Guide to master GEMS catalogue
August 07, 2009
Catalogue version: gems_20090807.fits

Column entries in the published FITS catalogue, their headers and meanings. Some rest-frame luminosities are extrapolated in some redshift ranges. We give the redshift intervals, where no extrapolation errors are expected. All quantities use H_0=70 km sec^{-1} Mpc^{-1}, Ω_m=0.3, Ω_Λ=0.7.

CATALOGUE CROSS-CORRELATION: The master catalogue is a merged version of the GEMS V-band catalogue, the COMBO-17 catalogue and the GEMS z-band catalogue. Merging of the GEMS V-band and the COMBO-17 catalogues was performed analogous to the procedure described in Gray et al. 2009. In contrast, the GEMS z-band data were merged into the resulting product using a nearest neighbour scheme (1 arcsecond matching radius) firstly cross-correlating with the GEMS V-band, and subsequently with the COMBO-17-only detections. The remaining sources, i.e. the ones neither matched with GEMS V-band nor COMBO-17 (9424 sources), were appended as well.

GEMS V-band information	
st_number	object number
st_x_image	x-position from SExtr in [pix] on tile
st_y_image	y-position from SExtr in [pix] on tile
st_cxx_image	ellipse parameter from SExtr in [pix]
st_cyy_image	ellipse parameter from SExtr in [pix]
st_cxy_image	ellipse parameter from SExtr in [pix]
st_theta_image	pos. angle from SExtr in [deg] in image coordinates (measured from right to up)
st_theta_world	pos. angle in [deg] in world coordinates
st_ellipticity	ellipticity from SExtr
st_kron_radius	Kron radius in units of [st_a_image]
st_a_image	semi-major half-axis from SExtr in [pix]
st_b_image	semi-minor half-axis from SExtr in [pix]
st_alpha_J2000	right ascension from SExtr in [deg]
st_delta_J2000	declination from SExtr in [deg]
st_ background	background value from SExtr in [counts]
st_flux_best	“best” flux from SExtr in [counts]
st_fluxerr_best	error of st_flux_best
st_mag_best	“best” magnitude from SExtr in [AB mag]
st_magerr_best	error of st_mag_best
st_flux_radius	half-light radius from SExtr in [pix]
st_isoarea_image	isophotal area from SExtr in [pix^2]
st_fwhm_image	FWHM from SExtr in [pix]
st_flags	SExtr quality flags
st_class_star	SExtr stellarity estimator
st_org_image	postage stamp image file name
st_file_galfit	GALFIT output filename containing fit data
st_X_galfit	x-position on postage stamp in [pix]
st_Xerr_galfit	error of st_X_galfit
st_Y_galfit	y-position from GALFIT in [pix]
st_Yerr_galfit	error of st_Y_galfit

GEMS V-band information	
st_MAG_galfit	total magnitude from GALFIT in [AB mag]
st_MAGerr_galfit	error of st_MAG_galfit
st_RE_galfit	half-light radius from GALFIT in [pix]
st_REerr_galfit	error of st_RE_galfit
st_N_galfit	Sérsic index from GALFIT
st_Nerr_galfit	error of st_N_galfit
st_Q_galfit	minor-to-major axis ratio from GALFIT (b/a)
st_Qerr_galfit	error of st_Q_galfit
st_PA_galfit	pos. angle in [deg] measured from up to left
st_PAerr_galfit	error of st_PA_galfit
st_sky_galfit	sky value from GALAPAGOS
st_tile	tile number in GEMS mosaic

