Kavli Institute Inaugural Symposium in memory of David Schramm

December 8 - 13, 2005 Chicago, IL

http://newviews.uchicago.edu/

SYMPOSIUM ABSTRACTS

1. **Kevork Abazajian** (Los Alamos National Laboratory)
   December 11, 2005; Parallel Session: ***DM Theory/Experiment***
   TALK: **Sterile Neutrino Dark Matter**
   I will give a brief overview of early universe sterile neutrino dark matter production and perturbation growth through the linear regime. I will also present possibilities of detection of dark matter decay as well as structure formation in sterile neutrino dark matter universes.

2. **Niayesh Afshordi** (ITC, Harvard University)
   December 10, 2005; Parallel Session: ***Dark Energy Experiment/Theory***
   POSTER: **Cosmological Backreaction: the Mystery and the Myth**
   In this talk, I discuss how back-reaction of large amplitude inhomogeneities can affect the local cosmological observables. I first argue that the back-reaction of super-Hubble modes to Friedmann cosmology is severely constrained by current cosmological observations. Similarly, the possibility of a significant back-reaction due to general relativistic corrections on small scales is also ruled out at the perturbative level. However, such corrections (although unlikely) are not ruled out at the non-perturbative level, and thus could potentially be responsible for the present day acceleration of the universe.

3. **Eun-Joo Ahn** (University of Chicago)
   December 12, 2005; Parallel Session: ***Early Universe***
   TALK: **Nonthermal instant leptogenesis**
   We propose an economical model of nonthermal leptogenesis following inflation during "instant" preheating. The model involves only the inflaton field, the standard model Higgs, and the heavy "right-handed" neutrino.

4. **Eun-Joo Ahn** (University of Chicago)
   December 11, 2005; Parallel Session: ***DM Theory/Experiment***
   POSTER: **Gamma ray background from dark matter annihilation in spikes**
   We calculate the gamma ray background from dark matter annihilations in cosmological halos. We estimate the importance of evolving "Spikes", i.e. enhancements in the Dark Matter distribution around Supermassive black holes lying at the center of galaxies.

5. **Denis Allard** (University of Chicago)
   December 10, 2005; Parallel Session: ***High Energy Particles***
   TALK: **UHE nuclei propagation and the interpretation of ankle**
   We consider the stochastic propagation of high-energy protons and nuclei in the cosmological microwave and infrared backgrounds, using revised photonuclear cross-sections and following primary and secondary nuclei in the full 2D nuclear chart. We confirm earlier results showing that the high-energy data can be fit with a pure proton extragalactic cosmic ray (EGCR) component if the source spectrum is $propto E^{-2.6}$. In this case the ankle in the cosmic ray (CR) spectrum may be interpreted as a pair-production dip associated with the propagation. We show that when heavier nuclei are included in the source with a composition similar to that of Galactic cosmic-rays (GCRs), the pair-production dip is not present unless the proton fraction is higher than 85%. In the mixed composition case, the ankle recovers the past interpretation as the transition from GCRs to EGCRs and the highest energy data can be explained by a harder source spectrum $propto E^{-2.2}$-- $E^{-2.3}$, reminiscent of relativistic shock acceleration predictions, and in good agreement with the GCR data at low-energy and holistic scenarios. We also show that he two scenarii predict very different elongation rates and observables of the transition that can be compared with current and future data.

6. **Charmaine Armitage** (University of Illinois at Urbana-Champaign)
   December 11, 2005; Parallel Session: ***CMB Theory/Experiment***
   POSTER: **In Search of B-modes: Deconvolution Map-Making for CMB Polarization Observations**
   The upcoming Planck satellite will provide new cosmological information contained in precision measurements of the polarization of the Cosmic Microwave Background (CMB) anisotropies. In particular, a measurement of the B-mode polarization would probe inflationary gravitational waves. Several challenges are faced in measuring this B-mode: the signal is tiny compared to the temperature anisotropies, and it is difficult to separate the E-mode from the B-mode. Thus, we expect that polarimetry experiments will be very sensitive to beam asymmetries and stray light. Deconvolution map-making (Armitage & Wandelt 2004) removes systematic effects due to beam asymmetries by solving the maximum-likelihood map-making problem for arbitrary beams. We compare results from our method with a standard map-making method and demonstrate that the true sky is recovered with high accuracy via the deconvolution method. We also consider foregrounds and show the effects of ignoring beam asymmetries on the reconstruction of point sources.

7. **Edward A. Baltz** (KIPAC)
   December 11, 2005; Parallel Session: ***DM Theory/Experiment***
   TALK: **Measuring Dark Matter Properties at High-Energy Colliders**
   The nature of the cosmic dark matter is one of the great mysteries in physics today. The best known candidate is the neutralino, the lightest superpartner in supersymmetric extensions of the Standard Model. We investigate the ability of the Large Hadron Collider (LHC) and the proposed International Linear Collider (ILC) to measure the properties of this dark matter candidate. Of interest to astrophysics are the relic density, direct detection cross sections, annihilation cross sections, and annihilation branching ratios to the gamma ray lines. In a general 24 parameter supersymmetric model, we illustrate how well these quantities are constrained by the LHC and ILC in four benchmark supersymmetric scenarios: one each in the bulk, the focus point, the stau coannihilation, and the A resonance regions. Furthermore, we illustrate how astrophysical measurements of these quantities contribute to collider studies of the supersymmetric particle spectrum and mixing matrices.

8. **John Beacom** (Ohio State University)
   December 10, 2005; Parallel Session: ***High Energy Particles***
   TALK: **Revealing the supernova--gamma-ray burst connection with TeV neutrinos**
   Gamma-ray bursts (GRBs) are rare but powerful explosions displaying highly relativistic jets. It has been suggested that a significant fraction of the much more frequent core-collapse supernovae are accompanied by comparably energetic but mildly relativistic jets, which would indicate an underlying supernova--GRB connection. We calculate the neutrino spectra from the decays of pions and kaons produced in jets in supernovae, and show that the kaon contribution is dominant and provides a sharp break near 20 TeV, which is a sensitive probe of the conditions inside the jet. For a supernova at 10 Mpc, 30 events above 100 GeV are expected in a 10 s burst in the IceCube detector.

9. **Krzysztof Belczynski** (New Mexico State University)
*December 11, 2005; Parallel Session: **Gamma Ray Bursts***
TALK: **NS-NS versus BH-NS binaries as short GRB progenitors**
We discuss evolutionary channels leading to the formation of double compact objects. In particular special emphasis is put on NS-NS and BH-NS systems. We point out that these two populations are very different in terms of their lifetimes and merger locations around host galaxies. The differences come from the (mostly overlooked) fact that the majority of NS-NS progenitor binary systems experience one extra mass transfer episode as compared to BH-NS progenitors. The evolution leading to this last mass transfer event and its outcome were confirmed by independent detailed evolutionary calculations. The striking result is that most NS-NS mergers take place promptly after a burst of star formation and they are found within host galaxies. However, a small fraction of NS-NS (~ few percent) is formed along classical channels (without the extra mass transfer episode) and form a population of long lived systems. BH-NS systems are expected to merge on the outskirts of massive host galaxies or outside of less massive hosts with a significant time delay (~ Gyrs) since star formation. If short GRBs are connected to compact object mergers as suggested by recent observations, our models point toward BH-NS as likely short GRB progenitors, possibly with a contribution of long lived NS-NS systems.

10. **Gary Bernstein** (University of Pennsylvania)
December 10, 2005
PLENARY TALK: **Weak Gravitational Lensing**
Weak gravitational lensing offers several independent measures of dark energy and can discern changes to General Relativity. I will review the theoretical methods and sensitivity forecasts, and then give an overview of the present and future observational situation.

11. **Roger Blandford** (KIPAC, Stanford)
December 9, 2005
PLENARY TALK: **Particle Astrophysics - Progress and Prospects**
This is a time of rapid discovery in particle (or high energy) astrophysics. The Chandra and XMM-Newton satellies followeed more recently by Swift and Suzaku are changing our view of the X-ray sky. On the ground, Auger and H.E.S.S. are investigating the origins of the highest energy particles and will shortly be joined by VERITAS and GLAST. These powerful facilites are starting to answer the most fundamental questions of particle astrophysics. Some outstanding questions will be explained and discussed and prospects for answering them will be described.

12. **David J. Boersma** (UW Madison)
*December 10, 2005; Parallel Session: **High Energy Particles***
TALK: **High Energy Neutrino Observatories at the South Pole**
The Antarctic Muon and Neutrino Detector Array (AMANDA) and its successor, IceCube, are instruments for high energy neutrino astronomy which use the Antarctic ice as a detector medium. In this talk I will summarize the recent AMANDA results, the progress of the construction of IceCube and the performance of the first deployed IceCube string.

13. **Jojo Boyle** (University of Chicago, EFI/KICP)
*December 10, 2005; Parallel Session: **High Energy Particles***
POSTER: **Precision Measurements of the Composition of Galactic Cosmic Rays**
Large-area detectors on long-duration balloon flights can measure the elemental composition of galactic cosmic rays directly and with high precision approaching the 10^15 eV Knee in the energy spectrum. We shall present and discuss observations made with the TRACER instrument in an Antarctic flight in 2003. Specifically, we shall describe the individual energy spectra of heavy nuclei, from oxygen to iron, up to energies exceeding 10^14 eV, discuss the corresponding cosmic-ray abundances at the acceleration sites, and investigate the constraints placed by the direct observations on the interpretation of air-shower measurements.

14. **Latham A. Boyle** (Princeton University)
*December 12, 2005; Parallel Session: **Early Universe***
TALK: **Probing the early universe with gravitational waves**
Are inflationary gravitational waves large enough to be detected? If so, what can they teach us about the early universe? We argue that, if the scalar spectral index n_s is between 0.95 and 0.98 (in accord with current observations), then the tensor/scalar ratio r is likely to satisfy $r gtrsim 10^{-2}$. Tensor perturbations in this range should be detectable in proposed cosmic microwave-background (CMB) polarization experiments and in direct gravitational-wave searches (such as the BBO laser-interferometer mission, currently being explored by NASA). It is well known that the gravitational-wave spectrum carries information about the physics of inflation itself, but we stress that it also carries important information about the "dark age" separating the end of inflation from the beginning of big bang nucleosynthesis. We discuss how this information may be extracted by combining CMB polarization experiments with direct gravitational-wave searches.

15. **Greg Bryan** (Columbia University)
*December 12, 2005; Parallel Session: **Clusters and Galaxy Formation***
TALK: **The Formation of the First Stars**
Current cosmological models predict that the first objects to form in the universe are also the smallest. In this talk, I will discuss our understanding of the formation of the very first generation of stars. These objects, which form out of a nearly pure Hydrogen and Helium gas, ended the preceeding "dark ages" and may play an important role in reionizing the universe. Remarkably, their formation is easier to understand than present day star formation both because the initial conditions are well-prescribed and the relevant physical processes are relatively simple. I will discuss recent results from numerical simulations of the first generation of stars, and in particular examine how their radiative feedback impacts the next generation.

16. **Nicolas G. Busca** (University of Chicago)
*December 10, 2005; Parallel Session: **High Energy Particles***
POSTER: **Cosmogenic neutrinos from ultra high energy cosmic rays**
We calculate the flux of neutrinos generated by the propagation of ultra-high energy iron over cosmological distances and show that even if ultra-high energy cosmic rays are composed of heavy nuclei, a significant flux of high-energy neutrinos should be present throughout the universe. The resulting neutrino flux has a new peak at ~10^14 eV generated by neutron decay and reproduces the double peak structure due to photopion production at higher energies (~10^18 eV). Depending on the maximum energy and cosmological evolution of extremely high energy cosmic accelerators the generated neutrino flux can be detected by future experiments.

