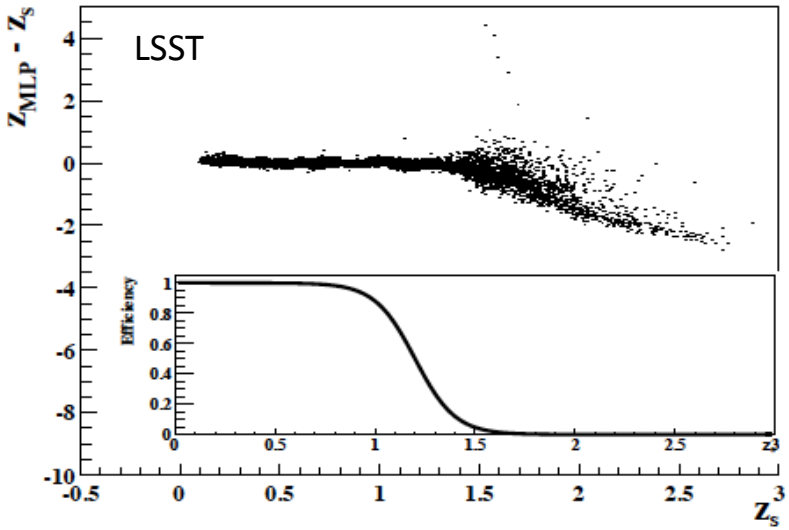
Comparison of 3 SED libraries on Candels – Goods catalog

Photo-z reconstruction is a decisive milestone for cosmology in LSST

Specs : |bias| < 0.003, RMS < 0.05



2 main methods:

- Machine learning -> non-completeness bias

- Template fiting -> need SEDs library

Combination of different codes (bayesian combination of PDF) and strategies (complementarity)

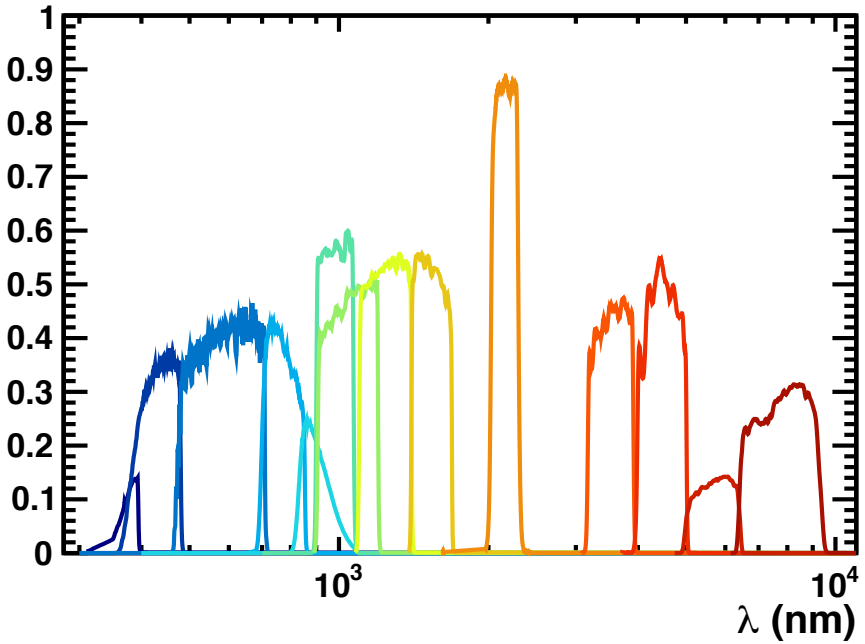
Which library ?

Needed for photo-z reconstruction and LSST simulation

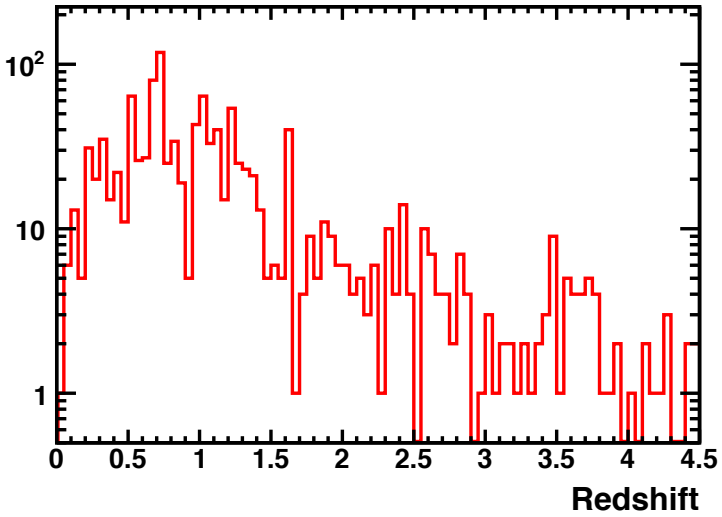
- Generic SEDs (observation)
- Synthetic SEDs (simulation)
- Semi-synthetic SEDs (extrapolation in PCA eigenvectors space)

Candels spectro-photometric catalog

Photometry in 14 bands	
U	VLT/VIMOS
F435W, F606W, F775W, F850LP	*HST/ACS*
F098M, F105W, F125W, F160W	*HST/WFC3*
Ks	VLT/ISAAC
ch1, ch2, ch3, ch4	*SPITZER/IRAC*

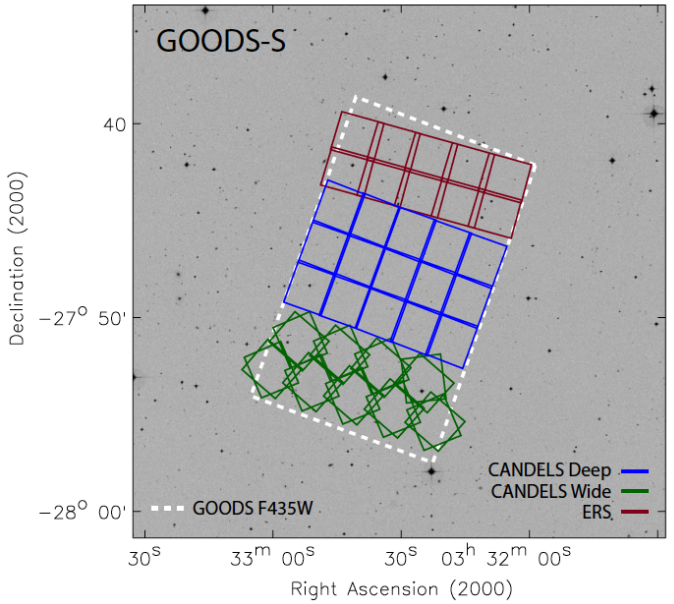


Spectroscopic redshift

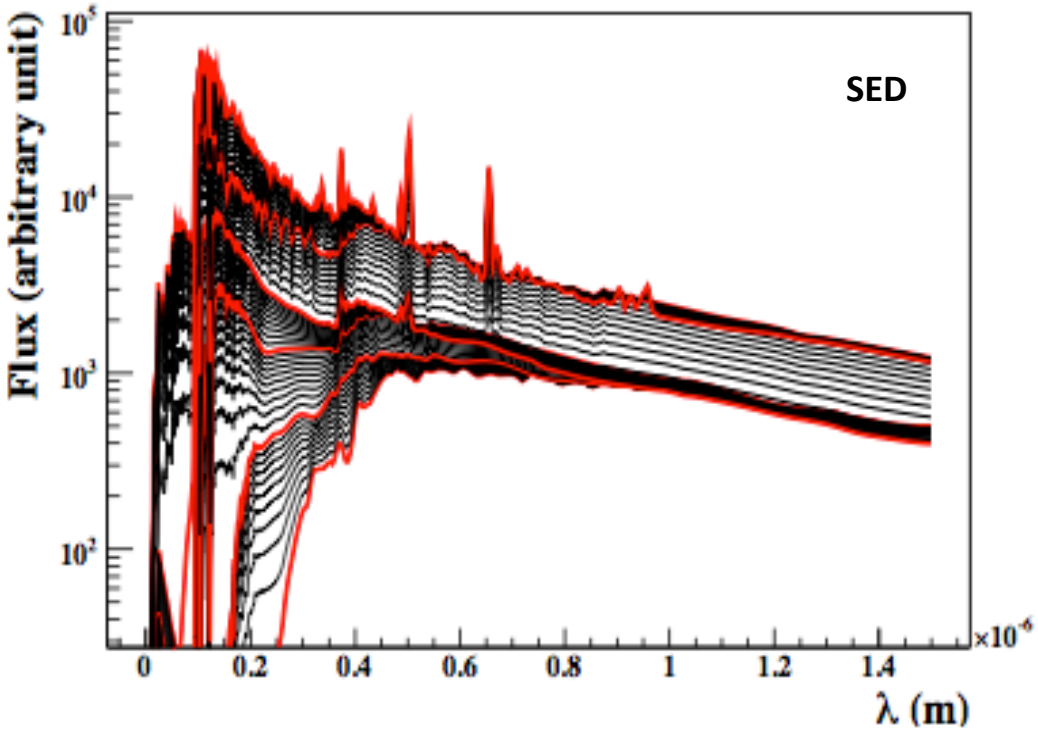


1169 galaxies

GOODS-S deep and ERS fields



CWWK library



51 templates interpolated from El, Sbc, Scd, Im (*Coleman et al)*, SB2, SB3 (*Kinney et al)*

