New Directions in Neutrino-Nucleus Scattering (NDNN) NUSTEC Workshop

Report of Contributions

https://indico.phys.vt.edu/e/44

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

Q2 dependence at large x and impact on EMC studies

Tuesday, March 16, 2021 9:40 AM (10 minutes)

Using electron scattering data from SLAC E139 and muon scattering data from NMC in the DIS region, we determine the F2A/F2p and F2A/F2n per nucleon structure function ratios, spanning 0.3 < x < 0.8 and 5 < Q2 < 200 GeV/c This region is of particular relevance to studies of the EMC Effect. The structure of the free proton is well known from numerous experiments, but the free neutron structure function has remained difficult to access. Recently, the free neutron structure function has been extracted in a systematic study of the global data within a parton distribution function extraction framework and is available from the CTEQ-Jefferson Lab (CJ) Collaboration. In this talk, we leverage the recent global free neutron extraction to study the Q2 dependence at large x and its impact on the EMC Effect in nuclei.

Primary author: KALANTARIANS, Narbe (Virginia Union University)

Presenter: KALANTARIANS, Narbe (Virginia Union University)

Session Classification: Flash Talks

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

The GENIE Event Library Generator Interface

Monday, March 15, 2021 12:45 PM (10 minutes)

The GENIE event generator is a well-integrated part of many experiments' simulation infrastructure, interacting with the neutrino flux model and the description of the experimental geometry. It is desirable to be able to simulate full events based on alternate neutrino generators, but these generators either lack these integrations or implement incompatible interfaces. GENIE 3.2 provides a new "EvtLib" module which allows seamless incorporation of the interaction physics from another generator within the GENIE framework by means of a library of pre-generated events. I will describe the design and usage of this module, using the integration of the GiBUU generator with NOvA as an example.

Primary author: BACKHOUSE, Chris

Presenter: BACKHOUSE, Chris

Session Classification: Flash Talks

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

Constraints on neutrino electromagnetic properties from COHERENT elastic neutrino-nucleus scattering

Tuesday, March 16, 2021 11:35 AM (10 minutes)

Neutrino electromagnetic properties are import windows in neutrino physics to go beyond the Standard Model. The coherent elastic neutrino-nucleus scattering process is a powerful probe of the neutrino electromagnetic properties, which was first observed in 2017 at the COHERENT experiment by the cesium-iodide(CsI) detector and later in 2020 at the argon(Ar) detector.
In this talk, we present the constraints of neutrino electromagnetic properties from COHERENT CsI and Ar data, including the neutrino charge radii, millicharges and magnetic moments. The combined CsI and Ar limits are also obtained, and compared with other experimental results. We show that the COHERENT data can provide competitive constraints of the neutrino charge radii, in particular for the muon neutrino related components.

Primary authors: GIUNTI, Carlo; PICCIAU, Emmanuele; DORDEI, Francesca (CERN and INFN Cagliari); CADEDDU, Matteo (INFN); CARGIOLI, Nicola; ZHANG, Yiyu; LI, Yufeng

Presenter: ZHANG, Yiyu

Session Classification: Flash Talks

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

Angular distributions in Monte Carlo event generation of weak single-pion production

Monday, March 15, 2021 1:05 PM (10 minutes)

One of the substantial sources of systematic errors in neutrino oscillation experiments that utilize neutrinos from accelerator sources stems from a lack of precision in modeling single-pion production (SPP). Oscillation analyses rely on Monte Carlo event generators (MC), providing theoretical predictions of neutrino interactions on nuclear targets. Pions produced in these processes provide a significant fraction of oscillation signal and background on both elementary scattering and detector simulation levels. Thus, it is of critical importance to develop techniques that will allow us to accommodate state-of-the-art theoretical models describing SPP into MCs.

In this work, we investigate various algorithms to implement single-pion production models in Monte Carlo event generators. Based on comparison studies, we propose a novel implementation strategy that combines satisfactory efficiency with high precision in reproducing details of theoretical models predictions, including pion angular distributions. The proposed implementation is model-independent, thereby providing a framework that can include any model for SPP. We have tested the new algorithm with the Ghent Low Energy Model for single-pion production implemented in the NuWro Monte Carlo event generator.

Primary author: NIEWCZAS, Kajetan (Ghent University)

Presenter: NIEWCZAS, Kajetan (Ghent University)

Session Classification: Flash Talks

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

Coherent elastic neutrino-nucleus scattering with the NuMI beamline and the νBDX-DRIFT detector

Tuesday, March 16, 2021 11:55 AM (10 minutes)

νBDX-DRIFT is a directional low-pressure TPC detector suitable for measurements of coherent elastic neutrino-nucleus scattering (CEνNS) using a variety of gaseous target materials which include carbon disulfide, carbon tetrafluoride and tetraethyllead. In this talk, I will briefly discuss various aspects of the physics opportunities that measurements using the NuMI beamline offer. Special attention will be given to SM parameters measurements and searches for new physics, including light DM.

