

Dark Energy Activities of the Honscheid Group

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Our group has been working primarily on cluster weak lensing projects in cosmology. All the below is in collaboration with J.P. Draskovic, K. Honscheid, G.N.Smith, and J.C. Young in the OSU Physics Department, along with C.Kochanek, P. Martini, M.Peebles, E. Rozo, D.H. Weinberg in the OSU Astronomy Department H. Lin at FNAL.

Our primary projects have been analyzing on a realistic image cluster simulation of the DES focal plane, working on automating the public IMCAT pipeline and delivering it to the DES Data Management team to include in time for the next suite of image simulations, analyzing actual cluster data from the LBT, being a part of the worldwide GREAT08 team which is working to improve weak lensing pipelines to the precision necessary to make maximal usage of the data coming from the next round of major sky surveys.

We take these in turn in the next sections.

1 DES Cluster Simulation

The data management pipeline and analysis tools are being extensively exercised in with realistic images.

The Dark Energy Survey (DES), scheduled to begin taking data in the Fall of 2011, will use several techniques to place constraints on Dark Energy, including weak lensing measurements of galaxy cluster masses. Using tools developed for the pre-observation Data Challenges, we constructed a set of realistic images containing a simulated galaxy cluster. We then processed these images through two completely independent weak lensing pipelines. We demonstrated that the shear measurements are robust enough to reconstruct the cluster mass reconstruction reliably, and we further studied how different choices in the weak lensing pipelines affect the final cluster mass reconstruction.

As in the case of the previous Shear TEsting Program (STEP), for which a set of simulated images was made with constant shear and constant PSF across the field), it will be very useful to test multiple weak lensing pipelines on these cluster simulations, which are more suited to cluster weak lensing analyses than

the STEP ones, and which we make publicly available to the wider community¹. We ourselves analyzed these sample cluster images with two pipelines based on two publically available weak lensing codes: IMCAT (an implementation of the Kaiser, Squires, & Broadhurst) and Shapelets, and will give the results in a forthcoming paper.

Because the STEP simulations were so simplistic as far as a constant PSF and shear across the field goes, it is highly valuable to the entire Weak Lensing community to release these images for others to test their pipelines upon, and we expect to see several groups doing just that in the coming year.

2 Automating IMCAT pipeline

Another independent project we have been involved with is the automation of the publically available IMCAT pipeline into one continuous script that can be run as part of the DES Data Management (DESDM) chain so that as future image simulations are run, they will include our automated pipeline and the the shear results from it. Though two shear measurement pipelines already exist in the DES simulation framework, there has been a strong desire at high levels to include a third in case of discrepancies between the first two. Our group has now finished the first stage of automating the pipeline in python code so that provided with the files that the DESDM team will be supplying for each image, only one command needs to be run to export the shears from our method in the end. This will be highly useful as the 2009 image simulation run begins in the Autumn, and already the Weak Lensing Working Group conveners have thanked us for this contribution, though it has yet to be fully implemented into the DESDM chain, which we are working closely with the expert members of WL (Weak Lensing) group on.

3 LBT Cluster Data

We continue analyzing the six clusters taken with the the LBT (Large Binocular Telescope) at the Mt. Graham International Observatory in 2007-2008. This is highly useful for us as it is the one place where we must deal with the actual complexities of real-world data including image processing and physical processes such as subhalos masking exact shear profiles, triaxiality, and accidental cluster alignment. Once done, we can also compare our results to known mass-concentration relations, and contribute to the debate about whether clusters appear overconcentrated relative to the expectation from LCDM structure evolution, and thus whether there may be cosmological disagreements with the standard LCDM theory, or possibly baryonic processes that are not accounted for in the standard picture.

¹<http://ccapp.osu.edu/DEScuster>

4 GREAT08

The GRavitational lEnsing Accuracy Testing 2008 (GREAT08) Challenge focuses on a problem that is of crucial importance for future observations in cosmology. As mentioned above, the worldwide gravitational WL (Weak Lensing) community worked together on the Shear TEsting Program (STEP) to make progress on techniques to measure the shear distortions induced by clusters and structure in the Universe. The GREAT08 Challenge was a chance for those not already in the WL community to contribute their ideas and statistical expertise on the subject. The Challenge was a success with several groups participating who had never before worked in this area, and bringing in several new insights about how to weight shear contributions from individual galaxies that will contribute to even better pipelines in the future. Our group contributed in several ways, by testing the code for one of the pipelines that was made public to ensure it worked, by giving presentations to statisticians at OSU which were then made available on the GREAT08 website, and by downloading GREAT08 test images and doing preliminary analysis of them to verify they were ready to be made public for the challenge.

5 Research Presentations

My talks since last summer include:

M.S.S. Gill – *Cluster lensing in real data and STEP Simulation followups*, Santa Fe Cosmology Workshop 2009, Santa Fe, NM (July 2009)

M.S.S. Gill – *What lensing of clusters can tell us about cosmology through the M-C relation*, Special Cosmology Colloquium, UFRJ (Universidade Federal do Rio de Janeiro), Rio de Janeiro, Brazil (June 2009)

M.S.S. Gill – *What lensing of clusters can tell us about cosmology through the M-C relation*, Cosmology Colloquium, CBPF, Rio de Janeiro, Brazil (June 2009)

M.S.S. Gill – *Results of DES Cluster Simulation WL Analysis*, DES Collaboration Meeting, CBPF (Centro Brasileiro de Pesquisas Físicas), Rio de Janeiro, Brazil (May 2009)

M.S.S. Gill – *Cosmology with LBT Cluster Weak Lensing Data*, Special Cosmology Seminar, UCB (University of California at Berkeley), Berkeley, CA (March 2009)

M.S.S. Gill – *Cosmology with LBT Cluster Weak Lensing Data and DES Simulations*, Cosmology Seminar, LANL (Los Alamos National Laboratory), Los Alamos, NM (Feb 2009)

M.S.S. Gill – *LBT Cluster Weak Lensing Data and Dark Energy Survey Cluster Simulations Analysis*, DES Collaboration Meeting, OSU, Columbus, Ohio, USA (November 2008)