NUFACT2014, XVIth International Workshop on Neutrino Factories and Future Neutrino Beam Facilities

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University of Glasgow

Book of Abstracts

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New Accelerator Facilities for Neutrino Physics

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WG2 convenors: plans and questions

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WG3 convenors: plans and questions

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WG4 convenors: plans and questions

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WG3 Answers to Questions

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European Long-baseline Neutrino Oscillation Projects

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Corresponding Authors: strait@fnal.gov, mbishai@bnl.gov

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Lepton Flavour Violation Experiments

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Muon Facilities for Precision Experiments

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Constraints on non-standard flavor-dependent interactions from Superkamiokande and Hyperkamiokande

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[1] *Tokyo Metropolitan University*

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Flavor-dependent neutral current non-standard interactions in propagation of neutrino induce extra matter effect for neutrinos. Such interactions for the nu-e and nu-tau sectors have poor constraints from current experimental data, and they can be as large as those in the Standard Model. In this talk I would like to discuss the constraints on such non-standard interactions from atmospheric neutrino experiments such as Superkamiokande and Hyperkamiokande.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

No

WG4: Muon Physics (Yes/No):

No

WG1: Neutrino Oscillation Physics (Yes/No):

Yes

Type of presentation:

Oral presentation

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Energy Estimation for the NOvA Numu Disappearance Analysis

Author: Susan Lein[1]

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The NOvA experiment studies neutrino oscillations by utilizing the NuMI neutrino beam at Fermilab. It consists of two functionally-identical, liquid scintillator tracking calorimeters placed 14 milliradians off-axis from the beam and 810 km apart. Precise energy estimation increases sensitivity to the oscillation parameters and comparing different energy measurements helps with event selection. Methods have been developed for the muon neutrino disappearance analysis to measure the neutrino energy of selected events. These techniques
and their performance will be presented in this poster.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

No

WG4: Muon Physics (Yes/No):

No

WG1: Neutrino Oscillation Physics (Yes/No):

Yes

Type of presentation:

Poster

45

Event Selection for the NOvA Numu Disappearance Analysis

Author: Nicholas Raddatz[1]

[1] *University of Minnesota*

The NOvA experiment is a long baseline neutrino osciallation experiment utilizing the NuMI beam at Fermilab.
The experiment will measure the oscillations of the primarily muon neutrino beam using two functionally-identical,
liquid scintillator tracking calorimeter detectors placed 810 km apart and 14 milliradians off-axis to the NuMI beam.
The muon neutrino disappearance analysis has developed a method for selecting charged current (CC) interactions
based on the identification of muons. A techinique for seperating the selected CC interactions into quasielastic and non-quasielastic sub-samples has also been developed. Seperating into sub-samples allows for better energy estimation in each individual sample resulting in increased sensitivity to the oscillation parameters. These methods and their performance will be presented in this poster.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

No

WG4: Muon Physics (Yes/No):

No

WG1: Neutrino Oscillation Physics (Yes/No):

Yes

Type of presentation:

Poster

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Oscillation Sensitivity with Upward-going Muons in ICAL at India-based Neutrino Observatory (INO)

Authors: Indumathi D[1]; Kanishka Rawat[2]; Vipin Bhatnagar[2]

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[2] *Physics Department, Panjab University, Chandigarh-160014, India*

The proposed magnetised Iron Calorimeter (ICAL) detector at the India-based Neutrino Observatory (INO) lab is mostly sensitive to the atmospheric muon neutrinos. These are detected through the detection of charged muons arising from the charged-current (CC) interactions of muon-neutrinos with the material of the detector and are the primary signal in the study of atmospheric neutrinos. Upward-going muons also known as rock muons arise from the interactions of atmospheric neutrinos with the rock material surrounding the detector in the earth's crust and then finally
reach the detector. It is important to study these, although their numbers are small. An additional complication is the energy loss that the muons undergo as they travel through the
rock to reach the detector. For this study, they are to be discriminated from:
(i) Neutrino events producing muons through interactions inside ICAL detector.
(ii) Cosmic ray muon events produced in the earth's atmosphere directly interacting with ICAL, which are the main background of the ICAL detector.
Hence, we need to study the upward-going muons with the separation of them from (i) and (ii). Analysis of upward-going muons requires an understanding of the reconstruction of muon tracks in ICAL as a function of both energy and direction also (that is, their energy and direction resolution). Since these muons arise from interactions of atmospheric neutrinos, they will also carry information on neutrino oscillations. We present results for oscillation studies with upward-going muons and discuss the significance of them in the INO-ICAL experiment.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

No

WG4: Muon Physics (Yes/No):

No

WG1: Neutrino Oscillation Physics (Yes/No):

Yes

Type of presentation:

Poster

WG1: Neutrino Physics / **48**

IsoDAR and DAEdALUS

Author: Joshua Spitz[1]

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IsoDAR is a novel experimental concept to use a powerful low energy cyclotron to produce a source of electron antineutrinos. Such a source, when combined with a liquid scintillator based detector such as KamLAND, can provide a direct probe of the reactor antineutrino anomaly and, in general, a definitive probe of the sterile neutrino. Further, IsoDAR can differentiate between one and two sterile

neutrinos in many scenarios as well as collect a sample of antineutrino-electron elastic scattering events that is approximately five times greater than has been collected to date. The experiment will be introduced within the context of the overall DAEδALUS program for discovering CP violation in the neutrino sector and recent progress will be discussed.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

No

WG4: Muon Physics (Yes/No):

Yes

WG1: Neutrino Oscillation Physics (Yes/No):

Yes

Type of presentation:

Oral presentation

WG2: Neutrino Scattering Physics / 49

Hadron Production measurements at the NA61/SHINE experiment for the T2K Neutrino Flux Prediction

Author: Davide Sgalaberna[1]

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The largest source of uncertainty on the initial neutrino flux in modern accelerator neutrino experiments is the poor knowledge on the production of hadrons that decay into neutrinos. T2K is a long baseline neutrino experiment that aims to precisely measure the parameters of the PMNS matrix via the $\nu_\mu \to \nu_e$ appearance and ν_μ disappearance as well as to look for the first indication of CP violation in the lepton sector. The required total systematic uncertainty on the neutrino flux as low as 5% can hopefully be achieved with high precision hadron production measurements, performed by the dedicated auxiliary NA61/SHINE experiment at the CERN SPS. Production of hadrons in 31 GeV/c proton interactions on Carbon is measured with a thin target (4% of the nuclear interaction length) to study the primary interactions and with a T2K replica target (1.9 interaction length) to investigate re-interactions in the long target.
The low statistic pilot data-set taken in 2007 was used to measure hadron multiplicities with the thin target and to demonstrate the capabilities of the spectrometer with the T2K replica target. High statistics 2009 and 2010 runs have been used to perform precise measurements. The latest 2009 results on charged pion, kaon and proton spectra are presented and experimental data are compared to model predictions.
The re-weighting procedure used to tune the T2K neutrino flux is presented as well. This method will be very important also for the future neutrino long-baseline experiments for which a precision of about 2% on the flux knowledge is required for the discovery of CP violation in the lepton sector.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

Yes

WG4: Muon Physics (Yes/No):

No

WG1: Neutrino Oscillation Physics (Yes/No):

Yes

Type of presentation:

Oral presentation

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Evidence for leptonic CP phase from NOVA, T2K and ICAL

Author: Monojit Ghosh[1]

Co-authors: Pomita Ghoshal [2]; Srubabati Goswami [1]; Sushant Raut [1]

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The phenomenon of neutrino oscillation is now well understood from the solar, atmospheric, reactor and accelerator neutrino experiments. This oscillation is characterized by a unitary PMNS matrix which is parametrized by three mixing angles and one phase known as the leptonic CP phase. Though there are already significant amount of information about the three mixing angles but the CP phase is still unknown. The long baseline experiments(LBL) have CP sensitivity coming from the appearance channel but atmospheric neutrinos known to have negligible CP sensitivity. In my presentation I will describe the synergy between the LBL experiment NOVA, T2K and the atmospheric neutrino experiment ICAL@INO for obtaining the first hint of CP violation in the lepton sector.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

No

WG4: Muon Physics (Yes/No):

No

WG1: Neutrino Oscillation Physics (Yes/No):

Yes

Type of presentation:

Poster

WG4: Muon Physics and High Intensity applications / 51

The MUSE Experiment: Studying the Proton Radius Puzzle with μp Elastic Scattering

Author: Katherine MESICK[1]