Primary author: ARISTIZABAL, Diego (USM)

Presenter: ARISTIZABAL, Diego (USM)

Session Classification: Flash Talks

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

Extracting the nucleon axial form factor from LQCD using chiral perturbation theory

Tuesday, March 16, 2021 9:30 AM (10 minutes)

The nucleon axial form factor is not only a fundamental property for the understanding of hadron structure but also a key ingredient of neutrino-nucleon cross sections, whose precise knowledge is required for the analysis of neutrino oscillations. We have calculated this form factor at low momentum transfers in Baryon Chiral Effective Theory, using the extended on mass shell renormalisation scheme, and including the Delta(1232) as an explicit degree of freedom. To assess the convergence of the perturbative expansion and estimate truncation errors, the study is performed at leading and next to leading one-loop orders. We fit recent lattice QCD results to determine the unknown low energy constants of the theory. Then we extract the axial charge and radius without relying on ad-hoc parametrizations.

Primary authors: ALVARADO, Fernando (IFIC); Dr RUSO, Luis Alvarez (IFIC)

Presenter: ALVARADO, Fernando (IFIC)

Session Classification: Flash Talks

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

Compatibility of Neutrino Deep Inelastic Scattering Data in a Global Nuclear Parton Density Determination.

Tuesday, March 16, 2021 9:50 AM (10 minutes)

Neutrino deep inelastic scattering (DIS) data has been shown to exhibit tension with charge lepton DIS data in global analysis of nuclear parton distribution functions (nPDFs), nevertheless there is still no consensus about their compatibility. We re-analyze neutrino DIS data from NuTeV, Chorus and CDHSW, as well as dimuon data from CCFR and NuTeV, and the recent vector boson production data from LHC by fitting nPDFs using nCTEQ framework. Special emphasis is placed on the normalization uncertainty and corrections from target mass, deuteron and higher twist effect. To highlight the compatibility/incompatibility, different kinematic regions of the data are investigated and possible breakdown of twist two factorization is also discussed.

Primary author: Mr MUZAKKA, Khoirul Faiq (University of Muenster)

Presenter: Mr MUZAKKA, Khoirul Faiq (University of Muenster)

Session Classification: Flash Talks

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

Inelastic neutrino-nucleus scattering in the superscaling model

Wednesday, March 17, 2021 7:40 AM (10 minutes)

The superscaling SuSAv2 model, that was successfully used to explain electron scattering data in the quasielastic (QE) as well as in the high inelastic regions (see [1] and refs. therein), is here extended to charged-current neutrino scattering processes on nuclei. We provide a detailed description of the Delta nucleon resonance and compare our predictions based on the pure Relativistic Fermi Gas (RFG) and SuSAv2 scaling functions with previous results obtained using a Delta scaling function fitted to the analysis of (e,e') data. The model is extended to the complete neutrino inelastic spectrum, resonant, non-resonant and deep inelastic scattering (DIS), by considering different parametrizations of the weak inelastic single-nucleon structure functions and a Parton Distribution Function (PDF) model. Our predictions, including also two-particle two-hole contributions, are compared with data taken by the T2K collaboration.

[1] "Electron- versus neutrino-nucleus scattering". J.E. Amaro, M.B. Barbaro, J.A. Caballero, R. Gonzalez-Jimenez, G.D. Megias, I. Ruiz Simo. J. of Phys. G47, 124001 (2020).

Primary author: Mr GONZALEZ ROSA, Jesus (University of Seville)

Co-authors: Mr FRANCO, Juan Manuel (University of Seville); Dr CABALLERO, Juan Antonio (University of Seville); Dr MEGIAS, Guillermo Daniel (University of Seville, University of Tokyo); Dr BARBARO, Maria B. (Universita di Torino)

Presenter: Mr GONZALEZ ROSA, Jesus (University of Seville)

Session Classification: Flash Talks

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

Extraction of the Inclusive Muon Neutrino Charged Current Cross Section at MicroBooNE using Wiener SVD Unfolding

Monday, March 15, 2021 9:55 AM (10 minutes)

The MicroBooNE detector is a Liquid Argon Time Projection Chamber (LArTPC) located along the Booster Neutrino Beam (BNB) at Fermilab. One of its key physics goals is the measurement of neutrnio-Argon interaction cross sections. Due to the detector's fully active volume as well as its capability for high-efficiency event reconstruction, MicroBooNE is well suited to utilize the Wiener-SVD unfolding method to generate nominal neutrino flux-averaged cross section measurements. This approach relies on a minimal set of assumptions to measure the inclusive charged current muon neutrino-Argon cross section as a function of truth kinematic variables. This allows easy comparison with measurements from other experiments and predictions from various models, and enables a new round of cross section measurements for MicroBooNE.

Primary author: COOPER-TROENDLE, London (Yale University)

Presenter: COOPER-TROENDLE, London (Yale University)

Session Classification: Flash Talks

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

Measurement of the Electron-Neutrino Charged-Current Inclusive Cross-Section on Argon in MicroBooNE

Monday, March 15, 2021 10:05 AM (10 minutes)

Electron-neutrino appearance is a crucial channel for searches of sterile neutrinos in short-baseline experiments and measurements of Charge-Parity (CP) violation in long-baseline oscillation experiments. The precise knowledge of the electron neutrino cross section will, therefore, play a key role in reducing the uncertainties of these future experiments. There are only a handful of electron neutrino cross section measurements in the hundred MeV to GeV range and only one on argon, therefore, there is a need for new, high statistics measurements of this quantity. MicroBooNE is a Liquid Argon Time Projection Chamber (LArTPC) located at Fermilab which simultaneously receives a flux of neutrinos from the on-axis Booster Neutrino Beam (BNB) beam and off-axis Neutrinos at the Main Injector (NuMI) beam. While MicroBooNE uses BNB data for short baseline sterile oscillation searches, data from the NuMI beam provide an excellent opportunity to simultaneously measure the electron-neutrino cross section, thanks to its higher electron-neutrino flux component. This talk will cover the current status of inclusive charged-current electron neutrino cross-section measurement on argon in MicroBooNE using the NuMI beam.

