Comparison of cluster finder algorithms on cosmoDC2 data

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LSST-France meeting

Annecy

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Outline

Cosmology from cluster count

Cluster catalog
Selection function

Mass-richness relation

Cosmology (cluster abundance)

Likelihood

- Scope of the project
- Cluster catalog status
- Performance comparison
- redMaPPer/WaZP comparison

Scope of the project

DESC project 248 (link)

Comparison of cluster finder algorithms on DC2 data

- Comparison on both cosmoDC2 and DC2 datasets
- Use of CLEVAR for catalog matching and for performance estimation (common framework, try to automatize)
- Algorithms: redMaPPer, WaZP and AMICO

Several DESC friend projects

Part 1. Overall comparison

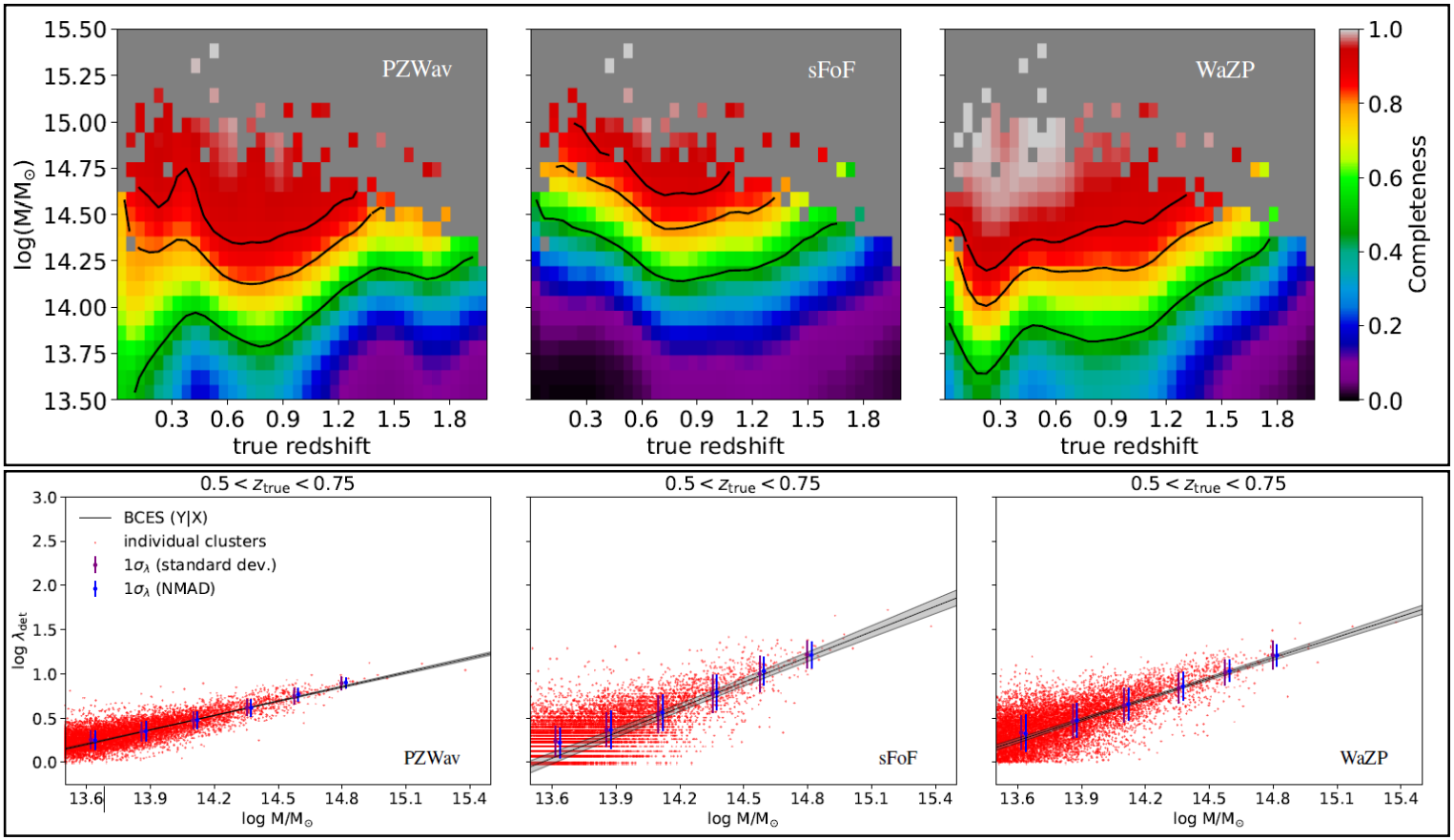
- Completeness and purity
- Mass-richness scaling relation
- Cluster redshift coverage and accuracy

