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The GOGREEN and GCLASS Surveys: Second Data Release

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ABSTRACT
This describes the second public data release of the GOGREEN and GCLASS surveys of galaxies in dense environments at $0.8 < z < 1.5$. The most significant difference from the first release is the inclusion of photometric catalogues for SpARCS1033 at $z = 1.461$, which were not available at the time of DR1. This release also includes some clarifications and the correction of several minor errors. It includes all the same components as DR1, including fully reduced images and spectra, with catalogues of advanced data products including redshifts, line strengths, star formation rates, stellar masses and rest-frame colours. The release can be obtained from CADC and from NOIRLab.

Key words: Galaxies: evolution, Galaxies: clusters

1 INTRODUCTION

This paper describes the second public data release (DR2) of two galaxy redshift surveys: the Gemini CLuster Astrophysics Spectroscopic Survey (GCLASS; Muzzin et al. 2012) and the Gemini Observations of Galaxies in Rich Early Environments (GOGREEN) survey (Balogh et al. 2017). Both surveys are founded on extensive multiobject spectroscopy of galaxy clusters with the Gemini telescopes: GCLASS covering a redshift range $0.8 < z < 1.3$ and GOGREEN spanning an overlapping $1 < z < 1.5$. There are five clusters in common between the two surveys, with the additional GOGREEN spectroscopy extending the sample to lower stellar masses. In total the two surveys target 26 unique galaxy groups and clusters. The publication describing the first data release (Balogh et al. 2021, hereafter DR1) provides details about the survey science, design, data reduction and data products. Publications based on these data should cite that paper.

At the time of DR1, the K-band imaging for one cluster, SpARCS1033, had not yet been completed. As the photometric catalogues are selected in the K-band, no such catalogues were released for that cluster. The data reduction and analysis of this final cluster were presented in Hewitt et al. (2025, in preparation). The main motivation for this second release is to provide the catalogues for this final cluster, thus completing the survey. We also take the opportunity with this release to provide some clarifications and minor corrections to the catalogues.

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2 PUBLIC DATA RELEASE CONTENTS

All catalogues, including the full K_s-selected photometric catalogues, and reduced data (images and spectroscopy) are available via the CADC (https://www.cadc-ccda.hia-iha.nrc-cnrc.gc.ca/en/community/gogreen), and NSF's NOIRLab (https://datalab.noao.edu/gogreendr2/). Pointers to these catalogues and other information can currently be found on the GOGREEN web page at http://gogreensurvey.ca/data-releases/data-packages/gogreen-and-gclass-second-data-release/.

2.1 The cluster sample

In Table 1 we list the central coordinates and redshifts of all clusters in the sample, unchanged from DR1 (Table 1 therein). We also provide the total number of good (quality three or greater) redshifts, the number of those that come from GOGREEN or GCLASS spectroscopy, and a simple estimate of the total number of members. The latter is simply those galaxies with $|\Delta z/(1+z)| < 0.02$, regardless of distance from the cluster centre. Finally, the table also includes information about the associated $K-$band image quality and depth, and the corresponding stellar mass limit for quiescent galaxies.

Velocity dispersions for some of the clusters have been computed using various subsamples and methods in the literature. In Table 2 we compile all these, for convenience. The first entry represents simply the standard deviation of all cluster members, defined as above to be those with $|\Delta z/(1+z)| < 0.02$. A 2- or 2.5-σ clipping is used (depending on the system), and the uncertainties are 68% confidence levels from bootstrap resampling. We only provide numbers for systems with at least twenty members. The accompanying Jupyter notebook provides code to replicate these numbers.

