Photometric redshifts for VST ATLAS using random forest regression

Owen Turner **Supervisor: Dr. R. G. Mann**

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1. Random forest regression
2. Spatial overlap between ATLAS and SDSS
3. Application to ATLAS area
4. X-ray selected galaxy clusters in ATLAS

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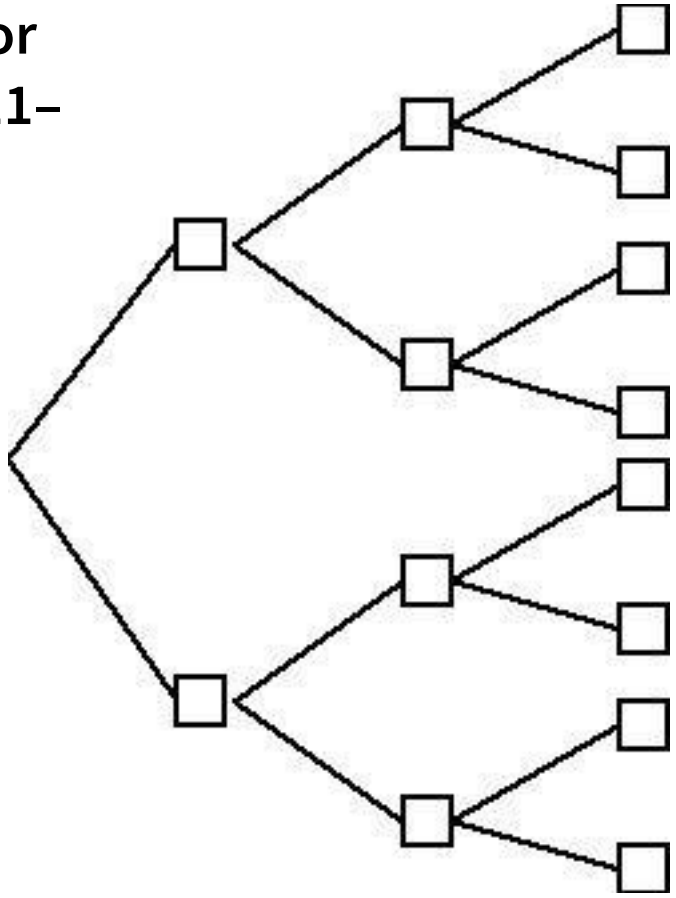
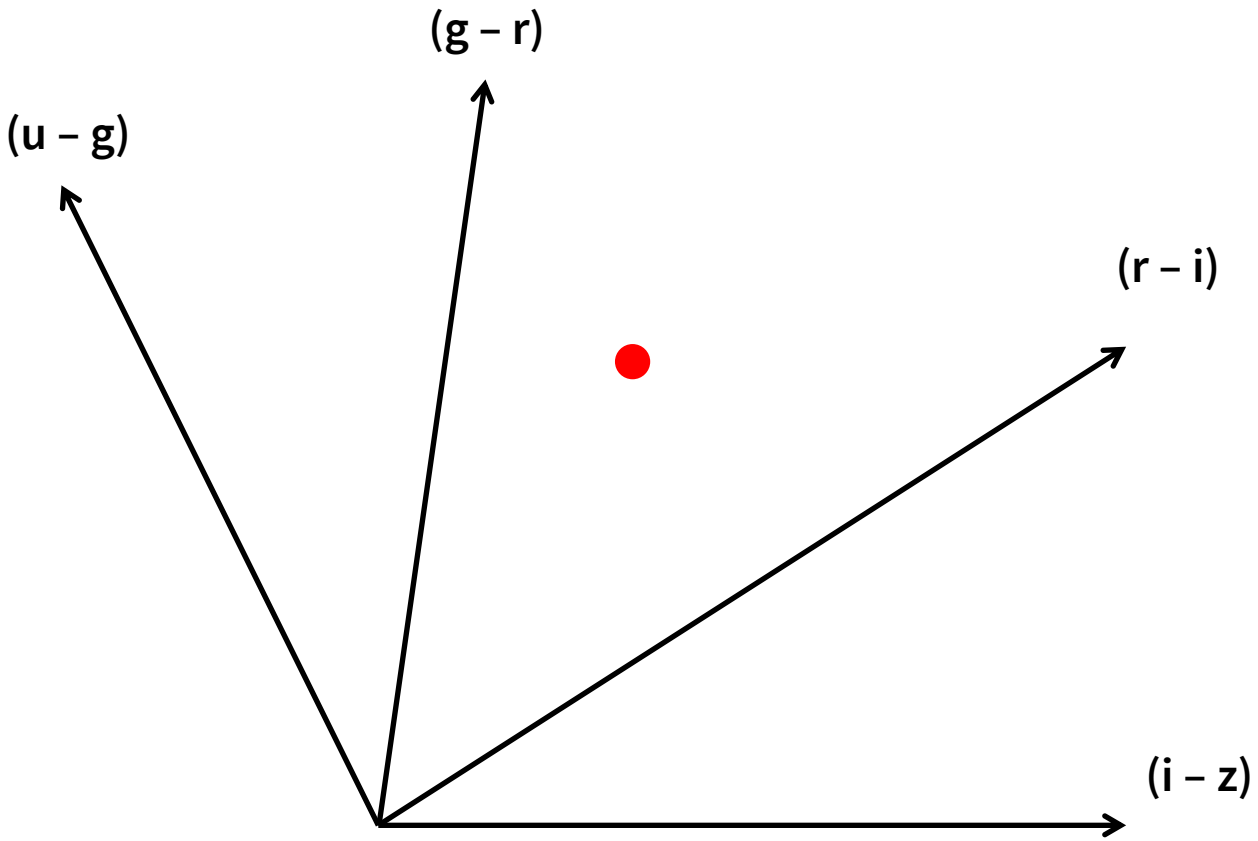
Random Forest Regression

