



DARK ENERGY  
SURVEY

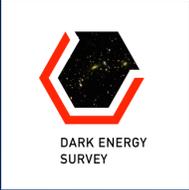


# Optical Cluster Finder Comparison Project

Jeeseon Song  
University of Michigan

In Collaboration with **Dark Energy Survey Cluster Working Group**

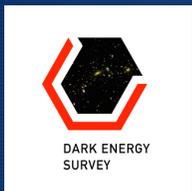




# Credit goes to...

## 💧 **Dark Energy Survey Cluster Working Group**

- 💧 Simulation – Risa Wechsler, Michael Busha
- 💧 Cluster finding crew – Wayne Barkhouse, Leon Baruah, Christophe Benoist, Jiangang Hao, Ricardo Ogando, Eli Rykoff, Marcelle Soares-Santos
- 💧 Brazil Science Portal – Brazil DES team, including Ricardo Ogando, Luiz da Costa



# What Why How

## WHAT

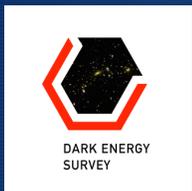
- Various optical cluster finders **comparison**.
- General **performance**?
- **Bias** to any special clusters?
- Input **parameters** sensitive to cluster finding?
- Common parameter that all cluster finders sensitive to?

## WHY

- So many optical cluster finders >> numerous cluster catalogs.
- Do we understand them **systematically**?

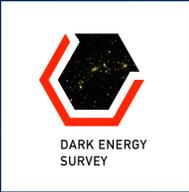
## HOW

- Requires **consistent** analysis tools
  - Simulation, Matching, Completeness/Purity measures, etc



# Other work to compare

- [Kim et al \(2002 ApJ 123, 20\)](#)
  - Optical **cluster finder comparison**
  - 3 cluster finders (VT, MF, HMF (=VT+MF))
  - Artificial clusters + SDSS background + Monte Carlo
- [Knebe et al \(2011 MNRAS 415, 2293\)](#)
  - **Halo finder comparison**
  - 17 halo finders (FoF, SO, phase-space)
  - Well-defined halos + field halos
  - Cosmological scale simulation with large scale structure



# How are galaxies painted?

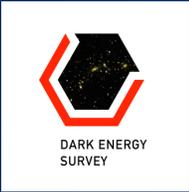


- N-body only simulation – halos, subhalos
- **Subhalos** become galaxies.
- **SDSS DR7** used
  - r-band LF – density matching
  - Other colors painted by **r-band magnitude** and **local density**.
- Go through various **validation tests**...

# Participants

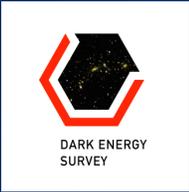
CF

- **GMBCG** – Hao et al 2010 ApJS 191 254
- **MF** – based on Postman et al 1996 AJ 111 615
- **redMaPPer** – based on Rykoff et al. astro.ph1104.2089
- **VTRS** – Barkhouse et al 2006 ApJ 645 955
- **WAzP** – Benoist et al
- **zVT** – Soares-Santos et al 2011 ApJ 727 45S



# What are we measuring?

- Performance in **number counts**
  - Performance in **membership** assignment (when available)
  - Impact of **input parameters**
    - Color cut
    - Luminosity cut
  - **Mass-observable** scaling relation
  - **Centering**
- Measuring systematics
- Testing impact on cosmology

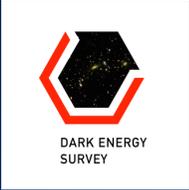


# What are we measuring?

- Performance in number counts
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- Centering
- These are compared in different observable [mass, redshift] space