Name	RA (J2000)	Dec (J2000)	z	N_z	N_{GG}	N_{mem}	IQ (K_s) [″]	$K_{s,lim}$ [mag_{AB}]	$M_{\star,lim}$ [$M_\odot$]
SPT Clusters									
SPT-CL J0546-5345	86.6562	-53.7580	1.068	101	60	68	0.64	23.47	9.90
SPT-CL J2106-5844	316.5191	-58.7411	1.126	80	67	53	0.42	23.19	9.79
SPT-CL J0205-5829	31.4390	-58.4829	1.323	78	61	31	0.75	23.25	9.9
SpARCS Clusters									
SpARCS0034-4307	8.6751	-43.1315	0.867	84	84	38	1.01	21.53	10.42
SpARCS0036-4410	9.1875	-44.1805	0.869	110	110	60	1.59	22.11	10.53
SpARCS1613+5649	243.3110	56.8250	0.871	129	129	88	0.81	22.55	9.97
SpARCS1047+5741	161.8890	57.6871	0.956	125	125	47	0.61	22.68	10.17
SpARCS0215-0343	33.8500	-3.7256	1.004	88	88	52	1.00	21.73	10.45
SpARCS1051+5818	162.7968	58.3009	1.034	176	171	51	0.72	24.17	9.35
SpARCS1616+5545	244.1718	55.7571	1.157	201	188	69	0.75	23.76	9.59
SpARCS1634+4021	248.6475	40.3643	1.177	151	150	68	0.65	24.01	9.50
SpARCS1638+4038	249.7152	40.6452	1.194	141	135	62	0.71	23.94	9.54
SpARCS0219-0531	34.9316	-5.5249	1.328	252	56	12	0.73	23.27	9.90
SpARCS0035-4312	8.9571	-43.2068	1.335	207	120	28	0.39	23.81	9.70
SpARCS0335-2929	53.7649	-29.4822	1.368	107	63	30	0.58	22.91	10.07
SpARCS1034+5818	158.70560	58.3092	1.388	45	40	14	0.58	24.22	9.55
SpARCS1033+5753	158.3565	57.8900	1.460	67	59	11	0.8	23.89	9.74
COSMOS/SXDF Clusters									
SXDF64XGG	34.3319	-5.2067	0.916	11	11	8	0.71	25.3	8.9
SXDF49XGG	34.4996	-5.0649	1.091	81[1]	81	14	0.71	25.3	8.9
COSMOS-63	150.3590	1.9352	1.1722	24	24	16	0.75	23.7	9.5
SXDF76bXGG	34.7474	-5.3235	1.182	72[2]	72	7	0.71	25.3	8.9
COSMOS-221	150.5620	2.5031	1.196	52	52	12	0.75	23.7	9.6
COSMOS-28	149.4692	1.6685	1.316	53	53	15	0.75	23.7	9.7
COSMOS-125	150.6208	2.1675	1.404	38	38	8	0.75	23.7	9.8
SXDF87XGG	34.5360	-5.0630	1.406	81[1]	81	8	0.71	25.3	9.1
SXDF76aXGG	34.7461	-5.3041	1.459	72[2]	72	6	0.71	25.3	9.1

[1] SXDF49XGG and SXDF87XGG share a single GMOS field. This number represents the total number of spectra in that field, so is the same for both groups.
[2] SXDF76aXGG and SXDF76bXGG share a single GMOS field. This number represents the total number of spectra in that field, so is the same for both groups.

Table 1. The table presents the 26 galaxy clusters and groups in the GOGREEN and GCLASS samples, ordered by redshift within three approximate halo mass classes. The total number of good (Redshift Quality greater than 3) redshifts included in the release is given in column (4), with those coming from GOGREEN and/or GCLASS in column (5). An approximate number of members, defined as those with $|\Delta z/(1+z)| < 0.02$ is given in column (7). Columns (8) and (9) are the FWHM and depth of the K-band imaging. For GOGREEN and GCLASS imaging the depth is appropriate for recovery of our target galaxies, as described in van der Burg et al. (2020). For COSMOS and SXDF we use the 5σ, 2 arcsec aperture depths from (Muzzin et al. 2013) and (Mehta et al. 2018), respectively. Column (10) provides the stellar mass limit for quiescent galaxies. These are from (van der Burg et al. 2020) where available; otherwise they are estimated from the scaling provided in Hewitt et al. (in prep).

The next two columns provide the dispersions from Balogh et al. (2021) and Biviano et al. (2021), respectively. For most systems, the values from DR1 were based on an earlier, pre-release version of the analysis done in Biviano et al. (2021). In most cases the results are very similar. The SXDF and COSMOS group velocity dispersions are described in Reeves et al. (2021). The GCLASS clusters were previously analysed by Biviano et al. (2016), and these are presented in the next column. SpARCS1033 was not available for any of these earlier analyses, and Hewitt et al. (in preparation) made a simple estimate of the velocity dispersion, which we report in column (6). The final column shows recent estimates from Abdulshafy et al. (in preparation), using a caustic method for identifying members.