Primary author: MISTRY, Krishan

Presenter: MISTRY, Krishan

Session Classification: Flash Talks

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

Measurement of charged-current interactions on water using a nuclear emulsion detector in the NINJA experiment

Wednesday, March 17, 2021 7:30 AM (10 minutes)

The NINJA experiment aims to measure neutrino interactions, especially on water, using a nuclear emulsion detector. Owing to the excellent spatial resolution of the nuclear emulsion, we can measure low-momentum hadrons effectively.

In this presentation, we report results from a pilot experiment using a 3-kg water target, based on the latest NINJA paper. Multiplicity, angle, and momentum distributions of the outgoing muons, charged pions, and protons from neutrino-water interactions are reported, and they are compared with several interaction models. In the pilot run, protons from neutrino-water interactions were measured with a 200MeV/c threshold for the first time. We found good agreement between the observed data and model predictions for all kinematic distributions other than the number of charged pions and the muon kinematics shapes. These results clearly demonstrated the capability of the emulsion detector for the neutrino interaction modeling.

Primary author: Ms HIRAMOTO, Ayami (Kyoto University)

Co-authors: Mr SUZUKI, Yosuke (Nagoya University); THE NINJA COLLABORATION

Presenter: Ms HIRAMOTO, Ayami (Kyoto University)

Session Classification: Flash Talks

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

Introduction - Welcome

Monday, March 15, 2021 7:20 AM (10 minutes)

Introduction Welcome

Presenters: MARIANI, Camillo (Virginia Tech); Dr DUFFY (CO-CHAIR), Kirsty (Fermilab)

Session Classification: Monday

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

Studying neutrino charged-current interactions in the COHERENT liquid argon detectors

Tuesday, March 16, 2021 11:45 AM (10 minutes)

A core-collapse supernova burst (SNB) releases 99% of a star's gravitational potential energy via neutrinos over a period of several seconds. These neutrinos have energies in the few to 10s of MeV range. Lack of knowledge of low-energy neutrino cross sections will limit the amount of physics extracted during a future SNB. In particular, the electron neutrino-argon charged-current inelastic interaction (nueCC) cross section has never been measured at the SNB neutrino energy range. Furthermore, different cross section calculations are only theoretically motivated and contain significant variations when comparing different models. The COHERENT liquid argon (LAr) detector, known as CENNS-10, observes neutrinos with energies in the 10s of MeV at the Spallation Neutron Source at Oak Ridge National Laboratory. The proposed upgrade to CENNS-10, known as COH-Ar-750, will have a larger fiducial volume and the possibility to optimize both the detector design and data acquisition to detect the nueCC interaction. The COHERENT LAr detectors provide current and future opportunities to study the nueCC interaction at the relevant neutrino energy range for SNB neutrinos. This talk will detail simulation studies focused on COHERENT LAr detector sensitivity to the nueCC interaction.

Primary author: CONLEY, Erin (Duke University)

Presenter: CONLEY, Erin (Duke University)

Session Classification: Flash Talks

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

T2K Experiment

Monday, March 15, 2021 7:30 AM (30 minutes)

Primary author: Dr CUDD, Andrew

Presenter: Dr CUDD, Andrew

Session Classification: Monday

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

NOva Experiment

Monday, March 15, 2021 8:00 AM (30 minutes)

Primary author: Dr ALIAGA SOPLIN, Leonidas (Fermilab)

Presenter: Dr ALIAGA SOPLIN, Leonidas (Fermilab)

Session Classification: Monday

Contribution ID: **28** Type: **not specified**

SBND/ICARUS

Monday, March 15, 2021 8:30 AM (15 minutes)

Presenter: CARNEIRO, Mateus (Oregon State University)

Session Classification: Monday

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

MicroBooNE

Monday, March 15, 2021 8:45 AM (30 minutes)

Primary author: ASHKENAZI, Adi (Tel Aviv University)

Presenter: ASHKENAZI, Adi (Tel Aviv University)

Session Classification: Monday

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

DUNE: Status and Physics

Monday, March 15, 2021 9:15 AM (30 minutes)

Primary author: Dr ALEENA, Rafique (Argonne National Laboratory)

Presenter: Dr ALEENA, Rafique (Argonne National Laboratory)

Session Classification: Monday

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

Generator Tools Workshop Overview

Monday, March 15, 2021 11:00 AM (10 minutes)

Primary authors: Dr FIELDS, Laura (University of Notre Dame); Dr PICKERING, Luke (Michigan State University); Dr BETACOURT, Minerba

Presenter: Dr FIELDS, Laura (University of Notre Dame)

Session Classification: Monday

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

GENIE Tuning Effort

Monday, March 15, 2021 11:45 AM (20 minutes)

Primary authors: Dr RODA, Marco; Dr RODA, Marco (University of Liverpool)

