IPA 2017

Report of Contributions

https://events.icecube.wisc.edu/e/82

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

Distinguishing Flavors of Astrophysical Neutrinos

Monday, 8 May 2017 15:00 (15 minutes)

We are entering a new era of neutrino astronomy with the recent IceCube discovery of high-energy astrophysical neutrinos. Important questions, such as what their sources are, arise with these events. The flavor composition of these neutrinos has been identified as a rich observable, containing information about the production processes and neutrino properties. So far, only ν_μ charged current interactions can be uniquely identified in IceCube. We propose new methods that can help identify ν_τ events. Our method could significantly enhance the IceCube flavor measurement sensitivity, making it possible to tell if new physics is required to explain the flavor composition.

Primary author: LI, Shirley (The Ohio State University)

Co-authors: BEACOM, John (The Ohio State University); Dr BUSTAMANTE, Mauricio (Center for Cosmology and Astroparticle Physics, The Ohio State University)

Presenter: LI, Shirley (The Ohio State University)

Session Classification: Neutrino Astronomy

Track Classification: Neutrino Astronomy - Convenor: Gisela Anton, FAU / ECAP

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

Constraints on the astrophysical flux and the dark matter decay with IceCube HESE data

Monday, 8 May 2017 14:30 (18 minutes)

The IceCube detection of High Energy Starting Events (HESE) and the upward muon track events (6 year data) are presently hard to explain with the single power-law astophysical flux for energies above 30TeV. We investigate the possibility that a significant component of the additional neutrino flux originates due to the decay of a very heavy dark matter particle via several possible channels into standard model particles. We perform a full 5 parameter fit to IceCube data in which we vary astrophysical flux normalization, power-law index, dark matter mass, dark matter lifetime and dark matter decay mode. We show that that dark matter with mass in the range 200-400 TeV, lifetime around 10^27s and soft-channel decay mode (DM –> W^+ W^-, b \bar b, etc) provides much better fit to IC data than the best-fit astrophysical flux alone. For hard decay channels such as DM –> nu_e + \bar nu_e, the best fit gives mass of few PeV, thus contributing only to the highest energy events. We have also done analysis by using the prior that would fix power-law index to the best fit value for upward muon track events (gamma \sim 2.13), and we find that in this case, all dark matter decay channels contribute substaintially, but the fit overall is not as good as without the prior.

Primary author: Prof. SARCEVIC, INA (University of Arizona)

Co-authors: Dr BHATTACHARYA, Atri (Space sciences, Technologies and Astrophysics Research (STAR) Institute, Universit\'{e} de Li\'{e}ge, B\^{a}t.~B5a, 4000 Li\'{e}ge, Belgium); Dr ARMAN, Esmaili (INFN, Laboratori Nazionali del Gran Sasso, Assergi (AQ), Italy); Dr PALOMARES-RUIZ, Sergio (Instituto de F\'{\i}sica Corpuscular (IFIC), CSIC-Universitat de Val\'{e}ncia, Apartado de Correos 22085, E-46071 Valencia, Spain)

Presenter: Prof. SARCEVIC, INA (University of Arizona)

Session Classification: Dark Matter

Track Classification: Dark Matter - Convenor: Carsten Rott, SKKU

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

DarkSide- An Instrumental Background Free Search for Dark Matter

Monday, 8 May 2017 17:24 (18 minutes)

The DarkSide program for the direct detection of WIMP dark matter is a phased program, set at Laboratori Nazionali del Gran Sasso in Italy. TheDarkSide-50 detector is a two-phase argon TPC installed at the center of two nested veto detectors, a 30-tonne liquid scintillator neutron veto and a 1,000-tonne water Cherenkov muon veto. While operating in 2014 with a fill of argon extracted from the atmosphere, DarkSide-50 demonstrated its capability to operate in a background-free mode even in presence of the strong radioactive background due to the 39Ar isotope. In 2015 DarkSide was filled with 150 kg of argon extracted from deep underground reservoirs, allowing DarkSide-50 to make the most sensitive measurement of the 39Ar activity in underground argon. This underground argon was then used to set the strongest WIMP dark matter limit using liquid argon, to date. Today DarkSide-50 is the only noble liquid dark matter detector operating in background-free mode. Plans for scaled-up extraction of the underground argon, along with major developments in the technology of silicon photomultipliers (SiPMs) and their cryogenic applications within the DarkSide collaboration, have paved the way for the next detector in the DarkSide family, DarkSide-20k. This 20-tonne fiducial mass detector is in its final stages of approval, with the aim of construction starting as soon as funding is released. Overviews of the DarkSide program and of the recent results from DarkSide-50 will be presented, as well as details for the next generation dual-phase liquid argon TPC, DarkSide-20k.

Primary author: Prof. RENSHAW, Andrew (University of Houston)

Presenter: Prof. RENSHAW, Andrew (University of Houston)

Session Classification: Dark Matter

Track Classification: Dark Matter - Convenor: Carsten Rott, SKKU

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

Comprehensive explanation of ultrahigh energy cosmic ray "anomalies": Quark matter formation by heavy nuclear primaries

Tuesday, 9 May 2017 14:48 (18 minutes)

The Pierre Auger Collaboration has reported an excess in the number of muons of a few tens of percent over expectations computed using extrapolation of hadronic interaction models tuned to accommodate LHC data, I'll present an explanation for the muon excess assuming the formation of a deconfined quark matter (fireball) state in central collisions of ultrarelativistic cosmic rays with air nuclei. At the first stage of its evolution, the fireball contains gluons as well as u and d quarks. The very high baryochemical potential inhibits gluons from fragmenting into $u\bar{u}$ and $d\bar{d}$, and so they fragment predominantly into $s\bar{s}$ pairs. The hadronization which follows this leads to the strong suppression of pions and hence photons, but allows heavy hadrons to be emitted carrying away strangeness. In this manner, the extreme imbalance of hadron-to-photon content provides a way to enhance the muon component of the air shower. I'll also discuss theoretical systematics from hadronic interaction models used to describe the cascades of secondary particles produced in the fireball explosion. I'll compare the predictions of the leading LHC-tuned models (EPOS-LHC and QGSJet-II-04) considered in the Auger analysis.

Primary author: ANCHORDOQUI, Luis (CUNY)

Presenter: ANCHORDOQUI, Luis (CUNY)

Session Classification: Cosmic Rays

Track Classification: Cosmic Rays - Convenor: Andreas Haungs, KIT

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

Neutrino Astronomy of Transient Signals

Wednesday, 10 May 2017 12:00 (30 minutes)

The recent discovery of high-energy astrophysical neutrinos has opened a new window to the Universe. However, the sources of those neutrinos are still unknown. Many of the plausible candidates are of transient nature, such as gamma-ray bursts, supernovae, tidal disruption events and flares of active galactic nuclei. Combining neutrino data with electromagnetic (EM) measurements in a multimessenger approach will increase our ability to identify the neutrino sources and help to solve long-standing problems in astrophysics such as the origin of cosmic rays. The systematic search for transient signals is challenging and requires regular all-sky monitoring of the EM sky or rapid real-time follow-up of interesting neutrino events.
I will review the recent progress in probing transient source populations as neutrino sources.

Primary author: FRANCKOWIAK, Anna (DESY)

Presenter: FRANCKOWIAK, Anna (DESY)

Session Classification: Plenaries

Track Classification: Neutrino Astronomy of Transient Signals- Anna Franckowiak, DESY

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

Direct Dark Matter search with nuclear emulsion based detector

Monday, 8 May 2017 17:42 (18 minutes)

Direct dark matter searches are promising techniques to identify the nature of dark matter particles. A variety of experiments have been developed over the past decades, aiming to detect Weakly Interactive Massive Particles (WIMPs) via their scattering in a detector medium. Exploiting directionality would also give a proof of the galactic origin of dark matter making it possible to have a clear and unambiguous signal to background separation. The directional detection of Dark Matter requires very sensitive experiment combined with highly performant technology. The NEWSdm experiment, based on nuclear emulsions, is proposed to measure the direction of WIMP-induced nuclear recoils. We discuss the potentiality, both in terms of exclusion limits and potential discovery, of a directional experiment based on the use of a solid target made by newly developed nuclear emulsions and read-out systems reaching sub-micrometric resolution.

Summary

NEWSdm collaboration submitted Letter of Intent to the Gran Sasso Scientific
Committee. Since a few years a lot of R&D is undertaken in emulsion and scanning technologies in the collaboration. We would like to report ongoing activities; reporting the update on our sensitivity including the direction information. Please consider enclosed abstract for an oral presentation.

Primary author: Prof. GULER, Ali Murat (METU)

Co-author: NEWSDM, Collaboration (NEWSdm)

Presenter: Prof. GULER, Ali Murat (METU)

Session Classification: Dark Matter

Track Classification: Dark Matter - Convenor: Carsten Rott, SKKU

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

Multi-messenger particle astrophysics

Wednesday, 10 May 2017 10:00 (30 minutes)

I illustrate different techniques used in multi-messenger particle astrophysics relevant for the identification of the origin of the observed high-energy neutrinos, and their major challenges. These techniques range from generic approaches (such as the relationship between the diffuse gamma-ray and neutrino backgrounds if produced in the same interaction chain), over the secondary production in known environments (such as in cosmic microwave and infrared backrounds), to the neutrino production in astrophysical objects with largely unknown target densities (such as GRBs and AGNs). One example for the future challenges is the spectrum and composition of the primary cosmic rays at the highest energies, and their impact on the neutrino production both from the sources themselves and from the propagation of the cosmic rays (cosmogenic neutrinos).

Primary author: Dr WINTER, Walter (DESY)

Presenter: Dr WINTER, Walter (DESY)

Session Classification: Plenaries

Track Classification: Multi-Messenger Particle Astrophysics- Walter Winter, Zeuthen

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

KASCADE-Grande: Composition studies in the view of the post-LHC hadronic interaction models

Tuesday, 9 May 2017 17:06 (18 minutes)

The KASCADE-Grande experiment has significantly contributed to the current knowledge about the energy spectrum and composition of cosmic rays for energies between the knee and the ankle. Meanwhile, post-LHC versions of the hadronic interaction models are available and used to interpret the entire data set of KASCADE-Grande. In addition, a new, combined analysis of both arrays, KASCADE and Grande, were developed increasing significantly the accuracy of the shower observables. Results of the new analyses with the entire data set of the KASCADE-Grande experiment will be discussed.

Primary author: Dr HAUNGS, Andreas (KIT)

Presenter: Dr HAUNGS, Andreas (KIT)

Session Classification: Cosmic Rays

Track Classification: Cosmic Rays - Convenor: Andreas Haungs, KIT

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

Cosmic Ray Streaming in Galaxy Clusters

Tuesday, 9 May 2017 14:30 (18 minutes)

The origin of diffuse radio emission in galaxy clusters remains an open question in astrophysics. This emission indicates the presence of cluster-wide magnetic fields and high energy cosmic ray (CR) electrons. I will discuss how the properties of the observed radio emission in clusters are shaped by different CR transport processes, namely CR streaming. I present simple numerical simulations of the Coma cluster that predict other observable signatures, such as gamma radiation, that can differentiate between models for the source of the CR electrons.

Primary author: WIENER, Joshua (UW Madison)

Presenter: WIENER, Joshua (UW Madison)

Session Classification: Cosmic Rays

Track Classification: Cosmic Rays - Convenor: Andreas Haungs, KIT

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

Gravitational Waves and Prospects for Multimesenger Astronomy

Monday, 8 May 2017 09:00 (30 minutes)

The recent observation in LIGO of gravitational waves from Black Hole binary mergers represents the beginning of a new way to study the universe. Prospects for detecting other gravitational wave sources and prospects for multi-messenger astronomy will be discussed.