In Table 3 we provide an update to Table 2 from van der Burg et al. (2020), that describes the imaging depths for each cluster in the GOGREEN sample. The only difference from the published version is that it includes the final cluster, SpARCS1033.

2.2 Data Release Products

The data structure is the same as for DR1. The 1D and 2D spectra are identical to DR1, and will not be described further here. Similarly, the images are identical to those in DR1, though DR2 includes images for SpARCS1033 in the same format. In addition, the following errors in the DR1 release have been corrected:

- In DR1, some $g-$band magnitudes were missing from the PHOTO.FITS file. This has been fixed.
- Some of the line index (EWOII, EWHdelta and D4000) measurements in the REDSHIFT_CATALOGUE.FITS file were erroneously set to a value of 0. A few others deviated (by $< 10\%$) from their correct values.
- In DR1, objects with Redshift_Quality = 6 were either stars or AGN; this information was erroneously omitted from DR1 documentation. For DR2, Redshift_Quality=6 for stars and 7 for AGN.
- The MAGZPs_CAL.LIST file in DR1 contained incorrect

Name	σ (km/s)	DR1	Biviano et al. (2021)	Biviano et al. (2016)	Hewitt et al.	Abdulshafy et al.
			SPT Clusters			
SPT-CL J0546-5345	1040^{+150}_{-75}	980 ± 70	977 ± 84	-	-	1106^{+238}_{-168}
SPT-CL J2106-5844	1270^{+100}_{-90}	1055 ± 85	1055 ± 106	-	-	1276^{+232}_{-187}
SPT-CL J0205-5829	630^{+160}_{-190}	680 ± 60	678 ± 91	-	-	689^{+365}_{-222}
			SpARCS Clusters			
SpARCS0034-4307	680^{+150}_{-200}	700 ± 150	405 ± 51	609^{+75}_{-66}	-	581^{+156}_{-107}
SpARCS0036-4410	750^{+1900}_{-140} (1)	750 ± 90	799 ± 82	911^{+99}_{-90}	-	930^{+248}_{-155}
SpARCS1047+5741	570^{+600}_{-300} (1)	660 ± 120	668 ± 89	680^{+98}_{-86}	-	651^{+277}_{-167}
SpARCS0215-0343	640^{+230}_{-190}	640 ± 130	656 ± 70	758^{+85}_{-77}	-	780^{+253}_{-181}
SpARCS1051+5818	520 ± 140 (1)	690 ± 40	689 ± 75	530^{+73}_{-65}	-	736^{+200}_{-137}
SpARCS1616+5545	970^{+170}_{-190}	780 ± 40	782 ± 71	701^{+81}_{-73}	-	686^{+170}_{-131}
SpARCS1634+4021	830^{+95}_{-60}	715 ± 40	715 ± 60	835^{+91}_{-82}	-	872^{+181}_{-154}
SpARCS1638+4038	560^{+230}_{-60}	565 ± 30	564 ± 63	585^{+73}_{-65}	-	601^{+161}_{-115}
SpARCS0219-0531	-	810 ± 80	-	-	-	-
SpARCS0035-4312	740^{+280}_{-200}	840 ± 50	840 ± 111	941^{+159}_{-137}	-	813^{+252}_{-151}
SpARCS0335-2929	510^{+150}_{-180} (1)	540 ± 30	542 ± 75	-	-	727^{+225}_{-185}
SpARCS1034+5818	-	250 ± 30	-	-	-	-
SpARCS1033+5753	-	955 ± 90	-	-	1090 ± 290	-
			COSMOS/SXDF Clusters			
SXDF64XGG	-	530 ± 80	-	-	-	-
SXDF49XGG	-	255 ± 50	-	-	-	-
COSMOS-63	-	-	-	-	-	-
SXDF76bXGG	-	210 ± 65	-	-	-	-
COSMOS-221	-	200 ± 50	-	-	-	-
COSMOS-28	-	285 ± 75	-	-	-	-
COSMOS-125	-	-	-	-	-	-
SXDF87XGG	-	700 ± 110	-	-	-	-
SXDF76aXGG	-	520 ± 180	-	-	-	-