[1] *Rutgers University*

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The Proton Radius Puzzle refers to the disagreement between the proton charge radius as determined from muonic hydrogen and the radius determined from atomic hydrogen level transitions and ep elastic scattering form factor data. The discrepancy of $\sim 7\sigma$ is not yet explained, and though numerous resolutions
have been proposed there is no generally accepted resolution to the puzzle. The MUon Scattering Experiment (MUSE) Collaboration will simultaneously measure elastic ep and μp scattering at the Paul Scherrer Institute, testing the interesting possibility that ep and μp scattering cross sections are different. The experiment will also measure scattering with both polarities of e and μ,
directly disentangling two-photon exchange effects. We plan to measure in the kinematic region of $Q^2 = 0.002 - 0.07$ GeV^2, and determine the relative cross sections to a few tenths of a percent. This will allow the proton radius difference to be extracted to ∼0.01 fm, similar to the significance of the current measurements of the discrepancy. A physics overview of the experiment and the current status of the experiment will be presented.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

No

WG4: Muon Physics (Yes/No):

Yes

WG1: Neutrino Oscillation Physics (Yes/No):

No

Type of presentation:

Oral presentation

WG4: Muon Physics and High Intensity applications / 52

tau cLFV decays

Author: Cornelis Onderwater[1]

[1] *University of Groningen (NL)*

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This talk covers the recent results and prospects of tau cLFV decays from LHCb, super-B (Belle-II), as well as BaBar and Belle experiments.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

No

WG4: Muon Physics (Yes/No):

Yes

WG1: Neutrino Oscillation Physics (Yes/No):

No

Type of presentation:

Oral presentation

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TITUS: An Intermediate Distance Detector for the Tokai-to-Hyper-Kamiokande Neutrino Beam

Author: Mark Rayner[None]

The Tokai Intermediate Tank for Unoscillated Spectrum (TITUS) detector is a proposed addition to the Hyper-Kamiokande (Hyper-K) experiment, located approximately 2 km from the J-PARC neutrino beam. The design consists of a 2 kton Gd-doped water Cherenkov tank, surrounded by a magnetized iron detector designed to range-out muons. The target material and location were chosen so that the neutrino interactions and beam spectrum at TITUS would match those of Hyper-K. Including a 0.1% Gd concentration allows for nu/antinu discrimination via neutron tagging. The primary goal of TITUS is to make cross-section measurements that reduce the systematic uncertainty of the long-baseline oscillation physics program at Hyper-K and enhance its sensitivity to CP violation. TITUS can also be used for physics unrelated to the J-PARC beam, functioning as an independent detector for supernova neutrino bursts and measuring the neutron rate to improve Hyper-K proton decay searches.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

No

WG4: Muon Physics (Yes/No):

No

WG1: Neutrino Oscillation Physics (Yes/No):

Yes

Type of presentation:

Poster

WG4: Muon Physics and High Intensity applications / 54

MuSun Experiment: Measuring the Rate of Muon Capture on Deuteron

Author: Xiao Luo[1]

[1] *Boston University*

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The goal of the MuSun experiment at PSI is to measure the rate of muon capture on the deuteron with a precision of 1.5%. This rate will be used to fix the low-energy constant that describes the two-nucleon weak axial current in Chiral perturbation theory. It will therefore calibrate evaluations of solar proton-proton fusion and neutrino-deuteron scattering(SNO experiment). MuSun forms part of the systematic program to achieve a new level of precision in confronting the theories of weak interactions, QCD and few body physics. MuSun inherits some of the well developed techniques and apparatus from a successful measurement of the rate for muon capture on the proton, the MuCap experiment, also performed at PSI. As in MuCap, MuSun uses a TPC as anactive target, but to optimize the molecular kinetics, its ultra-pure deuterium gas in kept at 30K. The status of the hardware and details of the data analysis for a high statistics run taken in 2013 will be presented.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

No

WG4: Muon Physics (Yes/No):

Yes

WG1: Neutrino Oscillation Physics (Yes/No):

No

Type of presentation:

Oral presentation

WG1: Neutrino Physics / 55

Neutrino masses and mixings from discrete symmetries

Author: Christoph Luhn[1]

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WG1: Neutrino Physics / 56

Model comparison and experimental constraints

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WG1: Neutrino Physics / 57

Neutrino masses and mixings from continous symmetries and discussion

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MINOS/MINOS+

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T2K

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NOvA

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NuFact

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Double CHOOZ

66

Daya Bay

WG1: Neutrino Physics / 67

New Results from RENO

Authors: Hyunkwan Seo[1]; Hyunkwan Seo[None]

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The Reactor Experiment for Neutrino Oscillation(RENO) started data-taking from August, 2011 and has observed the disappearance of reactor electron antineutrinos to measure the smallest neutrino mixing angle theta 13. The experiment has accumulated roughly 800 days of data to make an accurate measurement of the reactor neutrino flux and spectral shape. Antineutrinos from six reactors at Hanbit Nuclear Power Plant in Korea, are detected and compared by two identical detectors located in the near and far distances from the reactor array center. In this talk, we present new results on precisely measured theta 13 value as well as reactor neutrino flux and spectrum based on the 800 day data sample.

WG1: Neutrino Oscillation Physics (Yes/No):

Yes

Type of presentation:

Oral presentation

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Daya Bay and the reactor anomaly

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Muon g-2 status and computations

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Muon g-2 phenomenological consequences

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JUNO

WG1: Neutrino Physics / 72

INO

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PINGU

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WG1: Neutrino Physics / 74

Quantifying the sensitivity of oscillation experiments to the neutrino mass ordering

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During the last two years, there has been some confusion in the field on how to assess the sensitivity of future neutrino oscillation experiments to the neutrino mass ordering. A factor of two difference to the common approach has been proposed. We resolve the situation by going back to the basic statistical definitions and apply the results to compare future possibilities of experiments aiming for determination of the mass ordering. We find that the typical median sensitivity measure is very close to that given by the common approach. We also discuss other possible measures of sensitivity and briefly discuss the situation for other observables, such as CP violation and the octant of θ_{23}.

WG1: Neutrino Physics / 75

Status of MicroBooNE and future FNAL short-baseline program

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WG1: Neutrino Physics / 76

Source neutrino experiments

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WG1: Neutrino Physics / 77

Tagged electron neutrinos

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Short-baseline oscillation measurements at T2K

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WG1: Neutrino Physics / 79

Testing the Standard Model with the lepton g-2

Author: Massimo Passera[1]

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WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

No

WG4: Muon Physics (Yes/No):

Yes

WG1: Neutrino Oscillation Physics (Yes/No):

Yes

Type of presentation:

Oral presentation

WG1: Neutrino Physics / 80

Testing New Physics with the lepton g-2

Author: Paride Paradisi[1]

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WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

No

WG4: Muon Physics (Yes/No):

Yes

WG1: Neutrino Oscillation Physics (Yes/No):

No

Type of presentation:

Oral presentation

WG4: Muon Physics and High Intensity applications / 81

Measurement of the hyperfine splitting energy of the ground-state muonic hydrogen

Author: Katsuhiko ISHIDA[1]

Co-authors: Katsumi Midorikawa [2]; Kazuo Tanaka [3]; Masaharu Sato [4]; Masahiko Iwasaki [4]; Norihito Saito [2]; Satoshi Wada [2]; Shinji Okada [4]; Sotaro Kanda [5]; Teiichiro Matsuzaki [4]; Yasuyuki Matsuda [3]; Yu Oishi [4]; Yue Ma [4]

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[4] *RIKEN Nishina Center*

[5] *University of Tokyo*

Corresponding Author: ishida@riken.jp

A new measurement is planned to precisely determine the muonic proton hyperfine splitting energy with laser spectroscopy by using the intense pulsed muon beam at RIKEN-RAL or J-PARC. A tunable intense mid infra-red laser will be used to cause the hyperfine transition. With circularly polarized laser at the resonant energy, we expect to create observable muon spin polarization in the spin-triplet state. The precise energy value will give in turn the proton Zemach radius.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

No

WG4: Muon Physics (Yes/No):

Yes

WG1: Neutrino Oscillation Physics (Yes/No):

No

Type of presentation:

Oral presentation

WG4: Muon Physics and High Intensity applications / 82

Muon g-2/EDM at J-PARC

Author: Katsuhiko Ishida[1]

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A new experiment is under preparation to measure the muon g-2 and EDM at J-PARC with a novel technique called ultra-slow muon beam. I present the recent progresses, especially those in the ultra-slow muon beam production.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

No

WG4: Muon Physics (Yes/No):

Yes

WG1: Neutrino Oscillation Physics (Yes/No):

No

Type of presentation:

Oral presentation

WG2: Neutrino Scattering Physics / 83

Using electron scattering to constrain the axial-vector form factor

Author: Raúl González-Jiménez[1]

Co-authors: J. A. Caballero [1]; T. W. Donnelly [2]

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[2] *Center for Theoretical Physics, Laboratory for Nuclear Science and Department of Physics, MIT*

Corresponding Author: raugj@us.es

An important number of neutrino scattering experiments involve nuclei as targets.
Many of these experiments are placed at the intermediate energy regime (from hundreds of MeV to a few GeV) where the quasi-elastic (QE) scattering process is one of the dominant channels in the reaction mechanism.
Some examples are MiniBooNE, Minerνa, NOMAD and T2K experiments.

