French participation to galaxy clusters analyses in DESC

Astronomy ESFRI & Research Infrastructure Cluster
ASTERICS - 653477

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Outline

- French group and activities
- DESC group and science road map
- Our position in DESC
- How to increase our contribution?

French Cluster group

- Mainly from three IN2P3 labs participants
  - LAPP
    - Dominique Boutigny
    - Nicolas Chotard
    - Yves Zolnierowski
    - Sylvie Rosier
    - Mariana Penna Lima (new postdoc arriving in May)
  - LPSC
    - Céline Combet
    - Cécile Renault
    - Jean-Stéphane Ricol
  - LUPM
    - Johan Cohen-Tanugi
- + 4 in the cluster mailing list
- From the scientific coordination group survey
  - Main activity: 4
  - Secondary activity: 4
  - Interested by: 8

Main activity

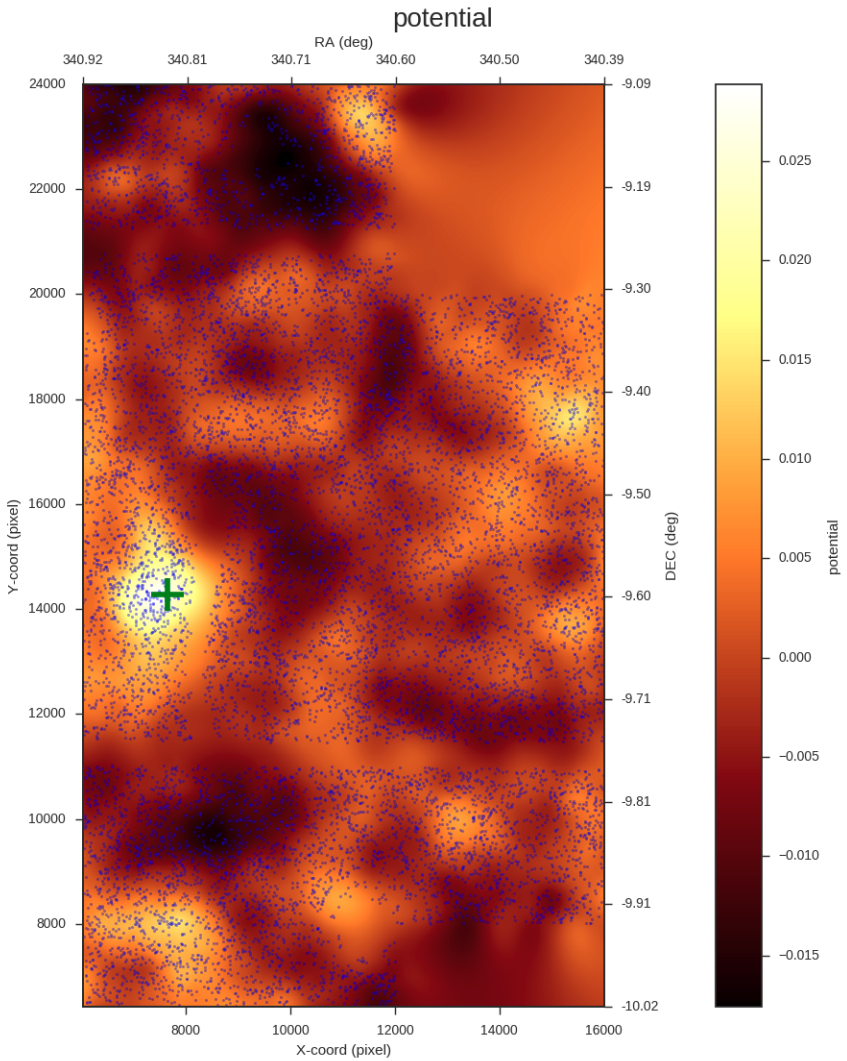
- Development of a complete pipeline for cluster analysis in the LSST stack framework
- 2 steps
  - Data reprocessing using the LSST DM stack (**reprocessing task force)**
  - Data-analysis pipeline based on the DM stack outputs
- Online docs:
  - A step by step documentation on reprocessing is available in the associated github repo
  - Online python package for the Clusters analysis
- First step is to reproduce the results from the Weighing The Giants collaboration (WTGI, WTGII, WTGIII)
- And go further in the analysis with new methods and new cluster studies