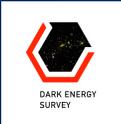
} Measuring systematics

} Testing impact on cosmology



# Matching / Membership

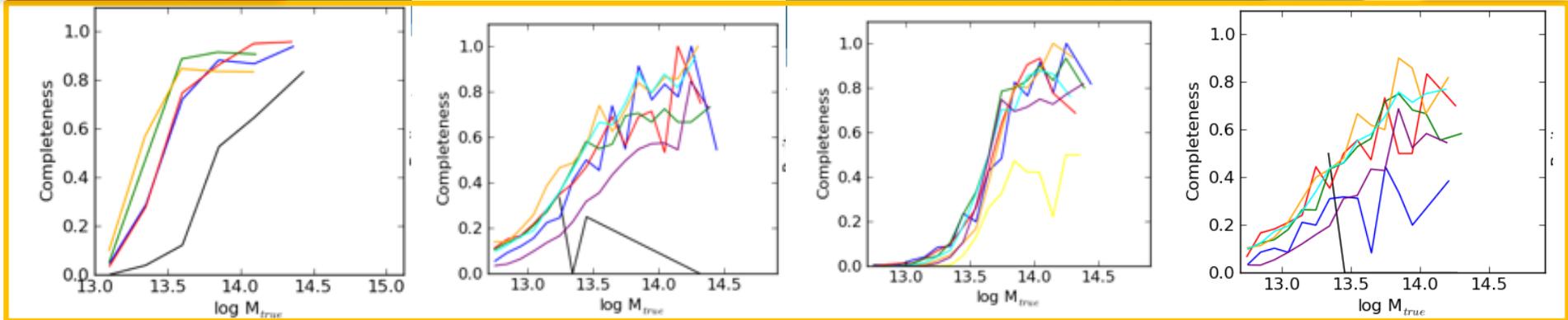
- **Proximity** Matching
  - Cylindrical matching – within  $\Delta z$ ,  $\Delta \theta$
- **Membership** Matching
  - Members identified by a CF – more members, better match
  - No membership? No problem!
    - a RS-based membership assignment performed :  $\lambda$  -parameter measurement (Roza 08)



# Performance in number count (Completeness)



Raw matching

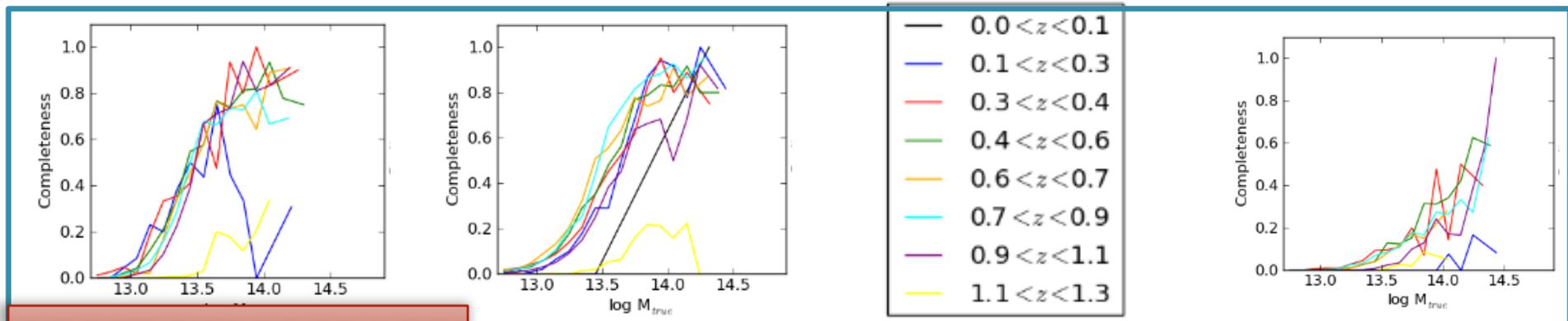


C4

GMBCG

redMaPPer

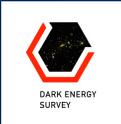
Matched Filter



$\lambda$ -membership matching

1/20/12

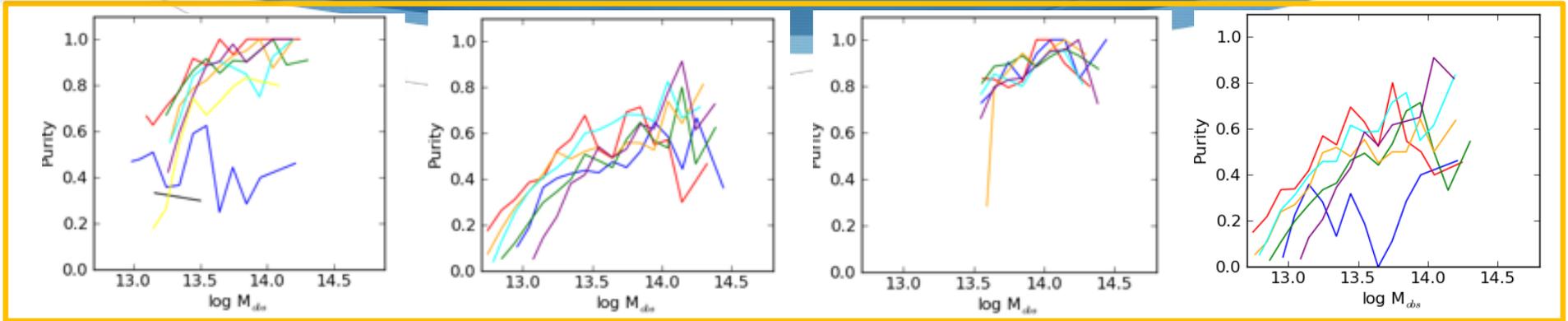
Jeeseon Song - Cosmology on the Beach  
2012 (Cancun)



