John N. Matthews, University of Utah:  
Overview of the results of the High Resolution Fly's Eye

The High Resolution Fly's Eye (HiRes) collected ultra high-energy cosmic ray data between 1997 and 2006. The experiment observed cosmic ray showers via the air fluorescence technique. There were two observatory stations separated by 12.6 km, which each measured showers resulting from cosmic rays in monocular mode. The data from the two stations was also combined to form a stereo measurement of the showers. The experiment measures such properties as the energy spectrum, chemical composition, and p-air cross-section of these cosmic rays. An overview of measurements will be presented.

James Matthews, Louisiana State University:  
Recent Results from the Pierre Auger Observatory

The Southern site of the Pierre Auger Observatory has recently been completed. We will discuss recent results on studies of the highest energy cosmic rays, including: (i) the energy spectrum, (ii) arrival directions, (iii) the depth of the shower maximum, (iv) an upper limit on the primary photon flux, (v) the upper limit on the diffuse neutrino flux. Plans for the future expansion of the observatory in the Northern Hemisphere will be described.

Charlie Jui, University of Utah:  

The Telescope Array (TA) Experiment, hosted by the University of Utah, is the largest ultra-high energy (UHE) cosmic ray detector in the northern hemisphere. It is located near Delta, Utah, about 200 kilometers southwest of Salt Lake City. The detector consists of 512 three square meter scintillation counters distributed in a rectangular grid of 1.2 km spacing. At the corners of the ground array sit three fluorescence detector stations. Each station views 108 degrees in azimuth and between 3-31 degrees in elevation looking over the ground array providing full hybrid coverage at above 10 EeV. TA began operation at the beginning of 2008. A low energy extension to TA (TALE) will add a Fourth fluorescence site at 6 kilometers from the station at Long Ridge. An array of 24 telescopes covering 200 degrees in azimuth will provide stereo observation in the 1-10 EeV decade. A tower detector with four meter diameter mirrors viewing between 31 and 73 degrees in elevation will extend fluorescence and hybrid observations down to 0.03 EeV, in conjunction with an infill array of scintillation and muon detectors.

Luis C. Reyes, University of Chicago:  
Early Observations of Gamma-ray Blazars with Fermi LAT

The Large Area Telescope (LAT), one of two instruments on the Fermi Gamma-ray Space Telescope (formerly GLAST, launched June 11, 2008) is a pair conversion detector designed to study the gamma-ray sky in the energy range 20 MeV to >300 GeV. Because of its improved sensitivity with respect to previous missions, Fermi LAT is advancing our understanding of gamma-ray blazars as: i) sources of high-energy radiation, and ii) as a cosmological population. In this contribution, we present science highlights from the first few months of science observations.

Jeremy Perkins, Smithsonian Astrophysical Observatory:  
Recent Blazar Results from the VERITAS Observatory

We report on very high energy (VHE, E > 100 GeV) gamma-ray observations of several blazars with VERITAS, an array of imaging atmospheric Cherenkov telescopes located in southern Arizona. VERITAS, the most sensitive VHE instrument in the northern hemisphere, has recently discovered gamma-ray emission from the high frequency peaked BL Lac object 1ES 0806+524, and the intermediate-frequency peaked BL Lac objects W Comae and 3C 66A. Additionally, VERITAS has many ongoing and completed multiwavelength campaigns and a very active blazar monitoring program.
Brenda Dingus, Los Alamos National Laboratory:
Unexplained TeV Cosmic Ray Anisotropy Observed by Milagro

The 7-year data set of the Milagro TeV observatory contains over 200 billion extensive air showers of which most are due to hadronic cosmic rays. These data are searched for evidence of anisotropy and features are observed on large angular scales as well as down to ~10 degrees in extent. The large-scale features have been observed by other TeV cosmic ray detectors, and the Milagro observations reveal a different energy dependence than the majority of the cosmic rays as well as a time variability. The smaller scale features are detected as excess regions with greater than 12 sigma significance after subtracting out the large-scale features. The Milagro observations are consistent with hadronic air showers and a pure gamma-ray origin is ruled out with high significance. However, these anisotropies are difficult to explain because the gyroradius of a 10 TeV proton is 0.01 parsec in a 1 microGauss magnetic field. Potential astrophysical explanations require unexpectedly organized magnetic fields with an unknown nearby source or unknown heliospheric effects.