17. **Christian Y. Cardall** (Physics Division, Oak Ridge National Laboratory)
*December 11, 2005; Parallel Session: **Gamma Ray Bursts***
POSTER: **Neutrinos from Thick Gamma-ray Burst Accretion Disks**
Both the collapsar model (for long/soft bursts) and the compact object merger model (for short/hard bursts) involve the formation of an accretion disk around the black hole, facilitating the jet formation that powers the burst. A possible source of jet energy is the annihilation of neutrinos and antineutrinos emitted by the disk. Estimates of this neutrino energy input have been made in the context of thin-disk models; however, the disks are in fact thick. We go a step beyond thin-disk models by approximately computing the vertical structure of the disk, including the effects of neutrino interactions.

18. **Sean Carroll** (University of Chicago)
December 11, 2005
PLENARY TALK: **Dark Energy, or Worse?**
The universe is accelerating, and we don't know why. I'll discuss the pros and cons of the different possible explanations, and what we need to do (both theoretically and experimentally) to distinguish between them.

19. **Jacqueline Chen** (University of Chicago, KICP)
*December 10, 2005; Parallel Session: **Large Scale Structure/Lensing***
POSTER: **The Projected Radial Distribution of Galactic Satellites**
The Sloan Digital Sky Survey (SDSS) spectroscopic sample can be used to constrain the projected radial distribution of galactic satellites around isolated L* galaxies. Using mock galaxy catalogs derived from high-resolution cosmological simulations, we investigate the effects of interloper contamination and show that interlopers significantly bias the estimated slope of the projected radial distribution of satellites. In addition, the distribution of interlopers around galaxies is non-uniform in projection and in velocity space because galaxies are clustered and reside in crowded environments. We develop and test different interloper subtraction algorithms, and use the most reliable to correct for interloper contamination in analyses of observations. We find that the best fit power-law slope of the interloper-corrected surface density distribution of satellites is alpha ~ -1.7 +/- 0.1, independent of the galaxy and satellite luminosities.

20. **James R. Chisholm** (University of Florida)
*December 11, 2005; Parallel Session: **DM Theory/Experiment***
POSTER: **Clustering of Primordial Black Holes**
We investigate the spatial clustering properties of primordial black holes (PBHs). With minimal assumptions, we show that PBHs are created highly clustered. Using the peaks theory model of bias, we compute the PBH correlation function and power spectrum.

21. **Daniel J. H. Chung** (University of Wisconsin - Madison)
*December 12, 2005; Parallel Session: **Early Universe***
TALK: **Towards a Unique Inflaton Candidate in MSSM**
Based on our new analysis of reheating history of a large class of inflationary models involving the MSSM, we show that Hu Hd flat direction is the most likely candidate. The main new physics observation is that finite density effects lead to a correction of 10^12 in the reheating temperature arising from the decay of Q-balls, a class of non-topological solitons.

22. **Sarah Church** (Stanford University)
December 12, 2005
PLENARY TALK: **Future Prospect for CMB Measurements**
Recent measurements of the Cosmic Microwave Background (CMB) radiation have ushered in a new era of precision cosmology. I will summarize future prospects in this field including both CMB polarization and small-scale temperature measurements.

23. **Kim Coble** (Chicago State University)
*December 11, 2005; Parallel Session: **CMB Theory/Experiment***
POSTER: **A Characterization of Faint Radio Point Sources at Centimeter Wavelengths**
Extra-galactic point sources can be an important foreground contaminant in cosmic microwave background and Sunyaev-Zel'dovich effect experiments. We analyze deep interferometric observations obtained with the BIMA and OVRO arrays in order to characterize the spatial and flux distributions of point sources. We compute counts of mJy point source fluxes at 28.5 GHz from 93 fields centered on known massive galaxy clusters and 18 non-cluster fields, characterizing the point source distribution.

24. **Joerg M. Colberg** (Carnegie-Mellon University)
*December 10, 2005; Parallel Session: **Large Scale Structure/Lensing***
POSTER: **Quantifying the Large-Scale Structure of the Universe**
The Large-Scale Structures of Matter visible both in large galaxy redshift catalogues and in simulations of cosmic structure formation show a very complicated network, with vast voids surrounded by filaments and sheets. Measuring the topological properties of this structure has proven quite difficult, and the question of the exact composition of this structure is unsolved. We present a new method to quantify the sizes and shapes of the individual elements, of which the cosmic network is composed. We shows results obtained by applying the method to the largest and most detailed simulation of cosmic structure formation to date.

25. **Juan I. Collar** (University of Chicago)
December 13, 2005
PLENARY TALK: **Dark Matter Detection**

26. **Hael Collins** (University of Massachusetts, Amherst)
*December 12, 2005; Parallel Session: **Gravity/Branes/Strings***
TALK: **An effective theory of initial conditions in inflation**
The effective theory of an initial state is a method for encoding the effects of new physics in the short distance properties of a state. This talk provides a brief outline of the construction of an effective state and its renormalization before discussing how it is applied in the trans-Planckian problem of inflation. The effective state idea then provides a general, model-independent, parameterization of the trans-Planckian signal in the cosmic microwave background.

27. **Janet Conrad** (Columbia University)
December 11, 2005
PLENARY TALK: **Neutrino Experiments**

28. **Charlie Conroy** (University of Chicago)
*December 10, 2005; Parallel Session: **Large Scale Structure/Lensing***
POSTER: **Modeling Luminosity-Dependent Clustering from z~5 to the Present**

29. **Asantha Cooray** (UC Irvine)
*December 12, 2005; Parallel Session: **Clusters and Galaxy Formation***
TALK: **Central and Satellite Galaxies in Groups and Clusters**
In this talk, I will present some recent analytical results on the luminosity evolution of central and satelllite galaxies in groups and clusters. Physical processes such as dissipationless merging of galaxies will be discussed to explain the luminosity growth of central galaxies. Results based on SDSS will also be presented on the distribution of satellite galaxies including statistics of dwarf galaxies. These results will then be combined to explain overall statistics of the galaxy population. Some results on cosmology, from cluster population, will also be presented.

30. **Ed Copeland** (University of Nottingham)
December 10, 2005
PLENARY TALK: **Cosmic superstrings**
We investigate the formation and evolution of a network of cosmic superstrings that may have survived until today and discuss possible ways that they could be detected if we hit lucky and find they are indeed around.

31. **Tom Crawford** (University of Chicago, KICP)
*December 10, 2005; Parallel Session: **Dark Energy Experiment/Theory***
POSTER: **Cluster finding in mm-wave SZ data: Challenges and non-idealities**
In the limit of perfectly behaved galaxy clusters, perfectly behaved instruments, and perfectly behaved astrophysical contaminants, finding clusters in millimeter-wave Sunyaev-Zel'dovich data is a solved problem. In this presentation, I investigate the effects of departures from ideality in all three of these categories on the efficiency of cluster detection and the fidelity of cluster mass estimates as a function of cluster mass and redshift.

32. **Neal Dalal** (CITA)
*December 10, 2005; Parallel Session: **Large Scale Structure/Lensing***
TALK: **Density profiles of galaxy clusters using strong + weak lensing**
The density profiles of clusters may be determined robustly by combining strong- and weak-lensing measurements. Recent analyses of several lensing clusters have shown that these objects have NFW concentrations much higher than expected theoretically. Using N-body simulations, we show that the volume of universe required to find a single cluster with such a concentration is much larger than the Hubble Volume. This argues that these clusters are not described by dissipationless cold dark matter.

33. **Julianne J. Dalcanton** (University of Washington)
December 12, 2005
PLENARY TALK: **Galaxy Formation: The Big Picture**
Galaxies are one of the most effective tracers of the structure of the universe on megaparsec to kiloparsec scales. Within the context of cold dark matter theories, the basic paradigm of galaxy formation is largely worked out and is remarkably successful at predicting the spatial distribution of galaxies and their internal properties. I will give an overview of the many successes of current models, but point to the many areas where substantial discrepancies remain.

34. **Daniel De Marco** (Bartol Research Institute, University of Delaware)
*December 10, 2005; Parallel Session: **High Energy Particles***
TALK: **Combined analysis of the spectrum and anisotropies of UHECRs**
We discuss the information that can be obtained from the combined analysis of the spectrum and anisotropy of Ultra High Energy Cosmic Rays. We discuss how the present results can be improved with the data expected from the Pierre Auger Observatory.

35. **Tiziana Di Matteo** (Carnegie Mellon University)
*December 12, 2005; Parallel Session: **Clusters and Galaxy Formation***
TALK: **The Role of Black Holes in Galaxy Evolution**

36. **Jason Dick** (University of California Davis)
*December 10, 2005; Parallel Session: **Dark Energy Experiment/Theory***
TALK: **Searching in the Light for Dark Energy Density Time-variation**
With the preponderance of quintessence models to attempt to explain dark energy, it becomes challenging to decide upon an efficient parametrization to use to measure a signal of deviation from a cosmological constant. Simple parametrizations like w(a) = w_0 + w_a(1-a) will not explain a wide variety of cosmological models. Here I will describe a method of eigenmode analysis that allows the data to tell us the most efficient parametrization to use. This parametrization is model-independent and provides an efficient means of focusing upon varying dark energy that we can actually measure. We present constraints from SN, BAO and CMB data on time-variation and also the mean curvature.

37. **Long H. Duong** (University of Minnesota)
*December 11, 2005; Parallel Session: **DM Theory/Experiment***
TALK: **Event Discrimination Using ZIP Detectors**
The CDMS dark matter search at the Soudan Underground Lab has reported observing no WIMP candidates after operating two towers of 6 Ge and 6 Si ZIP detectors over a period of 74.5 live days. ZIP detectors can discriminate background events (gammas and betas) from WIMP candidates since the former are electron recoils (ER), and the latter are expected to be predominantly nuclear recoils (NR). In this talk we discuss the current discrimination efficacy of the CDMS ZIP detectors and prospects for future improvements, in particular at lower recoil energies, via use of advanced analysis techniques. We end with a status report of what may be achieved with the modified interdigitated ZIP (iZIP) design currently under investigation.

38. **Abe D. Falcone** (Pennsylvania State University)
*December 11, 2005; Parallel Session: **Gamma Ray Bursts***
TALK: **Recent Results from the Swift X-ray Telescope: Observations of Early Gamma Ray Burst Afterglows**
Swift was launched 2004 November 20. Since that time, the Burst Alert Telescope has detected approximately 2 gamma ray bursts (GRBs) per week, and the pointed instruments, including the X-ray Telescope and the Ultraviolet Optical Telescope, have slewed to a large fraction of these bursts with unprecedented speed. The prompt observation of GRB positions has allowed the X-ray telescope to study GRB afterglows at times that are several orders of magnitude earlier than past observations. Many exciting results have emerged, including X-ray afterglow detections of multiple short-hard bursts, ubiquitous flares at late times (100-10000 s) which imply delayed sporadic internal engine activity, a new canonical afterglow light curve that includes the transition from the prompt emission and multiple breaks in the power law-decay slope, as well as other new results. A summary of these recent observations and their implications will be discussed, with particular emphasis on the emergence of new phenomena in the early X-ray afterglows of long bursts.

39. **Xiaohui Fan** (University of Arizona)
December 12, 2005
PLENARY TALK: **Reionization/ Dark Ages**

40. **Chad Fendt** (University of Illinois at Urbana Champaign)
*December 11, 2005; Parallel Session: **CMB Theory/Experiment***
POSTER: **Fast, Accurate and Robust Power Spectrum Computation**
We provide a fast, accurate, robust and flexible method of calculating cosmic microwave background power spectra and transfer functions using local polynomial interpolation. This method has several important properties. First, it is extremely fast and accurate over a large volume of parameter space. Furthermore, its accuracy can continue to be improved by using a larger training set or more polynomial terms. This method is generalizable to an arbitrary number of cosmological parameters and to any range of ell-values in multipole space. For $99%$ of the 7 parameter models in our test set, we are able to calculate the TT-spectrum with error less then 1 cosmic standard deviation, the TE spectrum with error less then 1.5 cosmic standard deviations and the EE spectrum with error less then 3 cosmic standard deviations. After being initialized in a few seconds, the algorithm takes approximately 3 milliseconds to calculate the power spectra. This is approximately 4000 times faster than CAMB even for flat models. This method can be used to simultaneously calculate all scalar, tensor and lensed power spectra and all transfer functions.

