J/ApJ/788/125 An ALMA survey of ECDFS submillimeter galaxies (Simpson+, 2014)

An ALMA survey of submillimeter galaxies in the extended Chandra Deep
Field-South: the redshift distribution and evolution of submillimeter galaxies.

Simpson J.M., Swinbank A.M., Smail I., Alexander D.M., Brandt W.N.,
Bertoldi F., de Breuck C., Chapman S.C., Coppin K.E.K., da Cunha E.,
Danielson A.L.R., Dannerbauer H., Greve T.R., Hodge J.A., Ivison R.J.,
Karim A., Knudsen K.K., Poggianti B.M., Schinnerer E., Thomson A.P.,
Walter F., Wardlow J.L., Weiss A., van der Werf P.P.

<Astrophys. J., 788, 125 (2014)>
=2014ApJ...788..125S (SIMBAD/NED BibCode)

ADC_Keywords: Galaxies, photometry ; Photometry, millimetric/submm ;
Photometry, UBVRIJKLMNH ; Redshifts
Keywords: galaxies: evolution - galaxies: high-redshift - galaxies: starburst

Abstract:
We present the first photometric redshift distribution for a large
sample of 870 μm submillimeter galaxies (SMGs) with robust
identifications based on observations with ALMA. In our analysis we
consider 96 SMGs in the Extended Chandra Deep Field South, 77 of which
have 4-19 band photometry. We model the SEDs for these 77 SMGs,
deriving a median photometric redshift of z_{phot}=2.3±0.1. The remaining
19 SMGs have insufficient photometry to derive photometric redshifts,
but a stacking analysis of Herschel observations confirms they are not
spurious. Assuming that these SMGs have an absolute

H-band magnitude
distribution comparable to that of a complete sample of z~1-2 SMGs,
we demonstrate that they lie at slightly higher redshifts, raising the
median redshift for SMGs to z_{phot}=2.5±0.2. Critically we show that
the proportion of galaxies undergoing an SMG-like phase at z≥3 is at
most 35%±5% of the total population. We derive a median stellar mass
of M_*=(8±1)x10^{10} $M_\odot$, although there are systematic
uncertainties of up to 5x for individual sources. Assuming that the
star formation activity in SMGs has a timescale of ~100 Myr, we show
that their descendants at z~0 would have a space density and M_H
distribution that are in good agreement with those of local ellipticals.
In addition, the inferred mass-weighted ages of the local ellipticals
broadly agree with the look-back times of the SMG events. Taken
together, these results are consistent with a simple model that
identifies SMGs as events that form most of the stars seen in the
majority of luminous elliptical galaxies at the present day.

Description:

In this study we undertake a multi-wavelength analysis of the
ALMA-detected submm galaxies from the catalog presented by Hodge et al.
(2013, J/ApJ/768/91) (see also Karim et al. 2013MNRAS.432....2K). To
briefly summarize the observations, we obtained 120 s integrations
of 122 of the original 126 LESS submm sources, initially identified
using the LABOCA camera on the APEX telescope (Weiss et al. 2009,

J/ApJ/707/1201). These Cycle 0 observations used the compact
configuration, yielding a median synthesized beam of ~1.6"x1.2". The
observing frequency was matched to the original LESS survey, 344 GHz
(Band 7), and we reach a typical rms across our velocity-integrated
maps of 0.4 mJy/beam.

File Summary:

FileName	Lrecl	Records	Explanations
ReadMe	80	.	This file
table1.dat	98	19	Summary of Photometry
table2.dat	214	96	Photometry
table3.dat	84	77	Derived Properties

See also:
J/ApJS/155/73 : Photometric redshifts of X-ray sources in CDF-S

(Zheng+, 2004)
J/ApJ/622/772 : Redshift survey of submillimeter galaxies (Chapman+, 2005)
J/ApJ/699/1610 : Spitzer survey of submillimeter galaxies (Hainline+, 2009)
J/ApJ/707/1201 : LABOCA ECDFS Submillimeter Survey (LESS) (Weiss+, 2009)
J/ApJS/191/124 : Optical spectroscopy of ECDF-S X-ray sources

