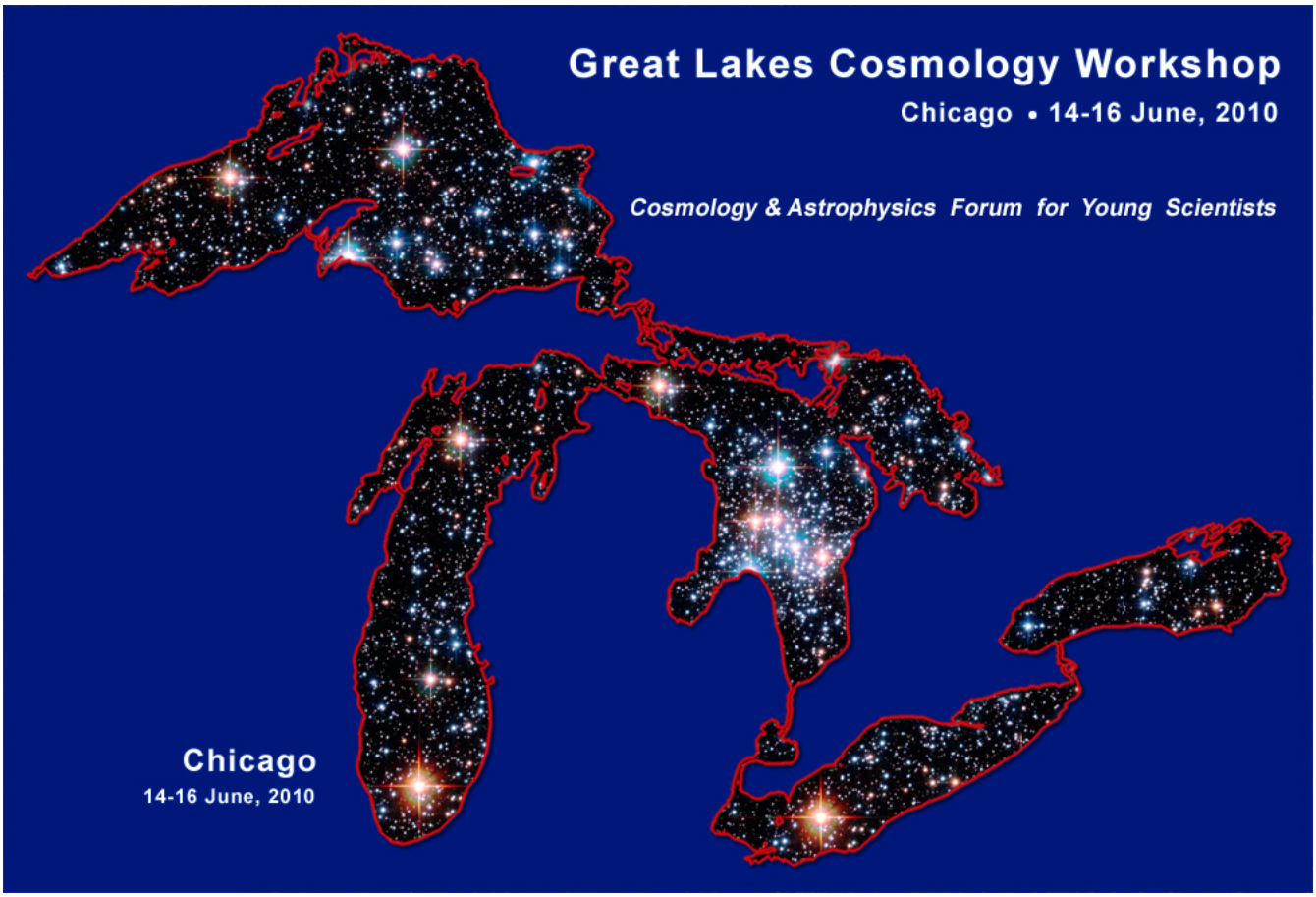
10th Great Lakes Cosmology Workshop **June 14 - 16, 2010**

Cosmology & Astrophysics Forum for Young Scientists **Chicago, IL**



http://kicp-workshops.uchicago.edu/glc-2010/

WORKSHOP ABSTRACTS

1. **Nishant Agarwal** (Cornell University)
Poster: ***Cascading Cosmology***

June 14, 2010

Rachel Bean (Cornell University), Justin Khoury (University of Pennsylvania), Mark Trodden (University of Pennsylvania)
Cosmic acceleration is one of the central puzzles in cosmology today. It has been proposed that the presence of large extra dimensions could source infrared modifications to the gravitational force law, leading to an accelerated expansion of the universe. We study cosmology in a 6D cascading gravity brane-world model. Starting from a 6D Einstein-Hilbert action, we develop an effective 5D action and obtain from it covariant junction conditions across a 3-brane. We subsequently study the cosmological evolution induced on a 3-brane moving in a static bulk and find that cascading gravity can indeed generate an accelerating solution. Our results open up the interesting possibility that a more general treatment of cascading gravity may lead to an accelerating universe without a cosmological constant.

2. **Chaoyun Bao** (University of Minnesota School of Physics and Astronomy)
Poster: ***The impact of an Achromatic Half Wave Plate on the Measured Polarization of the CMB***

June 14, 2010

C.Bao (1), C.Baccigalupi (2), J.Didier (3), B.Gold (1), S.Hanany (1), A.Jaffe (4), S.Leach (2), T.Matsumura (5), A.Miller (3), and D. O'Dea (4)

(1) University of Minnesota School of Physics and Astronomy, Minneapolis,MN 55455
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Some cosmic microwave background polarimeters are planning to use an achromatic half-wave plate to modulate the incident polarization. An achromatic half-wave plate rotates the angle of the incident polarization by an amount that depends on the spectrum of the incident radiation. The polarization angle measured by the instrument also depends on the detection bandwidth of the experiment. We present a computational study of this effect and assess its consequences for the extraction of the inflationary B-mode signal in the presence of both CMB and Galactic dust signals.

3. **Paramita Barai** (University of Nevada, Las Vegas)
Poster: ***Contribution of AGN Outflows to the Metal Enrichment History of the IGM on Cosmological Scales***

June 14, 2010

Paramita Barai
We investigate the large-scale influence of outflows from Active Galactic Nuclei (AGN) in enriching the InterGalactic Medium (IGM) with metals in a cosmological context. A substantial fraction of AGN are observed to host outflows powered by their central supermassive black holes. The outflows expand and permeate significant volumes of the Universe, having feedback on further evolution of the filled volumes. We implement semi-analytical prescriptions of the propagation of AGN outflows (along with a model of metal enrichment) within a cosmological volume, and perform N-body simulations of large-scale structure formation in a $Lambda$CDM Universe. The AGN outflows carry metals generated by stellar populations within the host galaxy and distribute the metals into the large-scale IGM. We compute the fractional volume of the simulation box filled by the outflows of a cosmological population of AGN over the Hubble time, and analyze the resulting metallicity in the filled volumes. The dependences of the IGM metal-enrichment on other factors (such as, AGN luminosity and IGM overdensity) are studied, and compared with observations. Results from our N-body cosmological simulations will be presented.

4. **Nick Battaglia** (University of Toronto, CITA)
Talk: ***Simulations of Large-Scale Structure with AGN Feedback***

June 14, 2010 (4:15 PM - 4:30 PM)

Nick Battaglia, J. Richard Bond, Christoph Pfrommer, Jonathan Sievers, Debora Sijacki
We explore how radiative cooling, supernova feedback, cosmic rays and a new model of the energetic feedback from active galactic nuclei (AGN) affect thermal Sunyaev-Zel'dovich (SZ) power spectra. To do this, we use a suite of hydrodynamical TreePM-SPH simulations of the cosmic web in large periodic boxes and tailored higher resolution simulations of individual galaxy clusters. Our AGN feedback simulations match the recent universal pressure profile and cluster mass scaling relations of the REXCESS X-ray cluster sample. For multipoles $elllesssim 2000$, our power spectra with and without enhanced feedback are similar, suggesting theoretical uncertainties over that range are relatively small. We find the power at high $2000-10000$ multipoles which ACT and SPT probe is sensitive to the feedback prescription, hence can constrain the theory of intracluster gas, in particular for the highly uncertain redshifts >0.8. The apparent tension between $sigma_8$ from primary cosmic microwave background power and from analytic SZ spectra inferred using ACT and SPT data is lessened with our AGN feedback spectra.

5. **Eric J Baxter** (University of Chicago)
Talk: ***Constraining Dark Matter in Galactic Substructure***

June 14, 2010 (2:30 PM - 2:45 PM)

Eric J. Baxter, Scott Dodelson, Savvas M. Koushiappas, Louis E. Strigari
The potential for gamma ray telescopes such as the Fermi Gamma Ray Space Telescope to indirectly detect dark matter by observing the photons produced in dark matter annihilations has recently become an exciting possibility. Because gamma ray backgrounds are considerably larger than the expected signal from dark matter, careful statistical analysis and background extraction will likely be essential to a successful detection. We consider two aspects of the dark matter signal that can be used to distinguish it from backgrounds: its angular distribution and its probability distribution function. We project constraints on the dark matter annihilation cross section from the Fermi telescope when both of these discriminants are used.

6. **Matthew B Bayliss** (University of Chicago/KICP)
Talk: ***Strong Lensing Clusters in RCS-2 and the SDSS: Statistics and Properties of Lenses and Lensed Sources***

June 15, 2010 (12:15 PM - 12:30 PM)

Matthew B. Bayliss, Michael D. Gladders, Joseph F. Hennawi, Keren Sharon, Felipe Barrientos, Hakon Dahle, Eva Wuyts, Mauricio Carrasco, Benjamin P. Koester, Megan Gralla, Masamune Oguri, Howard Yee, and David Gilbank
Statistical properties of galaxy cluster-scale strong lenses inform us about the structure formation history of the universe and the halo density profiles of the most massive structures in the universe, both of which rely on the overall cosmology from which these structures arise. We present extensive follow-up data - principally multi-object spectroscopy - on a new sample of several hundred strong lensing clusters identified in the Sloan Digital Sky Survey and the second Red-Sequence Cluster Survey. Statistics of the foreground lensing clusters, such as their distribution in redshift and core mass properties, are compared to theoretical expectations. Detailed spectroscopic and photometric observations of the lensed background sources are used to make a direct measurement of the redshift distribution and luminosity function of lensed sources, which can be used to inform future simulation efforts to predict cluster strong lensing statistics.

7. **Allan I Bayntun** (McMaster University)
Poster: ***deSitter Branes in Two Extra Dimensions***

June 14, 2010

Allan Bayntun, C.P. Burgess, Leo van Nierop
The back-reaction of branes onto the surrounding bulk geometry has been shown to be an important effect when considering brane-world models. This presentation will summarize recent progress in developing the appropriate matching conditions of codimension-2 branes, and the application to various models. The upshot of this is the branes themselves in some of these models are deSitter, which could lead to an alternative mechanism for inflation in extra dimensions.

8. **Matthew R Becker** (University of Chicago)
Talk: ***NlogN Multiple-plane Ray Tracing on the Sphere***

June 15, 2010 (2:00 PM - 2:15 PM)

Matthew R. Becker, Andrey V. Kravtsov
In the next generation of large, deep optical imaging surveys, weak gravitational lensing will be used extensively, including as a direct probe of dark energy and modified gravity through cosmic shear measurements, and additionally, as the preferred method to measure the normalization of cluster mass scaling relations needed for cluster abundance experiments. The ubiquitous use of weak gravitational lensing and the need to commission our data analysis algorithms and likelihood functions demand that we produce high-resolution, self-consistent weak lensing information over a curved sky from structure formation simulations. We present the first multiple-plane ray tracing algorithm which can efficiently meet these demands. It has a fully spatially adaptive ray field, produces weak lensing deflection, magnification, and shear fields self-consistently over a curved sky, uses a spatially adaptive Poisson solver, is fully parallel through MPI, and has a running time that scales approximately as O(NlogN), as opposed to O(N^(3/2)), in the limit of high-resolution. Our new tool enables ray tracing simulations of weak lensing to reach unprecedented sizes and resolution in order to enable the weak lensing science of the coming decades.

9. **Suman Bhattacharya** (Los Alamos National Lab)
Poster: ***Galaxy Clusters as a probe of early dark energy***

June 14, 2010

Suman Bhattacharya
We study a class of early dark energy (EDE) models, in which, unlike in standard dark energy models, a substantial amount of dark energy exists in the matter-dominated era. We self-consistently include dark energy perturbations, and show that these models may be successfully constrained using future observations of galaxy clusters, in particular the redshift abundance, and the Sunyaev-Zel'dovich (SZ) power spectrum. We make predictions for EDE models, as well as $Lambda$CDM for incoming X-ray (eROSITA) and microwave (South Pole Telescope) observations. We show that galaxy clusters' mass function and the SZ power spectrum will put strong constraints both on the equation of state of dark energy today and the redshift at which EDE transits to present-day $Lambda$CDM like behavior for these models, thus providing complementary information to the geometric probes of dark energy. Not including perturbations in EDE models leads to those models being practically indistinguishable from $Lambda$CDM.

10. **Lindsey Bleem** (University of Chicago)
Talk: ***An Overview of SPT-POL***

June 15, 2010 (9:30 AM - 9:45 AM)

The SPT-POL Collaboration
Starting in 2012 the South Pole Telescope (SPT) will begin a ~600 deg^2 survey to measure the polarization anisotropy of the cosmic microwave background (CMB). These observations will measure the CMB B-mode (curl component) angular power spectrum, and will be used to search for the large angular scale B-mode signal induced by inflationary gravitational waves. The B-mode spectrum will also enable a measurement of the neutrino mass from the effect of neutrinos on the growth of large scale structure, which lenses the CMB polarization spectrum. In my talk I will discuss the science motivation of SPT-POL and I will highlight some of the hardware developed in the production of the SPT-POL polarization sensitive camera.