[1] Using 2σ clipping

Table 2. The table presents a compilaton of the velocity dispersions calculated for each system, from different sources. The first column shows a simple, uniform computation using 2.5σ clipping (unless indicated otherwise) and selecting all galaxies within $|\Delta z/(1+z)| < 0.02$ of the cluster redshift, independent of distance from the centre. This is only provided for systems with at least 20 members. The second column reports the values published in DR1, which use a different membership criterion and only include galaxies within 1 Mpc. The third entry is from Biviano et al. (1997), which include a weighting for spectroscopic incompleteness and cluster membership probability. Fourth is the earlier analysis of the GCLASS clusters from Biviano et al. (2013). In the fifth column the velocity dispersion of SpARCS1033 from Hewitt et al. (in prep) is reported, and the final column provides results from Abdulshafy et al. (in prep) using a caustic-based membership classification, and including only galaxies within an estimate of R_{200}.

$K-$band filter names for SpARCS0335 and SpARCS1616. These have been fixed.

- The zeropoint for the SpARCS-1616 Y-band image was missing from the MAGZPs_CAL.LIST. **IT STILL IS UNLESS WE CAN FIND IT!**

Here we describe the main catalogue products, which include some minor changes from DR1. Changes are highlighted in **boldface**. Apart from those associated with the errors noted above, these are all changes for convenience or clarification.

2.2.1 *Cluster Catalogue*

We provide a FITS table CLUSTERS.FITS with information about each cluster in the GOGREEN and GCLASS samples. Column names and descriptions are given in Table 4. This includes position, redshift and velocity dispersion measurements, as well as filenames for the corresponding images and photometric catalogues. The only difference from DR1 is the catalogue now includes information on the photometric catalogues for the additional cluster, SpARCS1033.

Table 3. A reproduction of Table 2 in van der Burg et al. (2020), updated to include SpARCS1033. The reported depths are median 5-σ limits measured on the PSF-homogenized stacked images in circular apertures with a diameter of 2″, after correction for Galactic dust extinction.

Name	u/U	B/g	V	r/R	i/I	z/Z	Y/J_1	J	K_s	[3.6] μm	[4.5] μm	[5.8] μm	[8.0] μm
SPTCL-0205	26.2[b]	26.7[b]	25.6[b]	25.9[b]	25.4[b]	24.2[b]	24.2[h]	23.9[h]	24.0[h]	23.7[j]	23.2[j]	–	–
SPTCL-0546	25.3[b]	26.1[b]	25.3[b]	25.6[b]	25.0[b]	23.8[b]	24.1[h]	23.9[h]	23.9[h]	24.0[j]	23.8[j]	–	–
SPTCL-2106	26.0[b]	26.3[b]	25.9[b]	25.8[b]	25.3[b]	24.6[b]	24.4[h]	24.1[h]	23.6[g]	23.7[j]	23.0[j]	–	–
SpARCS-0219	25.8[b]	26.0[b]	25.3[b]	25.5[b]	25.2[b]	24.1[b]	24.4[h]	24.3[h]	24.0[h]	24.0[j]	23.8[j]	21.4[j]	21.4[j]
SpARCS-0335	26.3[b]	26.4[b]	25.9[b]	26.3[b]	25.5[b]	24.6[b]	25.2[g]	24.3[h]	23.7[h]	24.4[j]	24.3[j]	21.6[j]	21.6[j]
SpARCS-0035	25.9[b]	26.4[b]	25.8[b]	26.0[b]	25.5[b]	25.5[d]	24.2[h]	24.9[g]	24.2[g]	24.6[j]	24.5[j]	22.8[j]	22.6[j]
SpARCS-1033	–	26.3[c]	–	26.2[c]	25.7[c]	25.6[e]	25.1[e]	24.4[i]	24.4[i]	24.4[j]	24.2[j]	21.5[j]	21.5[j]
SpARCS-1034	–	26.0[c]	–	26.1[c]	25.5[c]	25.4[e]	25.1[e]	24.5[i]	24.0[i]	22.7[j]	22.4[j]	19.9[j]	19.7[j]
SpARCS-1051	26.3[a]	26.1[c]	–	26.1[c]	25.6[c]	25.4[e]	25.0[e]	24.5[i]	24.1[i]	22.6[j]	22.5[j]	19.7[j]	19.6[j]
SpARCS-1616	25.9[a]	26.2[c]	–	26.1[c]	25.7[c]	25.6[e]	24.7[e]	24.2[i]	23.8[i]	22.7[j]	22.6[j]	21.2[j]	21.3[j]
SpARCS-1634	25.9[a]	26.4[c]	–	26.2[c]	25.8[c]	25.0[f]	–	24.2[i]	23.8[i]	23.0[j]	22.8[j]	21.3[j]	21.3[j]
SpARCS-1638	26.1[a]	26.4[c]	–	26.2[c]	25.6[c]	25.3[f]	24.2[c]	24.1[i]	23.6[i]	22.8[j]	22.5[j]	21.3[j]	21.4[j]
COSMOS/ UltraVISTA	26.8[a]	26.9[c]	26.4[c]	26.4[c]	26.0[c]	25.2[c]	24.5[k]	24.3[k]	23.8[k]	23.9[j]	23.6[j]	21.7[j]	21.7[j]