Primary author: Prof. BARISH, Barry (California Institution of Technology)

Presenter: Prof. BARISH, Barry (California Institution of Technology)

Session Classification: Plenaries

Track Classification: Results from LIGO- Barry Barish, Caltech

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

High-energy neutrinos, cosmic rays, and gamma rays from gamma-ray bursts

Tuesday, 9 May 2017 14:48 (18 minutes)

Ultra-high-energy cosmic rays and high-energy astrophysical neutrinos are routinely detected, but their sources remain unknown. Gamma-ray bursts (GRBs) have long been considered attractive candidate sources. Recently, the lack of neutrinos detected in coincidence with known GRBs has motivated revisions of the multi-messenger emission mechanism — gamma rays, cosmic rays, neutrinos — from within the GRB jet. By embedding this revised mechanism in a simulation of multiple emission regions within the jet, we obtain a robust prediction for the minimal diffuse GRB neutrino flux, likely within the reach of the planned detector upgrade, IceCube-Gen2. Further, we show that, by looking for features in the shape of the GRB gamma-ray light curve, we can assess whether a particular burst is likely to be an intense neutrino source.

Primary author: Dr BUSTAMANTE, Mauricio (Center for Cosmology and Astroparticle Physics, The Ohio State University)

Co-authors: Mr HEINZE, Jonas (DESY); Prof. MURASE, Kohta (Pennsylvania State University); Dr WINTER, Walter (DESY)

Presenter: Dr BUSTAMANTE, Mauricio (Center for Cosmology and Astroparticle Physics, The Ohio State University)

Session Classification: Gamma Rays

Track Classification: Gamma Rays - Convenor: Reshmi Mukherjee, Columbia

Contribution ID: **13** Type: **not specified**

Detector Systematics in IceCube Neutrino Oscillation Analyses

Monday, 8 May 2017 14:30 (15 minutes)

The IceCube Neutrino Observary instruments about 1 km^3 of deep, glacial ice below the geographic South Pole with 5160 digital optical modules (DOMs) to register the Cherenkov light of passing charged particles. The DeepCore subdetector, a more densely instrumented region located in the clearest section of ice, provides sensitivity to neutrinos in the range of 5-100 GeV.
Using the DeepCore detector, IceCube provides competitive measurements of the the atmospheric oscillation parameters and puts constraints on sterile neutrino properties. These measurements are limited by the knowledge of systematics. This talk highlights the calibration and modelling of the most important detector systematics, namely the ice properties and the absolute photon detection efficiency and their impact on the analysis results.

Primary author: RONGEN, Martin (o=rwth,ou=Institutions,dc=icecube,dc=wisc,dc=edu)

Presenter: RONGEN, Martin (o=rwth,ou=Institutions,dc=icecube,dc=wisc,dc=edu)

Session Classification: Neutrino Properties

Track Classification: Non-Accelerator-Based Neutrino

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

Neutrinos from Supernovae

Tuesday, 9 May 2017 11:00 (30 minutes)

What is required to develop the full potential of neutrino astronomy? Robust detections, spanning a variety of energies and sources. Interdisciplinary work to define theoretical predictions. And careful comparisons of experiment and theory to develop new conclusions about astrophysical sources and neutrinos themselves. Supernova neutrinos must be part of this program. I will describe the experimental prospects, the latest predictions, and what we hope to learn, and how all of this relates to other sources of neutrinos, such as those detected by IceCube.

Primary author: Prof. BEACOM, John (Ohio State University)

Presenter: Prof. BEACOM, John (Ohio State University)

Session Classification: Plenaries

Track Classification: Neutrinos from Supernovae- John Beacom, Ohio State

Contribution ID: **15** Type: **not specified**

Search for diffuse neutrino emission from the Galactic Plane with 7 years of IceCube data.

Monday, 8 May 2017 17:15 (15 minutes)

The origin of high-energy astrophysical neutrinos measured by the IceCube Neutrino Observatory remains a mystery despite extensive searches for multimessenger correlations. In particular, no point sources have been identified so far. However a likely source for diffuse neutrino emission are cosmic-ray interactions in the galactic plane. Due to the excellent pointing of their track-like signature, muon neutrino induced muons are an ideal channel for measuring spatial correlations. Two methods were developed to test for a spatially-extended flux from the entire galactic plane, both maximum likelihood fits but with different background estimation techniques. We consider three templates for galactic neutrino emission based primarily on gamma-ray observations and models that cover a wide range of possibilities. We present constraints from seven years of IceCube Neutrino Observatory muon data on the neutrino flux coming from the galactic plane.

Primary authors: HAACK, Christian (o=rwth,ou=Institutions,dc=icecube,dc=wisc,dc=edu); Dr DUMM, Jonathan (o=research,ou=Institutions,dc=icecube,dc=wisc,dc=edu)

Presenter: HAACK, Christian (o=rwth,ou=Institutions,dc=icecube,dc=wisc,dc=edu)

Session Classification: Neutrino Astronomy

Track Classification: Neutrino Astronomy - Convenor: Gisela Anton, FAU / ECAP

Contribution ID: **16** Type: **not specified**

Nearby Pulsars and the Cosmic-Ray Positron Excess

Tuesday, 9 May 2017 15:24 (18 minutes)

Recent measurements of the Geminga and B0656+14 pulsars by the gamma-ray telescope HAWC (along with earlier measurements by Milagro) indicate that these objects generate significant fluxes of very high-energy electrons. From the measured gamma-ray intensity and spectrum of these pulsars, one can calculate and constrain their expected contributions to the local cosmic-ray positron spectrum. Among models that are capable of reproducing the observed characteristics of the gamma-ray emission, we find that pulsars invariably produce a flux of high-energy positrons that is similar in spectrum and magnitude to the positron fraction measured by PAMELA and AMS-02. In light of this result, it appears very likely that pulsars provide the dominant contribution to the long perplexing cosmic-ray positron excess.

Primary author: Prof. HOOPER, Dan (Fermilab/University of Chicago)

Presenter: Prof. HOOPER, Dan (Fermilab/University of Chicago)

Session Classification: Cosmic Rays

Track Classification: Cosmic Rays - Convenor: Andreas Haungs, KIT

Contribution ID: **17** Type: **not specified**

Testing the Neutrino Mass Ordering with Multiple Years of IceCube/DeepCore

Monday, 8 May 2017 14:45 (15 minutes)

The measurement of the Neutrino Mass Ordering (NMO), i.e. the ordering of the neutrino mass eigenstates, is one of the major goals of many future neutrino experiments. One strategy is to measure matter effects in the oscillation pattern of atmospheric neutrinos as proposed for the PINGU extension of the IceCube Neutrino Observatory. Already, the currently running IceCube/DeepCore detector can explore this type of measurement, albeit with lower significance. Furthermore, such an analysis exercises the measurement principle and evaluation of systematic uncertainties and thus prototypes future analyses with PINGU. We present a three-dimensional likelihood analysis for multiple years of IceCube data searching for indications of the NMO with a data sample reaching to energies below 10 GeV.

Primary author: LEUERMANN, Martin (o=rwth,ou=Institutions,dc=icecube,dc=wisc,dc=edu)

Co-author: WREN, Steven (o=manchester,ou=Institutions,dc=icecube,dc=wisc,dc=edu)

Presenter: LEUERMANN, Martin (o=rwth,ou=Institutions,dc=icecube,dc=wisc,dc=edu)

Session Classification: Neutrino Properties

Track Classification: Accelerator-Based Neutrinos - Convenor: Jennifer Thomas, University College London

Contribution ID: **18** Type: **not specified**

Modeling Cosmic Ray Acceleration by Galactic Wind Termination Shocks

Tuesday, 9 May 2017 15:06 (18 minutes)

Diffusive shock acceleration (DSA) at supernova remnant (SNR) shock fronts is thought to accelerate galactic cosmic rays (CRs) to energies below the knee, while an extragalactic origin is presumed for CRs with energies beyond the ankle. CRs with energies between 3 × 1015 and 1018 eV, which we dub the "shin," have an unknown origin. It has been proposed that DSA at galactic wind termination shocks, rather than at SNR shocks, may accelerate CRs to these energies. Our work uses the galactic wind model of Bustard et al. (2016) to analyze whether galactic wind termination shocks may accelerate CRs to shin energies within a reasonable acceleration time and whether such CRs can subsequently diffuse back to the Galaxy, where they can interact with dense ambient material to produce gamma-rays and neutrinos. I will argue for acceleration times on the order of 100 million years rather than a few billion years, as assumed in some previous works, and I will outline our analytic formulae, applicable to any wind model, for CR acceleration. Even with generous assumptions, we find that very high wind velocities are required to set up the necessary conditions for acceleration beyond 1017 eV. We also estimate the luminosities of CRs accelerated by outflow termination shocks, including estimates for the Milky Way wind.

Primary author: Mr BUSTARD, Chad (University of Wisconsin - Madison)

Co-authors: COTTER, Cory (UW-Madison); ZWEIBEL, Ellen (UW-Madison)

Presenter: Mr BUSTARD, Chad (University of Wisconsin - Madison)

Session Classification: Cosmic Rays

Track Classification: Cosmic Rays - Convenor: Andreas Haungs, KIT

Contribution ID: **19** Type: **not specified**

The Design and Status of nEXO: a Next-Generation Neutrinoless Double-Beta Decay Experiment

Tuesday, 9 May 2017 14:50 (15 minutes)

The determination of the Majorana nature of the neutrino is the chief goal of the proposed next generation of neutrinoless double-beta decay (0νββ) experiments. By achieving a sensitivity on the rate of 0νββ in 136Xe of 1.9 × 1025 years, the predecessor to nEXO, EXO-200, has demonstrated the feasibility of using 136Xe for potentially observing neutrinoless double-beta decay. Building on the proven methods of EXO-200, the nEXO collaboration plans to use 5-tonnes of liquid Xe enriched in 136Xe in a single monolithic time projection chamber. The primary focus of design is to achieve a sensitivity to the 0νββ of 136Xe of 1 × 1028 years within 10 years of data taking thereby allowing the experiment to probe the effective Majorana neutrino mass allowed by the inverted neutrino mass hierarchy. Initial design and current R&D efforts will be presented.

Primary author: Dr DAUGHHETEE, Jacob (University of South Dakota)

Presenter: Dr DAUGHHETEE, Jacob (University of South Dakota)

Session Classification: Neutrino Properties

Track Classification: Non-Accelerator-Based Neutrino

Contribution ID: **20** Type: **not specified**

Constraining the TeV Gamma-Ray Sky with HAWC

Tuesday, 9 May 2017 14:30 (18 minutes)

The High Altitude Water Cherenkov (HAWC) gamma-ray observatory is a wide field-of-view observatory sensitive to 100 GeV – 100 TeV gamma rays and cosmic rays. Located at an elevation of 4100 m on the Sierra Negra volcano in Mexico, HAWC observes extensive air showers from gamma rays via their production of Cherenkov light within an array of water tanks. Through its detection of high-energy gamma rays, the HAWC observatory is sensitive to a wide variety of astrophysical sources, including active galactic nuclei, pulsar wind nebulae, and galactic diffuse emission. HAWC's high energy reach, wide field of view, and high uptime also enable searches for gamma-ray bursts and signatures of dark matter. These also enable HAWC to perform gamma-ray follow-up observations of discoveries with other messengers, including gravitational waves and neutrinos.

Primary author: Dr HARDING, J. Patrick (Los Alamos National Laboratory)

Presenter: Dr HARDING, J. Patrick (Los Alamos National Laboratory)

Session Classification: Gamma Rays

Track Classification: Gamma Rays - Convenor: Reshmi Mukherjee, Columbia

Contribution ID: **21** Type: **not specified**

Imaging Atmospheric Cherenkov Telescopes: Present and Future.

Monday, 8 May 2017 11:30 (30 minutes)

The current generation of imaging atmospheric Cherenkov telescope arrays have been operating for over a decade, and have succeeded in measuring the high energy emission from almost 200 sources. These observations probe the mechanisms of particle acceleration in a wide variety of extreme environments, and over a huge range of spatial scales - from pulsar magnetospheres to the jets of active galaxies.

While current instruments have demonstrated the power of the technique, they are far from reaching its limits. A major new facility, the Cherenkov Telescope Array, promises to achieve sensitivity improvements of an order of magnitude, with a corresponding explosion in the source population.

