New Perspectives 2012

Thursday 14 June 2012 - Thursday 14 June 2012

Fermi National Accelerator Laboratory

Book of Abstracts

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Afternoon Session / **21**

Adding CMS Tier 3 Computing to an Already Existing Cluster at Texas A&M University

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In this talk, we will present a brief overview of the CMS Tier3 site at Texas A&M Universty. It is largely unique in that we added resources to an already-existing cluster to create our site as opposed to creating a stand-alone system. We will comment on some of the particulars of our site, the advantages and disadvantages of this choice, as well as how it has performed. We will also discuss some powerful new custom monitoring tools we've developed to optimize our cluster performance.

Final Session / **30**

CCPi0 Reconstruction in MINERvA

Author: Jose Luis Palomino Gallo[1]

[1] *CBPF*

MINERvA is a neutrino-nucleus scattering experiment with multiple nuclear targets.
The experiment is looking for reconstruct neutral pion production, in charge current and neutral current interactions.
Neutral pions are detected through the 2 photons decay, then produce electromagnetic showers.
We will describe how we are reconstructing and identifying electromagnetic showers.
The invariant mass of the pair of photons will isolate CCPi0 events.

Final Session / **31**

Charge Current Quasi-Elastic Anti-Neutrino Scattering in MINERvA

Author: Jesse Chvojka[1]

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MINERvA is a fine-grained high statistics neutrino scattering
experiment located at Fermilab working to better understand low energy
(few GeV) neutrino and anti-neutrino cross-sections. Improved
understanding of cross-sections will reduce systematic errors
at current and future neutrino oscillation experiments. Recent
anti-neutrino charge current quasi-elastic (nu_mu_bar + p -> mu + n)

results on a partial data set will be discussed including extraction of dsigma/dQˆ2.

Midmorning Session / **41**

Elastic Scattering of Muon Neutrinos from Electrons in MINERvA at NuMI Beam Line

Author: Jaewon Park[1]

[1] *University of Rochester*

nu_mu + e elastic scattering process is theoretically well understood in ˜1% accuracy. This pure leptonic process has a distinct final state of a single, very forward electron. Measurement of the rate of such events provides a useful constraint on the muon neutrino flux incident on the MINERvA detector. Distinguishing electron from gamma background is important on the analysis. e/gamma separation based on dE/dx will be described. nu_mu + e is studied using partial data set. I present the status of single electron reconstruction and comparison of data and simulation.

Morning Session / **73**

GSA Welcome

Afternoon Session / **17**

H->Gamma Gamma Search at CMS from the Bottom Up

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Optimizing the performance of the CMS Electromagnetic Electromagnetic Calorimeter is crucial for a successful search for Higgs in the diphoton decay channel. In this talk, we will review the work done over the past two years to optimize the ECAL performance with an emphasis on the ECAL calibration and monitoring techniques.

Summary:

The talk will be mostly on the CMS ECAL, but the Higgs to Gamma Gamma search will also be reviewed to emphasize the importance of achieving the best ECAL energy resolution.

Midmorning Session / **37**

Improved Measurement of Electron-antineutrino Disappearance at Daya Bay

Author: Bryce Littlejohn[1]

[1] *UW-Madison*

Many experiments in the last few decades have demonstrated the neutrino's ability to change flavor while traveling through space and time, or oscillate. One of the last remaining unknown parameters describing this oscillation, theta13, is crucial in defining the magnitude of CP-violation in the lepton sector and examining the neutrino's role in the universe's matter-antimatter asymmetry. The Daya Bay experiment has measured theta13 with unprecedented precision by observing disappearance of reactor antineutrinos with identical detectors at multiple reactor distances. This talk will present the most recent results from Daya Bay including more than four full months of three-site physics data.

Afternoon Session / **14**

Improving the Trigger Efficiency Calculation for the WH-lvbb analysis at the CDF experiment

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At CDF, we search for the associated production of a Higgs boson and a W boson, where the Higgs boson decays into a b + anti-b quark pair and the W boson decays into a lepton and the corresponding neutrino. Events are selected with a signature of a lepton, large missing transvers energy, and two or three jets. The events are selected by a variety of triggers, and those triggers are divided into several streams based on the types of requirements of the trigger. In previous WH searches we only use some of triggers, because the trigger efficiency can be calculated easily under those circumstances. In this presentation, we will describe two new triggers to select leptons and will demonstrate a new method using neural networks to calculate the trigger efficiency for a set of triggers. In this way, we maximized the acceptance of events selected, and the gain in the sensitivity of the WH analysis is about 5%.

