CANDELS GOODS-N Multiwavelength Catalog
Barro et al., 2019, ApJS, 243, 22

— Photometric Datasets

This a WFC3 F160W (H-band) selected catalog in the CANDELS/GOODS-N field containing photometry from the ultraviolet (UV) to the far-infrared (IR), photometric redshifts, and stellar parameters derived from the analysis of the multiwavelength data. The catalog contains 35,445 sources over the 171 arcmin^2 of the CANDELS F160W mosaic.The 5σ detection limits of the mosaic range between H = 27.8, 28.2, and 28.7 in the wide, intermediate, and deep regions, which span approximately 50%, 15%, and 35% of the total area. The multiwavelength photometry includes broadband data from:

- 9 HST bands (ACS F435W, F606W, F775W, F814W, and F850LP; HST/WFC3 F105W, F125W, F140W, and F160W)
- 4 Ground-based optical/NIR bands. (U, U', K, Ks)
- 25 Ground-based optical medium-bands from 500 — 941 nm (SHARDS).
- 4 Spitzer IRAC mid-IR bands (3.6μm, 4.5μm, 5.8μm, 8.0μm)
- 7 Spitzer+Herschel far-IR bands (24μm, 70μm, 100μm, 160μm, 250μm, 350μm, 500μm)

Filters	Telescope/Instrument	Survey	Reference
U	KPNO 4m/Mosaic	Hawaii HDFN	Capak et al. (2004)
U'	LBT/ LBC	-	Grazian et al. (2017)
25 medium-band optical	GTC / OSIRIS	SHARDS	Pérez-González et al. (2013)
F435W, F606W, F775W, F850LP	HST/ACS	GOODS	Giavalisco et al. (2004)
F814W	HST/ACS	CANDELS	Grogin et al. (2011); Koekemoer et al. (2011)
F105W, F125W, F160W	HST/WFC3	CANDELS	Grogin et al. (2011); Koekemoer et al. (2011)
F140W	HST/WFC3	AGHAST	GO: 11600 (PI: B. Weiner)
K_s	Subaru/MOIRCS	MODS	Kajisawa et al. (2011)
K	CFHT/Megacam	-	Hsu et al. (2019)
3.6, 4.5 μm	Spitzer/IRAC	SEDS	Ashby et al. (2013)
5.8, 8 μm	Spitzer/IRAC	GOODS	Dickinson et al. (2003)
24, 70 μm	Spitzer/MIPS	GOODS/FIDEL	Dickinson et al. (2003)
100, 160 μm	Herschel/PACS	PEP	Berta et al. (2011), Lutz et al. (2011)
250, 350, 500 μm	Herschel/SPIRE	GOODS/Herschel, HerMES	Oliver et al. (2012),Magnelli et al. (2013)

— Photometric and Value-Added Catalogs

In addition to the multiband photometry, we release value-added catalogs with emission-line fluxes, stellar masses, dust attenuations, UV- and IR-based star formation rates, and rest-frame colors. This data release consists of 30 catalogs:

- 4 Photometric catalogs (1 broad-band, 1 medium-band and 2 supplementary with SExtractor based properties)
- 2 Redshift catalogs (primary and supplementary photo-z's from the team calculations)
- 2 Stellar population properties catalogs (based on different codes)
- 2 Emission line catalogs (from the HST/G102 and G141 grism spectra)
- 5 Star formation rate catalogs (1 per field, based on UV and IR data)
- 15 Star formation rate flag catalogs (3 per field in corresponding to the MIPS, PACS and SPIRE bands).

1.- Photometric catalogs

hlsp_candels_hst_wfc3_goodsn-barro19_multi_v1-1_photometry-cat
hlsp_candels_hst_wfc3_goodsn-barro19_multi_v1-2_photometry-cat
hlsp_candels_hst_wfc3_goodsn-barro19_multi_v1-3_photometry-cat