41. **Jeffrey P. Filippini** (UC Berkeley)
*December 11, 2005; Parallel Session: **DM Theory/Experiment***
POSTER: **Dark Matter at 10^-45 cm^2**
The next few years will see the beginning of the next generation of experiments to directly detect WIMP dark matter. These experiments will reach an order of magnitude deeper into WIMP parameter space than current projects, probing WIMP-nucleon cross sections near 10^-45 cm^2. This is a particularly well-motivated region of parameter space for dark matter candidates in many models. Many of these candidates also show a rich interplay of physics between direct detection and accelerator searches at the LHC (and possible ILC). This poster reviews the motivation for this next stage in dark matter searches and the physics results that may come of it.

42. **Victor Flambaum** (Argonne National Lab.,University of New South Wales)
*December 12, 2005; Parallel Session: **Early Universe***
POSTER: **Variation of fundamental constants from Big Bang to atomic clocks**
Theories unifying gravity with other interactions suggest temporal and spatial variation of the fundamental "constants" in expanding Universe. I discuss effects of variation of the fine structure constant $alpha=e^2/hbar c$, strong interaction and quark mass. The measurements of these variations cover lifespan of the Universe from few minutes after Big Bang to the present time and give controversial results. There are some hints for the variation in Big Bang nucleosynthesis, quasar absorption spectra and Oklo natural nuclear reactor data. A very promising method to search for the variation of the fundamental constants consists in comparison of different atomic clocks. A billion times enhancement of the variation effects happens in transition between accidentally degenerate atomic energy levels.

43. **Ryan J. Foley** (UC Berkeley)
*December 11, 2005; Parallel Session: **Gamma Ray Bursts***
TALK: **Studying the ISM of Young Galaxies Hosting Gamma-Ray Bursts**
We will describe analysis on the ISM of GRB host galaxies through optical spectroscopy of GRB afterglows. These observations impact both our understanding of the GRB progenitor as well as unique insight into star-forming regions of young, distant galaxies. We will review the constraints on metallicity, surface density, molecular fraction, dust content and ionization state affored by these observations. We will then discuss the results for several recent GRB events with emphasis on characterizing the progenitor environment.

44. **Joseph W. Fowler** (Princeton University)
*December 11, 2005; Parallel Session: **CMB Theory/Experiment***
TALK: **The Atacama Cosmology Telescope Project**

45. **Derek B. Fox** (Penn State University)
*December 11, 2005; Parallel Session: **Gamma Ray Bursts***
TALK: **New Views of Compact Object Mergers via Short Gamma-Ray Bursts**
I will discuss the revolution in our understanding of short gamma-ray bursts that was triggered this year by the discovery of the first four afterglows of these elusive events. The existence of the short bursts as a distinct population was first suggested in 1974, and confirmed in 1993. Until now, however, the afterglow revolution that revealed the origins of long-duration gamma-ray bursts in the deaths of massive stars had passed the short bursts by. With four afterglows and seven (likely) redshifts in-hand, I will argue that the short bursts are now revealed to be the electromagnetic signatures of compact object merger events. These merger events will be a primary target population for LIGO, advanced LIGO, and other ground-based gravitational wave detectors in the next decade. I will discuss how studies of the prompt and afterglow emissions of short bursts thus provide a new view on these events, complementary to that provided by observation of their gravitational wave emissions.

46. **Aurelien A. Fraisse** (Princeton University)
*December 11, 2005; Parallel Session: **CMB Theory/Experiment***
POSTER: **Limits on Defects Formation in Hybrid Inflationary Models with Three Year Wilkinson Microwave Anisotropy Proble (WMAP) Observations**
In 2003, the emph{Wilkinson Microwave Anisotropy Probe} (WMAP) science team published unprecedented precise results on temperature fluctuations in the Cosmic Microwave Backroung (CMB). These results were precise enough to enable us to constrain the existence of topological defects in the Universe (astro-ph/0503402).

During the conference, we will present the limits on topological defects formation in hybrid inflationary models from 3-year WMAP observations, using both the measured temperature and polarization of the CMB.

We will in particular give upper limits for the value of the string scale (Gmu), the superpotential coupling in both D- and F-term inflationary models ($Lambda$ and $Kappa$), the gauge coupling in D-term inflation (g), and other limits on the energy levels of symmetry breakings for various inflationary models. Degeneracies between the defects contribution to the CMB and other cosmological parameters will also be presented.

47. **Wendy L. Freedman** (Carnegie Observatories)
December 9, 2005
PLENARY TALK: **Future of HO**

48. **Katherine Freese** (University of Michigan)
December 9, 2005
PLENARY TALK: **A Dynamical Solution to the Cosmological Constant Problem**
The large number of vacua in the stringy landscape may lead to interesting new cosmology. First, tunneling between from one vacuum to another (e.g. tunneling through a series of minima in a tilted cosine potential) provides a new mechanism for inflation: Chain Inflation. Second, a dynamical solution to the cosmological constant problem may be provided by a field with the same potential but without tunneling. After inflation, the universe reheats, and different regions of the universe fall into different minima of the potential. Domain walls shove aside higher energy vacua in favor of lower energy ones, but it is shown that this process stops before the universe can fall into very negative energy vacua. Gravitation itself provides a cutoff at a minimum vacuum energy, thereby leaving the universe with a small cosmological constant comparable in magnitude to the current vacuum energy.

49. **Josh Frieman** (University of Chicago and Fermilab)
December 11, 2005
PLENARY TALK: **Shedding Light on Dark Energy**

50. **James N. Fry** (University of Florida)
*December 10, 2005; Parallel Session: **Dark Energy Experiment/Theory***
POSTER: **Effects of Inhomogeneities on Cosmic Expansion**
I evaluate the effect of inhomogeneity on the expansion rate of the universe to Newtonian order in potential and velocity but taking into account fully nonlinear density inhomogeneities. At linear order in density, kinetic and gravitational potential energies contribute to the total energy of the universe with the same scaling with expansion factor as spatial curvature. In the strongly nonlinear regime, growth saturates, and the net effect of the inhomogeneity energy on the expansion rate remains negligible at all times. The dominant contribution comes from scales well within the horizon. In particular, inhomogeneity contributions never mimic the effects of dark energy or induce an accelerated expansion.

51. **Ghazal Geshnizjani** (UW-Madison)
*December 12, 2005; Parallel Session: **Gravity/Branes/Strings***
TALK: **Perturbations in a Regular Bouncing Universe**
We consider a simple toy model of a regular bouncing universe. The bounce is caused by an extra time-like dimension, which leads to a sign flip of the rho^2 term in the effective four dimensional Randall Sundrum-like description. We find a wide class of possible bounces: big bang avoiding ones for regular matter content, and big rip avoiding ones for phantom matter.
Focusing on radiation as the matter content, we discuss the evolution of scalar and tensor perturbations. Ruling out such a model as a realistic one, we also find that the spectrum (evaluated at Hubble crossing) is sensitive to the bounce.

52. **Michael D. Gladders** (Carnegie Observatories)
December 12, 2005
PLENARY TALK: **Galaxy Clusters and Cosmology**

53. **Nick Gnedin** (Fermilab)
*December 12, 2005; Parallel Session: **Clusters and Galaxy Formation***
TALK: **Modeling Cosmic Reionization**
I will review the recent progress in developing methods for modeling cosmic reionization on (very) small and (very) large scales.

54. **Christopher Gordon** (University of Chicago)
*December 10, 2005; Parallel Session: **Dark Energy Experiment/Theory***
TALK: **A Low Quadrupole from Inhomogenous Dark Energy**
The WMAP CMB temperature data had an anomalously low quadrupole. I discuss how a possible explanation of this is that the dark energy is not smooth on large scales. The high sound speed of dark energy would naturally explain why the suppression mainly takes place at the quadrupole. However it is necessary for the dark energy perturbations to be anti-correlated with the matter perturbations. I will discuss how this could result from the dark energy being coupled to the scalar field driving inflaton. I will also show how the dark energy perturbations can be made sufficiently large if the dark energy is pseudo-Nambu-Goldstone boson. I will also explain why this scenario does not predict a suppression in the large scale polarization perturbations and how this may be used to differentiate it from other suppression mechanisms.

55. **Anne M. Green** (University of Nottingham)
*December 11, 2005; Parallel Session: **DM Theory/Experiment***
TALK: **The first WIMPy halos**
The dark matter distribution on small (sub-galactic) scales may depend on the properties of the first generation of dark matter halos to form, which are in turn determined by the microphysics of the dark matter particles. I will discuss how collisional damping and free-streaming set the scale of the first WIMP halos and review simulations of the formation of these halos. I will also discuss their fate and the potential implications for WIMP direct and indirect detection experiments.

56. **Joseph F. Hennawi** (UC Berkeley)
*December 10, 2005; Parallel Session: **Large Scale Structure/Lensing***
TALK: **Cluster Strong Lensing**

57. **Jacqueline N. Hewitt** (MIT Kavli Institute)
December 13, 2005
PLENARY TALK: **21cm Observations of the Epoch of Reionization**
Observations of the 21cm line of neutral hydrogen have the potential to probe the processes of structure formation and reionization in a unique way, complementing other techniques in cosmology. The high redshift means that observations have to be done at frequencies of 200 MHz and below, a part of the spectrum that has not received much attention since the earliest days of radio astronomy. I will present plans for low-frequency radio arrays designed to detect and map the primordial hydrogen structures. Even a relatively modest collecting area in principle is capable of detecting the power spectrum of fluctuations and the largest "bubbles" around quasars. Larger arrays could map a broad range of structures and, through sensitive power spectrum measurements, possibly provide interesting constraints on cosmological parameters.

58. **Catherine E. Heymans** (UBC)
December 10, 2005; Parallel Session: ***Large Scale Structure/Lensing***
TALK: **A STEP towards high precision cosmology from weak gravitational lensing**
Weak gravitational lensing has shown itself to be a promising new tool for cosmology. Technically, however, it is rather challenging to detect. We require the accurate measurement of the weak shear that is induced by foreground structures on the shapes of observed galaxy images. The challenge comes in extracting this cosmological shear information from data that is subject to stronger image distortions that result from the atmosphere, telescope and camera. The unique qualities of weak lensing as a dark matter and dark energy probe demand that all technical challenges are met and overcome and for this reason the Shear TEsting Programme, STEP, began.

STEP is a large collaborative project to improve the accuracy and reliability of weak gravitational lensing measurements through the rigorous testing of shear measurement pipelines, the exchange of data and the sharing of technical knowledge. In this talk I will review the different methods currently used to detect weak lensing and present the first results from STEP on the current accuracy of each of these methods. I will conclude with a discussion on how these results impact on current and future lensing surveys.

59. **Christopher M. Hirata** (Institute for Advanced Study)
December 10, 2005; Parallel Session: ***Dark Energy Experiment/Theory***
TALK: **Superhorizon perturbations and cosmic acceleration**
There have been several recent proposals to explain the acceleration of the universe using superhorizon inhomogeneities. These models and criticisms thereof will be discussed.

60. **Shirley Ho** (Princeton University)
December 12, 2005; Parallel Session: ***Clusters and Galaxy Formation***
POSTER: **Cluster ellipticities: influence of mean density and mass fluctuation amplitude**
We investigated the influence of mean density, mass fluctuation, dark energy equation of state on the cluster ellipticities.Using dark matter simulations of different cosmological parameters, we found that there is a strong dependence of cluster ellipticities on $sigma_8$ and a weak dependence on $omega_m$. Although measuring ellipticities is a very challenging task, with the current and upcoming surveys in different wavelengths, we are expecting an ever increasing sample of clustesrs. Therefore, with large number of clusters, we maybe able to utilize the cluster ellipticties as a cosmological tool. The dependence on the parameters ($sigma_8$ and $omega_m$ is also positively correlated, which is different from cluster abundances, therefore, this will potentially break the degneracy between $omega_m$ and $sigma_8$. Results with different dark energy equation of states will also be discussed.