Michelle Hui, University of Utah:
VERITAS Observations of Galactic Gamma-Ray Sources

VERITAS, an array of imaging atmospheric Cherenkov telescopes located in southern Arizona, is sensitive to gamma rays from 100 GeV to more than 30 TeV. We present results from VERITAS galactic observations since 2006, which include strong detections of supernova remnants IC 443 and Cassiopeia A; a survey of selected pulsar wind nebulae; and the detection of LS I +61 303, an X-ray binary with variable gamma-ray flux that is at maximum close to the apastron.

Petra Huentemeyer, University of Utah:
Observation of TeV Gamma-Ray Sources & Diffuse Emission with Milagro

With its large field of view and long observation time, the Milagro experiment was an ideal instrument for surveying large regions of the Northern Hemisphere sky at high energies. In my talk, I will review the TeV gamma-ray sources that have been detected by the Milagro experiment as well as the diffuse TeV gamma-ray emission measurement in the Galactic plane. The spatial distribution of the diffuse emission as well as the overall flux are compared to the predictions of the cosmic-ray propagation model GALPROP.

Helio Takai, Brookhaven National Laboratory:
Development of Bi-Static Radar for Ultra High Energy Cosmic Rays Detection

The concept of using radar for the detection of cosmic rays was introduced in 1941 by Blackett and Lovel. Since then many authors have explored and discussed how this technology could be implemented in practice. Through the years, radio technology has evolved significantly and today it may allow for the implementation of a radar for the detection of cosmic rays. If radar technology is available, it will allow for the implementation of extremely large area detectors at reasonable cost. Radar can easily cover areas in excess of 10,000 km2 with few stations, or used in conjunction with fluorescence detectors for high resolution energy measurements. We are exploring the implementation of a forward scattering bi-static radar for the detection of cosmic ray showers. A forward scattering radar has a transmitter located far from the receiver. The receiving station has little or no signal from the transmitter which only develops when ionization is produced between them. The method is inspired in a well-established technique for the detection of meteors. In the presentation, we will describe the theoretical expectations for the technique and discuss how the search for radar echo is being implemented on Long Island, NY. We will discuss the status of the experiment and present preliminary observations. Educational aspects of the experiment will also be discussed as the experiment has active high school participation.

Jordan Goodman, University of Maryland:
Science with the HAWC Observatory

The High Altitude Water Cherenkov (HAWC) observatory is a wide field-of-view TeV gamma ray telescope to be built at an elevation of 4100 m at Sierra Negra, near Puebla, Mexico. This talk will concentrate on the capabilities of HAWC to perform gamma-ray studies that are unattainable with the current suite of instruments. With nearly 100% duty cycle and sensitivity more than an order of magnitude better than its predecessor, Milagro, HAWC will provide an unbiased survey of the northern sky in the TeV band. We will show how HAWC will extend our knowledge of the behavior of sources above 30 TeV as well as have unprecedented sensitivity to VHE transients and to spatially extended sources.
Steve Blanchet, University of Maryland:
Seesaw at the Weak Scale, the Baryon Asymmetry & the LHC
I will consider theories where the Standard Model neutrinos acquire mass through the three possible seesaw mechanisms (Type I, II and III) at the weak scale. I will show that in such scenarios, the requirement that any pre-existing asymmetry, regardless of its origin, not be washed out leads to correlations between the pattern of neutrino masses and the spectrum of new particles at the weak scale, leading to definite predictions for the LHC.

Lisa Randall, Harvard University:
Searching for Unconventional Dark Matter
We'll discuss TeV-mass dark matter candidates and the potential for indirect detection as well as possible candidates compatible with DAMA and other direct dark matter searches.

Michael Ramsey-Musolf, University of Wisconsin – Madison:
Minimal Electroweak-Scale Cosmology at the LHC
It is well known that new physics at the electroweak scale could solve important puzzles in cosmology, such as the nature of dark matter and the origin of the cosmic baryon asymmetry. In this talk, I discuss some of the simplest, non-supersymmetric possibilities, their collider signatures, and the prospects for their discovery and identification at the LHC.