We have analysed elastic electron-proton and QE electron-nucleus scattering reactions aiming to show how these processes can be used as tools to constrain the axial-vector form factor.
This is a fundamental ingredient for the description of QE neutrino-nucleus cross sections.
%
From an experimental point of view, the use of electrons as projectiles, in comparison to neutrinos, has important advantages.
For instance, it is possible to produce monochromatic beams with a better control of the kinematics that makes easier to determine the channels involved in the reaction.

Although the electromagnetic (EM) interaction is dominant in electron-nucleon/nucleus scattering reactions, the electron feels also the weak neutral current (WNC) interaction.
The parity violating asymmetry ($calA^{PV}$) is defined as $calA^{PV} = (\sigma^+ - \sigma^-)/(\sigma^+ - \sigma^-)$, where $\sigma^{+/-}$ represents the electron-proton or electron-nucleus differential cross section with positive/negative helicity of the incident electron.
This observable is different from zero due exclusively to the presence of the weak interaction.
Thus, the PV asymmetry serves to study the different ingredients that enter in the nucleon weak neutral current, particularly, the WNC form factors.

There exist an important number of PV electron-proton asymmetry data taken at different kinematics.
By performing a statistical analysis of the full set of data we provide estimates on the electric and magnetic strange form factors ($G^s_{E,M}$) and on the axial-vector one (G_A).
Additionally, we find that these three form factors ($G^s_{E,M}$ and G_A) are strongly correlated
%
(see refs. [1,2] for more details).

We also present a brief discussion on the PV asymmetry linked to the QE electron-nucleus scattering process.
This observable could provide information on the WNC nucleon form factors that complements the one obtained from the elastic reaction.
In particular, it can help to constrain the isovector contribution in the axial-vector form factor [3].

[1] R. González-Jiménez, J. A. Caballero, T. W. Donnelly. arXiv:1403.5119 [nucl-th] (2014).

[2] R. González-Jiménez, J. A. Caballero, T. W. Donnelly. Phys. Rep., 524, 1 (2013).

[3] R. González-Jiménez, J. A. Caballero, T. W. Donnelly. In preparation.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

Yes

WG4: Muon Physics (Yes/No):

No

WG1: Neutrino Oscillation Physics (Yes/No):

No

Type of presentation:

Oral presentation

WG4: Muon Physics and High Intensity applications / 84

Status of the New Muonium HFS Experiment at J-PARC/MUSE

Author: Patrick Strasser[1]

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At the J-PARC Muon Science Facility (MUSE), we are now planning a new measurement of the ground state hyperfine structure (HFS) of muonium. High precison measurements of muonium HFS is the most sensitive tool for testing QED theory. Fundamental constants of the muon mass and magnetic moment are currently determined by the previous muonium HFS experiment at LAMPF. The new high intensity muon beam that will soon be available at MUSE H-Line will provide an opportunity to improve the precision of these experimental values. An overview of the different aspects of this new muonium HFS measurement, and the current status of the preparation of the gas chamber/RF cavity, detectors and magnetic field measurement system will be presented.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

No

WG4: Muon Physics (Yes/No):

Yes

WG1: Neutrino Oscillation Physics (Yes/No):

No

Type of presentation:

Oral presentation

WG1: Neutrino Physics / 85

Event and Energy Reconstruction in the NOvA Experiment

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The NOvA experiment is a long baseline neutrino osciallation experiment utilizing the NuMI beam at Fermilab. The experiment will measure the oscillations of the primarily muon neutrino beam using two functionally-identical, liquid scintillator tracking calorimeter detectors placed 810 km apart and 14 milliradians off-axis to the NuMI beam. The cellular detector design allows for multiple sampling of particle energy depositions. These measurements provide input to particle identification and neutrino signal selection algorithms.Additionally, the presice energy measurment of neutrino interactions increases the sensitivity to the oscillation parameters measuered. The methods used in energy estimation and their impact on neutrino event reconstruction will be presented.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

Yes

WG4: Muon Physics (Yes/No):

No

WG1: Neutrino Oscillation Physics (Yes/No):

Yes

Type of presentation:

Oral presentation

WG2: Neutrino Scattering Physics / 86

Extraction of Neutrino Flux from the Inclusive Muon Cross Section

Author: Tomoya Murata[1]

Co-author: Toru Sato [1]

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Extraction of the neutrino-flux from the data of the neutrino-nucleus reaction is of crucial importance to obtain the parameters of neutrino mixing. The observed events of neutrino reaction are the average over the neutrino flux.
In this presentation, we report a new method to extract neutrino flux from the data of inclusive muon production cross section by using maximum entropy method (MEM). The method is tested by using pseudo data of muon distribution. The results shows that the neutrino flux is well reconstructed without assuming quasi-elastic reaction mechanism using MEM.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

Yes

WG4: Muon Physics (Yes/No):

No

WG1: Neutrino Oscillation Physics (Yes/No):

No

Type of presentation:

Oral presentation

WG4: Muon Physics and High Intensity applications / 87

Search for muon to electron conversion at J-PARC MLF : Recent status on DeeMe

Author: Yohei Nakatsugawa[1]

[1] *KEK*

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The charged Lepton Flavor Violation (cLFV) is a clear evidence of the new physics beyond the Standard Model, and $\mu - e$ conversion is considered as one of the most powerful probes to search for cLFV.
DeeMe is a new experiment to search for $\mu - e$ conversion at J-PARC Materials and Life Science Experimental Facility (MLF). This experiment will be carried out at a brand-new beamline (H Line) which will be constructed at J-PARC MLF Muon Science Establishment (MUSE).
The signal electrons from $\mu - e$ conversion occurred in the muonic atoms formed in the muon production target are captured and transported to the magnetic spectrometer by the beamline. The signal electrons can be identified by momentum analysis since they are monochromatic (105 MeV/c). The single event sensitivity achieved by DeeMe experiment is estimated to be 2×10^{-14} with Silicon-Carbide (SiC) muon production target and 1-year data acquisition, while the current upper limit is of the order of 10^{-13}.
DeeMe already has Stage-2 approval from PAC under KEK-IMSS (Institute of Materials Structure Science). The preparation of the experiment is in progress in an effort to start data taking in 2015. The simulation studies, detector R&D and development of SiC target are ongoing.
The current status of DeeMe will be reported.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

No

WG4: Muon Physics (Yes/No):

Yes

WG1: Neutrino Oscillation Physics (Yes/No):

No

Type of presentation:

Oral presentation

88

Overview of the NOvA experiment

Author: Jan Zirnstein[1]

[1] *University of Minnesota*

The NOνA experiment, with a baseline of 810 km, samples Fermilab's upgraded NuMI beam with a Near Detector on-site and a Far
Detector (FD) at Ash River, MN, to observe oscillations of muon neutrinos. The
detectors are functionally identical, fully constructed, and currently in the final phase of
commissioning. The 344,064 liquid scintillator-filled cells of the 14
kton FD provide high granularity of a large detector mass and enable
us to reject the 120 kHz cosmic ray muon rate at a factor of 1 in 40 million
events in the ν_e signal region and 1 in 20 million in the ν_μ signal region.
NOνA seeks to determine the neutrino mass hierarchy and shed light on the CP violating phase angle. This poster gives an overview of the detectors, the
upgraded NuMI beam, the current status of the experiment, and current
sensitivities of various aspects of the science goals of NOνA.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

No

WG4: Muon Physics (Yes/No):

No

WG1: Neutrino Oscillation Physics (Yes/No):

Yes

Type of presentation:

Poster

WG2: Neutrino Scattering Physics / 89

Quasielastic neutrino-nucleus scattering in a continuum random phase approximation approach

Author: Vishvas Pandey[1]

Co-authors: Jan Ryckebusch [1]; Marco Martini [1]; Natalie Jachowicz [1]; Tom Van Cuyck [1]

[1] *Ghent University*

Corresponding Author: vishvas.pandey@ugent.be

We present a detailed description of a continuum random phase approximation approach to inclusive quasielastic electron and neutrino-nucleus scattering. The description of the nucleus starts from a mean field (MF) potential, where long-range correlations are added by means of a continuum random phase approximation (CRPA) based on a Green's function approach using an effective Skyrme interaction as residual interaction. The formalism is validated
by confronting our cross-section predictions with inclusive electron-scattering data for a variety of nuclear targets (^{12}C, ^{16}O, ^{40}Ca), in the kinematic region where quasi-elastic scattering is expected to be the dominant process. We report on cross sections calculations for charged-current quasielastic (anti)neutrino scattering off ^{12}C in the energy range of interest for the MiniBooNE experiment and compare our results with the MiniBooNE (anti)neutrino cross-section measurements. The CRPA predictions reproduce the gross features of the measured double-differential cross sections. We pay special attention to the low-energy excitations which can account for non-negligible contributions in

the MiniBooNE, T2K and other similar experiments, and require a microscopic nuclear investigation beyond the Fermi gas model.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

