

Amas de galaxies

Etat général des activités

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On behalf of the Euclid SGS/OU-LE3 WPs and SWG
Galaxy Clusters

Euclid France 2015



Why Euclid is unique for clusters

- Large sky coverage, Strong statistics, sampling high z tail (deep NIR)

Analytical estimated selection function of the photometric catalog nearly flat:

All Λ CDM clusters with $M > 2 \cdot 10^{14} M_{\odot}$ detected at 3σ up to $z=2$:

>60000 clusters of which 18000 with $z > 1$

- Calibration of the mass-observable relation and scatter:

- State of the art WL mass estimates



- Stack of velocity dispersions

- + Multiwavelength Synergy for scaling relations: e-Rosita, Athena+, Planck,...

Cluster activity in Euclid

Science Working Group Clusters of Galaxies

~ 110 members (2015)

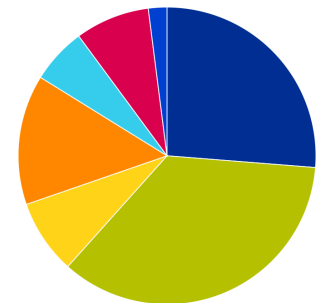
Leads: L. Moscardini , J. Weller , J. Bartlett 

Fix the science objectives

Requirements: pipeline products and performances

Final science analyses

SWG CL




8 Workpackages: <http://euclid.roe.ac.uk/projects/cgswg/wiki>

- ◆ Sample Selection (A. Gonzalez, A. Iovino, L. Moscardini)
- ◆ Mass Modelling (A. von der Linden, M. Meneghetti, H. Hoekstra)
- ◆ Likelihood (S. Borgani, J. Weller)
- ◆ Statistics on Cluster Samples (J. Weller, J. Bartlett, L. Moscardini)
- ◆ Mass-Observable Relation (J. Bartlett, A. Biviano, S. Maurogordato)
- ◆ Validation (S. Bardelli, A. Stanford/M. Brodwin)
- ◆ Astrophysics of galaxy clusters (S. Mei, G. de Lucia)
- ◆ External Data (T. Reiprich, P. Rosati, J.B. Melin)

Cluster activity in Euclid

SGS: OU-LE3 WP Clusters of Galaxies

Implementation: Leads: A. Biviano , S. Maurogordato  ~ 85 members (2015)

Validation: Leads.: R. Pello , B. Hoyle  ~ 21 members (2015)

Tasks: Implement/validate algorithms

- Cluster detection & Selection Function
 - Needs an optimized cluster finder (purity & completeness) with well controlled selection function
- Mass proxy estimates: richness – velocity dispersion – WL aperture masses
 - Well calibrated mass-observable relation
- Cluster Clustering
 - Better constraints on DE eos when combined with $N(M,z)$

More on: <http://euclid.roe.ac.uk/projects/oule3-clus-impl/wiki>

WP Implementation: Structure

15 processing functions (PFs) defined in the Processing Function Requirements Specification Document:

6 PFs « pure » Clusters WP:

DET-CL : The galaxy cluster detection

S. Maurogordato & A. Biviano

SEL-CL : The Purity and Completeness of the galaxy cluster

A. Biviano & S. Maurogordato

RICH-CL : The Richness of the galaxy cluster catalog

C. Benoist & A. Gonzalez

Z-CL : The mean redshift of the galaxy cluster

O. Cucciati & A. Iovino

SIGV-CL : The velocity dispersion of a galaxy cluster

M. Girardi & A. Iovino

PROF-CL : The radial profile of the galaxy cluster

C. Adami & G. Mamon

1 PF joint with Weak Lensing WP:

COMB-CL : Estimation of Weak Lensing aperture masses for cluster candidates detected from the galaxy catalogue.