GEMS z-band information	
stz_number	object number
stz_flux_best	“best” flux from SExtr in [counts]
stz_fluxerr_best	error of st_flux_best
stz_mag_best	“best” magnitude from SExtr in [AB mag]
stz_magerr_best	error of st_mag_best
stz_kron_radius	Kron radius in units of [st_a_image]
stz_flux_radius	half-light radius from SExtr in [pix]
stz_isoarea_image	isophotal area from SExtr in [pix^2]
stz_x_image	x-position from SExtr in [pix] on tile
stz_y_image	y-position from SExtr in [pix] on tile
stz_alpha_J2000	right ascension from SExtr in [deg]
stz_delta_J2000	declination from SExtr in [deg]
stz_theta_image	pos. angle from SExtr in [deg] in image coordinates (measured from right to up)
stz_ellipticity	ellipticity from SExtr
stz_fwhm_image	FWHM from SExtr in [pix]
stz_flags	SExtr quality flags
stz_class_star	SExtr stellarity estimator
stz_gems_id	original GEMS ID
stz_file_galfit	GALFIT output filename containing fit data
stz_sky_galfit	sky value from GALAPAGOS
stz_X_galfit	x-position on postage stamp in [pix]
stz_Xerr_galfit	error of st_X_galfit
stz_Y_galfit	y-position from GALFIT in [pix]
stz_Yerr_galfit	error of st_Y_galfit
stz_MAG_galfit	total magnitude from GALFIT in [AB mag]
stz_MAGerr_galfit	error of st_MAG_galfit
stz_RE_galfit	half-light radius from GALFIT in [pix]
stz_REerr_galfit	error of st_RE_galfit
stz_N_galfit	Sérsic index from GALFIT
stz_Nerr_galfit	error of st_N_galfit
stz_Q_galfit	major-to-minor axis ratio from GALFIT

GEMS z-band information	
stz_Qerr_galfit	error of st_Q_galfit
stz_PA_galfit	pos. angle in [deg] measured from up to left
stz_PAerr_galfit	error of st_PA_galfit
stz_tile_z	tile number in GEMS mosaic

COMBO-17 general information	
COMBO_nr	COMBO-17 A901/2 field object number
ra	right ascension (J2000)
dec	declination (J2000)
xpix	x-position on COMBO-17 *R*-frame in pixels
ypix	y-position on COMBO-17 *R*-frame in pixels
Rmag	total *R*-band magnitude
e_Rmag	1-σ error of total *R*-band mag
ap_Rmag	aperture *R*-band magnitude in run E
apd_Rmag	difference total to aperture (point source ~0)

Various flags for sample selection	
phot_flag	COMBO-17 photometry flags (see below)
combo_flag	COMBO-17 sample flag (see Table below)
gems_flag	GEMS V-band sample flag (see Table below)
gemsz_flag	GEMS z-band sample flag (see Table below)

COMBO-17 classification results	
chi2red	χ^2/N_f of best-fitting template
chi2reds	χ^2/N_f of best-fitting star template
chi2redg	χ^2/N_f of best-fitting galaxy template
chi2redq	χ^2/N_f of best-fitting QSO template
chi2redw	χ^2/N_f of best-fitting WD template
mc_class	multi-colour class (see table below)
mc_z	mean redshift in distribution *p*(*z*)
e_mc_z	standard deviation (1-σ) in distribution *p*(*z*)
mc_z2	alternative redshift if *p*(*z*) bimodal
e_mc_z2	standard deviation (1-σ) at alternative redshift
mc_z_ml	peak redshift in distribution *p*(*z*)
mc_Ebmv	mean *E*(*B*–*V*) in distribution *p*(*z*)
e_mc_Ebmv	standard deviation (1-σ) in distribution *p*(E(B-V))
mc_Ebmv_ml	peak value in distribution *p*(*E*(*B*–*V*))
mc_age	mean template age index
e_mc_age	standard deviation (1-σ) of template age index
mc_age_ml	peak in template age index distribution