Yes

WG4: Muon Physics (Yes/No):

No

WG1: Neutrino Oscillation Physics (Yes/No):

Yes

Type of presentation:

Oral presentation

WG4: Muon Physics and High Intensity applications / 90

The search for CLF violation in the MEG & MEG II experiments

Author: Francesco Tenchini[1]

[1] *I*

Corresponding Author: francesco.tenchini@pi.infn.it

Within the scope of the Standard Model, the $\mu \to e + \gamma$ decay is forbidden by lepton flavor conservation. Several lepton flavor violating extensions of the Standard Model however predict a measurable $\mu \to e + \gamma$ branching ratio. The MEG experiment at PSI presently holds the current best experimental limit for this decay (5.7×10^{-13} at 90% CL) and is currently being upgraded for an improvement of a factor 10 in sensitivity in a time scale of about 4 years. The MEG II upgrade R&D status will be presented, along with the current state of the MEG I data analysis.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

No

WG4: Muon Physics (Yes/No):

Yes

WG1: Neutrino Oscillation Physics (Yes/No):

No

Type of presentation:

Oral presentation

WG1: Neutrino Physics / 91

Energy Measurement in the T2K Oscillation Analysis

Author: Susan Cartwright[1]

[1] *Department of Physics*

Corresponding Author: s.cartwright@sheffield.ac.uk

T2K has published oscillation measurements for ν_μ disappearance and for ν_e appearance. Both of these rely on energy measurements in the Super-Kamiokande far detector. In this talk, I shall discuss the Super-K energy measurement, its calibration and its systematics, for both muons and electrons. I shall also briefly discuss energy measurement in the ND280 near detector.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

No

WG4: Muon Physics (Yes/No):

No

WG1: Neutrino Oscillation Physics (Yes/No):

Yes

Type of presentation:

Oral presentation

WG2: Neutrino Scattering Physics / 92

2p-2h excitations in neutrino scattering: angular distribution and frozen approximation

Author: Ignacio Ruiz Simo[1]

Co-authors: Conrado Albertus [1]; Jose Enrique Amaro [1]; Juan Antonio Caballero [2]; Maria Barbaro [3]; T. William Donnelly [4]

[1] *University of Granada*

[2] *University of Sevilla*

[3] *University of Torino*

[4] *Massachusetts Institute of Technology (MIT)*

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We study the phase-space dependence of 2p-2h excitations in neutrino scattering using the relativistic Fermi gas model \cite{Rui14}. We follow a similar approach to Refs. \cite{Pace03,Ama10}, but focusing in the phase-space properties, comparing with the non-relativistic model of \cite{Van81}. A careful mathematical analysis of the angular distribution function for the outgoing nucleons is performed. Our goals are to optimize the CPU time of the 7D integral to compute the hadronic tensor in neutrino scattering, and to conciliate the

different relativistic and non relativistic models by describing general properties independently of the two-body current. For some emission angles the angular distribution becomes infinite in the Lab system, and we derive a method to integrate analytically around the divergence. Our angular distribution is the same as the one obtained in the Monte Carlo generators by a boost from the CM isotropical distribution. Our formalism is applied to neutrino scattering from C-12, in the particular case of the seagull MEC diagrams. Our results show that the frozen approximation, obtained by neglecting the momenta of the two initial nucleons inside the integral of the hadronic tensor, reproduces fairly the exact response functions.

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WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

Yes

WG4: Muon Physics (Yes/No):

No

WG1: Neutrino Oscillation Physics (Yes/No):

No

Type of presentation:

Oral presentation

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Enhancing the reach of INO-ICAL using correlated muon and hadron information

Author: Moon Moon Devi[1]

Co-authors: Amol Dighe [1]; Sanjib K. Agarwalla [2]; Tarak Thakore [1]

[1] *Tata Institute of Fundamental Research, Mumbai*

[2] *Institute of Physics, Bhubaneswar*

The magnetized iron calorimeter (ICAL) at the India-based neutrino observatory (INO) aims at distinguishing the neutrino mass hierarchy as well as determining the atmospheric neutrino parameters with a fine precision. The ICAL can detect muons with good reconstruction
efficiency and momentum (E_μ, $\cos\theta_\mu$) resolution. It is also capable of measuring the hadron energy $E'_{had} = E_\nu - E_\mu$, by calibrating the hadron shower hits. For a given neutrino event, the correlation between E'_{had} and E_μ is an important property, which may be used for improving the oscillation parameter estimation. We take care of this correlation by bining the events in the three observables (E_μ, $\cos\theta_\mu$, E'_{had}). A χ^2 analysis is performed after incorporating the ICAL muon and hadron response, obtained from GEANT4 simulation. We find that, with an exposure of 500 kt - year, the ICAL can rule out the wrong hierarchy with a $\Delta\chi^2 \approx 9.5$, which marks an enhancement of about 40\% compared with the muon-only analysis. The inclusion of hadron information also improves the precision bounds on $|\Delta m^2_{32}|$, θ_{23} and its octant. We show that 10 years of ICAL exposure would be able to measure $\sin^2\theta_{23}$ and $|\Delta m^2_{32}|$ to a relative 1σ precision of 12\% and 2.9\% respectively.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

No

WG4: Muon Physics (Yes/No):

No

WG1: Neutrino Oscillation Physics (Yes/No):

Yes

Type of presentation:

Poster

WG3: Accelerator Physics / 94

Opportunities for Experiments Based on Stored Muon Beams at Fermilab

Author: Milorad Popovic[1]

Co-author: Jean-Francois Ostiguy [2]

[1] *FNAL*

[2] *Fermilab*

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In an attempt to better utilize the existing accelerator complex, we revisit the idea of using the Debuncher as a storage ring for muons. As it stands now, the accelerator complex providing beam to the New Muon g-2 Experiment will deliver 6x10-6 stored muons/POT. Our initial estimates show that Neutrino cross-sections can be measured to better than 10% using a detector positioned approximately10 meters downstream of one of the Debuncher straights. The existing ICARUS detector would be an excellent candidate for this application. Providing a suitable building to house the detector would be the only investment required. Finally, we describe possible improvements in collecting and storing muons that would allow cross-section measurements with a precision of a few percent with a modest additional investment.

WG3: Accelerator Physics (Yes/No):

Yes

WG2: Neutrino Scattering Physics (Yes/No):

No

WG4: Muon Physics (Yes/No):

Yes

WG1: Neutrino Oscillation Physics (Yes/No):

No

Type of presentation:

Oral presentation

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AlCap

WG4: Muon Physics and High Intensity applications / 100

COMET Phase-I

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Comet Backgrounds

WG4: Muon Physics and High Intensity applications / 102

Mu2e

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Comet Phase-II

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Mu2e extinction

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WG4: Muon Physics and High Intensity applications / **106**

g-2 at Fermilab

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WG1: Neutrino Physics / **107**

NEUT development for T2K and relevance of updated 2p2h models

Author: Callum Wilkinson[1]

[1] *University of Sheffield*

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The MiniBooNE large axial-mass anomaly has motivated the development of new theoretical Charged Current Quasi-Elastic (CCQE) cross-section models in recent years. This talk reviews the development of NEUT to incorporate these more sophisticated CCQE models, including multi-nucleon interaction (2p2h) effects. The focus is on a fit to tune the new models available in NEUT to data from MINERvA and MiniBooNE data, and to select a default model for T2K from those available. The relationships to various T2K analyses are explained, and the effect on neutrino energy reconstruction from measured lepton kinematics is discussed.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

Yes

WG4: Muon Physics (Yes/No):

No

WG1: Neutrino Oscillation Physics (Yes/No):

Yes

Type of presentation:

Oral presentation

WG4: Muon Physics and High Intensity applications / **108**

J-PARC MUSE

Author: Yasuhiro Miyake[1]

[1] *KEK*

Corresponding Author: yasuhiro.miyake@kek.jp

The J-PARC MUSE is designed to extract efficiently either pions or muons from a muon production graphite target to the four muon beam lines, the so-called D-Line, U-Line, S-Line and H-Line, enabling a variety of muon related experiments, at the ten experimental areas (D1, D2, U1A, U1B, S1, S2, S3, S4, H1 and H2) utilizing unique features of the pulsed muon beams.
In the symposium, the present status of the J-PARC MUSE will be reported.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

No

WG4: Muon Physics (Yes/No):

Yes

WG1: Neutrino Oscillation Physics (Yes/No):

No

Type of presentation:

Oral presentation

WG2: Neutrino Scattering Physics / 109

T2K off-axis cross section measurements

Author: Raquel Castillo[1]

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Understanding neutrino interaction cross section with nuclei has become a limiting factor for running and future neutrino oscillations experiments. As part of the effort of improving oscillation results, the near detector of the T2K experiment (ND280) has performed several measurements of neutrino cross-sections with nuclei at neutrino energies from ˜500 MeV to few GeV. Most recent results on T2K neutrino interaction cross sections measurements will we presented as well as current developments and prospects.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