11. **Immanuel Buder** (University of Chicago, KICP)
Talk: ***QUIET and QUIET-II: HEMT-based coherent CMB polarimetry***

June 14, 2010 (10:00 AM - 10:15 AM)

Immanuel Buder for the QUIET Collaboration
QUIET is a ground-based experiment that measures the polarization of the Cosmic Microwave Background (CMB) radiation. Existing CMB polarization data have been used to constrain the cosmological parameters that model the history of our universe. The exciting target for many current and future CMB experiments is detecting and measuring the faint polarization signals caused by gravity waves from the inflationary epoch which took place <10^-30 s after the Big Bang. QUIET is unique in searching for these signals using High Electron Mobility Transistor (HEMT) based coherent detectors. This technology offers different means of controlling systematic effects and a choice of frequencies complementary to the more commonly used bolometric detectors. QUIET finished an observing season at 40 GHz (Q-Band) in June 2009; observing at 90 GHz (W-Band) is ongoing from the Chajnantor Plateau in Chile. With 90 detector modules, the W-Band array is the largest ever of HEMT polarimeters. The combined polarization sensitivity is 70 (60) micro-Kelvin for a 1 second exposure of the Q (W) Band array. I will present the status of analysis from both arrays and introduce QUIET-II, the much more sensitive 1600-detector successor experiment to QUIET.

12. **Anna Cabre** (University of Pennsylvania)
Poster: ***Dynamical masses of galaxy groups and clusters***

June 15, 2010

Anna Cabre, Bhuvnesh Jain
We study applications of the virial theorem to halos in N-body simulations. We examine various line of sight measures of dynamical masses and discuss applications to data.

13. **Yan-Chuan Cai** (University of Pennsylvania)
Talk: ***Minimizing bias stochasticity***

June 16, 2010 (4:45 PM - 5:00 PM)

Yan-Chuan Cai, Gary Bernstein, Ravi Sheth
In the presence of stochastic biases or "shot noise," dark matter halos are not faithful tracers of their underlying dark matter. Understanding halo stochasticity is crucial for reconstructing the dark matter field from observations of halos through galaxy redshift surveys. We have developed a method to minimize the stochasticity using multiple tracers of the matter field. We test our method using halos in N-body simulations and forecast the fidelity of reconstruction of the matter field. We show that the standard Poisson sampling model fits the halo distribution poorly: the optimal weighting is quite different from Poisson weighting, and the mass can be reconstructed to much higher accuracy than predicted by the Poisson model.

14. **Erminia Calabrese** (University of Rome "La Sapienza")
Poster: ***Non-Gaussianity in WMAP Data Due to the Correlation of CMB Lensing Potential with Secondary Anisotropies***

June 14, 2010

Erminia Calabrese

15. **Blair Cardigan Smith** (McMaster University)
Poster: ***Comparing the Dark Matter Haloes of Group and Field Galaxies***

June 15, 2010

Blair Cardigan Smith, Laura C. Parker
Weak galaxy-galaxy lensing results in the shapes of background galaxies being distorted by massive galaxies along the line of sight. Measuring the distortions due to all such foreground galaxies allows mass, and hence the dark matter haloes of these galaxies, to be mapped. However, the distortion induced by a foreground galaxy is small, and the galaxy-galaxy lensing signal from hundreds to thousands of systems must be combined to accumulate statistically significant results. In this sense, the average dark matter halo properties for a large sample of foreground galaxies can be characterized using galaxy-galaxy lensing. This technique has previously been used to demonstrate that dark matter haloes of galaxies in the cluster environment are truncated relative to isolated field galaxies. This truncation likely also occurs, though to a lesser extent, in the intermediate density environment of galaxy groups (~10e13 solar masses). We will present a preliminary analysis of the group versus field haloes using a maximum likelihood lensing method. With this technique we can simultaneously measure the masses and radial extents of the haloes in our sample.

16. **Nachiketa Chakraborty** (University of Illinois, Urbana-Champaign)
Talk: ***The Primordial Lithium Problem: Can We Avoid New Phyiscs?***

June 14, 2010 (4:45 PM - 5:00 PM)

Nachiketa Chakraborty
The primordial abundances of light elements form an important evidence of the Big Bang Model of the universe. With precise measurements of the baryon-to-photon ratio, η from WMAP, these final abundances, which are functions of η alone in general, are fixed and must be consistent. As a result, any discrepancy between the theoretical and observational abundances of these elements, as exists for lithium, may be due to inadequacies in the Big Bang Nucleosynthesis Model which is based on the Standard Model of particle physics and cosmology. This could potentially point to new physics beyond the Standard Model such as decaying dark matter, or incompleteness of the nuclear reaction network. The theoretical 7 Li abundance is 3-4 times more than the observational values at ηWMAP. In order that the former matches the latter, 7 Li destruction needs to be enhanced as the production channels are more constrained. This could be achieved within the Standard Model via missed resonant nuclear reactions, which is the possibility we explore. We find some potential candidate resonances which can solve the lithium problem if their resonance energies and widths are within some reasonable range of values. These resonance properties need experimental verification. If experiment rules them out, then we may be compelled to invoke new physics to solve the lithium problem and potentially constrain dark matter models.

17. **David Chamulak** (Argonne National Labortaory)
Talk: ***How standard is the candle?: A theoretical look at metallicity effects in Type Ia supernovae.***

June 15, 2010 (4:30 PM - 4:45 PM)

David A. Chamulak, Edward F. Brown, Alan C. Calder, Aaron P. Jackson, F.X. Timmes, Dean M. Townsley, and James W. Truran
Type Ia supernovae (SNe Ia) are bright stellar explosions thought to occur when a thermonuclear runaway consumes roughly a solar mass of degenerate stellar material. The light curves from such events can be standardized and subsequently used as cosmological distance indicators. Over the last decade, SNe Ia have become the premier standard candle for measuring the geometry of the universe. However, observations indicate brighter supernovae in metal-rich environments even after standardization. Numerical models are steadily becoming more refined and can begin to probe the connection between the properties of the progenitor white dwarf (e.g. its birth mass, composition, and binary companion) and the outcome of the explosion. We have performed numerical calculations to examine the effect of metallicity on the hydrodynamics and nucleosynthesis taking place in SNe Ia. Our findings show how distant supernovae, which exploded long ago when the universe was on average poorer in heavy elements, may be somewhat different than nearby supernovae.

18. **Anbo Chen** (University of Michigan)
Poster: ***Analyzing projection contamination in cluster cosmology***

June 15, 2010

Anbo Chen and August Evrard

19. **Kim Coble** (Chicago State University)
Poster: ***Probing Student Understanding of Cosmology***

June 14, 2010

K. Coble (1), G. Cochran (1), V. Hayes (1), D. Larrieu (1), M. Nickerson (1), J. Bailey (2), R. Sanchez (2), K. McLin (3), A. Metevier (3) L. Cominsky (3)

(1) Chicago State University
(2) University of Nevada Las Vegas
(3) Sonoma State University
Recently, powerful new observations and advances in computation and visualization have led to a revolution in our understanding of the origin, evolution and structure of the universe. These gains have been vast, but their impact on education has been limited. We are bringing these tools and advances to the teaching of cosmology through research on undergraduate learning in cosmology as well as the development of a series of interactive web-based cosmology learning modules. In order to investigate student ideas about the structure, composition, and evolution of the universe, our group has developed an open-ended cosmology survey. We administered the survey prior to instruction and conducted follow-up student interviews using the survey. Preliminary results regarding student misconceptions in cosmology, student attitudes toward inquiry, and important implications for instruction in cosmology will be presented.

20. **Marcus S Cohen** (New Mexico State University)
Poster: ***HOW TOPOLOGICAL DEFECTS BREAK SCALE INVARIANCE***

June 14, 2010

Marcus S Cohen
The rest energy trapped in codimension-J defects-monopoles, vortices, and branes- remains constant, while the vacuum energy scales inversely the the scale factor. This creates a quartic scale potential, which admits two phase transitions, which we identify as inflation and baryogenesis. Using the volume in spin space, Pin(4,C) as an action, these defects appear as Lagrangian singularities in the 8-spinor phase space, classified by the Coxeter groups, <p,q,r>s. Their classes correspond to the families of leptons (J=1), mesons (J=2) and hadrons (J=3). What is remarkable is that their rest energies, (s/2)^3, match the observed particle masses within 4%!

21. **Richard I Cook** (Brown University)
Poster: ***What can Orthogonal Transfer Imagers do for Weak Lensing?***

June 14, 2010

Richard I Cook, Ian Dell'Antonio
We perform tests for systematic effects and the first weak lensing mass reconstruction using the OPTIC orthogonal transfer camera in order to determine the level of bias induced by local guiding with OT imagers. We show that induced systematic ellipticities lie below the 1% level threshold required for cluster lensing and devise tests and simulations to probe the systematic effects at the level of accuracy required for cosmic shear studies. We also use the superior resolution offered by OPTIC to recover the mass peak missing from the Deep Lens Survey mass reconstruction of Abell 781.

22. **Abigail Crites** (University of Chicago)
Poster: ***Development of Polarization Sensitive Bolometers for SPT-POL***

June 14, 2010

SPT-POL collaboration
I will discuss the detector technology being developed for use on the South Pole Telescope (SPT) to measure the polarization of the cosmic microwave background (CMB) radiation. Our primary science goals are to constrain the B-mode polarization signal, which can measure both the energy scale of inflation and the neutrino mass. To achieve the sensitivity required to meet these goals, we require a focal plane with ~1500 polarization sensitive detectors at observing frequencies of 95 and 150 GHz. In collaboration with Argonne National Labs (ANL) and the National Institute of Standards and Technology (NIST), we have developed two transition edge sensor (TES) detector technologies for SPT-POL. I will present the design and status of each, including optimizing and characterizing the optical and thermal properties of the detectors.

23. **Carlos Cunha** (University of Michigan)
Invited Talk: ***Photometric redshift statistics or how to avoid biased cosmological constraints***

June 16, 2010 (2:00 PM - 2:30 PM)

Carlos Cunha
In this talk I'll explain how to extract redshift information from broad-band photometry of galaxies. I will show that the biases in photometric redshifts can largely be avoided if the correct probabilistic approach is used. In particular, I will describe the weights method (Lima et al. 2009, Cunha et al. 2009) of redshift estimation, its successes in cosmological applications and the challenges ahead.

24. **James C Davis** (Ohio State University)
Poster: ***Dark Matter searches with IceCube DeepCore***

June 14, 2010

James Davis for the IceCube Collaboration
The IceCube Neutrino observatory, a cubic kilometer ice Cerenkov detector, is nearing completion at the geographic South pole. DeepCore, the low energy extension to IceCube, was recently completed and lowers IceCube's energy threshold to the 25 GeV range. With effective background rejection capability, by using the surrounding IceCube detector as a veto, DeepCore can be used to search for southern sky neutrino sources, perform neutrino oscillation studies, and dark matter searches sensitive to lower mass WIMPs compared to IceCube only. The poster will summarize the status of DeepCore and prospects for the the WIMP search.

25. **Tijmen de Haan** (McGill University)
Poster: ***Calibrating the South Pole Telescope***

June 14, 2010

Tijmen de Haan, SPT collaboration
The calibration of a mm-wave telescope such as the South Pole Telescope (SPT) is a non-trivial procedure, given that the Transition Edge Sensor detectors are tuned each day, which can can result in a different gain for each of the ~700 detectors. The precipitable water vapour, although extremely low at the South pole, also absorbs a non-negligible fraction of astrophysical signals. I will explain the hybrid approach to calibration used in the SPT analysis pipeline, which involves a chopped thermal source located behind the secondary mirror as well as frequent observations of RCW38, a HII region located ~2 kpc away; together these yield relative detector-to-detector calibrations. I will also outline the absolute calibration, which cross-correlates the SPT maps with WMAP maps at relatively large angular scales, taking advantage of the relatively large amplitude of the primary CMB anisotropies.

26. **Colin DeGraf** (Carnegie Mellon University)
Talk: ***Small Scale Quasar Clustering from Hydrodynamic Simulations***

June 14, 2010 (4:30 PM - 4:45 PM)

Colin DeGraf
Clustering properties of quasars provides an important tool for studying typical host environments as well as properties (such as lifetime) of the quasars themselves, and the large quasar samples from surveys such as SDSS and the 2dF QSO Redshift Survey have resulted in increased investigations into both large and small scale clustering. I will present my findings on black hole clustering in cosmological hydrodynamic simulations, with particular emphasis on the mass of the groups hosting these black holes. In addition to the general dependence on redshift and luminosity, I will show how the black hole correlation function can be decomposed into two distinct components, and how the large-scale ('2-halo') component can be used as an estimator for the typical host group mass, while the small-scale ('1-halo') component shows significant bias relative to galaxy clustering as a result of galaxy mergers, consistent with recent small-scale clustering observations.

27. **Neelam Dhanda** (Michigan State University)
Poster: ***Galaxy Cluster survey power in light of mass-observable scatter evolution and constraints on Modified Gravity***

June 15, 2010

Neelam Dhanda, David A. Ventimiglia, G. Mark Voit
We study the power of next-generation cluster surveys (such as eROSITA) in constraining the cosmological parameters and especially the growth history of the Universe, using the information from galaxy cluster redshift and mass-function evolution and from Cluster Power Spectrum. We use the Fisher Matrix formalism to evaluate the potential for the galaxy cluster surveys to make predictions about cosmological parameters like the gravitational growth index. The primary purpose of this study has been to check whether we can rule out one or other of the underlying gravity theories in light of the present uncertainty of mass-observable relations and their scatter evolution.