Presenters: Dr RODA, Marco; Dr RODA, Marco (University of Liverpool)

Session Classification: Monday

Contribution ID: **33** Type: **not specified**

Exploring GENIE and Real-World Data through Simulation Tuning

Monday, March 15, 2021 12:25 PM (20 minutes)

Primary author: DIURBA, Richie (University of Minnesota)

Co-authors: DUFFY, Kirsty (Fermilab); Prof. DYTMAN, Steven (University of Pittsburg); Dr GARDINER, Steven (Fermi National Accelerator Laboratory)

Presenter: DIURBA, Richie (University of Minnesota)

Session Classification: Monday

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

Short Time Approximation

Tuesday, March 16, 2021 7:30 AM (30 minutes)

Presenter: Prof. PASTORE, Saori (Washington University in St. Louis)

Session Classification: Tuesday

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

Radiative Corrections

Tuesday, March 16, 2021 8:00 AM (30 minutes)

Presenter: TOMALAK, Oleksandr (University of Kentucky)

Session Classification: Tuesday

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

Polarization Effects in neutrino-nucleon interactions

Tuesday, March 16, 2021 8:30 AM (30 minutes)

Presenter: KOWAL, Beata (University of Wroclaw)

Session Classification: Tuesday

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

Neutrino-Nucleon Form Factors from Lattice QCD

Tuesday, March 16, 2021 9:00 AM (30 minutes)

Presenter: MEYER, Aaron (University of California Berkeley/LBNL)

Session Classification: Tuesday

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

Minerva Experiment

Tuesday, March 16, 2021 10:45 AM (30 minutes)

The MINERvA collaboration has made important progress in the NovA (ME) era with analyses in both neutrino and anti-neutrino modes with up to 12.1x1020 and 12.4x1020 protons on target respectively. Three of these high-statistics analyses, of special importance for oscillation experiments like DUNE, NOvA and T2K, are near completion and highlighted in this presentation. The muon-neutrino 3D CC Quasi-Elastic analysis off CH, in bins of P||μ, Ptμ and visible energy, is the first of its kind in the few GeV region and has looked in detail at kinematic regions previously unavailable comparing MINERvA data against several models.
The muon anti-neutrino 2D CC Quasi-Elastic analysis off CH, is the anti-neutrino complement of the already published neutrino result. It is being compared to the same models as the neutrino sample and will be an important probe at high Q2 where models fail to describe the data. A measurement of the muon neutrino CC Coherent Production of Pions is being made from C, CH, Fe and Pb. It is the first simultaneous measurement of more than one target, and the first measurement from pure C, Fe and Pb. The latter being the heaviest nucleus where the interaction has been observed.

Presenter: RAMIREZ DELGADO, Manuel Alejandro (University of Pennsylvania)

Session Classification: Tuesday

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

Comparison of Validation Methods for Final State Interactions in Hadron Production Experiments

Wednesday, March 17, 2021 10:00 AM (20 minutes)

Presenter: TENA VIDAL, Julia (University of Liverpool)

Session Classification: Wednesday

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

Quantum Monte Carlo

Wednesday, March 17, 2021 10:45 AM (20 minutes)

Presenter: Dr BARONI, Alessandro

Session Classification: Wednesday

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

QMC-based approach to inter-nuclear cascades

Wednesday, March 17, 2021 10:20 AM (25 minutes)

Primary authors: LOVATO, Alessandro (Argonne National Laboratory & INFN); Dr ISAACSON, Josh

Presenter: LOVATO, Alessandro (Argonne National Laboratory & INFN)

Session Classification: Wednesday

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

Neural Net for Sampling

Presenter: Dr SANCHEZ, Federico

Session Classification: Wednesday

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

nCTEQ15HIX – Extending nPDF Analyses into the High-x, Low Q2 Region

Wednesday, March 17, 2021 11:05 AM (25 minutes)

Primary author: Dr SEGARRA, Efrain

Presenter: Dr SEGARRA, Efrain

Session Classification: Wednesday

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

E4nu

Wednesday, March 17, 2021 11:30 AM (20 minutes)

Presenter: PAPADOPOULOU, Afroditi (MIT Graduate Student)

Session Classification: Wednesday

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

HyperKamiokande

Session Classification: Thursday

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

ANNIE: Roadmap for neutron multiplicity measurement

Thursday, March 18, 2021 7:50 AM (20 minutes)

Primary author: NIESLONY, Michael

Presenter: NIESLONY, Michael

Session Classification: Thursday

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

THEIA

Thursday, March 18, 2021 8:35 AM (25 minutes)

Presenter: BAGDASARIAN, Zara (UC Berkeley)

Session Classification: Thursday

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

H2/N2

Thursday, March 18, 2021 8:10 AM (25 minutes)

Presenter: Prof. PETTI, Roberto (University of South Carolina)

Session Classification: Thursday

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

COHERENT

Thursday, March 18, 2021 9:45 AM (20 minutes)

Presenter: Dr HEATH, Matthew (ORNL)

Session Classification: Thursday

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

Towards ab initio computations of neutrino scattering on medium-mass nuclei

Thursday, March 18, 2021 10:05 AM (20 minutes)