- S. Carliles et al. ‘Random forests for photometric redshifts’, APJ, 712:511–515, 2010
- Used to compute SDSS photometric redshifts, with a training set size of 850,000 rows
- Bootstrap aggregation of the individual tree predictions
- Well understood gaussian error properties



Training set variables



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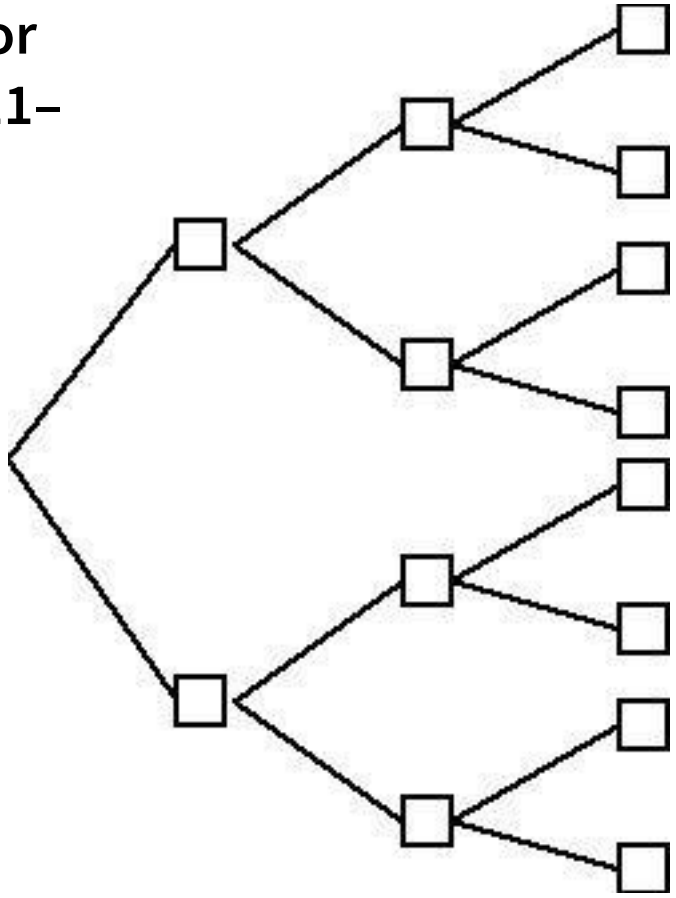

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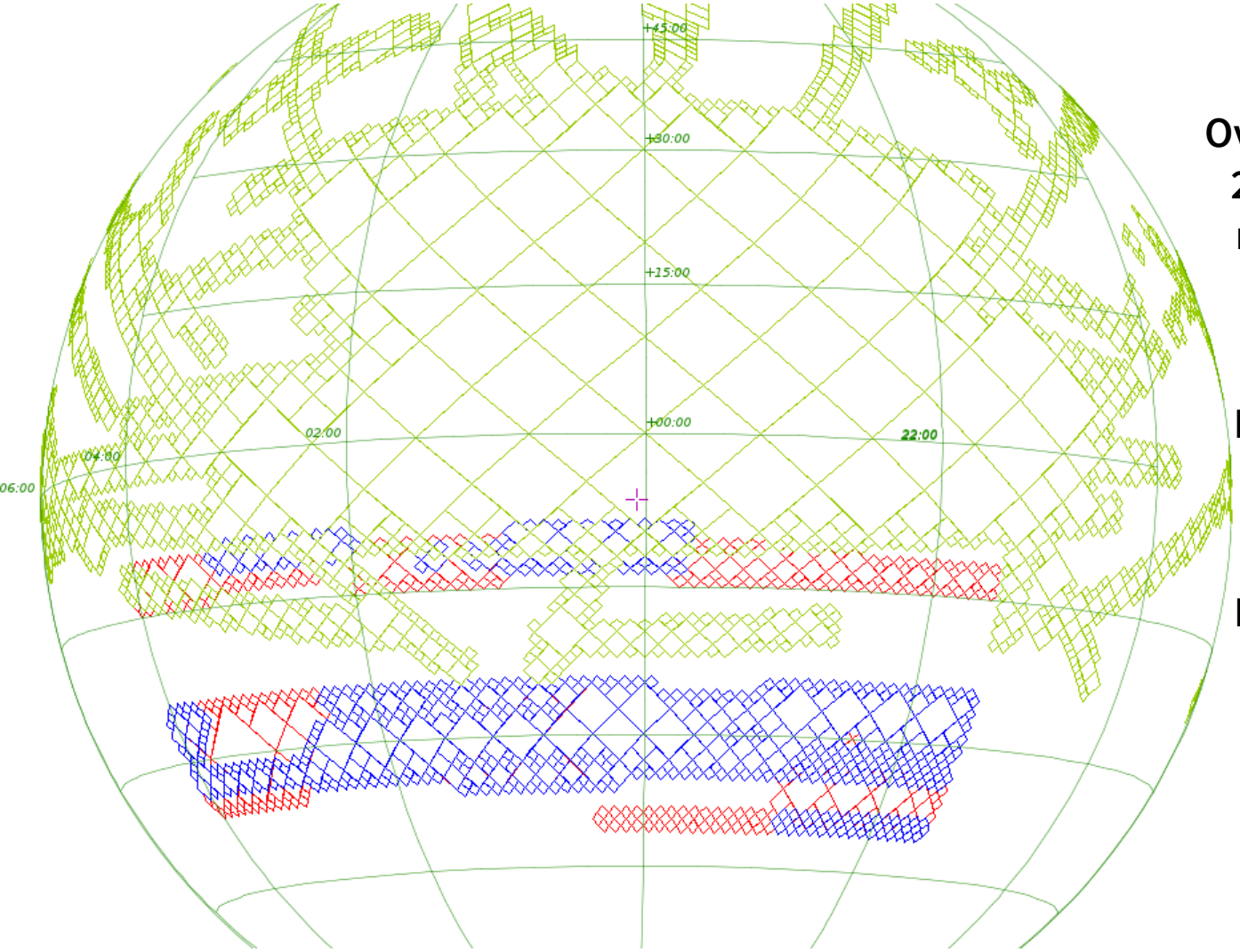
Spatial overlap with SDSS



