

# Cluster (mis)detection and Lensing

Data Status of the Cluster Cosmological Pipeline

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# Who am I?

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From New Jersey, USA

Euclid Roles:

Interact with all levels of the photometric pipeline: pixels to cosmology

- Co-lead of WP2/DR1-CL-KP2 on cluster weak lensing mass modeling
- Member of shear calibration group
- Cluster Liaison to 3x2pt pipeline group

# Detection Codes:

## AMICO:

Bellagamba+19 Maturi+19

-linear optimal matched-filter code

uses *prior knowledge* of the properties of the cluster galaxy population

- luminosity function, radial profile, magnitude info

## PZWav:

EC: Adam+19, Werner+23, and Thongkham+24

-difference-of-Gaussians smoothing kernel

nearly *model-independent* approach

- typical cluster size to suppress LSS

Inputs:

RA, Dec, Mag H, **P(z)**, **mask**

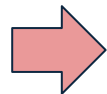
# Lensing Code

## COMB-CL

Lesci+24, Sereno+24, Ingoglia+25

Measures individual and stacked shear profiles, covariance matrices

Major refactoring since January 2025



|                          |            |   |
|--------------------------|------------|---|
| colour_cuts.py           | +16 -22    | 🔍 |
| cov_boot.py              | +105 -0    | + |
| cov_lss.py               | +116 -72   | 🔍 |
| default_column_names.yml | +79 -0     | + |
| shear.py                 | +229 -1007 | 🔍 |
| shear_lib.py             | +720 -0    | + |
| shear_proc.py            | +0 -748    | 🔍 |
| shear_tables.py          | +252 -0    | + |
| single_profile.py        | +364 -0    | + |
| stack.py                 | +369 -0    | + |
| stack_profile.py         | +392 -0    | 🔍 |

Inputs:

- Cluster Catalog: RA, Dec, z
- Galaxy Catalog: RA, Dec, z,  $g_{1,2}$   
+mag or tomo bin info



“One science-ready catalog  
please”



“One science ready catalog  
please”



“One science ready catalog  
please”



Wikimedia commons

# 3x2pt Data Validation

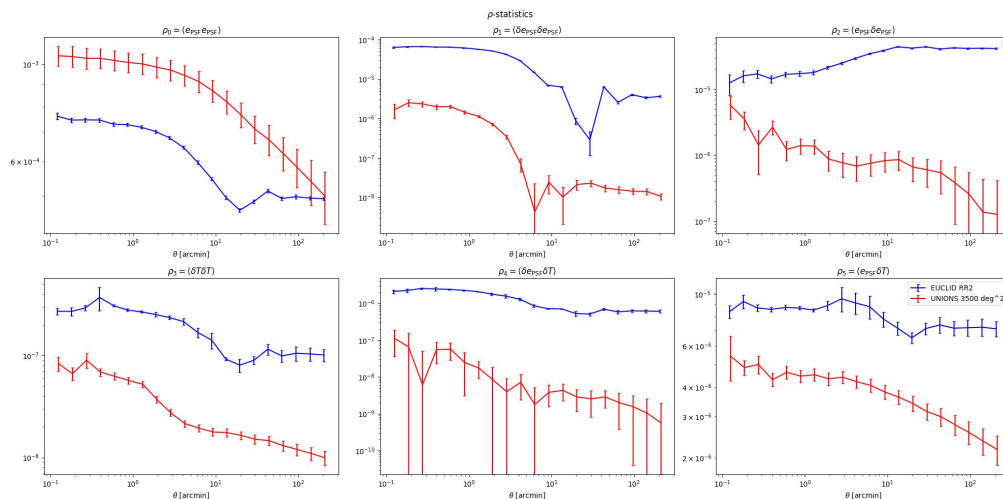
Hundreds of millions of objects

**Summary statistics** require computations over huge area

- Null tests: detect problems in the data

Example: rho statistics  
(Sacha Guerrini)

Cluster physics: What  
causes the null tests to  
fail?