Part 2. Direct (1-to-1) comparisons between catalogs

- Matched/unmatched clusters
- Properties for matched clusters:
richness, redshift, centering, etc.

Euclid Cluster Finder Challenge

Euclid preparation III. Galaxy cluster detection in the wide photometric survey, performance and algorithm selection [arXiv:1906.04707]



Goal: select the best-for-Euclid-mission cluster detection algorithms
6 detection algorithms considered ➔ 2 selected (AMICO and PZWav)

Catalog status

Sky areas:
cosmoDC2: 440 deg^2
cosmoDC2 small: 57 deg^2
DC2: 303 deg^2

cosmoDC2

GCR

cosmoDC2_v1.1.4_small
cosmoDC2_v1.1.4

✓

redMaPPer

GCR

- cosmoDC2
True z, with close-to-perfect error model
Λ>5
cosmoDC2_v1.1.4_redmapper_v0.8.1

- DR6 catalog
dc2_redmapper_run2.2i_dr6_wfd_v0.8.1

✓

WaZP
cosmoDC2 small
z-band

- True z
Run 6563

- z-smeared (0.03)
Run 6684

- Photo-z (BPZ)
Run 6685

✓

AMICO
cosmoDC2 small
Photo-z (BPZ)
Catalog still in validation

✓

CLEVAR

DESC package developed by M. Aguena (as DESC pipeline scientist)

Cluster Evaluation Resources (CIEvaR)

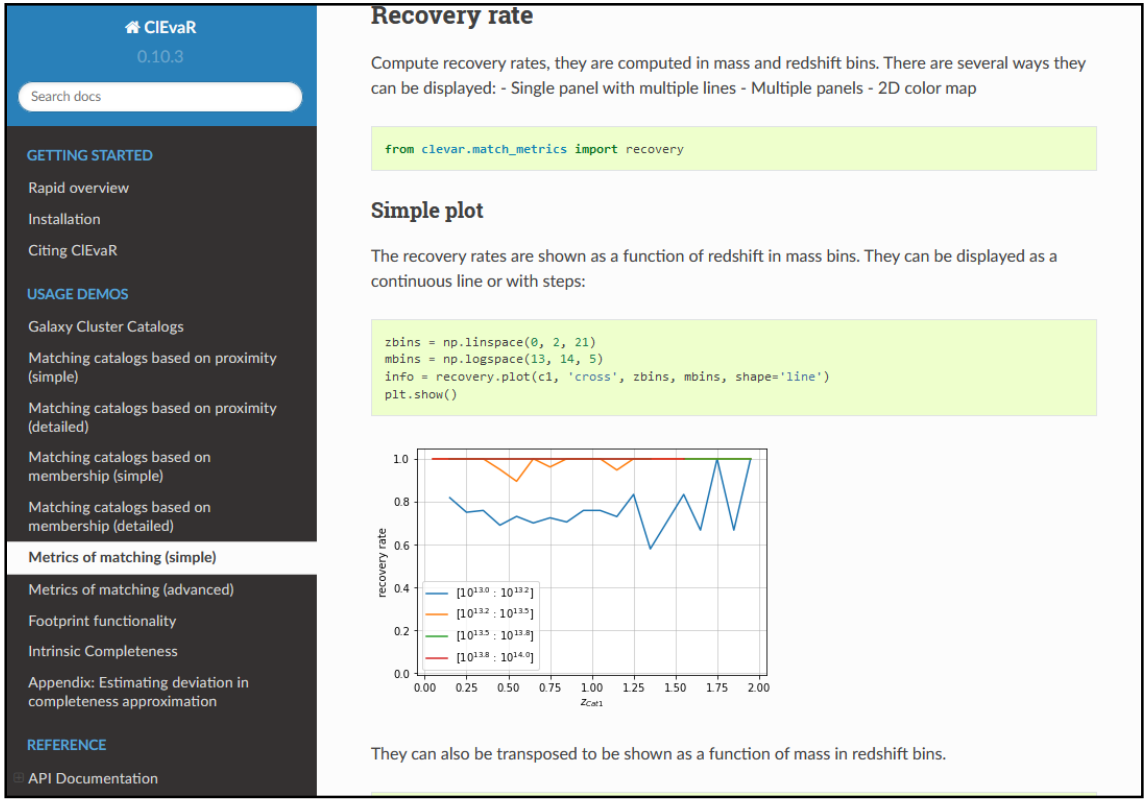
Build and Check passing coverage 100% Library to validate cluster detection. A detailed documentation of the code can be found at https://lsstdesc.org/clevar.

