Particle Astrophysics 2011

Report of Contributions

Contribution ID: **1** Type: **not specified**

Cosmology and the Cosmic Microwave Background

The last decade has been a remarkable time for cosmology. We now have a testable model for the origin and evolution of the Universe from its first instants to the present day. The model contains some remarkable components about which we know very little. Baryonic matter accounts for only a few percent of the make-up of the Universe; dark matter accounts for only a quarter; and the dominant component is the mysterious dark energy which is causing the expansion of the Universe to accelerate. The model starts with a period of inflation from quantum fluctuations at extremely high energy and leads eventually to all the splendid structure around us today. Much of the model has been determined from measurements of cosmic microwave background radiation (CMB). After a brief review of the field, this talk will focus on the newest CMB results and those being pursued to test the model and to investigate the nature of dark energy and inflation.

Primary author: CARLSTROM, John (KICP, University of Chicago)

Presenter: CARLSTROM, John (KICP, University of Chicago)

Track Classification: Cosmology - John Carlstrom

Contribution ID: **2** Type: **not specified**

Dark Matter

Friday, 29 April 2011 09:00 (45 minutes)

We have strong evidence that about 83% of matter in our Universe is dark, revealing its presence only by its gravitational attraction. If the dark matter is made up of Weakly Interacting Massive Particles (WIMPs), it can be directly detected via elastic scattering from nuclei in ultra-low background, deep underground detectors. WIMPs arise naturally in many beyond-Standard-Model theories, a popular example being the neutralino, or the lightest supersymmetric particle. After an introduction to the direct-detection method, I will review the current techniques to search for these hypothetical particles. The focus will be on recent results, and on the most promising techniques for the near future.

Primary author: BAUDIS, Laura (Physik Institut, U of Zurich)

Presenter: BAUDIS, Laura (Physik Institut, U of Zurich)

Session Classification: Dark Matter - Laura Baudis, U of Zurich

Track Classification: Dark Matter - Laura Baudis

Contribution ID: **3** Type: **not specified**

TeV Gamma Rays

Saturday, 30 April 2011 11:45 (45 minutes)

Gamma rays, like neutrinos, are "messengers" of distant, high-energy cosmic events, and are thus indispensible tools to help understand quite a few fundamental questions in our Universe. The field of gamma-ray astronomy is a section of high-energy particle astrophysics research. The window of TeV gamma-ray astronomy was only opened in 1989, with the discovery of the first TeV gamma-ray source, the Crab Nebula, by the Whipple collaboration. Since then, this research field is rapidly expanding; over 100 Galactic and extragalactic sources have been discovered, and quite a number of fundamental astrophysics questions have been studied. In my talk, I will review the physics goals, observation techniques, links to other sections of high-energy particle astrophysics, and prospects for the coming years.

Primary author: LORENZ, Eckart (Max Planck Institute for Physics, Munich)

Presenter: LORENZ, Eckart (Max Planck Institute for Physics, Munich)

Session Classification: TeV Gamma Rays - Eckart Lorenz, Max Planck Institute, Munich

Track Classification: TeV Gamma Rays - Eckart Lorenz

Contribution ID: **4** Type: **not specified**

IceCube

Friday, 29 April 2011 17:15 (45 minutes)

The completion of the IceCube neutrino observatory represents a milestone for neutrino astronomy. A cubic kilometer of the Antarctic glacier has been transformed into the world's largest particle detector, aiming to explore and chart the sites of the most violent processes in the Universe. Some of these sources are out of reach for conventional astronomy, since the Universe is opaque to high-energy gamma rays originating from beyond the edge of our own Galaxy. IceCube also joins the hunt for dark-matter particles and aims to study the properties of neutrinos themselves. IceCube has been producing science during construction. The talk will present some results and celebrate the achievement that IceCube represents.

Primary author: BOTNER, Olga (Dept. of Physics & Astronomy, Uppsala U)

Presenter: BOTNER, Olga (Dept. of Physics & Astronomy, Uppsala U)

Session Classification: IceCube - Olga Botner, Uppsala University

Track Classification: IceCube - Olga Botner

Contribution ID: **5** Type: **not specified**

Mediterranean Neutrino Telescopes

Friday, 29 April 2011 15:15 (45 minutes)

Most of the information that we have about the Universe has been conveyed by photons originating in electromagnetic processes. Neutrino telescopes offer the possibility to see the Universe with new "eyes," allowing the study of the most powerful cosmic accelerators via high-energy neutrinos generated in hadronic processes.