I will discuss some of the highlight results from the past few years of TeV gamma-ray astronomy, and provide some expectations for the future

Primary author: Dr HOLDER, Jamie (University of Delaware)

Presenter: Dr HOLDER, Jamie (University of Delaware)

Session Classification: Plenaries

Track Classification: IACT: present & future- Jamie Holder, Delaware

Contribution ID: **22** Type: **not specified**

Boosted Dark Matter and its implications for the features in IceCube HESE data

Monday, 8 May 2017 14:48 (18 minutes)

We study the implications of the premise that any new, relativistic, highly energetic neutral particle that interacts with quarks and gluons would create cascade-like events in the IceCube (IC) detector which would be observationally indistinguishable from neutral current deep-inelastic (DIS) scattering events due to neutrinos. Consequently, one reason for deviations, breaks or excesses in the expected astrophysical power-law neutrino spectrum could be the flux of such a particle. Motivated by features in the recent 1347-day IceCube high energy starting event (HESE) data, we focus on particular boosted dark matter (χ) related realizations of this premise, where χ is assumed to be much lighter than, and the result of, the slow decay of a massive scalar (ϕ) which constitutes a major fraction of the Universe's dark matter (DM). We show that this hypothesis, coupled with a standard power-law astrophysical neutrino flux is capable of providing very good fits to the present data, along with a possible explanation of other features in the HESE sample: i.e., a) the paucity of events beyond ~ 2 PeV b) a spectral feature resembling a dip in the 400 TeV–1 PeV region and c) an excess in the $50 - 100$ TeV region.

(based on 1612.02834, "Boosted Dark Matter and its implications for the features in IceCube HESE data")

Primary author: Prof. GANDHI, Rajesh (HRI)

Presenter: Prof. GANDHI, Rajesh (HRI)

Session Classification: Dark Matter

Track Classification: Dark Matter - Convenor: Carsten Rott, SKKU

Contribution ID: **23** Type: **not specified**

Search for point-like sources in the astrophysical muon neutrino flux with IceCube

Monday, 8 May 2017 17:30 (15 minutes)

Using a sample of neutrino-induced muon track events, IceCube has confirmed the high-energy diffuse astrophysical neutrinos flux, first found in a sample of high energy starting events. In order to identify the sources of this diffuse flux, these muon-neutrino events are ideal because of their excellent angular resolution. Here we present a search for point-like neutrino sources based on the same sample that was used to measure the diffuse high-energy astrophysical muon-neutrino flux with a livetime of seven years. This high purity sample is restricted to the Northern hemisphere and consists of ~425000 events with a median angular resolution of ~1° at 1 TeV that decreases to ~0.3° at 1 PeV. In this analysis an unbinned likelihood maximization is used that is optimized for point-like neutrino emission with the same characteristics as the diffuse muon neutrino flux. The sensitivity improves for sources with an E^{-2} spectrum by 30% compared to previous analysis and is at a level of $E^2 \partial\phi/\partial E = 3 \cdot 10^{-13}\,\mathrm{TeV\,cm^{-2}\,s^{-1}}$. We report about the status of this search and present an analysis searching for a population of neutrino sources, which are too weak to be significant individually.

Primary author: Mr REIMANN, René (RWTH Aachen)

Presenter: Mr REIMANN, René (RWTH Aachen)

Session Classification: Neutrino Astronomy

Track Classification: Neutrino Astronomy - Convenor: Gisela Anton, FAU / ECAP

Contribution ID: **24** Type: **not specified**

A Deep Learning Approach to the MicroBooNE Low Energy Analysis

Tuesday, 9 May 2017 15:05 (15 minutes)

MicroBooNE is a liquid argon Time Projection Chamber (TPC) located in the Booster Neutrino Beam at Fermilab. One of its main goals is to study the >3σ excess observed at low energy (Eν ~ 200-600 MeV) by the MiniBooNE experiment, which was located in the same beam.

Two independent analyses are ongoing in MicroBooNE to study this possible excess.
One of them uses Deep Learning Convolutional Neural Network (CNN) tools, originally developed for image analysis, to reconstruct and identify particle tracks in the (1-proton, 1-lepton)CCQE neutrino final state topology.

I will first present the detector and discuss the low energy excess seen by MiniBooNE, then detail the CNN-based event reconstruction with emphasis on Neural Network techniques and our benchmarking strategy.

Primary author: Dr HOURLIER, Adrien (Massachusetts Institute of Technology)

Presenter: Dr HOURLIER, Adrien (Massachusetts Institute of Technology)

Session Classification: Neutrino Properties

Track Classification: Accelerator-Based Neutrinos - Convenor: Jennifer Thomas, University College London

Contribution ID: **25** Type: **not specified**

Searches for Dark Matter with the Fermi Large Area Telescope

Tuesday, 9 May 2017 15:06 (18 minutes)

The era of precision cosmology has revealed that ~80% of the total amount of matter in the universe is dark matter. One promising candidate, motivated by both particle physics and astrophysics, is the Weakly Interacting Massive Particle (WIMP). WIMPs are predicted to couple to the Standard Model via annihilation or decay. The annihilation or decay products of particular interest are neutrinos and gamma rays, which are detectable by IceCube and the Fermi Large Area Telescope (Fermi LAT) respectively. Since they do not carry charge, they can be traced back to the original source. Indirect searches such as these complement direct and collider (production) searches and are necessary to fully investigate the particle nature of dark matter. For nearly nine years, Fermi LAT has been surveying the sky in the energy range 20 MeV to >300 GeV from low Earth orbit. I present several recent results from the Fermi LAT Collaboration for a variety of indirect search targets, including the dwarf spheroidal galaxies, and the Galactic center. To date, the Fermi LAT Collaboration has not detected a convincing WIMP signal and hasreported upper limits, which for some search targets are now challenging the standard expectations for WIMP dark matter. I will also discuss the prospects with the Fermi LAT and future gamma-ray telescopes.

Primary author: Dr CAPUTO, Regina (UMD/NASA/GSFC)

Presenter: Dr CAPUTO, Regina (UMD/NASA/GSFC)

Session Classification: Gamma Rays

Track Classification: Gamma Rays - Convenor: Reshmi Mukherjee, Columbia

Contribution ID: **26** Type: **not specified**

Solar Neutrinos as a Probe of Dark Matter-Neutrino Interactions

Monday, 8 May 2017 16:30 (18 minutes)

Sterile neutrinos at the eV scale have long been studied in the context of anomalies in short baseline neutrino experiments. Their cosmology can be made compatible with our understanding of the early Universe provided the sterile neutrino sector enjoys a nontrivial dynamics with exotic interactions, possibly providing a link to the Dark Matter (DM) puzzle. Interactions between DM and neutrinos have also been proposed to address the long-standing "missing satellites" problem in the field of large scale structure formation. Motivated by these considerations, in this paper we discuss realistic scenarios with light steriles coupled to DM. We point out that within this framework active neutrinos acquire an effective coupling to DM that manifests itself as a new matter potential in the propagation within a medium of asymmetric DM. Assuming that at least a small fraction of DM has been captured by the Sun, we show that a sizable fraction of the parameter space of these scenarios can be probed by solar neutrino experiments, especially in the regime of small couplings and light mediators where all other probes become inefficient. In the latter regime these scenarios behave as familiar 3+1 models in all channels except for solar data, where a Dark MSW effect takes place. Solar Dark MSW is characterized by sizable modifications of the most energetic 8B and CNO neutrinos, whereas the other fluxes remain largely unaffected.

Primary authors: Dr CAPOZZI, Francesco (The Ohio State University); SHOEMAKER, Ian (University of South Dakota); Dr VECCHI, Luca (Università di Padova)

Presenter: Dr CAPOZZI, Francesco (The Ohio State University)

Session Classification: Dark Matter

Track Classification: Dark Matter - Convenor: Carsten Rott, SKKU

Contribution ID: **27** Type: **not specified**

Status of Global Fits to Sterile Neutrinos

Monday, 8 May 2017 15:45 (15 minutes)

Recent short baseline results have indicated anomalies consistent with ~1 eV2 sterile neutrinos. However, these results are in tension with other null searches, including that of IceCube. This talk will present the most recent global fit results, including IceCube, discuss the source of the tension, in particular the MiniBooNE neutrino result, and present directions of future attack on the problem, including the IsoDAR experiment.

Primary author: CONRAD, Janet (MIT)

Presenter: CONRAD, Janet (MIT)

Session Classification: Neutrino Properties

Track Classification: Accelerator-Based Neutrinos - Convenor: Jennifer Thomas, University College London

Contribution ID: **29** Type: **not specified**

Status of the CUORE experiment

Tuesday, 9 May 2017 15:35 (15 minutes)

CUORE (Cryogenic Underground Observatory for Rare Events) is an array of 988 TeO2 bolometers arranged in 19 towers with a total active mass of 742 kg located at the Laboratori Nazionali del Gran Sasso (LNGS) in Italy. The primary purpose of CUORE is to search for the neutrinoless double beta decay of 130Te, which if observed, would establish the Majorana nature of neutrinos as well as providing information on the absolute mass scale of the neutrino. The CUORE detector reached a base temperature below 10 mK in early 2017 and is currently undergoing commissioning with the anticipated start of physics data-taking happening very soon. We will discuss the status of the CUORE experiment, review the installation and commissioning phases, and present the most recent results from CUORE-0, a single-tower array of 52 bolometers, operated at LNGS between 2013-2015.

Primary author: FUJIKAWA, Brian (Lawrence Berkeley National Laboratory)

Presenter: GLADSTONE, Laura (o=research,ou=Institutions,dc=icecube,dc=wisc,dc=edu)

Session Classification: Neutrino Properties

Track Classification: Non-Accelerator-Based Neutrino

Contribution ID: **30** Type: **not specified**

Dark Matter Searches with the Micro-X Sounding Rocket

Monday, 8 May 2017 15:42 (18 minutes)

The Micro-X sounding rocket uses a Transition Edge Sensor (TES) array to make X-ray observations. The improved energy resolution of TESs compared to traditional space-based X-ray detectors brings new precision to both supernova observations and the X-ray search for sterile neutrino dark matter. Current X-ray observations disagree over the potential presence of a 3.5 keV X-ray line consistent with a sterile neutrino interaction, and Micro-X is in a unique position to establish or refute the presence of this line. We present the construction status of the instrument and expectations for flight observations, with special emphasis given to the prospects of sterile neutrino studies.

Primary author: HUBBARD, Antonia (Northwestern)

Presenter: HUBBARD, Antonia (Northwestern)

Session Classification: Dark Matter

Track Classification: Dark Matter - Convenor: Carsten Rott, SKKU

Contribution ID: **31** Type: **not specified**

Multi-messengers from quasar outflows

Tuesday, 9 May 2017 15:24 (18 minutes)

We show that the quasar outflows can naturally account for the missing component of the extragalactic gamma-ray background (EGB) below ~ 1 GeV through neutral pion production in interactions between protons accelerated by the forward outflow shock and interstellar protons. We adopt outflow parameters that best fit the most recent Fermi-LAT data on the EGB and derive a cumulative neutrino background of ~ 10^-7 GeV/cm^-2/s/sr at neutrino energies above 10 TeV, which naturally explains the most recent IceCube data without tuning any free parameters. Additionally, we show that the same quasar outflows are capable of accelerating protons to energies up to 10^20 eV. The spectral shape and amplitude is consistent with recent observations for outflow parameters constrained to fit secondary gamma-rays and neutrinos without any additional parameter tuning. This indicates that quasar outflows simultaneously account for all three messengers at their observed levels.