# Performance in number count (Purity)



Raw matching

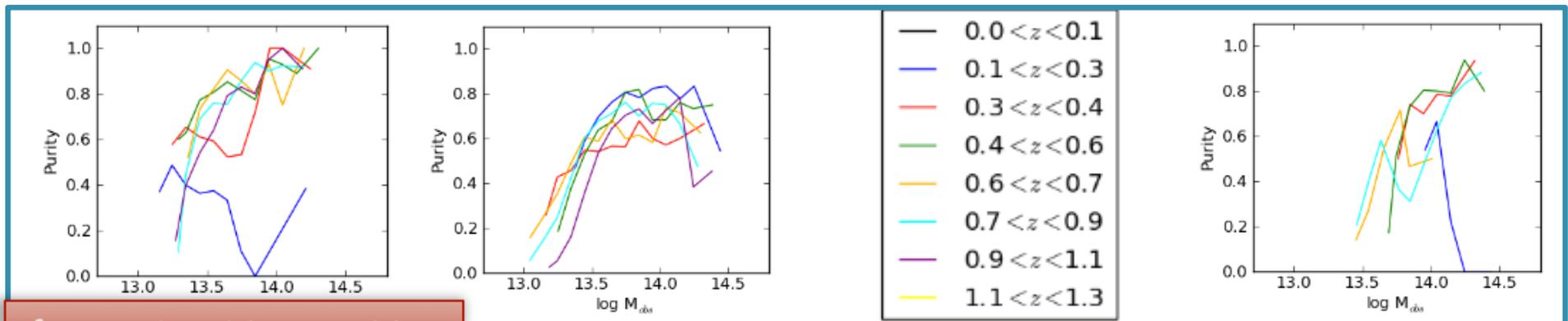


C4\*

GMBCG

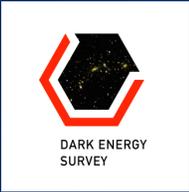
redMaPPer

Matched Filter



$\lambda$ -membership matching

17/20/12

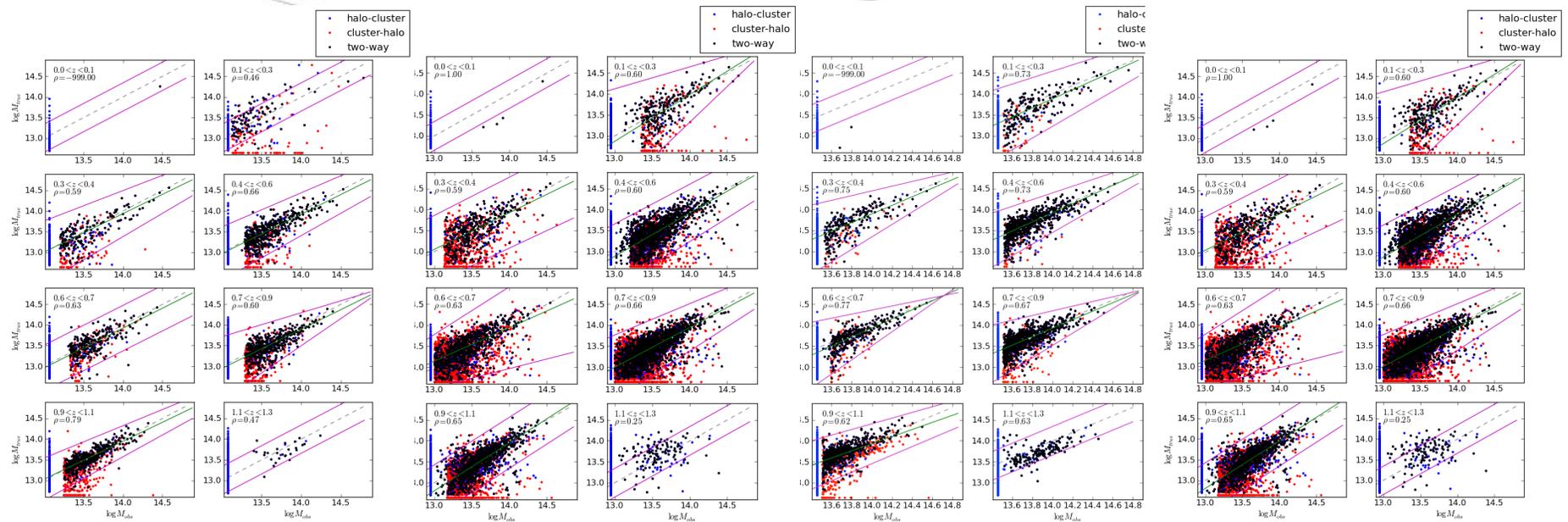


# What are we measuring?

- Performance in number counts
  - Performance in membership assignment (when available)
  - Impact of **input parameters**
    - Color cut
    - Luminosity cut
  - **Mass-observable** scaling relation
  - **Centering**
- } Testing projection effect
- } Testing impact on cosmology



# Mass-observable scaling relation



C4

GMBCG

redMaPPer

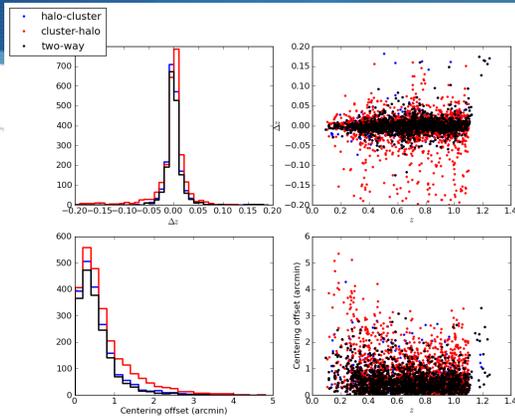
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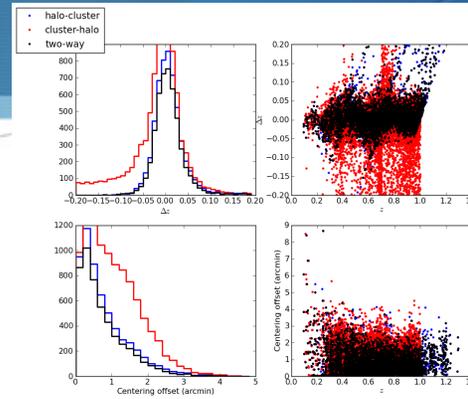
# Centering / redshift est.