Overlap between 27th Nov 2013 ATLAS proprietary release and SDSS DR10

Region 1

RA: 21:30:00 → 04:15:00

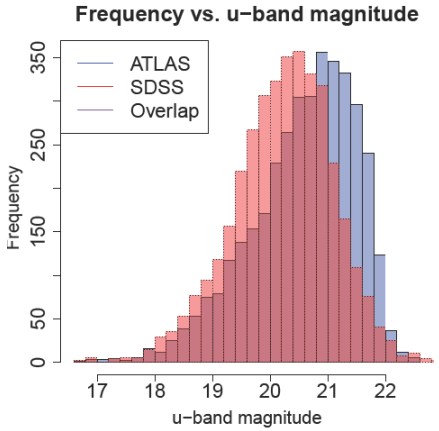
DEC: -8:30:00 → -14:45:00

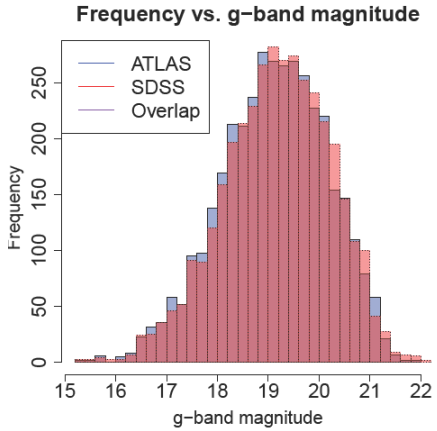
Region 2

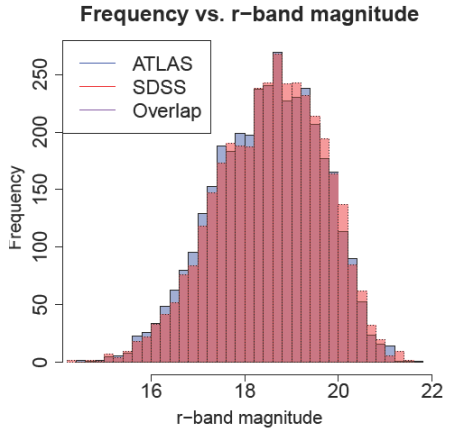
RA: 10:00:00 → 15:30:00

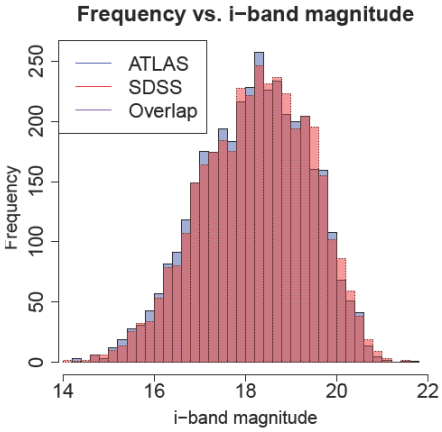
DEC: -5:00:00 → -12:00:00

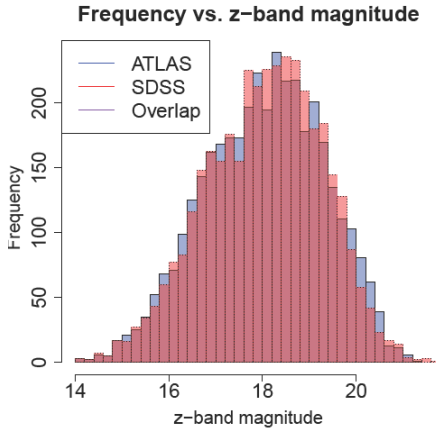
Filter corrected stellar magnitudes











Spatial overlap with SDSS

- Checking for spatial structure in the ATLAS photometry
- Cross matching between SDSS DR10 and November ATLAS data release to gather spectroscopic redshifts for training
- The number and depth of u-band observations led to the omission of (u-g) as a training variable
- Gives a training set roughly 4000 rows in length