28. **Tiziana Di Matteo** (Carnegie Mellon University)
Invited Talk: ***Structure Formation in the Early Universe: the build-up of supermassive black holes***

June 14, 2010 (3:45 PM - 4:15 PM)

Tiziana Di Matteo

29. **Benedikt Diemer** (University of Chicago)
Talk: ***Confronting Simulations and Observations of Type Ia Supernovae***

June 15, 2010 (5:00 PM - 5:15 PM)

Benedikt Diemer, Joseph P. Bernstein, George C. Jordan IV, Daniel Kasen, Rick Kessler, and Don Q. Lamb
Observations using Type Ia supernovae led to the discovery of dark energy and are one of the most promising methods for determining its properties. Most scientists believe that in order to use them as a reliable distance indicator we need to develop a much more accurate understanding of the underlying mechanisms. The Flash Center has begun a systematic and comprehensive program to test all current models of Type Ia supernovae, using large-scale 2D and 3D simulations and high-quality light curves and spectra obtained by the SDSS-II Supernova Survey team and its collaborators. We describe the first results of comparisons between 2D simulations and data-driven models of Type Ia supernovae. We highlight the effect of viewing angle on observable properties, including the Philips relation.

30. **Jörg P Dietrich** (University of Michigan)
Poster: ***Cosmology with the shear-peak statistics***

June 15, 2010

Jörg Dietrich, J. Hartlap
Weak-lensing searches for galaxy clusters are plagued by low completeness and purity, severely limiting their usefulness for constraining cosmological parameters with the cluster mass function. A significant fraction of 'false positives' are due to projection of large-scale structure and as such carry information about the matter distribution. We demonstrate that by constructing a "peak function", in analogy to the cluster mass function, cosmological parameters can be constrained. To this end we carried out a large number of cosmological N-body simulations in the Omega_m-sigma_8 plane to study the variation of this peak function. We demonstrate that the peak statistics is able to provide constraints competitive with those obtained from cosmic-shear tomography from the same data set. By taking the full cross-covariance between the peak statistics and cosmic shear into account, we show that the combination of both methods leads to tighter constraints than either method alone can provide.

31. **Megan Donahue** (Michigan State University)
Invited Talk: ***Baryon Fractions in Clusters of Galaxies***

June 15, 2010 (11:00 AM - 11:30 AM)

Megan Donahue
The baryon mass fraction of clusters of galaxies is relevant to cosmology and our understanding of galaxy formation. I will review the status of baryon fraction measurements in clusters of galaxies. I will present recent observations of clusters and groups and introduce the recently-announced Multi-Cycle HST Treasury Program targeting massive clusters of galaxies.

32. **Emily R Drabek** (Fermi National Accelerator Laboratory)
Poster: ***Spectroscopy Of Two Strong Lensing Clusters***

June 15, 2010

Emily Drabek, E. Buckley-Geer, H. Lin, S. Allam, J. Kubo, T. Diehl, D. Tucker, D. Kubik, J. Annis
Two strong lensing systems, characterized by rich clusters with prominent blue arcs, were found in the Sloan Digital Sky Survey (SDSS). These systems, known as SDSS J1439+32 and SDSS J1343+41, had follow-up spectroscopic observations with the Mayall 4m telescope at Kitt Peak National Observatory. Using multi-slit spectroscopy, we measured the redshifts of the cluster member galaxies. Based on these redshifts, we will present the velocity dispersions of the clusters as well as estimates of the dynamical masses of the clusters.

33. **Jon Dudley** (McGill University)
Poster: ***Cosmological Parameter Estimation from Galaxy Cluster Abundances***

June 15, 2010

Jon Dudley, SPT Collaboration
In this presentation I will describe the current status of cosmological parameter estimation from galaxy clusters discovered by the South Pole Telescope (SPT). I will outline the cosmological cluster analysis performed in Vanderlinde et al. (2010), including the methodology involved in relating a cluster observable, in this case its SZE detection significance, with a fundamental galaxy cluster property, such as its mass. By using the measured abundances of galaxy clusters as a function of both mass and redshift (acquired through optical follow-up) we are able to constrain cosmological parameters. The current MCMC pipeline utilized in this analysis will be described along with future plans to include both optical and X-ray follow-up observations in this analysis.

34. **Cora Dvorkin** (KICP/University of Chicago)
Talk: ***Generalized Slow Roll for Large Power Spectrum Features***

June 14, 2010 (9:15 AM - 9:30 AM)

Cora Dvorkin
I will show an approximation for calculating the curvature power spectrum that is well-suited for order unity deviations in power caused by sharp features in the inflaton potential. As an example, I will show that predictions for a step function potential, which has been proposed to explain order unity glitches in the CMB temperature power spectrum at multipoles l=20â^'40, are accurate at the percent level. In this approach, there is a single source function that is responsible for observable features, and this function is simply related to the local slope and curvature of the inflaton potential. These properties make this approximation useful for model-independent studies of features, both large and small, in the observable power spectrum. In particular, the source function can be parametrized by a set of principal component (PC) basis functions, and Markov Chain Monte Carlo (MCMC) likelihood analysis can be used to determine joint constraints on the principal component amplitudes and cosmological parameters.

35. **Scott Fallows** (University of Minnesota)
Talk: ***The future of CDMS***

June 14, 2010 (12:00 PM - 12:15 PM)

Scott Fallows, Matthew Fritts, The CDMS Collaboration
The next phase of the Cryogenic Dark Matter Search is already underway at the Soudan Underground Lab. Two new detector designs are planned for SuperCDMS, each 2.5 times thicker and with improved phonon reconstruction performance. The first type has been in use since late 2009, and analysis of data from its first run is in progress. The second type is planned for installation this summer and features interleaved charge channels that should dramatically reduce the experiment's dominant background. I will describe these new detectors and their benefits in the context of background reduction.

36. **Wenjuan Fang** (University of Michigan)
Poster: ***Anisotropic Extinction Distortion of the 3D Galaxy Correlation Function***

June 15, 2010

Wenjuan Fang (University of Michigan), Lam Hui (Columbia University), Morgan May (Brookhaven National Lab)
Besides peculiar velocities and gravitational lensing--via the magnification bias, the two-point galaxy correlation function in redshift space will also be anisotropically distorted by extinction from dust in galactic haloes. We perform a study of the anisotropic features in the galaxy correlation function caused by all the three effects, focusing on those induced by dust extinction and their comparison with those from magnification bias, and estimate the effect of dust extinction on Baryon Acoustic Oscillation measurements from both the angular-averaged (the monopole) and the line-of-sight galaxy correlation function. I will show the results in this presentation.

37. **Marzieh Farhang** (University of Toronto, CITA)
Talk: ***Measuring the Amplitude of Gravitational Waves by CMB Experiments***

June 14, 2010 (9:30 AM - 9:45 AM)

M. Farhang, J. R. Bond, O. Dore, C. B. Netterfield
The polarization of the cosmic microwave background (CMB) provides us with a unique tool to study the very early universe, the epoch of inflation. As by-products, inflation produces scalar and tensor perturbations in the metric of space-time. A divergence-free pattern in the CMB polarization, or B modes, can only be produced on large scales by these tensor perturbations and is a distinctive observable fingerprint of the inflationary epoch. Thus measuring a non-zero amplitude for the B modes r or putting a tight upper limit on it is the goal of many current and coming CMB experiments. Among the many challenges for observing these tiny signals is separating the B modes from the curl-free, much larger polarization component (E modes) for small sky maps. Due to pure geometrical effects, these two modes are mixed for partial sky observations, increasing the errors of the B modes. Several methods have been suggested to minimize this effect by clean separation of the modes. However, if the target of the measurement is only the amplitude of the B modes (and not the details of the spectrum) a map-based likelihood estimator optimally deals with this problem by naturally avoiding the E-B mixing and exploits all relevant information in the map losslessly. We argue that this method, though being computationally more expensive than other approaches, is feasible and can be the proper method of choice for r measurements. Using this method, we find the sky coverage dependence of r measurements for two different observational cases. We show that small deeply observed sky patches, especially if they are galactic- foreground-free, give the smallest errors on r.

38. **Damon Farnsworth** (University of Minnesota)
Poster: ***Radio Polarization Probes of Cosmic Large Scale Structure***

June 14, 2010

Damon Farnsworth, Lawrence Rudnick
Magnetic fields play a crucial role in the formation and evolution of large scale structure (LSS). Radio polarimetry and the Faraday rotation measure (RM) synthesis technique will soon allow us to probe the Faraday structure of magnetised plasma in galaxy clusters and cosmic filaments. While RM synthesis is very promising with the arrival of LOFAR and the forthcoming SKA, we show that it has (possibly severe) limitations. Insufficient or improper $lambda^2$ sampling can easily yield misleading results when complex Faraday structure is present, even when deconvolution of the response function is performed. We present the case of 3C33S, a radio lobe structure whose wideband WSRT 350 MHz observations yielded (apparently) unambiguous RM synthesis results. However, we show that the RM synthesis solution is incompatible with traditional polarization diagnostics such as the observed depolarization between 350 MHz and archival 1.4 GHz NVSS observations. We demonstrate that resolving complex Faraday structure, such as magnetic field reversals in the ICM/IGM will likely require the combination of low and high frequency observations such as LOFAR and ASKAP. This work was partially supported at the University of Minnesota by NSF grant AST 0607674.

39. **Robert Feldmann** (Fermi National Accelerator Laboratory)
Talk: ***The Morphological Evolution of Group Galaxies***

June 16, 2010 (9:45 AM - 10:00 AM)

Robert Feldmann
One of the major challenges in galaxy evolution is to understand the origin of galaxy morphology and to characterize the physical mechanisms that lead to its dependence on environment. In particular, the evidence that elliptical, S0 and passive spiral galaxies preferentially reside in environments of relatively high density, such as galaxy groups, suggests that density dependent processes may play an important role in driving the structural evolution. We address this question with the help of high resolution, cosmological, hydrodynamical simulations that follow the evolution of galaxies within individual galaxy groups. Specifically, we study the evolution of structure, star formation rates and gas content of the contained central and satellite galaxies and investigate which processes, such as mergers or gas accretion, lead to their morphological and spectral transformations.

40. **Matthew C Fritts** (University of Minnesota)
Poster: ***WIMP Search Results from CDMS II***

June 14, 2010

Matthew Fritts, CDMS Collaboration
The phase of the Cryogenic Dark Matter Search known as CDMS II was completed last year after 6 years of searching for WIMPs with 30 Ge and Si detectors operating in the Soudan Underground Lab. We have set the world-leading upper limit on the spin-independent WIMP-nucleon cross-section for WIMPs of mass greater than 50 GeV under standard dark matter halo assumptions, probing large sections of parameter space of interest in terms of supersymmetric models. I will describe the experiment and the WIMP-search results, and their significance.

41. **Drew Fustin** (KICP, University of Chicago)
Talk: ***Latest dark matter limits from COUPP***

June 14, 2010 (12:15 PM - 12:30 PM)

Drew Fustin
Recent results from COUPP set the world's best limit on the spin-dependent WIMP-proton cross section. While the bubble chamber technique is immune to the gamma and beta backgrounds, previous COUPP bubble chambers have suffered from a substantial alpha-decay background. However, the 4kg bubble chamber deployed in the NuMI tunnel at Fermilab demonstrated significant alpha rejection by distinguishing the acoustic signature of bubbles arising from alpha-decays from those nucleated by nuclear recoils (from neutrons or WIMPs). Once the 4kg bubble chamber is deployed in SNOLab this summer, it will probe interesting parameter space for spin-dependent interactions and will be competitive with world-leading experiments in the spin-independent sector.

42. **Natalie N Gandilo** (University of Toronto)
Poster: ***Spider: A Suborbital CMB Polarimeter***

June 14, 2010

The Spider collaboration
Spider is a long-duration balloon-borne polarimeter targeting the B-mode polarization of the Cosmic Microwave Background (CMB) at one degree resolution. Spider's ultimate goal is to detect the signature of inflationary gravity waves on the CMB B-mode polarization, and thus probe the energy scale and dynamics of the very early universe. Spider will achieve the required sensitivity to detect a primordial gravitational-wave component if the tensor to-scalar ratio of primordial fluctuations is larger than r=0.03.

43. **Amanda C Gault** (University of Wisconsin Madison)
Talk: ***The Millimeter-wave Bolometric Interferometer (MBI)***

June 14, 2010 (11:00 AM - 11:15 AM)

The MBI Collaboration
We report on the design and tests of a prototype of the Millimeter-wave Bolometric Interferometer (MBI). MBI is designed to make sensitive measurements of the polarization of the cosmic microwave background (CMB). It combines the differencing capabilities of an interferometer with the high sensitivity of bolometers at millimeter wavelengths. The prototype, which we call MBI-4, views the sky directly through four corrugated horn antennas. Future versions of MBI will have ~ 1000 antennas. These antennas have low sidelobes and nearly symmetric beam patterns, so spurious instrumental polarization from reflective optics is avoided. The MBI-4 optical band is defined by filters with a central frequency of 90 GHz. The set of baselines, determined by placement of the four antennas, results in sensitivity to CMB polarization fluctuations over the multipole range l = 150 - 270. The signals are combined with a Fizeau beam combiner and interference fringes are detected by an array of spiderweb bolometers. In order to separate the visibility signals from the total power detected by each bolometer, the phase of the signal from each antenna is modulated by a ferrite-based waveguide phase shifter. Initial tests and observations have been made at Pine Bluff Observatory (PBO) outside Madison, WI. This work was supported by NASA grants NAG5-12758, NNX07AG82G, the Rhode Island Space Grant and the Wisconsin Space Grant.