https://github.com/LSSTDESC/clevar

Matching between catalogs (proximity or membership)

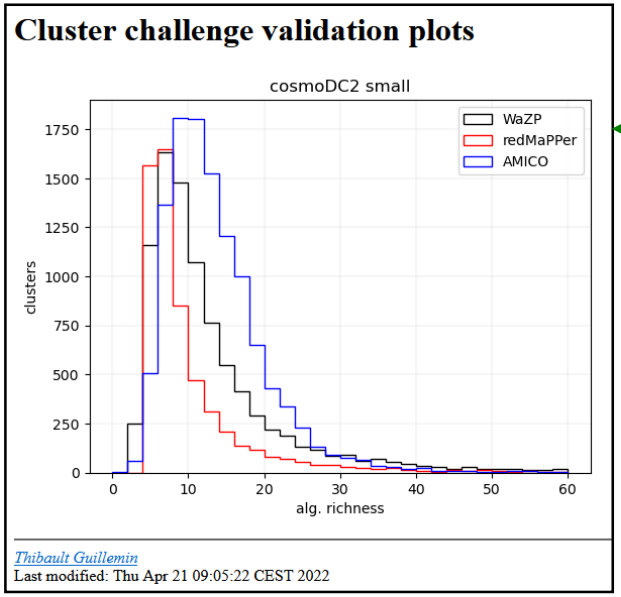
Recovery rates

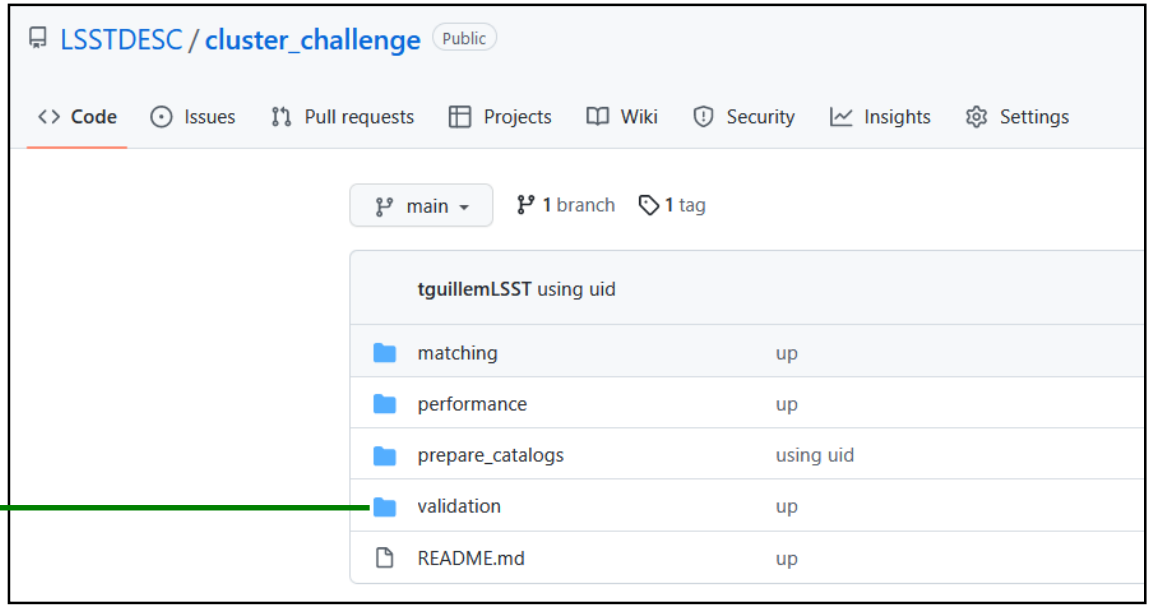
Scaling relations (e.g mass-richness)