Yes

WG4: Muon Physics (Yes/No):

No

WG1: Neutrino Oscillation Physics (Yes/No):

No

Type of presentation:

Oral presentation

WG1: Neutrino Physics / 110

T2K oscillation results

Author: Christophe Bronner[1]

[1] *U*

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The Tokai to Kamioka (T2K) experiment is a long baseline neutrino oscillation experiment, using a nearly pure muon neutrino beam produced by an accelerator. The neutrinos are produced at J-PARC on the east coast of Japan, and detected after 295 km of propagation in Super-Kamiokande. An additional complex of detectors located 280 meters from the target allows to characterize the neutrino beam and constrain systematic uncertainties. In this talk, I will be presenting the results of the neutrino oscillation analysis, especially emphasizing newly available muon neutrino disappearance analysis, and joint muon neutrino disappearance / electron neutrino appearance analysis using the data collected until the summer of 2013.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

No

WG4: Muon Physics (Yes/No):

No

WG1: Neutrino Oscillation Physics (Yes/No):

Yes

Type of presentation:

Oral presentation

WG4: Muon Physics and High Intensity applications / 111

The Mu3e Experiment - Introduction and Current Status

Author: Moritz Kiehn[1]

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The Mu3e experiment searches for the lepton flavor violating decay $\mu \rightarrow eee$ aiming for a sensitivity of better than 1 in 10^{16} decays, a four order of magnitude improvement over the previous search by the SINDRUM experiment. This sensitivity is achieved by a novel experimental design based on thin monolithic active silicon pixel detectors and scintillating fibres and tiles.

In this talk, the Mu3e Experiment is introduced and the experimental challenges are discussed. The current state of the detector development with a focus on pixel sensor prototypes and their performance is presented.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

No

WG4: Muon Physics (Yes/No):

Yes

WG1: Neutrino Oscillation Physics (Yes/No):

No

Type of presentation:

Oral presentation

WG2: Neutrino Scattering Physics / 112

LAriaT - Liquid Argon in a Testbeam

Author: Jason St. John[1]

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Liquid Argon Time Projection Chambers offer very good 3D and calorimetric resolution and allow relatively easy construction of large mass detectors, making them a prime candidate for future precision neutrino measurements. Surprisingly, there has been relatively little effort in calibrating the response of these detectors. The LArIAT (Liquid Argon In A Testbeam) experiment aims to fill that gap, and to measure interaction cross sections on LAr. Running in the Fermilab testbeam facility on a beam of charged particles of measured momentum, it will seek to characterize and refine the LArTPC's particle identification capabilities, including the electron-gamma separation, electron recombination parameters, and non-magnetic muon sign determination. The status of the construction of the first phase of the experiment, which will reuse the ArgoNeuT TPC, will be presented, as well as plans for the second phase which will examine containment of EM and hadronic showers.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

Yes

WG4: Muon Physics (Yes/No):

No

WG1: Neutrino Oscillation Physics (Yes/No):

No

Type of presentation:

Oral presentation

WG1: Neutrino Physics / 113

Status of the Double Chooz experiment

Author: Matthieu Vivier[1]

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The Double Chooz reactor antineutrino experiment aims for a precision measurement of the neutrino mixing angle θ_{13}, by measuring an energy-dependent deficit in the detected antineutrino spectrum. Double Chooz is located at the Chooz nuclear power plant in France, and currently operates with a single far detector filled with gadolinium-loaded liquid scintillator at a baseline of 1.05\,km. A second near identical detector is currently finished being assembled, and will start its commissioning phase.
In this talk, I will give an overview of the current status of the experiment. The physics motivations and the working principle of the detectors will be briefly reviewed. The different measurements of θ_{13} conducted so far by the collaboration, each sensitive to different systematics and giving consistent results, will be presented, with a special emphasis on the latest θ_{13} oscillation results. Finally, a brief status of the near detector on-site integration will be presented.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

No

WG4: Muon Physics (Yes/No):

No

WG1: Neutrino Oscillation Physics (Yes/No):

Yes

Type of presentation:

Oral presentation

WG4: Muon Physics and High Intensity applications / 115

Status of MuSIC facility

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[1] *Osaka Univ.*

Corresponding Author: matumoto@lambda.phys.tohoku.ac.jp

A muon beam facility called "MuSIC"has been built at Research Center of Nuclear Physics, Osaka University. MuSIC consists of the pion capture solenoid and the muon transport with a 36° curved solenoid. The intensity of MuSIC is expected to be 2 x 108[μ+/sec/μA] from an experiment performed at MuSIC.
In 2014 a new beamline was built downstream of the curved solenoid. The new beamline has slits, quadrupole magnets, bending magnets and a spin rotator. This new beam line will be utilized for muon experiments including μSR experiments.
In this talk, I will talk about its detail design and prospects of MuSIC including the new beamline.

WG3: Accelerator Physics (Yes/No):

Yes

WG2: Neutrino Scattering Physics (Yes/No):

No

WG4: Muon Physics (Yes/No):

Yes

WG1: Neutrino Oscillation Physics (Yes/No):

No

Type of presentation:

Oral presentation

WG1: Neutrino Physics / 116

Short-baseline oscillation measurements at T2K

Author: Javier Caravaca[1]

[1] *IFAE*

Corresponding Author: jcaravaca@ifae.es

The T2K experiment has searched for electron-neutrino disappearance in a electron-neutrino flux at short base-line due to oscillation to sterile neutrinos. The reactor and gallium anomalies, not explinable by the three neutrino framework and compatible with the hypothesis of a new mass eigenstate of $\sim 1eV^2$, are tested with the near detector (ND280) of T2K. At 280m from the hadron production point and with an average electron-neutrino energy of $\sim 500MeV$, ND280 is sensitive to non-standard neutrino oscillations for a neutrino mass difference of $\sim 2eV^2$. The analysis of the electron-neutrino interaction rates as well as a good understanding of the backgrounds allow to constrain the oscillation parameter space and to reject some regions of the gallium and reactor anomalies. On the other hand, the performances of the future nuPRISM detector on searches of electron-neutrino appearance at short base-line will be also discussed.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

No

WG4: Muon Physics (Yes/No):

No

WG1: Neutrino Oscillation Physics (Yes/No):

Yes

Type of presentation:

Oral presentation

WG2: Neutrino Scattering Physics / 117

The impact of new neutrino scattering data on generator models

Author: Steven Boyd[1]

Co-author: Steven Dytman [2]

[1] *University of Warwick*

[2] *Univ of Pittsburgh*

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Monte Carlo event generators need to keep up with recent data. This is important but difficult since the models are strongly dependent of data/models from other probes. Recent data are of high quality and provide new challenges. This talk will examine recent results from Minerva and Argoneut using the GENIE event generator.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

Yes

WG4: Muon Physics (Yes/No):

No

WG1: Neutrino Oscillation Physics (Yes/No):

No

Type of presentation:

Oral presentation

WG2: Neutrino Scattering Physics / 118

νPRISM: A new way of probing neutrino interactions

Author: Mark Scott[1]

[1] *TRIUMF*

Corresponding Author: mscott@triumf.ca

In both neutrino interaction and neutrino oscillation measurements the rate of events you observe directly depends on the energy of the incident neutrino. Unfortunately this energy cannot be measured directly, and experiments rely instead on the outgoing lepton and observed nucleons. To translate these observables into a neutrino energy we must assume knowledge of the neutrino interaction and average over the neutrino flux. Current measurements of neutrino-nucleon interactions do not agree well with existing models and indicate that the relationship between neutrino energy, true underlying interaction and particle kinematics is not well determined.