# Cluster Overlay

- Michel Aguena, Calum Murray

Webpage of cluster detections with mask and object detections

J044040.8-355328\_z0.93

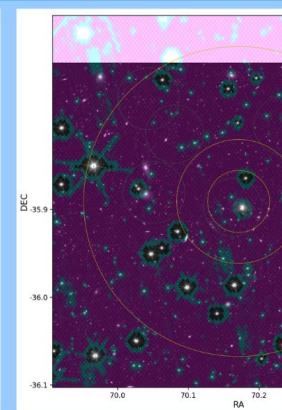
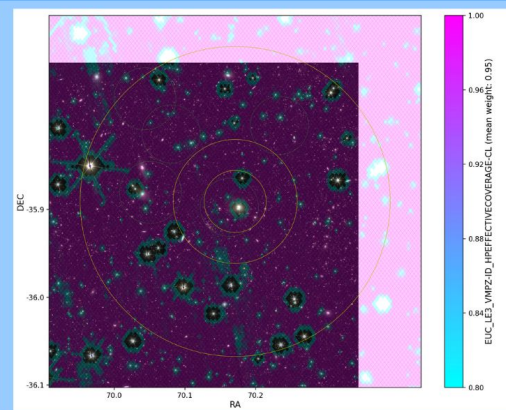
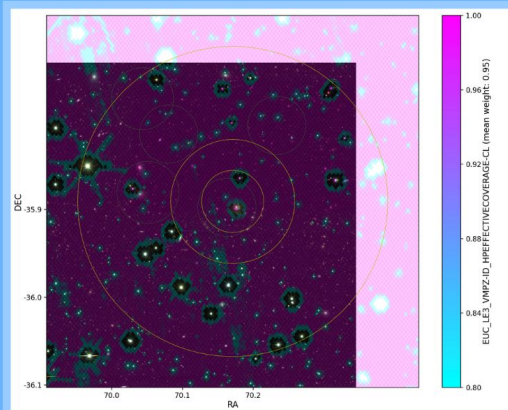
[back](#)

TILE

DES-GRI (individual filters)

NIR-YJH (individual filters)