Putting tools in place

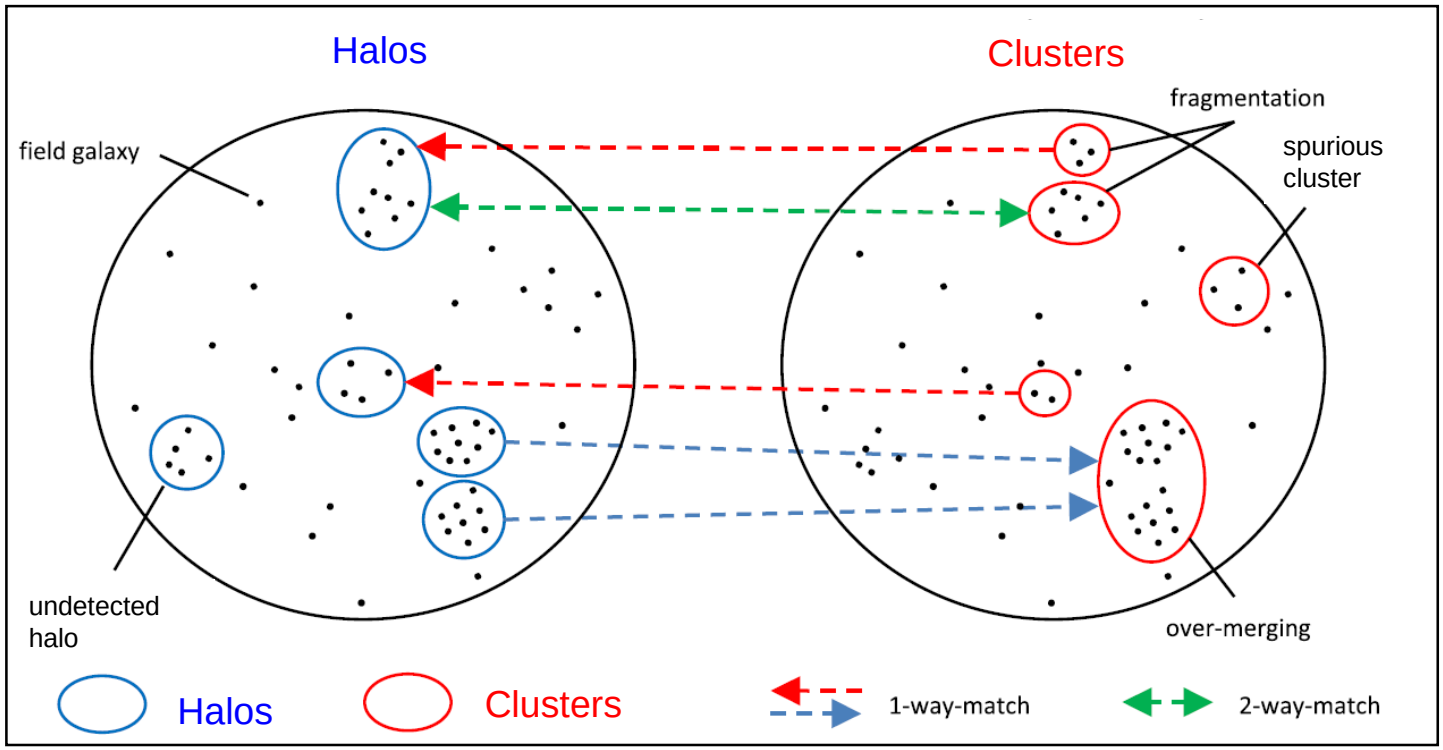
Dedicated package, heavily using CLEVAR
https://github.com/LSSTDESC/cluster_challenge