Column No.	Column Title	Description
1	ID	Object identifier, beginning from 1
2	IAU Name	
3, 4	R.A., decl.	Right ascension and declination (J2000.0; decimal degrees)
5	FLAGS	SExtractor F160W flag used to designate suspicious sources that fall in contaminated regions
6	CLASS_STAR	SExtractor CLASS_STAR parameter in the F160W band
7	X-ray	X-ray ID from Alexander et al. (2003)
8–41	Flux, Flux_Err	Flux and flux in each filter. Sources that are not observed have (−99.00, −99.00, 0). Filters are included in order KPNO_U, LBC_U, F435W, F606W, F775W, F814W, F850LP, F105W, F125W, F160W, MOIRCS_Ks, CFHT_Ks, 3.6 μm, 4.5 μm, 5.8 μm, and 8.0 μm
1	ID	Object identifier, beginning from 1
2–10	FLUX_MAX	in *HST* bands
11–28	FLUX_ISO, FLUXERR_ISO	Isophotal flux and flux error in nine *HST* bands
29–46	FLUX_ISOCOR, FLUXERR_ISOCOR	Isophotal flux and flux error in nine *HST* bands
47–64	FLUX_AUTO, FLUXERR_AUTO	AUTO flux and flux error in nine *HST* bands
65–82	FLUX_PETRO, FLUXERR_PETRO	PETRO flux and flux error in nine *HST* bands
83–100	FLUX_BEST, FLUXERR_BEST	BEST flux and flux error in nine *HST* bands
101–280	FLUX_APER, FLUXERR_APER	APER flux and flux error in nine *HST* bands and 10 circular apertures of radius 1.47, 2.08, 2.94, 4.17, 5.88, 8.34, 11.79, 16.66, 23.57, 33.34, 47.13
1	ID	Object identifier, beginning from 1
2	X_IMAGE	Object position along x [pixel]
3	Y_IMAGE	Object position along y [pixel]
4	XPEAK_IMAGE	x coordinate of the brightest pixel [pixel]
5	YPEAK_IMAGE	y coordinate of the brightest pixel [pixel]
6	XMIN_IMAGE	Minimum x coordinate among detected pixels [pixel]
7	YMIN_IMAGE	Minimum y coordinate among detected pixels [pixel]
8	XMAX_IMAGE	Maximum x coordinate among detected pixels [pixel]
9	YMAX_IMAGE	Maximum y coordinate among detected pixels [pixel]
10	X2_IMAGE	Variance along x [pixel**2]
11	Y2_IMAGE	Variance along y [pixel**2]
12	XY_IMAGE	Covariance between x and y [pixel**2]
13	CXX_IMAGE	Cxx object ellipse parameter [pixel**(-2)]
14	CYY_IMAGE	Cyy object ellipse parameter [pixel**(-2)]
15	CXY_IMAGE	Cxy object ellipse parameter [pixel**(-2)]
16, 17	A_IMAGE, B_IMAGE	F160W profile rms along major and minor axes (pixel)
18, 19	ERRA_IMAGE, ERRB_IMAGE	F160W profile rms along major and minor axes (pixel)
20, 21	THETA_IMAGE, ERRTHETA_IMAGE	F160W position angle (degree)
22	ISOAREAF_IMAGE	SExtractor F160W isophotal area (filtered) above detection threshold (pixel^2)
23–31	ISOAREA_IMAGE	SExtractor isophotal area (filtered) above detection threshold (pixel^2) in *HST* bands
32–40	BACKGROUND	Background at centroid position in *HST* bands
41–49	FLUX_RADIUS_1	RADIUS_1 with the 0.2 fraction of light in *HST* bands
50–58	FLUX_RADIUS_2	RADIUS_2 with the 0.5 fraction of light in *HST* bands
59–67	FLUX_RADIUS_3	RADIUS_3 with the 0.8 fraction of light in *HST* bands
68–76	FWHM_IMAGE	FWHM of the image of an object, in units of pixel (1 pixel = 0$''$06) in *HST* bands
77	KRON_RADIUS	F160W band Kron radius from SExtractor (in unit of A_IMAGE or B_IMAGE)
78	PETRO_RADIUS	F160W band Petrosian radius from SExtractor (in unit of A_IMAGE or B_IMAGE)

Notes —
Flags : Regarding the F160W detection band
`0’: Non-contaminated source. `2’: Source detected at the image edges or on the few artifacts of the f160w image. `1’: Sources detected on star spikes, halos and the bright stars producing them.

2.- SHARDS photometric catalog

hlsp_candels_hst_wfc3_goodsn-barro19_multi_v1_photometry-shards-cat

The SHARDS optical imaging data has a particular characteristic that has to be taken into account to obtain accurate SEDs: the passband of the filter seen by different parts of the detector changes, getting bluer as we move away from the optical axis. Therefore, every galaxy in SHARDS counts with a unique set of SHARDS passbands, which are defined by their transmission curves (whose shapes do not change and, therefore, are the same for all galaxies) and their central wavelengths (which change and must be provided for each galaxy). In order to properly account for this effect, the SHARDS photometry of the F160W sources is provided in a separate catalog (see table below) which includes the central wavelength for each galaxy and filter. Furthermore, the SHARDS science images in each of the 25 filters, which are released with this paper, are provided jointly with a map of the central wavelength for each pixel that can be used to account for the wavelength shift (see Pérez-González et al. 2013 for more details).

