

Optical Followup [How do we get redshifts for all of our clusters?]

Lindsey Bleem Argonne National Laboratory



Outline

1. How are cluster redshifts measured?

2. What will the survey landscape look like when **CMB-S4** is taking data?

3. What I see as the most straight-forward path forward





- Photometrically
 - Red Sequence Redshifts (e.g., SDSS, DES, HSC, LSST)







Image: J. Hao





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The red sequence of RCS-2 galaxy clusters as a function of redshift (Credit: Ben Koester).



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COSMOs Sims from





- **Photometrically**
 - Red Sequence Redshifts (e.g., SDSS, DES, HSC, LSST)
 - 1.6 um "Stellar Bump" (Spitzer, WISE, SPHEREX (R~40))
 - Clustering in Photo-z space (Optical + IR surveys)
- Spectroscopically
 - Optical/NIR
 - X-ray





Fishing in the Redshift Desert



Figure 4: The effective redshift desert, the range of redshifts where both [OII] 3727 Å and Ly α 1216 Å become undetectable, for three different instrumental set-ups: LDSS3-C detector with VPH-All grism (red), IMACS f/2 with the 200 lines/mm grism (blue), and IMACS f/4+GISMO add-on with 150 lines/mm grating and order-blocking filter (5694-9819 Å) (green). The width of the boxes represents the wavelength range where total system throughput > 0.05 and the height of the boxes indicates the corresponding redshift desert. We also include the observed wavelength of [OII] and Ly α as a function of source redshift, which sets the boundaries of the redshift desert.

ASTRONOMY

Figure by Keren Sharon UMichigan



L Bleem & A Gonzalez CMB-S4 Summer Collaboration Meeting Aug 12th 2020





TARGETED OBSERVATION FACILITIES



Athena

2030-2035



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+ BOA or Other Wide Field spectroscopic capabilities?

SURVEY CLASS FACILITIES

A Path Forward

- The combination of wide-field Euclid, LSST, and SPHEREx survey data will provide excellent coverage out to z~1.7 (maybe even up to z~2).
- The deep surveys from e.g., Roman and Athena will help us to even better characterize this performance. Can also explore new methods like Churazov et al 2015 2015MNRAS.450.1984C combining X-ray/SZ surveys.
- We can (and already are with SPT-3G) conduct detailed targeted observations of representative subsets of our sample to validate our redshift estimations and enable estimates of the redshift distribution of our high-z systems for cosmology.
- As discussed last summer, for astrophysical characterization extensive followup will be required.







Probability of False Association