Paolo Gondolo, University of Utah:
Dark Stars, or the Effect of Dark Matter on the First Stars
Weakly interacting massive particles can annihilate and provide an important heat source for the first stars to form in the Universe. The first phase of stellar evolution may be Dark Stars, powered by dark matter heating rather than fusion. This talk presents the story of these Dark Stars: how they form, how long they might live, and what they might become at the end of their life.

Chris Fryer, Los Alamos National Laboratory:
Neutrinos from the First Stars
The first generation of stars are very different from the current day population of stars because both the formation and evolution of these stars are very different than their modern day counterparts. The resulting neutrino emission will also vary from what we expect in the current population of stars. Here I review our current understanding of the stellar formation and evolution of first stars and present results on the neutrino emission from the collapse of these stars. I discuss the current uncertainties in calculating the neutrino emission and estimate how these uncertainties will affect these results.
Geoffrey Mills, Los Alamos National Laboratory:
Results from the MiniBooNE Experiment
I will discuss the latest neutrino oscillation results from the MiniBooNE experiment that include the first results from the antineutrino-mode run and the reanalysis of the neutrino-mode low energy excess. I will also present some future plans for the MiniBooNE experiment and the Fermilab 8GeV booster neutrino beamline.

Mark Vagins, Institute for the Physics and Mathematics of the Universe - University of Tokyo:
GADZOOKS! How to See the Diffuse Supernova Neutrino Background... Soon!
Water Cherenkov detectors have been used for many years to study neutrino interactions and search for nucleon decays. Super-Kamiokande, at 50 kilotons the largest such underground detector in the world, has enjoyed over ten years of interesting and important physics results. Looking to the future, for the last six years R&D on a potential upgrade to the detector has been underway. Enriching Super-K with 100,000 kilograms of a water-soluble gadolinium compound - thereby enabling it to detect thermal neutrons and dramatically improving its performance as a detector for supernova neutrinos, reactor neutrinos, atmospheric neutrinos, and also as a target for the upcoming T2K long-baseline neutrino experiment - will be discussed.

Thomas Sonley, Massachusetts Institute of Technology:
Measuring Atmospheric Neutrinos at the Sudbury Neutrino Observatory
While the Sudbury Neutrino Observatory was designed to detect low energy solar neutrinos, it can also track high-energy muons from cosmic ray showers and atmospheric neutrino interactions. Because of SNO’s great depth and flat overburden, the cosmic ray muon flux is negligible unless the muons are traveling at a relatively steep angle (zenith angle less than 66 degrees). This means that neutrino-induced muons can be observed both above and below the horizon. The neutrinos from below the horizon will have undergone oscillations, while the neutrinos from above will not. This unique sample of unoscillated neutrinos will allow SNO to constrain the flux of high-energy atmospheric neutrinos in addition to extracting oscillation parameters. This talk will describe SNO’s measurements of the atmospheric muon neutrino flux, oscillation parameters, and the flux of cosmic ray muons at a depth of 6000 meters water equivalent using the entire SNO dataset.

Irina Sarcevic, University of Arizona:
High Energy Neutrinos from Charm in Astrophysical Sources
We show that charm production enhances a flux of very high-energy neutrinos from astrophysical sources with jets driven by central engines, such as gamma ray bursts or supernovae with jets. The neutrino flux from semi-leptonic decays of charmed mesons is subject to much less hadronic and radiative cooling than the conventional flux from pion and kaon decays and therefore has a dominant contribution at higher energies, of relevance to future ultrahigh energy neutrino experiments.

Irina Mocioiu, Pennsylvania State University:
Lessons from neutrinos in the IceCube Deep Core Array
The IceCube Deep Core Array extends the reach of the IceCube detector to neutrinos of low energy (down to 10 GeV) and any direction. We discuss how neutrinos detected in this array can be used to obtain useful information about neutrino properties and new physics.
Uwe Oberlack, Rice University:
Direct Dark Matter Searches

Direct searches for Dark Matter particle interactions in low background detectors have seen substantial progress in recent years. The realization of new detector technologies, most notably the liquid noble gas TPC's, and optimization of more mature ones has led to a significant steepening in the rate of progress in sensitivity. I will review the current status of direct Dark Matter searches, and provide an outlook on the near and midterm future. Finally, I will expand on the status of the XENON Dark Matter program.