61. **Joerg R. Hoerandel** (University of Karlsruhe)
December 11, 2005
PLENARY TALK: **From the Knee to the toes: the Challenge of Cosmic Ray Composition**
Cosmic rays - fully ionized atomic nuclei - are the only matter from outside the solar system, which is accessible to direct investigations. The understanding of the origin of the knee in their energy spectrum at energies of a few PeV is generally assumed to be a cornerstone in the understanding of the origin of high-energy cosmic rays. The multi-component air shower experiment KASCADE addresses this question, detecting cosmic rays in the energy range from 10^14 to 10^17 eV, by simultaneous measurements of electrons, muons, and hadrons. For this purpose a detailed understanding of the interaction processes in the atmosphere is mandatory. Recent developments in the improvement of air shower models and their limitations are discussed. The analysis of the primary energy spectrum and the mass composition reveals that the knee is caused by a cut-off for the light components. Energy spectra for individual mass groups will be presented. In addition, results of an analysis of arrival directions will be discussed. In several models a transition from galactic to extragalactic cosmic radiation is expected at energies from 10^17 to 10^18 eV. This is the energy range of the KASCADE-Grande experiment, which is operated since 2003. First results of the experiment will be presented. An alternative method to investigate high-energy cosmic rays is studied within the LOPES project. The detection of radio flashes from cosmic-ray air showers is reported using low-cost digital radio receivers. The dependence of the signals on the angle with respect to the geomagnetic field and on the energy of the primary particle are discussed. It is shown, that the radiation can be understood most likely in terms of the geosynchrotron effect. The results imply that it should be possible to use this technique for the large-scale detection of cosmic rays in future experiments.

62. **David W. Hogg** (NYU)
December 12, 2005; Parallel Session: ***Clusters and Galaxy Formation***
TALK: **Galaxy clusters and environments at redshift one-tenth**
I review what is known about the relationships between galaxy properties and galaxy environments at low redshifts and comment on what it all might mean. We find that galaxy properties are most closely connected to the properties of the density measured on length scales comparable to the virial radii of the dark-matter concentrations in which they lie. Though we find a strong morphology-density relationship, it can be fully explained by the star-formation-history-density relationship; there is no morphology-density relationship at fixed color. This is hard to reconcile with the processes we think set galaxy morphologies.

63. **Gilbert Holder** (McGill University)
December 10, 2005; Parallel Session: ***Dark Energy Experiment/Theory***
POSTER: **Likelihood Methods for Galaxy Cluster Surveys**
The possibility of using an approximate likelihood method is discussed, where number counts and clustering can be self-consistently compared and survey sensitivity is conceptually straightforward to implement.

64. **Daniel Holz** (Los Alamos National Lab, University of Chicago)
December 10, 2005; Parallel Session: ***Dark Energy Experiment/Theory***
TALK: **Gravitational-wave standard sirens**
We discuss the merger of supermassive binary black holes systems as potential standard candles. We estimate how well such systems will be observed by LISA, and the likelihood of identifying the host galaxies. We also discuss the degradation due to gravitational lensing.

65. **Isobel Hook** (University of Oxford)
December 11, 2005
PLENARY TALK: **Dark Energy from Supernova Surveys**
Type Ia supernovae (SNeIa) currently provide the most direct evidence for an accelerating universe and for the existence of the Dark Energy driving this acceleration. In this talk I will review the use of SNeIa as distance indicators at high redshift for constraining the cosmological parameters. I will present recent results from new, on-going surveys including the Supernova Legacy Survey, designed specifically to measure the equation of state parameter (w) of the Dark Energy. I will also briefly describe future prospects for supernova surveys from the ground and from space.

66. **Dan Hooper** (FNAL)
December 10, 2005; Parallel Session: ***High Energy Particles***
POSTER: **Probing Exotic Physics With Ultra-High Energy Neutrinos**
I will briefly discuss some of the exotic physics scenarios that can be tested by experiments capable of observing ultra-high energy neutrinos; in particular the Pierre Auger Observatory. Such observations will allow us to study physics at center-of-mass energies well beyond those accessible collider experiments, and over extremely long baselines.

67. **Lam Hui** (Columbia University)
December 10, 2005; Parallel Session: ***Dark Energy Experiment/Theory***
TALK: **Large scale structure induced fluctuations in supernova surveys**
I will demonstrate that large scale structure induced fluctuations in luminosity distance (beyond that from gravitational lensing) constitute a surprisingly significant source of error for dark energy measurements from supernova surveys. These fluctuations appear to have been overlooked in existing forecasts.

68. **Dragan Huterer** (KICP, University of Chicago)
December 11, 2005; Parallel Session: ***CMB Theory/Experiment***
TALK: **Mysteries of the large-angle microwave sky**
Tests of isotropy of the CMB are important as they may lead to evidence for exotic particle physics models processes in the early universe, or perhaps nontrivial topology. While the measurements are generally in good agreement with the currently favored cosmological model, large-scale CMB anisotropies as measured by the WMAP experiment exhibit statistically significant and entirely unexpected correlations with directions defined by the Solar System, as well as alignments of missing power in low multipoles. I discuss these findings, their relation to other widely discussed results from the large-angle CMB, and proposals to explain them via astrophysical, instrumental or cosmological mechanisms.

69. **Peter O. Hyland** (University of Wisconsin - Madison)
December 11, 2005; Parallel Session: ***CMB Theory/Experiment***
TALK: **The Millimeter-wave Bolometric Interferometer**
MBI-4 will observe the polarization of the Cosmic Microwave Background (CMB) by combining two technologies: bolometers and interferometers. The Millimeter-wave Bolometric Interferometer - 4 (MBI-4) is a four antenna test bed for a larger future experiment. Bolometers are total power detectors capable of background limited sensitivity on the ground and in space over the millimeter-wave spectrum. Interferometers have several desirable qualities for CMB measurements. They make differencing measurements, so rapid chopping is not required and systematic effects are minimized. They directly measure Fourier modes in the EE and TT power spectra. MBI-4 views the sky with 4 corrugated horn antennas, avoiding the potential spurious polarization effects from reflective optics. The signals from these antennas are combined with a Fizeau beam combiner and interference fringes are detected by an array of cooled bolometers. The antennas have a 7 degree FOV and are spaced to give baselines with sensitivity to l-space modes between 100 and 200. MBI-4 will begin observations from Pine Bluff Observatory outside Madison, WI this winter season.

70. **Kiyotomo Ichiki** (National Astronomical Observatory, JAPAN / KICP)
*December 11, 2005; Parallel Session: **CMB Theory/Experiment***
POSTER: **Magnetic Field Generation by the Cosmological Recombination**
The presence of substantial magnetic fields in galaxies and even larger scales such as clusters of galaxies is observationally indicated. The origin of such magnetic fields with large coherent length, however, is still one of the biggest mysteries in cosmology. Here we propose a new mechanism for generation of magnetic fields. We find that cosmological density fluctuations, which explain the large scale structure of the universe and cosmic microwave background temperature anisotropies, can also produce sufficient amount of magnetic fields on the cosmological scales at the epoch of recombination if we take the second order couplings into account. These magnetic fields should inevitably exist since we do not introduce any arbitrary assumptions. The magnetic fields generated in this mechanism may affect the formation of the primordial stars in the universe and be observed through time delays in pulses of gamma rays.

71. **Bhuvnesh Jain** (University of Pennsylvania)
*December 10, 2005; Parallel Session: **Large Scale Structure/Lensing***
POSTER: **Planning Weak Lensing Surveys**

72. **Marcin Jankiewicz** (Vanderbilt University)
*December 11, 2005; Parallel Session: **DM Theory/Experiment***
POSTER: **Long-Wavelength Modes of Cosmological Scalar Fields**
We give a numerical analysis of long-wavelength modes in the WKB approximation of cosmological scalar fields coupled to gravity via $xiphi^{2}R$. Massless fields are coupled conformally at $xi=1/6$. Conformality can be preserved for fields of nonzero mass by shifting xi. We discuss implications for density perturbations.

73. **Karsten Jedamzik** (LPTA-CNRS, University of Montpellier)
*December 11, 2005; Parallel Session: **DM Theory/Experiment***
TALK: **Supersymmetric Dark Matter and the Cosmic Lithium Problems**
The primordial 7Li abundance predicted to result from a standard Big Bang nucleosynthesis at the by WMAP inferred baryonic density is a factor 2-3 larger than that inferred by observations. Furthermore, recent observations show a 6Li abundance in old stars which is only with extreme difficulty explained by hypothetical cosmic ray populations at high redshift. I show, that one or both of these problems may be understood either by gravitino dark matter produced by the decay of stau NLSPs or neutralino dark matter annihilating during the epoch of BBN. It may thus be that the primordial 7Li and 6Li abundances represent an already existing indirect detection of dark matter.

74. **Kenji Kadota** (Fermilab)
*December 11, 2005; Parallel Session: **CMB Theory/Experiment***
POSTER: **Parameterizing the Power Spectrum: Beyond the Truncated Taylor Expansion**
The power spectrum is traditionally parameterized by a truncated Taylor series, which is often justified for the simple standard slow-roll inflation models. I will argue the potential problems in its justification from the viewpoint of particle theory motivated inflation model building, and show that there are regions of parameter space, which are both theoretically and observationally relevant, for which the traditional truncated Taylor series parameterization is inconsistent, and hence it can lead to incorrect parameter estimations. Motivated by this, we propose a simple extension of the traditional parameterization, which uses no extra parameters, but that covers not only standard-slow-roll inflation models but also a much wider class of inflation models well motivated from the particle theory. The likelihood analysis for the cosmological parameters using our parameterization and traditional one is also presented for the illustration.

75. **Tina Kahniashvili** (Kansas State University)
*December 12, 2005; Parallel Session: **Early Universe***
TALK: **Effects of primordial helicity and detection possibilities**
I present a short review of primordial helicity effects which may provide a measure of CP violation in the early Universe. In particular, I discuss (i) circular polarization of relic gravitational waves induced by primordial helicity; (ii) the imprint of cosmological magnetic helicity on Cosmic Microwave Background (CMB) temperature and polarization anisotropies, and (iii) the possibilty of the detection of magnetic helicity using correlators of the arrival velocities of charged cosmic rays from known sources. The talk is based on following our papers: 1. T. Kahniashvili and T. Vachaspati, "On the detection of magnetic helicity", (2005), in preparation; 2. T. Kahniashvili, G. Gogoberidze, and B. Ratra, PRL, 95, 151301 (2005); 3. T. Kahniashvili and Ratra, PRD, 71, 103006, (2005); 4. A. Kosowsky, T. Kahniashvili, G. Lavrelashvili, and B. Ratra, PRD, 71, 043006 (2005); 5. C. Caprini, R. Durrer, and T. Kahniashvili, PRD, 063006, (2004).

76. **Manoj Kaplinghat** (University of California, Irvine)
*December 11, 2005; Parallel Session: **CMB Theory/Experiment***
TALK: **Early Reionization and Dark Matter Physics**
I will discuss signatures of reionization in the Cosmic Microwave Background and how it is important for understanding the primordial power spectrum and the nature of dark matter.

77. **Darin Kinion** (LLNL)
*December 11, 2005; Parallel Session: **DM Theory/Experiment***
TALK: **Results from the Axion Dark-Matter Experiment (ADMX)**
Axions arising from the Peccei-Quinn solution to the Strong-CP Problem in QCD are a promising CDM candidate. Since 1996, the Axion Dark Matter eXperiment (ADMX) has been searching for galactic-halo axions using the Sikivie microwave cavity technique. The detector uses a microwave cavity permeated by a strong static magnetic field. Axions that enter the cavity convert to microwave photons when the cavity is resonant with the axion total energy. A sensitive microwave receiver is used to detect this signal above the thermal noise background. We will present an overview of the experiment and discuss the latest results excluding KSVZ axions over nearly an octave in mass. These results include limits on non-thermalized halo axions, which allow for very sharp (mHz) features in the cavity emission spectrum.