Column No.	Column Title	Description
1	ID	Object identifier, beginning from 1
2–76	Flux, Flux_Err, Eff_wav	Flux, flux error, and central effective wavelength (CWL) in each of the 25 SHARDS filters. Values of Flux > 0 with Flux_Err = 0 indicate upper limits for non-detected sources. Values of Flux = 0 and Flux_Err = 0 indicate that the source is not observed. The CWL is a function of the position of the object in the SHARDS mosaic (see Section 2.2.2)

Central wavelengths for the 25 SHARDS filters

Filter	CWL (nm)	Width (nm)
F500W17	500.0	15.0
F517W17	517.0	16.5
F534W17	534.0	17.7
F551W17	551.0	13.8
F568W17	568.0	14.4
F585W17	585.0	15.1
F602W17	602.0	15.5
F619W17	619.0	15.8
F636W17	638.4	15.4
F653W17	653.1	14.8
F670W17	668.4	15.3
F687W17	688.2	15.3
F704W17	704.5	17.1
F721W17	720.2	18.2

Filter	CWL (nm)	Width (nm)
F738W17	737.8	15.0
F755W17	754.5	14.8
F772W17	770.9	15.4
F789W17	789.0	15.5
F806W17	805.6	15.6
F823W17	825.4	14.7
F840W17	840.0	15.4
F857W17	856.4	15.8
F883W35	880.3	31.7
F913W25	913.0	27.8
F941W33	941.0	33.3

Note. https://guaix.fis.ucm.es/~pgperez/SHARDS/Filters

3.- Redshift catalog

hlsp_candels_hst_wfc3_goodsn-barro19_multi_v1_redshift-cat

The number of available spectrophotometric data sets for any given galaxy (i.e., whether they have SHARDS and/or grism data) depends on its magnitude and its location within the WFC3 mosaic. Therefore, we implemented a three-tier classification ('ztier_class') for the best photometric redshift estimates ('ztier') with increasing spectral resolution data. Tier 3 consists of photometric redshifts determined from broadband photometry only. Tier 2 redshifts are based on the SED fitting to both broadband and SHARDS medium-band data. Tier 1 redshifts include broad- and medium-band data plus the WFC3 grism spectra. Roughly ~80% of the galaxies in the catalog lie in the region of GOODS-N covered by the SHARDS medium-band survey, and a large fraction of those, ~60% at H<24 mag, also have grism detections in either G141 or G102.

The default option for the best redshift is 'zbest' which is equal to 'zspec', when available with good quality flag ('zspecflag'<3), or to 'ztier' otherwise.

Column No.	Column Name	Description
1	id	Object identifier
2	zspec	Spectroscopic redshift
3	zpecflag	Spectroscopic redshift quality flag (1—most reliable, 2—reliable, 3—unreliable)
4	zref	Original reference for the spectroscopic redshift
5	ztier	Best photometric redshift from the three-tiered estimate
6	ztier_err	Uncertainty in ztier computed from the 68% confidence region of the PDFz
7	ztier_class	Classification of ztier: 1—Broadband only, 2—Broadband and SHARDS, 3—Broadband, SHARDS, and WFC3 grism
8	zbest	Best redshift estimate from zspec, if available and with flag <3, or ztier

Notes —
References for the spectroscopic redshifts are from: Cowie et al. (2004), Chapman et al. (2005), Reddy et al. (2006), Barger et al. (2008), Ferreras et al. (2008), Poper et al. (2008), Daddi et al. (2009), Najino et al. (2009), Pirkzal et al. (2013), Wirth et al. (2015) and Kriek et al. (2015).

4.- Supplementary photometric redshift catalog

hlsp_candels_hst_wfc3_goodsn-barro19_multi_v1_supplemetary-photoz-cat

The redshifts given in this table are the supplementary photometric redshift estimates computed by five different investigators **using only broadband data**. For these particular estimates, homogeneity in the input photometric data was preferred over quality of the photo-z. The latter can be improved by adding higher spectral resolution data (as in the three-tier method), but such data are only available for smaller subsets of the whole sample.