In the Mediterranean Sea, a number of efforts (ANTARES, NESTOR and NEMO) are ongoing, to help develop the technology and techniques necessary to construct a multi-cubic-kilometer, deep-sea neutrino telescope. The most advanced of these projects, ANTARES, is located at a depth of 2475 meters offshore from Toulon, France. Various aspects of detector construction, calibration methods, and recent results obtained with the first ANTARES data will be detailed. The planned next-generation cubic-kilometer telescope, KM3NeT, will also be presented.

Such deep-sea infrastructure also provides synergetic opportunities for research in oceanography, seismology and marine sciences; some examples of these interdisciplinary activities will also be highlighted.

Primary author: COYLE, Paschal (Centre de Physique des Particules de Marseille, France)

Presenter: COYLE, Paschal (Centre de Physique des Particules de Marseille, France)

Session Classification: Mediterranean Neutrino Telescopes - Paschal Coyle

Track Classification: Mediterranean Neutrino Telescopes - Paschal Coyle

Contribution ID: **6** Type: **not specified**

Gamma Rays from Space

Saturday, 30 April 2011 11:00 (45 minutes)

The Fermi Gamma-Ray Space Telescope, formerly called GLAST, measures the cosmic gamma-ray flux in the energy range from 20 MeV to >300 GeV, with supporting measurements for gamma-ray bursts from 8 keV to 30 MeV. In addition, to breakthrough capabilities in energy coverage and localization, the very large field of view enables observations of 20% of the sky at any instant, and the entire sky on a timescale of a few hours. With its launch just over 2.5 years ago, Fermi opens a new and important window on a wide variety of phenomena, including pulsars, black holes and active Galactic nuclei, gamma-ray bursts, supernova remnants and the origins of cosmic rays, and searches for hypothetical new phenomena such as particle dark-matter annihilations. In addition to a summary of results and science opportunities, this talk notes important connections between IceCube and Fermi.

Primary author: RITZ, Steve (SCIPP, UCSC)

Presenter: RITZ, Steve (SCIPP, UCSC)

Session Classification: Gamma Rays from Space - Steve Ritz

Track Classification: Gamma Rays from Space - Steve Ritz

Contribution ID: **7** Type: **not specified**

Tracing Dark Matter in the Universe

Saturday, 30 April 2011 09:00 (45 minutes)

Where is the Dark Matter located? How is it distributed on large scales? I will discuss recent observations using the Sloan Digital Sky Survey that utilize gravitational lensing to trace the mass distribution around galaxies and clusters of galaxies to the largest scales yet observed. We compare the mass distribution with the observed distribution of light and show that, while the mass distribution is considerably more extended than light on galactic scales-representing the huge dark-matter haloes around galaxies, the mass follows light on larger scales.

On scales larger than a few hundred Kpc, there is no significant separation between dake and luminous (baryonic) matter; the mass and light follow each other with a nearly constant mass-to-light ratio. This universal M/L value indicates the end of the dark-matter excess over light; it thus represents the total mass-density of the Universe. The results suggest that most of the dark matter in the Universe is located in very large haloes around galaxies and inside clusters of galaxies, but no significant increase in the dark-matter component is present on larger scales. The "end" of the dark-matter distribution is reached on these scales. The implications for cosmology and the mass-density of the Universe, as well as for galaxy and structure formation, will be discussed.

Primary author: BAHCALL, Neta (Princeton University)

Presenter: BAHCALL, Neta (Princeton University)

Session Classification: Tracing Dark Matter in the Universe - Neta Bahcall, Princeton

Track Classification: Astronomy / Cosmology - Neta Bahcall

Contribution ID: **8** Type: **not specified**

Neutrino Telescopes - A Journey

Friday, 29 April 2011 14:30 (45 minutes)

One can write the history of large neutrino telescopes as a story of leaking glass spheres, of light-scattering bubbles in ice, of the impact of the Cold War and of breaking empires, of failures and of over-optimistic assumptions. It was all of that. But more importantly, it was and is a great journey, made possible through stamina, eventual technological breakthroughs, great innovations, scientific brilliance and frequent views to new landscapes.

From the first idea to build underwater neutrino telescopes to the first neutrino skymap with AMANDA-B10, it took 40 years (the usual quantum of historic pilgrimages). From 2000 to now, our sensitivity has improved by nearly a factor of 1000 (the usual quantum which historically made astronomical discoveries - nearly! - guaranteed). Will we have jumped too short with IceCube, or will we enter the promised land? The next years will show!