SEDs are extrapolated into UV and IR using stellar models (*Bruzual, Charlot*)

Spectra end at 2.5 μm -> only 10 out of 14 Candels bands are usable at all z

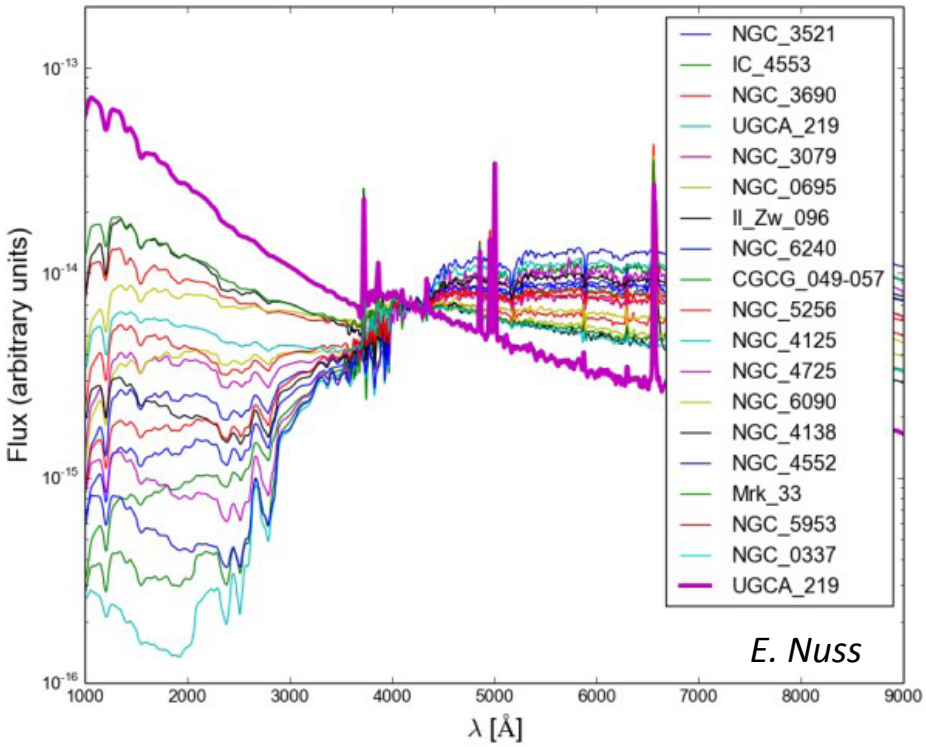
Brown library

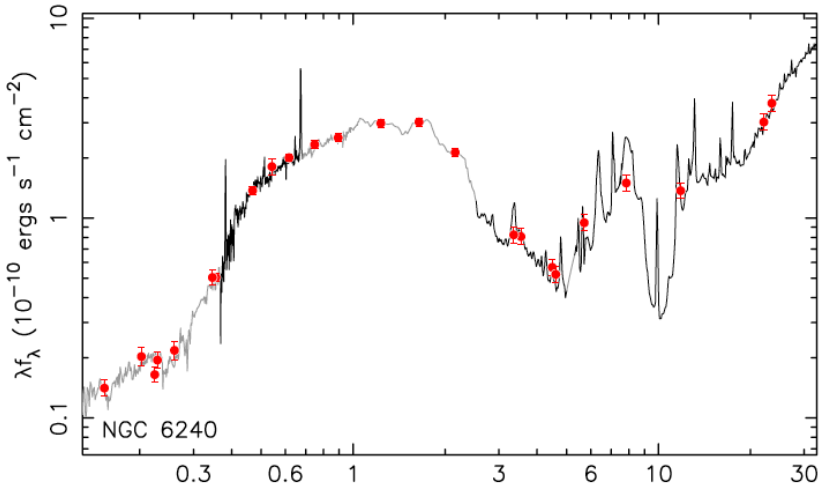
Brown et al, arXiv:1312.3029

129 SEDs of nearby galaxies (z < 0.05)

Broad range of galaxy types : ellipticals, spirals, merging galaxies, blue compact dwarfs, luminous infrared galaxies

Ground-based optical spectrophotometry + infrared spectroscopy from *Spitzer and Akari*





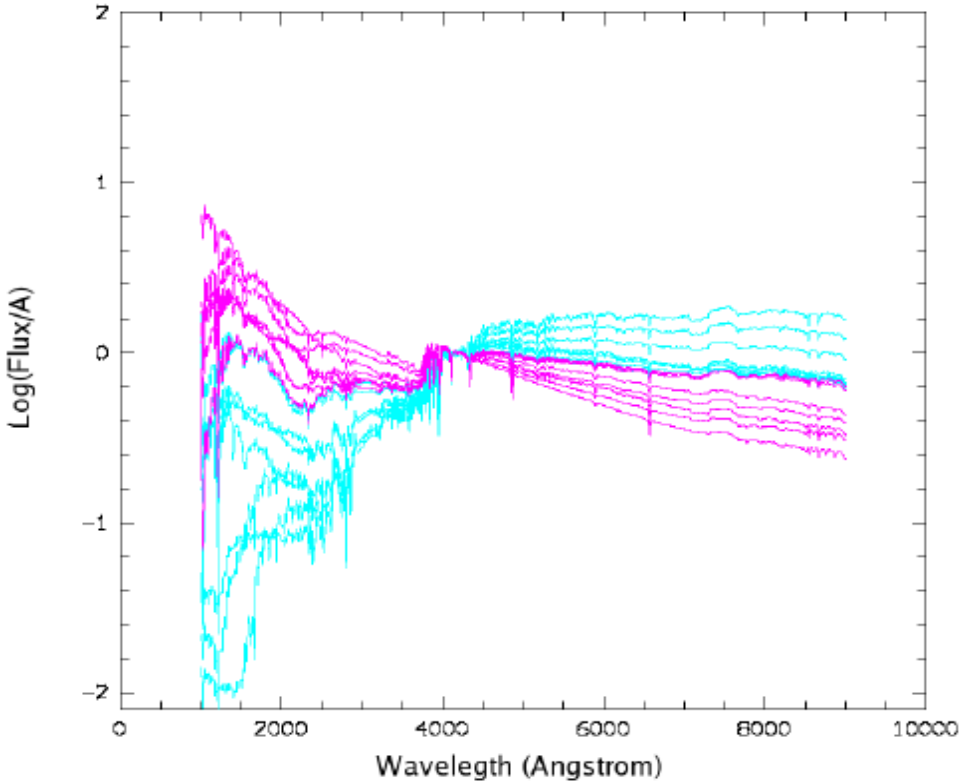
Fors2 library

Giraud et al, arXiv:1011.1947

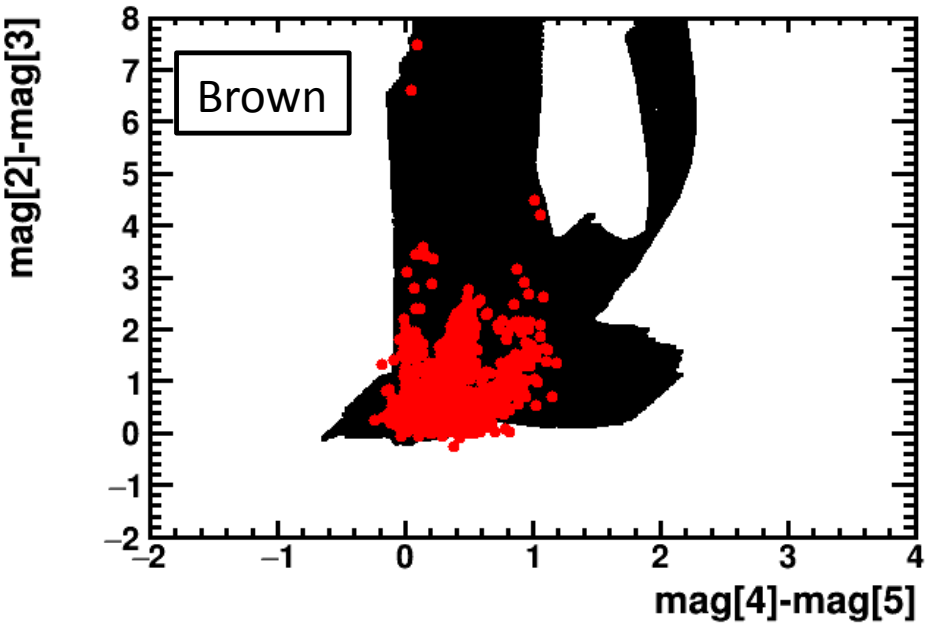
Redshift and flux distribution of 654 galaxies obtained with the FORS2 instrument (VLT UT1)
z = [0.275, 1.05]
Rest frame window : 3000 Å < λ < 6000 Å
Stellar mixing and synthetic spectra derived from SED using STARLIGHTV04
→ model continuum spectra extended to the range : 1000 Å < λ < 100000 Å