VIS

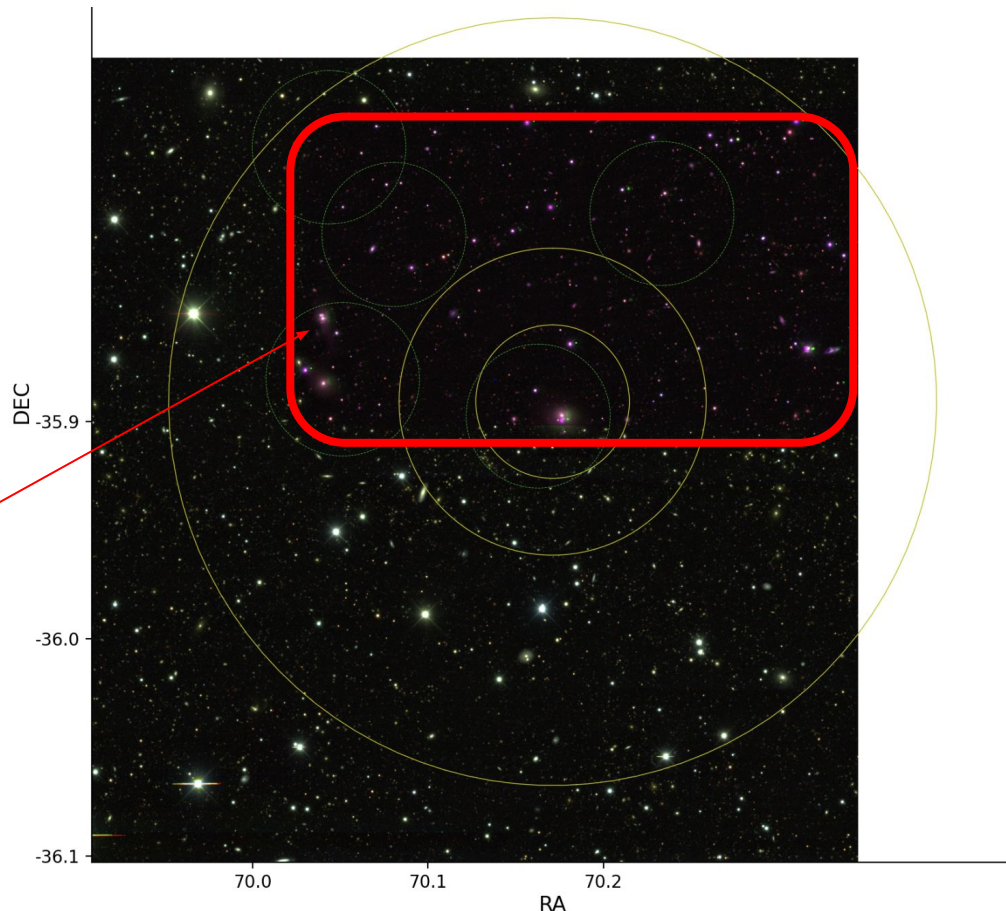


# Cluster Overlay

Example:

Many clusters at  $z \sim 0.9$  in some places

Objects here are red  
Signs of double objects

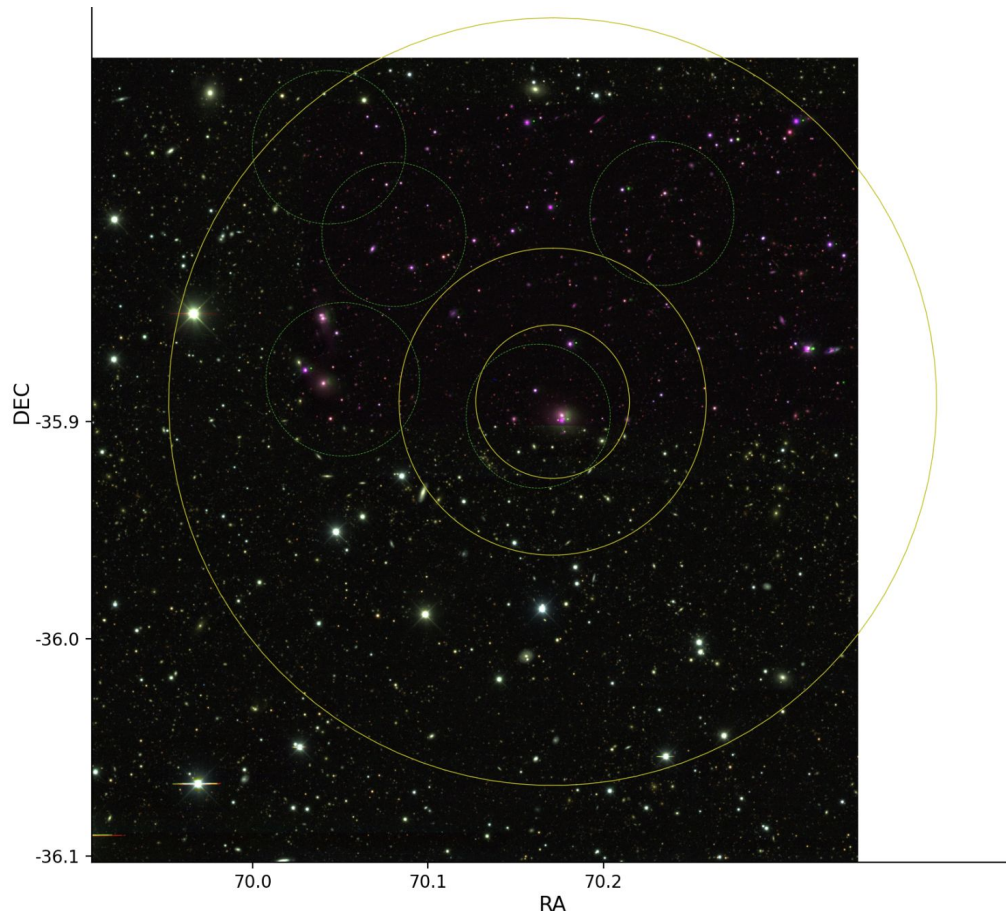


# Cluster Overlay

Example:

Many clusters at  $z \sim 0.9$  in some places

Astrometry problem in EXT data in images with bad seeing in RR2!