44. **Jean-Rene Gauthier** (University of Chicago/OCIW)
Talk: ***Constraining the gas content of dark matter halos***

June 16, 2010 (11:45 AM - 12:00 PM)

Jean-Rene Gauthier, Hsiao-Wen Chen, Jeremy Tinker, Jennifer Helsby
We present the results of an on-going survey of MgII absorbers in the spectra of background QSOs that are within close separation to low redshift (zsim 0.2) foreground galaxies. The aim of the survey is to characterize the cold gas content of dark matter halos. We first motivate the survey in a cosmological and galaxy formation context. We then describe the results of the survey with a particular focus on how the covering fraction of cool gas varies with galaxy properties. In addition, we present the results of a census of cool gas in the halos of Luminous Red Galaxies at zsim 0.5 and its implications for current models of galaxy formation.

45. **Megan B Gralla** (University of Chicago)
Talk: ***SZA Observations of Strong Lensing Galaxy Clusters***

June 15, 2010 (12:00 PM - 12:15 PM)

Megan Gralla, Mike Gladders, Dan Marrone, John Carlstrom, Ben Koester, Keren Sharon, Matt Bayliss, SZA Collaboration
Strong lensing selected galaxy clusters can now be reliably identified in both simulations and observations, making them ideal for testing structure formation models. The Sunyaev- Zel'dovich effect (SZE) traces the intra-cluster gas in galaxy clusters, which in turn traces the gravitational potential. Because the SZE is sensitive to the mass distribution on large scales and strong lensing is sensitive to the mass distribution in the dense central regions of clusters, observing strong lensing clusters in the SZE probes how concentrated these clusters are, which we can compare with predictions from cosmological simulations. We have observed ~ 15 clusters selected by their strong lensing signatures with the Sunyaev-Zel'dovich Array (SZA). While other studies using weak lensing as a mass tracer have found discrepancies between the observations and the simulations' predictions, we find the SZE-derived masses of these strong lensing clusters to be in reasonable agreement with what simulations predict.

46. **Loic Guennou** (Loic Guennou, LAM/visiting Scholar at Northwestern University)
Poster: ***An alternative method to constrain dark energy: Weak Lensing Tomography in the Direction of Rich Clusters***

June 15, 2010

Loic Guennou, LAm/visiting Scholar at Northwestern University, for the DAFT/FADA Collaboration
We present here the early results obtained from the American French collaboration called the Dark energy American French Team/French American DArk energy Team (DAFT/FADA). The goal of the DAFT/FADA collaboration is to carry out a weak lensing tomography survey of z = 0.4-0.9 rich clusters of galaxies. The reason for analyzing observations in the direction of clusters is that the shear signal is enhanced by about 10 over the field. Our work will eventually contain results based 91 rich clusters from the HST archive combined with ground based work to obtain photo-zs. Unlike supernovae or other methods such as cluster of galaxy counts, weak lensing tomography in the direction of clusters is purely based on geometry and does not depend on knowledge of the physics of the objects used as distance indicators. A crucial first step in carrying out this work is to determine the photo-zs of all the sheared background galaxy images. The photo-z process is a complicated task itself. This presentation, therefore, is devoted to describing our photo-z results for the first 10 clusters for which we have complete data. Weak lensing tomography carried out with these photo-zs is presented at this conference also (e.g. Murphy et al)

47. **Ravi R. Gupta** (University of Pennsylvania)
Talk: ***Constraining SN Ia Host Galaxy Properties Using Multi-wavelength Photometry***

June 15, 2010 (4:45 PM - 5:00 PM)

Ravi Gupta, Masao Sako, Charlie Conroy, Mariangela Bernardi, Laura Greggio, Matt Morris, Ben Dilday, Joshua A. Frieman, Robert C. Nichol, Mathew Smith
Observations of Type Ia supernovae are a key component of the standard cosmological model. Their luminosity-distance calibration provides evidence for the existence of dark energy, but the nature of their progenitor system remains unknown. Studying physical properties of the host galaxies can provide insight into the environment and stellar populations in which SNe Ia occur. Using the SDSS-II SN Ia sample we obtain host galaxy photometry spanning the ultraviolet, optical, and infrared bands from the GALEX, SDSS, and UKIDSS surveys, respectively. We then constrain mass and star-formation history of SN Ia host galaxies by comparing observed magnitudes to model magnitudes generated from stellar population synthesis codes. Future work with SDSS spectroscopy can be used to estimate the metallicity of these galaxies as well. Knowledge of both star formation and metallicity of host galaxies will improve our understanding of SN Ia progenitors and the diversity of their light curves.

48. **Andrew Hearin** (University of Pittsburgh)
Talk: ***The Influence of Catastrophic Photo-z Errors on Cosmology with Cosmic Shear***

June 16, 2010 (2:30 PM - 2:45 PM)

Andrew Hearin, Andrew Zentner
A goal of forthcoming imaging surveys is to use measurements of the cosmic shear due to weak gravitational lensing to constrain the properties of the dark energy. A challenge to this program is that redshifts to the lensed, source galaxies must be determined using photometric, rather than spectroscopic, information. We quantify the importance of uncalibrated photometric redshift outliers to the dark energy goals of forthcoming imaging surveys in an agnostic manner that does not assume any particular photometric redshift technique or template. We find that an outlier population of imaged galaxies whose photometric redshifts are distributed over a broad range must be limited to fewer than a fraction of 2-4 times 10^-4 for DES-, JDEM-, and LSST-like surveys. We also study the effects of outlier populations whose photo-z distributions are tightly localized about a systematically biased value. We conclude that such errors must be controlled to a per galaxy rate of 1-3 times 10^-3 to insure the induced systematic errors in dark energy parameters are rendered negligible. Additionally, we discuss the degradation of the statistical constraints on dark energy parameters induced by excising source galaxies at high and low photometric redshifts, concluding that removing galaxies with photometric redshifts greater than ~2.5 and less than ~0.3 may eliminate the influence of the most damaging catastrophic redshift outliers, with relatively a small (~ 20%) cost in statistical error.

49. **Jennifer E Helsby** (University of Chicago)
Poster: ***Title of the Presentation: An Empirical Characterization of Extended Cool Gas around Galaxies Using MgII Absorption***

June 15, 2010

Jennifer Helsby, Hsiao-Wen Chen, Jean-Rene Gauthier, Stephen A. Shectman, Ian B. Thompson, Jeremy L. Tinker
We report results of an unbiased survey of MgII absorption at z<0.5 to investigate the cool gas content of dark matter halos around known SDSS galaxies. Our sample of close QSO-galaxy pairs was selected in order to represent a wide range in galaxy luminosity and impact parameter (< 120 h^(-1) kpc). The spectroscopic sample contains measurements of 94 galaxies around 70 background QSOs (z_QSO>0.6). MgII absorption is detected in 47 of the 71 galaxies located in an 'isolated' environment, with upper limits on MgII absorption for the other 24 galaxies in the isolated sample. We confirm that there is an anticorrelation between galaxy impact parameter and rest frame absorption equivalent width, W_r(MgII 2796). There appears to be little dependence of absorber strength on galaxy color. We also report that the covering fraction of extended MgII absorbing gas is high, around ~70% for absorption W_r(MgII 2796)>= 0.3 Angstrom within R_gas.

50. **Thiem Hoang** (University of Wisconsin-Madison)
Poster: ***Improving the model of emission from spinning dust: effects of grain wobbling and transient spin-up***

June 14, 2010

Thiem Hoang, B. T. Draine, A. Lazarian
Observations continue to support the interpretation of the anomalous microwave foreground as electric dipole radiation from spinning dust grains as proposed by Draine & Lazarian. In this talk, we shall present a refinement of the original model by improving the treatment of a number of physical effects. First, we consider a {it disk-like} grain rotating with angular velocity at an arbitrary angle with respect to the grain symmetry axis (i.e., grain wobbling) and derive the rotational damping and excitation coefficients arising from infrared emission, plasma-grain interactions and electric dipole emission. The distribution function for grain angular velocity and the electric dipole emission spectrum for the disk-like grain are calculated using the Langevin equation, for cases both with and without fast internal relaxation. Our results show that for both cases, the peak emissivity of spinning dust, compared to earlier studies, increases by a factor of $sim $ 2 for the Warm Neutral Medium (WNM), the Warm Ionized Medium (WIM), the Cold Neutral Medium (CNM) and the Photodissociation Region (PDR), and by a factor sim 4 for Reflection Nebulae (RN). The frequency at the emission peak also increases by factors sim1.4 to sim2 for these media. The increased emission results from the non-sphericity of grain shape and from the anisotropy in damping and excitation along directions parallel and perpendicular to the grain symmetry axis. Second, we provide a detailed numerical study including transient spin-up of grains by single-ion collisions. The ionic impulses enhance the high-frequency tail of the emission spectrum for the CNM, WNM and WIM. In addition, we present an improved treatment of rotational excitation and damping by infrared emission.

51. **Aaron S Hoffer** (Michigan State University)
Poster: ***Brightest Cluster Galaxies in the Spitzer Archive***

June 15, 2010

Aaron S. Hoffer, Megan Donahue, R. S. Barthelemy
I will present infrared (IR) spectral energy distributions (SEDs) for a sample of brightest cluster galaxies (BCGs) in the Spitzer archive with well-measured X-ray core properties. The BCGs are a sample of X-ray clusters found in the Chandra archive, with X-ray properties such as gas temperature, density, and entropy profiles listed in the ACCEPT database (Cavagnolo et al. 2009). The SEDs include GALEX, 2MASS, and Spitzer IRAC and MIPS measurements where available. These spectral energy distributions are compared to Siebenmorgen and Krugel(2006) starburst galaxy models in the IR and Brent et al. (2008) star formation models which span the IR through the UV. The combination of GALEX UV and MIPS mid-IR measurements provide a more complete picture of unobscured and obscured star formation occuring in these systems than either of these measures alone, while the 2MASS and 3.5-4.6 micron photometry from Spitzer IRAC provide constraints on the stellar mass.

52. **Loren K Hoffman** (Northwestern University)
Poster: ***Orbital Dynamics of Galaxy Merger Remnants***

June 14, 2010

Loren K Hoffman
Since the violent relaxation in hierarchical mergers is incomplete, the distribution functions of galaxies contain a wealth of information about their formation pathways. Recent advances in integral field spectroscopy, multi-slit infrared spectroscopy, and dynamical modeling techniques have greatly improved our ability to harvest this information. There is a large body of evidence that gas-rich mergers play an important role in elliptical galaxy formation. I will discuss the physically intuitive orbital structure predicted by SPH (Gadget-2) simulations of dissipative mergers, and its tantalizing resemblance to dynamical models of some observed ellipticals. The merger model predicts a sharp kinematic transition between ~1 and 3 effective radii, highlighting the importance of large-radius spectroscopic observations in constraining galaxy formation models.

53. **Annie Hou** (McMaster University)
Poster: ***The Dynamical Evolution of Galaxy Groups***

June 15, 2010

Annie Hou, Laura C. Parker & William E. Harris
Galaxy groups are the most common environment in the local Universe. With roughly half of the present-day galaxy population in groups, this environment plays an important role in the evolution of galaxies. Groups span a wide range of dynamical states, from relaxed systems that have reached dynamical equilibrium to groups that are less-evolved and more dynamically complex. A key aspect of studying the dynamical state, and evolution of galaxy groups, is the ability to distinguish between dynamically relaxed and complex galaxy groups. We have developed a statistically reliable method to classify group dynamics and have applied this scheme to a sample of intermediate redshift galaxy groups from the Group Evolution and Environment Collaboration (GEEC) survey and to a sample of groups from the Sloan Digital Sky Survey (SDSS). We will present recent work on the dynamics of these groups and how the dynamical state correlates with the properties of the member galaxies. The ultimate goal of this work is to investigate the dynamical evolution of galaxy groups from z~1 to today, in hopes of understanding the role of dynamical state and environment on galaxy properties.

54. **Jimmy Hutasoit** (Carnegie Mellon University)
Poster: ***Neutrinos as Dark Matter Candidates***

June 14, 2010

Jimmy Hutasoit
We consider a sterile neutrino to be an unparticle, namely an "unsterile" neutrino, and study its mixing with a canonical active neutrino via a see-saw mass matrix. There is no unitary transformation that diagonalizes the mixed propagator and a field redefinition is required. The unsterile-like propagating mode features a resonance for anomalous dimension between 0 and 1/3, but the complex pole disappears when the anomalous dimension is larger than 1/3. The active-like propagating mode is described by a stable pole, but inherits a non-vanishing spectral density above the unparticle threshold. We also find that the radiative decay width of the unsterile neutrino into the active neutrino (and a photon) via charged current loops is suppressed, and this suppression weakens the bound from the X-ray or soft gamma-ray background when one considers the unsterile neutrino to be a dark matter candidate.

55. **Kenji Kadota** (University of Michigan)
Poster: ***Positrons in Cosmic Rays from Dark Matter Annihilations for Uplifted Higgs Regions in MSSM***

June 14, 2010

Kenji Kadota
We point out that there are regions in the MSSM parameter space which successfully provide a dark matter annihilation explanation for observed positron excess, while still remaining in agreement with all other data sets. This scenario can succeed without introducing any additional degrees of freedom beyond those already in the MSSM.

56. **Ryan Keisler** (University of Chicago)
Talk: ***The mm-wave Emission of Galaxy Clusters and Implications for SZE Surveys***

June 15, 2010 (10:00 AM - 10:15 AM)

Ryan Keisler
SZE surveys such as SPT and ACT are in the process of discovering hundreds of massive, high-redshift galaxy clusters. The ability to constrain cosmology with these cluster samples may be limited by uncertainties in how the SZ signal relates to mass. One such source of uncertainty is contamination of the SZ signal by mm-wave emission from member galaxies. I will present ongoing work to characterize this contamination using archival data from the IRAS, WMAP, NVSS, and GB6 surveys.