Primary author: WANG, Xiawei (Harvard University)

Presenter: WANG, Xiawei (Harvard University)

Session Classification: Gamma Rays

Track Classification: Gamma Rays - Convenor: Reshmi Mukherjee, Columbia

Contribution ID: **32** Type: **not specified**

Results of DM-Ice17 and the First Data from COSINE-100

Monday, 8 May 2017 17:06 (18 minutes)

DM-Ice is a phased experimental program using low-background NaI(Tl) crystals with the aim to unambiguously test the claim of dark matter detection by the DAMA experiment. DM-Ice17, consisting of 17 kg of NaI(Tl), has been continuously operating at a depth of 2457 m in the South Pole ice since December 2010. COSINE-100 is a joint collaboration between the DM-Ice and KIMS groups to search for dark matter annual modulation with NaI(Tl) crystal array. The first phase of the experiment consists of 8 NaI(Tl) crystals with total mass of ~106 kg and ~2000 liters of liquid scintillator as an active veto, situated at Yangyang underground laboratory in South Korea, and the physics run started in September 2016. The recent results of an annual modulation analysis with DM-Ice17 will be presented, along with the first data from COSINE-100.

Primary author: JO, Jay Hyun (Yale University)

Presenter: JO, Jay Hyun (Yale University)

Session Classification: Dark Matter

Track Classification: Dark Matter - Convenor: Carsten Rott, SKKU

Contribution ID: **34** Type: **not specified**

Imaging Galactic Dark Matter with IceCube High-Energy Cosmic Neutrinos

Monday, 8 May 2017 15:06 (18 minutes)

The origin of the observed extraterrestrial neutrinos is still unknown, and their arrival directions are compatible with an isotropic distribution. This observation, together with dedicated studies of Galactic plane correlations, suggest a predominantly extragalactic origin. Dark matter-neutrino interactions, which have been extensively studied in cosmology, would thus lead to a slight suppression of flux at energies below a PeV and deficit of events in the direction of Galactic center, which would be seen by IceCube. I will present results of a recent analysis using the four-year high-energy starting event dataset to constrain the strength of dark matter-neutrino interactions and show that in spite of low statistics IceCube can probe regions of the parameter space inaccessible to current cosmological methods.

Primary author: Dr VINCENT, Aaron (Imperial College London)

Co-authors: KHEIRANDISH, Ali (o=research,ou=Institutions,dc=icecube,dc=wisc,dc=edu); Dr ARGUELLES, Carlos (o=mit,ou=Institutions,dc=icecube,dc=wisc,dc=edu)

Presenter: Dr VINCENT, Aaron (Imperial College London)

Session Classification: Dark Matter

Track Classification: Dark Matter - Convenor: Carsten Rott, SKKU

Contribution ID: **35** Type: **not specified**

Recent results from the ANTARES neutrino telescope

Monday, 8 May 2017 16:45 (15 minutes)

ANTARES, the largest underwater neutrino telescope, has been continuously operating since 2007 in the Mediterranean Sea. The transparency of the water allows for a very good angular resolution in the reconstruction of neutrino events of all flavors. This results in unprecedented sensitivity for neutrino source searches in the Southern Sky at TeV energies, so that already valuable constraints can be set on the origin of the cosmic neutrino flux discovered by the IceCube Collaboration.

Based on an all-flavor dataset spanning nine years of operation of the detector, we will present the latest results of ANTARES searches for neutrino point sources, and for diffuse neutrino emission from the entire sky as well as from several interesting regions such as the Galactic Plane and the Fermi bubbles.

An overview of the rich multi-messenger program of ANTARES will be given, with e.g. optical and X-ray follow-up observations of promising neutrino candidates, and searches for neutrinos in coincidence with interesting transient astrophysical events such as Gamma-Ray Burst triggers, Fast Radio Bursts and the gravitational wave signals recently discovered by LIGO-Virgo.

ANTARES will also provide updated results on more exotic phenomena, such as magnetic monopoles. Of particular relevance are the strong constraints on the dark matter arising from the search of neutrinos from potential WIMP annihilation in massive objects like the Sun and the Galactic Center.

Primary author: Dr KOUCHNER, Antoine (APC-University Paris Diderot)

Presenter: Dr KOUCHNER, Antoine (APC-University Paris Diderot)

Session Classification: Neutrino Astronomy

Track Classification: Neutrino Astronomy - Convenor: Gisela Anton, FAU / ECAP

Contribution ID: **36** Type: **not specified**

Solar Atmospheric Neutrinos and the Sensitivity Floor for Solar Dark Matter Annihilation Searches

Monday, 8 May 2017 16:48 (18 minutes)

In this talk I will discuss the production of high-energy neutrinos from interactions of cosmic rays with the solar atmosphere. Production of solar atmospheric neutrinos has been previously considered in the literature both as a potential source of high-energy neutrinos and as an irreducible background for dark matter searches. In our new calculation we estimate the uncertainties that arise from the solar atmosphere and hadronic interaction models. We further improve on previous calculations by considering neutrino oscillations in the propagation of neutrinos through the Sun. We predict that current event selections should observe ~ 1 event per year in detectors such as IceCube or the proposed mediterranean neutrino observatory, KM3Net. Finally, for the first time, we put this rate in the context of indirect dark matter searches from the Sun by calculating the high-energy solar neutrino floor, which is analogous to the low-energy solar neutrino floor in dark matter direct detection experiments.

Primary authors: Dr FEDYNITCH, Anatoli (DESY); Prof. JONES, Benjamin (University of Texas at Arlington); Dr ARGUELLES, Carlos (o=mit,ou=Institutions,dc=icecube,dc=wisc,dc=edu); Ms DE WASSEIGE, Gwenhael (Vrije Universiteit Brussel)

Presenter: Dr ARGUELLES, Carlos (o=mit,ou=Institutions,dc=icecube,dc=wisc,dc=edu)

Session Classification: Dark Matter

Track Classification: Dark Matter - Convenor: Carsten Rott, SKKU

Contribution ID: **37** Type: **not specified**

Recent results and future perspectives on the Ultra-High Energy Cosmic Rays

Wednesday, 10 May 2017 09:00 (30 minutes)

Ultra-High Energy Cosmic Rays are charged particles of energies above 10^18 eV that originate outside of the Galaxy. Their very small flux is detected by the two giant experiments, the Pierre Auger Observatory and Telescope Array, which extend over areas of 3000 km^2 in the southern hemisphere and 700 km^2 in northern one, respectively. I will review the observational results reported by these experiments over the last decade and I will discuss the future perspectives to solve the open issues in the field.

Primary author: Dr VERZI, Valerio (Istituto Nazionale Fisica Nucleare)

Presenter: Dr VERZI, Valerio (Istituto Nazionale Fisica Nucleare)

Session Classification: Plenaries

Track Classification: High-Energy Cosmic Rays - Valerio Verzi, INFN Roma

Contribution ID: **38** Type: **not specified**

Recent Results from the NOvA Experiment

Monday, 8 May 2017 17:00 (15 minutes)

Recent results from the NOvA long-baseline neutrino oscillation experiment are beginning to constrain the parameters of the standard model neutrino properties. Intriguing results using the full data set combining measurements have provided some intriguing results that will be closely watched as data taking continues.

Primary author: MUALEM, Leon (Caltech)

Presenter: MUALEM, Leon (Caltech)

Session Classification: Neutrino Properties

Track Classification: Accelerator-Based Neutrinos - Convenor: Jennifer Thomas, University College London

Contribution ID: **39** Type: **not specified**

Search for High-Energy Neutrino Emission from Fast Radio Bursts

Monday, 8 May 2017 17:45 (15 minutes)

Fast radio bursts (FRBs) are bright millisecond-duration radio transients with high dispersion measures, suggesting extragalactic origin. Since their first discovery in 2007, FRBs have been observed at more than a dozen unique locations, with one source producing many repeated bursts. This repeating burst is the only FRB to which the distance has been measured. Many emission models have been proposed for FRBs, most requiring compact objects with strong magnetic fields. These models are leptonic in nature, however, the environments described in such models could in principle feature significant hadronic processes instead. We present the first results of a recent search for high-energy neutrinos spatially and temporally coincident with FRBs in 6 years of IceCube data.

Primary authors: KHEIRANDISH, Ali (o=research,ou=Institutions,dc=icecube,dc=wisc,dc=edu); Dr XU, Donglian (University of Wisconsin-Madison); VANDENBROUCKE, Justin (o=uwmad,ou=Institutions,dc=icecube,dc=wisc HEY, Sam (o=uwmad,ou=Institutions,dc=icecube,dc=wisc,dc=edu)

Presenter: FAHEY, Sam (o=uwmad,ou=Institutions,dc=icecube,dc=wisc,dc=edu)

Session Classification: Neutrino Astronomy

Track Classification: Multi-Messenger - Convenor: Elisa Resconi, TUM

Contribution ID: **40** Type: **not specified**

Muon Energy Reconstruction Methods for the IceCube Neutrino Observatory

Tuesday, 9 May 2017 17:00 (15 minutes)

The IceCube neutrino observatory relies on the ability to reconstruct the energies of muon events for a wide range of analyses, including all astrophysical diffuse analyses. Current methods use the mean energy loss rate of the events with good results found after effectively truncating the largest losses. Here we discuss a new energy reconstruction method which uses topological information of the muon track. The method uses a maximum likelihood that interprets the full pattern of reconstructed energy losses from each muon track to obtain a best estimate of the muon energy as the event entered the detector. In this talk the topological method will be compared to previous reconstruction methods via simulated muon event studies, and we also will discuss possible improvements.

Primary author: ROBERTSON, Sally (o=adelaide,ou=Institutions,dc=icecube,dc=wisc,dc=edu)

Co-author: Dr HILL, Gary (o=adelaide,ou=Institutions,dc=icecube,dc=wisc,dc=edu)

Presenter: ROBERTSON, Sally (o=adelaide,ou=Institutions,dc=icecube,dc=wisc,dc=edu)

Session Classification: Neutrino Astronomy

Track Classification: Neutrino Astronomy - Convenor: Gisela Anton, FAU / ECAP

Contribution ID: **41** Type: **not specified**

Compact imaging air Cherenkov telescopes as an additional component for large astro particle detectors like IceCube and HAWC

Tuesday, 9 May 2017 16:48 (18 minutes)

Imaging air Cherenkov telescopes (IACTs) are detecting the Cherenkov light of gamma-ray and cosmic-ray induced showers in the atmosphere. This light may add valuable information to large volume cosmic ray and gamma ray detectors like HAWC or IceCube-Gen2. For IceCube IACTs could work as an efficient veto for atmospheric neutrinos in the Southern Hemisphere and could also be used in combination with the surface component of IceCube, IceTop, to improve the capabilities to measure the composition of the CR spectrum. With HAWC small IACTs could provide an additional measurement of the primary particle energy and particle ID to improve the signal to background ratio. Therefore small IACTs specialized to work in harsh environments are under development. We will present the progress and future plans with these IACTs together with first data of an IACT prototype in coincidence with IceCube.

Primary author: AUFFENBERG, Jan (o=rwth,ou=Institutions,dc=icecube,dc=wisc,dc=edu)

Co-authors: Prof. WIEBUSCH, Christopher (o=rwth,ou=Institutions,dc=icecube,dc=wisc,dc=edu); Prof. BRETZ, Thomas (RWTH Aachen University)

Presenter: AUFFENBERG, Jan (o=rwth,ou=Institutions,dc=icecube,dc=wisc,dc=edu)

Session Classification: Cosmic Rays

Track Classification: Cosmic Rays - Convenor: Andreas Haungs, KIT

Contribution ID: **42** Type: **not specified**

IceCube's neutrinos - galactic or extra-galactic?

Monday, 8 May 2017 15:30 (15 minutes)

IceCube has observed a diffuse flux, for which we now need to determine the origin - which could possibly be a combination of galactic and extra-galactic sources. A number of authors have suggested that our galaxy can account for the whole IceCube flux. However, we know that our galaxy is not unique and that there must be other similar galaxies in the rest of the Universe producing neutrinos at a similar rate. If we assume that our galaxy produces almost all of the neutrinos observed and therefore that all other galaxies in the rest of the Universe are combining to produce almost nothing at IceCube, does this paint a consistent picture for the total IceCube flux and number and distribution of sources in the Universe?