Total galaxy rest-frame luminosities	
S280Mag	$M_{\mathrm{abs,gal}}$ in 280/40 (z≈[0.25,1.3])
e_S280Mag	1-σ error of $M_{\mathrm{abs,gal}}$ in 280/40
UjMag	$M_{\mathrm{abs,gal}}$ in Johnson *U* (ok at all z)
e_UjMag	1-σ error of $M_{\mathrm{abs,gal}}$ in Johnson *U*
BjMag	$M_{\mathrm{abs,gal}}$ in Johnson *B* (z≈[0.0,1.1])
e_BjMag	1-σ error of $M_{\mathrm{abs,gal}}$ in Johnson *B*
VjMag	$M_{\mathrm{abs,gal}}$ in Johnson *V* (z≈[0.0,0.7])
e_VjMag	1-σ error of $M_{\mathrm{abs,gal}}$ in Johnson *V*
usMag	$M_{\mathrm{abs,gal}}$ in SDSS *u* (ok at all z)
e_usMag	1-σ error of $M_{\mathrm{abs,gal}}$ in SDSS *u*
gsMag	$M_{\mathrm{abs,gal}}$ in SDSS *g* (z≈[0.0,1.0])
e_gsMag	1-σ error of $M_{\mathrm{abs,gal}}$ in SDSS *g*
rsMag	$M_{\mathrm{abs,gal}}$ in SDSS *r* (z≈[0.0,0.5])
e_rsMag	1-σ error of $M_{\mathrm{abs,gal}}$ in SDSS *r*

QSO rest-frame luminosities	
S145Mag	$M_{\mathrm{abs,QSO}}$ in 145/10 (z≈[1.4,5.2])
e_S145Mag	1-σ error of $M_{\mathrm{abs,QSO}}$ in 145/10

Observed seeing-adaptive aperture fluxes	
W420f_E	photon flux in filter 420 in run E
e_W420f_E	1-σ photon flux error in 420 in run E
W464f_E	photon flux in filter 464 in run E
e_W464f_E	1-σ photon flux error in 464 in run E
W485f_D	photon flux in filter 485 in run D
e_W485f_D	1-σ photon flux error in 485 in run D
W518f_E	photon flux in filter 518 in run E
e_W518f_E	1-σ photon flux error in 518 in run E
W571f_D	photon flux in filter 571 in run D
e_W571f_D	1-σ photon flux error in 571 in run D
W571f_E	photon flux in filter 571 in run E
e_W571f_E	1-σ photon flux error in 571 in run E
W571f_S	photon flux in filter 571 in run S
e_W571f_S	1-σ photon flux error in 571 in run S
W604f_E	photon flux in filter 604 in run E
e_W604f_E	1-σ photon flux error in 604 in run E
W646f_D	photon flux in filter 646 in run D
e_W646f_D	1-σ photon flux error in 646 in run D
W696f_E	photon flux in filter 696 in run E
e_W696f_E	1-σ photon flux error in 696 in run E
W753f_E	photon flux in filter 753 in run E
e_W753f_E	1-σ photon flux error in 753 in run E
W815f_E	photon flux in filter 815 in run E

Observed seeing-adaptive aperture fluxes	
e_W815f_E	1-σ photon flux error in 815 in run E
W815f_G	photon flux in filter 815 in run G
e_W815f_G	1-σ photon flux error in 815 in run G
W815f_S	photon flux in filter 815 in run S
e_W815f_S	1-σ photon flux error in 815 in run S
W855f_D	photon flux in filter 855 in run D
e_W855f_D	1-σ photon flux error in 855 in run D
W915f_D	photon flux in filter 915 in run D
e_W915f_D	1-σ photon flux error in 915 in run D
W915f_E	photon flux in filter 915 in run E
e_W915f_E	1-σ photon flux error in 915 in run E
Uf_F	photon flux in filter *U* in run F
e_Uf_F	1-σ photon flux error in *U* in run F
Uf_G	photon flux in filter *U* in run G
e_Uf_G	1-σ photon flux error in *U* in run G
Bf_D	photon flux in filter *B* in run D
e_Bf_D	1-σ photon flux error in *B* in run D
Bf_F	photon flux in filter *B* in run F
e_Bf_F	1-σ photon flux error in *B* in run F
Vf_D	photon flux in filter *V* in run D
e_Vf_D	1-σ photon flux error in *V* in run D
Rf_D	photon flux in filter *R* in run D
e_Rf_D	1-σ photon flux error in *R* in run D
Rf_E	photon flux in filter *R* in run E
e_Rf_E	1-σ photon flux error in *R* in run E
Rf_F	photon flux in filter *R* in run F
e_Rf_F	1-σ photon flux error in *R* in run F
Rf_G	photon flux in filter *R* in run G
e_Rf_G	1-σ photon flux error in *R* in run G
If_D	photon flux in filter *I* in run D
e_If_D	1-σ photon flux error in *I* in run D
Uf_S	photon flux in filter *U* in run S
e_Uf_S	1-σ photon flux error in *U* in run S
Bf_S	photon flux in filter *B* in run S
e_Bf_S	1-σ photon flux error in *B* in run S
Rf_S	photon flux in filter *R* in run S
e_Rf_S	1-σ photon flux error in *R* in run S