νPRISM is a proposed near detector for a long baseline neutrino beam experiment. Sited 1km from the beam production point, the detector spans a range of off-axis angles relative to the neutrino beam direction. As the off-axis angle changes so does the beam energy spectrum, providing a way of directly relating the neutrino energy to the experimental observables. This talk discusses the

νPRISM concept, showing how it can be used for neutrino cross section measurements and showing how it reduces neutrino interaction uncertainties in oscillation measurements.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

Yes

WG4: Muon Physics (Yes/No):

No

WG1: Neutrino Oscillation Physics (Yes/No):

No

Type of presentation:

Oral presentation

WG2: Neutrino Scattering Physics / 119

Recent results from the ARGONEUT liquid argon TPC

Author: Antonio Ereditato[1]

[1] *Universitaet Bern (CH)*

Corresponding Author: antonio.ereditato@cern.ch

The liquid argon TPC (LArTPC) is a particle detection technique that provides excellent energy and space resolution and is an optimal tool to study neutrino-nucleus interactions. ArgoNeuT, a 175 liter LArTPC, exposed to NUMI neutrino beamline at Fermilab, has collected thousands of low-energy neutrino and anti-neutrino interaction events.
Latest results, including measurements of charged current neutrino cross sections, studies of nuclear effects in neutrino-argon interactions and electron/gamma separation will be presented and discussed.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

Yes

WG4: Muon Physics (Yes/No):

No

WG1: Neutrino Oscillation Physics (Yes/No):

Yes

Type of presentation:

Oral presentation

120

CC1pi+ cross-section measurement on water using the T2K near detector

Author: Linda Cremonesi[1]

[1] *Queen Mary University of London*

The near detector of the T2K experiment (ND280) is a magnetised multi-purpose detector located at 280m from the beam target. While the primary function of ND280 is to measure the neutrino spectrum and beam flavour composition, it may also be used to measure the cross-section of processes relevant to oscillation analyses of T2K.
In the Tracker region of ND280 there are 2 fine-grained detectors (FGDs). The downstream FGD consists of polystyrene scintillator bars alternately oriented in the x and y directions and interleaved with water layers. The polystyrene scintillator bars allow 3D tracking of the
charged particles. The water layers serve as target for measurements of neutrino interactions on water.
The signal definition of this analysis is muon neutrino scattering with nucleon resonant excitation and production of a single charged pion (ν_μ CC1π^+, after final state interactions) in the water layers of this FGD. This analysis uses a Bayesian unfolding method with background subtraction and two sidebands to constrain the background coming from deep inelastic interactions and from interactions on carbon.
An estimate of the measurement capabilities will be shown using the NEUT simulation.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

Yes

WG4: Muon Physics (Yes/No):

No

WG1: Neutrino Oscillation Physics (Yes/No):

No

Type of presentation:

Poster

WG1: Neutrino Physics / 121

MIND at Neutrino Factories

Author: Ryan Bayes[1]

[1] *University of Glasgow*

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Magnetized iron calorimeters have been previously used in neutrino
detection applications, with MINOS being a good example. This
technology provides the benefits of excellent charge and particle
identification while being trivial to scale up in mass. These
properties make a magnetized iron neutrino detector (MIND) the ideal
far detector for neutrino factory applications. A full simulation of

MIND has been produced in conjunction with the Neutrino Factory International Design Study (IDS-NF) to evaluate its detector response. The digitized simulation is subject to a full reconstruction of muon tracks. A multivariate analysis was developed to select muon tracks with a high purity to reduce backgrounds from charge and flavour mis-identification. The detector response and background suppression is optimized for the requirements for the specific experiment and will be discussed. The sensitivity of oscillation physics experiments using a MIND at a neutrino factory will be discussed using the response derived from this analysis will be discussed with a focus on leptonic CP violation.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

No

WG4: Muon Physics (Yes/No):

No

WG1: Neutrino Oscillation Physics (Yes/No):

Yes

Type of presentation:

Oral presentation

WG2: Neutrino Scattering Physics / 122

Fine-Grained Tracker as a Near Detector for LBNE

Author: Xinchun Tian[1]

Co-author: Sanjib Mishra [1]

[1] *University of South Carolina*

Corresponding Author: tianxc@fnal.gov

The reference design of the near detector for the LBNE experiment is a high-resolution Fine-Grained Tracker (FGT) capable of precisely measuring all four species of neutrinos: ν_μ, ν_e, $\bar{\nu}_\mu$ and $\bar{\nu}_e$. The FGT is composed of a Straw-Tube Tracker (STT) with transition-radiation capability surrounded by a high resolution electromagnetic calorimeter (ECAL) and embedded in a dipole magnet. Muon-ID detectors instrument the iron-yoke of the magnet and the downstream and upstream stations outside the magnet. The STT is instrumented with Ar and other nuclear targets. The goals of the FGT is to constrain the systematic errors, below the corresponding statistical error in the far detector, for all oscillation studies; and to conduct a panoply of precision measurements and searches in Neutrino physics. We present sensitivity studies – critical to constraining the systematics in oscillation searches – of measurements of (1) the absolute neutrino flux, (2) neutrino-nucleon quasi-elastic (QE) and (3) resonance (Res) interactions. In QE and Res emphasis is laid in identifying in situ measurables that help constrain nuclear effects such as initial state pair wise correlations and final state interactions.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

Yes

WG4: Muon Physics (Yes/No):

No

WG1: Neutrino Oscillation Physics (Yes/No):

No

Type of presentation:

Oral presentation

WG2: Neutrino Scattering Physics / 123

Charged-Current Cross Section Measurements in the NOvA Experiment

Author: Lisa Goodenough[1]

[1] *Argonne National Lab*

Corresponding Author: lgoodenough@hep.anl.gov

The NOvA experiment is a long-baseline neutrino oscillation experiment with a 300 ton near detector and 14 kton far detector, located 810 km away, both positioned 14 mrad off-axis of the Fermilab NuMI neutrino beam. A 220 ton prototype Near Detector On the Surface (NDOS) was built on the surface at Fermilab 106 mrad off-axis of the NuMI beam. NDOS has been taking data since 2010. Two separate cross section measurements have been completed using NDOS data. In one analysis, muon-neutrino charged-current quasi-elastic (CCQE) events were identified and used to calculate the cross-section for CCQE interactions as a function of energy between 0.5 and 2.0 GeV. The second study measured the muon-neutrino inclusive charged-current cross section at 1.97 GeV. This talk will give an overview of the two analyses.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

Yes

WG4: Muon Physics (Yes/No):

No

WG1: Neutrino Oscillation Physics (Yes/No):

No

Type of presentation:

Oral presentation

WG4: Muon Physics and High Intensity applications / 124

Tuning of the ultra slow muon beamline by utilizing ionized hydrogen.

Author: Taihei Adachi[1]

Co-authors: Atsushi YABUUCHI [1]; Eiko TORIKAI [2]; Jumpei NAKAMURA [1]; Kusuo NISHIYAMA [1]; Patrick Strasser [1]; Takashi NAGATOMO [3]; Yasuhiro Miyake [1]; Yutaka Ikedo [1]; koichiro shimomura [1]

[1] *KEK*

[2] *University of Yamanashi*

[3] *International Christian University*

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The ultra slow muon beam, which has the kinetic energy range from a few eV to 30 keV and small beam size, is expected to be an innovative probe for surface and interface, and extends the scope of the μSR technique to thin films and small samples. A new muon beamline called "U-line", which designed to supply ultra slow muon beam, is now under construction at the Materials and Life Science Experimental Facility (MLF) in J-PARC. Surface muons are transported to a hot tungsten foil at the middle of the beamline. The muons stopped in the foil evaporated to vacuum as thermal muoniums. Then, the ultra slow muons are generated by the laser resonant ionization of muoniums. Before transporting ultra slow muons through the beamline, we ionized and transported H+ ions as an ultra slow beam and optimized the beam transportation and the beam properties. The latest results of tuning will be reported in the presentation.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

No

WG4: Muon Physics (Yes/No):

Yes

WG1: Neutrino Oscillation Physics (Yes/No):

No

Type of presentation:

Oral presentation

125

The ANNIE Experiment

Author: Francesca Di Lodovico[1]

[1] *University of London (GB)*

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In this poster we present the Atmospheric Neutrino Neutron Interaction Experiment (ANNIE) designed to measure the neutron yield of atmospheric neutrino interactions in gadolinium-doped water. It is a small, dedicated experiment designed to make this measurement using a beamline with known characteristics. This measurement will help in reducing the background from atmospheric neutrino interactions in proton decays.
The neutron tagging techniques based on such measurement will also be useful to a broader program of physics beyond proton decay as supernovas and neutrino interaction models.
An innovative aspect of the ANNIE design is the use of precision timing to localize interaction vertices in the small fiducial volume of the detector. We propose to achieve this by using early prototypes of LAPPDs (Large Area Picosecond Photodetectors). This

experiment will be a first application of these devices demonstrating their feasibility for WCh neutrino detectors. The ideas explored by ANNIE could have a transformative impact on water Cherenkov, scintillation, and other photodetection-based neutrino detector technologies.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

Yes

WG4: Muon Physics (Yes/No):

No

WG1: Neutrino Oscillation Physics (Yes/No):

Yes

Type of presentation:

Poster

WG1: Neutrino Physics / 126

The measurement of the reactor antineutrino flux and spectrum of Daya Bay Experiment

Author: Fengpeng An[1]

[1] *East China University of Science and Technology*

Corresponding Author: anfengpeng@gmail.com

Fengpeng An, On behalf of the Daya Bay Collaboration

East China University of Science and Technology, Shanghai, 200237, China

The Daya Bay Reactor Neutrino Experiment collected ˜300,000 inverse beta decay events in three antineutrino detectors at two sites near the reactor cores, over 217 days. This talk will present the methods we use to convert the observed positron energy spectrum to a reactor antineutrino spectrum, including normalization to reactor power.
We also present our results for the absolute reactor antineutrino flux and spectrum. Comparisons are made with the predictions of various flux models, and an example of using our spectrum to predict the spectrum from other reactor experiments will also be described.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

