CANDELS COSMOS Redshift Catalog README

Kodra et al., 2023, ApJ, 942, 36

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Contents

This file provides compiled and computed redshift information, recommendations for redshift useage from the SEDs/Photz Working Group, and details on the files containing summary statistics on the results from each photo-z computation participant. The tabulated values include the best photometric redshifts reported by CANDELS, spectroscopic redshifts where available, and 3D-HST (grism) redshifts where available. Additionally, this file includes the redshifts at which photo-z probability distributions peak (`z_peak`), weighted centroid values (`z_weight`), and 68.3% and 95.4% credible intervals for the redshift.

In addition to the six individual codes for which probability distributions functions (PDFs) were obtained, we also provide results for two methods of combining individual PDFs: the Hierarchical Bayesian method (HB; see Section 4.1), and the minimum f-divergence (mFDa; see Section 4.2). The HB method produces `z_weight` values that are closer to the spectroscopic redshifts in test samples, whereas the mFDa method provides credible intervals that are more accurate when tested with spectroscopy. Only 4 participants (Finkelstein, Fontana, Salvato, and Wuyts) are used in calculating the HB and mFDa values (hence the labels HB4 and mFDa4); restricting to this subset resulted in smaller errors and better-calibrated PDFs than using all 6 participants in the calculation.

We provide recommendations for usage as follows:

- We advise everyone to use the appropriate columns depending on the needs of each case. You should use `z_best` if you want the best estimate of an object's redshift without regard to uniformity (`z_best` is determined from the combined data set of spectroscopic redshifts, 3D-HST grism redshifts, and `mFDa4_z_weight` photometric redshifts).

- For the best single estimate of redshift calculated uniformly for all objects, you should use `HB4_z_weight`. This minimized errors in tests of estimated photometric redshifts against independent spectroscopic redshift sampled, yielding:
  $$\sigma_{\mathrm{NMAD}} = 0.02265, |\tfrac{(\Delta z)}{(1+z)}| > 0.15 \text{ and } \mathrm{Outlier\ Fraction} = 0.06688.$$
  Testing them against a carefully selected sample of 3D-HST grism redshifts, we again get the best results for `HB4_z_weight`:
  $$\sigma_{\mathrm{NMAD}} = 0.01881 \text{ and } \mathrm{Outlier\ Fraction} = 0.01901.$$

- Finally, if you want uniformly calculated redshifts, with relatively well-calibrated probability distributions / accurate error estimates, you should use mFDa4. The paper presents the tests of the accuracy of the probability distributions (and therefore the quality of the error estimates) for each participant and combination method that have led to this conclusion.

Column Description

1 File
2 ID
3 RA
4 DEC
5 z_best
6 z_best_type
7 z_spec
8 z_spec_ref
9 z_grism
10 mFDa4_z_peak
11 mFDa4_z_weight
12 mFDa4_z683_low
13 mFDa4_z683_high
14 mFDa4_z954_low
15 mFDa4_z954_high
16 HB4_z_peak
17 HB4_z_weight
18 HB4_z683_low
19 HB4_z683_high
20 HB4_z954_low
21 HB4_z954_high
22 Finkelstein_z_peak
23 Finkelstein_z_weight
24 Finkelstein_z683_low
25 Finkelstein_z683_high
26 Finkelstein_z954_low
27 Finkelstein_z954_high
28 Fontana_z_peak
29 Fontana_z_weight
30 Fontana_z683_low
31 Fontana_z683_high
32 Fontana_z954_low
33 Fontana_z954_high
34 Pforr_z_peak
35 Pforr_z_weight

36 Pforr_z683_low
37 Pforr_z683_high
38 Pforr_z954_low
39 Pforr_z954_high
40 Salvato_z_peak
41 Salvato_z_weight
42 Salvato_z683_low
43 Salvato_z683_high
44 Salvato_z954_low
45 Salvato_z954_high
46 Wiklind_z_peak
47 Wiklind_z_weight
48 Wiklind_z683_low
49 Wiklind_z683_high
50 Wiklind_z954_low
51 Wiklind_z954_high
52 Wuyts_z_peak
53 Wuyts_z_weight
54 Wuyts_z683_low
55 Wuyts_z683_high
56 Wuyts_z954_low
57 Wuyts_z954_high

Notes

- File: the name of the file with the probability distributions (PDFs) for a given object.

- ID: ID of the object as taken from the CANDELS photometry catalog below:
  `hlsp_candels_hst_wfc3_cos-tot-multiband_f160w_v1-1photom_cat.txt`

- RA: RA of the object as taken from the CANDELS photometric catalog above.

- DEC: DEC of the object as taken from the CANDELS photometric catalog above.

- `z_best`: the best estimate of the redshift as determined by the CANDELS team. `z_best` corresponds to the secure spectroscopic redshift if one is available, or secure 3D-HST grism-z if available and there is no spec-z, and finally photo-z when there is no spec-z or 3D-HST grism-z available. For the photo-z case, `mFDa4_z_weight` is used as `z_best`, since it produces the most accurate confidence intervals when tested, while it also produces very good results with point statistics (scatter, σ_{NMAD}, and outlier fraction). Only the most secure quality classes for spectroscopic redshifts are included in this catalog.