(Silverman+, 2010)
J/ApJS/203/15 : Counterparts to 1.4GHz sources in ECDF-S (Bonzini+, 2012)
J/ApJ/768/91 : ALMA observations of LESS submm galaxies (Hodge+, 2013)
J/MNRAS/442/577 : Selected ALESS submm galaxies radio properties

(Thomson+, 2014)

Byte-by-byte Description of file: table1.dat

Bytes	Format	Units	Label	Explanations
1- 19	A19	---	Filter	Filter used in the observation
21- 24	F4.2	um	lambda	Effective wavelength
26- 29	F4.1	---	Limit	3σ detection limit in AB mag
31- 48	A18	---	r_Limit	Detection limit reference
50- 68	A19	---	Bibcode	Reference bibcode
70- 83	A14	---	Cat	Catalog reference in VizieR
85- 98	A14	---	Com	Comment on reference

Byte-by-byte Description of file: table2.dat

Bytes	Format	Units	Label	Explanations
1- 5	A5	---	---	[ALESS]
7- 11	A5	---	ALESS	SMG identifier (NN.NN; NNN.N) (1)
13	A1	---	f_ALESS	[a] Flag on ALESS (2)
15	A1	---	l_UMmag	[>] The 3σ upper limit on UMmag
17- 21	F5.2	mag	UMmag	? MUSYC U band magnitude
23- 26	F4.2	mag	e_UMmag	? Uncertainty in UMmag
28	A1	---	l_U38mag	[>] The 3σ upper limit on U38mag
30- 34	F5.2	mag	U38mag	? MUSYC U38 band magnitude
36- 39	F4.2	mag	e_U38mag	? Uncertainty in U38mag
41	A1	---	l_UVmag	[>] The 3σ upper limit on UVmag
43- 47	F5.2	mag	UVmag	? VIMOS U band magnitude
49- 52	F4.2	mag	e_UVmag	? Uncertainty in UVmag
54	A1	---	l_Bmag	[>] The 3σ upper limit on Bmag
56- 60	F5.2	mag	Bmag	? MUSYC WFI B band magnitude
62- 65	F4.2	mag	e_Bmag	? Uncertainty in Bmag
67	A1	---	l_Vmag	[>] The 3σ upper limit

on Vmag
  69- 73 F5.2 mag   Vmag   ? MUSYC WFI V band
magnitude
  75- 78 F4.2 mag   e_Vmag ? Uncertainty in Vmag
      80 A1   ---   l_Rmag [>] The 3σ upper limit
on Rmag
  82- 86 F5.2 mag   Rmag   ? MUSYC WFI R band
magnitude
  88- 91 F4.2 mag   e_Rmag ? Uncertainty in Rmag
      93 A1   ---   l_Imag [>] The 3σ upper limit
on Imag
  95- 99 F5.2 mag   Imag   ? MUSYC WFI I band
magnitude
 101-104 F4.2 mag   e_Imag ? Uncertainty in Imag
     106 A1   ---   l_zmag [>] The 3σ upper limit
on zmag
 108-112 F5.2 mag   zmag   ? MUSYC Mosaic-II z band
magnitude
 114-117 F4.2 mag   e_zmag ? Uncertainty in zmag
     119 A1   ---   l_Jmag [>] The 3σ upper limit
on Jmag
 121-125 F5.2 mag   Jmag   ? J band magnitude
(TENIS if nothing in f_Ksmag)
                                (3)
 127-130 F4.2 mag   e_Jmag ? Uncertainty in Jmag
 132-133 A2   ---   f_Jmag Flag on Jmag (4)
     135 A1   ---   l_Hmag [>] The 3σ upper limit
on Hmag
 137-141 F5.2 mag   Hmag   ? H band magnitude
 143-146 F4.2 mag   e_Hmag ? Uncertainty in Hmag
     148 A1   ---   l_Ksmag [>] The 3σ upper limit
on Ksmag
 150-154 F5.2 mag   Ksmag   ? K_s band magnitude
(TENIS if nothing
                                 in f_Ksmag) (3)
 156-159 F4.2 mag   e_Ksmag ? Uncertainty in Ksmag
 161-162 A2   ---   f_Ksmag [* **] Flag on Ksmag and
Jmag (4)
     164 A1   --- l_3.6mag [>] The 3σ upper limit
on 3.6mag
 166-170 F5.2 mag   3.6mag SIMPLE/IRAC 3.6 micron
band magnitude
 172-175 F4.2 mag e_3.6mag ? Uncertainty in 3.6mag
     177 A1   --- l_4.5mag [>] The 3σ upper limit