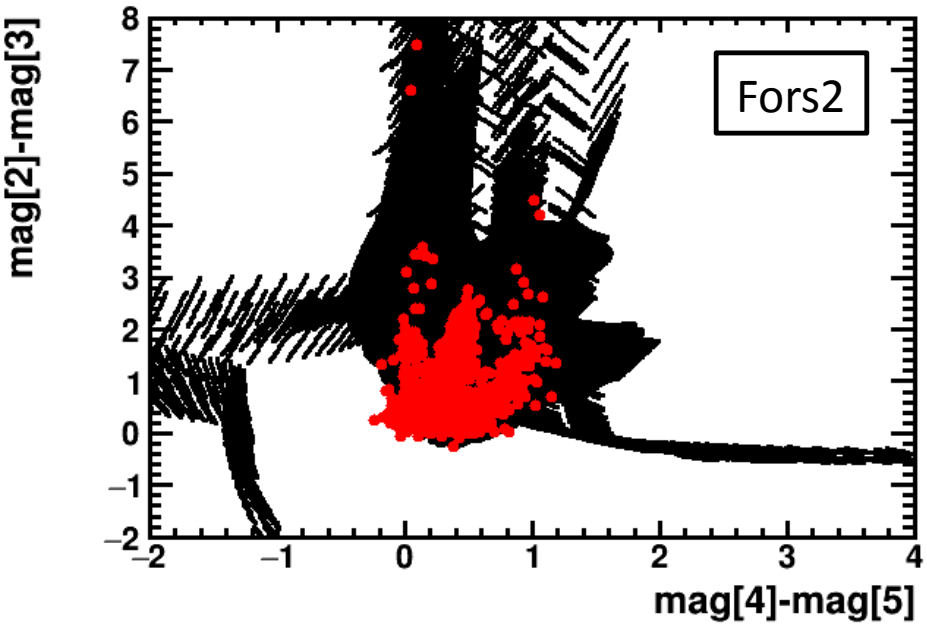
Two main classes:
- "Red" spectra (Absorption systems and red emission line galaxies)
-"Blue" spectra (Blue star forming galaxies)