Primary author: SPIERING, Christian (DESY)

Presenter: SPIERING, Christian (DESY)

Session Classification: Neutrino Telescopes - A Journey - Christian Spiering, DESY

Track Classification: Neutrino Telescopes - A Journey - Christian Spiering

Contribution ID: **9** Type: **not specified**

Non-Accelerator Neutrinos and the State of Neutrino Studies

Friday, 29 April 2011 11:00 (45 minutes)

I will begin with a summary of what we know about neutrinos, much of it learned in non-accelerator particle physics experiments employing the cosmic rays, the sun, radioactive sources and nuclear reactors. I will also tally the open questions about neutrinos, curiosities associated with neutrinos, and summarize efforts attempting to probe these (some to be covered the subsequent talk). We are now starting to apply neutrinos as well for studying the earth and for remote reactor monitoring

Primary author: LEARNED, John (University of Hawaii, Manoa)

Presenter: LEARNED, John (University of Hawaii, Manoa)

Session Classification: Non-Accelerator Neutrinos - John Learned, U of Hawaii-Manoa

Track Classification: Non-Accelerator Neutrinos - John Learned??

Contribution ID: **10** Type: **not specified**

Probing Neutrino Masses and Mixings with Accelerator (and Reactor) Neutrinos

Friday, 29 April 2011 11:45 (45 minutes)

It is now well established that neutrinos have mass and that there is mixing among the different neutrino types. This has led to many questions with respect to the properties of neutrinos, including why are the masses so small, are there more than three types such as additional sterile neutrino types, are there CP violations associated with neutrino oscillations, and are the neutrinos Dirac or Majorana particles?

In this talk, I will present the status and plans for exploring some of these questions using accelerator (and reactor) neutrinos. With respect to oscillations among the three standard neutrinos, the current program for measuring the third mixing angle, theta13, will be presented, along with future plans for using long baseline experiments to search for CP violation and the mass hierarchy. Finally, the status of possible oscillations to sterile neutrinos will be described including the results from LSND, MiniBooNE and the recent reanalysis of reactor oscillation data.

Primary author: SHAEVITZ, Mike (Columbia University)

Presenter: SHAEVITZ, Mike (Columbia University)

Session Classification: Accelerator Neutrinos - Mike Shaevitz

Track Classification: Accelerator Neutrinos - Mike Shaevitz

Contribution ID: **11** Type: **not specified**

Cosmology and the Cosmic Microwave Background

Saturday, 30 April 2011 09:45 (40 minutes)

The last decade has been a remarkable time for cosmology. We now have an testable model for the origin and evolution of the universe from its first instants to the present day. The model contains some remarkable components about which we know very little. Baryonic matter accounts for only a few percent of the make-up of the universe, dark matter accounts for roughly a quarter, and the dominant component is the mysterious dark energy which is causing the expansion of the universe to accelerate. The model starts with a period of inflation from quantum fluctuations at extremely high energy and leads eventually to all the splendid structure around us today. Much of the model has been determined from measurements of the cosmic microwave background radiation (CMB). After a brief review of the field, this talk will focus on the newest CMB results and those being pursued to test the model and to investigate the nature of dark energy and inflation.

Primary author: Mr CARLSTROM, John (The University of Chicago)

Presenter: Mr CARLSTROM, John (The University of Chicago)

Session Classification: Cosmology and the Cosmic Microwave Background - John Carlstrom, KICP, University of Chicago

Track Classification: Cosmology - John Carlstrom

Contribution ID: **12** Type: **not specified**

High energy neutrino sources

Friday, 29 April 2011 16:30 (45 minutes)

The completed IceCube detector achieves the minimum sensitivity required for the detection of high energy extra-Galactic sources of neutrinos. I will discuss the prospects for detecting such sources, and the outstanding astrophysics and physics open questions that may be resolved by their detection. These open questions include the origin of ultrahigh energy cosmic, the underlying physics of models describing high energy astrophysical sources, and neutrino properties (e.g. flavor oscillations and coupling to gravity).

Primary author: WAXMAN, Eli (Weizmann Institute)

Presenter: WAXMAN, Eli (Weizmann Institute)

Session Classification: Sources of High-Energy Neutrinos - Eli Waxman, Weizmann Institute

Track Classification: Sources of High-Energy Neutrinos - Eli Waxman

Contribution ID: **14** Type: **not specified**

Cosmic Rays

Friday, 29 April 2011 09:45 (45 minutes)

Alan Watson

Primary author: WATSON, Alan (U of Leeds)

Presenter: WATSON, Alan (U of Leeds)

Session Classification: Cosmic Rays - Alan Watson

Track Classification: Cosmic Rays - Alan Watson