Peter Sorensen, Lawrence Livermore National Laboratory:
Constraints on Inelastic Dark Matter in Light of XENON10

Several interesting explanations have been proposed to account for the apparent incompatibility of the DAMA/LIBRA modulation signal with the null results from CDMS-II and XENON10. Some of these have focused on light dark matter candidates ($m \cdot 10$ GeV c$^{-2}$) or on the possibility of a channeling effect in NaI crystals. Most of this work assumes elastic scatters of the dark matter particle from a target nucleus. Other recent work suggests that inelastic scatters could explain the contradictory observations. Among the predictions of inelastically interacting dark matter are a population of nuclear recoil events at higher (Enr & 30 keV recoil equivalent) energies in a xenon target. This is above the energy window used in the blind analysis of XENON10 data in 2007. I will discuss a reanalysis of XENON10 data extending to higher recoil energies, and comment on the implications for the DAMA/LIBRA modulation signal.

Jeter Hall, Fermi National Accelerator Laboratory:
The Cryogenic Dark Matter Search

The Cryogenic Dark Matter Search (CDMS II) is an experiment utilizing high purity germanium particle detectors to search for Dark Matter in the form of Weakly Interacting Massive Particles (WIMPs). We measure ionization and heat from particle interactions to separate the largely electromagnetic backgrounds from candidate WIMP-nucleon scatters. We report on the latest results which reach a sensitivity of $4.6 \times 10^{-44}$ cm$^2$ for the WIMP-nucleon spin-independent cross section, one of the most sensitive searches to date. We also report on the current status of the experiment and comment on the SuperCDMS experiment which is focused on increasing the sensitivity of this technology.

Sergio Bottai, National Institute of Nuclear Physics (INFN) - Florence:
Positrons & Antiprotons Detection with PAMELA

PAMELA is a satellite-borne experiment designed to study charged particles in the cosmic radiation with a particular focus on antiparticles. The experiment was launched on June 2006 and from July 2006 is successfully taking data. The data analysis and the main results concerning positrons and antiprotons detection are presented.

Rouzbeh Allahverdi, University of New Mexico:
Sneutrino Dark Matter in the Light of PAMELA

The recent results from PAMELA (and ATIC) on the excess of cosmic ray positron flux have led to tremendous excitement in the dark matter community. In particular, it turns out that a dark matter explanation requires going beyond the minimal supersymmetric standard model (MSSM). I will discuss a well motivated extension of MSSM, based on a U(1)$_{B-L}$, with the right-handed sneutrino being the dark matter candidate. Sneutrino annihilation to new Higgs fields with a mass in the 10 GeV range provides a good fit to the PAMELA data (and a reasonable fit to ATIC data) for a dark matter mass of 1-2 TeV. The direct detection cross section in this model is in the $10^{-9}$ pb range, which is within the reach of the upcoming dark matter experiments. Moreover, this model can lead to successful inflation and connect the small temperature anisotropy in the cosmic microwave background (CMB) to the tiny neutrino masses.
**Alexander Kusenko, University of California - Los Angeles:**

**Dark Matter's X-files: the Candidates, the Hints from Supernovae, & the First Results from Suzaku X-ray Telescope**

I will review the physics motivation and present the first results of the first dedicated dark-matter search using Suzaku X-ray telescope. The observations constrain the allowed parameter space for sterile neutrinos, which remain a viable dark-matter candidate for the masses and mixing angles consistent with the supernova physics and the observed pulsar velocities. Future observations with Suzaku and Chandra will improve one's ability to detect relic sterile neutrinos, and, possibly, SUSY WIMPs.

**Kalliopi Petraki, University of California - Los Angeles:**

**Cosmological & Astrophysical Implications of Sterile Neutrinos**

The discovery of neutrino masses implies the existence of new particles, the sterile neutrinos. These particles, whose number and mass scale are still undetermined, can have important implications for cosmology and astrophysics. A sterile neutrino with mass of a few keV can account for the dark matter of the universe. Its relic population can be produced via different mechanisms, which result to "warmer" or "colder" dark matter that can explain the small-scale structure of the universe. The X-ray photons produced in the radiative decay of the dark-matter sterile neutrino can speed up the formation of the first stars and constitute a potentially observable signal that can ultimately lead to its discovery. The same particle can be produced inside neutron stars and give rise to the observed velocities of pulsars. Heavier sterile neutrinos can be produced in supernova cores and affect greatly the thermal evolution of the star. Being short-lived, they would decay inside the envelope and facilitate the energy transport from the core to the vicinity of the supernova shock. This enhances the probability for a successful explosion. Such a scenario would give rise to a high-energy neutrino signature, detectable by galactic supernova neutrino observations.