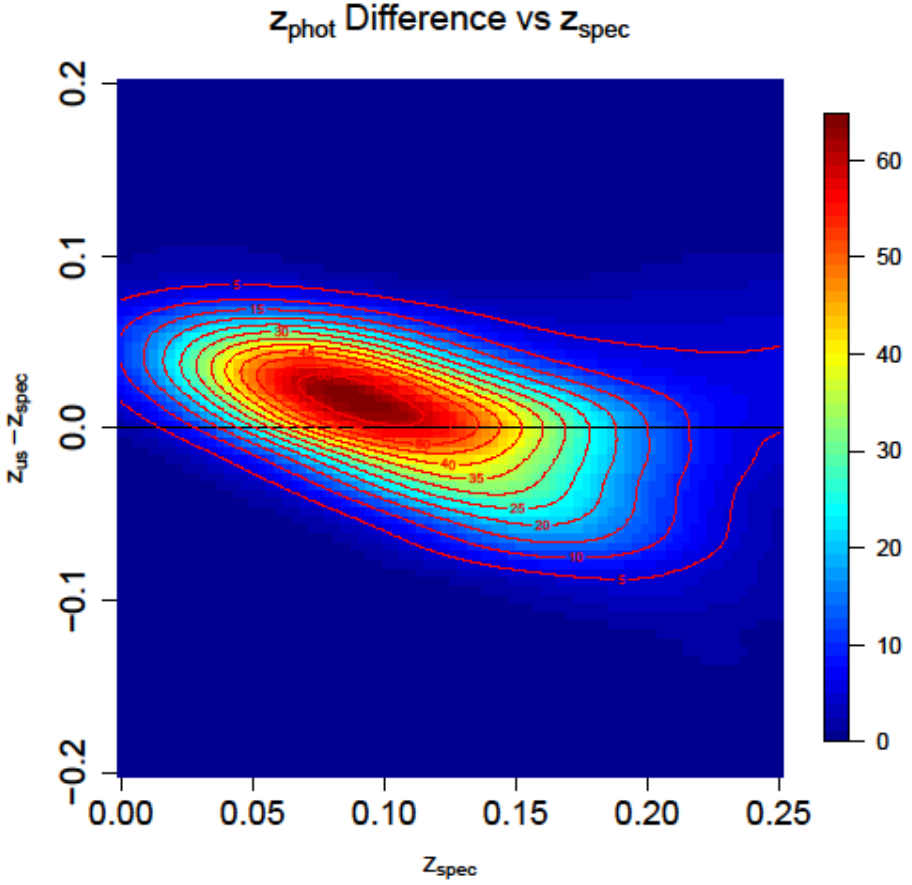
Split procedure

- Randomly divide the 4000 rows of training data in half
- Use the photometry and spectroscopic redshifts of the first half as training data to construct a forest
- Use the photometry and spectroscopic redshifts of the second half as test data for the RF algorithm
- Compare RF predictions with the test z_{spec} values

Predictions using ATLAS Petrosian photometry

Mean of the difference between z_{phot} and z_{spec} is: -0.0018

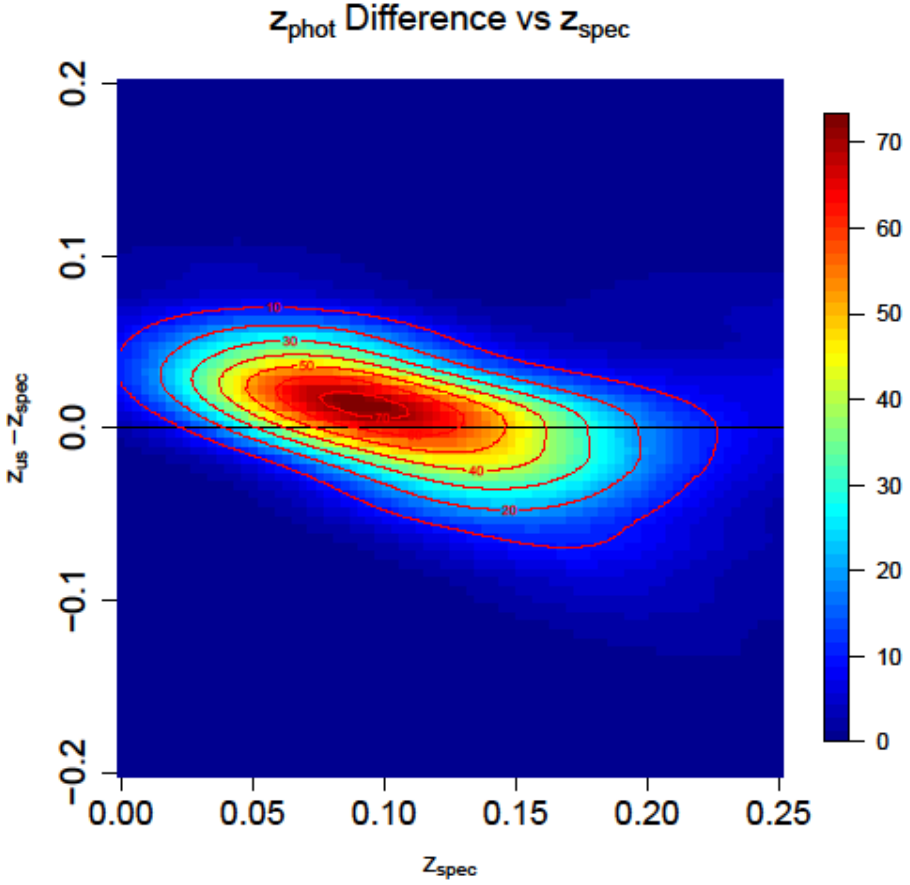
RMS of the difference between z_{phot} and z_{spec} is: 0.067



Predictions using SDSS Petrosian photometry

Mean of the difference between z_{phot} and z_{spec} is: -0.0011

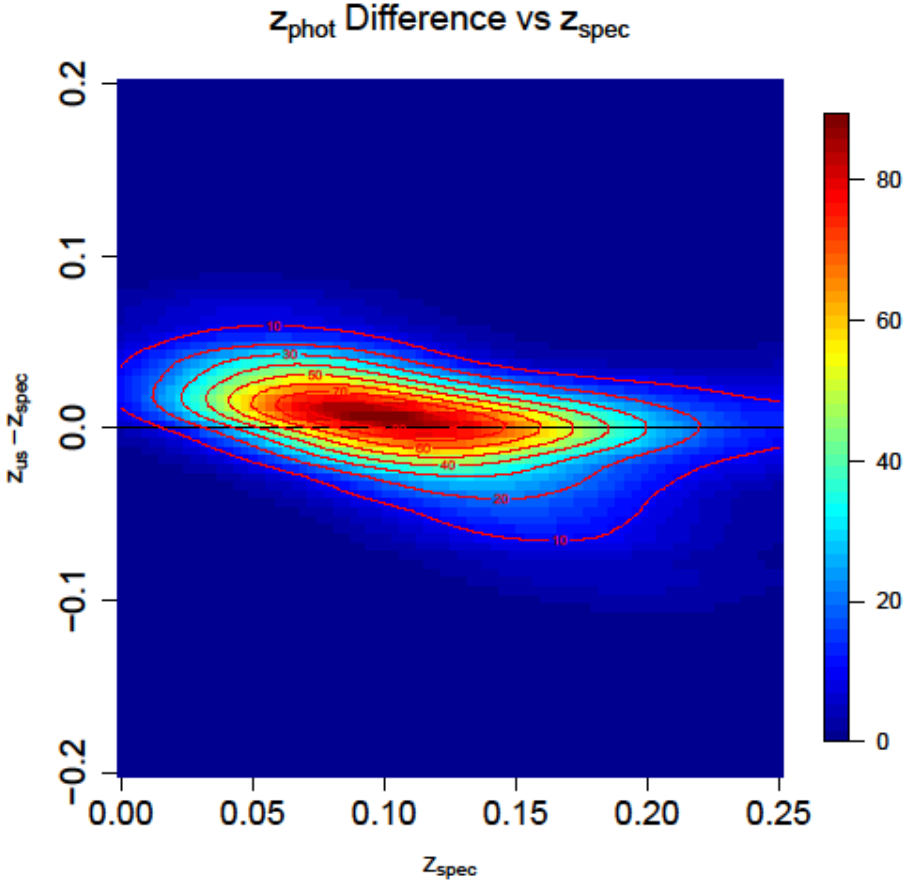
RMS of the difference between z_{phot} and z_{spec} is: 0.060