78. **Jason E. Koglin** (Columbia Astrophysics Laboratory)
*December 11, 2005; Parallel Session: **DM Theory/Experiment***
TALK: **Indirect Dark Matter Search with Antideuterons: Progress and Future Prospects of GAPS**
I discuss the experimental prospects for an indirect dark matter search exploiting antideuterons, which can be synthesized through annihilation. Many supersymetry models, as well as other models based on extra dimensions, predict a primary antideuteron flux from dark matter annihilation that is much greater than the secondary and tertiary background sources at low energies. The General Antiparticle Spectrometer (GAPS) method involves capturing antiparticles in a target material into excited energy states. The X-rays that are emitted as the antiparticle cascades to lower energy states before the exotic atom decays serve as a fingerprint that uniquely identifies the mass of the captured antiparticle. This approach provides large area and field of view in addition to excellent background rejection capability. Analysis of the performance of a prototype GAPS tested in an antiproton beam at the KEK accelerator in Japan in 2004 and 2005 will be presented. Future prospects for a GAPS balloon mission sufficiently sensitive to begin exploring many dark matter models will also be described.

79. **Katharina Kohler** (University of Colorado and Fermi Lab)
*December 10, 2005; Parallel Session: **Large Scale Structure/Lensing***
POSTER: **Large Scale Reionization**
We use cosmological simulations to explore the large-scale effects of reionization. To approximate the radiative transfer in the simulation we use clumping factors derived from small scale simulations. This allows us to construct synthetic spectra of quasars similar to observed spectra of SDSS quasars at high redshifts and compare them to observational data. These spectra can then be analyzed for HII region sizes, the presence of the Gunn-Peterson trough and the Lyman-$alpha$ forest.

80. **Rocky Kolb** (Chicago/Fermilab)
December 13, 2005
PLENARY TALK: **Summary of Symposium**

81. **Arthur Kosowsky** (University of Pittsburgh)
*December 11, 2005; Parallel Session: **CMB Theory/Experiment***
TALK: **Gravitational Waves and the Microwave Background**
Gravitational wave perturbations from an inflationary phase in the early universe leave a distinctive imprint in the polarization of the cosmic microwave background radiation. I will describe this signature and discuss theoretical predictions of its amplitude. Future detection prospects will be briefly reviewed.

82. **Savvas M. Koushiappas** (Los Alamos National Laboratory)
*December 12, 2005; Parallel Session: **Clusters and Galaxy Formation***
POSTER: **Testing models of supermassive black hole formation with gravity wave experiments**
The detection of gravity waves will open a new window with which to observe the high redshift Universe. I will discuss how gravity wave detectors can be used to yield important information about the formation and subsequent evolution of supermassive black holes at high redshift. The detection of a gravity wave background from the hierarchical merging of black hole seeds will yield information about their relative abundance and the efficiency of merging, thus providing insight into galaxy formation processes.

83. **Marek P. Kowalski** (LBNL)
*December 10, 2005; Parallel Session: **Dark Energy Experiment/Theory***
TALK: **Decelerating and Dustfree: Targeting SNe in Very High Redshift Galaxy Clusters**
We present a novel approach to obtaining Type Ia supernovae (SNe Ia) at very high redshifts (z>1). In a 219 orbit cycle 14 program, we are using the Advanced Camera for Surveys (ACS) and NICMOS on the Hubble Space Telescope (HST) to repeatedly observe massive galaxy clusters at z>1 to find and follow SNe. Clusters of galaxies are known to be dominated by nearly dust-free early type galaxies. SNe discovered in these galaxies are expected to have negligible dust extinction, the largest source of both statistical and systematic uncertainty in SNe derived distances. In addition, galaxy clusters contain a population of early type galaxies at a density approximately five times that in the high redshift field, leading to a much higher rate of detection of SNe Ia in this well-understood host environment. With 20 scheduled half-nights on the Subaru telecope as well as multiple nights on the Keck telescope, we are obtaining spectroscopic confirmation and redshift of newly discovered SNe and their hosts. This data will significantly improve supernova constraints of dark energy both in terms of statistical uncertainty, and perhaps more importantly, of systematic uncertainty. This sample of more than 20 galaxy clusters is also being studied for weak lensing, galaxy morphology, and color-magnitude relationship, as part of an entire program of cluster studies.

84. **Lawrence M. Krauss** (Case Western Reserve University)
December 9, 2005
PLENARY TALK: **David Schramm's life and legacy**

85. **Don Q. Lamb** (University of Chicago)
December 9, 2005
PLENARY TALK: **Solution to the Greatest Remaining Mystery About GRBs: The Nature of Short GRBs**

86. **David L. Larson** (University of Illinois at Urbana-Champaign)
*December 11, 2005; Parallel Session: **CMB Theory/Experiment***
POSTER: **Hot and Cold Spot Tests for non-Gaussianity in the WMAP CMB Data**
We check the Cosmic Microwave Background (CMB) data for non-Gaussianity with a detailed statistical analysis of the one and two-point properties of the local extrema in the WMAP (Wilkinson Microwave Anisotropy Probe) data. For the one-point functions, our previous work found that the simple white noise model indicated a 95% detection of non-Gaussianity in the mean temperature of the hot and cold spots: the hot and cold spots are not hot and cold enough. We have tested this with simulated noise and have found this result to be dependent on the noise model. In an analysis where we smooth to remove that dependence, we find a 99.7% detection in one of the two-point functions.

87. **Davide Lazzati** (JILA - University of Colorado)
*December 11, 2005; Parallel Session: **Gamma Ray Bursts***
TALK: **Gamma-Ray Bursts as standard candles**
It has been recently discovered that very tight correlations exist between spectral and energetical properties of long GRBs. Those correlations allow us to derive the intrinsic burst luminosity independently from redshift and therefore to construct a GRB Hubble diagram, on which cosmological models can be tested. I will discuss the power of this test, its intrinsic limitations and sources of systematic error and the present status of the data. I will compare it to other cosmological tests such as Type Ia supernovae, CMB maps, clusters of galaxies and micro-lensing surveys. I will show that the GRB Hubble diagram is a powerful and complementary test to most of them.

88. **Robyn Levine** (University of Colorado & Fermilab)
*December 12, 2005; Parallel Session: **Clusters and Galaxy Formation***
POSTER: **Formation of Supermassive Black Holes**
Observations such as the M-sigma relation provide evidence that the formation of supermassive black holes and their host galaxies are intrinsically linked. In order to understand how supermassive black holes form in the context of galaxy formation and cosmology, it is necessary to conduct studies on a large range of scales simultaneously. The technique of Adaptive Mesh Refinement (AMR) provides us with a large enough dynamical range to follow the transport of matter from cosmological scales all the way down to the edge of the accretion disk of a supermassive black hole. We address some of the issues encountered using AMR in cosmological simulations to study the formation of supermassive black hole.

89. **Eugene A. Lim** (Yale University)
*December 12, 2005; Parallel Session: **Early Universe***
TALK: **Gravity Waves from Preheating**
At the end of inflation, couplings of the inflaton to one or matter fields interact non-thermally to selectively excite some modes. This very non-equilibrium process will generically produce a non-scale invariant spectrum of gravity waves which may be detectable with future experiments such as the Big Bang Observer, providing us with an additional probe to constraint inflationary models.

90. **Arthur Lue** (University of Texas at San Antonio)
*December 10, 2005; Parallel Session: **Dark Energy Experiment/Theory***
TALK: **Differentiating Dark Energy from Modified Gravity**
The nature of the fuel that drives today's cosmic acceleration is an open and tantalizing mystery. I entertain the suggestion that the acceleration is not the manifestation of yet another new ingredient in the cosmic gas tank, but rather our first real lack of understanding of gravitational physics. I discuss questions about differentiating modified-gravity cosmologies from dark energy at astrophysically interesting, and even solar sytem, scales.

91. **Zhaoming Ma** (University of Chicago)
*December 10, 2005; Parallel Session: **Large Scale Structure/Lensing***
POSTER: **Effect of Photo-z on Baryon Oscillations**
I will discuss the effect of photometric redshift errors on the dark energy parameter constraints from baryon acoustic oscillations.

92. **Felipe A. Marin Perucci** (University of Chicago)
*December 11, 2005; Parallel Session: **DM Theory/Experiment***
POSTER: **Three-point correlation function from cosmological simulations**
We present results of the three-point correlation function (3PCF) for a galaxy sample constructed from a dark matter cosmological simulation. Since we have luminosity and color information about the galaxies of this sample, we can compare our results with those from SDSS or 2dFGRS, and also get information about the bias of galaxies with respect to the dark matter. We find that our results agree in general with the surveys measurements, and find interesting dependance of the 3PCF in galaxy properties.

93. **Crystal Martin** (UC Santa Barbara)
*December 12, 2005; Parallel Session: **Clusters and Galaxy Formation***
TALK: **Cold Outflows from Ultraluminous Galaxies**
Galaxy formation follows a landscape defined by the large scale structure of the universe, but gravity alone does not predict the properties of galaxies or the enrichment history of the intergalactic medium. The astrophysics of star formation and gas reheating, i.e. feedback, also play central roles. Empirical "recipes" have been instrumental for characterizing these complex processes and constraining theoretical models. Observations of starburst galaxies with Chandra and XMM-Newton have provided a direct image of (at least a portion of) the shock-heated outflows. The current challenge is to understand the dynamical relationship between the hot wind fluid and cooler gas entrained in the outflow. My talk will focus on measurements of the cool, outflowing gas in the most luminous local starbursts. Some of the resulting properties are not expected from winds driven by a nuclear starburst, and I will discuss alternative interpretations. The implications of fitted dynamical models for the fate of the outflow will be discussed in regard to the galaxy luminosity function and the enrichment of the intergalactic medium.

94. **Grant J. Mathews** (University of Notre Dame)
*December 12, 2005; Parallel Session: **Gravity/Branes/Strings***
POSTER: **Evolution of Dark Matter, Dark Energy, and Dark Radiation in Brane-World Cosmology**
It is a currently popular view that our universe can be a submanifold in a higher dimensional space time. This paradigm is motivated by the low-energy limit of heterotic M-theory in which the universe appears as compactified on a line segment between two 10-dimensional E8xE8 gauge theories. As a practical model the universe can be envisioned as a three-dimensional space (three-brane) in a five-dimensional anti-deSitter space. In this talk we explore the search for cosmological evidence of such a brane-world scenario in which the cosmic expansion can be modified by the curvature of the higher dimensions, the exchange of mass-energy with the higher dimensions, and/or the existence of Planck-mass particles. We show that this view allows for new interpretations of the nature and evolution of dark matter and dark energy. We show that there is marginal cosmological evidence from primordial nucleosynthesis, the CMB, galaxy clusters, and High-Z supernovae for some the the generic predictions from the existence of such higher dimensional physics.

95. **John N. Matthews** (University of Utah)
*December 10, 2005; Parallel Session: **High Energy Particles***
TALK: **Recent Results from The High Resolution Fly's Eye (HiRes)**
The High Resolution Fly's Eye (HiRes) observes ultra high energy cosmic rays (E >~3x10^17 eV) via the air fluorescence technique. This technique, which was first successfully used by the original Fly's Eye experiment, measures the incident particle's arrival direction (anisotropy), energy, and chemical composition. We will discuss recent HiRes results of these and other measurements.

96. **Andrew Mennim** (University of Portsmouth)
*December 12, 2005; Parallel Session: **Gravity/Branes/Strings***
TALK: **Resonant modes in brane-world inflation**
I will present an analysis of resonant modes of perturbations in the single-brane Randall-Sundrum model. Understanding these perturbations is crucial in order to determine the initial spectrum of perturbations and their evolution, possibly giving rise to testable predictions of features in the CMB power spectrum. The spectrum of modes shows a dependence on frequency analogous to some of the trans-Planckian effects considered recently in the literature, although at a lower energy scale.

97. **Amber Miller** (Columbia University)
*December 11, 2005; Parallel Session: **CMB Theory/Experiment***
TALK: **Preliminary Results from the SZA**
I would love to talk about preliminary SZA results.