**Danny Marfatia, University of Kansas:**

**Phase Transition in the Fine Structure Constant**

Within the context of mass-varying neutrinos, we construct a cosmological model that has a phase transition in the electromagnetic fine structure constant $\alpha$ at a redshift of $0.5$. The model accommodates hints of a time variable $\alpha$ in quasar spectra and the nonobservance of such an effect at very low redshifts. It is consistent with limits from the recombination and primordial nucleosynthesis era and is free of instabilities.

**Piero Madau, University of California Santa Cruz:**

**Galactic Cold Dark Matter Substructure**

The amount and spatial distribution of dark matter substructure in the Milky Way halo provide unique information and clues on the galaxy assembly process and the nature of the dark matter. I will present results from the "Via Lactea Project", a suite of extremely high-resolution simulations of Galactic CDM substructure, with a particular focus on the possibility of the Fermi Gamma-Ray Telescope detecting gamma rays from dark matter annihilations in the centers of subhalos.

**Jennifer Siegal-Gaskins, Center of Cosmology & AstroParticle Physics - Ohio State University:**

**The Angular Power Spectrum of the Diffuse Gamma-Ray Background as a Probe of Galactic Dark Matter Substructure**

Recent work has shown that dark matter annihilation in galactic substructure will produce diffuse gamma-ray emission of remarkably constant intensity across the sky, and in general this signal will dominate over the smooth halo signal at angles greater than a few tens of degrees from the galactic center. The large-scale isotropy of the emission from substructure suggests that it may be difficult to extract this galactic dark matter signal from the extragalactic gamma-ray background. I will show that dark matter substructure induces characteristic small-scale anisotropies in the diffuse emission which may provide a robust means of distinguishing this component. I will present the angular power spectrum of the emission from galactic dark matter substructure for several models of the subhalo population, and show that features in the power spectrum can be used to infer the presence of substructure. The anisotropy from substructure is substantially larger than that predicted for the extragalactic gamma-ray background, & consequently the substructure signal can dominate the measured angular power spectrum even if the extragalactic background emission is a factor of 10 or more greater than the emission from dark matter. I will show that for many scenarios a measurement of the angular power spectrum by Fermi will be able to constrain the abundance of substructure in the halo.
Ian Shoemaker, University of California - Los Angeles:
Relic Supersymmetric Qballs & Dark Matter

Supersymmetric generalizations of the standard model admit Q-ball solutions with baryon and lepton charges. Stable Q-balls formed at the end of inflation via the fragmentation of the Affleck-Dine condensate can comprise the dark matter. We have shown that the ground state of baryoleptonic Q-balls can be electrically charged. Such objects can acquire an electronic cloud, creating exotic Q-atoms and Q-molecules. The phenomenology of such Q-chemistry opens a new experimental probe on relic Q-balls.

David Schlegel, Lawrence Berkeley National Lab:
The Baryon Oscillation Spectroscopic Survey (BOSS)

The Baryon Oscillation Spectroscopic Survey (BOSS) on the SDSS Telescope will map 1.3 million galaxies at $z<0.7$ and measure hydrogen absorption in 160,000 QSOs at $z>2$. This will provide the definitive measurement of the low-redshift baryon acoustic oscillation (BAO) scale, and it will pioneer a powerful new method of measuring BAO at high redshifts.

Salman Habib, Los Alamos National Laboratory:
Meeting the Precision Cosmology Challenge

Structure formation probes of the content and evolution of the Universe are about to reach quite astonishing levels of accuracy (or so say observers). How much these probes can inform us about fundamental aspects of cosmology and particle physics depends on our ability to make accurate predictions to compare to the observations. Additionally, we must be able to understand, and account for, a host of niggling systematic issues. The future of precision theory, although apparently bright, appears to involve, unfortunately, a lot of hard work. I will briefly describe some of our efforts to simulate the dynamics of the Universe with the best error controls so far achieved, where we are headed with this, and how one can best combine our results with observations.