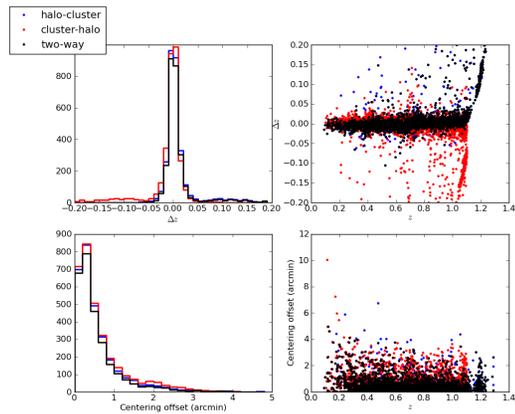
C4



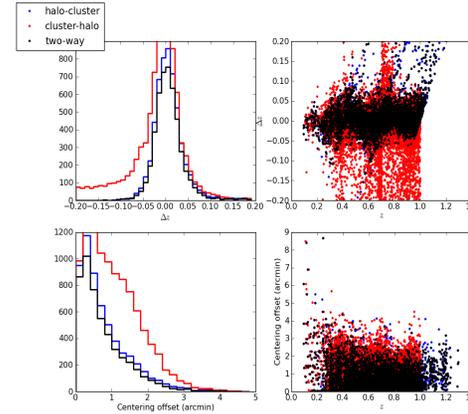
GMBCG



Lambda



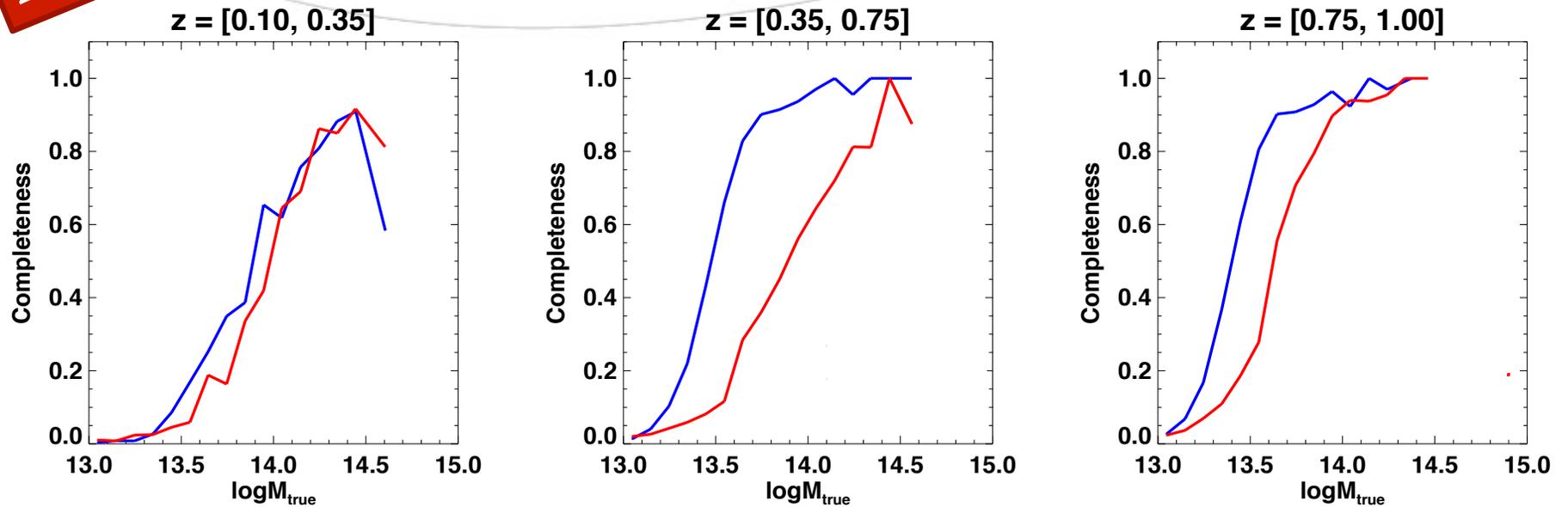
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# Example of close-up