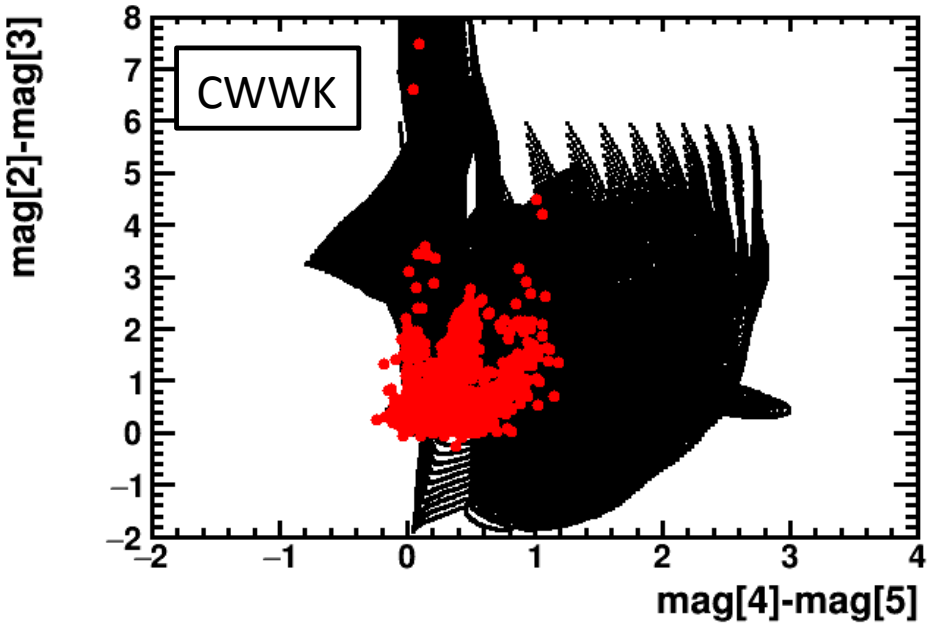
This work : only 38 SEDs



E. Nuss

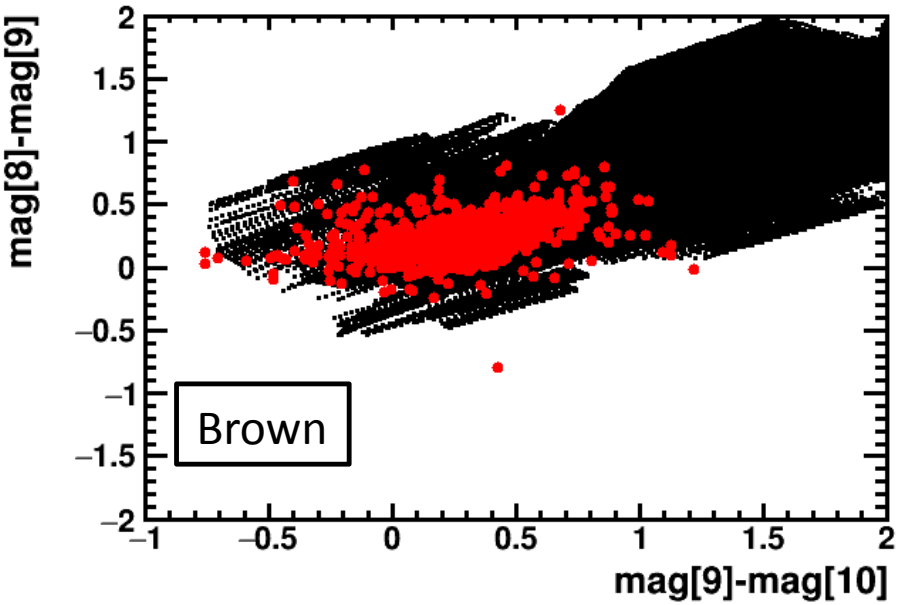


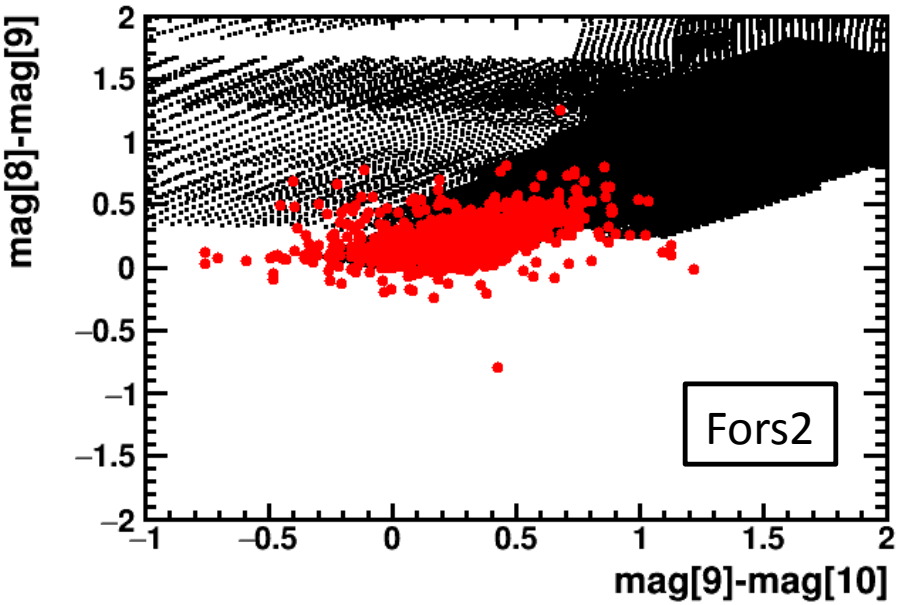


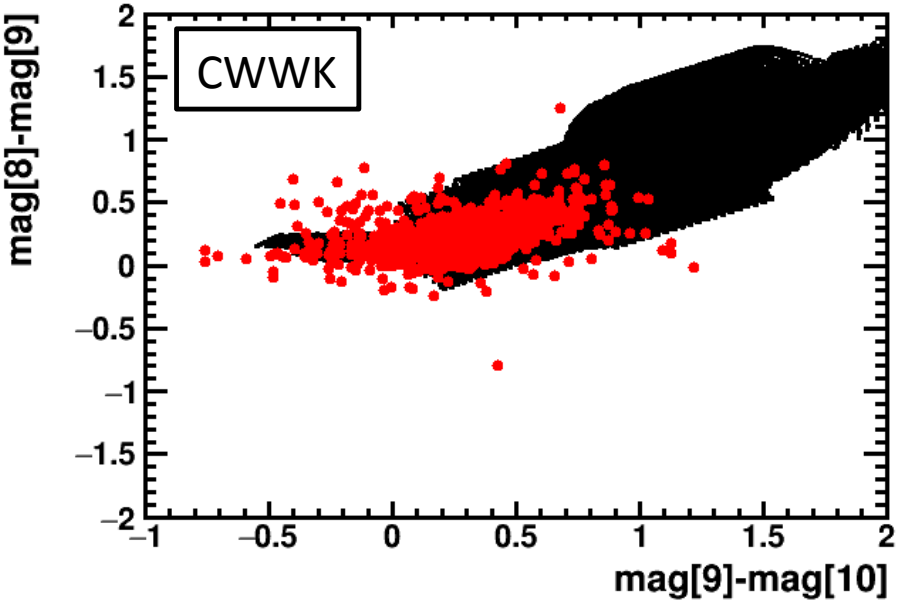


Color matching

All types
z = [0, 4.5]
E(B-V) = [0, 0.4]



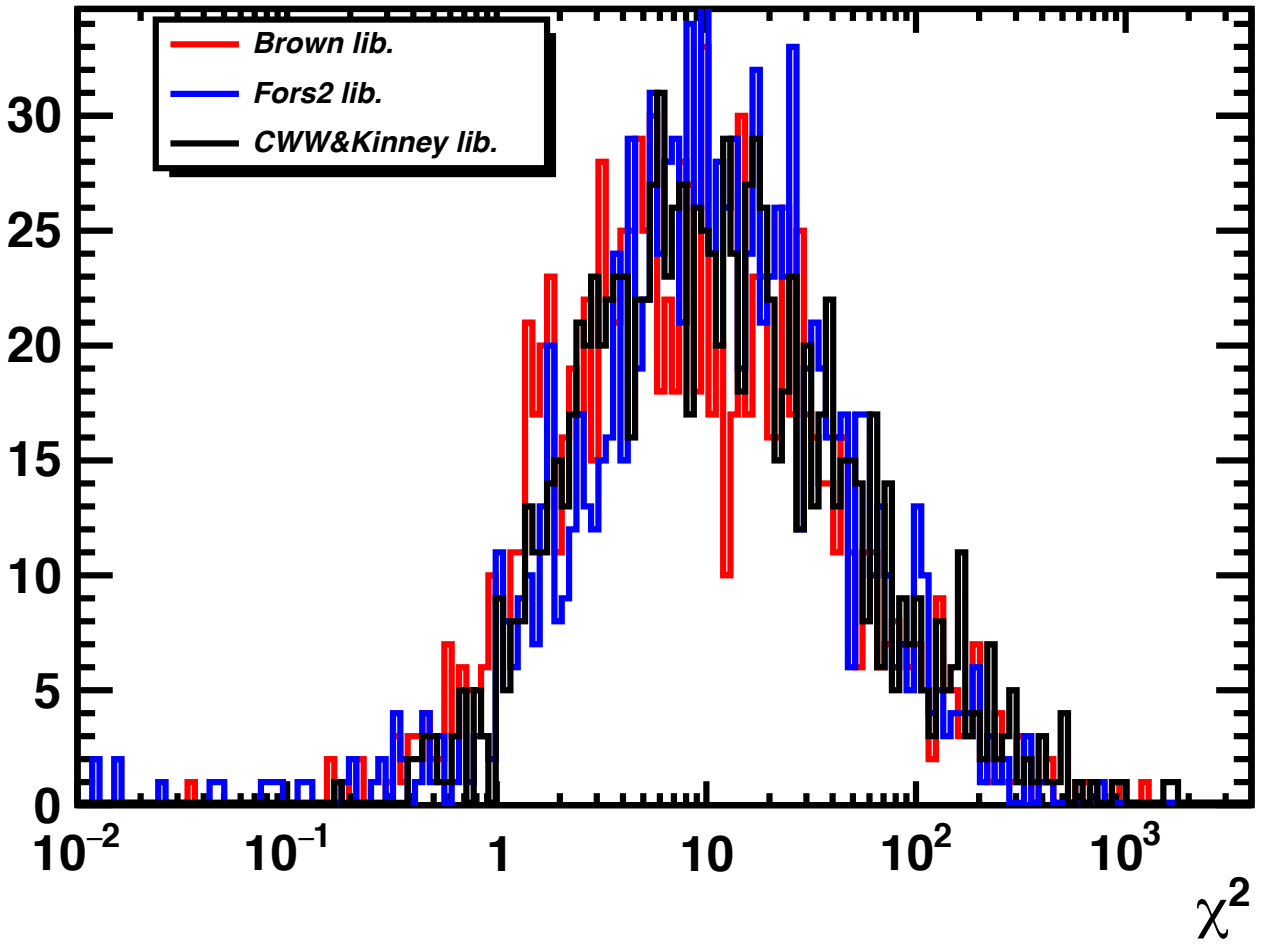


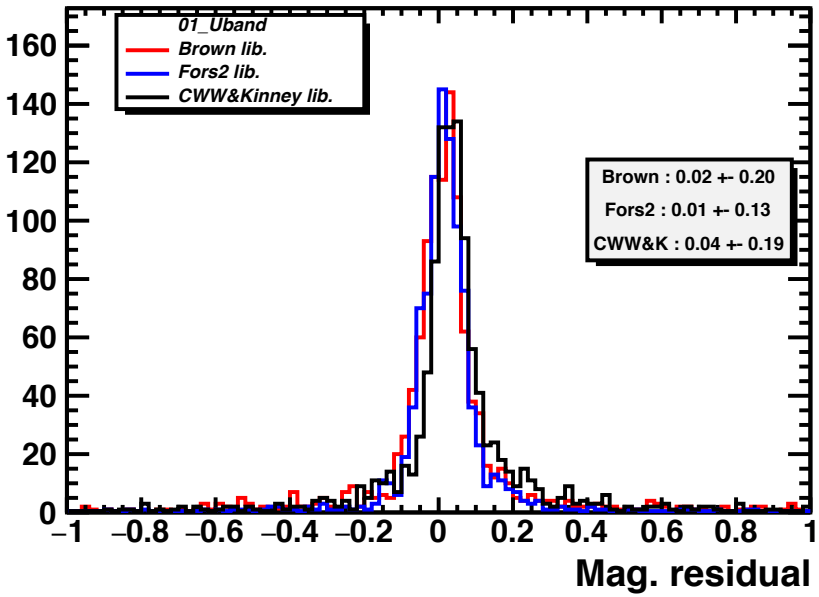


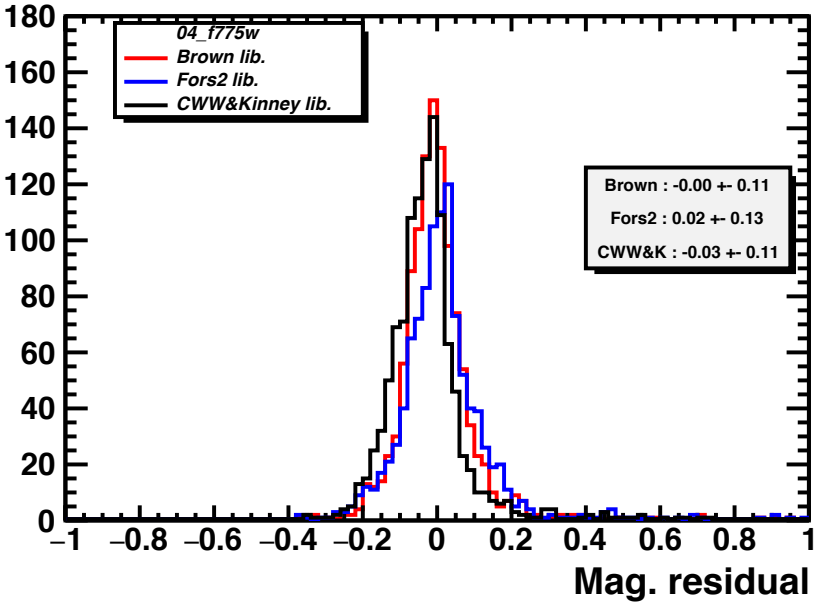
Brown lib. better mimics the data color plots