In my talk I will give an overview of the recent progress that has been made in describing neutrino-nucleus scattering within the ab-initio coupled-cluster framework. It has been successful in addressing the coherent elastic neutrino scattering on 40Ar. Lately, the coupled-cluster theory was combined with the Lorentz integral transform. These techniques open the door to obtaining nuclear responses (and consequently cross-sections) for medium-mass nuclei starting from first principles. A series of steps has been made in this direction. Firstly, the nuclear 1- and 2-body currents have been re-derived and checked for the case of neutrino-deuteron scattering. Afterwards, the Coulomb sum rule of 16O has been calculated, introducing a new technique to remove the center-of-mass contamination. Most recently, we have calculated for the first time the longitudinal response of 40Ca. These developments allow to extend the applicability of ab-initio methods in the field of neutrino-nucleus interactions to medium size nuclei, contributing this way directly to the neutrino oscillation program.

Primary author: SOBCZYK, Joanna (JGU, Mainz)

Co-author: Dr BACCA, Sonia (JGU, Mainz)

Presenter: SOBCZYK, Joanna (JGU, Mainz)

Session Classification: Thursday

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

Low Energy theory and Generator

Thursday, March 18, 2021 10:25 AM (20 minutes)

Primary author: PANDEY, Vishvas (Virginia Tech)

Presenters: Dr PANDEY, Vishvas (University of Florida); PANDEY, Vishvas (Virginia Tech)

Session Classification: Thursday

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

Electron Scattering vs Neutrino Scattering

Thursday, March 18, 2021 10:45 AM (20 minutes)

Presenter: ANKOWSKI, Artur (SLAC National Accelerator Laboratory, Stanford University)

Session Classification: Thursday

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

Jefferson Lab eAr experiment results

Thursday, March 18, 2021 11:05 AM (25 minutes)

Presenter: JIANG, Libo

Session Classification: Thursday

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

Semi-inclusive scattering for nu energy reconstruction

Thursday, March 18, 2021 11:30 AM (25 minutes)

Presenter: GONZALEZ JIMENEZ, RAUL (Complutense University of Madrid)

Session Classification: Thursday

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

Weak pion production in BChPT

Thursday, March 18, 2021 11:55 AM (25 minutes)

Primary author: Dr BLIN, Astrid

Presenter: Dr BLIN, Astrid

Session Classification: Thursday

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

Closeout

Session Classification: Wednesday

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

Electron scattering for neutrino physics at MAMI

Wednesday, March 17, 2021 9:05 AM (10 minutes)

We will present new results and opportunities for neutrino physics with high precision electron scattering experiments at the MAMI electron accelerator facility.

Primary authors: Dr BACCA, Sonia (JGU, Mainz); Dr DORIA, Luca (Johannes Gutenberg University Mainz)

Presenter: Dr DORIA, Luca (Johannes Gutenberg University Mainz)

Session Classification: Flash Talks

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

Overview of MINERvA's Binding Energy Study with the STKI Variables

Tuesday, March 16, 2021 11:25 AM (10 minutes)

The single transverse kinematic imbalance (STKI) variables are important new tools to identify deficiencies in the modeling of the nucleus in neutrino experiments. MINERvA has pioneered the measurement of a pair of STKI variables (dptx, dpty) with sensitivities to the implementation of the binding energy in GENIE 2.12.6. Our measurements indicate a discrepancy between data and MC in the peak position of dpty, which is reduced if the binding energy term in GENIE is added back to the final state nucleon.

Primary author: CAI, Tejin

Presenter: CAI, Tejin

Session Classification: Flash Talks

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

High Statistics Inclusive Cross Section Measurements from MINERvA

Tuesday, March 16, 2021 11:15 AM (10 minutes)

In an era of precision neutrino oscillation experiments using improved technology that generate large statistical samples, it is important to understand the properties of neutrino interactions on nuclei over a large volume of kinematic phase space. The MINERvA experiment, which utilizes the NuMI neutrino beam at Fermilab, measures cross sections across multiple materials ranging from helium to lead, and is able to compare results to models of these neutrino interactions. I will present a new double differential cross section measurement of charged current muon-neutrino interactions in hydrocarbon, in variables of the longitudinal and transverse momenta of the muon, with a high statistics sample composed of over 4 million events. This result is advantageous for comparisons with theorists since it is done in well-defined easily measurable variables, and is able to highlight areas in which there are model deficiencies.

Primary author: FILKINS, Amy (William & Mary)

Presenter: FILKINS, Amy (William & Mary)

Session Classification: Flash Talks

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

Coulomb corrections for charged current events

Wednesday, March 17, 2021 8:25 AM (10 minutes)

The Coulomb field of a nucleus exerts a force on charged leptons produced in charged-current neutrino nucleus interactions. Quantum mechanically this results in a distorted lepton wavefunction which can modify cross sections and have other phenomenological implications. In this talk we discuss recent progress on a analytic theory of Coulomb corrections for high energy charged current scattering events. We highlight how an Eikonal expansion can be used to recover, and systematically improve, certain phenomenological ansatzes used in the literature.

Primary authors: PLESTID, Ryan (University of Kentucky); Prof. HILL, Richard J (University of Kentucky and Fermilab); TOMALAK, Oleksandr (University of Kentucky)

Presenter: PLESTID, Ryan (University of Kentucky)

Session Classification: Flash Talks

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

Tau polarization in (anti-)neutrino-nucleon interactions.

