Herschel Sources in the Spitzer IRAC/MIPS Extragalactic Survey (SIMES) of the South Ecliptic Pole: Main Sequence normalization at high SFR levels

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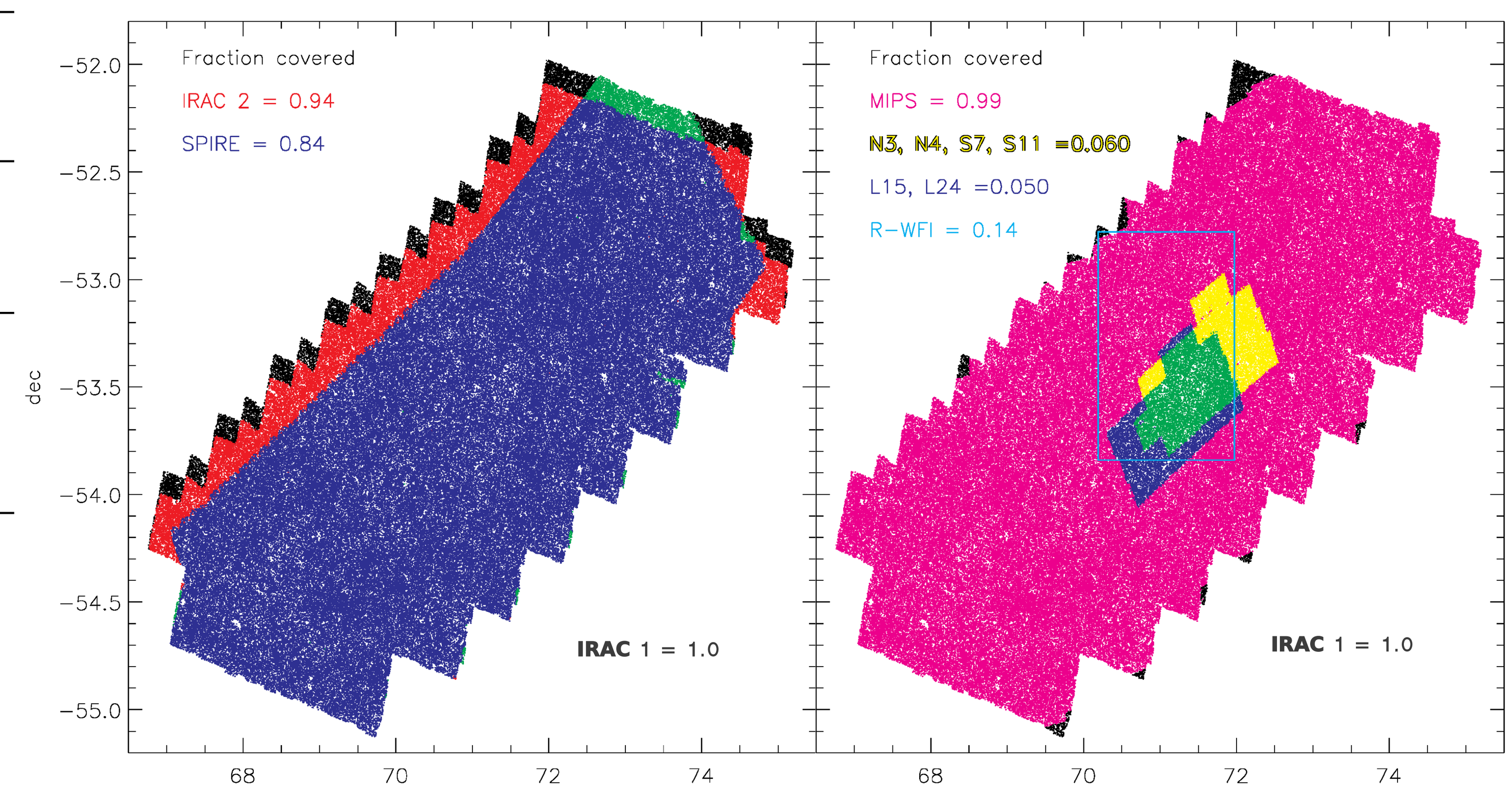
We present a characterization of the 250μm selected sources detected in the South Ecliptic Pole (SEP) field, performed exploiting the large wavelength coverage of the SIMES survey. The wavelengths explored span from shallow optical bands to deep mid and far Infrared Spitzer/IRAC and MIPS, AKARI/IRC, and Herschel/SPIRE observations. The large area covered (7 square degrees) and the elongated geometry (4:1) allow for large statistical samples and substantial reduction of the cosmic variance. Here we present the characterization of the IRAC and SPIRE detected sources. The data described are crucial for determining the stellar masses M, redshifts and star formation rates (SFR) of the sources. Thanks to the large sample of approximately 600 SPIRE selected sources, we can constrain the low-populated high-SFR and high-M* tail of the so called "main sequence" of star forming galaxies.*