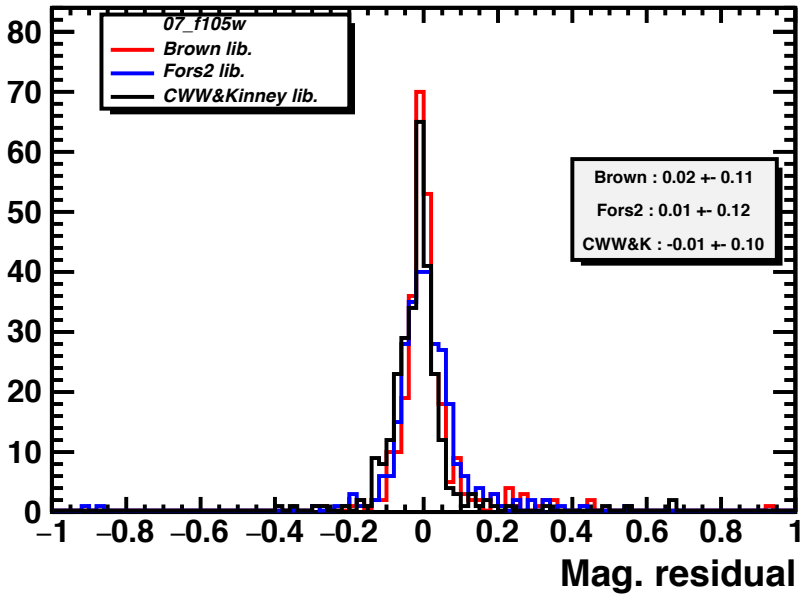
Catalog matching

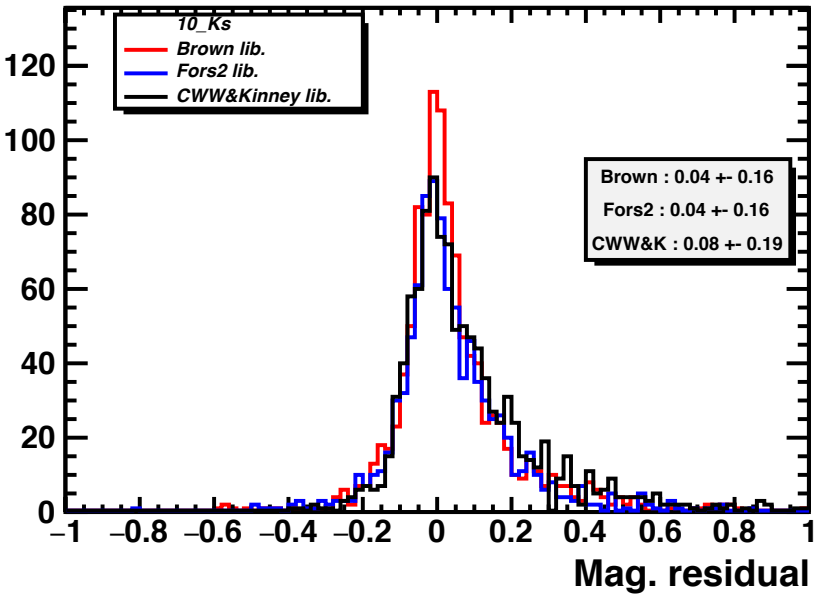
$$\chi^2 = \sum_b (F_{obs}[b] - F_{exp}[b](zs, type, ebv))^2 / \sigma^2_{obs}$$

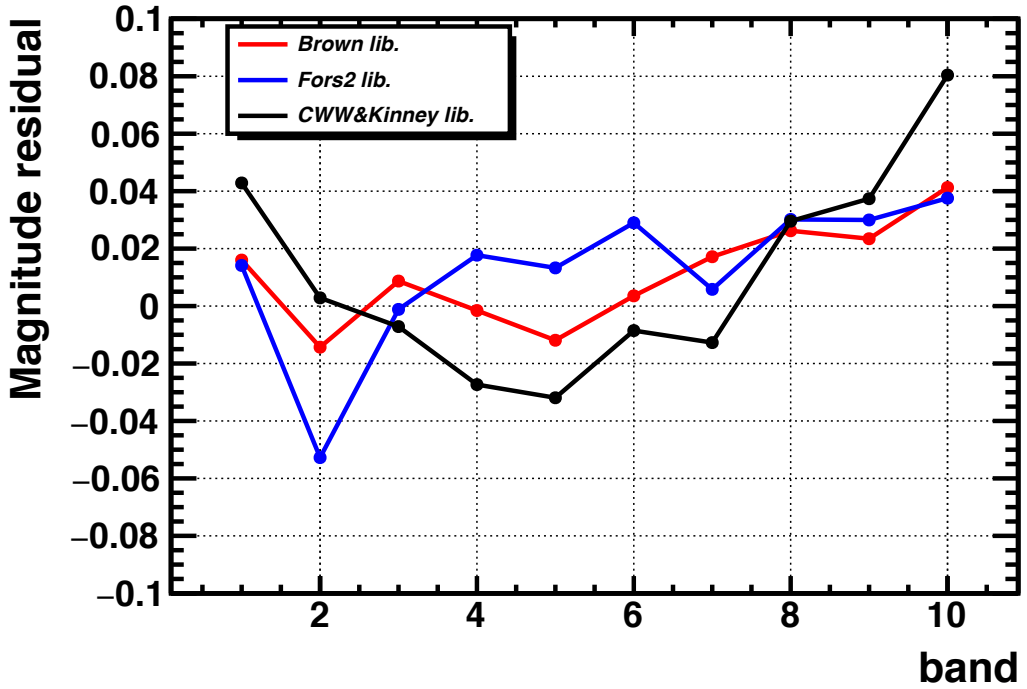



01_Uband
Brown lib.
Fors2 lib.
CWW&Kinney lib.
Brown : 0.02 +- 0.20
Fors2 : 0.01 +- 0.13
CWW&K : 0.04 +- 0.19
Mag. residual


04_f775w
Brown lib.
Fors2 lib.
CWW&Kinney lib.
Brown : -0.00 +- 0.11
Fors2 : 0.02 +- 0.13
CWW&K : -0.03 +- 0.11
Mag. residual


07_f105w
Brown lib.
Fors2 lib.
CWW&Kinney lib.
Brown : 0.02 +- 0.11
Fors2 : 0.01 +- 0.12
CWW&K : -0.01 +- 0.10
Mag. residual

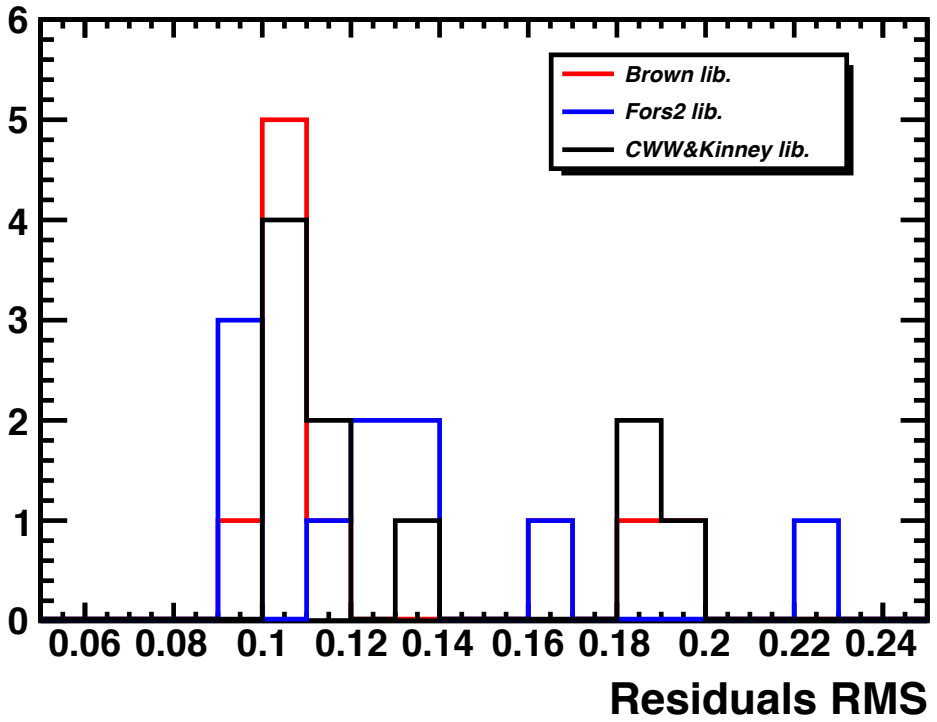

10_Ks
Brown lib.
Fors2 lib.
CWW&Kinney lib.
Brown : 0.04 +- 0.16
Fors2 : 0.04 +- 0.16
CWW&K : 0.08 +- 0.19
Mag. residual