Predictions using SDSS model photometry

Mean of the difference between z_{phot} and z_{spec} is: -0.00025

RMS of the difference between z_{phot} and z_{spec} is: 0.050



RMS error summary

Overlap area with (u-g) excluded

	Mean	RMS
ATLAS Pet	-0.002	0.067
SDSS Pet	-0.001	0.060
SDSS mod	-0.0003	0.050

Overlap area with (u-g) included

	Mean	RMS
ATLAS Pet	-0.001	0.060
SDSS Pet	-0.001	0.048
SDSS mod	-0.0002	0.040

Entire SDSS region with 850,000 rows of data and (u-g) included

	Mean	RMS
SDSS mod	-0.005	0.025

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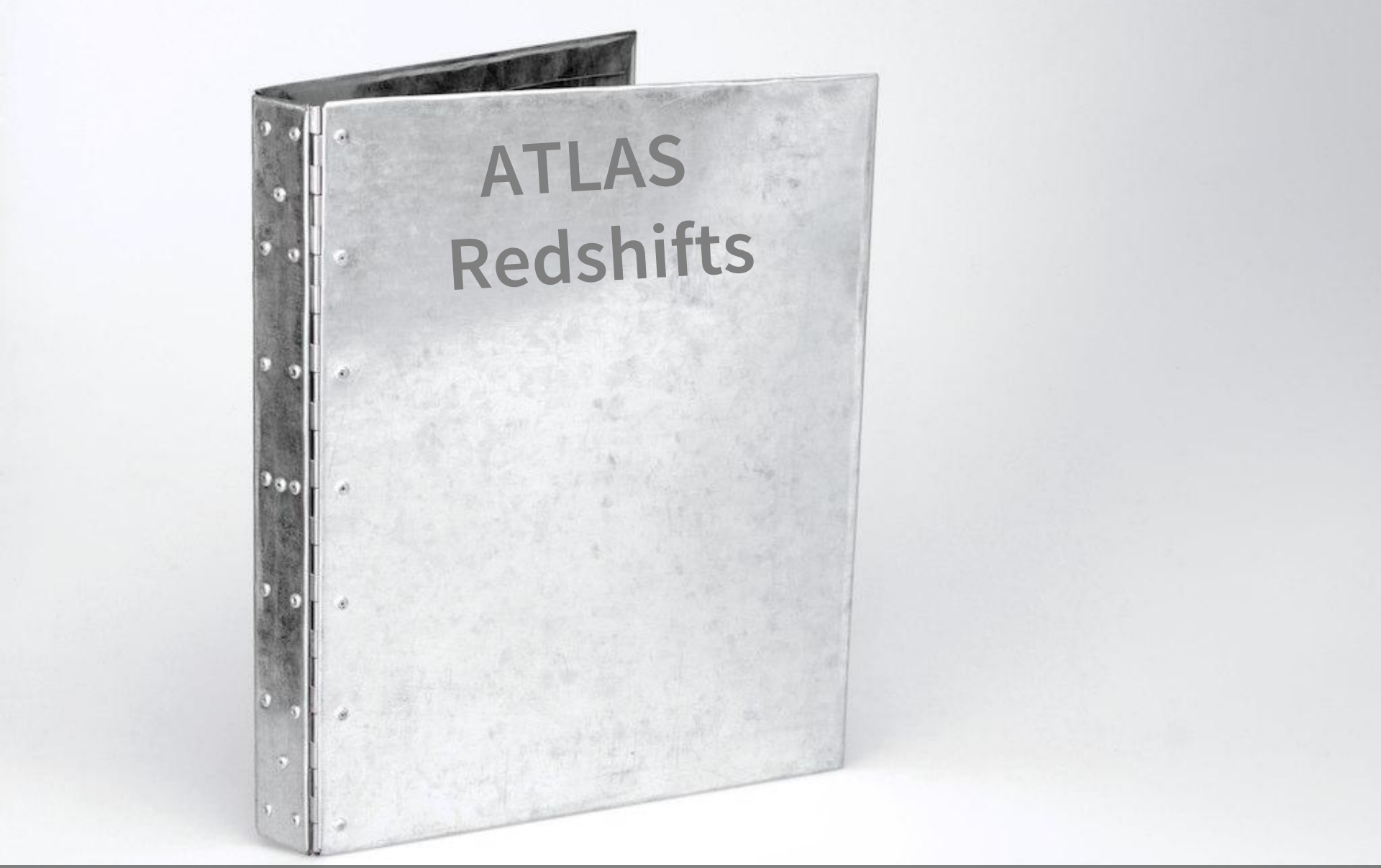