57. **Nishikanta Khandai** (Carnegie Mellon University)
Talk: ***On Detecting HI in emission at z=1***

June 16, 2010 (11:15 AM - 11:30 AM)

Nishikanta Khandai, Shiv K. Sethi, Tiziana DiMatteo, Rupert Croft
We model the distribution of Neutral Hydrogen (HI) in a large dark simulation at z $ = 1.0$. We consider three different models and use a detection strategy which stacks the 21 cm signal of sources at the peak of their line profile. We assume that we can estimate the location of the peak signal from a different survey like DEEP2 which has spectroscopic redshifts of galaxies in the redshifts under consideration. At z $ = 1$ the signal in 21cm emission of individual sources is dominated by two orders of magnitude in noise in a radio interferometer like the Giant Meter Radio Telescope (GMRT); making an individual detection in 21cm emission unlikely. With our stacking strategy we estimate that a few thousand sources will be sufficient to make a detection in HI emission at the redshifts under consideration.

58. **Rakesh Teja Konduru** (SV University Tirupati, India)
Poster: ***A new approach on space-time-matter***

June 14, 2010

Rakesh Teja Konduru
The simplest cosmological models are obtained by assuming that the large features of the universe are spatially homogeneous and are isotropic about the observer, and that can be showed from astronomical observations such as supernova and CMB radiation. In Einstein's model of universe space time curvature is appears as spherical shape. In this paper an attempt is made with certain new assumptions regarding the space time curvature. Here space time curvature due to a massive body is assumed as a cone. Those new assumptions revealed some new hidden truths regarding universe and explained what happens to universe at 0k (Kelvin) temperature.

59. **Donna Kubik** (Fermi National Accelerator Laboratory)
Poster: ***Development of an automated system to test and select CCDs for the Dark Energy Survey Camera (DECam)***

June 14, 2010

Donna Kubik for the Dark Energy Survey CCD packaging and testing team
The Dark Energy Survey Camera (DECam) will be comprised of a mosaic of 74 charge-coupled devices (CCDs). The goal of the Dark Energy Survey (DES) is to measure the dark energy equation of state parameter, w, to a statistical precision of 5% with four complementary methods. This goal sets stringent technical requirements for the CCDs. Testing a large number of CCDs to determine which best meet the DES requirements would be a very time-consuming manual task. We have developed a system to automatically collect and analyze CCD test data. The test results are entered into an online SQL database which facilitates selection of those CCDs that best meet the technical specifications for charge transfer efficiency, linearity, full well capacity, quantum efficiency, noise, dark current, cross talk, diffusion, and cosmetics.

60. **Kyler Kuehn** (Argonne National Laboratory)
Poster: ***DECam Prototype Observations for Calibration of the Dark Energy Survey***

June 14, 2010

Kyler Kuehn for the Dark Energy Survey Collaboration
The Dark Energy Survey (DES) makes use of the Dark Energy Camera (DECam) to survey approximately 1/4 of the southern sky in order to observe supernovae, galaxy clusters, baryon acoustic oscillations, and weak gravitational lensing, with the ultimate goal of obtaining unprecedented constraints on the Dark Energy Equation of State. A Prototype Dark Energy Camera (PreCam) will be fully operational more than a year prior to the start of DES, and will serve not only as a testbed for DECam hardware and software, but also as a means to make standard star calibration measurements throughout the proposed DES footprint. We describe the current status of the PreCam instrument, as well as its calibration goals and expected contribution to the overall scientific output of DES.

61. **Steve Kuhlmann** (Argonne National Laboratory)
Invited Talk: ***Challenges for Future Supernova Surveys***

June 15, 2010 (2:15 PM - 2:45 PM)

Steve Kuhlmann
Future surveys will record many thousands to millions of supernovae explosions. The challenges in using these supernovae for more precise cosmological constraints will be discussed.

62. **Erwin T Lau** (University of Chicago)
Talk: ***Shape of Intracluster Gas as Probe of Cluster Physics***

June 15, 2010 (10:15 AM - 10:30 AM)

Erwin T Lau, Andrey Kravtsov, Daisuke Nagai, Andrew Zentner, Alexey Vikhlinin
We present analysis of the three-dimensional shape of intracluster gas in clusters formed in cosmological simulations of the Lambda-CDM cosmology and compare it to the shape of dark matter distribution and the shape of the overall iso-potential surfaces. We find that in simulations with radiative cooling, star formation and stellar feedback (CSF), intracluster gas outside the cluster core is more spherical compared to non-radiative (NR) simulations, while in the core the gas in the CSF runs is more triaxial and has a distinctly oblate shape. The latter reflects the ongoing cooling of gas, which settles into a thick oblate ellipsoid as it loses thermal energy. The shape of the gas in the inner regions of clusters can therefore be a useful diagnostic of gas cooling. We find that gas traces the shape of the underlying potential rather well outside the core, as expected in hydrostatic equilibrium. At smaller radii, however, the gas and potential shapes differ significantly. In the CSF runs, the difference reflects the fact that gas is partly rotationally supported. Interestingly, we find that in non-radiative simulations the difference between gas and potential shape at small radii is due to random gas motions, which make the gas distribution more spherical than the equi-potential surfaces. Finally, we use mock Chandra X-ray maps to show that the differences in shapes observed in three-dimensional distribution of gas are discernible in the ellipticity of X-ray isophotes. Contrasting the ellipticities measured in simulated clusters against observations can therefore constrain the amount of cooling of the intracluster medium and the presence of random gas motions in cluster cores.

63. **Luke Leisman** (Calvin College)
Talk: ***Connecting Brightest Cluster Galaxies and Core Gas***

June 15, 2010 (11:30 AM - 11:45 AM)

Luke Leisman, Deborah Haarsma
In a galaxy cluster, the core of the intracluster gas distribution is often coincident with the Brightest Cluster Galaxy (BCG). The Representative XMM-Newton Cluster Structure Survey (REXCESS) provides data on 31 clusters in a sample unbiased by X-ray morphology. We imaged these clusters with the Southern Astrophysical Research (SOAR) telescope in R band to study the old stellar population in the BCG. The BCG central stellar density showed an unexpected correlation with core gas density, but only for non-cool-core clusters (Haarsma et al 2010). To study this further we are examining 92 galaxy clusters from the Archive of Chandra Cluster Entropy Profile Tables (ACCEPT) that also have optical data in the SLOAN Digital Sky Survey (SDSS). We will report on ongoing work on BCG-gas connections in this larger sample.

64. **Sam N Leitner** (University of Chicago)
Talk: ***Fuel Efficient Galaxies: Sustaining Star Forming Disks with Gas Recycling***

June 16, 2010 (9:30 AM - 9:45 AM)

Sam Leitner, Andrey Kravtsov
Late type star forming galaxies appear to be converting their gas to stars at an unsustainable rate that should lead to rapid evolution in their population. The gas infall rate that is observed in these galaxies is too small to balance the rate at which they consume gas, leading to speculation that an unobserved reservoir might be resupplying gas disks. We perform cosmological simulations of Milky Way mass halos and show that gas recycled through stellar winds can be the dominant source of fuel for star formation at late times. For the Milky Way, we find that this gas recycling, in addition to directly observed infall, can match the Galaxy's star formation rate without invoking an unobserved gas supply.

65. **Amy Y Lien** (University of Illinois at Urbana-Champaign)
Talk: ***The Cosmic Supernova Inventory from Future Sky Surveys: Cosmic Star Formation, Neutrinos, and Invisible Collapse***

June 15, 2010 (2:45 PM - 3:00 PM)

Amy Lien, Brian D. Fields, John F. Beacom
A new class of wide-field, repeated-scan optical sky surveys is coming online, and will map the sky in the time domain with unprecedented depth, completeness, and dynamic range. These surveys will obtain the cosmic supernova rate by direct counting, in an unbiased way and with high statistics (~ 10^5 events/year). Many science applications will therefore be feasible. Here, we focus on interesting applications related to star formation and supernova neutrino physics: (1) Because of the tight link between supernovae and star formation, synoptic sky surveys will provide precision measurements of the normalization and z < 1 history of cosmic star-formation rate in a manner independent of and complementary to current methods. (2) The cumulative (anti)neutrino production from all core-collapse supernovae within our cosmic horizon gives rise to the diffuse supernova neutrino background (DSNB). The observed flux depends on supernova physics, but also on the cosmic supernova history. The high precision measurement of the cosmic supernova rate will allow precise predictions of the DSNB and the observed flux will thus test supernova neutrino physics, probe optically invisible supernovae, and reveal the theoretical possibility that supernovae might collapse directly into black holes without releasing optical signals.

66. **Huan Lin** (Fermi National Accelerator Laboratory)
Poster: ***Cosmic Shear Analysis of the SDSS Stripe 82 Coadd Data***

June 15, 2010

Huan Lin, Hee-Jong Seo, Marcelle Soares-Santos, Jeff Kubo, Scott Dodelson, Jim Annis
The Sloan Digitial Sky Survey (SDSS) equatorial "Stripe 82" area has been repeatedly imaged, providing data that have been coadded to extend about 2 magnitudes fainter (down to i = 23.5) than the standard SDSS photometric depth. This coadd data set covers 270 sq. deg. and provides some 6 million galaxies with shape measurements that can be used in cosmic shear analysis. Here we present details of our Stripe 82 coadd imaging and catalog data, our procedures for shape measurement and PSF correction, and the status of our analyses to extract the cosmic shear signal from the SDSS coadd galaxy sample using both correlation function and power spectrum techniques.

67. **Christopher J MacDonald** (University of Pennsylvania)
Poster: ***Photometric Redshift Biases from Galaxy Evolution***

June 15, 2010

C.J. MacDonald & Gary Bernstein
Proposed cosmological surveys will make use of photometric redshifts of galaxies that are significantly fainter than any complete spectroscopic redshift surveys that exist to train the photo-z methods. We investigate the photo-z biases that result from known differences between the faint and bright populations: a rise in active galactic nucleus (AGN) activity toward higher redshift, and a metallicity difference between intrinsically luminous and faint early-type galaxies. We find that even very small mismatches between the mean photometric target and the training set can induce photo-z biases large enough to corrupt derived cosmological parameters significantly. Our results suggest that a metallicity shift of ~0.003 dex in an old population, or contamination of any galaxy spectrum with ~0.2% AGN flux, is sufficient to induce a 10^-3 bias in photo-z. These results highlight the danger in extrapolating the behavior of bright galaxies to a fainter population, and the desirability of a spectroscopic training set that spans all of the characteristics of the photo-z targets, i.e., extending to the 25th mag or fainter galaxies that will be used in future surveys.

68. **Felipe A Marin** (University of Chicago)
Poster: ***Modeling the Large Scale Bias of Neutral Hydrogen***

June 15, 2010

Felipe Marin, Nickolay Gnedin, Hee-Jong Seo, Alberto Vallinotto
We present analytical estimates of the large scale bias of neutral Hydrogen (HI) based on the Halo Occupation Distribution formalism. We use a simple, non-parametric model which monotonically relates the total mass of a halo with its HI mass at zero redshift; for earlier times we assume limiting models for the HI density parameter evolution, consistent with the data presently available, as well as two main scenarios for the evolution of our HI mass - Halo mass relation. We find that both the linear and the first non-linear bias terms exhibit a remarkable evolution with redshift, regardless of the specific limiting model assumed for the HI evolution. These analytical predictions are then shown to be consistent with measurements performed on the Millennium Simulation. Additionally, we show that this strong bias evolution does not sensibly affect the measurement of the HI Power Spectrum.

69. **Daniel J Matthews** (University of Pittsburgh)
Talk: ***Reconstructing Redshift Distributions with Cross-Correlations***

June 16, 2010 (2:45 PM - 3:00 PM)

Daniel J. Matthews, Jeffrey A. Newman
Many of the cosmological tests to be performed by planned dark energy experiments will require extremely well-characterized photometric redshift measurements. Current estimates are that the true mean redshift of the objects in each photo-z bin must be known to better than ~0.002(1+z) if errors in cosmological measurements are not to be degraded. A conventional approach is to calibrate these photometric redshifts with large sets of spectroscopic redshifts. However, at the depths probed by Stage III surveys (such as DES), let alone Stage IV (LSST, JDEM, Euclid), existing large redshift samples have all been highly (25-60%) incomplete, with a strong dependence of success rate on both redshift and galaxy properties. A powerful alternative approach is to exploit the clustering of galaxies to perform photometric redshift calibrations. Measuring the two-point angular cross-correlation between objects in some photometric redshift bin and objects with known spectroscopic redshift, as a function of the spectroscopic z, allows the true redshift distribution of a photometric sample to be reconstructed in detail, even if it includes objects too faint for spectroscopy or if spectroscopic samples are highly incomplete. We test this technique using mock DEEP2 Galaxy Redshift survey light cones constructed from the Millennium Simulation semi-analytic galaxy catalogs. From this realistic test, we find that the true redshift distribution of a photometric sample can, in fact, be determined accurately with cross-correlation techniques. We also compare the empirical error in the reconstruction of redshift distributions to previous analytic predictions, finding that additional components must be included in error budgets to match the simulation results.

70. **Antonio J Melgarejo** (Columbia University)
Talk: ***First results of the XENON100 detector***

June 14, 2010 (1:30 PM - 1:45 PM)

Antonio J. Melgarejo, on behalf of the XENON100 collaboration
The XENON100 experiment aims to directly detect cold dark matter particles via their collisions with Xenon nuclei. On this purpose a ultra-low background double phase (liquid-gas) xenon filled time projection chamber with a total mass of 170 kg (62 in the target region and 108 kg in the active shield) has been installed at the Gran Sasso Underground Laboratory (Italy) and is currently taking science data. The performance of the detector and its associated systems will be presented along with the most recent analysis of 11.2 days of background.