on 4.5mag
 179-183 F5.2 mag   4.5mag SIMPLE/IRAC 4.5 micron band magnitude
 185-188 F4.2 mag e_4.5mag ? Uncertainty in 4.5mag
     190 A1   --- l_5.8mag [>] The 3σ upper limit on 5.8mag
 192-196 F5.2 mag   5.8mag ? SIMPLE/IRAC 5.8 micron band magnitude
 198-201 F4.2 mag e_5.8mag ? Uncertainty in 5.8mag
     203 A1   --- l_8.0mag [>] The 3σ upper limit on 8.0mag
 205-209 F5.2 mag   8.0mag ? SIMPLE/IRAC 8.0 micron band magnitude
 211-214 F4.2 mag e_8.0mag ? Uncertainty in 8.0mag

Note (1): All photometry is left blank where a source is not covered by
  available imaging.
Note (2): Flag as follows:
  a = Source is within 4" of a 3.6 micron source of comparable, or greater,
      flux.
Note (3): We measure J and K_s photometry from three imaging surveys, but quote
  a single value, in order of 3σ detection limit (see Table 1).
Note (4): Flag as follows:
   * = Photometry measured from HAWK-I imaging;
  ** = Photometry measured from MUSYC imaging,
       otherwise photometry measured from TENIS imaging.

Byte-by-byte Description of file: table3.dat

Bytes	Format	Units	Label	Explanations
1- 5	A5	---	---	[ALESS]
7- 12	A6	---	ALESS	SMG identifier (NNN.NN)
14	A1	---	f_ALESS	[a] Flag on ALESS (1)
16- 17	I2	h	RAh	Hour of Right Ascension (J2000)

19- 20	I2	min	RAm	Minute of Right Ascension (J2000)
22- 26	F5.2	s	RAs	Second of Right Ascension (J2000)
28	A1	---	DE-	Sign of the Declination (J2000)
29- 30	I2	deg	DEd	Degree of Declination (J2000)
32- 33	I2	arcmin	DEm	Arcminute of Declination (J2000)
35- 38	F4.1	arcsec	DEs	Arcsecond of Declination (J2000)
40- 43	F4.2	---	zphot	Photometric redshift
45- 48	F4.2	---	E_zphot	Upper limit uncertainty in zphot
50- 53	F4.2	---	e_zphot	Lower limit uncertainty in zphot
55- 58	F4.2	---	zspec	? Spectroscopic redshift
60	A1	---	r_zspec	zspec reference (2)
62- 66	F5.2	---	Chi2	Reduced X^2
68- 69	I2	---	Detec	Number of detection
71- 72	I2	---	Obs	Number of observation
74- 79	F6.2	mag	HMag	Absolute H band AB magnitude
81- 84	F4.2	Msun/Lsun	M/L	H band mass-to-light ratio

Note (1): Flag as follows:
  a = As discussed in Section 3.2.1 these SMGs are potential gravitational
      lenses, or have significantly contaminated photometry. We advise that the
      photometric redshifts for these SMGs are treated with extreme caution.
Note (2): Reference as follows:
  b = Casey et al. (2011MNRAS.411.2739C);
  c = Zheng et al. (2004, J/ApJS/155/73);
  d = Swinbank et al. (2012MNRAS.427.1066S);
  e = Silverman et al. (2010, J/ApJS/191/124);
  f = Kriek et al. (2008ApJ...677..219K);
  g = Coppin et al. (2009MNRAS.395.1905C);
  h = Coppin et al. (2012MNRAS.427..520C); Danielson et

al. in prep;
  i = Bonzini et al. (2012, J/ApJS/203/15).

History:
    From electronic version of the journal

(End) Prepared by [AAS], Tiphaine Pouvreau [CDS] 17-Jul-2017