[a] CFHT/MegaCam, [b] VLT/VIMOS, [c] Subaru/SuprimeCam, [d] Blanco/DECam, [e] Subaru/HSC, [f] Gemini/GMOS, [g] VLT/HAWKI, [h] Magellan/FourStar, [i] CFHT/WIRCam, [j] *Spitzer*/IRAC, [k] VISTA/VIRCAM

column	parameter name	description
1	cluster	Short name of each cluster.
2	fullname	Longer format cluster name
3	cluster_id	An integer which is used to identify the corresponding photometry. It is a unique number for each SpARCS and SPT cluster; it is 14 for all COSMOS clusters and 13 for those in the SXDF.
4-5	RA_Best, DEC_Best	Coordinates, in J2000 degrees, for the best estimate of the cluster centre. For the SPT and SpARCS clusters, this is the location of the BCG. For the COSMOS and SXDF clusters, it is the average position of members as described in DR1.
6-7	RA_GMOS, DEC_GMOS	Coordinates, in J2000 degrees, for the centre of the GMOS spectroscopic observations (GOGREEN only).
8	PA_GMOS	Position angle, in degrees, for the GMOS spectroscopic observations (GOGREEN only).
9	Redshift	Best estimate of the cluster redshift, based on available spectroscopy, including publicly available spectra from other sources not included in this release.
10-11	vdisp, vdisp_err	Velocity dispersion and its uncertainty, in km/s, computed as described in DR1.
12-17	gogreen_mN	Name of each GOGREEN GMOS mask, for N from 1 to 6, used to obtain spectra for this program.
18-22	gclass_mN	Name of each GCLASS GMOS mask, for N from 1 to 5, used to obtain spectra for this program.
23	Kphot_cat	Name of K-selected photometry catalogue
24	photoz_cat	Name of photometric redshift catalogue
25	stelmass_cat	Name of catalogue with stellar mass information
26-37	IMAGE_X	Name of image for filter X for SpARCS and SPT clusters.
38	Preimage	Name of the GMOS z-band image, or Subaru pseudo-image, used for mask design. Note the preimages were used for mask design but are not optimally reduced, specifically regarding sky subtraction and astrometry.

Table 4. A description of the contents of the CLUSTERS.FITS table, which contains information relevant to each cluster system in the GCLASS and GOGREEN surveys.

2.2.2 *Photometry Catalogues*

Each SPT and SpARCS cluster in the GOGREEN and GCLASS sample has an associated set of catalogues based on the multiwavelength imaging. For DR2, this now includes SpARCS1033. The detailed structure of these catalogues is described in the documentation distributed with the data release. As in DR1, the COSMOS and SXDF photometry all comes from publicly available catalogues: Muzzin et al. (2013) and Mehta et al. (2018), respectively.

Photometric catalogues include aperture magnitudes in all bands. For the selection band (K_s) we also compute a total magnitude, $K_{\rm tot}$. This defines an aperture correction which we apply equally to all bands for a given cluster, to provide estimates of total magnitudes. Comparing these total magnitudes to the PanStarrs photometry generally shows good agreement, with residuals of < 0.1 mag. There are two exceptions: for SpARCS0215 our total magnitudes are ~ 0.2 larger in all filters, while for SpARCS0219 our magnitudes are between 0.2 (z) and 0.4 (ri) mag smaller.