Midmorning Session / **29**

MINERvA Test Beam

Author: Aaron Higuera[1]

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MINERvA is a neutrino scattering experiment in the NuMI beamline at Fermilab, designed to measure neutrino cross sections, final states and nuclear effects on a variety of targets in the few-GeV region. In order to calibrate the absolute energy scale of the detector, the MINERvA collaboration planned, designed, constructed and commissioned the MINERvA Test Beam experiment at Fermilab Test Beam Facility. In this talk we will present the current analysis of the MINERvA Test Beam.

Midmorning Session / **42**

MINERvA-MINOS Muon Energy Scale

Author: Gonzalo Diaz Bautista[1]

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The Main INjector ExpeRiment v-A is neutrino-nucleus scattering experiment that uses the NuMI beamline located at Fermilab with the purpose of study different neutrino interactions with nuclear targets as C, Pb and Fe; and determine the corresponding cross sections of these interactions. Charge-current inclusive is one of the principal neutrino interaction channels and, due to in this channel a muon is produced when the neutrino interacts with the target, MINERvA uses the information of those muons that are contained in the MINOS detector. However, there's an important systematical uncertainty in the reconstruction of this muon energy because of the curvature due to the magnetic field produced by the coil at the center of MINOS. That's why the MINERvA-MINOS muon energy scale is a very important study that helps us to find that systematical uncertainty.

Final Session / **34**

Magnetic Shielding Tests for MicroBooNE Photomultiplier Tubes in a Cryogenic Environment: First Results and Future Plans

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The MicroBooNE detector, a liquid argon time projection chamber (LArTPC) positioned in the Booster Neutrino Beam (BNB) line at Fermilab, tracks charged particles produced by interactions of those neutrinos and uses large (eight-inch diameter) photomultiplier tubes (PMTs) to detect liquid argon scintillation light. Magnetic fields, even those as small as those from the Earth, can adversely affect the performance of these tubes. The location of the PMTs inside the liquid argon cryostat poses the additional challenge of shielding within a cryogenic environment. This presentation discusses procedures developed and carried out using a cryogenic test stand at Fermilab. Results from these tests demonstrate the effectiveness of shields manufactured from a cryogenic magnetic material in greatly reducing the impact of geomagnetic fields on PMT operation. Further tests to complete this study will also be discussed.

Grateful acknowledgement is made of the support of this work by the National Science Foundation under grant PHY-1000214.

Summary:

Geomagnetic fields can degrade the performance of unshielded large diameter PMTs, and shielding tubes at cryogenic temperatures has not been extensively done. Our data show that the shields we employ work at both room and liquid nitrogen temperatures; consistency and other follow-up tests are planned for summer 2012.

Morning Session / **18**

Measurement of single diffractive differential cross section (dσ/(d|t|)) at √(s) = 1.96 TeV using the DØ Forward proton detectors

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This analysis uses the Forward Proton Detector (FPD), a sub-system of the DØ detector at the Tevatron collider at Fermilab to measure the single diffractive differential cross section (dσ/(d|t|)) at √(s) = 1.96 TeV center of mass energy. The single diffractive candidate sample was selected using triggers requiring hits in both proton detectors in an FPD spectrometer, and a veto on hits in the same side Luminosity Monitor, consistent with an intact proton. The four-momentum transfer |t| of the scattered protons were measured using the FPD system. The analysis presents the measurement of the differential cross section of single diffraction as a function of |t| in the range 0.2<|t|<1.25 GeV2. The differential cross section measurement is consistent with the theoretical and experimental expectations. The total single diffractive cross section(σsd) in the region 0.0<|t|<1.25 GeV2 is consistent with other experiments.

Final Session / **24**

Measuring electronics latencies in MINOS with Auxiliary Detectors

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The MINOS experiment uses two detectors separated by 734km to study neutrino oscillations between Fermilab and the Soudan Underground Laboratory. MINOS is also conducting a neutrino time of flight measurement between the two detectors. As a part of an improved technique, we have installed two identical pairs of small Auxiliary Detectors (AD) near both MINOS detectors to calibrate the difference of timing systems of the Near and Far Detector. The AD's, made using 'MINOS technology', comprise scintillator strips read out by wavelength-shifting fibers and 16-anode PMT's. The AD's are placed to observe muons from events registered in the MINOS detectors. AD hits are independently time-stamped using a CAMAC TDC and Brilliant Instruments Time Interval Analyzer.
The comparison between time stamps in AD's and both MINOS detectors provide the latency measurement of read out electronics.