Primary author: Ms ATKINS, Natasha (University of Adelaide)

Presenter: Ms ATKINS, Natasha (University of Adelaide)

Session Classification: Neutrino Astronomy

Track Classification: Neutrino Astronomy - Convenor: Gisela Anton, FAU / ECAP

Contribution ID: **43** Type: **not specified**

POEMMA: Probe Of Extreme Multi-Messenger Astrophysics

Tuesday, 9 May 2017 17:15 (15 minutes)

The Probe Of Extreme Multi-Messenger Astrophysics (POEMMA) has been recently selected by NASA for an in-depth probe mission concept study in preparation for the next decadal survey. POEMMA will combine the well-developed Orbiting Wide-field Light collectors (OWL) concept with the recently proposed CHerenkov from Astrophysical Neutrino Telescope (CHANT) concept to form a multi-messenger probe of the most extreme environments in the universe. POEMMA is designed to establish charged particle astronomy with ultrahigh energy cosmic rays (UHECRs) and to discover cosmogenic tau neutrinos (CTNs). The study of UHECRs and CTNs from space will yield orders-of-magnitude increase in statistics of observed UHECRs and the discovery of the cosmogenic flux of neutrinos for the full predicted range of UHECR models. These observations will solve the long-standing puzzle of the origin of the highest energy particle ever observed, providing a new window on the Universe and on its most energetic environments and events. The discovery of CTNs will help solve the puzzle of the origin of UHECRs and begin a new field of Astroparticle Physics with the study of neutrino properties at energies up to the 10 EeV scale.

Primary author: Prof. ANCHORDOQUI, Luis (University of Wisconsin Milwaukee)

Presenter: KRIZMANIC, John

Session Classification: Multi-messenger

Track Classification: Multi-Messenger - Convenor: Elisa Resconi, TUM

Contribution ID: **44** Type: **not specified**

Prospects for Observing Galactic Sources of Cosmic Neutrinos

Monday, 8 May 2017 14:45 (15 minutes)

We evaluate the prospects for detecting the neutrino emission from sources in the Galactic plane assuming that the highest energy photons originate from the decay of pions, which yields a straightforward prediction for the neutrino flux from the decay of the associated production of charged pions. Four promising sources are identified based on having a large flux and a flat spectrum. We subsequently evaluate the probability of their identification in IceCube data as a function of time. We show that observing them over the twenty-year lifetime of the instrumentation is likely, and that some should be observable at the 3σ level with six years of data. In the absence of positive results, we derive constraints on the spectral index and cut-off energy of the sources, assuming a hadronic acceleration mechanism. Moreover, we address the complex nature of neutrino emission from the Galactic disk and explore the prospects for observation of Galactic neutrinos emitters in light of HAWC's recent observations.

Primary authors: KHEIRANDISH, Ali (o=research,ou=Institutions,dc=icecube,dc=wisc,dc=edu); Prof. HALZEN, Francis (o=uwmad,ou=Institutions,dc=icecube,dc=wisc,dc=edu)

Presenter: KHEIRANDISH, Ali (o=research,ou=Institutions,dc=icecube,dc=wisc,dc=edu)

Session Classification: Neutrino Astronomy

Track Classification: Multi-Messenger - Convenor: Elisa Resconi, TUM

Contribution ID: **45** Type: **not specified**

Diagnose the Sources of IceCube Neutrinos with Fermi Observation

Monday, 8 May 2017 15:45 (15 minutes)

The sources of IceCube detected high energy neutrinos are unknown. During the processes of high energy neutrino production, there should be accompanying gamma-ray emission from neutral pion decay or secondary charged particle emission. Even in the processes that gamma-ray emission is dominated by accelerated electrons, there could be a relation between gamma-ray and neutrino emission. Therefore, we use the Fermi observations on the potential neutrino sources, and estimate their contributions to the IceCube detected diffuse neutrino flux. We find that the Galactic diffuse neutrino emission, gamma-ray bursts, and blazar jets cannot contribute a neutrino flux similar to IceCube flux, but the startburst galaxies are still promissing sources.

Primary author: Dr LI, Zhuo (Peking University)

Presenter: Dr LI, Zhuo (Peking University)

Session Classification: Neutrino Astronomy

Track Classification: Neutrino Astronomy - Convenor: Gisela Anton, FAU / ECAP

Contribution ID: **46** Type: **not specified**

Neutrino and anti-neutrino oscillation measurements at T2K

Monday, 8 May 2017 17:15 (15 minutes)

A comparison of neutrino oscillation measurements with those of anti-neutrino oscillation measurements may give information on CP violation in the lepton sector. In this talk, we present the latest results from T2K obtained using both neutrino and anti-neutrino data, which exclude CP conservation at the 90% CL.

Presenter: KRIZMANIC, John

Session Classification: Neutrino Properties

Track Classification: Accelerator-Based Neutrinos - Convenor: Jennifer Thomas, University College London

Contribution ID: **47** Type: **not specified**

Neutrino interaction cross sections in the T2K near detectors

Monday, 8 May 2017 17:30 (15 minutes)

A proper understanding of neutrino cross sections is crucial for the precise determination of the neutrino oscillation parameters. The T2K near detectors allow for a range of cross-section measurements on various target materials, often in an energy regime with few previous measurements. This talk will detail some of the recent cross-section results from T2K.

Presenter: YUAN, Tianlu (o=uwmad,ou=Institutions,dc=icecube,dc=wisc,dc=edu)

Session Classification: Neutrino Properties

Track Classification: Accelerator-Based Neutrinos - Convenor: Jennifer Thomas, University College London

Contribution ID: **48** Type: **not specified**

Applying Non-Poissonian Template Fitting to search for point sources in IceCube.

Tuesday, 9 May 2017 17:15 (15 minutes)

The Non-Poissonian Template Fitting (NPTF) technique has been used to show that the excess of gamma rays observed by Fermi is likely due to a population of unresolved point sources rather than dark matter emission. The IceCube experiment has positively identified neutrinos of astrophysical origin, but as yet, no point sources have been resolved. We present an analysis that applies NPTF to IceCube data, in the search for these point sources.

Primary author: COLLIN, Gabriel (o=mit,ou=Institutions,dc=icecube,dc=wisc,dc=edu)

Co-authors: Mr RODD, Nick (MIT); Mr BEN, Safdi (MIT)

Presenter: COLLIN, Gabriel (o=mit,ou=Institutions,dc=icecube,dc=wisc,dc=edu)

Session Classification: Neutrino Astronomy

Track Classification: Multi-Messenger - Convenor: Elisa Resconi, TUM

Contribution ID: **49** Type: **not specified**

Coherent transition radiation at radio frequencies from the electron beam sudden appearance

Tuesday, 9 May 2017 17:42 (18 minutes)

We report on the detection of coherent transition radiation from the electron beam sudden appearance. The Telescope Array Linear Accelerator (TA-LINAC) is constructed to calibrate the TA fluorescence detectors by directing a high-energy electron beam in to the air. This makes the TA-LINAC the perfect device to test future detection techniques, such as the radio detection method, to probe high-energy particle cascades. We report on the measurements of four independent radio set-ups searching for either the direct radio emission from the particle cascade or a radar echo. Due to the different signals sought for, these experiments operated over a wide range of frequencies from 50 MHz up to 12.5 GHz. Besides the signals sought for, all experiments detected a strong transient signal when the beam exits the accelerator. This signal can be described as an extreme form of coherent transition radiation. It is shown that the measurements agree well with the predicted signal over the entire frequency range. The in-nature application of this signal is found for high-energy particle cascades traversing different media such as air and ice or rock.

Primary author: DE VRIES, Krijn (VUB)

Co-authors: O'MURCHADHA, Aongus (University of Wisconsin / WIPAC); ISHIHARA, Aya (Chiba University); SHIN, Bokkyun (Osaka City University); IKEDA, Daisuke (University of Tokyo); PARTOUS, Florian (Vrije Universiteit Brussel / IIHE); THOMSON, Gordon (University of Utah); SAGAWA, Hiroyuki (University of Tokyo); MATTHEWS, John (University of Utah); HANSON, Kael (University of Wisconsin / WIPAC); MASE, Keiichi (Chiba University); FUKUSHIMA, Masaki (University of Tokyo); RELICH, Matthew (Chiba University); MOTLOCH, Pavel (University of Chicago); GAIOR, Romain (Chiba University / LPNHE); YOSHIDA, Shigeru (Chiba University); UEYAMA, Shunsuke (Chiba University); KUWABARA, Takao (Chiba University); SHIBATA, Tatsunobu (KEK); MEURES, Thomas (University of Wisconsin / WIPAC)

Presenter: DE VRIES, Krijn (VUB)

Session Classification: Cosmic Rays

Track Classification: Cosmic Rays - Convenor: Andreas Haungs, KIT

Contribution ID: **50** Type: **not specified**

Feasibility of an Air Cherenkov Array as an Atmospheric Neutrino Veto for IceCube

Tuesday, 9 May 2017 15:42 (18 minutes)

A primary challenge in neutrino astronomy is to distinguish neutrinos produced by astrophysical sources from muons and neutrinos produced in our atmosphere. Atmospheric neutrinos can be rejected if traces of their parent air showers are detected, such as penetrating muons observed by the outermost sensors in a neutrino telescope. Alternatively, air showers could be detected at the surface, either through particles reaching the ground or through Cherenkov emission by particles in the atmosphere. We present an initial study of the requirements and potential benefits of an array of air Cherenkov detectors that could be deployed above IceCube to enhance its sensitivity to astrophysical neutrinos.

Primary author: Prof. DEYOUNG, Tyce (Michigan State University)

Presenter: Prof. DEYOUNG, Tyce (Michigan State University)

Session Classification: Cosmic Rays

Track Classification: Cosmic Rays - Convenor: Andreas Haungs, KIT

Contribution ID: **51** Type: **not specified**

Effect of neutrino decay on sterile neutrino searches in IceCube

Monday, 8 May 2017 15:15 (15 minutes)

IceCube, a neutrino detector located at the South Pole, is an ideal testing ground for the hypothetical 1 eV sterile neutrino, which is motivated by the short-baseline neutrino anomalies. In a normal ordering 3+1 sterile neutrino scheme, the decay of the heaviest neutrino mass eigenstate to lighter eigenstates is unconstrained. In this talk, we will show how such a decay could modify the results of a sterile neutrino search in IceCube.

Primary authors: MOSS, Alexander (MIT); Dr ARGUELLES, Carlos (o=mit,ou=Institutions,dc=icecube,dc=wisc,dc=edu); RAD, Janet (MIT); MOULAI, Marjon (MIT)

Presenter: Dr ARGUELLES, Carlos (o=mit,ou=Institutions,dc=icecube,dc=wisc,dc=edu)

Session Classification: Neutrino Properties

Track Classification: Non-Accelerator-Based Neutrino

Contribution ID: **52** Type: **not specified**

Enhanced Starting Track Event Selection

Tuesday, 9 May 2017 16:45 (15 minutes)

The IceCube analyses that identify the astrophysical neutrino flux from the southern hemisphere must reject muons and neutrinos from the atmosphere. To do this, the analyses use the outer regions of the detector to identify and reject penetrating muon tracks produced by cosmic ray interactions with the atmosphere. In doing so they can remove atmospheric neutrinos and muons. By using the outer regions of the detector to veto, the analyses reduce the fiducial volume to the inner part of the detector. Here we will discuss a method that is optimized for finding muon neutrinos with a contained vertex and outgoing track. This selection utilizes the high quality directional information of muons to veto incoming events on a case by case basis. Once a trajectory and starting vertex have been determined, the likelihood for not seeing a hit on digital optical modules (DOMs) passed by the trajectory before the starting vertex can be calculated based on the observed hits. This opens most of the instrumented volume up for neutrino detection. The results of this technique will provide identifiable astrophysical neutrinos above 10 TeV originating from the southern sky. This region is interesting for galactic sources and currently has the weakest sensitivity to neutrino point sources. Expectations from an initial data sample and simulation assuming potential diffuse and galactic fluxes will be shown. In addition to aiding in the understanding interesting southern sky sources, these new events can also assist in providing insight to astrophysical neutrino flavor ratios and the diffuse astrophysical flux.