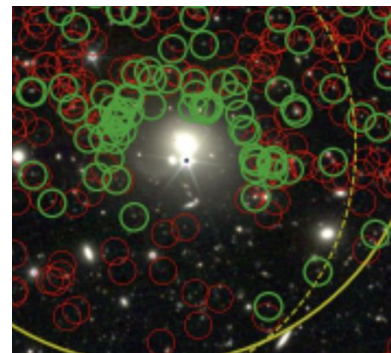
# Other problems identified by cluster detection:

Persistence problems in photo-zs

False detections near stars

False detections near large, nearby galaxies

Artifacts in ground based data



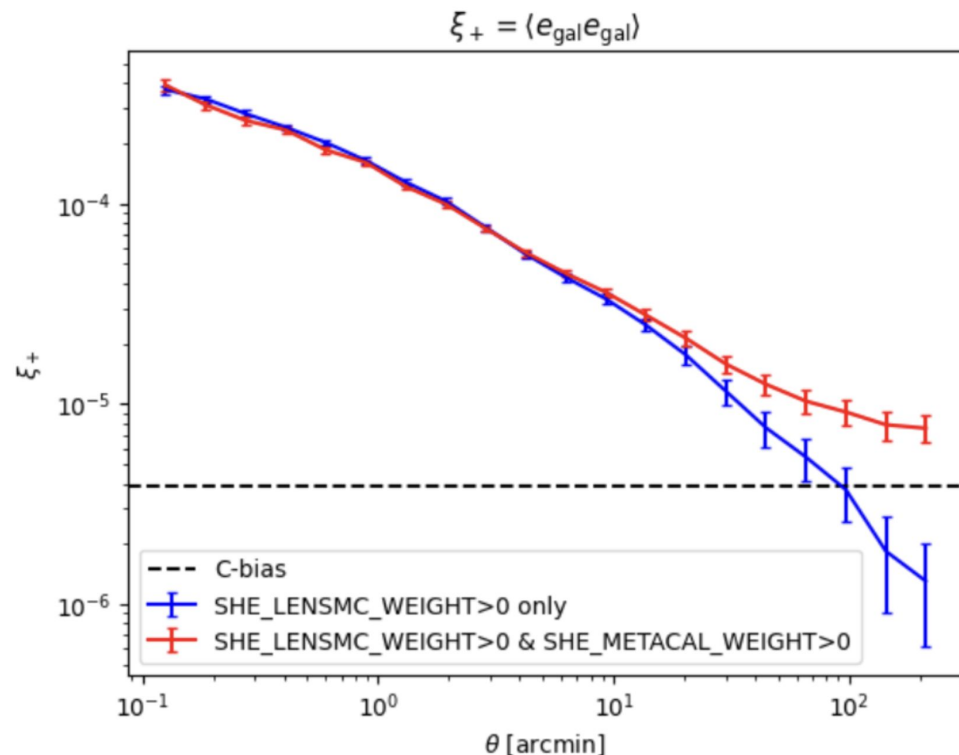
Significant efforts to improve masking by Christophe Benoist for DR1

# Artifacts change cosmic shear signal!

“Minor” changes to sample selection dramatically change correlation function.

Example in RR2:  
(Sacha Guerrini)