Data coverage and depth

Band	Area Covered [deg^2]	Depth
IRAC		
1	7.74	11.2-18.6μJy (3-5σ) [1]
2	7.26	5.7-9.5μJy (3-5σ)
MIPS	7.66	
24μm		0.26mJy (50% compl.) [2]
70μm		24mJy(50% compl.) [2]
SPIRE	6.52	
250μm		25.8-51.6mJy (5-10σ) [3]
350μm		21.2mJy (5σ) [3]
500μm		30.8mJy (5σ) [3]
AKARI		
N3	0.49(A)	29.3μJy (5σ)
N4	0.49(A)	22.8μJy (5σ)
S7	0.48(A)	170μJy (5σ)
S11	0.48(A)	230μJy (5σ)
L15	0.49(B)	459μJy (5σ)
L24	0.49(B)	1.07mJy (5σ)
	A&B=0.23	
R_c-WFI	1.15	0.70μJy (5σ)
WISE	7.74	
W1		80μJy (5σ) [4]
W2		110μJy (5σ) [4]
W3		1mJy (5σ) [4]
W4		6mJy (5σ) [4]
2MASS	7.74	
J		376μJy (5σ) [5]
H		460μJy (5σ) [5]
K_S		630μJy (5σ) [5]



Redshifts

We estimated photometric redshifts for our sources using a composite technique, that we checked using available spectro-photometric data (at comparable depths as our data) and redshifts **in the Lockman field**.

The *hyperz* code (Bolzonella et al. 2000) was used toghether with the Polletta (2007) template SED collection.

We compute three redshift estimates:

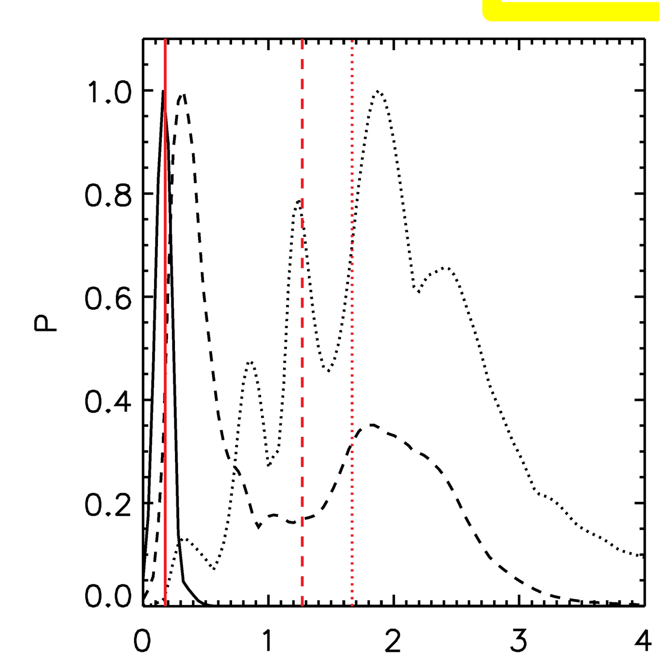
1) the maximum likelyhood redshift (col. 1)