98. **Emil Mottola** (Los Alamos National Laboratory)
*December 12, 2005; Parallel Session: **Gravity/Branes/Strings***
POSTER: **Short and Long Distance Effects in Cosmology and Dark Energy**
The effective field theory approach to gravity yields a unique modification of classical General Relativity, due to the quantum trace anomaly. The effects of the anomaly can be important in cosmological spacetimes with horizons, such as that of an accelerating universe. It is suggested that dark energy is vacuum energy due to a causal boundary effect at the cosmological horizon. A simple model with a purely vacuum energy de Sitter interior and Schwarzschild exterior, separated by a thin boundary layer where the quantum effects of the anomaly are important is outlined.

99. **Reiko Nakajima** (University of Pennsylvania)
*December 10, 2005; Parallel Session: **Large Scale Structure/Lensing***
POSTER: **Method of Estimating Weak Lens Shear to 1% Accuracy**
We have tested an implementation of the Bernstein & Jarvis (2002) weak lensing shear estimation method by measuring >10^7 simulated noisy images of galaxies convolved with asymmetric PSFs. We find that input shear can be recovered to an accuracy of 1%---better than any demonstrated accuracy to date, and sufficient for the next generation of weak lensing surveys. The galaxy shape measurements successfully reject >99% of PSF anisotropy.

100. **Richard O'Shaughnessy** (Northwestern University)
*December 11, 2005; Parallel Session: **Gamma Ray Bursts***
TALK: **Binary models for short gamma ray bursts**
Now that a few recent afterglows of short, hard gamma ray bursts have been localized, evidence suggests that these bursts arise from the disruption of a neutron star (NS) in either a NS-NS or black hole-NS binary. In this talk -- using state of the art techniques for single and binary star evolution that have been recently constrained by binary pulsar and supernova observations -- I present the predictions of population synthesis in a heterogeneous galaxy population for BH-NS and NS-NS mergers. Specifically, I address the following points, all of which appear to be underappreciated in the recent literature: (i) how long do merger progenitors survive?: Though most mergers, if they occur, happen relatively soon after the last supernovae, many double compact objects can take many Gyr to merge; (ii) which galaxies host megers?: Since mergers can follow significantly after star formation, since early-type galaxies contain a significant fraction of star forming mass, and since these same early-type galaxies are much more likely (from their reconstructed IMF) to have formed massive stars, elliptical galaxies can host a significant fraction of mergers; (iii) sufficiency and completeness: Not all binary mergers will have the required combination of strong kick and long merger time needed to reach distant, low-density regions of their host galaxies; thus, only a fraction of mergers and a fraction of the double-compact merger rate can correspond to short GRBs. Specifically, I will address whether enough binary mergers are expected to occur in conditions that could reproduce short GRBs and, conversely, what happens to the significant fraction which do not.

101. **Reuben W. Ogburn** (Stanford University)
*December 11, 2005; Parallel Session: **DM Theory/Experiment***
POSTER: **The SuperCDMS dark matter search**
The Cryogenic Dark Matter Search currently sets the most stringent limits on spin-independent WIMP-nucleon cross-section. The cryogenic detectors are crystals of Si (600 g total) and Ge (1.5 kg total) with tungsten transition-edge sensors for athermal phonon readout. The SuperCDMS proposal improves on CDMS with increased target mass, reduced background, and an ongoing program of detector improvements. SuperCDMS Phase A, with 25 kg of Ge, will explore cross-sections in the 10^-45 cm^2 range (normalized to one nucleon, at 60 GeV), while SuperCDMS Phase B and Phase C will increase the target mass to 150 kg and one ton respectively, reaching below 10^-46 cm^2. Recently, SuperCDMS has received a strong endorsement from the SNOLab facility in Ontario, providing a deep underground site with suitably low cosmogenic neutron flux. Ongoing detector development includes the migration to thicker target substrates (600 g of Ge instead of 250 g each), improvements in handling and minimization of radon exposure during fabrication, and several promising modifications to the phonon sensor geometry. This poster presents the plans, goals, and challenges for the SuperCDMS project.

102. **Keith A. Olive** (University of Minnesota)
December 9, 2005
PLENARY TALK: **Dark Matter (Theory)**

103. **Nikhil Padmanabhan** (Princeton University)
*December 10, 2005; Parallel Session: **Large Scale Structure/Lensing***
TALK: **The Clustering of Photometric Luminous Red Galaxies and their cosmological implications**
We present the first clustering results for a sample of ~ 600,000 photometrically selected luminous red galaxies from the Sloan Digital Sky Survey. The sample covers an area of ~ 4000 sq. deg, and is approximately volume limited from z=0.2 to z=0.6, with accurate photometric redshifts. This sample probes a volume of 1.5 Gpc/h^3, making it one of the largest volumes ever used for clustering surveys. We find evidence for power on gigaparsec scales, as well as evidence for baryonic oscillations in the power spectrum. We discuss the cosmological implications of these results, and the potential for further surveys.

104. **Vasiliki Pavlidou** (KICP, University of Chicago)
*December 10, 2005; Parallel Session: **High Energy Particles***
POSTER: **Cosmic Accretion Shocks: Energetics, Evolution and Effect of Environment**
Cosmic accretion shocks are important cosmological formations, not only due to their role in shaping the properties of the baryonic component of large-scale structures, but also as promising sites of high-energy particle acceleration. We present an analytical description of the energetics of the population of cosmic accretion shocks. We calculate how the shock-processed accretion power and mass current are distributed among different shock Mach numbers, and how they evolve with cosmic time. We calculate the cumulative energy processed by cosmic accretion shocks of any Mach number as a function of redshift, and we compare it to other energy inputs to the intergalactic medium. We find that the shock-processed energy becomes more than an order of magnitude higher than the supernova energy output in the local universe. Finally, we investigate and quantify the effect of environmental factors such as local clustering and filament preheating on the properties of the population of cosmic accretion shocks.

105. **Hiranya V. Peiris** (Kavli Institute for Cosmological Physics)
*December 12, 2005; Parallel Session: **Early Universe***
TALK: **Parameter Estimation, Slow Roll and the Inflationary Potential**
I discuss an algorithm for constraining and "reconstructing" the potential of single field inflationary models using astrophysical data. I review the use the inflationary slow-roll hierarchy to generate the potential and perturbation spectrum in terms of a finite number of parameters. I then incorporate this parameterization into MCMC fits to astrophysical data, bypassing the usual variables used to describe the spectrum (n_s, d n_s/dlnk, n_t etc). Finally, I show preliminary results based on currently available data.

106. **Federico Piazza** (ICG Portsmouth UK)
*December 12, 2005; Parallel Session: **Gravity/Branes/Strings***
TALK: **Enhanced gravitational scattering from large extra dimensions**
We show that Enhanced gravitational scattering on small scales (<0.1mm), which becomes possible in models with large extra dimensions, can establish equilibrium between different particle species in the early Universe. Ultra-light WIMPs (e.g., axions) can be thermalized by such a mechanism and therefore are not viable CDM candidates in models with a fundamental Planck scale below about 30 TeV.

107. **Michael Pluemacher** (Max-Planck-Institute for Physics)
*December 12, 2005; Parallel Session: **Early Universe***
TALK: **Leptogenesis**
I will review the current status of and recent developments in Leptogenesis.

108. **Levon Pogosian** (Department of Physics, Syracuse University)
*December 10, 2005; Parallel Session: **Dark Energy Experiment/Theory***
POSTER: **Investigating dark energy experiments with principal components**
In my talk, I will describe how a principal component approach can be used to contrast different kinds of probes of dark energy, and emphasize how an array of probes can work together to constrain an arbitrary equation of state history w(z). Rather than using a particular parameterization, we define a prior on the degree of smoothness of w(z). One can then examine how informative various experiments will be in constraining the evolution of dark energy given different choices for the prior.

109. **Marc Postman** (Space Telescope Science Institute)
*December 12, 2005; Parallel Session: **Clusters and Galaxy Formation***
TALK: **The Evolution of Galaxy Morphology**

110. **Tijana Prodanovic** (University of Illinois at Urbana-Champaign)
*December 10, 2005; Parallel Session: **High Energy Particles***
POSTER: **Constraining Structure Formation Cosmic Rays**
Shocks that arise during large-scale structure formation are the source of cosmological cosmic rays. Such structure formation cosmic rays (SFCRs) will lead to pre-Galactic lithium production, thus creating an even larger discrepancy between primordial lithium abundance inferred from WMAP and pre-Galactic lithium observations in metal-poor halo-stars. We present a model-independent approach of constraining this cosmological cosmic-ray population as well as their pre-Galactic lithium production by establishing connection between hadronic gamma-ray and lithium production by SFCRs. We also propose a new site suitable for testing pre-Galactic lithium production.

111. **Georg G. Raffelt** (Max Planck Institute for Physics, Munich)
December 9, 2005
PLENARY TALK: **Neutrinos in Astrophysics and Cosmology**
After an overview of the themes that connect astrophysics and cosmology with neutrino physics I will focus on two main topics. First, what can we learn from the neutrino signal of a future galactic supernova, both about supernova physics and about neutrino properties. Second, what can we learn about neutrino properties from cosmological observables, notably about the neutrino absolute mass scale from cosmological large-scale structure observables.

112. **Arttu Rajantie** (Imperial College London)
*December 12, 2005; Parallel Session: **Gravity/Branes/Strings***
TALK: **Heavy cosmic strings**
I show that cosmic strings with high winding numbers generally form in first order gauge symmetry breaking phase transitions, and demonstrate this with computer simulations. These strings are heavier than single-winding strings and they could therefore explain why the tension of the recently discovered cosmic string candidate CSL-1 appears to be above the upper bounds derived from pulsar timing or cosmic microwave background anisotropies.

113. **Lisa Randall** (Harvard University)
December 10, 2005
PLENARY TALK: **Relaxing to Three Dimensions**
Extra dimensions of space might be present in our universe. If so, we want to know "How do dimensions hide?" and "Why are three dimensions special?" I'll give potential answers to both these questions in the context of localized gravity.

114. **Dan Reichart** (University of North Carolina)
*December 11, 2005; Parallel Session: **Gamma Ray Bursts***
TALK: **Discovery and Identification of the Very High Redshift Afterglow of GRB 050904 and Future Prospects**
I will present our discovery of the afterglow of GRB 050904 and our identification of GRB 050904 as the first very high redshift GRB. We measure its redshift to be 6.39(+0.11,-0.12), which is consistent with the reported spectroscopic redshift (6.29 +/- 0.01). Now that very high redshift GRBs have been shown to exist, and at least in this case the afterglow was very bright, observing programs that are designed to capitalize on this science will likely drive a new era of study of the early universe, using GRBs as probes.

115. **Adam Riess** (STSCI)
*December 10, 2005; Parallel Session: **Dark Energy Experiment/Theory***
TALK: **Expansion History from Supernovae Near and Far**
I will present results from a 4-year series of campaigns using the Hubble Space Telescope to measure the Expansion History and Dark Energy from the Nearest and Farthest type Ia supernovae.

116. **Graziano Rossi** (University of Pennsylvania)
*December 12, 2005; Parallel Session: **Clusters and Galaxy Formation***
POSTER: **Ellipsoidal Collapse and Dark Halo Shapes**
The assumption that dark matter halos formed from an ellipsoidal collapse allows one to model how the abundance of halos depends on their mass. We show that this model is easily extended to study halo shapes. In such framework, halos are neither oblate nor prolate; they are triaxial, with axis ratios which are related to the shear field of the patch from which they formed. Comparison of the predicted axis-ratio distributions with those measured in simulations show that our model is accurate within a well defined mass-range. Thus, it provides a useful tool for studying halo shapes, and how these shapes are correlated with larger-scale structures.

117. **Gavin Rowell** (Max Planck Institut fuer Kernphysik)
*December 10, 2005; Parallel Session: **High Energy Particles***
TALK: **Recent H.E.S.S. Results in TeV Gamma-Ray Astronomy**
H.E.S.S. observations of the past years in the TeV gamma-ray domain have revealed numerous sources of multi-TeV particle production. I will outline a selection of recent H.E.S.S. results, highlighting their key astrophysical implications.