Also seen in UNIONS WL  
data



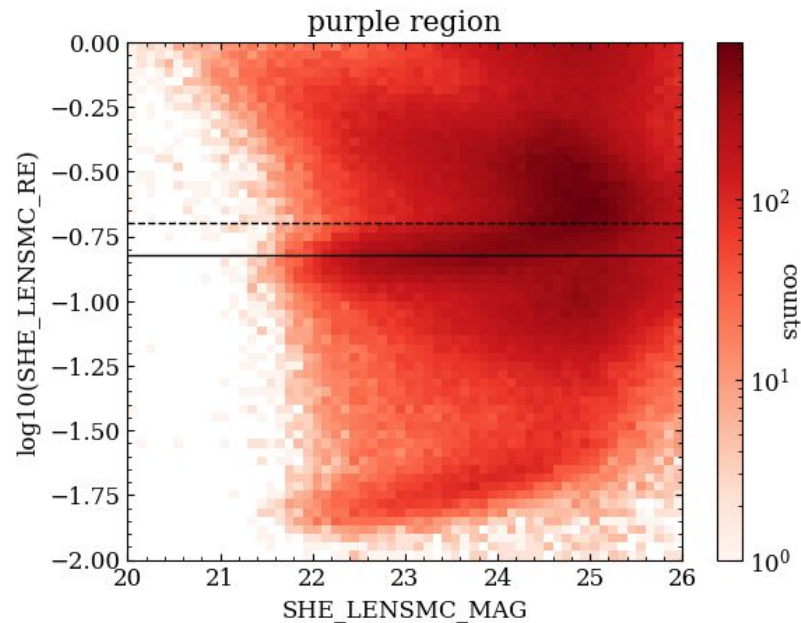
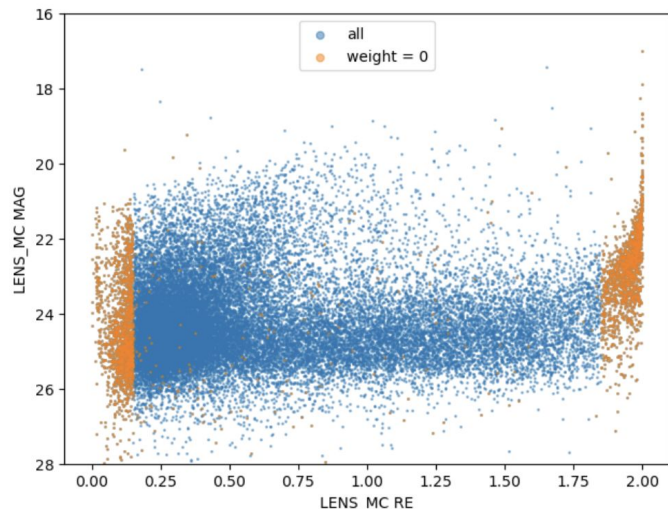


# Improving object selection diagnostics:

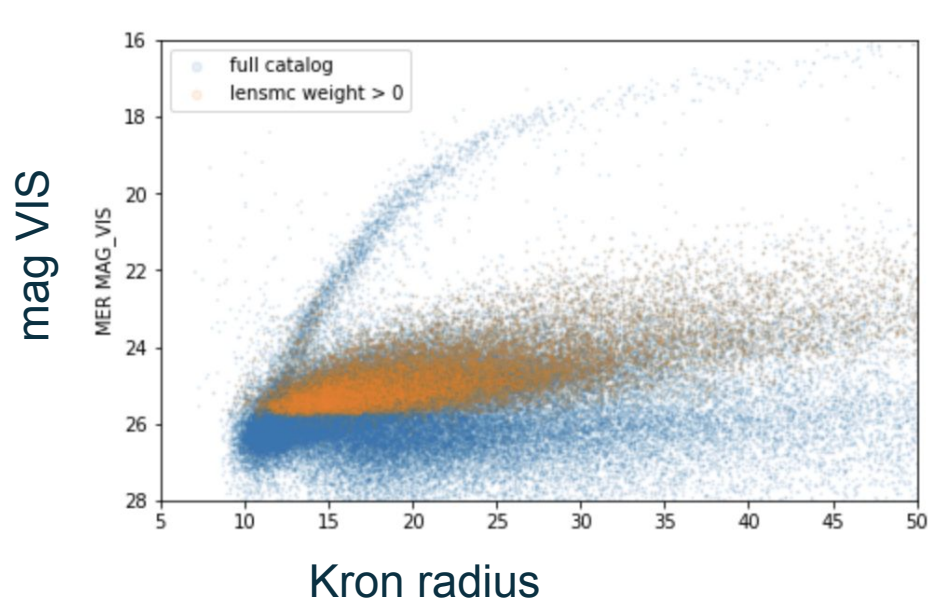
Looking at many objects in RR1:

