

# **NTN Workshop on Neutrino Non-Standard Interactions**



## **Report of Contributions**

Contribution ID: 2

Type: **not specified**

## Light Dark Matter with DUNE-PRISM

*Thursday 30 May 2019 09:45 (45 minutes)*

The upcoming DUNE Experiment will depend on precision measurement of neutrino fluxes and cross sections at its near detector in order to deliver on its stated neutrino physics goals, such as measurements of CP violation and the neutrino mass ordering, using its far detector. To this end, the DUNE-PRISM concept has been proposed – it consists of moving the near detector up to 36 m off-axis, allowing for measurements of different components of the neutrino flux. In addition, the DUNE near detector and PRISM concept allow for searches for new physics, such as light dark matter produced in the neutrino beam.

In this talk, I will discuss the capability of DUNE to search for light dark matter in the Near Detector facility. I will show that DUNE, particularly by leveraging the DUNE-PRISM concept, will allow for substantial improvement over existing searches for such dark matter, competitive with dedicated dark matter experiments in this regime.

**Author:** KELLY, Kevin (Fermilab)

**Presenter:** KELLY, Kevin (Fermilab)

**Session Classification:** Session 5

Contribution ID: 3

Type: **not specified**

## New physics in coherent neutrino scattering

*Thursday 30 May 2019 14:00 (45 minutes)*

In this talk, I am going to review the recent progress of coherent neutrino-nucleus scattering experiments and summarize the constraints on various BSM physics, including NSI, SPVAT (Scalar Pseudoscalar, Vector, Axialvector, Tensor) interactions, sterile neutrinos, light mediators, neutrino magnetic moments, dark matter, etc.

**Author:** XU, Xun-Jie (Max-Planck-Institut fuer Kernphysik)

**Presenter:** XU, Xun-Jie (Max-Planck-Institut fuer Kernphysik)

**Session Classification:** Session 7

Contribution ID: 4

Type: **not specified**

## Effective Field Theory for NSI in Elastic Neutrino - Nucleus Scattering

*Thursday 30 May 2019 11:45 (45 minutes)*

We formulate an Effective Field Theory (EFT) for Non Standard neutrino Interactions (NSI) in elastic scattering with light quarks, leptons, gluons and photons, including all possible operators of dimension 5, 6 and 7. We constrain the respective Wilson coefficient using the measurements by the COHERENT and CHARM collaborations. We also point out the constraining power of future elastic neutrino-nucleus scattering experiments. Finally, we explore the implications of the bounds for SMEFT operators above the electroweak breaking scale.

**Authors:** ZUPAN, Jure (University of Cincinnati); TAMMARO, Michele; ALTMANNSHOFER, Wolfgang (UC Santa Cruz)

**Presenter:** TAMMARO, Michele

**Session Classification:** Session 6

Contribution ID: 5

Type: **not specified**

## Octant of $\theta_{23}$ and NSI degeneracy at DUNE

*Thursday 30 May 2019 16:00 (45 minutes)*

We expound in detail the degeneracy between the octant of  $\theta_{23}$  and flavor-changing neutral-current non-standard interactions (NSI's) in neutrino propagation, considering DUNE as a case study. In the presence of such NSI parameters involving the  $e - \mu$  ( $\epsilon e \mu$ ) and  $e - \tau$  ( $\epsilon e \tau$ ) flavors, the  $\nu_{\mu} \rightarrow \nu_e$  and  $\nu_{\mu} \rightarrow \nu_{e \text{ bar}}$  appearance probabilities in long-baseline experiments acquire an additional interference term, which depends on one new dynamical CP-phase  $\phi_{\{e\mu/e\tau\}}$ . This term sums up with the well-known interference term related to the standard CP-phase  $\delta$  creating a source of confusion in the determination of the octant of  $\theta_{23}$ . We show that for values of the NSI coupling (taken one at-a-time) as small as few % (relative to the Fermi coupling constant  $G_F$ ), and for unfavorable combinations of the two CP-phases  $\delta$  and  $\phi_{\{e\mu/e\tau\}}$ , the discovery potential of the octant of  $\theta_{23}$  gets completely lost.