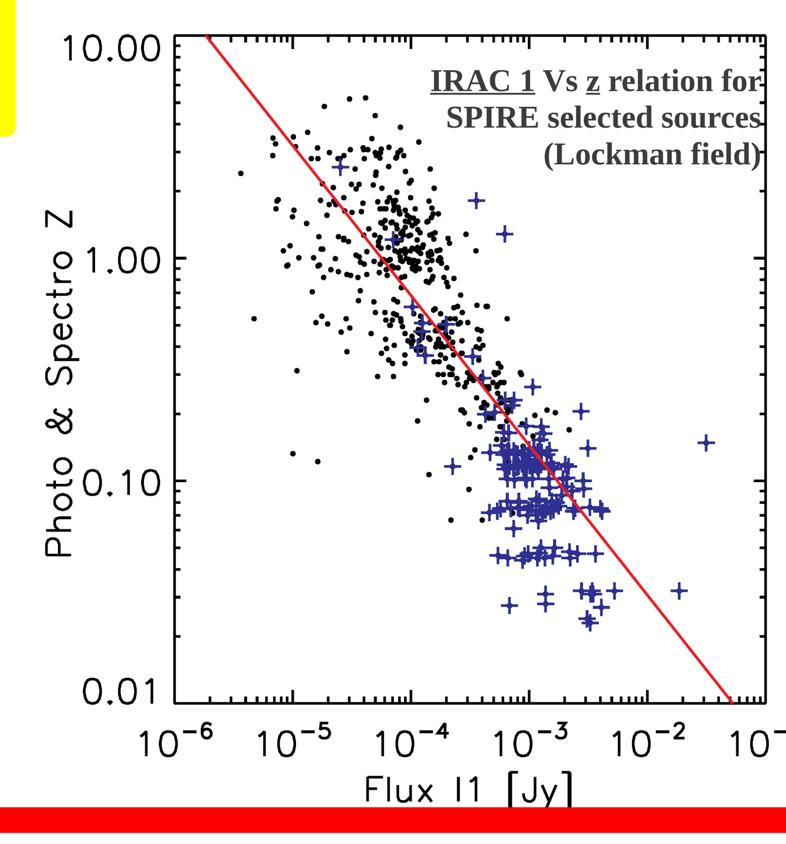
2) a weighted mean between the two most probable peaks in the redshift probability distribution (col 2)

3) weighted mean between the redshift computed in point 2 and the redshift computed from the the IRAC-1 redshift relation observed for SPIRE sources. We use a relative weight of 0.3 for the IRAC-1 redshifts.

Z_{ref} type	Simple hyperz output	Only from χ^2 minim. proc.	χ^2 minim. proc. and from z-I1 rel.
	$(z - z_{ref})/(1 + z_{ref})$ [RMS]		
Whole sample			
Z_{phot}	0.234 (535)	0.216 (535)	**0.190 (548)**
Z_{spec}	0.080 (134)	0.082 (134)	**0.058 (151)**
z(this work) > 0.5			
Z_{phot}	0.325 (236)	0.305 (284)	**0.287 (276)**
Z_{spec}	0.355 (10)	0.239 (12)	**0.151 (10)**