Shun-Sheng Li

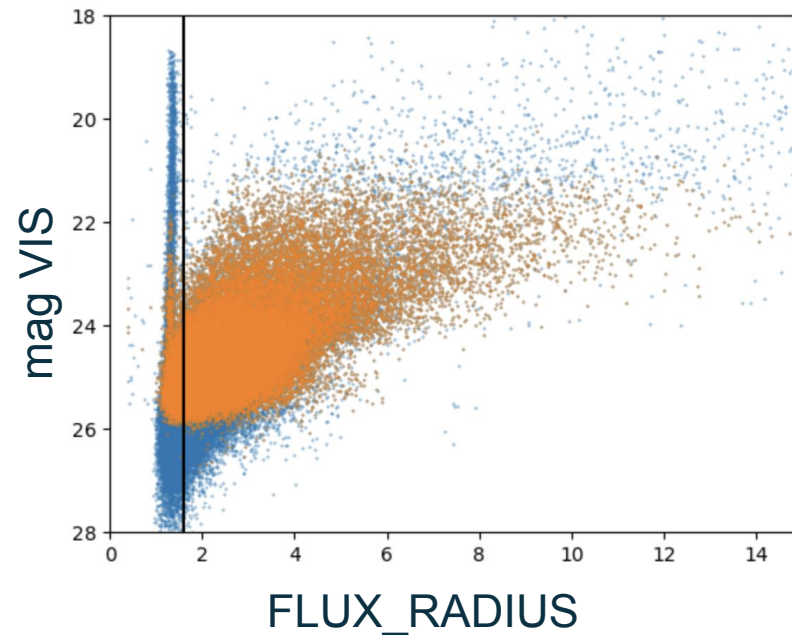
vs one tile in RR1



# Improving object selection diagnostics:



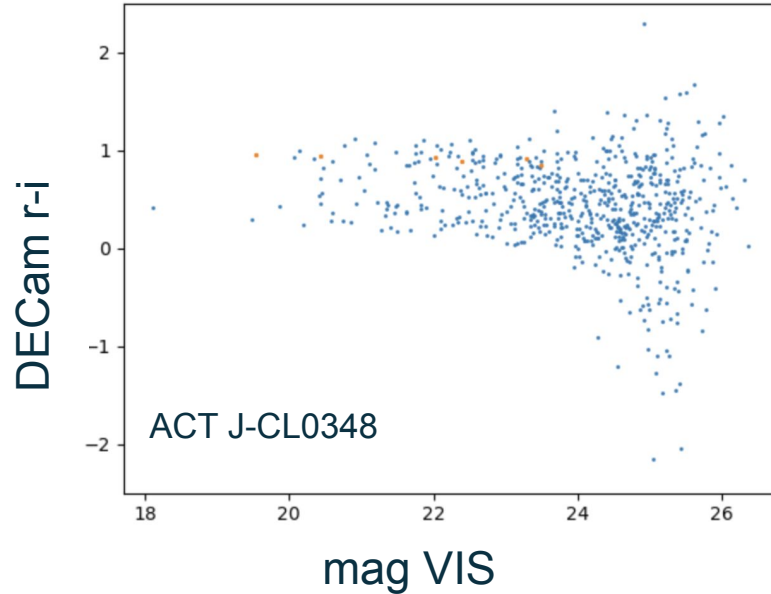
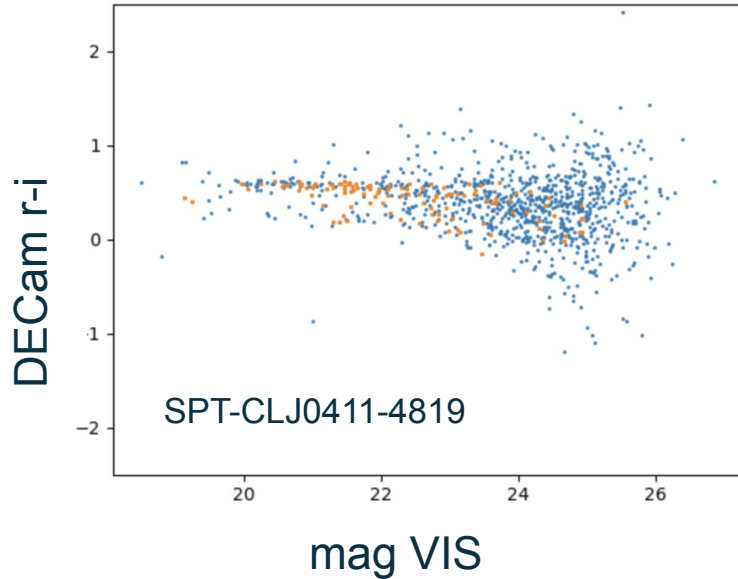
RR1