Hume Feldman, University of Kansas:
Nonlinear Effects in Cosmological Density Fluctuations Estimated from Cosmic Flows

The amplitude of cosmological density fluctuations, $\sigma_8$, has been studied and estimated by analyzing many cosmological observations. The values of the estimates vary considerably between the various probes. However, different estimators probe the value of $\sigma_8$ in different cosmological scales and do not take into account the nonlinear evolution of the parameter at later times. We show that estimates of the amplitude of cosmological density fluctuations derived from velocity flows are systematically higher than those inferred at early epochs because of nonlinear evolution at later times. Here we derive corrections to the value of $\sigma_8$ and compare amplitudes after accounting for this effect.

Ben Bromley, University of Utah:
Hypervelocity Stars

Three years ago, in a survey of blue stars targeted by the Sloan Digital Sky Survey, Brown et al. discovered an object moving at roughly 800 km/s away from the center of the Galaxy, clearly on an escaping trajectory. A plausible explanation for the existence of such a star was provided almost two decades earlier by Jack Hills: The star was once a member of a binary, and was flung outward—in slingshot fashion—when the binary strayed too close to Sgr A*, the massive black hole in the center of the Galaxy. Since the initial discovery, over a dozen more "hypervelocity" stars (HVS's) have been identified. Here we consider the use of HVS's as probes of the structure of the Galaxy's dark matter halo, and of their implication for the environment around Sgr A*. Thus, the small-scale astrophysics near the central black hole is connected with the large-scale distribution of matter in the Galaxy.
Gabriel Caceres, Pennsylvania State University:  
Neutralino Dark Matter as the Source of the WMAP Haze  

It has been argued that the anomalous emission from the region around the Galactic Center observed by WMAP, known as the "WMAP Haze", may be the synchrotron emission from relativistic electrons and positrons produced in dark matter annihilations. In particular, the angular distribution, spectrum, and intensity of the observed emission are consistent with the signal expected to result from a WIMP with an electroweak-scale mass and an annihilation cross section near the value predicted for a thermal relic. Here we revisit this signal within the context of supersymmetry and evaluate the parameter space of the Constrained Minimal Supersymmetric Standard Model. We find that over much of the supersymmetric parameter space the lightest neutralino is predicted to possess the properties required to generate the WMAP Haze. In particular, the focus point, A-funnel, and bulk regions typically predict a neutralino with a mass, annihilation cross section, and dominant annihilation modes that are within the range required to produce the observed features of the WMAP Haze. The stau-coannihilation region, in contrast, is disfavored as an explanation for the origin of this signal. If the WMAP Haze is indeed produced by annihilating neutralinos, prospects for future detection seem promising.

Daniel Holz, Los Alamos National Laboratory:  
Cosmology from Standard Sirens  

We discuss the use of gravitational wave siren sources as probes of cosmology. The inspiral and merger of a binary system, such as a pair of black holes or neutron stars, is extraordinarily bright in gravitational waves. By observing such systems, it is possible to directly measure a self-calibrated absolute distance to these sources out to very high redshift. When coupled with independent (electromagnetic) measures of the redshift, these "standard sirens" enable precision estimates of cosmological parameters. We review potential GW standard sirens for the LIGO and LISA gravitational wave observatories, including gamma-ray bursts and supermassive black hole inspirals. Percent-level measurements of the Hubble constant and the dark energy equation-of-state may be feasible with these instruments.

Anupam Mazumdar, Lancaster University:  
Observable Gravity Waves from MSSM Inflation  

I will discuss how inflation driven by supersymmetric partners of Standard Model quarks and leptons could leave their imprint in the gravity wave astronomy with a signature that can be detected by the forthcoming experiments such as LISA, LIGO and BBO.