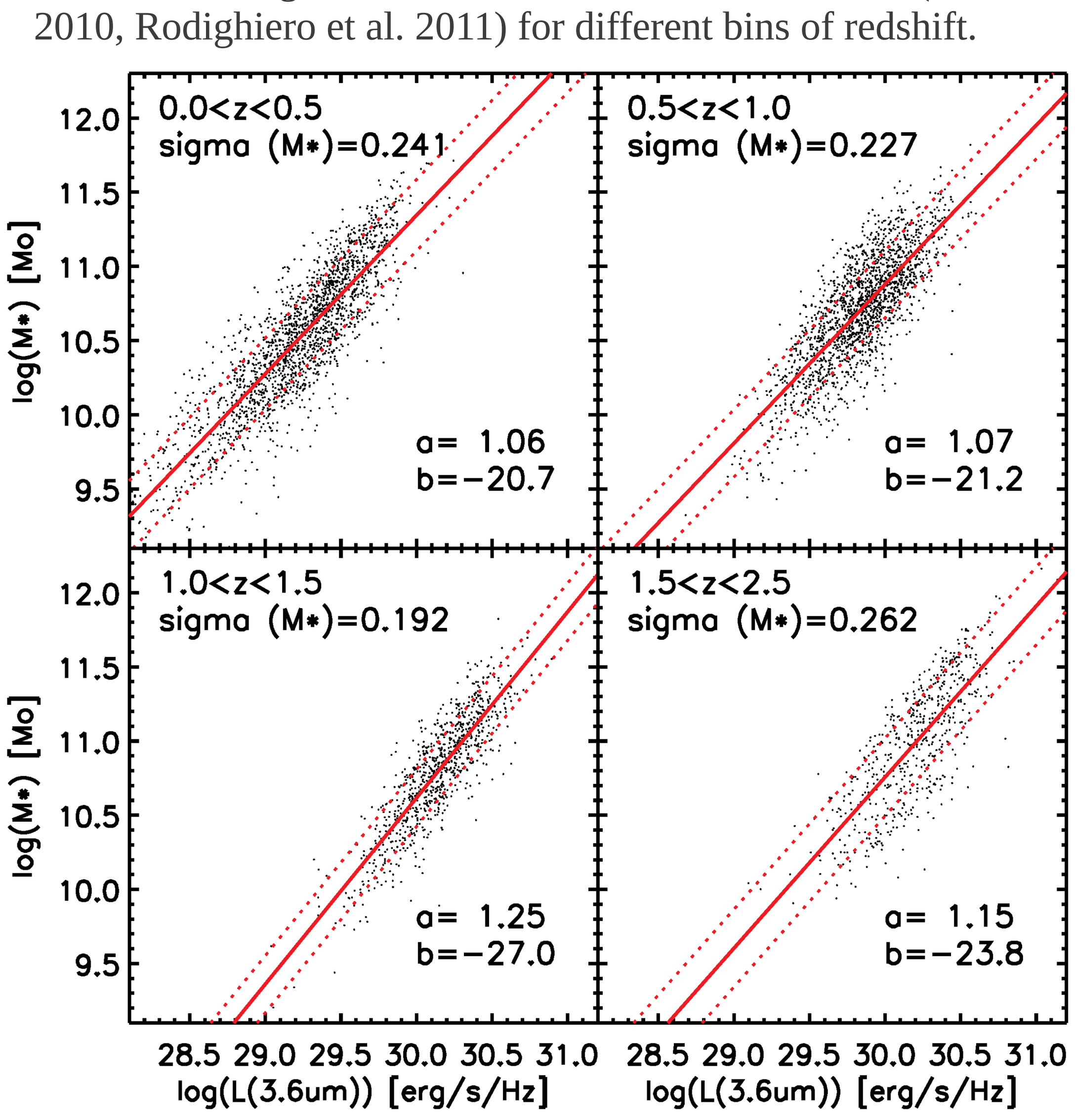
Tipical probability curves for sources without optical data (spectroscopic redshift in red)