Data analysis

- A step by step analysis
  - **Data access**: easier way to access the LSST data
  - **Data validation**: quality assessment of the data processing (color locus, ellipticity, etc)
  - **Extinction**: correct for the MW extinction – try several available dust maps
  - **Photometric redshift**: wrapper to several photometric redshift estimator codes
  - **Shear** as a function of radius + convergence maps
  - **Galaxy selection**: red sequence + redshif cuts + quality cuts
  - **Mass estimate**
- Clusters python package: all steps included and currently tested

➔ Data analysis pipeline of the LSST stack catalog in the context of DESC

Preliminary results



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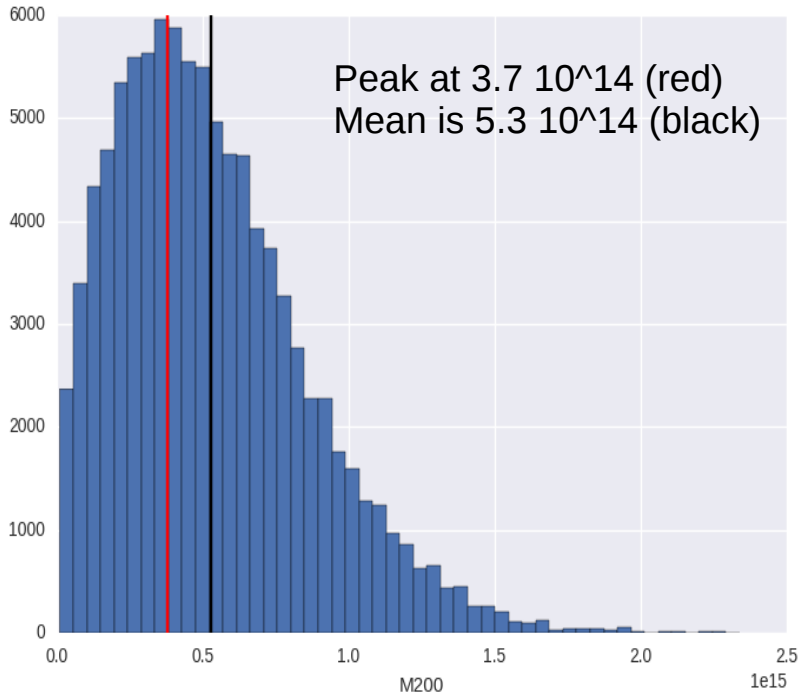

- Estimated mass:
  - 5.3 +- 3 10^14 Mo (M200)
- WTG III:
  - 15.7 +/- 2.5 10^14 Mo (M<1.5Mpc)

Short term

- Data Reprocessing
  - Automatize, debug, quality assessment
  - Process data from other sources (DECam, HSC)
  - Adapt the analysis to external or simulated data
- Analysis
  - Refine each part of the analysis
  - Validation of the mass measurement on
    - WtG catalogs
    - Reprocessed data for known galaxy clusters
  - Study known systematic (shear, photo-z, models)
  - Study new clusters

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DESC clusters WG

- WG coordinators
  - Anja von den Linden
  - Ian dell'Antonio (stepping down)
- Monthly telecon :
  - ~ 15 – 20 people connected, 1 – 2 presentations/telecon
  - Any cluster-related work. A lot of expertise!
  - Not necessarily LSST-related work, discussion.
- Bi-monthly cluster 'sub-telecon' :
  - Linked to 'Clusters' pipeline development
  - N. Chotard, D. Boutigny, C. Combet (DM stack reprocessing + pipeline development)
  - Anja von den Linden, D. Applegate, A. Wright (WtG expertise)
  - I. dell'Antonio, Robert Liu (DM stack users, cluster expertise)
  - [Collaboration started at DESC hack week, November 2016... These are great Opportunities!]
- Work is organized around the Science Roadmap

Clusters Science Roadmap

Galaxy Clusters Key Projects:

DC1 Key Project **CL1**: Cluster finding and characterization via red-sequence methods