RR2

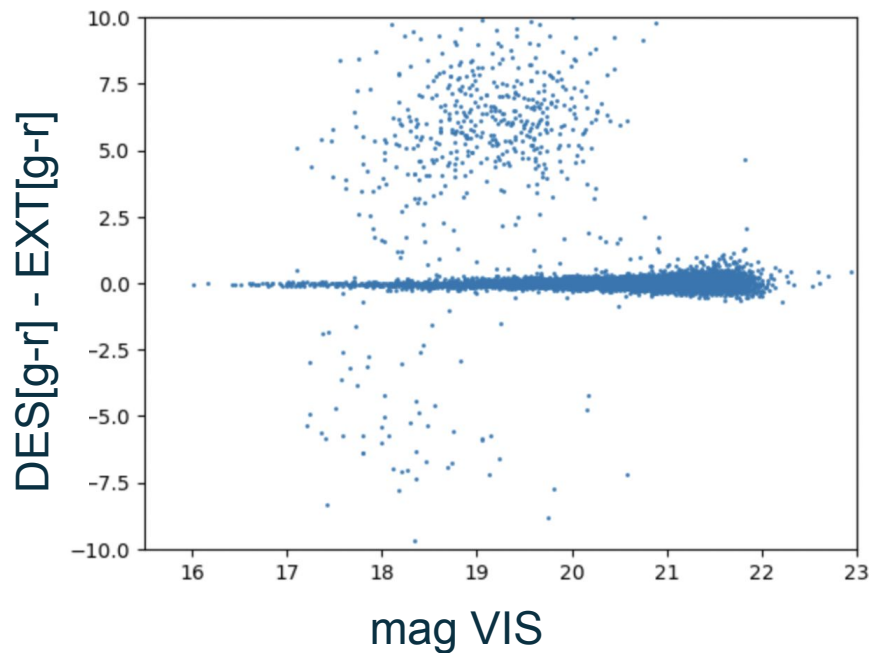
# Red Sequence Problems:

Cluster galaxies are “red and dead”