Final Session / **15**

Methods to determine neutrino flux at low energies-Investigation of the low ν method

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We investigate the "low-ν" method (developed by the CCFR/NUTEV collaborations) to determine the neutrino flux in a wide band neutrino beam at very low energies, a region of interest to neutrino oscillations experiments. Events with low hadronic final state energy nu < nu_cut (of 1, 2 and 5 GeV) were used by the MINOS collaboration to determine the neutrino flux in their measurements of neutrino (nu_mu) and antineutrino (nu_mu_bar) total cross sections. The lowest nu_mu energy for which the method was used in MINOS is 3.5 GeV, and the lowest energy is 6 GeV. At these energies, the cross sections are dominated by inelastic processes. We investigate the application of the method to determine the neutrino flux for nu_mu, nu_mu_bar energies as low as 0.7 GeV where the cross sections are dominated by quasi-elastic scattering and Delta(1232) resonance production. We find that the method can be extended to low energies by using nu-cut values of 0.25 and 0.50 GeV, which are feasible in fully active neutrino detectors such as MINERvA.

Final Session / 12

Non-Thermal Dark Matter Mimicking An Additional Neutrino Species In The Early Universe

Author: Farinaldo Queiroz[1]

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The South Pole Telescope (SPT), Atacama Cosmology Telescope (ACT), and Wilkinson Microwave Anisotropy Probe (WMAP) have each reported measurements of the cosmic microwave background's (CMB) angular power spectrum which favor the existence of roughly one additional neutrino species, in addition to the three contained in the standard model of particle physics. Neutrinos influence the CMB by contributing to the radiation density, which alters the expansion rate of the universe during the epoch leading up to recombination. In this paper, we consider an alternative possibility that the excess kinetic energy implied by these measurements was possessed by dark matter particles that were produced through a nonthermal mechanism, such as late-time decays. In particular, we find that if a small fraction (˜ 1%) of the dark matter in the universe today were produced through the decays of a heavy and relatively longlived state, the expansion history of the universe can be indistinguishable from that predicted in the standard cosmological model with an additional neutrino. Furthermore, if these decays take place after the completion of big bang nucleosynthesis, this scenario can avoid tension with the value of three neutrino species preferred by measurements of the light element abundances.

Final Session / 28

Particle Production Measurements using the MIPP Detector at Fermilab

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The Main Injector Particle Production (MIPP) Experiment at Fermilab is a hadron production experiment which uses 120 GeV/c primary protons from the Main Injector to produce secondary beams of charged pions, kaons, proton and anti-proton from 5 GeV/c to 90 GeV/c. It was designed to measure the total charged particle production of pions, kaons, protons and anti-protons using beams of charged pions, kaons, proton and anti-proton on nuclear targets. The MIPP measures particle production cross sections off various nuclei including Hydrogen, MINOS target and thin targets of Beryllium, Carbon, Bismuth and Uranium. It is a full acceptance spectrometer which provides

charged particle identification for particles from 0.1 to 120 GeV/c using Time Projection Chamber (TPC), Time of Flight (ToF), multicell Cherenkov (CKOV), and Ring Imaging Cherenkov (RICH) detectors and Calorimeter for neutrons.
We will describe the physics motivation to perform such cross section measurements and highlight the impact of hadronic interaction data on neutrino physics such as accelerator-based neutrino measurements with MINOS. We will present preliminary inelastic cross section measurements for 58 and 85 GeV/c proton interacting with Liquid Hydrogen target, and 58 and 120 GeV/c proton interacting with Carbon target having 2 % interaction length. We describe a new method to correct for low multiplicity inefficiencies in the interaction trigger using KNO scaling. Cross sections as a function of multiplicity and total cross sections are also presented for these two targets. The cross sections measured from the MIPP data are compared with the cross sections predicted from the Monte Carlo.

Midmorning Session / **43**

Pi0 Reconstruction in Neutral Current Events in MINERvA

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MINERvA is a neutrino experiment located at Fermilab. The main goal of the experiment is to study neutrino interactions using different targets and to measure differential neutrino cross sections. In this talk we concentrate on neutral pion reconstruction in the MINERvA experiment. We will show the present status of our energy, vertex and invariant mass reconstruction. This study is of vital importance to our understanding of NC neutrino interactions with a neutral pion in the final state. Most of the time only two photons can be observed with no observable tracks at the production vertex.