**Authors:** Dr PALAZZO, Antonio (Bari University & INFN Bari); CHATTERJEE, Sabya Sachi (Institute for Particle Physics Phenomenology, Durham University); Dr AGARWALLA, Sanjib Kumar (Institute of Physics, Bhubaneswar)

**Presenter:** CHATTERJEE, Sabya Sachi (Institute for Particle Physics Phenomenology, Durham University)

**Session Classification:** Session 8

Contribution ID: 6

Type: **not specified**

## New physics in rare neutrino scattering

*Thursday 30 May 2019 14:45 (45 minutes)*

Rare and unique neutrino scattering processes can serve as an ideal tool in the search for new physics. In this context, I will present the sensitivity of the DUNE near detector to leptophilic  $Z'$  models, using neutrino-electron and neutrino trident scattering. I will conclude illustrating how similar signatures can also arise in more exotic models and motivating the need for a program to measure multi-lepton final states in current and future neutrino facilities.

**Author:** HOSTERT, Matheus (IPPP, Durham University)

**Presenter:** HOSTERT, Matheus (IPPP, Durham University)

**Session Classification:** Session 7

Contribution ID: 7

Type: **not specified**

## Liquid Argon Technology for Theorists

*Thursday 30 May 2019 17:30 (45 minutes)*

Available estimates for the energy resolution of DUNE vary by as much as a factor of four. To address this controversy, and to connect the resolution to the underlying physical processes, we build an independent simulation pipeline for neutrino events in liquid argon, combining the public tools GENIE and FLUKA. Using this pipeline, we first characterize the channels of non-hermeticity of DUNE, including subthreshold particles, charge recombination, and nuclear breakup. Particular attention is paid to the role of neutrons, which are responsible for a large fraction of missing energy in all channels. Next, we determine energy resolution, by quantifying event-to-event stochastic fluctuations in missing energy. In the future, this framework can be used to assess the impact of cross section uncertainties on oscillation sensitivity.

**Author:** LI, Shirley (SLAC)

**Presenter:** LI, Shirley (SLAC)

**Session Classification:** Session 8

Contribution ID: 8

Type: **not specified**

## Overview of Neutrino Flavor Models

*Wednesday 29 May 2019 09:00 (45 minutes)*

I will review current state of models of neutrino masses. I will discuss the models' implications for particle physics phenomenology and for cosmology.

**Author:** CHEN, Mu-Chun (UC Irvine)

**Presenter:** CHEN, Mu-Chun (UC Irvine)

**Session Classification:** Session 1



Contribution ID: 9

Type: **not specified**

## Beginnings of Quantum Monte Carlo Short-Time Approximation Implementations for electron and neutrino scattering from He4 and C12 in GENIE

*Thursday 30 May 2019 16:45 (45 minutes)*

The study of inclusive neutrino ( $\nu$ ) cross sections and total fluxes for signs of (beyond) Standard Model interactions is critically dependent upon accurate theoretical modeling for consistent reconstruction of a  $\nu$ 's energy. Given the continuum of final state topologies available to such processes, the most popular form of this modeling within the experimental community generally occurs within event generators. One popular, longstanding, continually developing generator used today by Fermilab collaborations is GENIE; however, current simulations are usually based upon rather phenomenological, quasi-classical approximations, all fundamentally dependent upon underlying nuclear models which generally ignore crucial aspects of the nuclear response (such as nuclear many-body correlations). With a future path forward toward precision large scale experiments, a new lepton scattering GENIE module has begun development for  $^4\text{He}$  and  $^{12}\text{C}$ . This module will use nuclear response functions for electron scattering calculated with Quantum Monte Carlo computational methods that fully retain the complexity of the many-body correlations induced by the nuclear Hamiltonian and associated electroweak currents. Once completed, this module can be directly tested using world electron scattering data. Underlying physics, generator modeling assumptions, current implementation plans, and future comparisons will be discussed.

**Authors:** BARROW, Joshua (The University of Tennessee, FNAL); Dr PASTORE, Saori (WUSTL); Dr GARDINER, Steven (FNAL)

**Presenter:** BARROW, Joshua (The University of Tennessee, FNAL)

**Session Classification:** Session 8

Contribution ID: 10

Type: **not specified**

## Confronting Neutrino Mass Generation Mechanism with MiniBooNE Anomaly

*Wednesday 29 May 2019 16:00 (45 minutes)*

We present a novel framework that provides an explanation to the long-standing excess of electron-like events in the MiniBooNE experiment at Fermilab. We suggest a new dark sector containing a dark neutrino and a dark gauge boson, both with masses between a few tens and a few hundreds of MeV. Dark neutrinos are produced via neutrino-nucleus scattering, followed by their decay to the dark gauge boson, which in turn gives rise to electronlike events. This mechanism provides an excellent fit to MiniBooNE energy spectra and angular distributions. We propose here to use this fact to connect the generation of neutrino masses to a light dark sector, charged under a new U(1)<sub>D</sub> dark gauge symmetry. We introduce the minimal number of dark fields to obtain an anomaly free theory with the spontaneous breaking of the dark symmetry and obtain automatically the inverse seesaw Lagrangian. In addition, the so-called  $\mu$ -term of the inverse seesaw is dynamically generated and technically natural in this framework.