71. **Michael Milligan** (University of Minnesota)
Talk: ***The E and B Experiment (EBEX)***

June 14, 2010 (9:45 AM - 10:00 AM)

Michael Milligan, Asad M. Aboobaker, Peter Ade, Carlo Baccigalupi, Chaoyun Bao, Julian Borrill, Christopher Cantalupo, Daniel Chapman, Joy Didier, Matt Dobbs, Julien Grain, Will Grainger, Shaul Hanany, Seth Hillbrand, Johannes Hubmayr, Andrew Jaffe, Bradley Johnson, Terry Jones, Theodore Kisner, Jeff Klein, Andrei Korotkov, Sam Leach, Adrian Lee, Lorne Levinson, Michele Limon, Kevin MacDermid, Tomotake Matsumura, Xiaofan Meng, Amber Miller, Enzo Pascale, Daniel Polsgrove, Nicolas Ponthieu, Kate Raach, Britt Reichborn-Kjennerud, Ilan Sagiv, Graeme Smecher, Federico Stivoli, Radek Stompor, Huan Tran, Matthieu Tristram, Gregory S. Tucker, Yury Vinokurov, Amit Yadav, Matias Zaldarriaga
We report on the status of the E and B EXperiment (EBEX), a NASA-funded balloon-borne polarimeter designed to measure the polarization of the cosmic microwave background and foreground thermal emission from dust at high galactic latitude. EBEX will employ 1432 transition edge sensor (TES) bolometers, read out using frequency domain multiplexed SQUIDs, and will observe in three bands centered at 150, 250, and 410 GHz with 768, 384, and 280 bolometers, respectively. Polarimetry is achieved using a fixed wire grid and an achromatic half wave plate in continuous rotation on a superconducting magnetic bearing. The 1.5 meter Gregorian telescope and receiver optics produce a band-independent 8' beam. Together with a 420 square degree scan patch, EBEX provides sensitivity to angular scales from 0.2 to 5 deg, allowing a search for the primordial gravity wave B-mode signal predicted by inflation near ell ~ 100 as well as the lensing B-mode signal expected at higher ell modes. If foreground subtraction below the detector noise level can be achieved, simulations indicate that a 14-day Antarctic science flight will detect the primordial gravity wave signature if the tensor to scalar ratio r >= 0.1, or otherwise set a 2 sigma upper limit of r < 0.05. EBEX completed a 10-hour engineering test flight from Ft. Sumner, NM in June 2009.

72. **Blythe S Moreland** (University of Michigan)
Poster: ***Detecting Community Structure with Networks in MaxBCG Clusters***

June 15, 2010

Timothy McKay, Blythe Moreland
To probe the internal structure of MaxBCG galaxy clusters from the Sloan Digital Sky Survey, we take inspiration from the fields of network and graph theory where objects called nodes are connected by links that contain information about their interaction. Thus we can create a network of member galaxy nodes and link each node to every other, weighting the links with a metric that relates to the gravitational potential of the interaction. We investigate various algorithms that place galaxies in communities based on varying levels of connectivity, such that as the connectivity threshold is lowered the communities become less distinct. The peak of a modularity measurement allows us to select a community structure at which to measure various substructure indicators. In this project we look at the effectiveness of these methods and the information it provides on the characteristics of cluster substructure and its prevalence in the MaxBCG sample.

73. **Michael Mortonson** (CCAPP, Ohio State University)
Poster: ***A General Inflation Code for CMB Likelihood Analysis***

June 14, 2010

Michael Mortonson
Cosmic microwave background observations currently place interesting constraints on theories of inflation, and the precision of inflationary tests will increase greatly with upcoming data from Planck and other experiments. I will describe a new, publicly-available code that computes the primordial curvature power spectrum by integrating the inflationary mode equations for an arbitrary form of the inflaton potential. This approach has several advantages for the study of specific models of inflation over methods involving the slow roll approximation and empirical parameters such as the scalar spectral index and tensor-to-scalar ratio. The code is incorporated in CAMB for the computation of CMB angular power spectra and CosmoMC for likelihood analysis and parameter estimation, providing a simple extension of existing codes to infer constraints on inflationary parameters from a variety of cosmological data. I will present examples of constraints on models of inflation from current data and describe some possible future applications of this code.

74. **Alexander L Muratov** (University of Michigan)
Talk: ***The Cosmological Origin of The Globular Cluster Metallicity Distribution***

June 16, 2010 (9:15 AM - 9:30 AM)

Alexander L Muratov, Oleg Y Gnedin
The observed globular cluster populations of large spiral and elliptical galaxies seem to be ubiquitously bimodal in color and metallicity. At first glance, this may suggest that metal-rich and metal-poor globular clusters are two separate classes of objects, but the two groups have very similar average masses, ages, and sizes. Understanding the origin of this trend is a key to building self-consistent galaxy formation models, as globular clusters represent an early tracer of galactic star formation. We present a semi-analytical model developed in the context of hierarchical cosmology that traces globular cluster formation and dynamical evolution. We follow the mass assembly history of dark matter in several Milky Way-like simulated galaxies, and assign cold gas fractions and metallicities to the halos based on observationally motivated relations. We show that by assuming a single mechanism for massive cluster formation, the merging of gas-rich halos, the bimodal distribution naturally comes about in the hierarchical assembly framework. Blue clusters form by frequent mergers of low-mass gas-rich halos early on, while most red clusters form in a few stochastic mergers of massive, highly enriched halos. Dynamical evolution works to alter the power-law cluster initial mass function into a log-normal distribution that matches the observed Galactic population. We have explored the relevant range of adjustable model parameters, and found that bimodality as well as statistical consistency with the Galaxy is common and not strongly dependent on assumptions of the observed relations. To follow up, we are now running a new suite of cosmological hydrodynamic simulations which will resolve the formation of globular clusters directly. New n-body simulations will also provide a test to see the effectiveness of the model to describe globular cluster formation in different galactic environments.

75. **Kellen J Murphy** (Ohio University)
Poster: ***Weak lensing measurements with the HST***

June 14, 2010

Kellen Murphy, Douglas Clowe

76. **Smadar Naoz** (Northwestern University)
Talk: ***Gas in the first generation of galaxies***

June 16, 2010 (11:30 AM - 11:45 AM)

Smadar Naoz, Naoki Yoshida, Rennan Barkana, Andrei Mesinger
In recent years, the first and last chapters of the cosmic story have been unfolded. Observations of the cosmic microwave background radiation have revealed the chapter in the history of the Universe that took place only a few hundred thousand years after the Big Bang. The last chapter has been uncovered using observations of the morphology, and distribution of galaxies in the local Universe. However, the main event of the story is still missing. Basic questions regarding the transformations of the uniform early gas into the galaxies we see today, and what were the different properties of these objects, are still open. Therefore, the formation of the first galaxies is one of the most important research areas in cosmology. The estimation of the gas fraction in the first halos, using simulations and semi-analytical models, has been extensively investigated and used for various purposes. We study the gas content of halos in the early universe using both analytical calculation and high resolution hydrodynamical simulations (both the AMR and the Gadget2 simulations). We test the effect of different initial condition settings on the formation of high-z gas reach halos, by running the biggest simulations for a cosmological volume in terms of statistics. We find that before reionization, the minimum mass needed for a minihalo to keep most of its baryons throughout its formation is ~3e4 solar masses. This is consistent with the predictions from linear theory, which explain the above behavior.

77. **Sarah L Nickerson** (McMaster University)
Talk: ***Shedding Light on Dark Satellites***

June 16, 2010 (10:00 AM - 10:15 AM)

S. Nickerson, G. Stinson, H. Couchman, J. Bailin, J. Wadsley
We present a study of the satellites in orbit around an SPH, high-resolution, N-body galaxy raised in a cosmological context. The satellites' cumulative luminosity function matches closely that of our Local Group, while their cumulative mass functions uncovers an order of magnitude more dark satellites. Indeed, there exist dark satellites that are heavier than a number of luminous satellites. We find that there is more than one mechanism at work throughout their history to relieve these dark satellites of their baryons. The ultra violet background early in the Universe heats the gas enough that it has difficulty collecting in the lighter halos. Supernovae in the satellites that do form stars also heat gas and expel it. As the satellites fall into their host galaxy, tidal stripping gradually whittles away at the gas and stars while ram pressure stripping deals the final blow to separate gas cleanly from their dark matter halos. For the first time, we will apply criterion derived from these four mechanisms to the individual baryons so that the mechanisms can be studied in direct proportion to one another. We find that over their lifetime, lower mass satellites contain the cosmic fraction of baryons where ultraviolet plays a key roll, while more massive satellites contain an excess of baryons, particularly stars, where tidal and ram pressure stripping are more prominent. The key factor separating luminous and dark satellites at redshift zero turns out not to be their final mass, but the strength of the satellite's potential well at its beginning compared to the thermal energy contained in the gas in its neighborhood.

78. **Chris Orban** (Ohio State University)
Talk: ***Self-similar Bumps and Wiggles: Isolating the Evolution of the BAO Peak with Power-law Initial Conditions***

June 16, 2010 (4:30 PM - 4:45 PM)

Chris Orban (OSU) and David Weinberg (OSU)
A challenging theoretical neccessity for the next generation of surveys is the ability to precisely model the non-linear gravitational evolution of the baryon acoustic oscillations (BAO) signature in the galaxy distribution. In this study, rather than using standard LambdaCDM initial conditions, we simplify the problem to that of a powerlaw correlation function with a bump. This allows us to use self-similar scaling as a test for numerical artifacts associated with the finite box size or numerical resolution. We isolate the evolution of the BAO bump by running cosmological N-body simulations with these initial conditions, measuring the autocorrelation function, and dividing out the "background" linear-theory powerlaw. We then measure the shift of the BAO peak, and compare the evolution of the bump with the predictions of a variety of methods used in the literature to model the behavior of the BAO signature. Results are presented for both Omega_m = 1.0, Omega_DE = 0.0 (which when coupled with these initial conditions is a universe which evolves with self-similarly) and also for the more realistic case of low Omega_m, Omega_Lambda > 0. Implications for measuring the BAO signature with large-scale structure surveys are discussed.

79. **Stefania Pandolfi** (University of Rome "La Sapienza")
Poster: ***Inflation in a general reionization scenario***

June 14, 2010

Stefania Pandolfi
The recent exquisite measurements of Cosmic Microwave Background Temperature and Polarization have presented cosmologist with the opportunity of testing in iflationary physics. One of the most interesting results is that a Harrison-Z'eldovich primordial spectrum of fluctuations is now ruled out at more than 95% c.l.. However, as already pointed out by several authors, CMB constraints on cosmological parameters are usually inferred under the assumption of a instantaneous reionization scenario. Here we revisit the recent cosmological constraints from the seven year observations of the WMAP satellite adopting a more model-independent reionization scheme. We found that a HZ spectrum is well inside the 95% c.l. for the WMAP7 dataset and not excluded at more than 95% c.l. when the full CMB dataset is considered. A scale-invariant spectrum is therefore disfavored by current CMB data, but not conclusively.

80. **Molly S Peeples** (Ohio State University)
Talk: ***Can SPH correctly solve for hydrostatic equilibrium?***

June 16, 2010 (5:00 PM - 5:15 PM)

Molly Peeples, David Weinberg
Cold gas accretion into a hot halo, gas being stripped from infalling satellites, and cold gas ejected through galactic winds are all important processes in galaxy evolution. These are a few examples of where the interactions between two distinct gas phases can affect global galaxy properties. I will show that smooth particle hydrodynamics (SPH) generically fails to find the correct hydrostatic equilibrium solution for a cold dense cloud in a hot tenuous medium, leading to a cold cloud that is too compact (and therefore overdense). I will illustrate how this behavior depends on both numerical and physical parameters and on the choice of algorithm, in particular comparing SPH to the recently proposed "relative pressure" SPH (rpSPH). Finally, I will address the hydrodynamic drag force on cold clouds moving through a hot medium, which is a important potential source of numerical artifacts in simulations of galaxy formation or cluster evolution.

81. **Marco Peloso** (University of Minnesota)
Invited Talk: ***Status of Inflation***

June 14, 2010 (8:45 AM - 9:15 AM)

Marco Peloso
I will review the theoretical and experimental status of primordial inflation. 30 years after its proposal, inflation is now part of the standard cosmological picture. Key predictions (as the presence of acoustic peaks in the CMB anisotropies) have been confirmed, and major experimental advances (for instance, on non-gaussianity and primordial gravity waves) are forthcoming. These measurements will help us discriminating between competing models of inflation.

82. **Ue-Li Pen** (Canadian Institute for Theoretical Astrophysics)
Invited Talk: ***21cm cosmology***

June 16, 2010 (10:45 AM - 11:15 AM)

Ue-Li Pen, K. Masui, T. Chang, J. Peterson, P. McDonald
I review progress made in the mapping of 21cm intensity detection at z~1, and the cosmological implication for planned surveys. 21cm cosmology may enable fast, economic BAO, lensing, and gravity wave measurements.

83. **Carolyn C Peruta** (Michigan State University)
Poster: ***Galactic Chemical Evolution***

June 15, 2010

Carolyn Peruta, Brian W. O'Shea, Jason Tumlinson
I present some recent observations of old, metal-poor populations of stars in the Galactic halo, and the theoretical and numerical efforts that we are undertaking to understand said observations. Our main theoretical advance is to create a detailed population synthesis model that predicts the nucleosynthetic output of a population of stars with a given metallicity and IMF as a function of time, and to incorporate this into the Enzo AMR code. This will be used to generate detailed predictions of the chemical and dynamical histories of both stellar populations and interstellar and intergalactic gas during the formation history of Milky Way-like galaxies.

84. **Andres A. Plazas** (University of Pennsylvania)
Poster: ***DES Weak Lensig pipeline tests***

June 14, 2010

Andres A. Plazas, Gary Bernstein, Mike Jarvis
Weak Lensing (WL) is one of the most promising techniques to probe the evolution and contents of the Universe (eg., dark matter and dark energy). Future surveys, like the Dark Energy Survey (DES), allows for measuring its effect (on the few percent level) on galaxies shapes with an accuracy limited by systematic errors. Shear recovery accuracy tests must be performed on existing WL algorithms to quantify and characterize these systematics. We create simple simulated images and span different regions of the relevant parameter space (e.g., S/N, PSF asymmetries, etc) to test the core algorithm of the DES Weak Lensing pipeline. Future plans include using more realistic simulations (DC5, GREAT08) and real data.