Shane Larsen, Utah State University: LISA:  
Seeing the Cosmos in Low Frequency Gravitational Waves  

Late in the next decade, NASA and ESA will launch the first gravitational wave observatory in space: the Laser Interferometer Space Antenna (LISA). LISA is a constellation of spacecraft that operate in concert as a 5-million kilometer armlength interferometer. It will be sensitive to low-frequency radiation in the millihertz regime of the gravitational wave spectrum. In this part of the spectrum, LISA will observe massive black hole binaries, interacting binaries in the galaxy, the capture of stellar mass objects by supermassive black holes in galactic nuclei, and possibly stochastic backgrounds of gravitational radiation of cosmological origin. In this talk, we will discuss the LISA configuration and operations, and discuss the science that LISA's observations of the Cosmos will reveal.

George Cassiday, University of Utah:  
History of Cosmic Ray Physics at Utah  

In the early 1960's, Jack Keuffel established the first cosmic ray physics group at the University of Utah in order to build a large neutrino detector deep under the Wasatch Mountains in a silver mine in Park City, Utah. Its construction and subsequent operation was funded by a grant that Jack had obtained from the NSF. Jack came from Princeton University where, as a young assistant professor, he developed a charged-particle detector, known as the “Keuffel counter”, the precursor of the spark chamber and, upon modification, would become one of the critical components of the Utah neutrino detector. Jack was one of a number of scientists hired at Utah in the 60's and 70's as part of an expansion program made possible by an NSF Center of Excellence grant obtained by Peter Gibbs, then chairman of the physics department. It is my pleasure, as the sole remaining member of that original group, to describe the history of those early efforts in cosmic ray physics that took place under Jack’s direction. In addition, I’ll discuss the history of the experimental cosmic ray physics programs that followed Jack’s seminal work, which never would have occurred had it not been for Jack’s insights, guidance and energetic desire to perpetuate cosmic ray physics at Utah.
Richard Massey, Royal Observatory Edinburgh:  
Weak Lensing Surveys

The past few years have seen dramatic progress in measurements of weak gravitational lensing, the slight deflection of light from distant galaxies due to the curvature of intervening space. The deflections can be observed as slight distortions in the apparent shapes of those galaxies: an effect known as "cosmic shear". Because the distortion is only slight, and imaging from ground-based telescopes is subject to confusing additional blurring by the atmosphere, the effect is most easily seen from space. Indeed, recent gravitational lensing observations from the Hubble Space Telescope have provided direct proof for an additional, invisible component of mass in clusters of galaxies, and large-scale maps of the total distribution of mass in the Universe. I review the current state of the art, then prospects and challenges for future measurements of gravitational lensing from dedicated new satellites.

Gil Holder, McGill University:  
Cluster Cosmology and the South Pole Telescope

Clusters of galaxies are sensitive probes of cosmology. The number as a function of redshift is very sensitive to things like the dark matter density and the dark energy equation of state, and in general to any physics that affects the growth of structure, such as modified gravity. However, the number density is also strongly dependent on the mass of the object which is being studied, and mass is not a direct observable. The South Pole Telescope is a large CMB experiment that is cataloging clusters through the Sunyaev-Zeldovich effect. I'll discuss the prospects for dark energy/modified gravity studies with the experiment.

Andy Howell, Las Cumbres Observatory Global Telescope Network & UC Santa Barbara:  
Latest Results from the Supernova Legacy Survey (SNLS)

The Supernova Legacy Survey was a five-year program which discovered more than 400 spectroscopically confirmed Type Ia supernovae (SNe Ia) in the range 0.2<z<1.0. I show the cosmological results from the 3rd year analysis, with emphasis on sources of systematic error. I also discuss the influence of progenitor age and metallicity on the use of supernovae as standard candles, and how the properties of SNe Ia may evolve with redshift.

Richard Kessler, University of Chicago:  
Cosmological Results Based on Five SN–Ia Samples

We present cosmological results based on five SN–Ia samples: Nearby, SDSS-II, ESSENCE, SNLS and HST. The largest and newest sample contains 103 SNe Ia from the first season of the SDSS-II Supernova Survey. Cosmological results and systematic uncertainties have been estimated using both the MLCS and SALT-II methods.