Cluster-halo matching

Complex task, several procedures possible

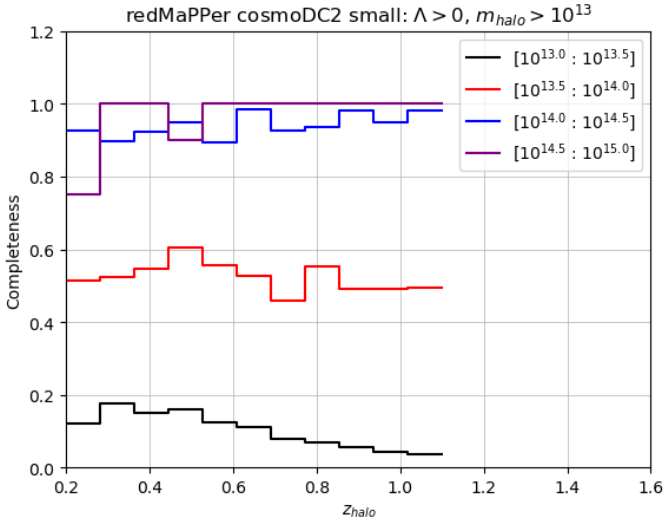


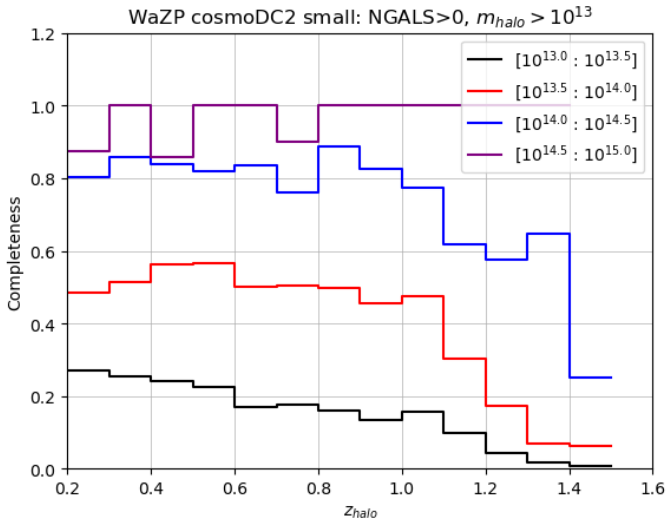
Adapted from arXiv:0903.3411

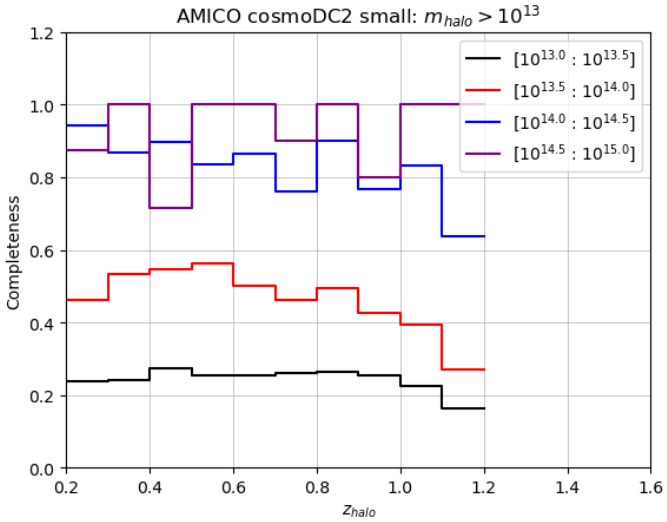
Matching performed with CLEVAR
proximity: ‘delta_z':0.05, 'match_radius': '1 mpc’
cross-matched pairs selected