Observed aperture Asinh Vega magnitudes	
W420magA_E	magnitude in filter 420 in run E
e_W420magA_E	1-σ magnitude error in 420 in run E
W464magA_E	magnitude in filter 464 in run E
e_W464magA_E	1-σ magnitude error in 464 in run E
W485magA_D	magnitude in filter 485 in run D
e_W485magA_D	1-σ magnitude error in 485 in run D

Observed aperture Asinh Vega magnitudes	
W518magA_E	magnitude in filter 518 in run E
e_W518magA_E	1-σ magnitude error in 518 in run E
W571magA_D	magnitude in filter 571 in run D
e_W571magA_D	1-σ magnitude error in 571 in run D
W571magA_E	magnitude in filter 571 in run E
e_W571magA_E	1-σ magnitude error in 571 in run E
W571magA_S	magnitude in filter 571 in run S
e_W571magA_S	1-σ magnitude error in 571 in run S
W604magA_E	magnitude in filter 604 in run E
e_W604magA_E	1-σ magnitude error in 604 in run E
W646magA_D	magnitude in filter 646 in run D
e_W646magA_D	1-σ magnitude error in 646 in run D
W696magA_E	magnitude in filter 696 in run E
e_W696magA_E	1-σ magnitude error in 696 in run E
W753magA_E	magnitude in filter 753 in run E
e_W753magA_E	1-σ magnitude error in 753 in run E
W815magA_E	magnitude in filter 815 in run E
e_W815magA_E	1-σ magnitude error in 815 in run E
W815magA_G	magnitude in filter 815 in run G
e_W815magA_G	1-σ magnitude error in 815 in run G
W815magA_S	magnitude in filter 815 in run S
e_W815magA_S	1-σ magnitude error in 815 in run S
W855magA_D	magnitude in filter 855 in run D
e_W855magA_D	1-σ magnitude error in 855 in run D
W915magA_D	magnitude in filter 915 in run D
e_W915magA_D	1-σ magnitude error in 915 in run D
W915magA_E	magnitude in filter 915 in run E
e_W915magA_E	1-σ magnitude error in 915 in run E
UmagA_F	magnitude in filter *U* in run F
e_UmagA_F	1-σ magnitude error in *U* in run F
UmagA_G	magnitude in filter *U* in run G
e_UmagA_G	1-σ magnitude error in *U* in run G
BmagA_D	magnitude in filter *B* in run D
e_BmagA_D	1-σ magnitude error in *B* in run D
BmagA_F	magnitude in filter *B* in run F
e_BmagA_F	1-σ magnitude error in *B* in run F
VmagA_D	magnitude in filter *V* in run D
e_VmagA_D	1-σ magnitude error in *V* in run D
RmagA_D	magnitude in filter *R* in run D
e_RmagA_D	1-σ magnitude error in *R* in run D
RmagA_E	magnitude in filter *R* in run E
e_RmagA_E	1-σ magnitude error in *R* in run E
RmagA_F	magnitude in filter *R* in run F
e_RmagA_F	1-σ magnitude error in *R* in run F
RmagA_G	magnitude in filter *R* in run G
e_RmagA_G	1-σ magnitude error in *R* in run G