85. **Robert V. Poltis** (SUNY at Buffalo)
Poster: ***Can primordial magnetic fields seeded by electroweak strings cause an alignment of quasar axes on cosmological scales?***

June 14, 2010

Robert V. Poltis (SUNY at Buffalo), Dejan Stojkovic (SUNY at Buffalo)
The decay of non-topological electroweak strings formed during the electroweak phase transition in the early universe may leave an observable imprint in the universe today. Such strings can naturally seed primordial magnetic fields. Protogalaxies then tend to form with their axis of rotation parallel to the external magnetic field, and moreover, the external magnetic field produces torque which forces the galaxy axis to align with the magnetic field, even if the two axis were not aligned initially. This can explain an (observed, but as of yet unexplained) alignment of the quasars' polarization vectors. We demonstrate that the shape of a magnetic field left over from two looped electroweak strings can explain the non-trivial alignment of quasar polarization vectors and make predictions for future observations.

86. **Brett Ragozzine** (Ohio University)
Talk: ***Weak Lensing Results of the Merger A1758***

June 16, 2010 (3:00 PM - 3:15 PM)

Brett Ragozzine, Douglas Clowe
Abell 1758 is a system of merging clusters and has been analyzed using weak lensing. The two convergence peaks line up with the two brightest cluster galaxies, which differs from the X-ray contours. Results of A1758 reaffirm the results of the Bullet Cluster.

87. **Rebecca R Reesman** (Ohio State University)
Talk: ***Anisotropy Signatures of Millisecond Pulsars in Diffuse Gamma Ray Emission***

June 14, 2010 (2:15 PM - 2:30 PM)

Rebecca R Reesman, Jennifer Siegal-Gaskins, Vasiliki Pavlidou, Stefano Profumo, Terry Walker
We explore the possible contribution of unresolved millisecond pulsars (MSPs) to the high-latitude diffuse gamma-ray emission and examine the anisotropy properties of this source class. The presence of a signal from dark matter annihilation in Galactic subhalos in the diffuse gamma-ray background is expected to induce a modulation in the anisotropy energy spectrum. We examine whether the contribution from MSPs could interfere with a dark matter detection by producing a similar feature.

88. **Carsten Rott** (Ohio State University / CCAPP)
Invited Talk: ***Neutrino Telescopes and the Hunt for Dark Matter***

June 14, 2010 (1:45 PM - 2:15 PM)

Carsten Rott
There is overwhelming evidence for the existence of dark matter, yet its nature remains unknown. Weakly Interacting Massive Particles (WIMPs) are theoretically well motivated and could explain the dark matter phenomenon. Astro-particle physics can provide important clues on the properties of these elusive particles through the search for messengers produced in the self annihilation or decay of dark matter. After an overview of such indirect searches, I will focus in more detail on one particular messenger, the neutrino. Neutrinos can be used to probe the dark matter self annihilation cross section by looking for annihilation signals from the Galactic dark matter halo and also test the WIMP-proton scattering cross section by search for signals from dark matter captured in the gravitational well of the Sun. I will provide an overview of the latest searches as well as an in depth look on the instruments.

89. **Farzad Sadjadi** (School of Physics & Astronomy, University of Minnesota, Twin Cities)
Talk: ***Effects of substructure distribution along the line of sight in multi-plane gravitational lensing simulations.***

June 15, 2010 (1:45 PM - 2:00 PM)

Farzad Sadjadi
I will present results from a new multi-plane gravitational lensing simulation. This computer model uses a parallelized reverse-ray-tracing approach on desktop hardware. For a given arrangement of ray sources located in a plane at high redshift, the resulting image patterns, as seen by an observer at low redshift, are calculated. Statistical analysis of these lensed image shapes are used to devise diagnostics to determine if the substructure influencing multiple lensed images is internal to the lensing galaxies and clusters or is widely distributed along the line of sight.

90. **Hee-Jong Seo** (Fermi National Accelerator Laboratory)
Invited Talk: ***High-precision predictions for the acoustic scale in the non-linear regime.***

June 16, 2010 (4:00 PM - 4:30 PM)

Hee-Jong Seo, Jonathan Eckel, Daniel Eisenstein, Kushal Mehta, Marc Metchnik, Nikhil Padmanabhan, Phillip Pinto, Ryujichi Takahashi, Martin White, Xiaoying Xu
Baryon acoustic oscillations (BAO) in large-scale structure can provide an excellent standard ruler test to measure the cosmological distance scale, such as the angular diameter distance and the Hubble parameter, and therefore dark energy properties. This requires that we understand all of the physical effects that alter the acoustic feature during the nonlinear evolution of structure. There are two important aspects of the nonlinear effects on BAO. First, the BAO signature is gradually reduced with increasing time due to nonlinear growth of density fields, redshift distortions, and possibly galaxy bias. Second, such various nonlinear effects may alter the observed acoustic scale at low redshift, relative to the linear acoustic scale derived from the CMB, which will result in a biased estimation of dark energy parameters if not accounted for. In this talk, I will present effects of such nonlinearities on BAO from N-body simulations: nonlinear growth and redshift distortions degrade the contrast of BAO while shifting BAO less than ~0.5% at z=0.3. I will also discuss the effect of halo/galaxy bias: we do not detect a shift for small biases (b <3) while we detect a shift less than 1% for large biases (b>3). I will show that the one step density-field reconstruction removes such nonlinear shifts and substantially improve the measurement errors. Finally I will shortly discuss observing BAO using 21cm emission.

91. **Amir Shahmoradi** (Michigan Tech University)
Talk: ***Gamma-Ray Bursts as Cosmological Tools***

June 15, 2010 (5:15 PM - 5:30 PM)

Amir Shahmoradi, Robert J. Nemiroff
During the past decade, there has been considerable effort in using Gamma-Ray Bursts (GRBs) as cosmological probes. GRBs are seen well beyond Type Ia supernovae, and hence hold promise as unique probes of universe density and composition -- including dark energy -- in the distant universe. To be so useful, a standard candle must be identified from measured GRB characteristics. In particular, there recently has been a flurry of reports of strong correlations among specific GRB spectral parameters and intrinsic GRB brightness. We show that data accumulated by the now-defunct Compton Gamma Ray Observatory speaks against these recently popular correlations. Specifically, we demonstrate how detector limitations and selection effects strongly bias such correlations. Based on these analyses, we speculate on which attributes of GRBs may still be valuable in cosmological studies.

92. **Charles Shapiro** (Institute of Cosmology & Gravitation (Portsmouth, UK))
Poster: ***Will Multiple Probes of Dark Energy Find Modified Gravity?***

June 15, 2010

Charles Shapiro, Scott Dodelson
Recent analyses have sought to detect deviations from general relativity using multiple cosmological data sets. We take this opportunity to test a long-standing claim about upcoming dark energy experiments: that constraints on dark energy equation of state parameters from multiple probes will not overlap if the underlying theory of general relativity is incorrect. We project constraints in the w_0-w_a plane from the four different techniques of the Dark Energy Survey in the event that the underlying true model is modified gravity. We find that the standard technique of looking for overlap has some shortcomings and propose as an alternative a Multi-dimensional Consistency Test. We use a fisher matrix approach to show that this test can be sensitive to modified gravity.

93. **Christopher D Sheehy** (University of Chicago)
Talk: ***The Keck array and BICEP2: ground based CMB polarimeters***

June 14, 2010 (11:15 AM - 11:30 AM)

Christopher D. Sheehy
The Keck array, scheduled to begin observing from the South Pole in early 2011, is a ground-based, bolometric polarimeter targeting the polarization of the cosmic microwave background radiation (CMB). It is optimized to detect the faint cosmological B-mode component of the CMB polarization that is a generic prediction of inflationary models. The initial deployment will consist of 3 monochromatic copies of the BICEP2 experiment, operating at 150 GHz in compact, pulse tube cooled cryostats. A future upgrade to Keck will add additional receivers at 100 and 220 GHz. In this presentation we discuss the performance to date of BICEP2, which has been operating since early 2010, and the prospects for Keck to detect inflationary B-modes.

94. **Sijing Shen** (McMaster University)
Poster: ***The Enrichment of the Intergalactic Medium with Adiabatic Feedback***

June 14, 2010

Sijing Shen, James Wadsley, Greg Stinson
We present a study of the chemical enrichment of the intergalactic medium (IGM) using smooth particle hydrodynamics (SPH) simulations. An adiabatic feedback mechanism is adopted, in which gas cooling is prevented in the timescale of supernova bubble expansion, and galactic winds are generated without explicit wind particles. Models for metal cooling and the turbulent diffusion are also employed, and their effects are investigated. The simulations produce the cosmic star formation histories (SFH) consistent with observations until z sim 0.5, and simultaneously the observed evolution of the universal neutral hydrogen fraction $Omega_{H I}$, suggesting that the feedback model can regulate SFR without disrupt cold gas accretion onto galaxies. We investigated the evolution of the mass and metallicities in stars and various gas phases. With decreasing redshift, metal evolve from mostly residing in the IGM to the interstellar medium (ISM), to being locked into stars. The IGM metals primarily reside in the Warm-Hot Intergalactic Medium (WHIM) throughout cosmic history, differing from most kinetic feedback wind models. We discuss its implication in the observations of metal absorption systems. The feedback model generates galactic winds most efficiently in halos with intermediate mass range 10^{10}M$_{sun}$ - $10^{11.5}$ M$_{sun}$. The decline in stellar feedback in high and low mass end is likely correlated with the star formation rate in those galaxies.Metals enable cooling which allows WHIM gas to cool onto galaxies and increases star formation. Metal diffusion allows winds to mix prior to escape, decreasing the IGM metal content in favor of gas within galactic halos and star forming gas.

95. **Tom Shutt** (Case Western Reserve University)
Invited Talk: ***Dark matter detection: living large***

June 14, 2010 (11:30 AM - 12:00 PM)

Tom Shutt
Recent advances in technology promise a radical increase in the sensitivity of searches for WIMP dark matter, and should allow a nearly complete test of supersymmetric dark matter in the next decade or so. Such efforts are complementary to the LHC. I will discuss the state of the field, including my experiment, LUX, which will be operated in the site of Ray Davis' solar neutrino experiment in the Homestake mine in South Dakota. Experiments at the scale of 10 tons more are being considered as part of the development of the proposed new DUSEL national underground physics laboratory. Such experiments would have unprecedented sensitivity, and would begin to be limited by a nearly-irreducible signal from coherent scattering of astrophysical neutrinos.

96. **Melanie Simet** (University of Chicago)
Poster: ***Weak Lensing around Clusters in SDSS Stripe 82***

June 14, 2010

Melanie Simet, Jeffrey Kubo, Scott Dodelson, James Annis, Jiangang Hao, Huan Lin, Hee-Jong Seo, Marcelle Soares-Santos
Weak lensing measurements can be used to determine galaxy cluster masses and to explore large-scale structure, both two-dimensionally (known as cosmic shear measurements) and three-dimensionally by slicing the cosmic shear data in redshift (known as tomography). We analyze a data set of clusters and background galaxies from coadded images from the Sloan Digital Sky Survey, a sample which has proportionally more background galaxies and proportionally fewer lensing clusters than the main Sloan data set in the North, in combination with photometric redshifts. We first compute the cluster mass-richness relation as a check of our method and data. Then, as a first step to tomography, we attempt to observe the change in shear with redshift around these clusters.

97. **Kyle T Story** (University of Chicago)
Poster: ***Measurements and Future Prospects of the Secondary Cosmic Microwave Background Anisotropies with the South Pole Telescope***

June 14, 2010

K.T.Story, P.A.R.Ade, K.A.Aird, B.A.Benson, L.E.Bleem, J.E.Carlstrom, C.L.Chang, H.-M. Cho, T.M.Crawford, A.T.Crites, T.deHaan, M.A.Dobbs, E.M.George, N.R.Hall, N.W.Halverson, G.P.Holder, W.L.Holzapfel, J.D.Hrubes, M.Joy, R.Keisler, L.Knox, A.T.Lee, E.M.Leitch, M.Lueker, J.J.McMahon, J.Mehl, S.S.Meyer, J.J.Mohr, T.E.Montroy, S.Padin, T.Plagge, C.Pryke, C.L.Reichardt, J.E.Ruhl, K.K.Schaffer, L.Shaw, E.Shirokoff, H.G.Spieler, Z.Staniszewski, A.A.Stark, K.Vanderlinde, J.D.Vieira, R. Williamson and O.Zahn
We present the recently released results of the first South Pole Telescope (SPT) power spectrum, and discuss prospects for the next power spectrum. In 2009, we published power spectrum measurements for the first 100 deg^2 observed by the SPT at 150 and 220 GHz. We find the power spectrum to be consistent with the standard Lambda-CDM cosmological model on large angular scales, l ~< 3000, where the primary CMB anisotropy is dominant. On smaller angular scales we see strong evidence for a point source contribution, consistent with a population of dusty star-forming galaxies. We combine the 150 and 220 GHz data to remove the majority of the point source power, and use the point source subtracted spectrum to detect Sunyaev-Sel'dovich (SZ) power at 2.6 sigma. The SZ power is observed to be lower than the power predicted by the fiducial model using WMAP5 cosmological parameters. Possible explanations for this discrepancy are that the current models over-estimate the thermal pressure of intracluster gas, or that the value of sigma_8 is currently being over-estimated. We are currently working on producing a power from 700 additional deg^2 observed by SPT at 90, 150 and 220 GHz. By using three frequency bands we expect to resolve the kinetic as well as the thermal SZ power spectrum. In addition to including more data, we are working on an improved estimator to further reduce the bandpower errors, such as optimal mode-weighting.