No

WG4: Muon Physics (Yes/No):

No

WG1: Neutrino Oscillation Physics (Yes/No):

Yes

Type of presentation:

Oral presentation

WG1: Neutrino Physics / 127

Recent oscillation analysis results from Daya Bay

Author: Jie Zhao[1]

[1] *I*

Corresponding Author: zhaojie@ihep.ac.cn

The Daya Bay Reactor Neutrino Experiment is designed to precisely determine the neutrino mixing angle θ13 utilizing eight functionally identical electron-antineutrino (υe) detectors. Using 217 days of data with six detectors, and 404 days with eight detectors, 108907 (613813 and 383402) antineutrino candidates were detected in the far hall (near halls). Combining the neutrino rate deficit and spectral distortion, the Daya Bay experiment made the improved measurement of $\sin^2 2\theta_{13} = 0.084 \pm 0.005$ and $\Delta m_{ee} = 2.44^{+0.10}_{-0.11} \times 10^{-3}$ eV^2.
In this talk, we will focus on the improvement of the detector energy response and backgrounds, the consistency of detectors, and the combined fitting to the six and eight detector data set.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

No

WG4: Muon Physics (Yes/No):

No

WG1: Neutrino Oscillation Physics (Yes/No):

Yes

Type of presentation:

Oral presentation

WG2: Neutrino Scattering Physics / 128

Status of muon neutrino cross section measurements with the T2K on-axis detectors

Author: Kento Suzuki[1]

[1] *Kyoto University*

Corresponding Author: k.suzuki@scphys.kyoto-u.ac.jp

The Tokai-to-Kamioka (T2K) experiment is designed to measure neutrino oscillation parameters. It uses an almost pure muon neutrino (ν_μ) beam that originates at J-PARC.
INGRID consists with 14 independent modules (7 vertical and 7 horizontal modules) , each of which are composed of iron plates and scintillator planes. The modules make up a cross-shape with center on beam-axis. It measures the ν_μ beam direction and intensity. Another detector called Proton

Module sits on-axis between the horizontal and vertical modules. The Proton Module is a fully-active tracking detector which is made of layers of plastic scintillator bars.
We will present a resent status of the measurements of the ν_μ cross sections with these two detectors in the T2K experiment.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

Yes

WG4: Muon Physics (Yes/No):

No

WG1: Neutrino Oscillation Physics (Yes/No):

No

Type of presentation:

Oral presentation

129

”Measurement of the intrinsic electron neutrino and electron anti-neutrino components in the T2K beam with the ND280 Tracker”

Author: Luke Southwell[1]

[1] *Lancaster University*

Corresponding Author: southwel@exchange.lancs.ac.uk

The main irreducible background in the T2K electron-neutrino appearance analysis is the electron-neutrino contamination in the muon-neutrino beam. In order to quantify this background, a selection for charged-current electron-neutrino interactions in the near detector (ND280) Tracker region was developed by combining the particle identification abilities of the time projection chambers and electromagnetic calorimeters. We measured a data/MC ratio of 1.01+- 0.10 for the electron-neutrino component of the beam which is an important confirmation of our predictions of the expected backgrounds. In 2014 the T2K experiment reversed the polarity of the magnetic horns and began running with an anti-neutrino beam for the first time. Differences in the oscillation probabilities between neutrinos and anti-neutrinos may provide insight into charge-parity violation in the leptonic sector. The current ND280 Tracker electron-neutrino charged-current selection has been used as a starting point for the electron anti-neutrino charged-current selection. The additional challenges and selection criteria of the electron anti-neutrino selection will be presented.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

Yes

WG4: Muon Physics (Yes/No):

No

WG1: Neutrino Oscillation Physics (Yes/No):

Yes

Type of presentation:

Poster

WG2: Neutrino Scattering Physics / 130

Measurement of Resonance Interaction in The NOMAD Detector

Author: Hongyue Duyang[1]

Co-authors: Sanjib Mishra [1]; Xinchun Tian [2]

[1] *University of South Carolina*

[2] *Univesrity of South Carolina*

Corresponding Authors: hongyue.duyang@cern.ch, tianxc@fnal.gov

Resonance interaction is one of the most important modes in the oscillation region of the next generation long-baseline neutrino oscillation experiments, but it is also the least well measured. This talk presents a measurement of charge current resonance interaction in NOMAD detector following techniques developed for the LBNE near-detector. The measurement uses two topologies induced by resonance-interactions: 3-track and 2-track. The cross-section of the full-resonance and its ratio to the inclusive charge current interactions will be reported. Precise measurement of resonance interaction to constrain the nuclear effect will also be discussed.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

Yes

WG4: Muon Physics (Yes/No):

No

WG1: Neutrino Oscillation Physics (Yes/No):

No

Type of presentation:

Oral presentation

WG2: Neutrino Scattering Physics / 132

Measurement of electron neutrino CCQE-like cross-section in MINERvA

Author: Jeremy Wolcott[1]

[1] *University of Rochester*

Corresponding Author: jwolcott@pas.rochester.edu

The electron-neutrino charged-current quasi-elastic (CCQE) cross-section on nuclei is an important input parameter to appearance-type neutrino oscillation experiments. Current experiments typically work from the muon neutrino cross-section and apply corrections from theoretical arguments to obtain a prediction for the electron neutrino cross-section, but to date there has been no experimental verification of the estimates for this channel at an energy scale appropriate to such experiments. We present a preliminary result from the MINERvA experiment on the first measurement of an exclusive reaction in few-GeV electron neutrino interactions, namely, the cross-section for a CCQE-like process. The result is given both as differential cross-sections vs. the electron energy, electron angle, and Q^2, as well as a total cross-section vs. neutrino energy.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

Yes

WG4: Muon Physics (Yes/No):

No

WG1: Neutrino Oscillation Physics (Yes/No):

No

Type of presentation:

Oral presentation

WG4: Muon Physics and High Intensity applications / 133

Status of the Alcap experiment

Author: Phillip Litchfield[1]

[1] *U*

Corresponding Author: p.litchfield@ucl.ac.uk

The AlCap experiment is a joint project between the COMET and Mu2e collaborations. Both experiments intend to look for the lepton-flavour violating conversion $\mu + A \to e + A$, using tertiary muons from high-power pulsed proton beams. In these experiments the products of ordinary muon capture in the muon stopping target are a important concern, both in terms of hit rates in tracking detectors and radiation damage to equipment. The goal of the AlCap experiment is to provide precision measurements of the products of nuclear capture on Aluminium, which is the favoured target material for both COMET and Mu2e. The results will be used for optimising the design of both conversion experiments, and as input to their simulations. Data was taken in December 2013 and is currently being analysed.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

No

WG4: Muon Physics (Yes/No):

Yes

WG1: Neutrino Oscillation Physics (Yes/No):

No

Type of presentation:

Oral presentation

WG2: Neutrino Scattering Physics / 134

Hadronization processes in neutrino interactions

Author: Teppei Katori[1]

[1] *Queen Mary University of London*

Corresponding Author: t.katori@qmul.ac.uk

Current and future high precision neutrino oscillation experiments try to measure outgoing hadrons on top of leading leptons. For example, such hadron measurement allows to perform a better energy-momentum reconstruction of neutrinos. For this purpose, precise simulation of hadron production is necessary. Traditionally, PYTHIA6 is used to simulate the hadronization processes, but the agreement with bubble chamber neutrino-hadron production data is not always good. In this talk, I would like to review recent work on this subject, and discuss the impact on future projects, such as PINGU.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

Yes

WG4: Muon Physics (Yes/No):

No

WG1: Neutrino Oscillation Physics (Yes/No):

No

Type of presentation:

Oral presentation

WG4: Muon Physics and High Intensity applications / 136

Backgrounds studies for the COMET Phase-I and Phase-II

Author: Akira SATO[1]

Co-author: Chen Wu [2]

[1] *Osaka University*

[2] *Nanjing University*

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The COMET experiment will search the muon to electron conversion , which violates lepton-flavor conservation, with a phased approach. The first stage, COMET-Phase-I, will achieve a single event sensitivity of 3×10^{-15} with a short muon transport solenoid and a cylindlical detector system. Then in the stage two, COMET Phase-II, finally achieves the sensitivity of 3×10^{-16} with a long C shape muon transport solenoid and a curved solenoid spectrometer system. We plan to start the data taking from 2016 and 2019 for Phase-I and Phase-II, respectively. Construction COMET experimental hall and detector are currently underway as well as detailed simulation studies. In this presentation, status and results of backgrounds studies will be reported.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

No

WG4: Muon Physics (Yes/No):

Yes

WG1: Neutrino Oscillation Physics (Yes/No):

No

Type of presentation:

Oral presentation

WG2: Neutrino Scattering Physics / 137

Implications of recent MINERvA results for neutrino energy reconstruction

Author: Jeremy Wolcott[1]

[1] *University of Rochester*

Corresponding Author: jwolcott@pas.rochester.edu

Among the most important tasks of neutrino oscillation experiments is correctly estimating the parent neutrino energy from the by-products of their interactions. Large uncertainties in our current understanding of such processes can significantly hamper this effort. We explore two recent measurements made using the MINERvA detector in the few-GeV NuMI muon neutrino beam at Fermilab: the differential cross-section vs. Q^2 for charged-current quasi-elastic scattering, and the differential cross-sections vs. pion angle and pion kinetic energy for resonant single charged pion production. We furthermore discuss their implications for energy reconstruction in oscillation measurements.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

Yes

WG4: Muon Physics (Yes/No):

No

WG1: Neutrino Oscillation Physics (Yes/No):

Yes

Type of presentation:

Oral presentation

WG2: Neutrino Scattering Physics / 138

The observation of gamma rays via neutral current interaction at Super-Kamiokande using the T2K neutrino beam.