Primary author: JERO, Kyle (o=uwmad,ou=Institutions,dc=icecube,dc=wisc,dc=edu)

Presenter: JERO, Kyle (o=uwmad,ou=Institutions,dc=icecube,dc=wisc,dc=edu)

Session Classification: Neutrino Astronomy

Track Classification: Neutrino Astronomy - Convenor: Gisela Anton, FAU / ECAP

Contribution ID: **53** Type: **not specified**

Muon Neutrino Disappearance Results with IceCube/Deepcore

Monday, 8 May 2017 15:00 (15 minutes)

Located at the South Pole Station in Antarctica, the IceCube Neutrino Observatory is the world's largest neutrino telescope. In the clearest part of the ice sits a more densely instrumented section, DeepCore, that is able to measure neutrinos from 5-80 GeV. Using DeepCore, neutrino oscillations can be observed via ν_μ disappearance. This talk will highlight the new and greatly improved atmospheric disappearance results from IceCube/DeepCore, using three years of data and over 40,000 neutrino events.

Primary authors: A M DE ANDRE, Joao Pedro (o=msu,ou=Institutions,dc=icecube,dc=wisc,dc=edu); HIGNIGHT, Joshua (o=msu,ou=Institutions,dc=icecube,dc=wisc,dc=edu)

Presenter: A M DE ANDRE, Joao Pedro (o=msu,ou=Institutions,dc=icecube,dc=wisc,dc=edu)

Session Classification: Neutrino Properties

Track Classification: Accelerator-Based Neutrinos - Convenor: Jennifer Thomas, University College London

Contribution ID: **54** Type: **not specified**

On the Charm Contribution to the Atmospheric Neutrino Flux

Monday, 8 May 2017 15:30 (15 minutes)

We revisit the atmospheric neutrino flux at high energies where the decay of charmed hadrons produced in cosmic ray airshowers is expected to dominate the flux. The forward production of charmed hadrons can potentially increase the predicted flux but it is relatively uncertain due to lack of forward coverage from modern colliders. Using archival data, IceCube atmospheric neutrino flux measurements, and a model independent parametrization of forward charm production we draw an upper limit of the charm contribution to the atmospheric neutrino flux. We find this upper limit cannot accommodate the observed PeV neutrino flux or create additional structures in the neutrino spectrum.

Primary author: WILLE, Logan (o=uwmad,ou=Institutions,dc=icecube,dc=wisc,dc=edu)

Co-author: Prof. HALZEN, Francis (o=uwmad,ou=Institutions,dc=icecube,dc=wisc,dc=edu)

Presenter: WILLE, Logan (o=uwmad,ou=Institutions,dc=icecube,dc=wisc,dc=edu)

Session Classification: Neutrino Properties

Track Classification: Non-Accelerator-Based Neutrino

Contribution ID: **55** Type: **not specified**

Telescope Array Experiment

Tuesday, 9 May 2017 17:24 (18 minutes)

Telescope Array (TA) is the largest cosmic ray detector in the Norther hemisphere, which measures primary particles in 4 PeV to 100 EeV range. TA is a hybrid detector. The main TA detector consists of 507 plastic scintillation counters on a 1.2km square grid, overlooked by 3 fluorescence detector stations. By May 2017, TA will have collected 9 years of data above 1 EeV. Results of this contribution are based on the first 7 years of TA data. Recently built TA low energy extension detector, which consists of an additional fluorescence detector and an infill array, has now collected 2 years of data. TALE broadens the energy range of TA to 4 PeV.
The following results of TA are presented: (1) Cosmic ray energy spectrum above 4 PeV, which extends over 4 orders of magnitude in energy and shows 4 features (2) Measurements of cosmic ray mass composition in 1 to 100 EeV range, which is found to be light, most likely protonic (3) Search for gamma rays and neutrinos above 1 EeV, and (4) Cosmic ray anisotropy studies above 10 EeV. We have seen an evidence of a dependence of the flux on the arrival direction, and a concentration of events above 57 EeV, called the 'hotspot', centered in the Ursa Major.

Primary author: Dr IVANOV, Dmitri (University of Utah)

Presenter: Dr IVANOV, Dmitri (University of Utah)

Session Classification: Cosmic Rays

Track Classification: Cosmic Rays - Convenor: Andreas Haungs, KIT

Contribution ID: **56** Type: **not specified**

VHE Gamma-ray Searches for Astrophysical Neutrino Sources: VERITAS Status and Prospects for CTA

Tuesday, 9 May 2017 15:42 (18 minutes)

Neutrino astronomy is an emerging area of study in high-energy astrophysics, and astrophysical neutrinos are natural cousins of very high energy (VHE; E > 100 GeV) gamma rays. The VERITAS gamma-ray observatory has an active program of follow-up observations in the directions of high-energy neutrinos detected by IceCube which are potentially astrophysical, including prompt alerts, and the planned Cherenkov Telescope Array (CTA) has similar plans. Since both neutrinos and gamma rays are produced in hadronic interactions, a joint study of both channels could reinforce the hadronic origin of the gamma rays, revealing high-power cosmic-ray accelerators and probing their properties. We present recent results from the VERITAS follow-up program and prospects for CTA.

Primary author: HUMENSKY, Brian (Columbia University)

Presenter: HUMENSKY, Brian (Columbia University)

Session Classification: Gamma Rays

Track Classification: Gamma Rays - Convenor: Reshmi Mukherjee, Columbia

Contribution ID: **57** Type: **not specified**

AMON Status Report: Realtime Alerts and Archival Studies

Tuesday, 9 May 2017 16:45 (15 minutes)

The Astrophysical Multimessenger Observatory Network (AMON) will perform realtime coincidence searches for multimessenger astrophysical transients from multiple high-energy observatory subthreshold data streams. The resulting coincidences will be distributed in realtime to followup observatories and other interested parties in the form of AMON alerts. In addition to realtime analyses, AMON performs studies of the archival data from different partner observatories. In this talk, I will present both AMON realtime and archival studies and discuss the strengths and weaknesses of each approach.

Primary author: KEIVANI, Azadeh (The Pennsylvania State University)

Presenter: KEIVANI, Azadeh (The Pennsylvania State University)

Session Classification: Multi-messenger

Track Classification: Multi-Messenger - Convenor: Elisa Resconi, TUM

Contribution ID: **58** Type: **not specified**

Search for Astrophysical Tau Neutrinos in IceCube

Tuesday, 9 May 2017 16:30 (15 minutes)

The IceCube Neutrino Observatory has observed a diffuse astrophysical neutrino flux, consistent with equal mixture of neutrino flavors. Regardless of the production mechanism at the source, an appreciable amount of tau neutrinos is expected via mixing over astronomical distances. Identification of tau neutrinos is essential for the precise measurement of the astrophysical neutrino flavor content, which in turn helps test neutrino oscillation paradigms over extremely long baselines and possibly shed light on new physics beyond the Standard Model. A tau neutrino undergoing charged current interaction in IceCube will produce two subsequent energy losses: one from the neutrino-hadron interaction, and the other from the decay of the secondary tau lepton. Such double depositions of energy can appear as a causally connected "double bang" topology for high neutrino energies (>PeV) or as double pulses in the waveforms of photon sensors at lower neutrino energies (>100 TeV). I will present a recent search for astrophysical tau neutrinos creating double pulses using three years of IceCube data, and overview the ongoing effort to improve the double pulse waveform identification techniques for future analyses.

Primary author: Dr XU, Donglian (University of Wisconsin-Madison)

Co-author: WILLE, Logan (o=uwmad,ou=Institutions,dc=icecube,dc=wisc,dc=edu)

Presenter: Dr XU, Donglian (University of Wisconsin-Madison)

Session Classification: Neutrino Astronomy

Track Classification: Accelerator-Based Neutrinos - Convenor: Jennifer Thomas, University College London

Contribution ID: **59** Type: **not specified**

A Search for Cosmic-ray Proton Anisotropies with the Fermi Large Area Telescope

Tuesday, 9 May 2017 16:30 (18 minutes)

In eight years of operation, the Fermi Large Area Telescope (LAT) has detected a large sample of cosmic-ray protons. The LAT's wide field of view and full-sky coverage make it an excellent instrument for studying anisotropies in the arrival directions of protons at all angular scales. These capabilities enable the LAT to make a full-sky 2D measurement of cosmic-ray proton anisotropy complementary to many recent TeV measurements, which are performed by projecting onto right ascension. Any detected anisotropies probe the structure of the local interstellar magnetic field or could indicate the presence of a nearby source. We will present initial results from the Fermi LAT Collaboration on the full-sky proton anisotropy from approximately 100 GeV - 10 TeV.

Primary authors: VANDENBROUCKE, Justin (o=uwmad,ou=Institutions,dc=icecube,dc=wisc,dc=edu); MEEHAN, Matthew (UW: Madison)

Presenter: MEEHAN, Matthew (UW: Madison)

Session Classification: Cosmic Rays

Track Classification: Cosmic Rays - Convenor: Andreas Haungs, KIT

Contribution ID: **60** Type: **not specified**

Realtime Gamma Ray Neutrino Coincident Analyses with AMON

Tuesday, 9 May 2017 17:00 (15 minutes)

The existence of a high-energy diffuse astrophysical neutrino flux has recently been confirmed by the IceCube Neutrino Observatory, but in the absence of any high-confidence counterparts the nature of the sources of these high-energy neutrinos is still unknown. Several candidate neutrino source populations, such as Gamma-ray Bursts and Blazar Flares predict a prompt gamma-ray emission along with the neutrino emission. Searches for multimessenger signals such as these are the main goal of the Astrophysical Multimessenger Observatory Network (AMON), which is currently under development at Penn State.
AMON will connect observatories from around the world, enabling realtime coincidence searches using subthreshold data of all four messengers (neutrinos, cosmic rays, gamma rays, and gravitational waves) and rapid followup of these alerts. Searching for statistically significant spatial and temporal coincidences allows us to lower the false positive rate and effectively dive deep down into these high-background data streams. This talk will focus on the realtime analyses in the works for neutrino and gamma ray coincidences, primarily focusing on using subthreshold triggers from Swift's Burst Alert Telescope (BAT) and neutrinos from IceCube.

Primary author: Mr DELAUNAY, James (Penn State)

Presenter: Mr DELAUNAY, James (Penn State)

Session Classification: Multi-messenger

Track Classification: Multi-Messenger - Convenor: Elisa Resconi, TUM

Contribution ID: **61** Type: **not specified**

PROSPECT: A Precision Reactor Oscillation and Spectrum Experiment

Tuesday, 9 May 2017 14:35 (15 minutes)

PROSPECT is a reactor antineutrino experiment consisting of a segmented 6Li-loaded liquid scintillator antineutrino detector designed to probe short-baseline neutrino oscillations and precisely measure the reactor antineutrino spectrum. The experiment will be located at the High Flux Isotope Reactor (HFIR) at Oak Ridge National Lab. The three ton detector will be located 7-12 m from the compact, highly enriched uranium HFIR core. Over the past three years, PROSPECT has deployed multiple detectors at HFIR and Yale University to understand the local background environment and to demonstrate active and passive background rejection. Measuring the neutrino spectrum from 235U at a range of baselines will give insight to the recent reactor spectrum discrepancies, provide an important benchmark for future reactor experiments, and will probe the eV-scale sterile neutrino best-fit region at 3sigma within one year of operation at HFIR. In this talk, we will discuss the design, experimental program, and discovery potential of the experiment.