Morning Session / **20**

Search for Anomalous Wtb Couplings in Single Top Quark Production at DØ

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The large mass of the top quark, close to the electroweak symmetry-breaking scale, makes it a good candidate for probing physics beyond the Standard Model, including possible anomalous couplings. We examine DØ's data to study the Lorentz structure of the Wtb coupling. The standard model predicts a left-handed vector coupling at the Wtb vertex. The most general lowest dimension, CP-conserving Lagrangian admits right-handed vector and left- or right-handed tensor couplings as well. We find that the data prefer the left-handed vector coupling and set upper limits on the anomalous couplings.

Afternoon Session / **16**

Search for Dark Matter and Large Extra Dimensions in Monojet Events in pp Collisions at sqrt(s)=7 TeV

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A search for dark matter particles and large extra dimensions in events with an energetic jet and an imbalance in transverse momentum is performed in a sample of pp collision data corresponding to an integrated luminosity of 5.0 fb-1collected at a center-of-mass energy of 7 TeV with the CMS detector at the LHC. The data are in good agreement with the expected contributions from standard model processes. Constraints on the dark matter-nucleon scattering cross sections are determined in models relevant to spin-independent and spin-dependent interactions. For the spin-independent model, these are the most constraining limits for a dark matter particle with mass below 3.5 GeV/c2, a region unexplored by direct detection experiments. For the spin-dependent model, these are the most stringent constraints over the 1–400 GeV/c2 mass range. The constraints on the Arkani-Hamed, Dimopoulos, and Dvali model parameters MD determined as a function of the number of extra dimensions are also an improvement over the previous results.

Summary:

This study include search for new physics with MonoJet+MET such as Dark Matter, Extra Dimensions, Unparticle ...

We will present results for Dark Matter and Extra Dimensions.

Afternoon Session / **23**

Search for Heavy Stable Charged Particles at CMS

Author: Venkatesh Veeraraghavan[1]

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Several models of new physics, including split supersymmetry, predict the existence of a heavy particle, which is long-lived on timescales of the bunch spacing of the LHC. Such a particle would be observable using the Compact Muon Solenoid (CMS) at the Large Hadron Collider (LHC), and although produced at high momentum, it would travel slowly due to its large mass. We describe a search for these particles, using the experimental techniques of time of flight and dE/dx measurement. Results are presented based on data recorded with CMS in 2011.

Morning Session / **25**

Search for Higgs Boson Produced in Association with a Vector Boson Using Like-Sign Dilepton Events at CDF

Author: Daisuke Yamato[1]

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We present a search for the neutral higgs boson produced in associated with a vector boson using high-p_T isolated like-sign dilepton events in $p\bar{p}$ collisions at $\sqrt{s}$ = 1.96 TeV. The data were collected with the CDF-II detector at the Fermilab Tevatron collider. We employ the Boosted Decision Tree technique for separating the backgrounds from signal events to improve the search sensitivity. No signal is observed in the CDF data and we set limits on the production rate of the Higgs boson in the standard model and in an alternative fermiophobic scenario.

Morning Session / **22**

Search for Resonant Production of Muon Jets

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We present an inclusive, signature-based search for groups of collimated muons (muon jets) designed to achieve high sensitivity to a broad class of models predicting such signatures and performed using data collected by the CMS experiment. The analysis searches for production of new light bosons which, depending on their mass, may have substantial branching ratio for decays into pairs of muons. The results are interpreted in a model independent fashion as well as in the context of several benchmark scenarios: one of them is motivated by the Supersymmetry with hidden dark sector where cascades of particle decays include light dark photons and another one by the Next-to-Minimal Supersymmetric Standard Model (NMSSM) predicting the SM-like Higgs boson decay to a pair of light CP-odd Higgs bosons.

Afternoon Session / **33**

Search for Standard Model Higgs Boson associated with W boson using DLM at CDF

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The analysis to search for the Standard Model Higgs boson in high Pt lepton + 2 jets events is performed at the CDF experiment. To extract the information of signal like events from data, Dynamical Likelihood Method(DLM) is established. For the separation of signal against backgrounds, Support Vector Machine(SVM) is applied using the result of DLM and the final discriminant is formed with SVM discriminant. Finally, from the final discriminant, the 95% C.L. upper limit of Higgs production cross section is estimated.

Morning Session / **27**

Search for contact interactions in the di-lepton channel with CMS

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A search for contact interactions has been performed using the dimuon mass spectrum based on LHC data of 5.3 fb-1 produced from proton-proton collisions and collected by the CMS detector in 2011 at center-of-mass energy of 7 TeV. Unlike the expectation from the contact interaction process, no significant deviation in the dimuon mass spectrum from the spectrum predicted by the standard model is observed. 95% C.L. lower limits are set on the energy scale parameter Lambda for both destructive [9.5 TeV] and constructive [13.0 TeV] interference in the left-left isoscalar model, which are the most stringent limits to date. Details of the 2011 results and the planned extension for such a search in the same model [left-left isoscalar] in the di-muon and di-electron channel at 8 TeV using data taken this year will be discussed.