Wednesday, March 17, 2021 7:50 AM (10 minutes)

Detection and identification of tau-neutrino events is of primary interest for the neutrino-oscillation program. While accelerator experiments like DONUT and OPERA reported events with tau-leptons, atmospheric neutrino studies at Super-Kamiokande and IceCube established the $\nu_\mu \to \nu_\tau$ oscillation. Future experiments such as DUNE, DsTau and SHiP are also planning to detect tau-leptons.

The tau-neutrinos are primarily revealed via their charged-current interactions, $\overset{(-)}{\nu}_\tau N \to \tau^\pm X$. The short lifetime and heavy mass of tau's make them challenging to identify. However, due to the parity-violating decay modes, the spin information is preserved in tau decay product's kinematics. Therefore, the polarization information plays a vital role in tau-detection.

In this work, we study the semi-inclusive ν_τ-nucleon cross-section and the polarization of produced tau-leptons in a broad kinematic range encompassing quasi-elastic scattering (QE), inelastic scattering(IS), and deep inelastic scattering (DIS) processes. We improve the previous study of Hagiwara et al.(Nucl. Phys. B668 (2003) 364) in the inelastic and deep inelastic regimes. In the IS channel, which is dominated by the excitation of baryon resonances, we rely on the Dynamical Couple Channel model to provide an accurate description of the process in a broader range of hadronic invariant masses, extending to 2 GeV. On the other hand, in the DIS region, we improve the kinematic treatment (especially for low Q^2) and write the structure functions in a more consistent way.

Primary author: Dr ALAM, M. Rafi (Aligarh Muslim University, Aligarh, India)

Co-authors: Dr RUSO, Luis Alvarez (IFIC); Prof. SATO, Toru (Research Center for Nuclear Physics, Osaka University)

Presenter: Dr ALAM, M. Rafi (Aligarh Muslim University, Aligarh, India)

Session Classification: Flash Talks

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

Towards the measurement of neutrino cross section on water in the 1 GeV region using the WAGASCI detector of the T2K experiment

Wednesday, March 17, 2021 8:00 AM (10 minutes)

The WAGASCI-BabyMIND project inside the T2K experiment aims at measuring the neutrino cross-section on water and CH with the T2K neutrino beam. The project name comes from two newly developed detectors: the WAGASCI detector, a 3D grid-like water and scintillator detector that acts as the water target, and the BabyMIND detector, a magnetized muon spectrometer made of many intertwined planes of scintillators and magnetized iron.
nbsp;nbsp;nbsp;nbsp; The motivation of the WAGASCI experiment is to reduce the systematic uncertainty on the neutrino cross-section with the same target and acceptance as the SuperKamiokande far detector, which the current ND280 near detector does not cover completely. The first physics run with full setup collected data from Nov. 2019 to Feb. 2020. This data set corresponds to a beam exposure of about 5.0×10^20 protons on target in neutrino mode.
nbsp;nbsp;nbsp;nbsp; In this talk, we will present the current status of the analysis for the water target, mainly focusing on the evaluation of the performance of the WAGASCI and BabyMIND detectors.

Primary authors: YASUTOME, Kenji (Kyoto University); PINTAUDI, Giorgio (Yokohama National University)

Co-authors: RUGGLES, Charlie (University of Glasgow); Mr TRAN, Ngoc (Institute For Interdisciplinary Research in Science and Education); WAGASCI COLLABORATION

Presenter: PINTAUDI, Giorgio (Yokohama National University)

Session Classification: Flash Talks

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

Quasielastic interactions of monoenergetic kaon decay-at-rest neutrinos

Wednesday, March 17, 2021 8:35 AM (10 minutes)

Monoenergetic muon neutrinos with an energy of 236 MeV are readily produced in intense medium-energy proton facilities at Fermilab and J-PARC when a positive kaon decays at rest in neutrino beamline absorbers.
These kaon decay-at-rest (KDAR) neutrinos offer a distinctive opportunity to study neutrino-nucleus interactions without having to deal with the complications raised by pion decay-in-flight neutrinos with broad energy-distributions.
These monoenergetic neutrinos are important for obtaining a better understanding of the role of e.g. initial and final-state interactions, and correlations in the nuclear medium, and they can help to reduce experimental and theoretical uncertainties and ambiguities in an unprecedented way.
The KDAR charged-current muon interaction occurs in a kinematic region that is strongly affected by nuclear effects such as Pauli-blocking and long-range correlations.
We present cross sections of electron- and neutrino-nucleus scattering in the kinematic region probed by KDAR neutrinos, paying special attention to the low-energy aspects of the scattering process.
Our model takes the description of the nucleus in a mean-field (MF) approach as the starting point, where we solve Hartree-Fock (HF) equations using a Skyrme (SkE2) nucleon-nucleon interaction.
We introduce long-range nuclear correlations by means of the continuum random phase approximation (CRPA) framework where we solve the RPA equations using a Green's function method in configuration space.
We discuss the relevance of a precise determination of KDAR ν_μ-nucleus cross sections for neutrino oscillation experiments. In particular for the MiniBooNE experiment that observes a large excess of electron-like events in a ν_μ beam in the (reconstructed) energy bins that overlap with the KDAR ν_μ energy.