Column No.	Column ID.
1	id
2	zphot_finkelstein
3	zphot_finkelstein_inf68
4	zphot_finkelstein_sup68
5	zphot_salvato
6	zphot_salvato_inf68
7	zphot_salvato_sup68
8	zphot_fontana
9	zphot_fontana_inf68
10	zphot_fontana_sup68
11	zphot_wuyts
12	zphot_wuyts_inf68
13	zphot_wuyts_sup68
14	zphot_wiklind
15	zphot_wiklind_inf68
16	zphot_wiklind_sup68

The codes and assumptions used by each different investigator are the following: Finkelstein, using EAZY based on the standard templates with emission lines plus an additional high-z galaxy template (BX14 from Erb et al. 2010); Salvato, using Lephare (Arnouts & Ilbert 2011) based on BC03+Polleta AGN templates without emission lines; Fontana, using zphot (Fontana et al. 2000) based on BC03 templates with emission lines; Wuyts, using EAZY based on the standard templates with emission lines; and Wiklind, using WikZ from Wiklind et al. (2008) based on BC03 templates without emission lines.

5.- Stellar population properties catalog from FAST

hlsp_candels_hst_wfc3_goodsn-barro19_multi_v1_mass-fast-cat

Column No.	Column ID.	Description
1	id	Object identifier
2	z	=zbest from Table 7
3	ltau	log[tau/yr]
4	metal	metallicity (fixed to 0.020)
5	lage	log[age/yr]
6	Av	dust reddening
7	lmass	$\log[M/M_{\odot}]$
8	lsfr	$\log[\mathrm{SFR}/(M_{\odot}/\mathrm{yr})]$
9	lssfr	log[sSFR(/yr)]
10	la2t	$\log[\mathrm{age}/\tau]$
11	chi2	minimum χ^2
12	M_U	abs. magnitude in Johnson U
13	M_V	abs. magnitude in Johnson V
14	M_J	abs. magnitude in 2MASS J

6. - Stellar population properties catalog from Synthesizer

hlsp_candels_hst_wfc3_goodsn-barro19_multi_v1_mass-synthesizer-cat

Column No.	Column ID.	Description
1	id	Object identifier
2	z	=zbest from Table 7
3	ltau	log[tau/yr]
4	metal	metallicity (fixed to 0.020)
5	lage	log[age/yr]
6	Av	dust reddening
7	lmass	$\log[M/M_{\odot}]$

7.- Emission line catalog based on G102 and G141 spectra

hlsp_candels_hst_wfc3_goodsn-barro19_multi_v1_emission-line-grism-g102-cat
hlsp_candels_hst_wfc3_goodsn-barro19_multi_v1_emission-line-grism-g141-cat

Column name	Description
id	Object identifier
z	Grism redshift used in the emission-line fit, identical to `ztier` in the redshift catalog
X_FLUX	Emission-line flux in units of 10^{-17} ergs s^{-1} cm^{-2}
X_ERR	Error in the emission-line flux in units of 10^{-17} ergs s^{-1} cm^{-2}
X_SCALE	Multiplicative scaling factor to correct the flux of the emission line to the photometry
X_EQW	Emission-line equivalent width in Å

Note. X = emission-line name, as given in the accompanying table.

Line	Catalog ID	Rest Wavelength (Å)	Ratio
Lyα	Lya	1215.400	…
C IV	C IV	1549.480	…
Mg II	Mg II	2799.117	…
Ne V	Ne V	3346.800	…
Ne VI	Ne VI	3426.850	…
[O II]	O II	3729.875	…
[Ne III]	Ne III	3869.000	…
He I	He Ib	3889.500	…
Hδ	Hd	4102.892	…
Hγ	Hg	4341.680	…
[O III]	O IIIx	4364.436	…
He II	He II	4687.500	…
Hβ	Hb	4862.680	…
[O III]	O III	5008.240, 4960.295	2.98:1
He I	He I	5877.200	…
[O I]	O I	6302.046	…
Hα	Ha	6564.610	…
[S II]	S II	6718.290, 6732.670	1:1
S III	S III	9068.600, 9530.600	1:2.44

8.- Mid-to-far IR photometry and UV+IR SFR catalogs (in the 5 CANDELS fields)

hlsp_candels_hst_wfc3_goodsn-barro19_multi_v1_sfr-gdn-cat
hlsp_candels_hst_wfc3_goodss-barro19_multi_v1_sfr-gds-cat
hlsp_candels_hst_wfc3_cosmos-barro19_multi_v1_sfr-cos-cat
hlsp_candels_hst_wfc3_uds-barro19_multi_v1_sfr-uds-cat
hlsp_candels_hst_wfc3_egs-barro19_multi_v1_sfr-egs-cat

This tables contain Spitzer+Herschel mid-to-far IR fluxes, dust attenuations, and SFRs, based on different tracers, for all sources in the five CANDELS fields.

The **mid-to-far IR fluxes** are computed for sources detected on the Spitzer/MIPS, and Herschel/PACS and SPIRE images and then assigned to their most likely counterparts in the F160W-selected CANDELS catalogs. By construction, there is only one possible F160W counterpart to each detection in an FIR band (secondary counterparts within different cross matching radius are given in the Flag catalog).

