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Cold gas within and around galaxy clusters: The incidence of Mg II as a function of cluster masses
[NT: better title TBD]

Neil H. Crighton[1⋆], Nicolas Tejos[2] and Sebastián López[3]

[1] *Centre for Astrophysics and Supercomputing, Swinburne University of Technology, Hawthorn, Victoria 3122, Australia*
[2] *Department of Astronomy and Astrophysics, UCO/Lick Observatory, University of California, 1156 High Street, Santa Cruz, CA 95064, USA*
[3] *Departamento de Astronomía, Universidad de Chile, Casilla 36-D, Santiago, Chile*

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ABSTRACT
We investigate the incidence of Mg II absorption line systems in galaxy clusters as a function of cluster mass. Our results are....

Key words: –intergalactic medium –quasars: absorption lines –galaxies: clusters: intracluster medium –large scale structure of the Universe –galaxies: evolution

1 INTRODUCTION

[NT: brief introduction]

2 DATA

2.1 Galaxy clusters

We use the red-sequence Matched-filter Probabilistic Percolation (redMaPPer) catalog (Rykoff et al. 2014) ...
[NT:
- Description of the redMaPPer cluster catalog
- Explain why redMaPPer: advantages
- Clusters centers as probabilities
- Cluster members as probabilities
- Cluster Richness corrected by incompleteness
- Photometric uncertainties are small
- Some spectroscopic redshift exists
- Adopted richness--mass relationship
- Explain completeness and purity
]

2.2 Mg II absorption line systems

We use the Mg II catalog published by ...

[NT:
- Description of the Mg II catalog
- Explain why this catalog in particular: advantages
- Explain the main observables relevant for this study: z, EW, Vdisp?
- Explain why completeness level issues, and why these do not affect our analysis.]

3 DATA ANALYSIS AND RESULTS

3.1 Cross-match between clusters and Mg II systems

[NT:
- Show plots of redshift overlap
- Explain subsample of the cluster catalog used in this analysis
- Explain subsample of the Mg II catalog used in this analysis
- Justify the maximum scale adopted (40 Mpc? use as motivation the mean distance between clusters?)
- Define redshift path per cluster
- Define hits
]

3.2 The incidence Mg II in clusters

[NT:
- Define incidence in clusters, dN/dz
- Define incidence as a function of co-moving separation
- Define incidence as a function of virial radii; emphasize why is important to scale by virial mass: massive clusters are larger. Dark matter haloes are expected to show self-similarity, others)

⋆ E-mail: neilcrighton@gmail.com

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Figure 1. Clusters and Mg II redshift distribution...

Figure 2. dN/dz for our full sample; in both, co-moving and r200 units

- Plot these two quantities for our full samples in both co-moving and r200 separations.
- Mention whether these two seem consistent with each other but leave interpretation to the Discussion section. If no qualitative differences, stick to r200.]

3.3 The incidence Mg II in clusters as a function of cluster mass

[NT:
- Define cluster mass bins; explain why we chose these particular bins.
- Main result of the paper: incidence as a function of cluster masses
- Plot incidence as a function of cluster masses, in r200 (or both in case is worth it)]

3.4 Physical model

[NT:
- Explain our model to fit the results
- Mention whether our model consistent with the known masses of the clusters in each mass bin? (either result will be very interesting) but leave full interpretation to Discussion section
]

Figure 3. dN/dz for our cluster-mass subsamples; in both, co-moving and r200 units; this figure should contain our model

4 DISCUSSION

[NT:
- General implications of results, focusing on the main result
- Although we focused on the larger scales, we can speculate now on our reported results on scales < 1 Mpc (subject to large statistical uncertainties).
- Why is important to have cold gas in clusters
- Are the observed trends consistent with expectations?
]

4.1 Comparison to previous work

[NT:
- Lopez+2008
- Zhu+14
- Gauthier+14
- etc.
- emphasize why our experiment is different (we focus on the most massive haloes in the universe and we know the masses of the clusters very well)
- focus on agreements and disagreements
]

4.2 Future prospects [??]

[NT:
- What can be done to extend this work?
- Is it worth to aim for less massive groups? Is there evidence for a different behaviour in these lower mass haloes?
- Mention work on the smaller scales that we will do ?
- Address different galaxy populations (star-forming, non-star-forming)
- Split by Mg II EW for a fixed cluster mass
- Investigate properties of clusters showing and not showing Mg II.
- Put limits on the covering fraction of Mg II inside galaxy clusters [this seems important, should we address this in this paper rather than

later? We could to it for the strongest absorbers without worrying much about incompleteness].
]

5 SUMMARY

[NT: Brief summary]

ACKNOWLEDGMENTS

We thank contributors to SciPy[1], Matplotlib[2], Astropy[3], and the Python programming language[4]; the free and open-source community; and the NASA Astrophysics Data System[5] for software and services.

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APPENDIX A: CHECK FOR SYSTEMATIC EFFECTS

[NT:
-Plot QSO properties as a function of cluster masses, and transverse separation in the same way the analysis was presented.
-Plot properties of clusters (mass distribution, redshift distribution) with Mg II versus those without ?]

This paper has been typeset from a TEX/ LATEX file prepared by the author.

Figure Here.

Figure A1. Properties of QSOs as a function of transverse distance.

[1] http://www.scipy.org
[2] http://www.matplotlib.sourceforge.net
[3] http://www.astropy.org(Astropy Collaboration et al. 2013)
[4] http://www.python.org
[5] http://adswww.harvard.edu