As in DR1, for convenience we provide a single table PHOTO.FITS with some of the most useful parameters gathered from these catalogues, for all objects with photometric measurements in all available filters. The contents of this table are described in Table 5. This is analagous to Table 3 in Balogh et al. (2021); differences are highlighted in boldface. The descriptions about how each parameter is computed apply to the SpARCS and SPT systems. For the COSMOS and SXDF, we use closely corresponding quantities from Muzzin et al. (2013) and Mehta et al. (2018), respectively. For SXDF we calculate the rest-frame UVJ colours ourselves, using the

EAZY code Brammer et al. (2008), as these are not provided in the Mehta et al. (2018) catalogue.

2.2.3 *Redshift Catalogue*

The redshift catalogue REDSHIFT_CATALOGUE.FITS, described in Table 6, includes an entry for every object with a GOGREEN or GCLASS spectrum[1]. There are no duplicates: if a galaxy has a spectrum in both surveys, only the GOGREEN entry is included here.

2.3 Scripts and notebooks

We provide four JUPYTER PYTHON3 notebooks with the data release.

- DR2_NOTEBOOK is an updated version of the notebook provided with DR1. It provides examples for reading the data, displaying spectra and images, and reproducing many of the plots in the DR1 paper.
- BUILD_TABLE3, is the notebook used to construct Table 5 from the raw photometric and spectroscopic catalogues. This is also an updated version of the notebook provided in DR1.
- DR2 STATS AND CHECKS provides some scripts for comparing the catalogues of DR2 with those of DR1, to illustrate the additional features and corrected errors. It also includes code to compute the number of redshifts and members reported in Table 1, and the velocity dispersions in column 2 of Table 2.
- CHECKPHOTOZP is used to compare our photometry to that of PanStarrs, as described in § 2.2.2.

3 CONCLUSIONS

This represents the second public Data Release of the GCLASS (Muzzin et al. 2012) and GOGREEN (Balogh et al. 2017) galaxy cluster surveys. The data are available at the CADC (`https://www.cadc-ccda.hia-iha.nrc-cnrc.gc.ca/en/community/gogreen`), and NSF's NOIRLab (`https://datalab.noao.edu/gogreendr2/`). Any additional bug reports will be announced via the GOGREEN website at `http://gogreensurvey.ca/`.

This paper has been typeset from a TEX/LATEX file prepared by the author.

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[1] This excludes the stars deliberately observed on some masks for the purposes of telluric corrections.