A. Leonard

R-LE3-PRD-F-201	Derived	Each of these algorithms shall be able to produce a catalogue for the Wide and Deep Survey respectively which includes the following quantities and associated uncertainties per each cluster candidate : an estimate of central position in projected coordinates (right ascension and declination), an estimate of redshift, an estimate of characteristic size, an estimate of richness, and the signal to noise of the detection.	G-CL.DP.1-1 G-CL.DP.1-2
R-LE3-PRD-F-205	Derived	The OU-LE3 SEL-CL PF shall provide the selection function corresponding to the algorithms used for detection defined in R-LE3-PRD-F200/F201 as a function of redshift and of S/N, taking into account the observing and instrumental conditions, and the visibility masks for the galaxy catalogue defined in R-LE3-PRD-F310/311/312/313.	G-LRD-CL.DP.1-5
R-LE3-PRD-F-206	Derived	The cluster selection function shall provide, for all locations on the celestial sphere, an estimate of the probability that a cluster of a given richness, had it existed in the Universe at any ra, dec and redshift would have been observed with Euclid.	G-LRD-CL.DP.1-5

WP Implementation: Structure

2 joint PFs with Internal data WP

LF-CL : The cluster luminosity **function** M. Bolzonella, E. Zucca

MF-CL : The cluster stellar mass **function** M Bolzonella, **S. Mei**

6 joint PFs with « Galaxy clustering » WP: coordinator for clusters F. Marulli

2PCF-CL: The 2-point correlation function for cluster catalogs, **S. de la Torre** & F. Marulli

PK-CL : The power spectrum for cluster catalogs, A. Balaguera-Antolinez & F. Marulli

3PCF-CL: The 3-point correlation function for cluster catalogs, M. Moresco & F. Marulli

BK-CL: The **bispectrum for cluster catalogs**, C. Porciani & F. Marulli

CM-2PCF-CL: The covariance matrix of the 2-pt correlation function for cluster catalogs, B. Hoyle

CM-PK-CL: The covariance matrix of the power spectrum for cluster catalogs, B. Hoyle

DET-CL & SEL-CL

Cluster Challenges:

- Run « blindly » the cluster detection algorithms on mocks
8 algos with complementary methods
- Match the detections with the original parent halo catalog
- Perform a comparison of the performances (purity, completeness...)
- 2014: 2 Challenges run on Durham mocks (C. Baugh & A. Merson)

A. Iovino, S. Farrens, A. Biviano, [S. Maurogordato](#), A. Cappi, [C. Adami](#), F. Bellagamba, [C. Benoist](#), O. Cucciati, [F. Durret](#), A. Gonzalez, [R. Licitra](#), [S. Mei](#), M. Roncarelli, [J. Bartlett](#), C. Baugh, S. Borgani, A. Merson, L. Moscardini, [M. Vannier](#), 2015
http://wiki.cosmos.esa.int/euclid/index.php/EC_SGS_OU_LE3

➤ Improve the algorithms and the simulations

Completeness (Mass-redshift plane)

Wavelet

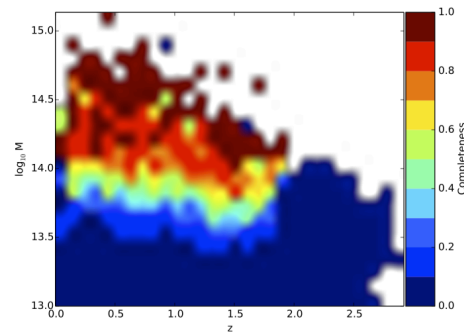
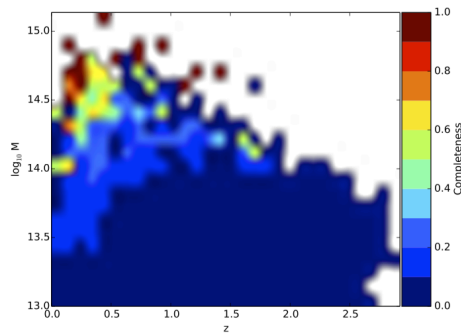
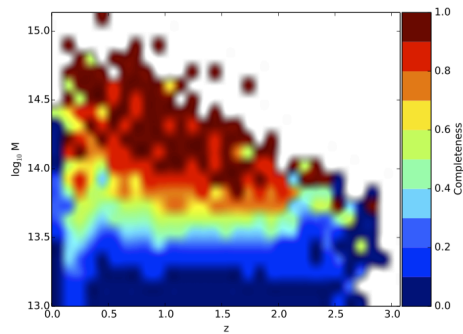
Voronoi