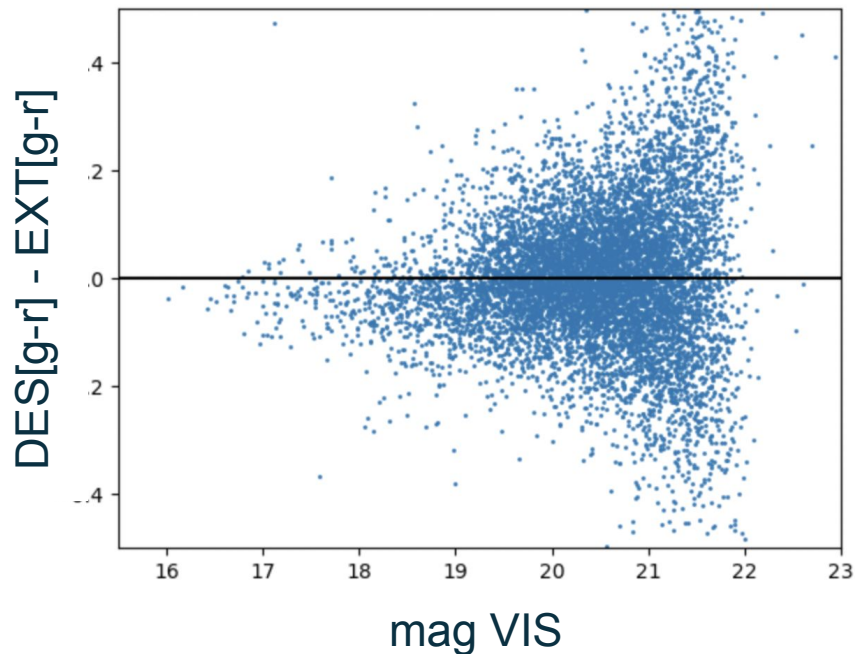




# Comparison to DES RedMagic galaxies



Q1 Masking Issue



Q1 Ext PSF issue

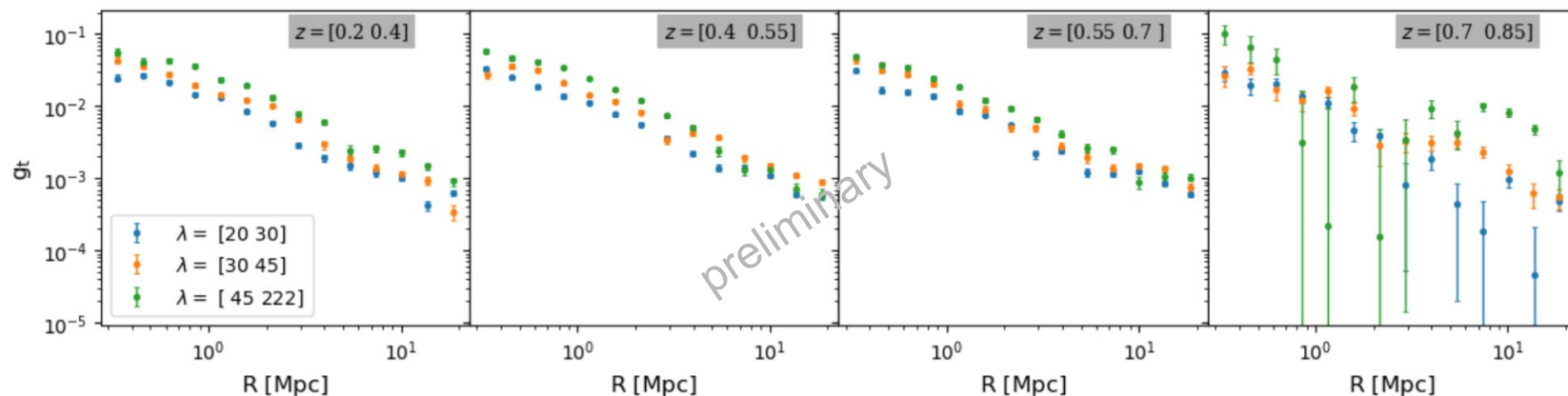
We have the tools to validate the galaxy catalogs

Now, let's get shear profiles from COMB-CL:

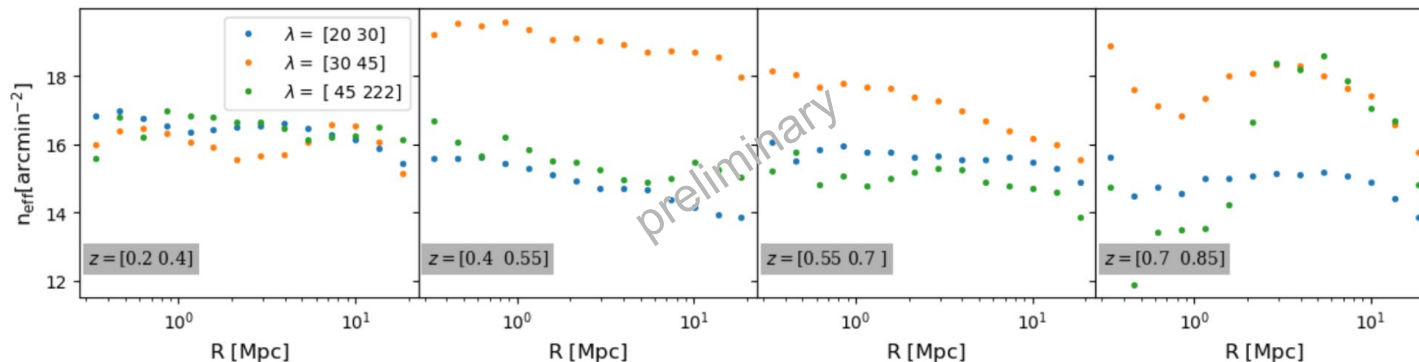
# RR2 Shear Profiles

~1500 DES Y3 Clusters with Richness  $> 20$

LensMC Lensing with Lesci+24 Color Cuts



# RR2 number density Profiles



# Conclusion

The cluster cosmology group plays an **essential part** of the validation feedback loop- most problems have been fixed!

We are already producing **results** from cluster detection in Q1 and cluster weak lensing in RR2

We are making good progress towards **robust cosmology constraints** with strong connections between pixels and contours.

We need **continued synergy** with the rest of the photometric pipeline, especially for shear and photo-z calibration.