column	parameter name	description
1	Cluster	Name of the corresponding cluster, when there is an associated photometric catalogue. Objects in the COSMOS or SXDF photometric catalogues are identified with those labels, unless there is a GOGREEN spectroscopic redshift, in which case we use the name of the associated target. Note that SXDF49 and SXDF87 share a field, and are identified here only by SXDF49. Similarly SXDF76a and SXDF76b are identified here as SXDF76.
2	cPHOTID	This is a unique identifier for each object in this table. The first digit identifies the source of the photometry (1: GOGREEN; 2: GCLASS; 3: UltraVISTA/COSMOS; 4:SPLASH/SXDF). The next two digits are the cluster_id column from Table 4. The remaining numbers are the PHOTID identifier in the main photometric catalogues.
3	SPECID	The ID corresponding to Table 6 for objects with a corresponding GCLASS or GOGREEN spectrum.
4,5,6,7	**RA_centre, Dec_centre, Cluster_z,vdisp**	The position, redshift and velocity dispersion (in km/s) of the cluster with which the object is associated. This information is taken from the Clusters.fits table, and just identifies the cluster that was targeted when the galaxy was observed. It does not mean the galaxy is a member of the cluster.
8,9	ra,dec	J2000 positions, in degrees. Calibrated with SDSS DR7 or USNO-b whenever a cluster falls outside of the SDSS footprint.
10,11	zspec,Redshift_Quality	The spectroscopic redshift and quality flag for the associated spectrum, if any. **This includes literature redshifts from the provided** SPECZ_MATCHED **files, which can be consulted to identify the source of the redshift. Literature redshifts are all assigned** REDSHIFT_QUALITY**=4.** GOGREEN redshift qualities are: (4) excellent; (3) likely; (2) possible, but use with caution; (1) not usable. A value of 6 identifies a possible star or quasar spectrum.
12	**zspec_gogreen**	**New in DR2, this column identifies redshifts from GOGREEN or GCLASS only. These are also used in the** ZSPEC **column**
13,14,15	zphot,zphot_l68,zphot_u68	Photometric redshift, upper and lower uncertainties from the 68 per cent confidence region. Based on the *zpeak* output from EAZY (Brammer et al. 2008), where for the GOGREEN galaxies a polynomial correction is applied to improve the correspondence with spectroscopy.
16,17,18	$NUV-V$, $U-V$,$V-J$	**Rest-frame colours between GALEX** NUV**, Johnson** U**,** V **and** J**, as measured with** EAZY **(Brammer et al. 2008). Note that** $NUV-V$ **colours are only available for the GOGREEN clusters. Small offsets, as described in van der Burg et al. (2020), have been applied to** $U-V$ **and** $V-J$ **colours on a cluster-by-cluster basis to improve correspondence with UltraVISTA.** For the COSMOS galaxies the rest-frame colours are from the UltraVISTA catalogue.
19	Star	Star/galaxy classification based on colours, as described in van der Burg et al. (2020). Flag is 1 for a star, and 0 otherwise.
20	K_flag	`SExtractor` flag in the K-band.
21	totmask	Manual mask at position of detection, where objects are masked (totmask= 1) if they do not have an image in all available filters for that cluster. Only sources with totmask=0 are included in this compilation catalogue. Photometry for other sources must be obtained from the original catalogues.
22	Mstellar	Total stellar masses, measured with the FAST (Kriek et al. 2009) code and assuming the best redshift for the object (spectroscopic or *zphot*). These assume $\tau-$model star formation histories, and are known to underestimate the stellar mass obtained with a non-parametric star formation history, by up to 0.3 dex (Leja et al. 2019). For objects in COSMOS and SXDF the stellar masses are taken from their respective catalogues.
23-52	X_i_tot	Total fluxes in each filter X_i. These are derived from the Ks_tot flux and the appropriate colour, computed in 2″ diameter circular apertures from PSF-matched images. IRAC aperture fluxes have been measured in a two-step process, similar to the description in Appendix A of van der Burg et al. (2013). The measurements within a 3″ aperture are scaled by a factor determined by comparing the 2″ aperture K_s flux with that within a 3″ aperture measured on an image convolved to match the IRAC point spread function. This is done to avoid having to convolve all the high resolution ground-based data to the IRAC psf. For objects in COSMOS and SXDF the fluxes are taken from their respective catalogues, scaled by the corresponding Ks_tot flux. Includes: $u, g, r, i, z, y, V, B, J, H, K_s$, IRAC1, IRAC2, IRAC3, IRAC4, IA484, IA527, IA624, IA679, IA738, IA767, IB427, IB464, IB505, IB574, IB709, IB827, fuv, nuv, and $mips24$.
53-83	eX_i_tot	Associated uncertainty estimates for filter X_i, assuming that the sole source of uncertainty is the background *rms*. It therefore depends on position on the stack (as the depth is not necessarily uniform), but does not depend on the source flux.

Table 5. A description of the contents of the PHOTO.FITS table, which contains selected photometric data for each cluster system in the GCLASS, GOGREEN samples, COMOS UltraVISTA (v1.4; Muzzin et al. 2013) and SXDF SPLASH(v1.6; Mehta et al. 2018) fields.