Primary authors: NIKOLAKOPOULOS, Alexis (UGent); Dr PANDEY, Vishvas (University of Florida); JACHOWICZ, Natalie (Ghent University); Dr SPITZ, Joshua (University of Michigan)

Presenter: NIKOLAKOPOULOS, Alexis (UGent)

Session Classification: Flash Talks

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

Dark Neutrino Simulations with GENIE on SBND

Monday, March 15, 2021 12:55 PM (10 minutes)

A potential explanation of the MiniBooNE low energy excess posits the existence of a novel dark sector, involving a dark neutrino and a dark gauge boson. In this model neutrinos interact with nuclei and up-scatter into dark neutrinos. I will present a new GENIE module that generates the Dark Neutrino interactions from this model, allowing simulations of their expected signal on the Short Baseline Near Detector (SBND), a LArTPC detector under construction as part of Fermilab's Short-Baseline Neutrino Program.

Primary author: DE ICAZA, Iker (University of Sussex)

Presenter: DE ICAZA, Iker (University of Sussex)

Session Classification: Flash Talks

Contribution ID: **77** Type: **not specified**

An improved muon neutrino charged-current single positive pion cross section on water using michel electron reconstruction in the T2K near detector

Monday, March 15, 2021 9:45 AM (10 minutes)

Alongside acting as the off-axis near detector for T2K, ND280 is also used to measure a variety of neutrino interaction rates, in order to give a better understanding of the individual cross sections.

I will present the status of an updated measurement of the muon neutrino cross section with one positively charged pion in the final state (ν_μCC1π^+) in ND280. The updated measurement will provide access to new regions of phase space, with the inclusion of kinematic reconstruction of the charged pion from its subsequent decay chain to Michel electrons, the first time this technique will have been used in T2K analyses. Increased statistics and updated systematic treatments will also provide a more accurate measurement.

New or updated neutrino cross section measurements can be used to compare to our current interaction models, in order to reduce model-related systematics, which will be particularly important for next generation oscillation experiments.

Primary author: JENKINS, Sam (University of Sheffield)

Presenter: JENKINS, Sam (University of Sheffield)

Session Classification: Flash Talks

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

Status of the ENUBET monitored neutrino beam

Tuesday, March 16, 2021 12:05 PM (10 minutes)

The ENUBET experiment, included in the CERN Neutrino Platform effort as NP06/ENUBET, is developing a new neutrino beam based on conventional techniques in which the flux and the flavor composition are known with unprecedented precision ($\mathcal{O}(1\%)$). Such a goal is accomplished monitoring the associated charged leptons produced in the decay region of the ENUBET facility. Positrons and muons from kaon decays are measured by a segmented calorimeter instrumenting the walls of the decay tunnel, while muon stations after the hadron dump can be used to monitor the neutrino component from pion decays. Furthermore, the narrow momentum width (<10%) of the beam provides a precise measurement ($\mathcal{O}(10\%)$) of the neutrino energy on an event by event basis, thanks to its correlation with the radial position of the interaction at the neutrino detector. ENUBET is therefore an ideal facility for a high precision neutrino cross-section measurement at the GeV Scale, that could enhance the discovery potential of the next-generation of long baseline experiments, and for the study of non-standard neutrino models. We report here a new improved design of the proton target and of the meson transfer line, that ensures a larger neutrino flux while preserving a purity in the lepton monitoring similar to the one previously achieved. The final design of the ENUBET demonstrator for the instrumented decay tunnel, that is due by end 2021, will be also discussed. It has been determined on the basis of the results of the 2016-2018 testbeams and will prove the scalability and performance of the selected detector technology. Progress on the full simulation of the ENUBET facility and of the lepton reconstruction, towards the full assessment of neutrino flux systematics, will be also reported.

Primary author: PARI, Michelangelo (University of Padova)

Presenter: PARI, Michelangelo (University of Padova)

Session Classification: Flash Talks

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

Importance of study of quasielastic hyperon production at DUNE energies

Wednesday, March 17, 2021 8:55 AM (10 minutes)

In the era of precision measurement, the main aim is to determine the neutrino oscillation parameters with better precision and to search for the CP violation in the leptonic sector, for which the simultaneous knowledge of neutrino and antineutrino cross section in the same energy region, for a given nuclear target is required. In the few GeV energy region of neutrinos and antineutrinos, the contribution to the total scattering cross section comes from the quasielastic, inelastic, and deep inelastic scattering processes. In the case of antineutrinos, apart from the aforementioned processes, the single hyperon production, although being Cabibbo suppressed, also contributes to the total scattering cross section in some kinematic regimes. The produced hyperons then decay into a nucleon-pion system thus giving an additional contribution to the single pion production, especially in the low energy region which receives a dominant contribution from the Δ excitation. We have estimated that in the low energy region of $\sim$ 0.3 to 0.6 GeV, the hyperon production competes with the Δ production cross sections [1].