Observed aperture Asinh Vega magnitudes	
ImagA_D	magnitude in filter *I* in run D
e_ImagA_D	1-σ magnitude error in *I* in run D
UmagA_S	magnitude in filter *U* in run S
e_UmagA_S	1-σ magnitude error in *U* in run S
BmagA_S	magnitude in filter *B* in run S
e_BmagA_S	1-σ magnitude error in *B* in run S
RmagA_S	magnitude in filter *R* in run S
e_RmagA_S	1-σ magnitude error in *R* in run S

Galaxy rest-frame luminosities	
rf_UmV	rest-frame colour U-V Johnson
smrf_UmV	error of rest-frame colour U-V
DL_37	luminosity distance 0.3/0.7 for H_0=70 km sec^{-1} Mpc^{-1}
sed_type	1=old red, 2=dusty red, 3=blue cloud

MC_CLASS

Definition of entries for the "mc class" column and comparison of object numbers between the COMBO-17 data sets of the A901/2 and the CDFS field. The samples refer to a magnitude range of R_{ap}=[16, 24] and only objects with phot_flag<8. The CDFS is underdense in galaxies at z = [0.2, 0.4]. We note that these definitions are based on the COMBO-17 data SED and on the morphology; star-galaxy separation employing morphological information from the *HST* imaging is considered separately.

Class entry	Meaning	N
Star	Stars (only point sources)	989
WDwarf	White dwarf (only point sources)	9
Galaxy	Galaxies (shape irrelevant)	11654
Galaxy (Star?)	Binary or low-z galaxy (star SED but extended; ambiguous colour space)	46
Galaxy (Uncl!)	SED fit undecided (most often galaxy)	247
QSO	QSOs (only point sources)	69
QSO (Gal?)	Seyfert-1 AGN or interloping galaxy (AGN SED but extended; ambiguous colour space)	32
Strange Object	Unusual strange spectrum ($\chi^2_{\mathrm{red}} > 30$)	3

PHOT_FLAG

The final catalogue contains quality flags for all objects in an integer column ("phot_flag"), holding the original SExtractor flags in bit 0 to 7, corresponding to values from 0 to 128, as well as some COMBO-17 quality control flags in bits 9 to 11 (values from 512 to 2048). We generally recommend that users ignore objects with flag values phot_flag≥8 for any statistical analysis of the object population. If an object of particular interest shows bad flags, it may still have accurate COMBO-17 photometry and could be used for some purposes. Often, only the total magnitude was affected by bright neighbours, while the aperture SED is valid.

GEMS_FLAG

ID	Sample	N
0	not in GEMS footprint (only in COMBO-17)	19937
1	in GEMS footprint, but not detected by GEMS (only in COMBO-17or GEMS-z)	3201
2	detected by GEMS, but not HST extended source	2491
3	HST extended source, but GALFIT ran into constraint	27283
4	HST extended source, but GALFIT successful	77477

- "successful" means that GALFIT did not run into a constraint, i.e. 0.2 < n < 8; 0.3 < Re < 750
- galaxy selection with lower cut log(FLUX_RADIUS)>0.35

GEMSZ_FLAG

ID	Sample	N
0	not in GEMS-z footprint (only in COMBO-17)	63601
1	in GEMS-z footprint, but not detected by GEMS-z (only in COMBO-17 or GEMS-V)	25295
2	detected by GEMS, but not HST extended source	2327
3	HST extended source, but GALFIT ran into constraint	5188
4	HST extended source, but GALFIT successful	33978

- "successful" means that GALFIT did not run into a constraint, i.e. 0.2 < n < 8; 0.3 < Re < 500
- galaxy selection with lower cut log(FLUX_RADIUS)>0.45

COMBO_FLAG (photometric information only)

ID	Sample	N
0	not in COMBO-17 footprint (only in GEMS)	0
1	in COMBO-17 footprint, but not detected by COMBO-17 (only in GEMS)	66889
2	detected by COMBO-17, but not galaxy (i.e. SED classification of star, QSO, QSO (Gal?), strange object, white dwarf)	51553
3	galaxy (i.e. SED classification of Galaxy, Galaxy (Uncl!), Galaxy (Star?)) with R_{ap}<24; i.e. foreground & background galaxies	11947