Primary author: Dr LITTLEJOHN, Bryce (Illinois Institute of Technology)

Presenter: Dr SURUKUCHI, Pranava (Illinois Institute of Technology)

Session Classification: Neutrino Properties

Track Classification: Accelerator-Based Neutrinos - Convenor: Jennifer Thomas, University College London

Contribution ID: **62** Type: **not specified**

Searches for astrophysical sources of neutrinos using cascade events in IceCube

Monday, 8 May 2017 17:00 (15 minutes)

The IceCube neutrino observatory has observed a flux of high-energy astrophysical neutrinos using both track events from muon neutrino interactions and cascade events from interactions of all neutrino flavors. Searches for astrophysical neutrino sources have focused on track events due to the significantly better angular resolution of track reconstructions. To date, no such sources have been confirmed. In this talk we turn our attention to complementary and statistically-independent source searches using cascade events with deposited energies as small as 1 TeV. Compared to the classic approach using tracks, the cascade channel offers improved sensitivity to sources in the southern sky, especially if the emission is spatially extended or follows a soft energy spectrum. We will show results from a first search using 263 cascades collected from May 2010 to May 2012, as well as projected sensitivity estimates for an upcoming analysis of six years of data.

Primary author: RICHMAN, Mike (o=drexel,ou=Institutions,dc=icecube,dc=wisc,dc=edu)

Presenter: RICHMAN, Mike (o=drexel,ou=Institutions,dc=icecube,dc=wisc,dc=edu)

Session Classification: Neutrino Astronomy

Track Classification: Neutrino Astronomy - Convenor: Gisela Anton, FAU / ECAP

Contribution ID: **63** Type: **not specified**

Radio Phased Arrays for the Detection of High Energy Neutrinos

Tuesday, 9 May 2017 17:45 (15 minutes)

Ground-based radio arrays offer a promising future for the detection of high energy neutrinos, including the prospect of reducing the energy threshold of the radio detection technique to a level necessary to overlap with the high-energy range probed by IceCube (∼10-100~PeV). Contemporary ground-based radio arrays, such as ARIANNA and ARA, are designed primarily to detect coherent radio Cherenkov emission from cosmogenic ultra-high energy neutrino interactions in the Antarctic ice. Here we describe the implementation of a radio phased array in a ground-based neutrino detector that would both lower the energy threshold and provide a more efficient coverage of the instrumented volume of ice. The phased arrays are made of a compact assembly of antennas and electronically steered into multiple beams covering a wide solid-angle of the ice, searching for coherent, transient nanosecond-scale power signatures. A proof-of-principle dual-polarization phased array detector is currently being constructed as an interferometric trigger system for an ARA station and will be deployed at the South Pole later this year. The array design, sensitivity, and outlook for future scaling up will be discussed.

Primary author: OBERLA, Eric (KICP University of Chicago)

Co-author: VIEREGG, Abigail (KICP University of Chicago)

Presenter: OBERLA, Eric (KICP University of Chicago)

Session Classification: Neutrino Astronomy

Track Classification: Neutrino Astronomy - Convenor: Gisela Anton, FAU / ECAP

Contribution ID: **64** Type: **not specified**

Optical surveys and particle astrophysics: prospects in the LSST era

Wednesday, 10 May 2017 11:30 (30 minutes)

Steady advances in telescope and camera technology have allowed us to explore the night sky deeper, wider, and faster with each new generation of instruments. The next major experiment in this endeavor is the Large Synoptic Survey Telescope (LSST), now under construction in Chile, with first light scheduled in 2020. LSST will catalog more stars and galaxies than all previous astronomical surveys combined, and will monitor transient, variable, and moving objects over a ten-year period, generating ~10 million alerts each night. I will focus on the ways that LSST and other optical surveys complement gamma-ray, neutrino, and gravitational wave experiments in the study of dark matter, dark energy, neutrino physics, and the dynamic universe.

Primary author: BECHTOL, Keith (LSST)

Presenter: BECHTOL, Keith (LSST)

Session Classification: Plenaries

Track Classification: Optical surveys and particle astrophysics: prospects in the LSST era-Keith Bechtol, LSST

Contribution ID: **65** Type: **not specified**

Search for heavy dark matter decay with IceCube

Monday, 8 May 2017 15:24 (18 minutes)

Search for heavy dark matter decay with IceCube
Many heavy (m>100TeV) dark matter models predict the dark matter particle to decay into standard model particles, including neutrinos.
These neutrinos would produce a unique signal, both in terms of their energy and angular distributions, in the IceCube detector. This talk describes the search for such a signal using two years of high energy cascade data.
A combination of a dark matter decay signal and known backgrounds would be fitted to the data and compared to simulations. If no signal is observed, this analysis is expected to set a new lower limit on the lifetime of heavy dark matter particles. In the talk I will present the sensitivities and the first results.

Primary author: DUJMOVIC, Hrvoje (o=sungkyunkwan,ou=Institutions,dc=icecube,dc=wisc,dc=edu)

Presenter: DUJMOVIC, Hrvoje (o=sungkyunkwan,ou=Institutions,dc=icecube,dc=wisc,dc=edu)

Session Classification: Dark Matter

Track Classification: Dark Matter - Convenor: Carsten Rott, SKKU

Contribution ID: **66** Type: **not specified**

Prompt atmospheric neutrino flux predictions: QCD models and nuclear effects

Monday, 8 May 2017 14:30 (15 minutes)

As the leading high energy neutrino background to the diffuse astrophysical neutrino flux, the flux of neutrinos produced in the PeV energy range by cosmic ray interactions in the atmosphere is of particular interest. The prompt atmospheric neutrino flux is evaluated in three frameworks: next to leading order QCD, kT factorization including low-x resummation, and in the dipole model. A comparison of our evaluations with LHC forward charm production data is made. Nuclear corrections are included for the atmospheric flux prediction. Depending on the approach, nuclear corrections can suppress the predicted neutrino flux by as much as 50% at the highest energies.

Primary author: Prof. RENO, Mary Hall (University of Iowa)

Co-authors: Prof. STASTO, Anna (Pennsylvania State University); Dr BHATTACHARYA, Atri (Universite de Liege); Prof. KIM, C.S. (Yonsei University); Prof. SARCEVIC, INA (University of Arizona); Prof. ENBERG, Rikard (Uppsala University); Dr JEONG, Yu Seon (University of Arizona)

Presenter: Prof. RENO, Mary Hall (University of Iowa)

Session Classification: Neutrino Astronomy

Track Classification: Neutrino Astronomy - Convenor: Gisela Anton, FAU / ECAP

Contribution ID: **68** Type: **not specified**

A framework for testing leptonic unitarity by neutrino oscillation experiments

Tuesday, 9 May 2017 15:20 (15 minutes)

In this talk, I will discuss leptonic unitarity violation at energy scale much lower than the electroweak scale in neutrino oscillation phenomena. The main features which distinguish it from high scale unitarity violation are preservation of lepton flavor universality and absence of zero-distance neutrino flavor transition. For concreteness, we work in the framework of 3 active plus N sterile neutrino model and restrict the active-sterile and sterile-sterile neutrino mass squared differences to be in between 0.1 eV^2 and 1 MeV^2. The upper bound is such that the sterile states are kinematically allowed to participate in neutrino oscillation while the lower bound is such that our model becomes insensitive to details of the sterile sectors (mass spectra and mixing) due to partial decoherence effects.

Primary authors: Dr CHEE SHENG, Fong (University of Sao Paulo); Prof. NUNOKAWA, Hiroshi (PUC, Rio de Janeiro); Prof. MINAKATA, Hisakazu (Yachay Tech)

Presenter: Dr CHEE SHENG, Fong (University of Sao Paulo)

Session Classification: Neutrino Properties

Track Classification: Accelerator-Based Neutrinos - Convenor: Jennifer Thomas, University College London

Contribution ID: **69** Type: **not specified**

Evolution of the Reactor Antineutrino Flux and Spectrum at Daya Bay

Monday, 8 May 2017 16:30 (15 minutes)

The Daya Bay experiment has utilized eight functionally identical underground detectors to sample reactor antineutrino fluxes from three pairs of nuclear reactors in South China, accruing the largest reactor antineutrino sample to date. This talk will summarize Daya Bay's most recent result, which presents observations of correlations between reactor core fuel evolution and changes in the detected reactor antineutrino flux and energy spectrum. Four antineutrino detectors in two experimental halls were used to identify 2.2 million inverse beta decays (IBDs) over 1230 days spanning multiple fuel cycles for each of Daya Bay's six 2.9 GW reactor cores. A 10σ variation in IBD yield was found to be energy-dependent, rejecting the hypothesis of a constant antineutrino energy spectrum at 5.1 standard deviations. While measurements of the energy-dependence of this variation show general agreement with predictions from recent reactor models, the variation in integrated IBD yield disagrees with recent predictions at 3.1σ. This discrepancy indicates that an overall deficit in measured flux with respect to predictions does not result from equal fractional deficits from the primary fission isotopes 235U, 239Pu, 238U, and 241Pu. A 7.8% discrepancy between the observed and predicted 235U yield suggests that this isotope may be the primary contributor to the reactor antineutrino anomaly.

Summary

Abstract on new Daya Bay result request by Jenny Thomas in Accelerator Neutrino-Based track.

Primary author: Dr LITTLEJOHN, Bryce (Illinois Institute of Technology)

Presenter: Dr LITTLEJOHN, Bryce (Illinois Institute of Technology)

Session Classification: Neutrino Properties

Track Classification: Accelerator-Based Neutrinos - Convenor: Jennifer Thomas, University College London

Contribution ID: **70** Type: **not specified**

A new method for finding point sources in high-energy neutrino data

Tuesday, 9 May 2017 17:30 (15 minutes)

The origin of astrophysical neutrinos remains a mystery. The isotropic spacial distribution of the observed events implies that to detect point sources, both order-of-magnitude more statistics and more advanced search tools are needed. Here we introduce a maximum-likelihood method for search of point-like sources using event pairs. We show that when a decent angular resolution is available, this method is capable of reducing the statistical errors significantly comparing to the traditional search method using individual events. We present our progress of applying this method to the IceCube public data. Finally in light of the pair method we predict in general the ability of a future high-energy neutrino detector to identify the first neutrino point sources.

Primary author: FANG, Ke (o=umd,ou=Institutions,dc=icecube,dc=wisc,dc=edu)

Co-authors: Mr BLAUFUSS, Erik (o=umd,ou=Institutions,dc=icecube,dc=wisc,dc=edu); Dr MILLER, M. Coleman (University of Maryland)

Presenter: FANG, Ke (o=umd,ou=Institutions,dc=icecube,dc=wisc,dc=edu)

Session Classification: Neutrino Astronomy

Track Classification: Neutrino Astronomy - Convenor: Gisela Anton, FAU / ECAP

Contribution ID: **71** Type: **not specified**

Black hole jets in clusters of galaxies as sources of high-energy cosmic particles

Tuesday, 9 May 2017 16:30 (15 minutes)

It has been a mystery that with ten orders of magnitude difference in energy, high-energy neutrinos, ultrahigh-energy cosmic rays, and sub-TeV gamma rays all present comparable energy injection rate, hinting an unknown common origin. Here we show that black hole jets embedded in clusters of galaxies may work as sources of all three messengers. By numerically simulating the propagation of cosmic ray particles in the magnetized intracluster medium (ICM), we show that the highest-energy cosmic rays leave the source rectilinearly, the intermediate-energy cosmic rays are confined by their massive host and interact with the ICM gas to produce secondary neutrinos and gamma rays, and the lowest-energy cosmic rays are cooled due to the expansion of the radio lobes inflated by the jets. The energy output required to explain the measurements of all three messengers is consistent with observations and theoretical predictions of black hole jets in clusters.

Primary author: FANG, Ke (o=umd,ou=Institutions,dc=icecube,dc=wisc,dc=edu)

Co-author: Dr MURASE, Kohta (The Pennsylvania State University)

Presenter: FANG, Ke (o=umd,ou=Institutions,dc=icecube,dc=wisc,dc=edu)

Session Classification: Multi-messenger

Track Classification: Multi-Messenger - Convenor: Elisa Resconi, TUM

Contribution ID: **72** Type: **not specified**

The Sun as a new laboratory for cosmic rays, gamma rays, neutrinos, and dark matter

Tuesday, 9 May 2017 17:30 (15 minutes)

The Sun must shine brightly in GeV—TeV gamma rays and neutrinos. These particles are produced by the interactions of cosmic rays with solar matter and radiation. Additional fluxes may be caused by the annihilation of dark matter in the solar core, perhaps with the eventual particles produced outside of the Sun through the decay of metastable mediators. Importantly, a new generation of experiments is reaching the sensitivity required to detect the Sun at high energies. In gamma rays, the Sun has been detected in the GeV range by Fermi and will soon be studied in the TeV range by ARGO-YBJ, HAWC, and LHAASO. In neutrinos, IceCube is nearing the sensitivity required to detect TeV neutrinos. I will detail the physics prospects for what these observations will teach us about cosmic rays in the inner solar system, solar magnetic fields, and dark matter. This talk will highlight work from our group, including arXiv:1508.06276, arXiv:1612.02420, arXiv:1703.04629, arXiv:1703.10280, as well as the rapid growth in interest from other groups.