	$\mathcal{F}_{\rm lim}$ [μJy]		$\mathcal{F}_{\rm lim}$ [mJy]				
	Spitzer/MIPS		*Herschel*/PACS		*Herschel*/SPIRE		
Field	24μm	70μm	100μm	160μm	250μm	350μm	500μm
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
GOODS-N	30	2500	1.6	3.6	9.0	12.9	12.6
GOODS-S	30	2500	1.1	3.4	8.3	11.5	11.3
EGS	45	3500	8.7	13.1	14.7	17.3	17.9
COSMOS	70	-	2.9	6.6	11.0	9.6	11.2
UDS	70	-	14.4	26.7	19.4	19.2	20.0

5-sigma limiting fluxes per field and band

The **UV+IR SFRs** are computed using a self-consistent combination of three SFR tracers: the ultraviolet (UV), the mid-, and the far-infrared emission. Briefly, these tracers are joined using a SFR ladder method, similar to the one described in Wuyts et al. (2011a), that can be cross-calibrated on relatively massive galaxies with intermediate dust attenuations and low IR fluxes. The first step of the ladder relies on UV data only, which is available for most galaxies but prone to larger uncertainties in dust obscured galaxies. The second step is based on UV and mid-IR data from MIPS 24 which is typically available for relatively massive galaxies up to z~3. The mid-IR data traces the absorbed UV emission, re-radiated in the IR by the obscuring dust, and provides a more accurate estimate of the ongoing SFR. The third and most accurate step is based on UV and Spitzer+Herschel mid-to-far IR data, which allows a more accurate characterization of the dust IR emission of the galaxies and, consequently, of the SFR.

A novelty of the SFRs in this catalog is that the UV-only SFRs are not computed using a UV attenuation derived from the fitting of the optical-to-NIR spectral energy distribution to stellar population models. Instead, we compute an attenuation correction derived empirically from the analysis of the ratio of IR to UV luminosities vs. the UV-slope (IRX-beta relations).

Column No.	Column Title	Description
1	id	Object identifier
2	z	Photometric redshift used in the IR SED fitting, corresponds to `zbest` in the redshift catalog
3 − 16	Flux, Flux_Err	Flux and flux error in each filter. Filters are included in order: MIPS 24 and 70 μm, PACS 100 and 160 μm and SPIRE 250, 350 and 500 μm [μJy]. Galaxies without IR detections have upper limits in MIPS24 with Flux = 20–70 [μJy] (see Table 13) and Flux_Err = 0. Upper limits in MIPS24 are used to estimate upper limits in SFR-IR, indicated with negative values.
17	$\mathrm{SFR}_{\mathrm{total}}^{\mathrm{ladder}}$	Use as default SFR. Best estimate of the total SFR: either $\mathrm{SFR}_{\mathrm{IR}}+\mathrm{SFR}_{\mathrm{UV}}^{\mathrm{obs}}$ for IR detected sources or $\mathrm{SFR}_{\mathrm{UV}}^{\mathrm{corr}}$ for the rest.
18	SFR_ladder_type	Type of SFR indicators used in $\mathrm{SFR}_{\mathrm{total}}^{\mathrm{ladder}}$: 1 for $\mathrm{SFR}_{\mathrm{total}}^{\mathrm{ladder}} = \mathrm{SFR}_{\mathrm{IR}}^{\mathrm{fit}} + \mathrm{SFR}_{\mathrm{UV}}^{\mathrm{obs}}$ 2 for $\mathrm{SFR}_{\mathrm{total}}^{\mathrm{ladder}} = \mathrm{SFR}_{\mathrm{IR}}^{\mathrm{W11}} + \mathrm{SFR}_{\mathrm{UV}}^{\mathrm{obs}}$ 3 for $\mathrm{SFR}_{\mathrm{total}}^{\mathrm{ladder}} = \mathrm{SFR}_{\mathrm{UV}}^{\mathrm{corr}}$
19	$\mathrm{SFR}_{\mathrm{UV}}^{\mathrm{corr}}$	UV-based star formation rate corrected for extinction using the IRX-β_{UV} relations. This value is a weighted average of $\mathrm{SFR}_{\mathrm{UV}}^{\mathrm{corr}}$ (160) and $\mathrm{SFR}_{\mathrm{UV}}^{\mathrm{corr}}$(280)
20	$\mathrm{SFR}_{\mathrm{UV}}^{\mathrm{corr}}$_Err	Uncertainty in the UV-based star formation rate corrected for extinction.
21	$\mathrm{SFR}_{\mathrm{IR}}$	IR-based star formation rate. This value is equal to: $\mathrm{SFR}_{\mathrm{IR}} = \mathrm{SFR}_{\mathrm{IR}}^{\mathrm{fit}}$ when SFR_ladder_type = 1. $\mathrm{SFR}_{\mathrm{IR}} = \mathrm{SFR}_{\mathrm{IR}}^{\mathrm{W11}}$ when SFR_ladder_type = 2. $\mathrm{SFR}_{\mathrm{IR}} = -\mathrm{SFR}_{\mathrm{IR}}^{\mathrm{W11}}$ when SFR_ladder_type = 3 (based on upper limits in MIPS24).
22	$\mathrm{SFR}_{\mathrm{UV}}^{\mathrm{obs}}$(160)	UV-based star formation rate not corrected for extinction determined from the UV luminosity at 160 nm.
23	$\mathrm{SFR}_{\mathrm{UV}}^{\mathrm{obs}}$(280)	UV-based star formation rate not corrected for extinction determined from the UV luminosity at 280 nm.
24	β_{UV}	UV slope
25	A_{UV} (160)	UV attenuation derived from the IRX-β_{UV} calibration for $\mathrm{SFR}_{\mathrm{UV}}^{\mathrm{obs}}$(160)
26	A_{UV} (280)	UV attenuation derived from the IRX-β_{UV} calibration for $\mathrm{SFR}_{\mathrm{UV}}^{\mathrm{obs}}$(280)
27	A(V)	Optical attenuation in the V-band derived from A_{UV} by assuming a Calzetti et al. (2000) attenuation law.
28	$\mathrm{SFR}_{\mathrm{IR}}^{\mathrm{W11}}$	IR-based star formation rate derived from the MIPS 24 μm flux following Calzetti et al. (2000).
29	$\mathrm{SFR}_{\mathrm{UV}}^{\mathrm{corr}}$(160)	UV-based star formation rate corrected for extinction using the IRX-β_{UV} relations determined from the UV luminosity at 160 nm.
30	$\mathrm{SFR}_{\mathrm{UV}}^{\mathrm{corr}}$(280)	UV-based star formation rate corrected for extinction using the IRX-β_{UV} relations determined from the UV luminosity at 280 nm.