**Authors:** JANA, SUDIP (OKLAHOMA STATE UNIVERSITY); MACHADO, Pedro (Fermilab); BERTUZZO, enrico (Scuola Normale Superiore); ZUKANOVICH FUNCHAL, renata (Universidade de São Paulo)

**Presenter:** JANA, SUDIP (OKLAHOMA STATE UNIVERSITY)

**Session Classification:** Session 4

Contribution ID: 11

Type: **not specified**

## Overview of Neutrino Physics at Colliders

*Wednesday 29 May 2019 09:45 (45 minutes)*

**Presenter:** HAN, Tao (Univ. Pittsburgh)

**Session Classification:** Session 1

Contribution ID: 12

Type: **not specified**

## Testing NSI at Colliders

*Wednesday 29 May 2019 11:45 (45 minutes)*

**Presenter:** GONCALVES, Dorival (Univ. Pittsburgh)

**Session Classification:** Session 2

Contribution ID: 13

Type: **not specified**

## **Global Fit Constraints on NSI**

*Wednesday 29 May 2019 11:00 (45 minutes)*

**Presenter:** MARTINEZ-SOLER, Ivan (Northwestern/Fermilab)

**Session Classification:** Session 2

Contribution ID: 14

Type: **not specified**

## **Dark Matter direct detection and NSI**

*Wednesday 29 May 2019 14:00 (45 minutes)*

**Presenter:** PEREZ-GONZALEZ, Yuber (Northwestern/Fermilab)

**Session Classification:** Session 3

Contribution ID: 15

Type: **not specified**

## **Large NSI in a Radiative Neutrino Mass Model**

*Wednesday 29 May 2019 14:45 (45 minutes)*

**Presenters:** THAPA, Anil (Oklahoma State Univ.); JANA, Sudip (Oklahoma State University)

**Session Classification:** Session 3

Contribution ID: 16

Type: **not specified**

## **Testing MiniBooNE Anomaly at Neutrino Scattering Experiments**

*Wednesday 29 May 2019 16:45 (45 minutes)*

**Presenter:** ARGUELLES, Carlos (MIT)

**Session Classification:** Session 4



Contribution ID: 17

Type: **not specified**

## **NSI with DUNE Alternative Configurations**

*Friday 31 May 2019 09:00 (45 minutes)*

**Presenter:** MEHTA, Poonam (JNU, New Delhi)

**Session Classification:** Session 9

Contribution ID: **18**

Type: **not specified**

## **Dark Tridents**

*Thursday 30 May 2019 09:00 (45 minutes)*

**Presenter:** DE GOUVEA, Andre (Northwestern)

**Session Classification:** Session 5

Contribution ID: **19**

Type: **not specified**

## Light Mediators

*Thursday 30 May 2019 11:00 (45 minutes)*

In this talk, I will discuss light mediator models and various experimental constraints with particular emphasis on the recent results from the COHERENT experiment. I will show one particular example of such a model which contains sub-GeV dark matter.

**Presenter:** DUTTA, Bhaskar (Texas A&M)

**Session Classification:** Session 6

Contribution ID: 21

Type: **not specified**

## NSI with IceCube

*Friday 31 May 2019 09:45 (45 minutes)*

**Presenter:** SALVADO, Jordi (Barcelona)

**Session Classification:** Session 9

Contribution ID: 22

Type: **not specified**

## **Inflation and NSI**

*Friday 31 May 2019 11:00 (45 minutes)*

**Presenter:** DENTON, Peter (Brookhaven)

**Session Classification:** Session 10

Contribution ID: 23

Type: **not specified**

## **Leptogenesis from Low Energy CP Violation**

*Wednesday 29 May 2019 17:30 (45 minutes)*

**Presenter:** TURNER, Jessica (Fermilab)

**Session Classification:** Session 4

Contribution ID: 25

Type: **not specified**

## Summary

*Friday 31 May 2019 11:45 (45 minutes)*

**Presenter:** MACHADO, Pedro (Fermilab)

**Session Classification:** Session 10

Contribution ID: 26

Type: **not specified**

## Welcome Address by the Chair of Physics

*Wednesday 29 May 2019 08:55 (5 minutes)*

**Presenter:** ALFORD, Mark (Washington University in St Louis)

**Session Classification:** Welcome Address