The study of single hyperon production is important in its own right as it provides information about the nucleon-hyperon transition form factors at high Q^2, which are presently known only at low Q^2 from the study of the semileptonic decays of hyperons, where the symmetries of the weak hadronic current like the T-invariance, G-invariance, and SU(3) symmetry are also tested. We have studied the dependence of different vector and axial vector currents including the second class current form factors on the total and differential cross section as well as the time reversal and G-parity violations in the antineutrino induced single hyperon production [2]. We plan to extend our study of the single hyperon production by taking into account the effect of SU(3) symmetry violating form factors used in the various analyses of the semileptonic hyperon decays. Recently, Thorpe et al. [3] have also studied the effect of second class currents, axial dipole mass, and SU(3) symmetry violation on the total and differential scattering cross sections in the antineutrino induced single hyperon production.

Theoretically, we have also studied the polarization components of the hyperons produced in the antineutrino reactions, and the dependence of the form factors on these polarization observables is studied. The longitudinal and perpendicular components of polarization lie in the plane while the transverse component of polarization lies perpendicular to the reaction plane and is forbidden by G- and T-invariance. The experimental measurement of the non-zero value of the transverse component of the polarized hyperon will directly show the violation of time reversal in the weak sector. Fortunately, such kind of studies can be performed at the DUNE experiment at Fermilab, which will use the liquid argon time projection chamber type of detector, and is itself a target and a detector and gives the 3-dimensional track of the interaction. Keeping the above considerations in mind, it is possible in the DUNE experiment to study the physics of T-violation in the leptonic sector by measuring the polarization components of the hyperons and leptons produced in the antineutrino reactions [4]. By studying the polarization components of the polarized hyperon, we may also study the effect of SU(3) symmetry violation in the strangeness sector.

We will present the results to show the effect of the second class current form factor and SU(3) symmetry breaking on the total and differential scattering cross sections as well as on the polarization components of the hyperon and leptons produced in the antineutrino scattering from free nucleons as well as from the Argon nuclear target at DUNE energies.

[1] A. Fatima, M. S. Athar and S. K. Singh, Front. in Phys. 7, 13 (2019).

[2] A. Fatima, M. Sajjad Athar and S. K. Singh, Phys. Rev. D 98, 033005 (2018).

[3] C. Thorpe, J. Nowak, K. Niewczas, J. T. Sobczyk and C. Juszczak, [arXiv:2010.12361 [hep-ph]].

[4] A. Fatima, M. Sajjad Athar and S. K. Singh, Phys. Rev. D 102, 113009 (2020), and to be published.

Primary authors: Dr FATIMA, A. (ALIGARH MUSLIM UNIVERSITY); Prof. SAJJAD ATHAR, M. (ALIGARH MUSLIM UNIVERSITY); Prof. SINGH, S. K. (ALIGARH MUSLIM UNIVERSITY)

Presenter: Dr FATIMA, A. (ALIGARH MUSLIM UNIVERSITY)

Session Classification: Flash Talks

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

Electroweak pion production off nucleons near threshold in ChPT

Wednesday, March 17, 2021 8:45 AM (10 minutes)

We study the CC and NC electroweak pion production off nucleons in a fully relativistic ChPT with explicit contributions of the Δ resonance at energies close to the threshold.

At low energies, the experimental data is scarce for weak pion-production processes and theoretical models should be fairly predictive. In order to do this some of the most relevant parameters in the amplitude, still unknown for the weak production process, were recently fitted with pion photo- and electroproduction data (>2800 data points) using the same relativistic ChPT+Δ approach. This work is able to reproduce very well the electromagnetic pion-production data with few parameters up to 70 MeV above the threshold and gives support to the chiral calculations of the neutrino induced pion production and allow for more precise predictions of the cross-sections.

We found that Δ contribution is still crucial to reproduce the data close to the threshold for the photo- and electroproduction processes and the current calculation of the neutrino pion-production shows similar results at several energies.

This study represents joint efforts at the neutrino-nucleon level and new achievement in the precision goals of future neutrino experiments establishing a strong base for further studies involving neutrino-nucleus processes.

Primary author: GUERRERO NAVARRO, Gustavo H (IFIC, University of Valencia)

Presenter: GUERRERO NAVARRO, Gustavo H (IFIC, University of Valencia)

Session Classification: Flash Talks

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

Plans for Theory Interfaces

Monday, March 15, 2021 11:10 AM (10 minutes)

Primary authors: Dr FIELDS, Laura (University of Notre Dame); PICKERING, Luke (Michigan State University); Dr BETACOURT, Minerba

Presenter: Dr BETACOURT, Minerba

Session Classification: Monday

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

Plans for Common Flux and Geometry Driver, Event Format, and FSI Separation (plus Q&A for two previous talks)

Monday, March 15, 2021 11:20 AM (25 minutes)

Primary authors: Dr FIELDS, Laura (University of Notre Dame); Dr PICKERING, Luke (Michigan State University); Dr BETACOURT, Minerba

Presenter: Dr PICKERING, Luke (Michigan State University)

Session Classification: Monday

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

New Physics Model Developments in GENIE

Monday, March 15, 2021 12:05 PM (20 minutes)

Primary author: Dr GARDINER, Steven (Fermi National Accelerator Laboratory)

Presenter: Dr GARDINER, Steven (Fermi National Accelerator Laboratory)

Session Classification: Monday

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

Workshop Photo

Thursday, March 18, 2021 9:30 AM (5 minutes)

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

Workshop Discussion Notes

Monday, March 15, 2021 7:00 AM (5 minutes)

During the workshop we had space for “offline” discussion on a shared google doc – a record of that google doc is kept here for later reference