Richard Cool, Princeton University:  
The Popular Model for the Formation of Early-Type Galaxies

The popular model for the formation of early-type galaxies is the hierarchical merging scenario. However, the details and frequency of merging are not yet known, particularly in dense environments. The high-mass end of the galaxy luminosity function, as the extreme example of the merger phenomenon, is the most sensitive to various merger model assumptions and thus provides an ideal testing ground for these models. I will present recent work utilizing wide-area spectroscopic surveys to place constraints on the merger histories of the most massive galaxies in the universe since z=1. In particular, I will show that the number density of very massive galaxies has evolved little in that same epoch, suggesting that very massive galaxies assembled their stellar mass at z>1. I will close with a brief introduction of PRIMUS, a new spectroscopic survey aimed at observing 15 square degrees of the southern sky with high-quality archival optical, infrared, and X-ray data and obtaining 300,000 galaxy redshifts to z=1. PRIMUS will be the largest intermediate-redshift galaxy survey to date as well as the largest sample of Spitzer-detected objects and will allow for a broad-range of investigations.
Steve Barwick, University of California - Irvine:
Searching for Sources of Extremely Energetic Neutrinos
Dedicated high-energy neutrino telescopes based on optical Cherenkov techniques have been scanning the cosmos for about a decade. At TeV scales, limits on the diffuse flux have improved by several orders of magnitude, eliminating the most optimistic models that tend to be normalized to the extragalactic x-ray or gamma-ray luminosity. At higher energies, they have provided the first neutrino flux limits from point sources and diffusely distributed sources such as cosmogenic neutrinos generated by the GZK process, whose existence is relatively secure but predicted flux is frustratingly small. To substantially improve the experimental capabilities at the very highest energies, new techniques are required. I will briefly discuss results from the radio-based Cherenkov detector ANITA, and describe a new concept called ARIANNA that promises to increase the sensitivity to neutrinos with energies in excess of $10^{17}$ eV. Radio Cherenkov telescopes have already ruled out some of the more exotic predictions for neutrino intensity at extreme energies and may soon test more conventional GZK models. In addition to flux measurements, these devices can probe for non-standard particle physics by investigating the neutrino cross-section.

Bing Zhang, University of Nevada:
GRB 080913 at z=6.7 & a Physical Classification Scheme of Gamma-Ray Bursts
GRB 080913 at z=6.7 is the current redshift record holder of GRBs. Surprisingly, it is an intrinsically short duration GRB. This raises the question whether it is an intrinsically short-duration collapsar event or a high-redshift compact star merger event. I'll discuss a physical classification scheme of GRBs: Type II GRBs are related to massive star core collapses and Type I GRBs are related to compact star mergers. I'll address why durations are no longer reliable indicators of the physical category, and discuss a practical strategy to infer the physical category of a GRB based on multiple observational criteria. According to these criteria, GRB 080913 is likely a short-duration Type II (collapsar) event.

Teresa Montaruli, University of Wisconsin – Madison:
Searching Astrophysical Neutrinos with Neutrino Telescopes
After an introduction on neutrino astronomy, I will describe the detection principle of neutrino telescopes and give the recent updates on their construction or operation. I will then present some of their results focusing on the status of searches for point searches in IceCube and in ANTARES. The analysis of 40 strings of IceCube data will bring the sensitivity to the level expected by many models on neutrino production.

Patrick Toole, Pennsylvania State University:
IceCube: Towards a Cubic Kilometer Neutrino Detector
The IceCube neutrino observatory, under construction in the deep ice below the South Pole, detects neutrinos by measuring either the light produced by the hadronic shower at their point of interaction, or the Cherenkov radiation emitted by secondary charged leptons, or both. The final detector configuration will consist of nearly 5000 optical modules deployed throughout a cubic kilometer of ice, plus an array of surface tanks to measure cosmic rays. The science goals of IceCube are broad, ranging from studies of cosmic rays and atmospheric neutrinos, to searches for astrophysical sources of neutrinos, to the indirect detection of dark matter. In this talk I will present the current status of IceCube as it approaches a cubic kilometer.

Alexander Friedland, Los Alamos National Laboratory:
What Big Stars Can Tell Us About Tiny Particles
I will discuss how astrophysical systems such as stars and supernovae can be used to search for, and constrain, particle physics beyond the Standard Model. Several examples will be considered: neutrino magnetic moment, axion-photon coupling, and models in which the photon can escape into extra dimensions. Time permitting I will also outline how the latter are related to the so-called "unparticle physics" models of Howard Georgi.