Primary authors: Mr ZHOU, Bei (CCAPP,OSU); Prof. BEACOM, John (Ohio State University); Mr NG, Kenny, Chun Yu (CCAPP, The Ohio State University); Ms LEANE, Rebecca (The University of Melbourne)

Co-authors: Prof. PETER, Annika (OSU); ROTT, Carsten (Sungkyunkwan University)

Presenter: Mr ZHOU, Bei (CCAPP,OSU)

Session Classification: Multi-messenger

Track Classification: Multi-Messenger - Convenor: Elisa Resconi, TUM

Contribution ID: **73** Type: **not specified**

Update on the CHIPS Detector

Tuesday, 9 May 2017 14:30 (5 minutes)

The CHIPS detector (10 kt) will be deployed in a flooded mine pit in the path of the NuMI beam in 2018.
The detector design has been informed from two years of prototype work where a small detector was
deployed in the Wentworth 2E pit, N. Minnesota. Detector plane and readout design has largely been fixed.
The goal of the experiment is to demonstrate a low cost solution for very large water Cherenkov detectors, sensitive enough to identify
electron neutrinos appearing from oscillations in a muon neutrino beam. Reconstruction and simulation indicate a
significant reduction in detector density is possible without loss of efficiency.

Primary author: Prof. THOMAS, Jennifer (UCL)

Presenter: Prof. THOMAS, Jennifer (UCL)

Session Classification: Neutrino Properties

Track Classification: Accelerator-Based Neutrinos - Convenor: Jennifer Thomas, University College London

Contribution ID: **74** Type: **not specified**

Latest news from MINOS+

Monday, 8 May 2017 16:45 (15 minutes)

Data taken in the MINOS+ configuration have been combined with the already-significant MINOS data set to provide a fertile ground to look for sterile neutrinos in the Fermilab NuMI beam using two detectors separated by a baseline of 734km. The new results, which include half the total MINOS+ exposure and cover a very large range of parameter space, will be presented.

Presenter: SCHRECKENBERGER, Adam (U Texas Austin)

Session Classification: Neutrino Properties

Track Classification: Accelerator-Based Neutrinos - Convenor: Jennifer Thomas, University College London

Contribution ID: **75** Type: **not specified**

HAWC results and future development

Wednesday, 10 May 2017 11:00 (30 minutes)

The High Altitude Water Cherenkov (HAWC) Observatory is an all-sky surveying instrument that covers 2/3 of the sky in 24 hours. It is located in Sierra Negra, Mexico at an elevation of 4,100 m, and was inaugurated in March 2015. In addition to providing continuous sky coverage for transient events with a >95% duty cycle, HAWC is also well suited to measure extended and large-scale structures. The array consists of 300 water Cherenkov detectors and is sensitive to extensive air showers triggered by cosmic rays and gamma rays from 100GeV to 100TeV. I will highlight HAWC's results from the past two years of operations, which include several TeV discoveries in the Galactic plane. I will also discuss HAWC's transient search for active galactic nuclei flares, gamma-ray bursts, and counterparts to gravitational waves and neutrinos. Lastly I will summarize the current effort on HAWC expansion and the development of a southern array.

Session Classification: Plenaries

Contribution ID: **76** Type: **not specified**

Marco Ajello, Fermi

Contribution ID: **78** Type: **not specified**

Chad Finley, IceCube

Contribution ID: **79** Type: **not specified**

Keith Olive, Dark Matter

Contribution ID: **80** Type: **not specified**

Karsten Heeger, Reactor neutrinos: Recent results and future prospects

Tuesday, 9 May 2017 09:00 (30 minutes)

Session Classification: Plenaries

Contribution ID: **81** Type: **not specified**

Paschal Coyle, KM3NeT

Tuesday, 9 May 2017 09:30 (30 minutes)

Session Classification: Plenaries

Contribution ID: **82** Type: **not specified**

Marek Kowalski, IceCube Gen2 Science

Contribution ID: **83** Type: **not specified**

Ryan Nichol, Radio Detection of cosmic nus

Tuesday, 9 May 2017 11:30 (30 minutes)

Session Classification: Plenaries

Contribution ID: **84** Type: **not specified**

Patrick Huber, Sterile nus

Contribution ID: **85** Type: **not specified**

Particle Physics: Science without Borders: Neutrinos Going Global

Monday, 8 May 2017 10:00 (30 minutes)

Particle Physics is one of the most basic of curiosity driven sciences. Collecting the global community together worldwide to begin the process of having a truly worldwide plan for large particle physics facilities is underway. The field of Particle Physics has always been international as evidenced by Tevatron collider at Fermilab, the Large Hadron Collider at CERN and the bottom quark "factory" in Japan where thousands of scientists from nearly 100 countries have worked together in unison. However the next generation of projects will take the field a step further. The complexity of the technologies, and not to mention substantial cost, are driving the field further in this direction. Interestingly, these complex international relationships dramatically cross national boundaries. The common goal of scientific discovery over rides differences. The complex sociology and intricate organizations where all scientists from across the planet seamlessly work together amazes politicians. Sometimes the countries working together are not normally "best of friends" at official levels. Working together is the only way for particle physics to advance. Students entering research, the government, or the private sector will need to embrace globalization more than ever.

Primary author: Dr LOCKYER, Nigel (FNAL)

Presenter: Dr LOCKYER, Nigel (FNAL)

Session Classification: Plenaries

Track Classification: The Fermilab Neutrino Program- Nigel Lockyer, Fermilab

Contribution ID: **86** Type: **not specified**

Results from the IceCube Neutrino Observatory

Monday, 8 May 2017 11:00 (30 minutes)

With one cubic kilometer of instrumented ice beneath the South Pole, IceCube enables the study of a wide range of phenomena including neutrino astronomy, dark matter searches, neutrino oscillations, and cosmic ray physics. Four years ago IceCube announced the first observations of the long-anticipated flux of high energy neutrinos from deep space. The neutrino energies are up to 100 million times greater than the energies of neutrinos previously observed from the sun and supernovae, and represent a new probe of the cosmos. I will review IceCube's recent results across a range of topics and in particular its progress on measuring and understanding the high energy astrophysical neutrino flux.

Primary author: FINLEY, Chad (Oskar Klein Centre, Stockholm University)

Presenter: FINLEY, Chad (Oskar Klein Centre, Stockholm University)

Session Classification: Plenaries

Track Classification: IceCube results- Chad Finley, Stockholm

Contribution ID: **87** Type: **not specified**

What the Glashow events can and cannot tell us

Monday, 8 May 2017 15:15 (15 minutes)

already given

Primary author: Prof. WEILER, Thomas (Vanderbilt University)

Presenter: Prof. WEILER, Thomas (Vanderbilt University)

Session Classification: Neutrino Astronomy

Track Classification: Neutrino Astronomy - Convenor: Gisela Anton, FAU / ECAP

Contribution ID: **88** Type: **not specified**

Results from Fermi

Monday, 8 May 2017 09:30 (30 minutes)

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Primary author: Dr AJELLO, Marco (Clemson University)

Presenter: Dr AJELLO, Marco (Clemson University)

Session Classification: Plenaries

Track Classification: Results from Fermi - Marco Ajello, Clemson

Contribution ID: **89** Type: **not specified**

Multi-PeV Signals from a New Astrophysical Neutrino Flux Beyond the Glashow Resonance

Monday, 8 May 2017 16:30 (15 minutes)

The IceCube neutrino discovery was punctuated by three showers with E_ν ~ 1-2 PeV. Interest is intense in possible fluxes at higher energies, though a marked lack of E_ν ~ 6 PeV Glashow resonance events implies a spectrum that is soft and/or cutoff below ~few PeV. However, IceCube recently reported a through-going track event depositing 2.6 $\pm$ 0.3 PeV. A muon depositing so much energy can imply E_{ν_μ}
$gtrsim$ 10 PeV. We show that extending the soft $E_\nu^{-2.6}$ spectral fit from TeV-PeV data is unlikely to yield such an event. Alternatively, a tau can deposit this much energy, though requiring E_{ν_τ} ~10x higher. We find that either scenario hints at a new flux, with the hierarchy of ν_μ and ν_τ energies suggesting a window into astrophysical neutrinos at E_ν ~ 100 PeV if a tau. We address implications, including for ultrahigh-energy cosmic-ray and neutrino origins.

Primary author: Dr LAHA, Ranjan (KIPAC, Stanford University and SLAC National Accelerator Laboratory, USA)

Presenter: Dr LAHA, Ranjan (KIPAC, Stanford University and SLAC National Accelerator Laboratory, USA)

Session Classification: Neutrino Astronomy

Track Classification: Neutrino Astronomy - Convenor: Gisela Anton, FAU / ECAP

Contribution ID: **90** Type: **not specified**

Cosmic-Ray Reservoirs as Non-Thermal Neutrino Sources

Wednesday, 10 May 2017 09:30 (30 minutes)

Starburst galaxies and galaxy clusters/groups serve as the storage rooms of cosmic rays. It was theoretically predicted that such cosmic-ray reservoirs are promising sources of neutrinos and gamma rays. The models are indeed consistent with the high-energy neutrino data measured by IceCube, and that they could give a convergence picture of neutrinos, gamma rays and ultrahigh-energy cosmic rays. We review these neutrino sources and discuss the medium-energy excess problem.

Primary author: Dr MURASE, Kohta (Penn State)

Presenter: Dr MURASE, Kohta (Penn State)

Session Classification: Plenaries

Track Classification: Non-Thermal Sources in the Universe- Kohta Murase, Penn State

Contribution ID: **91** Type: **not specified**

Supersymmetric Dark Matter after LHC Run I and Implications for Detection

Monday, 8 May 2017 12:00 (30 minutes)

The current status of supersymmetric models of dark matter is reviewed.
Prior to Run I at the LHC, there were great expectations for the discovery
of supersymmetry at the LHC and dark matter in direct detection experiments.
Unfortunately, there was no sign of supersymmetry in Run I (or Run II so far),
nor any direct detection signal. I concentrate on models
of supersymmetry inspired by Grand Unification and Supergravity.
In this context, viable regions of parameter space are typically reduced to
thin strips at increasingly high energy. Future prospects for direct and indirect detection
will be discussed.

Primary author: Prof. OLIVE, Keith (University of Minnesota)

Presenter: Prof. OLIVE, Keith (University of Minnesota)

Session Classification: Plenaries

Track Classification: Invited plenary

Contribution ID: **92** Type: **not specified**

Sterile Neutrinos

Tuesday, 9 May 2017 12:00 (30 minutes)

N/A

Primary author: Prof. HUBER, Patrick (Center for Neutrino Physics at Virginia Tech)

Presenter: Prof. HUBER, Patrick (Center for Neutrino Physics at Virginia Tech)

Session Classification: Plenaries

Track Classification: Status of Sterile Neutrinos- Patrick Huber, Virginia Tech

Contribution ID: **93** Type: **not specified**

Neutrino Astronomy with IceCube-Gen2

Tuesday, 9 May 2017 10:00 (30 minutes)

I will discuss science and status of the IceCube-Gen2 project.

Primary author: Mr KOWALSKI, Marek (Humboldt University)

Presenter: Mr KOWALSKI, Marek (Humboldt University)

Session Classification: Plenaries

Track Classification: Science potential of IceCube-Gen2- Marek Kowalski, Zeuthen