  For 3D-HST grism-z's, the following catalogs were used (see 3D-HST MAST page: https://archive.stsci.edu/prepds/3d-hst/):

    – `cosmos_3dhst.v4.1.5.zfit.linematched.fits`

- – `cosmos_3dhst.v4.1.cat.fits`

with the following cuts:

- – use_zgrism $== 1$
- – use_phot $== 1$
- – flag1 $== 0$
- – flag2 $== 0$
- – z_best_s $!= 0$
- – z_spec $<= 0$
- – z_max_grism > 0.6
- – z_grism_u68 $-$ z_grism_l68 < 0.01
- – (z_grism_u68 $-$ z_grism_l68)/(z_phot_u68 $-$ z_phot_l68) < 0.1
- – z_max_grism $>$ z_phot_l95
- – z_max_grism $<$ z_phot_u95

- z_best_type: flag that shows the type of redshift deemed as best by CANDELS. It is given by the letter "s" when z_best is a spectroscopic redshift, "g" when z_best is a grism-z, or "p" when z_best is a photometric redshift.

- z_spec: spectroscopic redshift when available. The spec-z's have been gathered from a variety of catalogs, including previous public releases (e.g., MOSDEF and DEEP2) and data being released here for the first time. Many of these redshifts were compiled by N.P. Hathi. Only the most secure classes of spec-z's are included in this column.

- z_spec_ref: is a code indicating the catalog from which a spectroscopic redshift was obtained, if applicable. The references corresponding to these codes are given at the end of this file.

- z_grism: is the 3D-HST grism redshift when available. Only the best quality grism-z's are provided in this column (see above Note on z_best for a full description of the selection).

- ..._z_peak: is the redshift at which a given probability distribution peaks (where "..." is replaced by the identifier for the relevant participant in this and the below column names).

- ..._z_weight: is the centroid of the probability distribution, calculated using only values around the highest peak, i.e., only the region where the distribution is larger than 0.05 of the peak value of the distribution.

- ..._z683_low: is the lower boundary of the 68.3% credible interval

- ..._z683_high: is the higher boundary of the 68.3% credible interval

- ..._z954_low: is the lower boundary of the 95.4% credible interval

- ...z954_high: is the higher boundary of the 95.4% credible interval

- Negative values (-1.0) are used whenever there is a file with a missing probability distribution, so that a relevant quantity could not be calculated.

Spectroscopic Redshifts

The catalogs from which the high quality spectroscopic redshifts were gathered are the following:

- `deimos_cos.dat`

- `vuds_cosmos_dr1.txt`

- `cosmosteam_publicspecz.dat`

- DEIMOS

- MOSDEF (MOSFIRE)

N.M. Hathi Spectroscopic Redshift Catalogs

References for spectroscopic redshifts catalogs and quality flags

3D-HST and MOSDEF:

- 3D_HST: Momcheva et al. 2016, ApJS, 225, 27

- MOSDEF: Kriek et al. 2015, ApJS, 218, 15

- quality flags for 3D-HST and MOSDEF are approximated as 3.0 and 4.0, respectively

VUDS:

- VUDS_2015: Le Fevre et al. 2015, A&A, 576, A79

- 4.0: 100% reliability

- 3.0: 95–100% reliability

- 2.0: 75–85% reliability

- 1.0: 50–75% reliability

- 9.0: $\sim$ 80% reliability (single emission line)

- AGN are labelled: 1x

- Objects other than primary are labelled: 2x, 3x, 4x

UCR DEIMOS Survey

- UCR_UNPUB: UCR DEIMOS Survey (contact: mobasher@ucr.edu)

- 4.0: highest confidence

- 1.0: lowest confidence

References from COSMOS team catalog (M. Salvato)

- PRIMUS: Coil et al. 2011, ApJ, 741, 8

- zBRIGHT: simon.lilly@phys.ethz.ch

- MOSFIRE: Kriek+ 2015, ApJS, 218, 15

- GEMINI-S: mbalogh@uwaterloo.ca

- XSHOOTER: marcella.brusa3@unibo.it

- IMACS: Trump et al. 2011

- FMOST: Silverman et al. 2015

- WFC3: Krogager et al. 2014

- FMOS: igr@roe.ac.uk

- IRS: fu@astro.caltech.edu

- FORS2: johan.comparat@uam.es

zCOSMOS

- zCOSMOS: Lilly et al. 2007, ApJS, 172, 70 and Lilly et al. 2009, ApJS, 184, 218

- Spec-z quality flags indicating reliability

  - Galaxies and stars:
    * >99.5% 4.x, 3.x
    * >99% 2.5
    * >95% 9.3, 9.5, 1.5
    * >90% 2.4
    * >70% 1.4, 9.1, 9.4
    * Unlikely to be correct: 1.1, 2.1
    * 4.x: Very secure (99.8%)
  - Broad line AGN:
    * 14.x, 13.x: Secure BLAGN
    * 12.x: Less secure BLAGN

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   * 18.x: One line BLAGN

   * 11.x: Insecure BLAGN

  – Secondary targets:

   * One of the above preceded by 2

Trump et al. (2009)

- Trump_2009: Trump et al. 2009, ApJ, 696, 1195

- Spec-z Quality Flags and redshift confidence:

  – 4: high-confidence redshift ($>$90% likely)

  – 3: likely redshift ($\sim$ 75% likely)

  – 2: degenerate redshift ($\sim$ 50% likely)

  – 1: redshift guess ($\sim$ 25% likely)