Wavelet

AG

FD

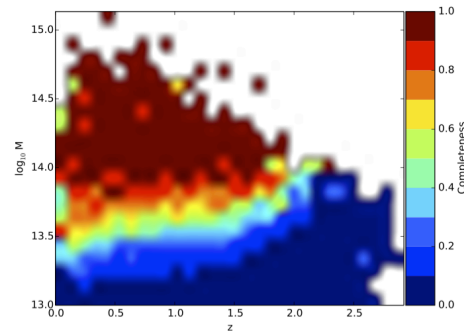
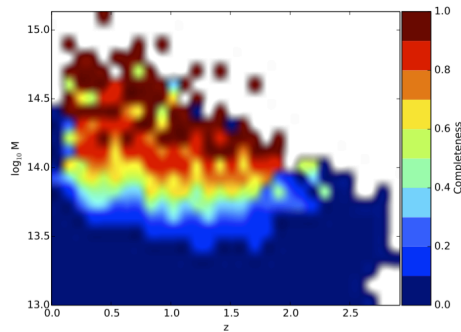
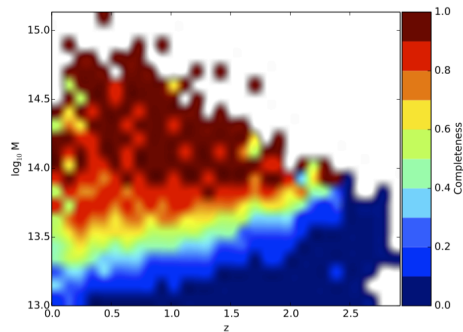
CB



FB

RL

SF



Optimal Filtering

Red Sequence

FOF

Matched with halos $M > 10^{14} M_{\text{sol}}$

Farrens, Iovino, Biviano, Maurogordato et al., 2015, Results of Cluster Challenge 2

Challenge III (2015):

Common challenge for Photometric/Spectroscopic/Weak Lensing based cluster finders

6 photometric/spectroscopic cluster finders:

Bellagamba (It), Benoist (F), Durret (F), Farrens (It/F), Gonzalez(US), Sanchez-Diaz(Es)

3 weak-lensing based cluster finders :

Leonard(UK/F), Maturi(D), Shan(D)

New mocks: Durham Deep: 25 deg² H<26 zrange [0-3]

MICE2: 5000 deg², H<23-24 zrange [0-1.4]

Reprocessed within the WP to introduce realistic errors

- Include errors on mags + Photozs + PDZs (PhotReal B. Ascaso & S. Mei, Hyperz R. Pello)
- Include spectro-zs with specifications from new grism config (A. Cappi)
- Include errors on ellipticities (A. Leonard)
- Organised by P.F Rocci & M. Vannier together with S. Maurogordato & A. Biviano

Refined analysis

More sophisticated matching procedures + New performances tests

Analysis fully automatized

Timeline for OU-LE3 Clusters PFs

- For [P2] PF : Detection
- Spring 2016: ML0 Algo selection
- Sep 2016 : ML1A Prototyping (highly recommended in C++/Python)
- Dec 2016 : ML1B Preliminary Scientific assessment of candidate prototypes
- May 2017 : ML2A migration of eligible prototype into CODEEN
- Nov 2017 :ML2B final consolidation of eligible proto
- Jan 2018 : ML3A Fully compatible to the prod
- May 2018 : ML3B Code validated

- For all [P3] PF :
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Urgent need for realistic galaxy catalogs for cluster algorithms development

- Today: Mocks have severe limitations, new releases are expected, but no time line...
 - MICE2 + large area (5000 deg²) but too shallow ($z < 1.4$) and incompleteness pattern on the sky ($H < 23$ / $H < 24$)
 - Durham Deep ($z < 3$, $H < 26$) but small area (25 deg²)
 - Old Durham Wide ($z < 2$, $H < 24$, 500 deg²), unrealistic colour distribution
- Post-processing of the mocks to get realistic catalogs
 - OU-SIM release ? When? 2018 release announced is too late for our purposes
 - Within the WP?

Very time demanding (CFC3 experience)

to be performed in collaboration with OU-SIM/OU-Photoz (Phosphorus code?)

Task Force on Mocks for OU-LE3 (Clusters only?)

Same mock for photometric and lensing cluster search

1000 deg², homogeneous $H < 24$ $z < 3$ mock

Reprocessed with realistic errors magnitudes & photoz

Introduce basic observational artefacts (masking)