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MC^2 Awesome analysis of MACS1752

Karen Y. Ng,[1] [order TBD] D. Wittman,[1] William A. Dawson,[3] M. James Jee,[2] Nathan Golovich[1]

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ABSTRACT

Key words: Galaxies: clusters: individual: MACS J1752.0+4440; Large-scale structure of Universe; methods: statistical

1 INTRODUCTION

2 DATA

2.1 Keck DEIMOS Observations and Spectra Reduction

- Date and observation conditions
- Refer to Will's 2014 paper for details of spectra reduction

2.2 Suburu / SuprimeCam Observation

Date and observation conditions

2.3 Hubble Space Telescope Observation

Date and observation conditions

2.4 Data Reduction for Keck DEIMOS data

We made use of the same data reduction packages, *spec2d* and *spec1d* packages (Newman et al. 2013) and a similar reduction procedure as Dawson et al. (2014). During our visual inspection, we adopted the same quality rankings for our spectra as Newman et al. (2013). This results in 357 objects with highest quality ranking ($Q = 4$), and 40 objects with the minimum quality spectra.

2.5 Data Reduction for Subaru and HST data

refer to James' CIZA paper

2.5.1 Extinction Correction

There is low extinction in the field of view of MACSJ1752. The mean of the extinction magnitude in E(B-V) is 0.036, while the corresponding standard deviation is 8.5×10^{-3} (ACCORDING TO WHOSE MAP?). We first perform cubic interpolation to infer the E(B-V) values at the spatial location of all the entries of our data catalog. Then we perform dust correction for other the G, R and I Subaru bands according to Schlafly & Finkbeiner (2010).

Table 1. Criteria used for source selection to prevent spurious sources.

Property	Criteria
R-band magnitude (ISO and AUTO)	$21 < R < 25$
Ellipticity measurement error	$\delta e < 0.25$
I band semi-minor axis	$b > 0.4$ pixels
Elliptical Gaussian fitting convergence	`STATUS` $= 1$
Significance cut in G,R and I band (ISO)	`MAG_ISO` / `MAG_ERR_ISO` > 5
I band SExTractor star flag	`CLASS_STAR` < 0.6
I band half-light radius	`I_FLUX_RADIUS` > 2.3 pixels
SExTractor FLAG cut	`FLAG` $\neq 8, 16, 32$

- Source count

2.5.2 Shape measurement and source selection

We perform a series of manual cuts to remove spurious data points that cannot belong to the source population. we perform signal-to-noise ratio (SNR) cuts to make sure the ellipticity errors are < 0.3 and the SNR are > 5.

The resulting source density count from our cleaned catalog is , which is within σ of the source density count of the training COSMOS fields catalog after removing stars and foreground galaxies. Finally, the effective lensing depth β, i.e. the mean of D_{LS}/DL[DOUBLE CHECK] etc. of the inferred source population is .

Determine stellar locus Fig. 6 Dawson et al. 2014 $I_{auto} vs Half - lightradius$ plot!!!

[I may just move all these to a new paper and stick with a quick-and-dirty approach]

After obtaining the source population. We make use of two state-of-the-art classification / regression algorithms, gradient boosting trees and a Random Forest algorithm, to select our source and obtained consistent results. Data cleaning, preprocessing and feature engineering have always been considered to be one of the most important steps in a data analysis (quote Machine learning paper).

The predictors that we included in the classification algorithms are all the colors and magnitudes that we have, the half-light radius, identification status flag and the redshift. The class labels in the predictions are member galaxies, source galaxies, and other contaminants such as stars, foreground galaxies, and unidentifiable contaminants with problematic status flags.

To minimize misclassification rates, we discarded samples with classification probability less than 0.5 in the dominant classification.

We make use of stratefied cross validation to find a training error rate is test error rate is .

The false positive rate from the out-of-bag samples is .

- K-correction? (not needed)
- Selection based on $(r - i)$ vs i band?
- Star galaxy separation based on half-light radius
- Source density counts

2.5.3 Source redshift estimation

Cosmic Evolution Survey photometric catalog (COSMOS) Ilbert et al. 2009 comparison of depth between our Subaru image and the COSMOS image?

3 METHOD

3.1 Optical analysis

3.1.1 Determining the number of galaxy subclusters and membership

3.1.2 Brightest Cluster Galaxies identification (BCG)

3.1.3 Number density and luminosity map

3.1.4 Dynamics of the subclusters

- LOS velocities
- mass estimation from velocity dispersion

3.2 Weak lensing (WL) analysis with LENSTOOL

3.3 Offset between the DM and galaxy centroids

3.4 Setup of Dawson's dynamical simulation

3.4.1 Weights due to radio relic info

4 RESULTS

5 DISCUSSION

5.1 Offset between the DM centroids and galaxy centroids

6 ACKNOWLEDGEMENTS

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APPENDIX A: MCMC DIAGNOSTICS FROM THE WL ANALYSIS

Fig 1. Chains indicating burn-in and the posterior density acceptance rate!

APPENDIX B: OUTPUTS FROM DYNAMICAL SIMULATION

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