9.- SFR Flags catalogs (in the 5 CANDELS fields — 3 per field: MIPS, PACS, SPIRE)

hlsp_candels_hst_wfc3_<field>-barro19_v1_sfr-flag-mips-xxx-cat
hlsp_candels_hst_wfc3_<field>-barro19_v1_sfr-flag-pacs-xxx-cat
hlsp_candels_hst_wfc3_<field>-barro19_v1_sfr-flag-spire-xxx-cat

This table provides mid-to-far IR photometric and proximity flags that can be used to clean the SFR catalog or to apply more restrictive conditions on the sources with IR detections.

Note that, while in SFR table there is only one possible F160W counterpart to each detection in an FIR band, these catalogs lists all the possible F160W counterparts to a given FIR source (in MIPS, PACS, and SPIRE), indicating their likelihood (from 1 to N) of being the primary counterpart to the IR detection. Only the F160W sources with the maximum likelihood (e.g., MIPS_order = 1) have IR fluxes in SFR table. The total number of F160W counterparts to a given IR source as well as their distances to such source and their respective IRAC fluxes are also indicated. In addition to the F160W multiplicity for a given FIR source, the catalog lists the multiplicity of that source in all other mid- to-far-IR bands up to itself. These multiplicities are computed for several cross-match radius relative to the typical spatial resolution of the FIR band (e.g., radius of 0.5, 1, 2, or 3 × the FWHM of the PSF). For the example, the MIPS flag catalog includes the multiplicities of F160W, IRAC, and MIPS sources within different radii. The PACS flag catalog includes multiplicities of F160W, IRAC, MIPS, and PACS sources, etc. The values in the flag catalogs provide a quick and simple way to find relative isolated FIR sources, or to identify FIR sources in crowded environments, which might lead to some contamination in the photometry.