98. **Paul M Sutter** (University of Illinois)
Poster: ***Examining subgrid models of supermassive black holes in cosmological simulation***

June 14, 2010

Paul M. Sutter, Paul M. Ricker
While supermassive black holes (SMBHs) play an important role in galaxy and cluster evolution, at present they can only be included in large-scale cosmological simulation via subgrid techniques. However, these subgrid models have not been studied in a systematic fashion. Using a newly-developed fast, parallel spherical overdensity halo finder built into the simulation code FLASH, we perform a suite of dark matter-only cosmological simulations to study the effects of subgrid model choice on relations between SMBH mass and dark matter halo mass and velocity dispersion. We examine three aspects of SMBH subgrid models: the choice of initial black hole seed mass, the test for merging two black holes, and the frequency of applying the subgrid model. We also examine the role that merging can play in determining the relations, ignoring the complicating effects of SMBH-driven accretion and feedback. We find that the choice of subgrid model can dramatically affect the black hole merger rate, the cosmic SMBH mass density, and the low-redshift relations to halo properties. We also find that it is possible to reproduce observations without accretion and feedback, depending on the choice of subgrid model.

99. **Christy A Tremonti** (University of Wisconsin-Madison)
Invited Talk: ***The Role of Feedback in Galaxy Formation***

June 16, 2010 (8:45 AM - 9:15 AM)

Christy A Tremonti
The growth of dark matter halos is now reasonably well understood, but the physics regulating the assembly of baryons is still a subject of much debate. A crucial question is how energy is returned to the interstellar medium by stars and accreting supermassive black holes. 'Feedback' of some form is incorporated into nearly all modern numerical simulations, however, observational constraints on its implementation and impact are surprisingly few. Some of the best empirical constraints on the feedback process come from the study of it's most dramatic manifestation: galactic-scale gaseous outflows or galactic winds. I will discuss some current observations of galactic winds and low and high redshift and highlight a sample of z~0.5 galaxies where powerful feedback appears to have abruptly halted star formation.

100. **Alexander van Engelen** (McGill University)
Talk: ***On the Cosmological Baryon Fraction***

June 15, 2010 (11:45 AM - 12:00 PM)

Alexander van Engelen, Gil Holder, Kenneth Nollett
The cosmological baryon fraction could have large spatial fluctuations that would not affect primary CMB physics, if the fluctuations are part of a compensated CDM-baryon isocurvature mode. Sufficiently large baryon fluctuations would lead to asymmetric power in CMB maps due to a varying Thomson optical depth. We calculate the signature of such fluctuations in the B-mode CMB polarization, and also find constraints from light-element abundances and galaxy cluster gas fractions.

101. **Keith Vanderlinde** (McGill University)
Invited Talk: ***An SZ-selected Cluster Catalog from the South Pole Telescope***

June 15, 2010 (9:00 AM - 9:30 AM)

Keith Vanderlinde, SPT Collaboration
I will present a catalog of galaxy clusters selected by their Sunyaev-Zel'dovich decrements in a blind 200 sq deg survey of the microwave sky by the South Pole Telescope (SPT). As might be expected from an SZ survey, these clusters span a wide range in redshift, with median z=0.74. The selection function has been studied extensively, and I will show the use of such a catalog in constraining cosmological parameters.

102. **Ali Vanderveld** (Caltech/JPL)
Talk: ***Gravitational lensing with HALO***

June 16, 2010 (3:15 PM - 3:30 PM)

Ali Vanderveld
Both strong and weak gravitational lensing are powerful probes of the dark sector, assuming imaging systematics can be minimized. The best way to do this is to observe from above the atmosphere. I will discuss one recent proposal for doing so -- the balloon-borne High Altitude Lensing Observatory (HALO).

103. **Doug Watson** (Vanderbilt University)
Poster: ***A COSMIC COINCIDENCE: THE POWER-LAW GALAXY CORRELATION FUNCTION***

June 15, 2010

Douglas F. Watson, Andreas Berlind, Andrew Zentner
We model the evolution of galaxy clustering through cosmic time to investigate the nature of the observed low-redshift, nearly power-law shape of xi(r), the galaxy two-point correlation function. While xi(r) on large scales is set by the initial power spectrum, departures from a power-law are mainly governed by galaxy pair counts on small-scales, which is driven by highly non-linear processes dictating the amount of substructure present within host halos. We use an analytical model for cold dark matter halo substructure to study subhalo populations within host halos. The model provides the freedom to turn on and off various physical effects that drive substructure evolution. This enables us to quantify the roles that different dynamical processes play in the destruction of substructure and determining the shape of xi(r). We map the evolution of the correlation function through redshift in order to highlight how the shape of xi(r) depends on a delicate balance between the accretion and destruction rates of subhalos. For a fixed host halo mass threshold, xi(r) evolves from being peaked at small scales at high redshift to nearly power-law at z=0 (for low host halo masses corresponding to low-luminosity samples), which is in qualitative agreement with observations. This observed low-redshift power-law coincidence is further bolstered by running our model into the future, demonstrating that the correlation function will once again deviate from a power-law due to the continual destruction of substructure. We then show what physically-motivated parameters may be used to predict at what mass range and at what redshift a power-law can be achieved. The fact that we happen to meet these specific requirements for sub-Lstar galaxies at z~0 is purely coincidental.

104. **Matthew P Wiesner** (Northern Illinois University)
Poster: ***Studying the Properties of Distant Galaxies Using a Sample of Strong Lenses from the Sloan Digital Sky Survey***

June 14, 2010

Matthew Wiesner, Huan Lin, Elizabeth Buckley-Geer, James Annis, Sahar Allam, Jeffrey Kubo, H. Thomas Diehl, Douglas Tucker, Donna Kubik
The Sloan Bright Arcs Survey has discovered and studied instances of strong gravitational lensing using data from the Sloan Digital Sky Survey. As part of this survey, we took images of 13 gravitational lenses and gravitational lens candidates at the WIYN telescope at Kitt Peak National Observatory in 2009. Using these data, we are seeking to determine the properties of these gravitational lensing systems, including the mass and shape of the lensing galaxies, the intrinsic luminosity and shape of the lensed galaxies, the dark matter distribution associated with the lensing galaxies, the properties of the galaxy clusters of which the lensing galaxies are a part, and the properties of the background galaxies.

105. **Michael Wood-Vasey** (University of Pittsburgh)
Invited Talk: ***Supernovae and other Transients from Pan-STARRS1 and Future Surveys***

June 15, 2010 (4:00 PM - 4:30 PM)

Michael Wood-Vasey
TBD

106. **Rory M Woods** (McMaster University)
Poster: ***Cosmological Unbiased Galaxy Formation Simulations Using SPH***

June 14, 2010

Rory Woods
The McMaster Unbiased Galaxy Simulations (MUGS) is a suite of simulations that aims to better understand aspects of galaxy formation through examination of a large, unbiased sample of galaxies simulated at high resolution. The simulations are run using n-body smoothed particle hydrodynamics (SPH) with the tree-code Gasoline. This poster will present results from the first nine galaxies that have completed. Mock images of the galaxies, created using Sunrise, show that the sample lies within the observed range of relations such as color and magnitude and the Tully-Fisher relationship. As well, the simulations show the important role that merger history and spin parameter play in galactic disk creation and evolution.

107. **Jun Wu** (University of Pittsburgh)
Poster: ***Sterile neutrinos as Warm dark matter candidates***

June 14, 2010

Jun Wu
Motivated by small scale problems of the standard Lambda-CDM model, we carry out a systematic study of keV sterile neutrinos as a WDM candidate. We investigate the production processes of sterile neutrinos from the decay of the standard model (SM) vector bosons as well as from some scalar beyond the SM at the electro-weak scale. We find the SM contribution is more important and sterile neutrinos can be produced from MSW resonances. We calculate the free-streaming length of sterile neutrinos which sets up a power spectrum cut-off much larger than that of CDMs. We focus on the small scale (< 0.2 Mpc) density perturbations and analytically study their growth in linear perturbation theory. These small scale perturbation modes enter the horizon in the Radiation Dominant (R.D.) era when sterile neutrinos are still relativistic. We trace the entire history of the time evolution for these small scale modes. We find that due to the Integrated Sachs-Wolf (ISW) effect, these perturbations receive a kick right after entering the horizon, exhibit an initial growth, but eventually decay because of the free-streaming effect. Finally, we examine the influence of different distribution functions on the time evolution of density perturbations.

108. **Eva Wuyts** (University of Chicago)
Poster: ***A bright, spatially extended lensed galaxy at z = 1.7 behind the cluster RCS2 0327-1326.***

June 15, 2010

Eva Wuyts
We present the discovery of an extremely bright and extended lensed source from the second Red Sequence Cluster Survey (RCS2). RCS2 032727-132609 is spectroscopically confirmed as a giant arc and counter-image from a background galaxy at $z=1.701$, strongly-lensed by the foreground galaxy cluster RCS2 0327-1326 at $z=0.564$. The giant arc extends over $sim 38$," and has a g'-band magnitude of 19.45, making it $sim 20$ times larger and $sim 3$ times brighter than the prototypical lensed galaxy MS1512-cB58. This is the brightest lensed galaxy in the Universe known to date. Its location in the `redshift desert' provides unique opportunities to connect between the large samples of galaxies known at $zsim3$ and $zsim1$. We have collected photometry in 9 bands, ranging from u to K_s, which densely sample the rest-frame UV and optical light, including the age-sensitive 4000,AA break. A lensing model has been constructed for the system, giving a robust total magnification of $2.5pm0.2$ for the counter-image. The resolution of the imaging data is insufficient to correctly model the apparent substructure of the giant arc; we limit ourselves to an estimated total magnification of $21pm2$, based on the relative physical scales of the arc and counter-image. Fits of single-component spectral energy distribution (SED) models to the photometry result in a moderately young age, $t = 150 pm 50$,Myr, small amounts of dust, $E(B-V) le 0.15$, and an exponentially declining star formation history with textit{e}-folding time $tau = 10-100$,Myr. After correcting for the lensing magnification, we find a stellar mass of $log(mathrm{M}/mathrm{M}_odot)=10.39pm0.20$ from the arc and $log(mathrm{M}/mathrm{M}_odot)=10.24pm0.21$ from the counter-image. Allowing for episodic star formation, an underlying old burst could contain up to twice the mass inferred from single-component modeling. RCS2 032727-132609 is typical of the overall population of star-forming galaxies near this redshift in terms of its age, brightness and stellar mass. Its large magnification and spatial extent provide a unique opportunity to study the physical properties of an individual high-redshift star-forming galaxy in great detail, opening up a new window to the process of galaxy evolution between $z=1.7$ and our local Universe.

109. **Mark Wyman** (Perimeter Institute)
Talk: ***Enhanced Peculiar Velocities in Brane-Induced Gravity***

June 15, 2010 (1:30 PM - 1:45 PM)

Mark Wyman, Justin Khoury
The mounting evidence for anomalously large peculiar velocities in our Universe presents a challenge for the Lambda CDM paradigm. The recent estimates of the large scale bulk flow by Watkins et al are inconsistent at the approximately 3 sigma level with Lambda CDM predictions. Meanwhile, Lee and Komatsu have recently estimated that the occurrence of high-velocity merging systems such as the Bullet Cluster (1E0657-57) is unlikely at a 6.5 - 5.8 sigma level, with an estimated probability of 3.3 times 10^{-11} and 3.6 times 10^{-9} in Lambda CDM cosmology. We show that these anomalies are alleviated in a broad class of infrared-modifed gravity theories called Cascading Gravity, in which gravity becomes higher-dimensional at ultra large distances. These theories include additional scalar forces that enhance gravitational attraction and therefore speed up structure formation at late times and on sufficiently large scales. The peculiar velocities are enhanced by 24-34 compared to standard gravity, with the maximal enhancement nearly consistent at the 2 sigma level with bulk flow observations. The occurrence of the Bullet Cluster in these theories is approximately 10^4 times more probable than in Lambda CDM cosmology.

110. **Hsiang-Yi Karen Yang** (University of Illinois at Urbana-Champaign)
Talk: ***The Impact of Cluster Structure and Dynamical State on Scatter in the SZ Flux-Mass Relation***

June 15, 2010 (9:45 AM - 10:00 AM)

H.-Y. Karen Yang, Suman Bhattacharya, Paul M. Ricker, Paul M. Sutter
Cosmological constraints from cluster surveys rely on accurate mass estimates from the mass-observable relations. In order to avoid systematic biases and reduce uncertainties, we study the form and evolution of the intrinsic scatter about the best-fit SZ flux-mass relation using a hydrodynamics plus N-body simulation of galaxy cluster formation. We examine the assumption of lognormal scatter that is often used in self-calibration studies and detect a non-negligible positive skewness that can bias cosmological constraints. We investigate the physical origin of the scatter by correlating it with measures of cluster morphology, halo concentration, and dynamical states. We show how the scatter can be reduced by calibrations using these correlations and by combining information from X-ray followups.

111. **Amanda Yoho** (Case Western Reserve University)
Talk: ***Degree Scale Anomalies in the CMB: Localizing the Dip in the First Peak to the North Ecliptic Pole***

June 16, 2010 (5:15 PM - 5:30 PM)

Amanda Yoho, Francesc Ferrer, Glenn Starkman
Noticeable deviations from the prediction of the fiducial LCDM cosmology are found in the angular power spectrum of the CMB. Besides large-angle anomalies, the WMAP 1st year data revealed a dip in the power spectra at l=200, which was more evident in the ecliptic poles region. Using the WMAP 3-year and 5-year data release, we study the intensity and spatial distribution of this feature in order to unveil its origin and its implications for the cosmological parameters. We show that in the first, third, and fifth year WMAP data there is a substantial suppression of the first Doppler peak in a region near the north ecliptic pole.