Morning Session / **39**

Search for the SM Higgs Boson in lepton tau Final States

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Co-authors: Paul Grannis [2] ; Subhendu Chakrabarti [2] ; Wanyu Ye [2]

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We present a search based on D0 data for the standard model Higgs boson in final states of two tau leptons and at least two jets, with one of the tau's decaying to an electron and the second decaying hadronically. A number of Higgs production and decay processes contribute in different proportions as a function of Higgs boson mass. The identification of hadronically decaying tau leptons is discussed, as well as multivariate techniques used, and the ratio of 95\% C.L. Higgs cross section lower limits from the data to that expected in the standard model is obtained.

Midmorning Session / **40**

Separating the neutrino and anti-neutrino content of accelerator-based neutrino beams

Author: Joe Grange[1]

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With the newly confirmed large value of theta13, accelerator-based neutrino experiments will soon seek to measure the mass ordering and CP violation. To do so requires precise oscillation measurements using both neutrino and anti-neutrino beams. However, since these are never purely neutrino or anti-neutrino in content, the detector must be able to separate the two contributions. This is most commonly done by employing a magnetic field, but statistical techniques such as those presented here offers a powerful handle on their overall level and energy dependence. I'll present the first measurement of the neutrino contribution to an anti-neutrino beam observed by a non-magnetized detector.

Final Session / **38**

Simulations and Experimental Plans to Study Beam Driven Wakefields with Dielectric Loaded Waveguides

Author: Francois Lemery[1]

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Wakefield acceleration has recently received much interest due to large acceleration gradients and cost effectiveness. We discuss recent simulation studies concerning the optimzation of the longitudinal current profile of a drive-bunch to maximize the peak accelerating field and transformer ratio in cylindrically symmetric dielectric lined wavguides (DLW). Moreover, we discuss the non-linear relationship between the longitudinal current profile of the drive-bunch and the parameters associated to the DLW. Lastly, we discuss experimental plans to study flat, longitudinally tailored drive-bunch shapes at ASTA.

Final Session / **35**

Status of Quasi-elastic Studies in the NOvA Near Detector Prototype

Author: Minerba Betancourt[1]

[1] *University of Minnesota*

NOvA is a long-baseline neutrino experiment using an off-axis neutrino beam produced by the NuMI neutrino beam at Fermilab. The NOvA experiment will measure quasi-elastic cross section at 2GeV. A short-term goal for the NOvA experiment is to develop a good understanding of the response of the detector. These studies are being carried out with the Near Detector prototype installed on the surface at Fermilab (NDOS). Using beam muon neutrino data, quasi-elastic charge-current interactions will be studied. Status of the quasi-elastic studies in NDOS will be shown.

Midmorning Session / **32**

Status of the NOvA Near Detector Prototype

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NOvA is a long-baseline neutrino experiment that anticipates observing oscillations of muon neutrinos into electron neutrinos. The muon neutrino source is the NuMI beam line at Fermilab. The Near and Far Detectors are built off-axis at Fermilab and northern Minnesota respectively. In order to carry out the long term goals of the experiment, the NOvA Near Detector Prototype, built on the surface at Fermilab, is currently studying aspects of the calibration and reconstruction that will impact the physics in the Near and Far Detectors. The NOvA prototype detector will run until the NuMI beam is shutdown for planned upgrades later this year. The beam muon neutrino data

collected during this time will allow the study of quasi-elastic charged current interactions in the NOvA Detectors. The current status of the NOvA prototype detector and preliminary data will be shown.

Midmorning Session / 13

The Advanced Superconducting Test Accelerator at Fermilab

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The Advanced Superconducting Test Accelerator (ASTA) at Fermilab is a superconducting linear electron accelerator currently undergoing construction at FNAL's New Muon Laboratory is planned to support a variety of user and Advanced Accelerator R&D (AARD) experiments. First beam is scheduled for 2012, and the beamline will be upgraded over the course of several years.

Final Session / 26

The SuperCDMS Experiment

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I will talk about the new SuperCDMS experiment. Using 10 kg of ultra cold (50 mK) Germanium detectors, this experiment will look for Dark Matter in the Soudan Underground Laboratory. Apart from being a traditional Dark Matter search, we also explore a novel low threshold search for light Dark Matter. We call this new search, CDMSlite. I will go over the motivation, detector physics and science of the SuperCDMS and CDMSlite experiments.