Column No.	Column Title	Description
1	id	Object identifier in the F160W catalog
2	MIPS_ID_order	ID of the MIPS24 counterpart in the catalog from Pérez-González et al. (2008) Multiple F160W counterparts can be associated with this source; the order of likelihood is indicated by _1, _2, etc.
3	MIPS_discriminator	Criteria used to determine the likelihood order of the F160W counterparts to a MIPS source: mips24, irac3.6, irac8.0, dist There is only one counterpart within $2\farcs5$ (mips24), or the primary counterpart is the brightest in this IRAC band or it is the closest in coordinates (dist)
4–9	Flux, Flux_Err	Flux and flux error in the MIPS24, IRAC80, and IRAC36 filters in units of μJy.
10	MIPS_distance	Distance between the F160W source and the closest MIPS source in arcseconds.
11	MIPS_order	Likelihood of the F160W source being the true counterpart of the MIPS source. From 1 to N, with 1 being the highest.
12	MIPS_n_counterparts	Number of F160W counterparts candidates for the closest MIPS source within $2\farcs5$.
13	MIPS24_snr_cuts	Flag regarding the S/N cuts applied in MIPS24: 0—no flux, 1 flux $>$ S/N limit, −1 flux $<$ S/N limit. Only sources with flag $>$ 0 are included in Table 17.
14–18	N_F160W_MIPS24_PSF	Number of F160W counterparts within 1, 0.5, 0.25, 2, and 3 times the size of the MIPS24 PSF ($2\farcs0$) around the MIPS24 primary.
19–23	N_F160W_MIPS24_WCS	Number of F160W counterparts within 1, 0.5, 0.25, 2, and 3 times the size of the WCS accuracy of the MIPS24 mosaic ($2\farcs0$) around the MIPS24 primary.
24–28	N_MIPS24_MIPS24_PSF	Number of MIPS24 counterparts within 1, 0.5, 0.25, 2, and 3 times the size of the MIPS24 PSF ($2\farcs0$) around the MIPS24 primary.
29–33	N_MIPS24_MIPS24_WCS	Number of MIPS24 counterparts within 1, 0.5, 0.25, 2, and 3 times the size of the WCS accuracy of the MIPS24 mosaic ($2\farcs0$) around the MIPS24 primary.
34–38	N_IRAC36_MIPS24_PSF	Number of IRAC36 counterparts within 1, 0.5, 0.25, 2, and 3 times the size of the MIPS24 PSF ($2\farcs0$) around the MIPS24 primary.
39–43	N_IRAC36_MIPS24_WCS	Number of IRAC36 counterparts within 1, 0.5, 0.25, 2, and 3 times the size of the WCS accuracy of the MIPS24 mosaic ($2\farcs0$) around the MIPS24 primary.

1	id	Object identifier in the F160W catalog
2	PACS_ID_order	ID of the PACS counterpart in the catalog from Pérez-González et al. (2008, 2010) Multiple F160W counterparts can be associated with this source; the order of likelihood is indicated by _1, _2, etc.
3	PACS_discriminator	Criteria used to determine the likelihood order of the F160W counterparts to a PACS source: pacs160, pacs100, mips24, irac3.6, irac8.0, dist There is only one counterpart within $3\farcs0$ (pacs160/pac100), or the primary counterpart is the brightest in this MIPS/IRAC band or it is the closest in coordinates (dist)
4–13	Flux, Flux_Err	Flux and flux error in the PACS160, PACS100, MIPS24, IRAC80, IRAC36 filters. In units of μJy.
14	PACS_distance	Distance between the F160W source and the closest PACS source within $3\farcs0$.
15	PACS_order	Likelihood of the F160W source being the true counterpart of the PACS source. From 1 to N, with 1 being the highest.
16	PACS_n_counterparts	Number of F160W counterparts candidates for the closest PACS source (IN WHICH RADIUS).
17	PACS100_snr_cuts	Flag regarding the S/N cuts applied in PACS100: 0—no flux, 1 flux $>$ S/N limit, −1 flux $<$ S/N limit. Only sources with flag $>$ 0 are included in Table 17.
18	PACS160_snr_cuts	Flag regarding the S/N cuts applied in PACS160: 0—no flux, 1 flux $>$ S/N limit, −1 flux $<$ S/N limit. Only sources with flag $>$ 0 are included in Table 17.
19–28	N_F160W_PACS_PSF	Number of F160W counterparts within 1, 0.5, 0.25, 2, and 3 times the size of the PACS100 and PACS160 PSF ($4\farcs5$/$7\farcs0$) around the PACS primary.
29–38	N_F160W_PACS_WCS	Number of F160W counterparts within 1, 0.5, 0.25, 2, and 3 times the size of the WCS accuracy of the PACS100 and PACS160 mosaics ($2\farcs0$/$2\farcs5$) around the PACS primary.
39–48	N_PACS_PACS_PSF	Number of PACS counterparts within 1, 0.5, 0.25, 2, and 3 times the size of the PACS100 and PACS160 PSF ($4\farcs5$/$7\farcs0$) around the PACS primary.
49–58	N_PACS_PACS_WCS	Number of PACS counterparts within 1, 0.5, 0.25, 2, and 3 times the size of the WCS accuracy of the PACS100 and PACS160 mosaics ($2\farcs0$/$2\farcs5$) around the PACS primary.
59–68	N_MIPS24_PACS_PSF	Number of MIPS24 counterparts within 1, 0.5, 0.25, 2, and 3 times the size of the PACS100 and PACS160 PSF ($4\farcs5$/$7\farcs0$) around the PACS primary.
69–78	N_MIPS24_PACS_WCS	Number of MIPS24 counterparts within 1, 0.5, 0.25, 2, and 3 times the size of the WCS accuracy of the PACS100 and PACS160 mosaics ($2\farcs0$/$2\farcs5$) around the PACS primary.
79–88	N_IRAC36_PACS_PSF	Number of IRAC36 counterparts within 1, 0.5, 0.25, 2, and 3 times the size of the PACS100 and PACS160 PSF ($4\farcs5$/$7\farcs0$) around the PACS primary.
89–98	N_IRAC36_PACS_WCS	Number of IRAC36 counterparts within 1, 0.5, 0.25, 2, and 3 times the size of the WCS accuracy of the PACS100 and PACS160 mosaics ($2\farcs0$/$2\farcs5$) around the PACS primary.