Brown is smooth in all bands

Fors2 doesn't match well F435W band

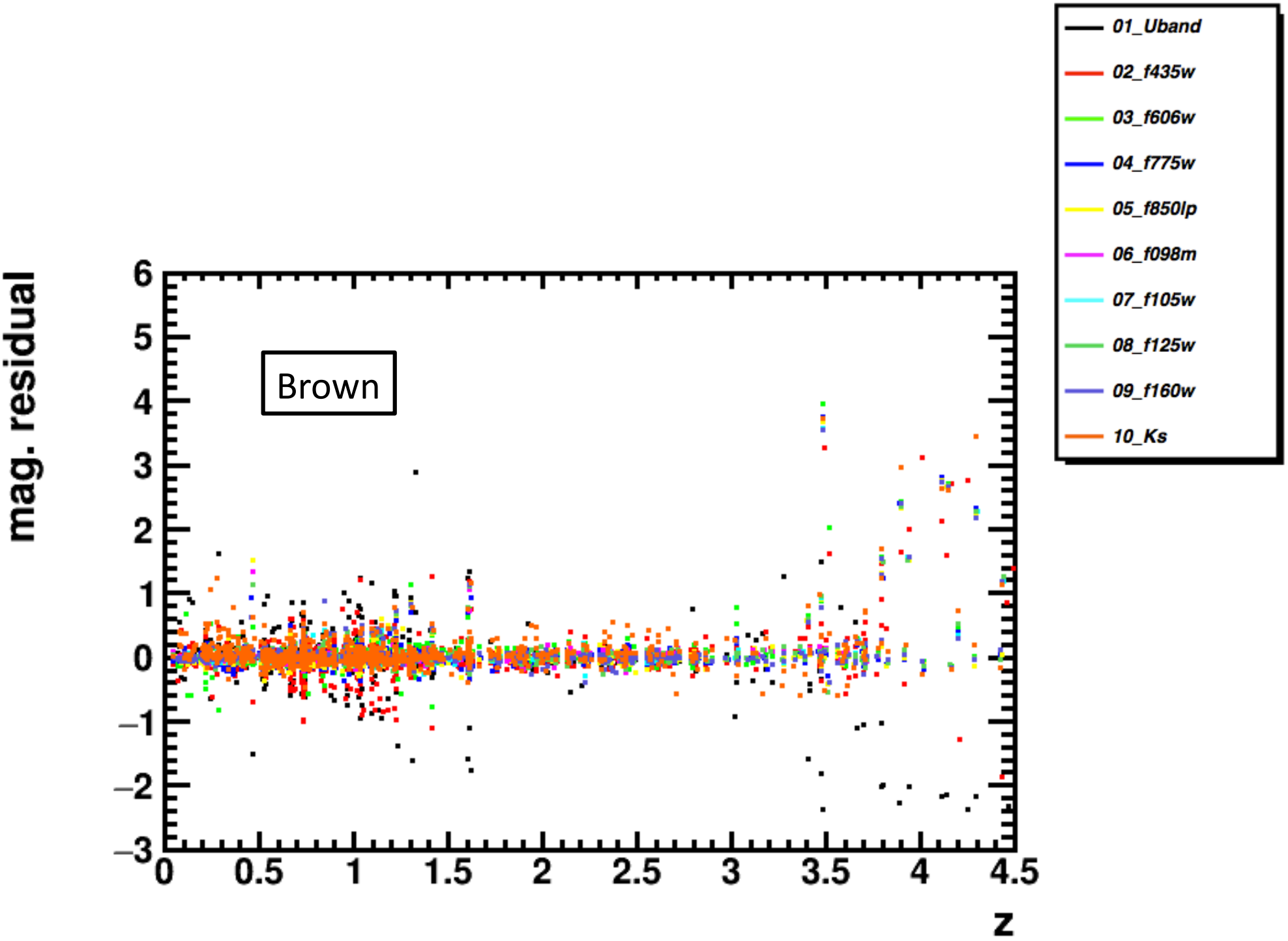
CWWK

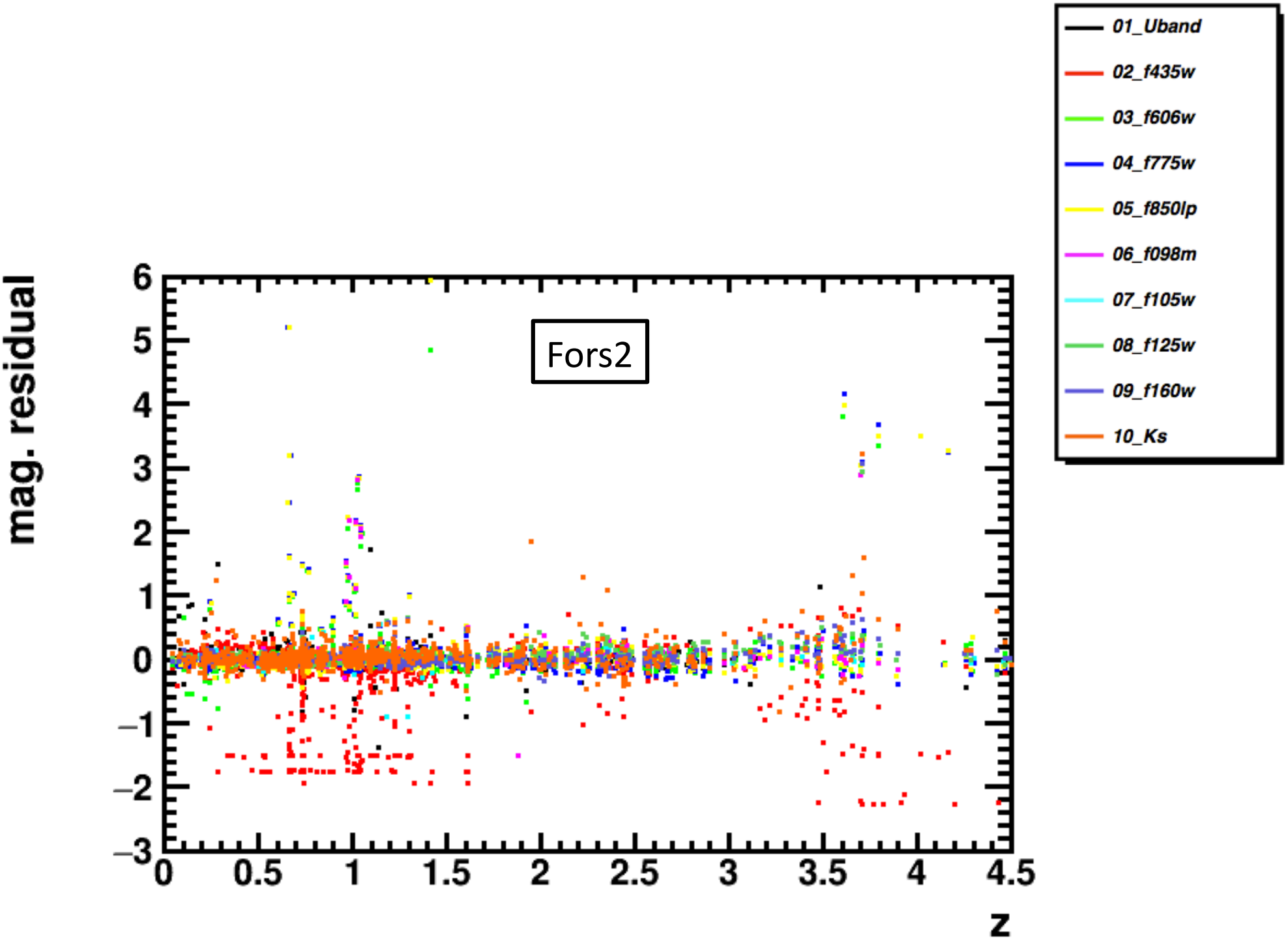


Brown : rms = 0.128

Fors2 : rms = 0.130

CWWK : rms = 0.135


mag. residual
z
Brown
01_Uband
02_f435w
03_f606w
04_f775w
05_f850lp
06_f098m
07_f105w
08_f125w
09_f160w
10_Ks
6
5
4
3
2
1
0
−1
−2
−3
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5