220 sqdeg



**WARNING:** Comparison results **not** to be taken at its face value!!

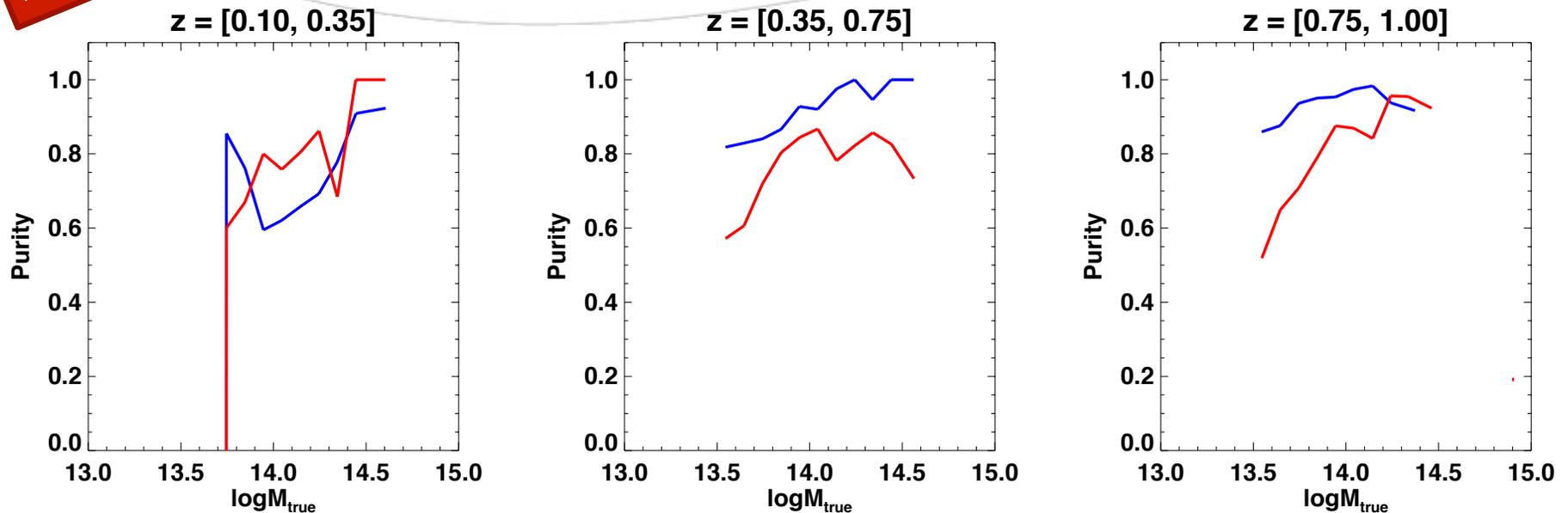
Thing to note – **CF1** on a previous version of sim  
**CF2** on the latest version