1	id	Object identifier in the F160W catalog
2	SPIRE_ID_order	ID of the SPIRE counterpart in the catalog from Pérez-González et al. (2008, 2010)
		Multiple F160W counterparts can be associated with this source the order of likelihood is indicated with _1, _2, etc.
3	SPIRE_discriminator	Criteria used to determine the likelihood order of the F160W counterparts to a SPIRE source: spire500, spire350, spire250, pacs160, pacs100, mips24, irac3.6, irac8.0, dist
		There is only one counterpart within 9.″0 (spire500, 350, 250), or the primary counterpart is the brightest in this PACS/MIPS/IRAC band, or it is the closest in coordinates (dist)
4–19	Flux, Flux_Err	Flux and flux error in the PACS160, PACS100, MIPS24, IRAC80, IRAC36 filters. In units of μJy.
20	SPIRE_distance	Distance between the F160W source and the closest SPIRE source in arcseconds.
21	SPIRE_order	Likelihood of the F160W source being the true counterpart of the SPIRE source. From 1 to N, with 1 being the highest.
22	SPIRE_n_counterparts	Number of F160W counterparts candidates for the closest SPIRE source within 9.″0.
23	SPIRE250_snr_cuts	Flag regarding the S/N cuts applied in SPIRE250: 0—no flux, 1 flux $>$ S/N limit, -1 flux $<$ S/N limit. Only sources with flag > 0 are included in Table 17.
24	SPIRE350_snr_cuts	Flag regarding the S/N cuts applied in SPIRE350: 0—no flux, 1 flux $>$ S/N limit, -1 flux $<$ S/N limit. Only sources with flag > 0 are included in Table 17.
25	SPIRE500_snr_cuts	Flag regarding the S/N cuts applied in SPIRE500: 0—no flux, 1 flux $>$ S/N limit, -1 flux $<$ S/N limit. Only sources with flag > 0 are included in Table 17.
26–30	N_F160W_SPIRE_PSF	Number of F160W counterparts within 1, 0.5, 0.25, 2, and 3 times the size of the SPIRE250, SPIRE 350, and SPIRE500 PSF (11.″0/11.″0/17.″0) around the SPIRE primary.
41–55	N_F160W_SPIRE_WCS	Number of F160W counterparts within 1, 0.5, 0.25, 2, and 3 times the size of the WCS accuracy of the SPIRE250, SPIRE 350, and SPIRE500 mosaics (9.″0/9.″0/15.″0) around the SPIRE primary.
56–70	N_SPIRE_SPIRE_PSF	Number of SPIRE counterparts within 1, 0.5, 0.25, 2, and 3 times the size of the SPIRE250, SPIRE 350, and SPIRE500 PSF (11.″0/11.″0/17.″0) around the SPIRE primary.
71–85	N_SPIRE_SPIRE_WCS	Number of SPIRE counterparts within 1, 0.5, 0.25, 2, and 3 times the size of the WCS accuracy of the SPIRE250, SPIRE 350, and SPIRE500 mosaics (9.″0/9.″0/15.″0) around the SPIRE primary.
86–100	N_PACS_SPIRE_PSF	Number of PACS counterparts within 1, 0.5, 0.25, 2, and 3 times the size of the SPIRE250, SPIRE 350, and SPIRE500 PSF (11.″0/11.″0/17.″0) around the SPIRE primary.