Fors2
mag. residual
z
01_Uband
02_f435w
03_f606w
04_f775w
05_f850lp
06_f098m
07_f105w
08_f125w
09_f160w
10_Ks
6
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3
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−2
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0
0.5
1
1.5
2
2.5
3
3.5
4
4.5

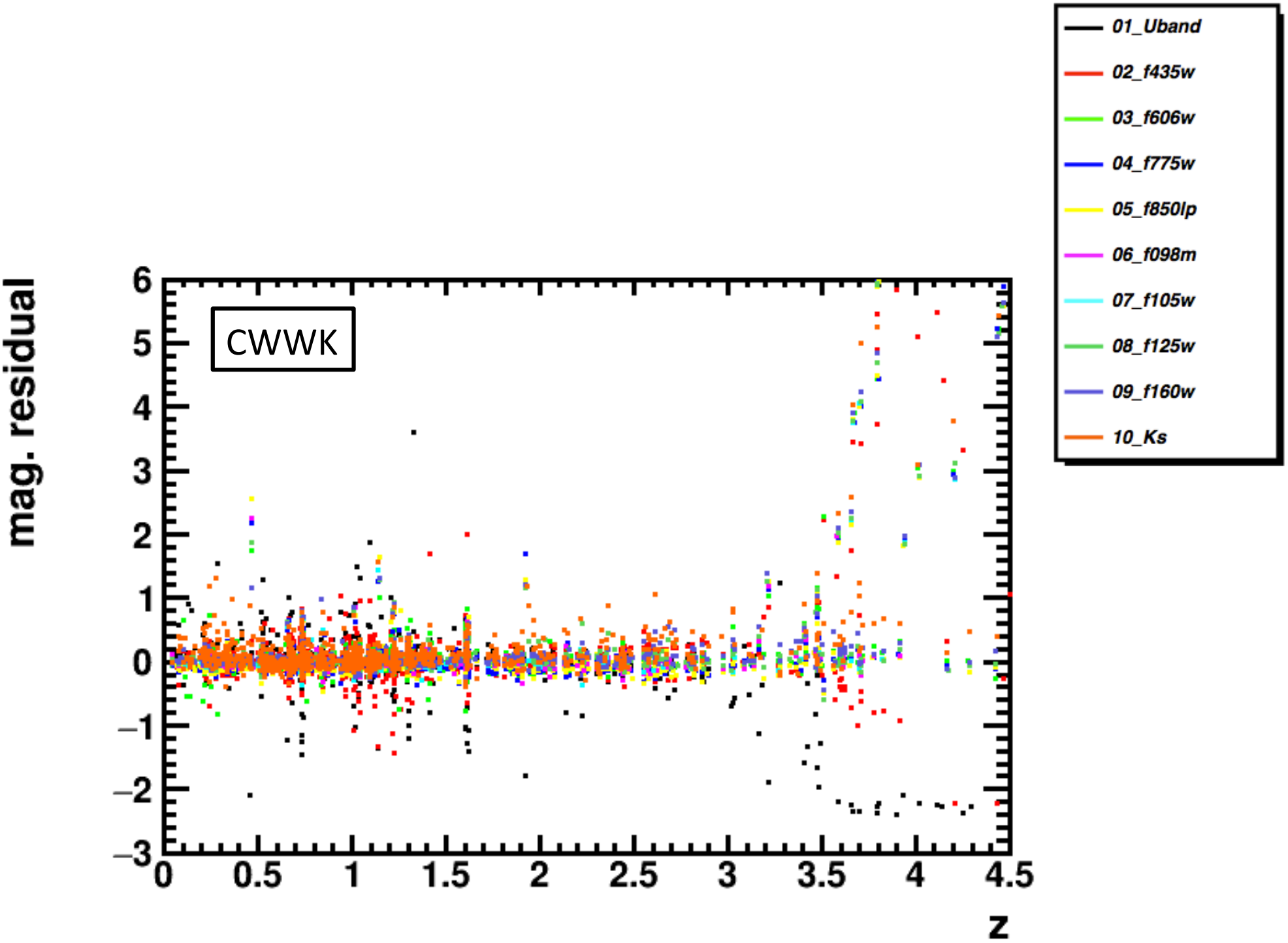
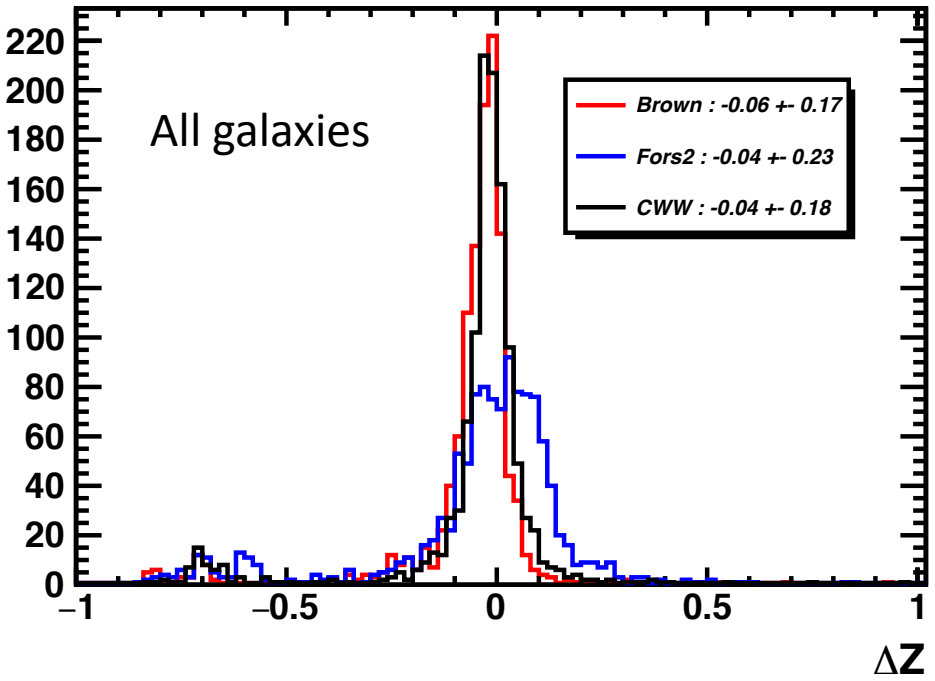

CWWK
mag. residual
z
6
5
4
3
2
1
0
−1
−2
−3
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
01_Uband
02_f435w
03_f606w
04_f775w
05_f850lp
06_f098m
07_f105w
08_f125w
09_f160w
10_Ks