Catalogue of 3.2 million ATLAS photometric redshifts

https://www.flickr.com/photos/53901504

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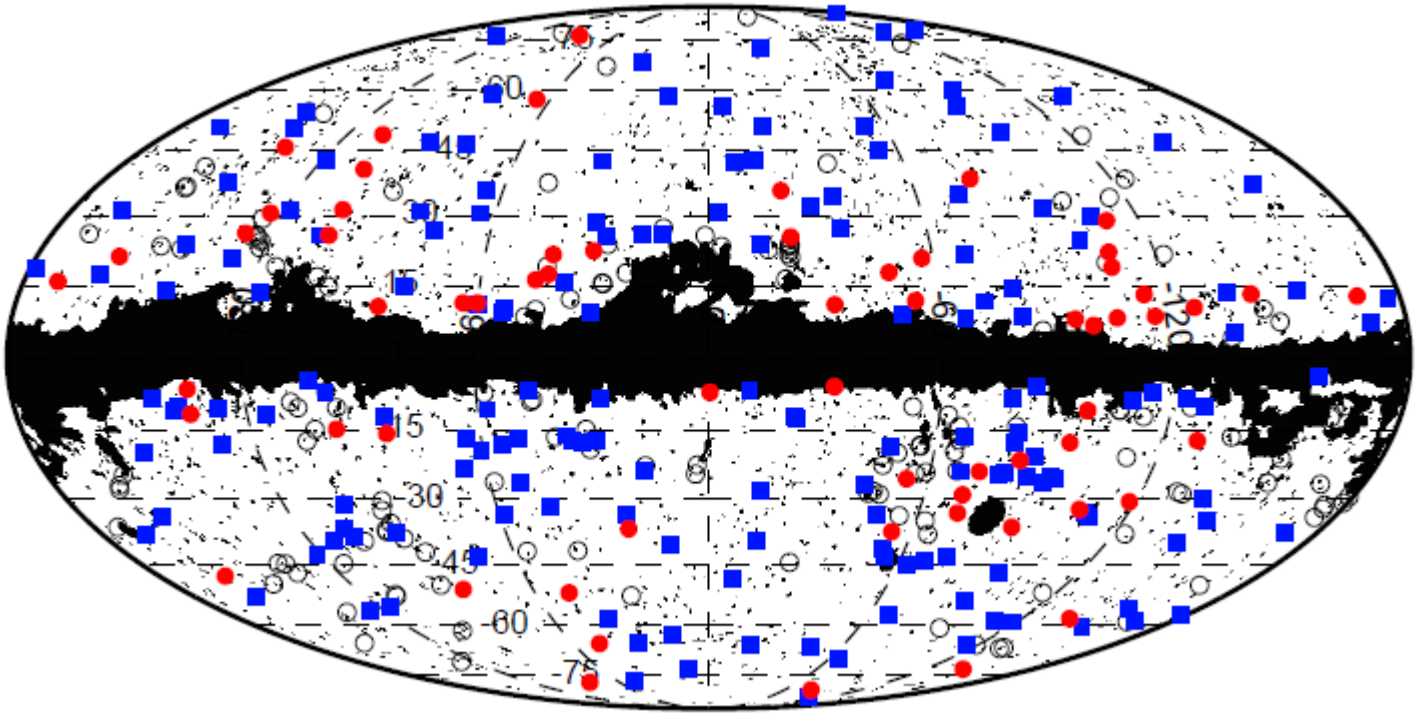
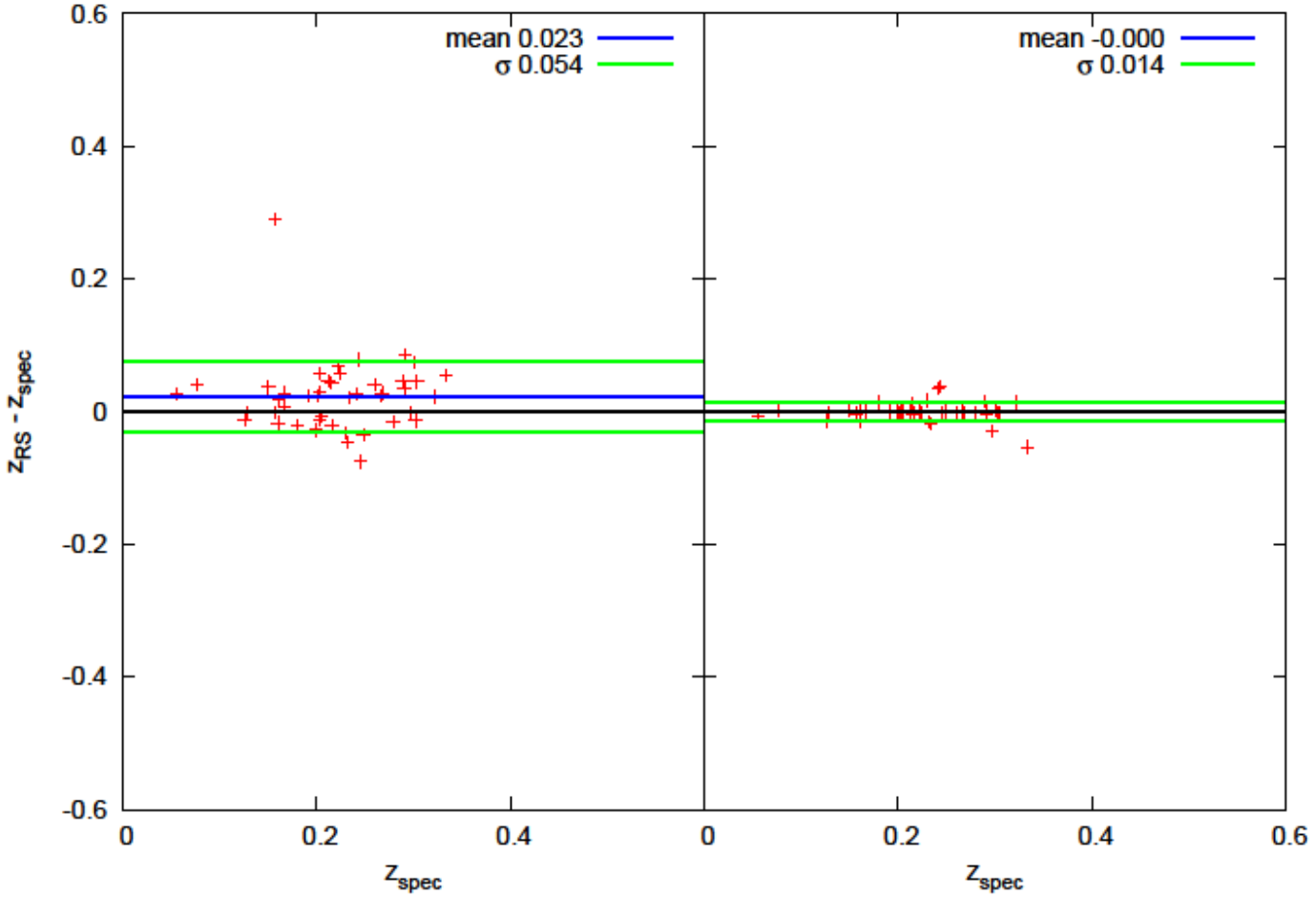
The XCS