Author: Yusuke Koshio[1]

[1] *Okayama University*

Corresponding Author: koshio@okayama-u.ac.jp

We report the first measurement of the neutral current quasi-elastic (NCQE) cross section on oxygen by observing nuclear de-excitation gamma rays with the T2K neutrino beam. These gamma rays are observed in the Super-Kamiokande water Cherenkov detector. We select candidate events by using the T2K beam timing, and observed 43 events in the 4-30MeV reconstructed energy region, comparing to the MC prediction 55.7. We observed an NCQE cross section of 1.35X10^{38}cm^{-2} with a 68% confidence interval of (1.06, 1.94)X10^{38}cm^{-2}.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

Yes

WG4: Muon Physics (Yes/No):

No

WG1: Neutrino Oscillation Physics (Yes/No):

No

Type of presentation:

Oral presentation

139

Progress towards COMET Phase-I

Author: Phillip Litchfield[1]

[1] *U*

Corresponding Author: p.litchfield@ucl.ac.uk

The COMET experiment is designed to search for flavour violation in the charged lepton sector, via the coherent neutrinoless process $\mu + A \rightarrow e + A$, which can probe a wide variety of BSM physics. Using the new high-power proton beam at J-PARC, the sensitivity of the final COMET experiment is substantially better than previous experiments.
In order to better understand the beam and ordinary muon decay backgrounds that are relevant at this sensitivity, an initial Phase-I of the experiment will use just the upstream $90°$ bend of the final COMET beam transport. In addition to studying the beam characteristics, the Phase-I experiment will also search for μ–e conversions with sensitivity 2 orders of magnitude better than the current limit. The Phase-I experiment is in the final stages of design, and construction of the COMET facility has already begun.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

No

WG4: Muon Physics (Yes/No):

Yes

WG1: Neutrino Oscillation Physics (Yes/No):

No

Type of presentation:

Oral presentation

WG2: Neutrino Scattering Physics / 140

Study of muon neutrino quasielastic scattering on iron using the MINOS near detector

Author: Nathan Mayer[1]

[1] *Tufts University*

Corresponding Author: nathan.mayer@tufts.edu

A sample enriched in quasielastic scattering events is selected from charged-current ν_μ interactions in iron using the MINOS near detector exposed to a wide-band ν_μ beam with peak flux at 3 GeV. Contributions from non-quasielastic backgrounds are evaluated using four independent kinematic sideband samples. The shapes of data distributions in four-momentum transfer, Q^2, are compared to expectations from a conventional Monte Carlo treatment of neutrino reactions within a nuclear medium modeled as a relativistic Fermi gas. Inclusion of a data-driven suppression of baryon resonance production at low Q^2 into the neutrino-nucleus simulation yields good agreement over the sidebands and a good description of the Q^2 distribution of the quasielastic-enhanced sample. By fitting the shape of the latter distribution using the dipole axial-vector form factor of the neutron,the effective value of the axial-vector mass is obtained: $M_A = 1.23^{+0.13}_{-0.09}(fit)^{+0.12}_{-0.15}$(syst.) GeV. This measurement probes quasielastic scattering in the nuclear medium of a large (A = 56) target nucleus using 123,000 candidate quasielastic ν_μFe interactions of energies $1 < E_\nu < 8$ GeV.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

Yes

WG4: Muon Physics (Yes/No):

No

WG1: Neutrino Oscillation Physics (Yes/No):

No

Type of presentation:

Oral presentation

WG4: Muon Physics and High Intensity applications / 141

COMET Phase II

Author: Ajit Kurup[1]

[1] *Imperial College London*

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The COMET experiment aims to search for muon to electron conversion with a sensitivity of $< 10^{-17}$. The experiment will be built in two phases, with Phase-I aiming at a sensitivity of $< 10^{-15}$ using a cylindrical drift chamber. The design of COMET Phase-II has a longer beam line to improve the quality of the muon beam and perform momentum selection of electrons. The detector system will include a straw tracker and a calorimeter, which will be prototyped and tested at Phase-I.

Staging the experiment is very important as this allows important measurements of the beam that will lead to a better understanding of backgrounds and the muon yield. These measurements can then be used to optimise the design of COMET Phase-II and will provide an improved estimate of the sensitivity of the experiment. The construction of Phase-I already underway and data taking will start in 2016 and Phase-II is scheduled to start data taking in 2019.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

No

WG4: Muon Physics (Yes/No):

Yes

WG1: Neutrino Oscillation Physics (Yes/No):

No

Type of presentation:

Oral presentation

WG2: Neutrino Scattering Physics / 144

Inclusive and Coherent Interactions with MINERvA Nuclear Targets

Author: Jorge G. Morfin[1]

Co-author: MINERvA Collaboration [1]

[1] *Fermilab*

Corresponding Author: morfin@fnal.gov

MINERvA is a neutrino experiment designed for detailed studies of neutrino nucleus scattering physics. Cross sections and nuclear effects can be measured with a large active core of scintillator (CH) and an upstream array of various A nuclear targets. This presentation will review the measured ratio of inclusive cross sections of the CH, C, Fe and Pb targets and, using the active scintillator core, introduce the latest MINERvA measurement; neutrino and antineutrino coherent pion production on CH.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

Yes

WG4: Muon Physics (Yes/No):

No

WG1: Neutrino Oscillation Physics (Yes/No):

No

Type of presentation:

Oral presentation

WG2: Neutrino Scattering Physics / 145

The CTEQ Nuclear Parton Distribution Functions

Author: Jorge G. Morfin[1]

Co-author: CTEQ Collaboration [2]

[1] *Fermilab*

[2] *International*

Corresponding Author: morfin@fnal.gov

Nuclear parton distribution functions (nPDFs) are important for the comparison of experimental scattering results off different nuclear targets in the middle-to-high W kinematic regime. The latest CTEQ nPDF study now has a new set of these distributions along with their errors. A review of an earlier CTEQ nPDF study that found a difference in nPDFs from neutino-A vs mu/e-A scattering will also be presented for discussion.

WG3: Accelerator Physics (Yes/No):

No

WG2: Neutrino Scattering Physics (Yes/No):

Yes

WG4: Muon Physics (Yes/No):

No

WG1: Neutrino Oscillation Physics (Yes/No):

No

Type of presentation:

Oral presentation

WG3: Accelerator Physics / 146

The Status of the Construction of MICE Step IV

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WG3: Accelerator Physics / 147

The Physics Programme of MICE Step IV

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WG3: Accelerator Physics / 148

Progress Towards Completion of the MICE Demonstration of Sustainable Muon Ionization Cooling

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WG3: Accelerator Physics / 149

Optimization of Beam Line Settings for MICE Step IV

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WG3: Accelerator Physics / 150

NuSTORM FODO solution

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WG3: Accelerator Physics / 151

NuSTORM RFFAG solution

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WG3: Accelerator Physics / 152

NuSTORM at CERN, Scenarios and Plans

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WG3: Accelerator Physics / 153

Neutrino Flux from nuSTORM facility

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WG3: Accelerator Physics / 154

Final results from IDS-NF study

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WG3: Accelerator Physics / 155

NuMAX overview

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WG3: Accelerator Physics / 156

Muon Acceleration: NuMAX and Beyond

Corresponding Author: bogacz@jlab.org

WG3: Accelerator Physics / 157

Design of NuMAX decay ring

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WG3: Accelerator Physics / 158

ESS linac modifications

Corresponding Author: david.mcginnis@esss.se

WG3: Accelerator Physics / 159

Accumulator ring for the ESS neutrino Super Beam

Corresponding Author: elena.wildner@cern.ch

WG3: Accelerator Physics / 160

ESSvSB: Update on secondary beam studies

Corresponding Author: nikolaos.vassilopoulos@iphc.cnrs.fr

WG3: Accelerator Physics / 161

An Experimental muon source for neutrino beam R&D at CSNS

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WG4: Muon Physics and High Intensity applications / 162

PRISM

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