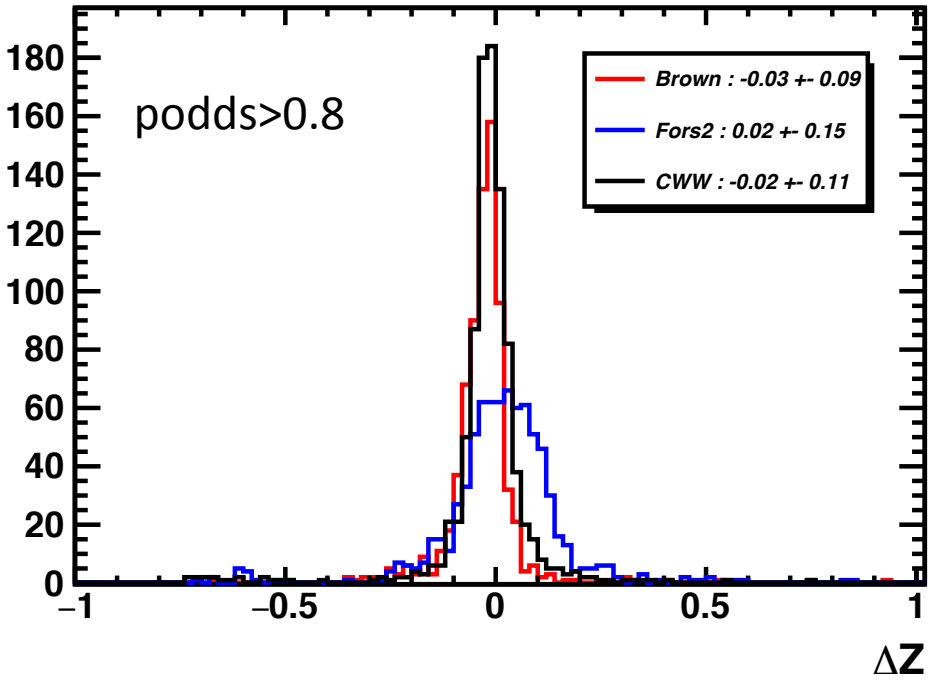
Photo-z reconstruction

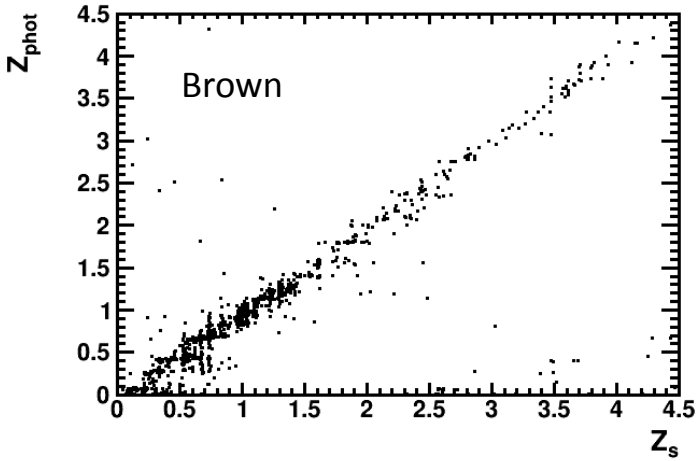
Fors2 show strong degeneracy
(or lack of SED)

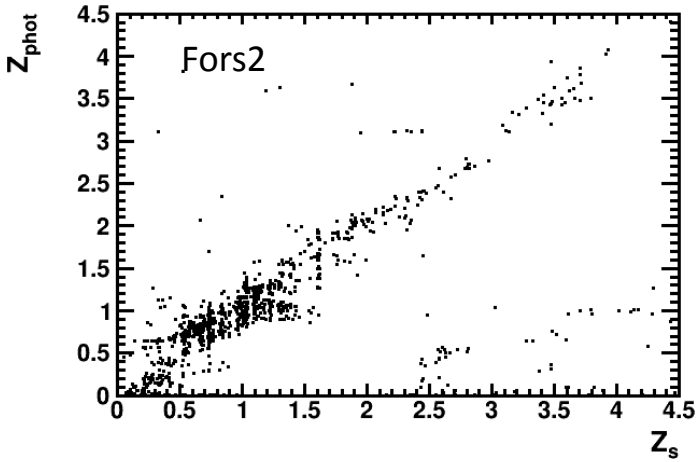
$$podds = \int_{Z_p - 0.06\,(1+Z_p)}^{Z_p + 0.06\,(1+Z_p)} PDF(z)$$

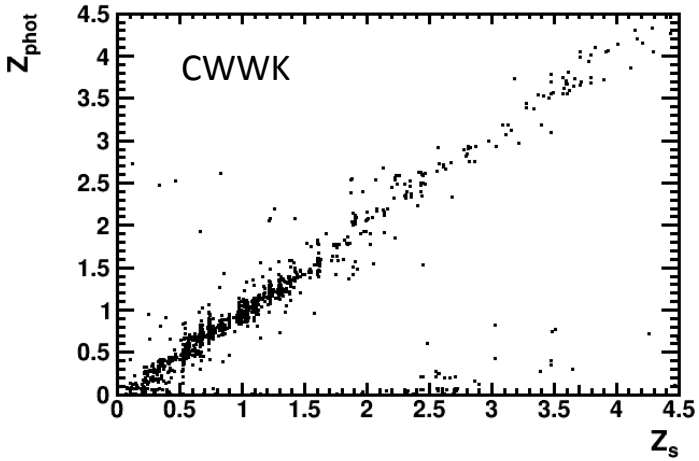
Brown : 732/1169 = 62.6%
Fors2 : 775/1169 = 66.3%
CCWK : 917/1169 = 78.4%

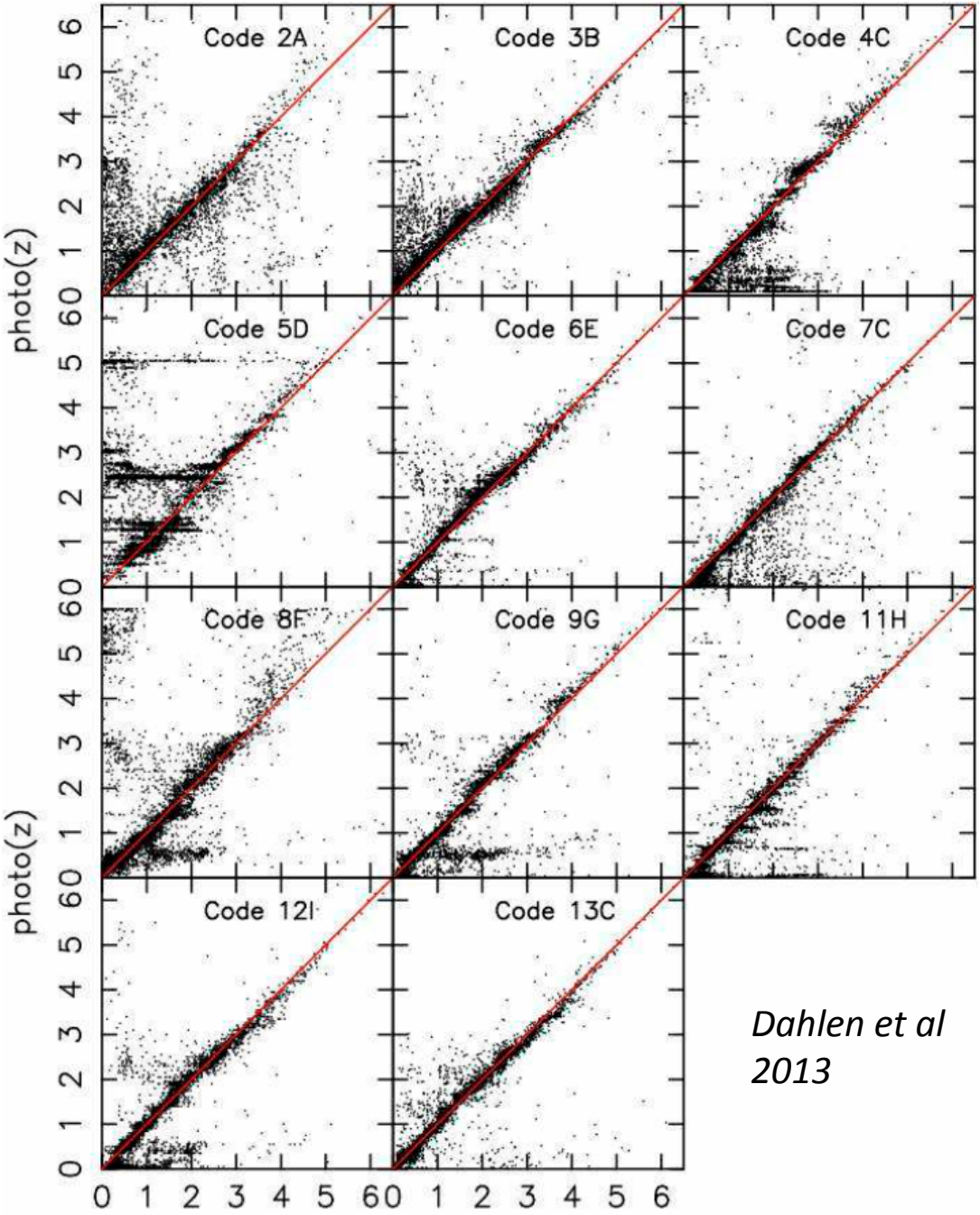












Dahlen et al 2013

Conclusions :

- Brown library mimics the data (color) slightly better
- CWWK & Brown are similarly good to reconstruct photo-z
- Fors2 is less performant for photo-z reconstruction
- This is a preliminary work, it has to be done on other catalogs