Stellar masses M*

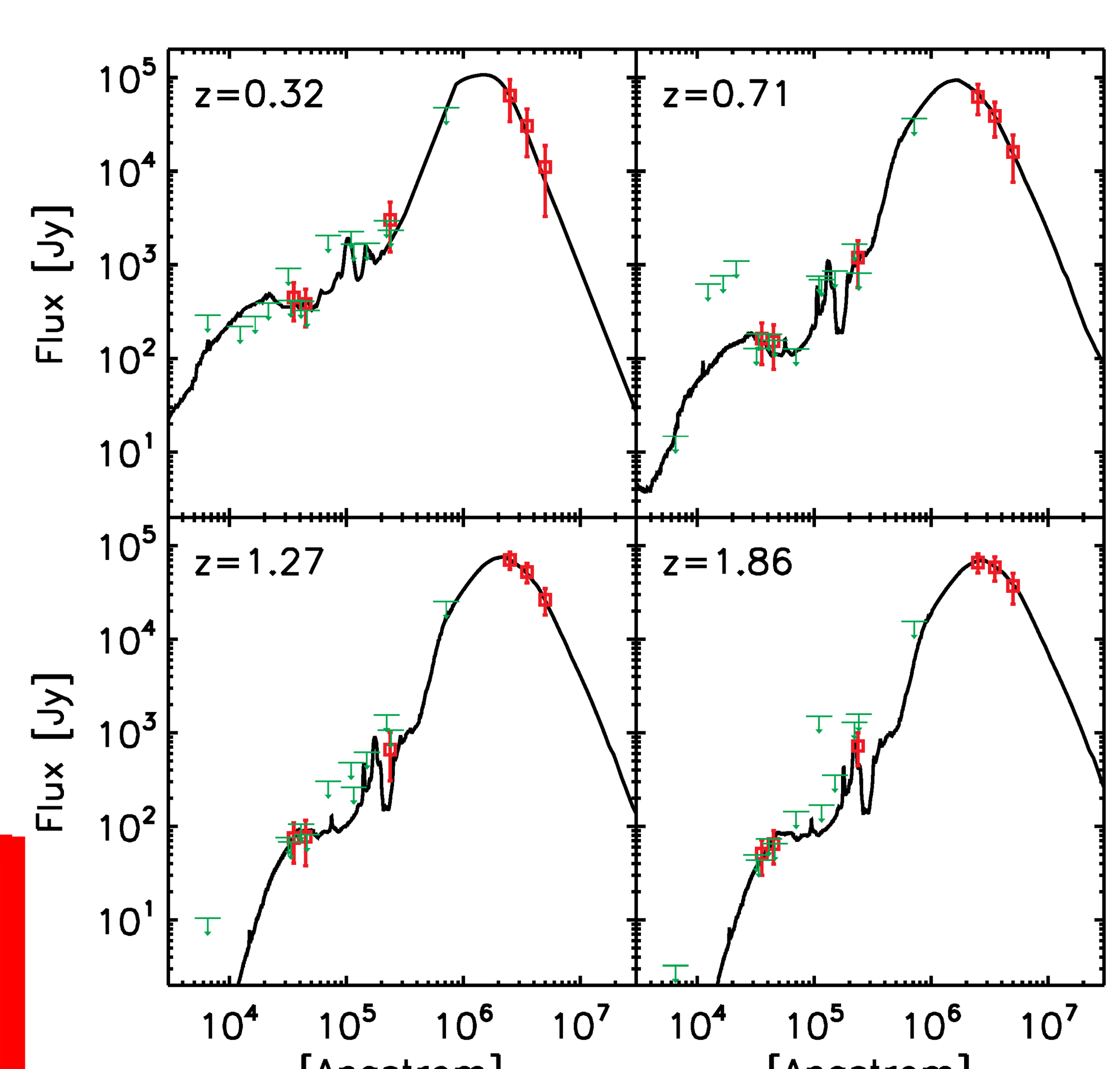
We computed approximated stellar masses using the existent relation between IRAC 1 luminosities and M*. This relation was calculated using IRAC 1 data in the COSMOS field (Ilbert et al. 2010, Rodighiero et al. 2011) for different bins of redshift.



IRAC 1 luminosities versus stellar masses M* as observed in the COSMOS field, for four redshift bins