- galaxy selection (COMBO_FLAG=3) is defined as: MC_CLASS="Gal*" && PHOT_FLAG<8 && AP_RMAG<24

A few examples of how to select some useful samples:

	Sample	Selection (Boolean AND)	N
1	GEMS galaxies (extended) w/ COMBO-17 info	COMBO_FLAG≥3 GEMS_FLAG≥3	9819
2	GEMS galaxies (extended) w/ COMBO-17 info AND redshifts	COMBO_FLAG≥3 GEMS_FLAG≥3 MC_Z≠NaN	8631
3	GEMS galaxies w/ good GALFIT AND w/ COMBO-17 info	COMBO_FLAG≥3 GEMS_FLAG≥4	9078
4	GEMS galaxies w/ COMBO-17 "QSO" or "QSO (Gal?)" class designation	GEMS_FLAG≥3 MC_CLASS="QSO*"	74
5	COMBO-17 stars unresolved in GEMS	GEMS_FLAG=2 MC_CLASS="Star"	889
6	GEMS galaxies (extended) w/ COMBO-17 info and GEMS z-band data	COMBO_FLAG≥3 GEMS_FLAG≥3 GEMSZ_FLAG≥2	7831
7	GEMS galaxies (extended) w/ COMBO-17 info AND redshifts and GEMS z-band galaxy (extended)	COMBO_FLAG≥3 GEMS_FLAG≥3 MC_Z≠NaN GEMSZ_FLAG≥3	6868
8	GEMS galaxies (extended) w/ COMBO-17 info AND redshifts w/o GEMS z-band data, but inside GEMS-z footprint	COMBO_FLAG≥3 GEMS_FLAG≥3 MC_Z≠NaN GEMSZ_FLAG=1	1745
9	GEMS z-band galaxies (extended) w/ COMBO-17 info AND redshifts w/o GEMS V-band data, but inside GEMS-V footprint	COMBO_FLAG≥3 GEMS_FLAG=1 MC_Z≠NaN GEMSZ_FLAG≥3	0

WARNING: Null values are indicated by "NaN"; except in the case of integer valued columns (ST_NUMBER, ST_FLAGS, STZ_NUMBER, STZ_FLAGS, STZ_TILE_Z, TILE, NR, PHOT_FLAG, COMBO_FLAG, GEMS_FLAG, GEMSZ_FLAG, MC_EBMV_ML, MC_AGE_ML, SED_TYPE)

An illustrative figure:

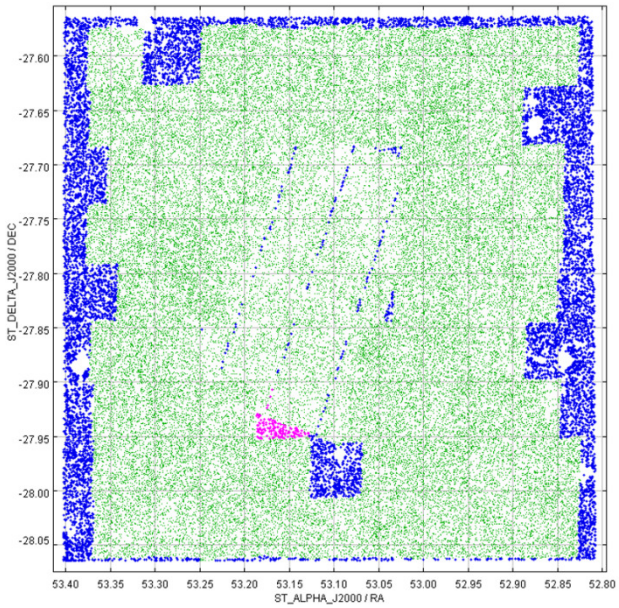

Figure 1: COMBO_FLAG=1 objects (green), GEMS_FLAG=0 objects (magenta) and GEMSZ_FLAG=0 objects (blue). Note, all GEMSZ_FLAG=0 objects also have GEMS_FLAG=0; the extra objects result from the missing tile №44 in V.