118. **Eduardo Rozo** (University of Chicago)
*December 10, 2005; Parallel Session: **Large Scale Structure/Lensing***
TALK: **Lensing Signatures of CDM Substructures**
We compute the statistical signature of dark matter substructures on the properties of multiply imaged quasars. We find that the average magnification perturbation induced by substructures is in mild disagreement with observations, and we will discuss current work to determine whether the disagreement persists when including nonlinearities.

119. **Douglas H. Rudd** (University of Chicago)
*December 12, 2005; Parallel Session: **Clusters and Galaxy Formation***
POSTER: **Measuring the Effect of Baryons on the Non-Linear Power Spectrum**
We use the new distributed parallel version of ART to compare the evolution of the non-linear power spectrum at scales k~0.1-50 h/Mpc in dissipationless N-body simulations, simulations with adiabatic gas physics, and simulations with with cooling and star-formation. The goal of the study is to assess the potential effect that baryon dissipation and condensation has on the power spectrum of matter distribution on quasi-linear scales, which will be probed by highly accurate weak lensing experiments such as DES and LSST.

120. **Jose Santiago** (Fermilab)
December 12, 2005; Parallel Session: ***Gravity/Branes/Strings***
TALK: **Constraining Inverse Curvature Gravity with Supernovae**
We show that the current accelerated expansion of the Universe can be explained without resorting to dark energy. Models of generalized modified gravity, with inverse powers of the curvature can have late time accelerating attractors without conflicting with solar system experiments. We have solved the Friedman equations for the full dynamical range of the evolution of the Universe. This allows us to perform a detailed analysis of Supernovae data in the context of such models that results in an excellent fit. Hence, inverse curvature gravity models represent an example of phenomenologically viable models in which the current acceleration of the Universe is driven by curvature instead of dark energy. If we further include constraints on the current expansion rate of the Universe from the Hubble Space Telescope and on the age of the Universe from globular clusters, we obtain that the matter content of the Universe is 0.07 <= omega_m <= 0.21 (95% Confidence). Hence the inverse curvature gravity models considered can not explain the dynamics of the Universe just with a baryonic matter component.

121. **Ryan Scranton** (University of Pittsburgh)
December 10, 2005; Parallel Session: ***Dark Energy Experiment/Theory***
TALK: **Future ISW Constraints on Dark Energy Clustering**
The integrated Sachs-Wolfe (ISW) effect in the cosmic microwave background (CMB) as measured through its correlation with galaxies provides a unique opportunity to study the dynamics of the dark energy through its large scale clustering properties. Ultimately, a deep all-sky galaxy survey out to z ~ 2 can make a ~ 10% measurement of the correlation and limit ~ 3% changes in the gravitational potential or total density fluctuation due to dark energy clustering on the Gpc scale. A canonical single scalar field or quintessence model predicts that these clustering effects will appear on the horizon scale with a strength that reflects the evolution of the dark energy density. In terms of a constant equation of state, this would allow tests of the quintessence prediction for models where w was within 5% of the value for a cosmological constant.

122. **Emiliano Sefusatti** (Fermilab)
December 10, 2005; Parallel Session: ***Large Scale Structure/Lensing***
POSTER: **Constraining cosmological parameters with the galaxy power spectrum and bispectrum**
We present estimates of the expected error bars on cosmological parameters from a joint likelihood analysis of the galaxy power spectrum and bispectrum including the full covariance matrix between the two statistics and the Sloan Digital Sky Survey geometry.

123. **Antonio J. Segui** (Universidad de Zaragoza)
December 12, 2005; Parallel Session: ***Gravity/Branes/Strings***
POSTER: **Friedman's equations and the apparent horizon (from wood to marble).**
Imposing the saturation of the generalized entropy bounds on FRW cosmologies, we arrive at a description of the Friedman's equations where the sources are geometrical and given in terms of the apparent horizon.

124. **Anjan A. Sen** (Dept. Of Physics and Astronomy, Vanderbilt University)
*December 10, 2005; Parallel Session: **Dark Energy Experiment/Theory***
POSTER: **Generalizing the Generalized Chaplygin Gas**
The generalized Chaplygin gas is characterized by the equation of state $p = - A/rho^alpha$, with $alpha > -1$ and $w > -1$. We generalize this model to allow for the cases where $alpha < -1$ or $w < -1$. This generalization leads to three new versions of the generalized Chaplygin gas: an early phantom model in which $w ll -1$ at early times and asymptotically approaches $w = -1$ at late times, a late phantom model with $w approx -1$ at early times and $w rightarrow - infty$ at late times, and a transient model with $w approx -1$ at early times and $w rightarrow 0$ at late times. We consider these three cases as models for dark energy alone and examine constraints from type Ia supernovae and from the subhorizon growth of density perturbations. The transient Chaplygin gas model provides a possible mechanism to allow for a currently accelerating universe without a future horizon, while some of the early phantom models produce $w < -1$ without either past or future singularities.

125. **Geraldine Servant** (CEA Saclay)
*December 12, 2005; Parallel Session: **Early Universe***
TALK: **Gravitational Waves from First Order Phase Transitions**
I present prospects for detection of gravitational waves from early universe phase transitions at first and second generation space interferometers.

126. **Alice Shapley** (Princeton University)
*December 12, 2005; Parallel Session: **Clusters and Galaxy Formation***
TALK: **Galaxies at z=2-3**
I will discuss recent observations of galaxy formation at z~2-3.

127. **Erin Sheldon** (New York University)
*December 10, 2005; Parallel Session: **Large Scale Structure/Lensing***
TALK: **Calbration of Cluster Masses with Weak Lensing in the SDSS**
I will present new results on the Mass-Luminosity and Mass-richness relations from weak lensing in the Sloan Digital Sky Survey. Using stacking techniques, I will show that the mass is calibrated to the 10% level over a factor of 30 in richness and a factor of 100 in mass. I will discuss the utility of these calibrations for future cluster surveys such as the SPT.

128. **Deirdre Shoemaker** (Penn State)
December 10, 2005
PLENARY TALK: **Gravitational Waves**
A new window in astronomy will open once gravitational-wave interferometers detect first light. These detectors will give us a revolutionary view of the Universe, complementary to the electromagnetic perspective. The detection and characterization of gravitational waves is a formidable undertaking, requiring innovative engineering, powerful data analysis tools and careful theoretical modeling. Equally important is to begin imagining the impact that an observationally driven field of gravitation will have on astronomy and cosmology. This talk reviews the progress and goals of this new field of Gravitational Wave Astronomy.

129. **Kris Sigurdson** (Institute for Advanced Study)
*December 11, 2005; Parallel Session: **DM Theory/Experiment***
TALK: **Probing the Dark Matter Particle Spectrum with the Dark Matter Power Spectrum**
We discuss scenarios where a signature of the particle content of the dark sector could be left on the matter power spectrum. If the present dark-matter abundance arises via the decay of a particle that interacts with the photon-baryon fluid (such as a charged species) then the memory of this interaction may be imprinted on the matter power spectrum. Such a feature would be difficult to explain within the context of standard inflationary models, and could thus provide an interesting indirect window into the the nature of the dark sector.

130. **Tristan L. Smith** (Caltech)
December 12, 2005; Parallel Session: ***Gravity/Branes/Strings***
POSTER: **Direct detection of the inflationary gravitational-wave background**
Inflation generically predicts a stochastic background of gravitational waves over a broad range of frequencies, from those accessible with cosmic microwave background (CMB) measurements, to those accessible directly with gravitational-wave detectors, like NASA's Big-Bang Observer (BBO) or Japan's Deci-Hertz Interferometer Gravitational-wave Observer (DECIGO), both currently under study. Here we investigate the detectability of the inflationary gravitational-wave background at BBO/DECIGO frequencies. To do so, we survey a range of slow-roll inflationary models consistent with constraints from the CMB and large-scale structure (LSS). We go beyond the usual assumption of power-law power spectra, which may break down given the 16 orders of magnitude in frequency between the CMB and direct detection, and solve instead the inflationary dynamics for four classes of inflaton potentials. Direct detection is possible in a variety of inflationary models, although probably not in any in which the gravitational-wave signal does not appear in the CMB polarization. However, direct detection by BBO/DECIGO can help discriminate between inflationary models that have the same slow-roll parameters at CMB/LSS scales.

131. **Alicia M. Soderberg** (Caltech)
December 11, 2005; Parallel Session: ***Gamma Ray Bursts***
TALK: **A Broadband Perspective on the GRB-SN Connection**
During the last few years we have revolutionized the understanding of local Type Ibc supernovae and their connection with long-duration gamma-ray busrts. Recent discoveries have shown that the emerging picture for core-collapse explosions is one of diversity. Compiling data from our dedicated radio survey of SNe Ibc and our comprehensive HST survey of GRB- and XRF-SNe together with optical and X-ray follow-up campaigns, I will review our current understanding of the GRB-SN connection. In particular, I will compare local SNe Ibc with GRB-SNe based on the following criteria: (1) the distribution of optical peak magnitudes (Nickel production), (2) evidence for copious energy coupled to (on-axis) relativistic ejecta, (3) evidence for GRB jets initially directed away from our line-of-sight, and (4) constraints on the circumburst density. By focusing on these points, I will describe the complex picture of stellar death that is emerging.

132. **Hans F. Stabenau** (University of Pennsylvania)
December 10, 2005; Parallel Session: ***Large Scale Structure/Lensing***
POSTER: **N-body simulations of alternate gravity models**
Two possible explanations for the observed cosmic acceleration are: dark energy, or deviation of gravity on cosmological scales from general relativity. Newtonian gravity has been directly tested experimentally from mm scales to solar system scales. On larger scales of cosmological interest we are extrapolating the predictions of theory. Using weak lensing power spectra from N-body simulations with a modified Poisson equation in a $Lambda$CDM background, we constrain possible deviations from Newtonian gravity on cosmological (Mpc) scales. We find that nonlinear gravity enhances the deviations of the low redshift power spectrum of these models. We estimate how well the parameters of the alternate gravity models are constrained by lensing observations.

133. **Albert Stebbins** (Fermilab)
December 10, 2005; Parallel Session: ***Dark Energy Experiment/Theory***
POSTER: **An Anthrocentric Universe?**
The "dark energy phenomena" (observed distance redshift relationship) is usually ascribed to an accelerated expansion of the universe, but none of the evidences for it are measures of acceleration. Acceleration is only inferred by the assumption of the cosmological principle. Dropping this principle and by necessity also the Copernican "principle of mediocrity" removes the evidence for dark energy or any other new physics. I examine whether it is possible to get a sensible cosmological model without dark energy, homogeneity, or mediocrity.

134. **Gary Steigman** (Ohio State University)
December 9, 2005
PLENARY TALK: **BBN: Successes and Challenges**
After some reflections on my long friendship and collaboration with Dave, I will review the status of Big Bang Nucleosynthesis (BBN) as a probe of the early Universe and of particle physics, and I will confront its predictions, and the constraints which emerge from them, with those derived from independent observations of the Universe at much later epochs in its evoluton. The relic abundances derived from the observational data are confronted with the BBN predictions, with an emphasis on the distinction between precision and accuracy, testing its internal consistency as well as its concordance with the Cosmic Background Radiation data from WMAP.

135. **Louie Strigari** (UC Irvine)
December 11, 2005; Parallel Session: ***Gamma Ray Bursts***
POSTER: **Probing Massive Star Formation with MeV Neutrinos and Gamma Rays**
The cosmological background of ~ MeV neutrinos and gamma rays provides strong constraints on the massive star formation and supernova rates. Understanding the expected fluxes of these backgrounds has important implications for the 'concordance' picture of star formation, from which we can test not only the supernova rates, but also the neutron star/black hole fractions as well as the high mass IMF. In this talk, I will review the detection staus of these backgrounds, discussing them in the context of traditional measures of the star formation rate.