Completeness

Completeness (m,z) = N_cl_cross_matched / N_halos (m,z)





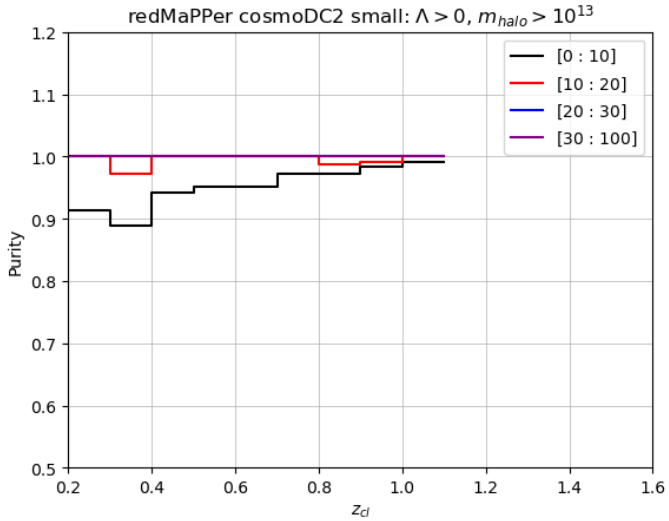


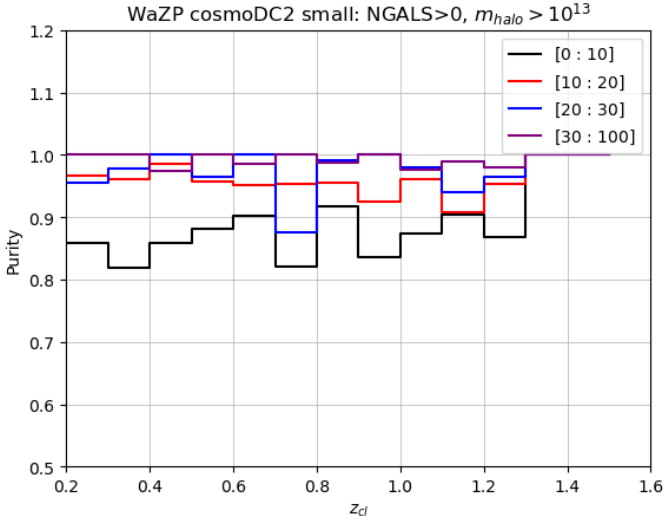
Completeness > 80% for $m>10^{14}$

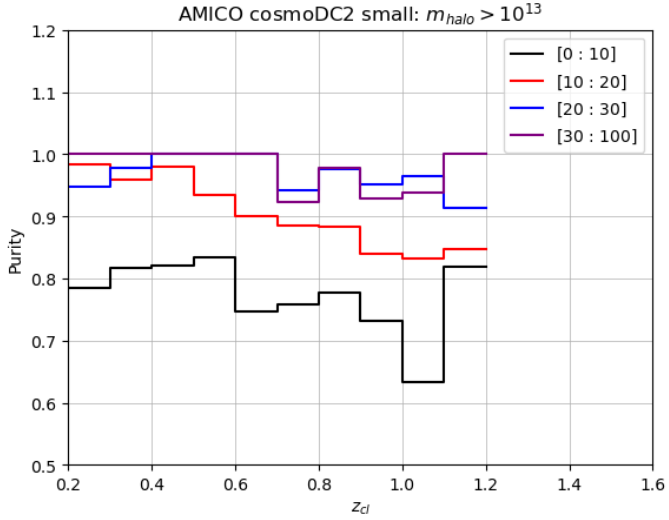
WaZP: completeness ~60% for $m>10^{14}$ in z range 1.1-1.5

Purity

Purity (r,z) = N_halo_cross_matched / N_cl (r,z)