DC1 Key Project **CL2**: Absolute mass calibration I

DC2 Key Project **CL3**: Absolute mass calibration II

DC2 Key Project **CL4**: Relative Mass Calibration

DC1&DC2&DC3 Key Project **CL5**: Cosmology Likelihood Module (CLCOSMO)

DC3 Key Project **CL6**: Analysis of **`DC3 Mock Lightcone`** and pre-cursor data. CC/SV observing plan

Deliverable CX1.2CL (DC1 DP: Measure the impact of blends on cluster shear profiles)

Deliverable CX1.6CL (DC2 DP: Shear Deblending including galaxy colors and clustering)

Deliverable CX12.6CL (DC3 DP: On the use of the DDFs to reduce cluster mass systematics)

- Official DESC science road map (here)
- Where do we fit in this list of tasks?

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Our contributions

- DC2 Key Project CL3: Absolute mass calibration II (CL3.5)
- DC3 Key Project CL6: Analysis of DC3 Mock Lightcone and pre-cursor data (CL6.5)

Deliverable **CL3.5** (**09/18**) – DC2 DP: Apply refined results to existing cluster lensing data

Objective: We will use the results of CL3.1, CL3.2 and CL3.4 to further improve mass measurements from available "LSST-like" cluster weak-lensing datasets (both currently existing and gathered in CL2.6). On this timescale, we will also look towards converting our data processing pipelines to DM stack.
Prerequisite Deliverables: CL2.6,CL3.1,CL3.2,CL3.4

Key Task CL3.5.1 (**ongoing**): Obtain additional "LSST-like" cluster weak-lensing datasets

Key Task CL3.5.2 (**12/17**): Analyze data; adopt DM stack (where ready) for parts of pipeline processing

Key Task CL3.5.3 (**03/18**): Measure cluster masses

Our contributions

- DC2 Key Project CL3: Absolute mass calibration II (CL3.5)
- DC3 Key Project CL6: Analysis of DC3 Mock Lightcone and pre-cursor data (CL6.5)

Deliverable **CL6.5** (**03/20**) – DC3 DP,VA: Cluster masses from Project re-processed survey data

Objective: We will use the DESC algorithms to process project reprocessed "LSST-like" survey data sets to extract cluster masses. Survey data sets that may be available at the time include CFHTLS, DES, and HSC.
Prerequisite Deliverables: CL2.6, CL3.5, CLMASSMOD, CLSHEAR, CLSMURFS, CLABSMASS

Key Task CL6.5.1 (**09/19**): Analyze Project reprocessed data sets using DESC algorithms.

Key Task CL6.5.2 (**12/19**): Measure cluster masses.

Key Task CL6.5.3 (**03/20**): Provide feedback to DM and relevant DESC groups.

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New force?

- New force will (or might) come strengthen the French group
  - Mariana Penna Lima (LAPP)
    - Cosmological analysis with galaxy clusters
    - Calibration of the mass-observable relations
  - Begoña Ascaso (APC)
    - Simulation: 500 deg^2 LSST public light-cone mock catalog
    - Observation: Degrade existing samples to test Weak Lensing pipeline on “real” LSST data
  - (Philippe Rosnet (LPC))
    - Might switch to cluster analysis in DESC
  - Others that I might have forgotten?
- Other potential collaborations could also help (Euclid, INSU, other?)

Longer term

- With the current group of people
  - Keep working on CL3.5 and CL6.5 (mass estimates on existing data-set)
  - Other things?
- Where we could contribute
  - Cluster cosmology needs accurate p(z) : CL3.4 → overlap with photoz-WG
  - Magnification?
  - Likelihood module, cosmological parameters CL5? (cluster cosmology with CAMEL?)
  - Cluster finding methods CL1? Others?

Summary

- Already a strong implication in the DESC cluster working group
  - Data reprocessing using the DM stack
  - Mass reconstruction analysis on these data
- First group meeting of the French cluster side of DESC during this meeting
  - A few persons interested in working on cluster analysis within DESC
  - One new postdoc at LAPP will soon join us
- Perspectives on longer term
  - Mass reconstruction (current team)
  - Cosmology with clusters (with Mariana)
  - Use of simulation (with Begona)
  - Cluster detection?
  - It will strongly depend on who will join