column	parameter name	description
1	Cluster	Short name of each cluster; matches the entry in Table 4
2	SPECID	A unique identification number. The first digit identifies the origin of the spectrum: 1 for GOGREEN and 2 for GCLASS. The next two digits correspond to the **cluster_id** identifier in the Cluster catalogue, that specify the photometric field. The remaining digits are the galaxy ID (only unique for a given field and source).
3,4	RA(J2000), DEC(J2000)	Target coordinates, in J2000 degrees. For GOGREEN, these coordinates correspond to the z' image coordinates used for mask design. These have been transformed to align with the K_s images; however positions will not match exactly with coordinates in the photometric catalogues.
5	OBJClass	This has a value of 1 for GOGREEN primary targets, i.e. those that match our photometric selection criteria. A value of 3 corresponds to a GOGREEN "mask filler" object, and 4 identifies a GCLASS spectrum. (OBJClass=2 was reserved for stellar sources used for telluric correction, and these are not included in the catalogue).
6	Redshift	The redshift measured from the spectrum
7	Redshift_Quality	The redshift quality flag. Both quality 3 and 4 are secure galaxy redshifts and can be used for scientific analysis; the difference between them is subjective and not rigorously defined. Quality 2 is a "best guess" but should be used with caution; this includes cases where there is plausible consistency with the photometric redshift, but no clearly identifiable spectral features. Quality 1 means no redshift is available. **DR1 included meaningless redshift values for these Quality 1 entries - these have been replaced with NaN. Quality 6 and 7 are reserved for likely stars and AGN, respectively**.
8	EXTVER	This is the science extension number in the FITS files with the 1D and 2D spectra (see DR1 for a description).
9	Spec_Flag	An integer used to identify spectra that have problems that might compromise the ability to measure a redshift or line indices of a spectrum. Flags are assigned for the following: 1: Mild slit contamination or artefacts that should not strongly affect measurements 2: Non-galaxy-like spectrum and/or image 4: Significant slit contamination from neighbouring objects. Redshift and features may be compromised. 8: Poor telluric correction or sky subtraction, due for example to inadequate correction for the stray light effect described in DR1. 16: Major artefacts or large masked regions that render the spectrum nearly useless. Flags can be added. So, for example, a flag of 12 means there is both contamination from neighbouring objects, and poor sky subtraction.
10	SNR_8500_VAR	The signal-to-noise ratio per pixel, measured in the range $7500 < \lambda < 9500$Å. The noise estimate is taken from the VAR array associated with the spectrum.
11	SNR_8500_RMS	The signal-to-noise ratio per pixel, measured in the range $7500 < \lambda < 9500$Å. The noise estimate is taken from the *rms* in the science spectrum over the same range.
12,13	D4000, eD4000	The D_n4000 index as defined in Balogh et al. (1999), and its uncertainty. **Some of these entries were incorrect in DR1, and have been corrected for DR2**.
14,15	EWOII, eEWOII	The equivalent width of the [OII] emission line and its uncertainty, in Å, using the line index definitions in Balogh et al. (1999). Positive values represent emission. **Some of these entries were incorrect in DR1, and have been corrected for DR2**.
16,17	EWHdelta, eEWHdelta	The equivalent width of the Hδ absorption line and its uncertainty, in Å, using the line index definitions in Balogh et al. (1999). Positive values represent absorption. **Some of these entries were incorrect in DR1, and have been corrected for DR2**.
18,19	EWOII_model, eEWOII_model	The equivalent width of the [OII] emission line and its uncertainty, in Å, calculated from the Gaussian fitting model described in Old et al. (2020).
20,21	F_OII,eF_OII	The integrated flux of the [OII] emission line and its uncertainty, in ergs/s/cm^2/Å, calculated from the Gaussian fitting model described in Old et al. (2020).
22,23	SFR,eSFR	The star formation rate in solar masses per year, estimated from the [OII] emission line flux and the stellar mass, using the calibration of Gilbank et al. (2010).
24	delta_BIC	The difference in Bayesian Information Criterion used to identify the presence of [OII] emission (ΔBIC > 10) or its absence (ΔBIC < -10). See Old et al. (2020) for more details.
25	member_Clean	Applicable only to the 11 SPT and SpARCS clusters in GOGREEN, this indicates likely cluster membership based on the CLEAN algorithm of Mamon et al. (2013). A value of 1 indicates a member, 0 is a non-member, and -1 indicates membership could not be determined.
26	member_EM	Applicable only to the 11 SPT and SpARCS clusters in GOGREEN, this indicates likely cluster membership based on the C.L.U.M.P.S. algorithm of Munari et al. (in prep). A value of 1 indicates a member, 0 is a non-member, and -1 indicates membership could not be determined.
27	member	A flag that identifies likely cluster members (1) or nonmembers (0). A value of -1 means membership could not be determined. For SpARCS and SPT clusters in GOGREEN, this is the maximum of the member_Clean and member_EM flags. For the five GCLASS clusters we use the membership given in Muzzin et al. (2012). Finally, for the systems in COSMOS and SXDF we define members as those within 1 Mpc and 2.5σ of the centre, as described in DR1.

Table 6. A description of the contents of the spectroscopic redshift catalogue REDSHIFT_CATALOGUE.FITS, which contains and entry for every unique object with a GOGREEN or GCLASS spectrum.