- Serendipitous galaxy cluster survey using all publicly available XMM data
- Isotropic cluster detections across the sky



Ross Hood GMPhoRCC algorithm

Confirmation of 274 of 523 XCS candidates in the ATLAS area



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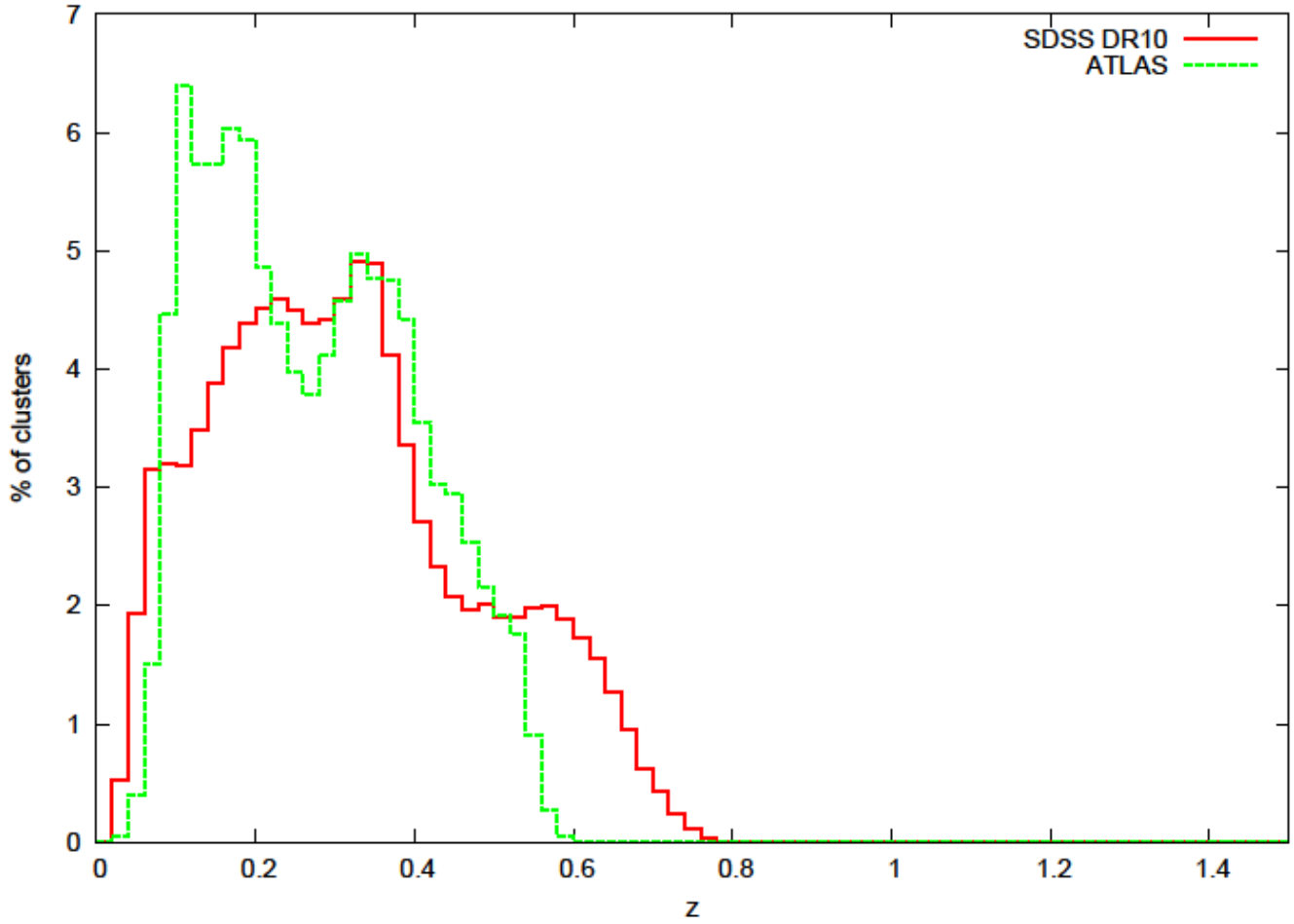

