19	03:31:48.93	-28:02:13.6	7.5 ± 1.9	4.05
20	03:31:29.43	-27:59:00.5	7.3 ± 1.8	4.04
21	03:31:06.90	-27:54:23.5	12.4 ± 3.1	4.03
22	03:33:02.81	-27:56:49.2	6.3 ± 1.6	4.03
23	03:31:54.42	-27:45:31.4	6.3 ± 1.6	4.02
24	03:31:49.48	-27:52:48.7	6.3 ± 1.6	4.01



Our signal-to-noise map after ~100 hours on-source (above) reveals some two-dozen sources above the noise level (listed to the left). Based on the closely Gaussian noise statistics of the map, we expect only some 3 of the 24 sources to be falsely detected. At this early stage in the project, we can already make some tentative conclusions on the source counts. We find 850µm source counts (right) that are 2-3 times lower than observed by Coppin et al. 2006 for SHADES (the SCUBA Half-Degree Extragalactic Survey). This is odd, since SHADES covers a similarly sized area to comparable depths. One explanation for the apparent discrepancy could be cosmic variance, although systematics (e.g. different image qualities) could play a role also. When the project reaches completion, we will be able to improve significantly our understanding of submm source counts.

Gaussian Noise Statistics



The map (left) exhibits perfectly Gaussian noise properties (above, data with red and Gaussian fit in black) with an expected excess at positive fluxes (blue) due to the presence of sources (resolved and unresolved). This may be taken as a measure of the exceptional and unprecedented (at 850µm) data quality that total power arrays can provide.

850μm Source Counts