136. **Fumihiro Takayama** (Cornell University)
December 12, 2005; Parallel Session: ***Early Universe***
TALK: **superWIMP dark matter**
SuperWeakly Interacting Massive Particle(superWIMP) may constitute the present dark matter. SuperWIMPs are produced through late decay of WIMPs. We discuss the cosmology and the prospects for future colliders.

137. **Argyro (Iro) Tasitsiomi** (U Chicago/ Princeton U)
December 12, 2005; Parallel Session: ***Clusters and Galaxy Formation***
POSTER: **Ly-alpha radiative transfer in cosmological simulations**
High resolution, along with appropriately treated cooling can result in simulated environments with very high optical depths. Thus, solving the Ly-alpha RT problem in cosmological simulations can take an unrealistically long time. For this reason, I develop methods to speed up the Ly-alpha RT. I test the RT code against simple Ly-alpha emitter models, and then I apply it to the brightest emitter of a gasdynamics+N-body Adaptive Refinement Tree (ART) simulation at z~8.

138. **David Tytler** (UC San Diego)
December 11, 2005; Parallel Session: ***CMB Theory/Experiment***
TALK: **The tension in Standard Big Bang Nucleosynthesis:**
Three methods of measuring the cosmological baryons density now agree within about 10%: the CMB, the D/H ratiousing Standard Big Bang Nucleosynthesis, and the Lyman-alpha absorption from the IGM at z=2 to 3. We recently measured the mean amount of absorption in the IGM with an error of 1%, and we use these measurements, and a large set of hydrodynamic simulations to determine the cosmological and astrophysical parameters of the IGM, including the temperature and the baryon density. Using this baryon density, SBBN predicts a factor 3 more 7Li than is seen in halo stars, and systematically more 4He that most measurements. We review the systematic errors with the measurements, and we discuss modifications to BBN that might explain the tension between D, He and Li.

139. **Alberto Vallinotto** (University of Chicago)
*December 12, 2005; Parallel Session: **Early Universe***
POSTER: **Curvature Perturbations from Broken Symmetries**
In a multi-field inflationary scenario, isocurvature perturbations generated during the slow-roll phase can be converted into curvature perturbations during the inflaton decay process provided that the inflationary potential is characterized by a global broken symmetry. In this talk, the general mechanism will be reviewed and an application to the specific case of a U(1) broken symmetry will be presented, showing how this mechanism represents a viable alternative for the production of curvature perturbations.

140. **Benjamin D. Wandelt** (University of Illinois at Urbana-Champaign)
*December 11, 2005; Parallel Session: **CMB Theory/Experiment***
TALK: **The Largest Scale Perturbations in the Universe and The Physics of the Beginning**
Is there a lack of power on large scales? No - it's only a 10% effect according to Bayesian analysis. But is the universe globally anisotropic? Cosmological initial conditions carry information about the physics that created the primordial perturbations. Causality limits what can we learn about the earliest moments of time and the global structure of the Universe. I will discuss new approaches for high-fidelity reconstruction of the primordial perturbations. I will also describe the results from statistical methods for a credible assessment of how well observations of these initial conditions fit our current understanding of the physics of the beginning.

141. **David Wands** (University of Portsmouth)
December 10, 2005
PLENARY TALK: **Inflation and the origin of structure**
Different theoretical models of inflation in the very early universe can be tested via the primordial perturbations they produce. Single-field models can result in deviations from scale-invariance and different tensor-scalar ratios. In multi-field models there is in addition the possibility of non-adiabatic and non-Gaussian perturbations.

142. **Alan Watson** (University of Leeds)
December 9, 2005
PLENARY TALK: **Recent Studies of Ultra High Energy Cosmic Rays**
The current status of measurements of the mass, arrival direction distributions and energy spectrum of cosmic rays of energy above 3 EeV will be reviewed

143. **Risa Wechsler** (KICP, University of Chicago)
*December 12, 2005; Parallel Session: **Clusters and Galaxy Formation***
POSTER: **Environmental Depedence of Halo Concentration and Occupation**

144. **Trevor C. Weekes** (Harvard-Smithsonian CfA)
December 13, 2005
PLENARY TALK: **The TeV Gamma-ray Universe**
The study of the universe in TeV gamma-rays is the study of the sources and distribution of very high energy particles (electrons and hadrons). The advent of advanced systems of atmospheric Cherenkov imaging telescope arrays (CANGAROO, HESS, MAGIC, VERITAS) has opened this extreme universe to observations with high sensitivity. Somewhat surprisingly these ground-based techniques match or exceed the sensitivity of space telescopes at lower energies and hence provide complementary observations to AGILE and GLAST. There is now evidence for more than three dozen TeV gamma-ray sources; the source catalog includes AGN, a Radio Galaxy, SNRs, plerions, binaries, a microquasar, the Galactic Center, and dark sources with no known counterpart. The status of new and proposed observatories will be reviewed. The prospects of the discipline for the determining the origin of the cosmic radiation, for the astrophysics of AGN, for cosmological studies, and for the detection of dark matter will be discussed.

145. **David H. Weinberg** (Ohio State University)
December 12, 2005
PLENARY TALK: **Interpreting Large Scale Structure**

146. **Daniel H. Wesley** (Princeton University)
*December 12, 2005; Parallel Session: **Gravity/Branes/Strings***
TALK: **String Pair Production in a Time-Dependent Gravitational Field**
I report on a calculation of the pair production of strings in a time-dependent gravitational field. I find that both the spectrum and pair production rate differ significantly from point particle results. This calculation has implications especially for the production of string relics in the early universe, as well as for other cosmological phenomena related to pair production.

147. **Amit Pratap Yadav** (University of Illinois at Urbana-Champaign)
*December 12, 2005; Parallel Session: **Early Universe***
POSTER: **Reconstruction of Primordial Scalar Potential Using Temperature and Polarization Maps**
Assuming linearity of the perturbations at the time of decoupling, we reconstruct the primordial scalar potential from the temperature and polarization anisotropies in the cosmic microwave background radiation. In doing so we derive an optimal linear filter which, when operated on the spherical harmonic coefficients of the anisotropy maps, returns an estimate of the primordial scalar potential fluctuations in a spherical slice. The reconstruction is best in a thick shell around the decoupling epoch; the quality of the reconstruction depends on the redshift of the slice within this shell. With high quality maps of the temperature and polarization anisotropies it will be possible to obtain a reconstruction of potential fluctuation on scales between l=2 and l ~ 300 at the redshift of decoupling, with some information about the three-dimensional shapes of the perturbations in a shell of width 250Mpc.

148. **Masahide Yamaguchi** (Aoyama Gakuin University)
*December 12, 2005; Parallel Session: **Early Universe***
POSTER: **Density fluctuations of an effectively single field inflation in a multi-field configuration**
We discuss primordial density fluctuations of an effectively single field inflation in a multi-field configuration, that is, only one field is light and the others are heavy. We show that adiabatic density fluctuations of such an inflation can be reproduced by use of the effective potential of the light field, which is obtained by inserting the minima of the heavy fields to the original potential, in case that kinetic energies of the heavy fields are much smaller than that of the light field.

149. **Tokonatsu Yamamoto** (Enrico Fermi Institute, University of Chicago)
*December 10, 2005; Parallel Session: **High Energy Particles***
POSTER: **The First Scientific Results from the Pierre Auger Observatory**
The Pierre Auger Observatory is the world's largest detector to study Ultra-High-Energy Cosmic Rays. The Southern site is now 60 % completed. The observatory has been collecting data for over 1 year and the cumulative exposure is already similar to that of the largest forerunner experiments. A hybrid technique uses model-independent energy measurements from Fluorescence detectors to calibrate the surface detector measurements. In this talk, we report the first estimation of the energy spectrum above 3 EeV and discuss its implications.

150. **Hasan Yuksel** (Ohio State University)
*December 11, 2005; Parallel Session: **DM Theory/Experiment***
TALK: **Constraints on Galactic Positron Production Models**
I will discuss implications of the observed Galactic positron annihilation gamma-ray line at 511 keV and constraints from INTEGRAL observations on some galactic positron production models including MeV particle dark matter.

151. **Hu Zhan** (University of California at Davis)
*December 10, 2005; Parallel Session: **Large Scale Structure/Lensing***
POSTER: **Cosmology with Galaxy Correlations from Photometric Redshift Surveys**
Deep and wide photometric redshift surveys are useful probes of the large-scale structure of the universe. We show that the proposed survey of the Large Synoptic Survey Telescope (LSST) will enable us to measure the galaxy power spectrum on very large scales that are not yet accessible to current galaxy surveys. One may use such large-scale galaxy power spectrum to probe possible features in the primordial power spectrum, which might explain some irregularities in the cosmic microwave background. On smaller scales, baryon acoustic oscillations (BAO) will be readily detectable by LSST. We forecast that LSST will measure the angular diameter distance to better than a few percent with BAO. Meanwhile, if the distribution of photometric redshift errors is accurately quantified as required by weak lensing, then LSST will also be able to measure the Hubble parameter with a comparable accuracy. This will allow LSST BAO to place constraints on dark energy equation of state parameters that are competitive with those from LSST shear power spectra.

152. **Bing Zhang** (University of Nevada Las Vegas)
*December 11, 2005; Parallel Session: **Gamma Ray Bursts***
TALK: **Gamma-ray burst early afterglows**
Gamma-ray burst early afterglows are essential to
understand the composition of the fireball, the transition between the prompt emission and the afterglow, emission sites of the prompt emission, activity of the central engine, as well as the immediate circumburst environment. I will review how the recent Swift observations give the answers to these outstanding problems.

153. **Pengjie Zhang** (Shanghai Observatory)
*December 10, 2005; Parallel Session: **Large Scale Structure/Lensing***
TALK: **Lensing Without Shear: the Power of Cosmic Magnification**
We develop a new tool to generate statistically precise dark matter maps from the cosmic magnification of galaxies with distance estimates. We show how to overcome the intrinsic clustering problem using the slope of the luminosity function, which has hitherto severely restricted this technique. This may allow precision cosmology beyond most current systematic limitations. SKA is able to reconstruct projected matter density map at smoothing scale $sim 10^{'}$ with S/N$geq 1$, at the rate of 200-4000 deg^2 per year, depending on the abundance and evolution of 21cm emitting galaxies. This power of mapping dark matter is comparable to, or even better than that of cosmic shear from deep optical surveys or 21cm surveys.

154. **Zheng Zheng** (Institute for Advanced Study)
*December 10, 2005; Parallel Session: **Large Scale Structure/Lensing***
TALK: **Breaking the Degeneracies between Cosmology and Galaxy Bias**
From the contemporary galaxy redshift surveys, such as the 2dF Galaxy Redshift Survey and the Sloan Digital Sky Survey, we are measuring galaxy clustering in great details. The main hurdle to use galaxy clustering data to constrain cosmological models is galaxy bias, the difference between galaxy and matter distributions, which encodes information about galaxy formation. Within the Halo Occupation Distribution framework, I will discuss the possibility to break the degeneracies between cosmology and galaxy bias using galaxy clustering data.

155. **Juande D. Zornoza** (IFIC - UW-Madison)
December 10, 2005; Parallel Session: ***High Energy Particles***
TALK: **Mediterranean Neutrino Telescopes**
Neutrino telescopes had begun to open a new window to study the Universe. The fact that neutrinos only interact weakly is an important advantage to get information from very far or dense astrophysical sources. However, this also represent a challenge for their detection. Experiments like Baikal and AMANDA have shown that the idea is feasible and they are obtaining important results, constraining theoretical models and measuring the atmospheric flux. In this talk we will review the status and perspectives of the experiments in the Mediterranean. After the deployment of several test lines during the last years, the first line of ANTARES will be installed by the beginning of 2006. NESTOR has deployed a test line in 2003 and will inmerse a full tower in 2006. NEMO plan to install two instrumented towers by the end of 2006. These intense experimental activities show the importance of the observation of high energy neutrinos from the Northern Hemisphere. The project KM3Net will join the efforts of these groups in order to design a cubic kilometer detector in the Mediterranean. This will provide, together with IceCube, full coverage of the high-energy neutrino sky, including the Galactic Center.