DARK ENERGY SURVEY

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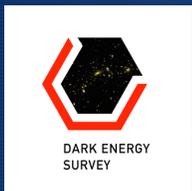


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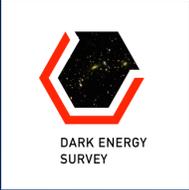
# What's going on right now?

- Proceeding with **FLUX** (cluster in U of Michigan) to power through all **tunable parameters**
  - Understanding **dependencies** of them on the selection functions
- More detailed exploration between **C4** and **redMaPPer**



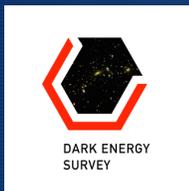
# What we've talked about are

- Brave cluster finders
  - C4, GMBCG, MF, VTRS, redMaPPer, WAzP, VT
- On N-body simulation, **assuming** this is **true** realization of the real universe
  - i.e., not looking at systematics from sims.
- CF runs – matching – completeness/purity/mass obs/centering/redshift estimation
- Massive runs through a cluster FLUX (@ Michigan).
- Deeper exploration focusing on C4 and redMaPPer.



# Science Portal - DES Brazil Team

- Parallel development in DES
- DES – generate 250-500 GB data per night
  - Hard to move around data
  - Let's bring software into the portal



# Science Portal

The Dark Energy Survey

Jeeseon Song,  
Welcome to the Testing portal.

## Science Portal

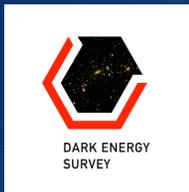
Home Release Notes My Workspace Pipelines Tools Data Server Documentation Help Credits Other Portals Logout

### Introduction to the Science Portal

This portal is a web-based service that gives the user means to reduce data, produce and validate catalogs, perform scientific analysis, monitor the progress of the survey, and to manage products. Links and documentation are all easily accessible in an integrated environment. The system tries to be self-evident with in-line help available in various parts of the system as well as short explanatory demonstration movies available in the Help session. The portal also provides tools for power-users and system administrators to oversee the entire system.

The services currently available under the menu folder include:

- **My Workspace:** provides access to the profile, processes, configurations, products from process and uploaded data. Besides that, the user can require a **developer status**, allowing the access to: 1) the portal machines through ssh; 2) the code repository in order to pull and push code;
- **Pipelines:**
  - **Data Reduction:** provides access to Quick Reduce, a tool to reduce DECam data in the mountain. Also an adapted version to CTIO 1m runs is currently available and will turn into the PRECam reduction pipeline.
  - **Advanced Products:** here the user can produce and export catalogs, either regular or value-added, and validate them using the tools available in the portal.
  - **Science:** provides access to the available scientific pipelines, grouped in sub-categories (sub-folders) representing different working and study groups. The available pipelines (processes) in each group varies in the degree of sophistication and scope but all consist of concatenated full configurable modules chosen according to the user-specified workflow and algorithms, that query for data, process one or more jobs, depending on the number of input data sets, and generate scientific products that are stored in a temporary directory, which can later be saved or exported by the user. The processes can be run offline with the users being notified by e-mail upon completion.



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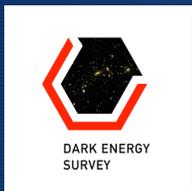
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- **Tools:** provides a large variety of tools, like processes running in the cluster, code manager, cluster environmental information, enabling the access to the administrative layer of the portal for those with permission. Here is also available the means to monitor the Survey Coverage



# Remarks...

- Cluster Finder comparison is a **MUST** to understand cluster catalog generated by cluster finder
  - Systematics, bias
  - Cosmologically AND astrophysically
- Want to be up-to-date on the DES status?
  - <http://www.darkenergysurvey.org>
  - <http://www.facebook.com/darkenergysurvey>