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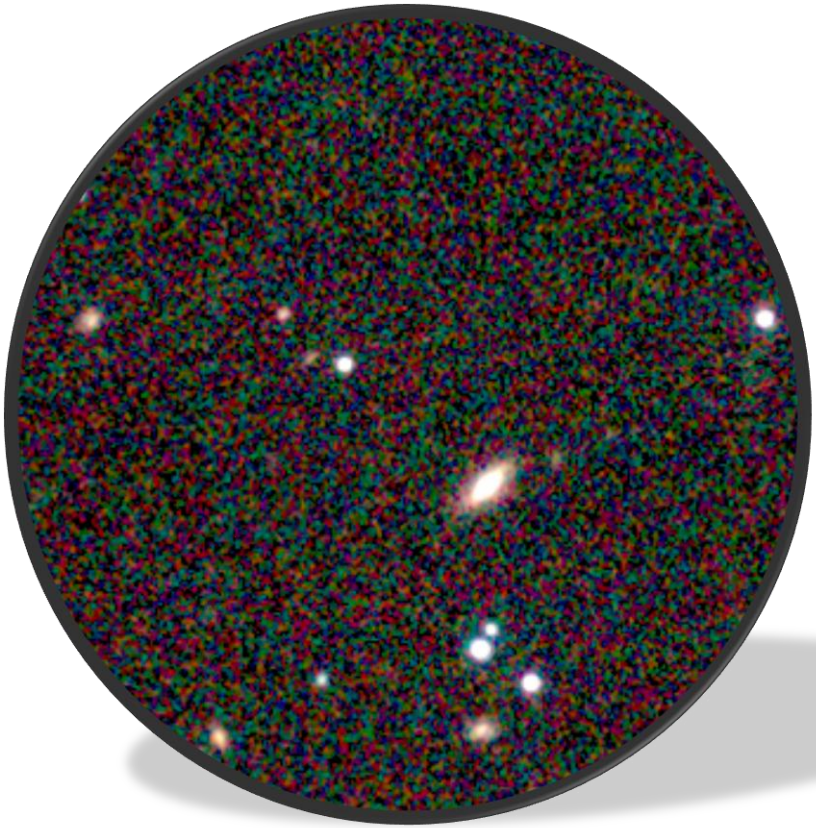
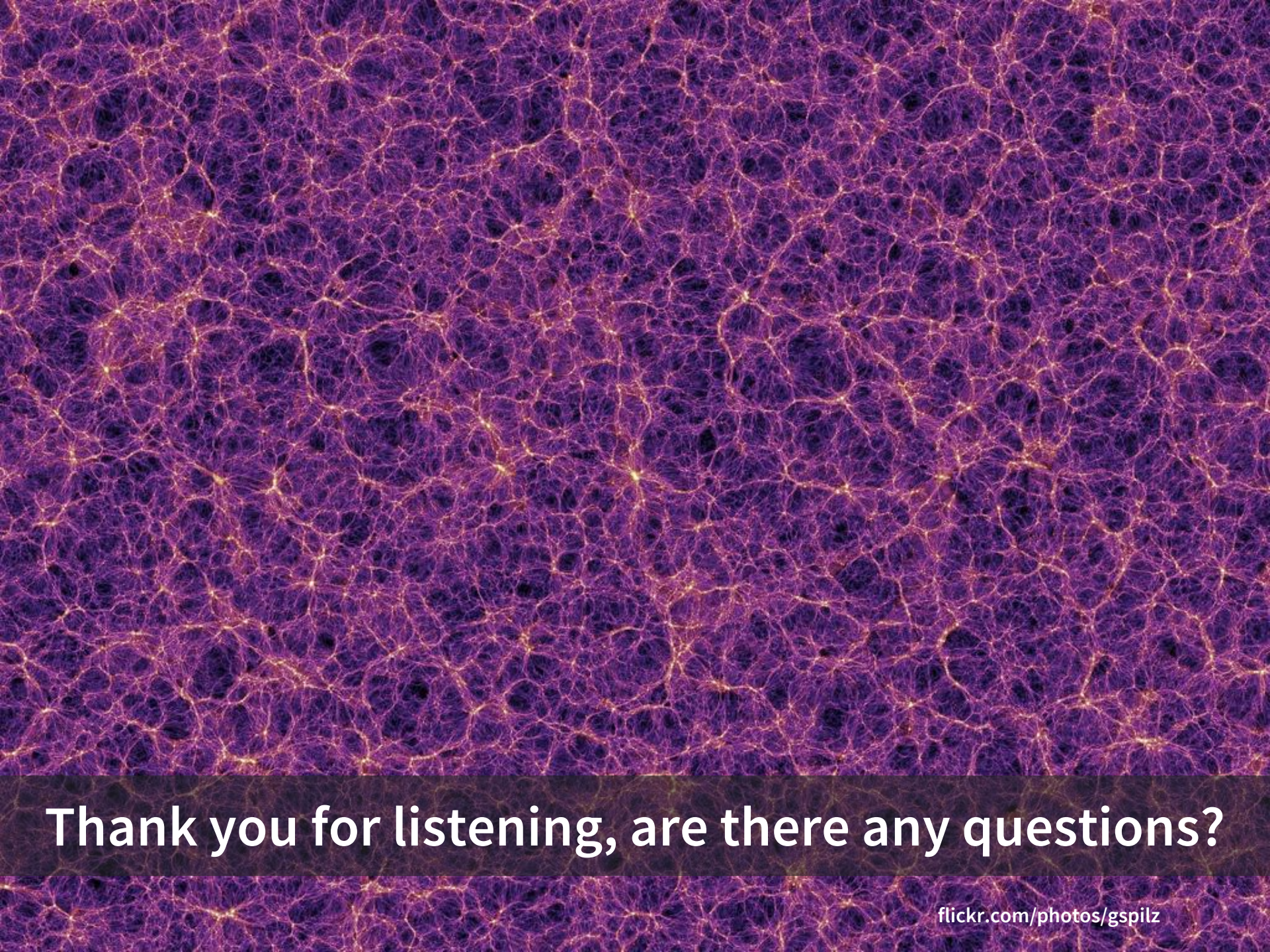


Summary

These are preliminary results which will improve with:

- A larger spectroscopic training set
- The use of model rather than Petrosian magnitudes
- Greater number counts and depth of u-band observations

Nonetheless the results are promising and support the use of the RF algorithm for computing ATLAS photometric redshifts


Thank you for listening, are there any questions?
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