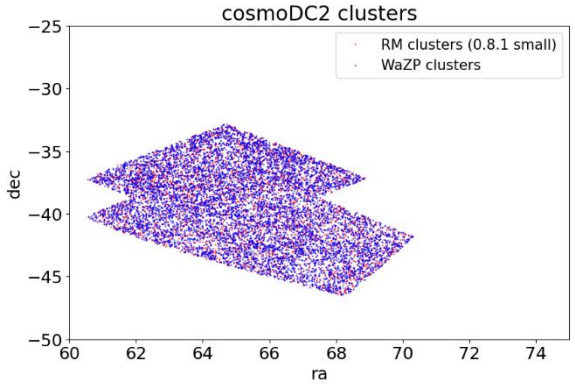




Richness definitions are different

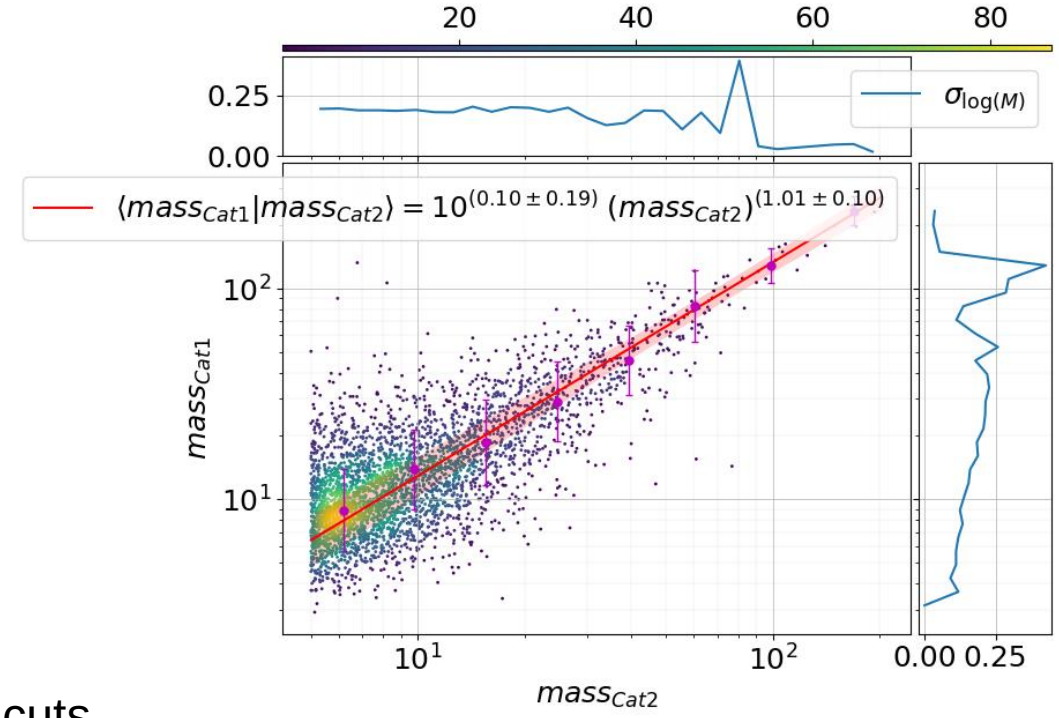
High purity even at very low richness: to be checked…

redMaPPer/WaZP direct comparison (1/2)