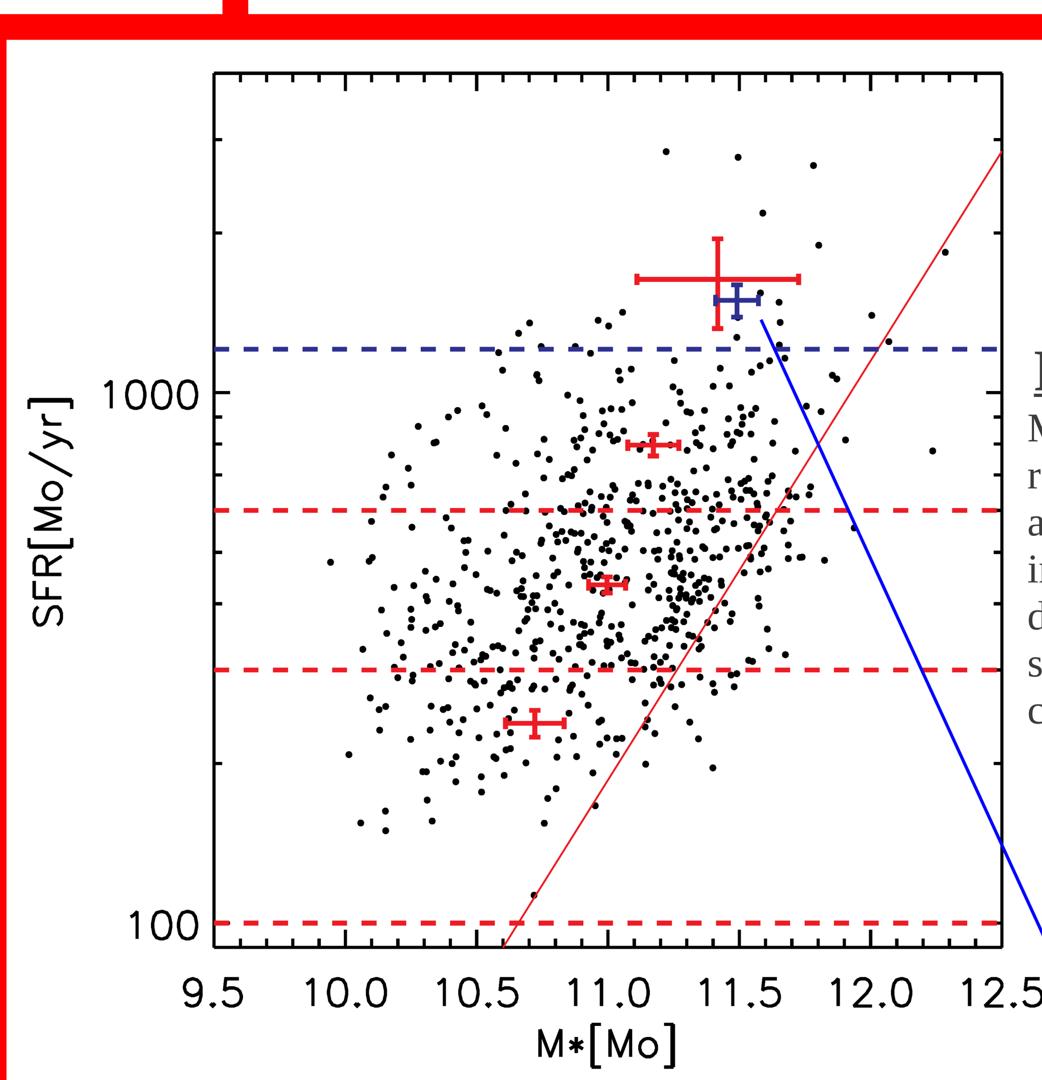
Average Polletta (2007) template SEDs and average Star Formation Rates

Because of the lack of optical photometry, redshifts and stellar masses of the individual sources are poorly constrained. The average properties of the galaxies in large redshift and mass bins, however, can provide useful information. We thus computed the mean observed SED of the SPIRE sources in each bin of redshift (red squares). We also added a new set of templates, averaging the best fit Polletta models of PACS-selected COSMOS galaxies in the same redshift bins and with SFR larger than our limits. We then found the best fit model for the mean SED and computed the SFRs from L(8-1000um). The fits were performed using only IRAC 1 & 2, MIPS 24, SPIRE 250, 350 & 500, and using the other shallower bands as a check.



References

Bertin & Arnouts (1996)
Bolzonella Miralles & Pello' (2000)
Calzetti et al. (2000)
Clements et al. (2011)
Cowie et al. (1996)
Gruppioni et al. (2008)
Ilbert et al. (2010)
Kennicutt (1998)
Oliver et al. (2012)
Onaka et al. (2007)
Polletta et al. (2007)
Rodighiero et al. (2011)
Rowan Robinson et al. (2013)



Results and comparison with previous works

Mean SFRs and stellar masses M*, computed from our data, in each redshift bin, are reported below. We also report the SFR lower limit accessible with the 250μm data. We compare our result (blue cross) in the highest redshift bin, and for a similar SFR selection, with the data presented in Rodighiero et al. 2011 for Herschel-PACS selected sources in the COSMOS field (red crosses). Our measurement is consistent with previous result, but with a much higher significance.

mean redshift	SFR limit [Mo/yr]	SFR [Mo/yr]	M* [Mo]
0.32	48.7	56.3±5.0	11.40±0.09
0.71	252.9	310.1±24.8	11.20±0.08
1.27	621.2	791.6±63.9	11.17±0.12
1.86	1207.7	1492.5±104.2	11.50±0.09