cosmoDC2 small area
Restricting to z_{cl}<1.15

WaZP-redMaPPer
richness-richness relation



After NGALS>25 and λ>20 cuts

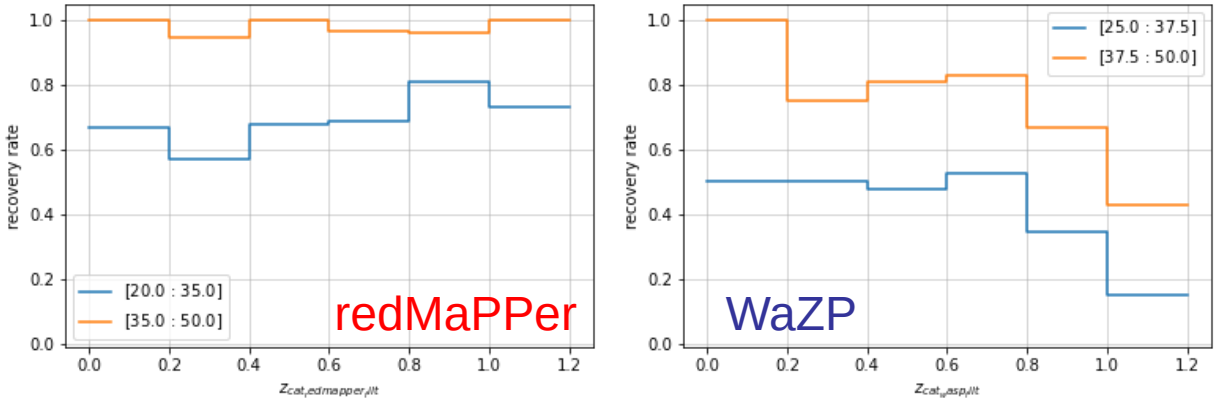
	N_all	N_cross	N_excl
WaZP	668	380 (57%)	288 (43%)
redMaPPer	536	380 (71%)	156 (29%)

NGALS>25 ↔ λ>20
(similar to DES Y1 analysis)

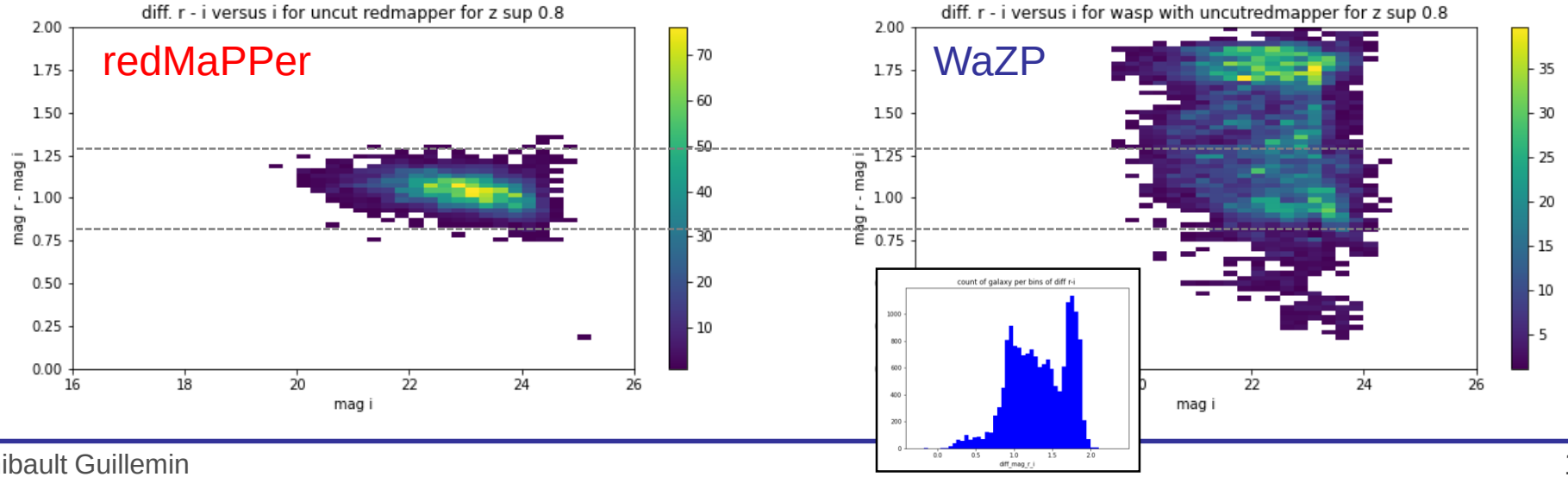
redMaPPer/WaZP direct comparison (2/2)

Stage de Franck Lesplingart (M1) en cours au LAPP

Recovery rate as a function of redshift



Color-magnitude diagrams (cross-matched pairs, z_{cl}>0.8)



Conclusion

- Cluster comparison project now active

➔ Catalogs being prepared and tools being put in place

- Mass-richness studies just started
- Determine selection functions (completeness, purity and mass-richness relation)
- Analyse DC2 catalogs
- Goal: publication around Summer 2023