

The 4th Workshop on New Physics Opportunities at Neutrino Facilities

Report of Contributions

Contribution ID: 2

Type: **not specified**

DM searches using SK LOWE data

Wednesday, June 5, 2024 9:50 AM (20 minutes)

I will cover what is not covered by the plenary talk, focusing on low-energy data

Primary author: CHOI, Koun (IBS)

Presenter: CHOI, Koun (IBS)

Session Classification: Contributed talks II

Contribution ID: 3

Type: **not specified**

Plenary2

Contribution ID: 4

Type: **not specified**

Plenary3

Contribution ID: 5

Type: **not specified**

Plenary4

Contribution ID: 6

Type: **not specified**

Plenary IV

Contribution ID: 7

Type: **not specified**

Plenary V

Contribution ID: 8

Type: **not specified**

Contributed talks

Contribution ID: 9

Type: **not specified**

White paper discussion

Contribution ID: **10**

Type: **not specified**

Physics at the SND@LHC

Tuesday, June 4, 2024 4:40 PM (20 minutes)

We review the physics at the SND@LHC and its recent achievements.

Primary author: CHOI, Ki-Young (Sungkyunkwan University)

Presenter: CHOI, Ki-Young (Sungkyunkwan University)

Session Classification: Contributed talks I

Contribution ID: 11

Type: **not specified**

Searching for ν_τ disappearance in the SHiP experiment

Tuesday, June 4, 2024 4:20 PM (20 minutes)

We study the expected sensitivity to the mixing between sterile and tau neutrinos directly from the tau neutrino disappearance in the high-energy fixed target experiment. Here, the beam energy is large enough to produce tau neutrinos at the target with large luminosity. During their propagation to the detector, the tau neutrino may oscillate into sterile neutrino. By examining the energy spectrum of the observed tau neutrino events, we can probe the mixing between sterile and tau neutrinos directly. In this paper, we consider Scattering and Neutrino Detector (SND) at SHiP experiment as a showcase, which uses 400 GeV protons from SPS at CERN, and expect to observe 6,300 tau and anti-tau neutrinos from the 2×10^{20} POT for 5 years operation. Assuming the uncertainty of 10%, we find the sensitivity $|U_{\tau 4}|^2 \sim 0.08$, (90% CL) for $\Delta m_{41}^2 \sim 500 \text{ eV}^2$ with 10% signal-to-background ratio. We also consider a far SND at the end of the SHiP Hidden Sector Decay Spectrometer (HSDS), in which case the sensitivity would be enhanced to $|U_{\tau 4}|^2 \sim 0.02$. Away from this mass, the sensitivity becomes lower than $|U_{\tau 4}|^2 \sim 0.15$ for Δm_{41}^2 lesssim 100 eV^2 or Δm_{41}^2 gtrsim 10^4 eV^2 .

Primary authors: YOO, Seong Moon (Sung Kyun Kwan University); Dr KIM, Sung Hyun (Gyeongsang National University); Prof. CHOI, Ki-Young (Sungkyunkwan University); Prof. KIM, Yeong Gyun (Gwangju National University of Education); LEE, Kang Young (GNU); LEE, Kyong Sei (Korea University); Dr PARK, Byungdo (Gyeongsang National University); Dr SOHN, Jong Yoon (Gyeongsang National University); Prof. YOON, Chun Sil (Gyeongsang National University)

Presenter: YOO, Seong Moon (Sung Kyun Kwan University)

Session Classification: Contributed talks I

Contribution ID: 12

Type: **not specified**

Secret neutrino interaction at rare meson decay and neutrino experiments

Wednesday, June 5, 2024 10:10 AM (20 minutes)

Secret coupling of neutrinos to a new light vector boson, Z' , with a mass smaller than few hundred MeV is motivated within a several scenarios which are designed to explain various anomalies in particle physics and cosmology. Due to the longitudinal component of the massive vector boson, the rates of three-body decay of charged mesons (M) such as the pion, kaon and D mesons to the light lepton plus neutrino and Z' ($M \rightarrow l\nu Z'$) are enhanced by a factor of $(m_M/m_{Z'})^2$ and followed by the subsequent decay of Z' into the pair of neutrino and anti-neutrino. On the other hand, the standard two body decay $M \rightarrow l\nu$ is suppressed by a factor of $(m_l/m_M)^2$ due to chirality.

Consequently, this new interaction can be examined through meson decay experiments, involving the detection of the charged lepton, and in neutrino experiments, which change the neutrino spectrum. The strongest current bound comes from kaon decay experiment the NA62 experiment. We investigate the potential of future neutrino experiments for identifying specifically ν_τ appearance in probing secret neutrino interactions.

Primary author: BAKHTI, Pouya (JBNU)

Co-authors: Dr RAJAEI, Meshkat (JBNU); Prof. SHIN, Seodong (Jeonbuk National University)

Presenter: BAKHTI, Pouya (JBNU)

Session Classification: Contributed talks II

Contribution ID: 13

Type: **not specified**

N_eff constraints on the Dark Axion Portal

Tuesday, June 4, 2024 3:40 PM (20 minutes)

Axions and dark photons are common in many extensions of the Standard Model. The dark axion portal—an axion coupling to the dark photon and photon—can significantly modify their phenomenology. We study the cosmological constraints on the dark axion portal from Cosmic Microwave Background (CMB) bounds on the energy density of dark radiation, ΔN_{eff} . By computing the axion-photon-dark photon collision terms and solving the Boltzmann equations including their effects, we find that light axions are generally more constrained by ΔN_{eff} than from supernova cooling or collider experiments. However, with dark photons at the MeV scale, a window of parameter space is opened up above the supernova limits and below the experimental exclusion, allowing for axion decay constants as low as $f_a \sim 10^4$ GeV. This region also modifies indirectly the neutrino energy density, thus relaxing the cosmological upper bound on the sum of ne

Primary authors: HONG, Heejoung; SON, Minho (Korea Advanced Institute of Science and Technology); Prof. YOU, Tevong (King's College London); Dr MIN, Ui

Presenter: HONG, Heejoung

Session Classification: Contributed talks I

Contribution ID: 14

Type: **not specified**

Reactor antineutrino flux from neutrino- ^{13}C neutral current interactions

Tuesday, June 4, 2024 4:00 PM (20 minutes)

We focus on the potential of neutrino - ^{13}C neutral current interactions in clarifying the reactor antineutrino flux around the 6 MeV region. The interactions produce 3.685 MeV photon line via the process of de-excitation of ^{13}C in organic liquid scintillators, which can be observed in reactor neutrino experiments. We expect the future measurements of neutrino - ^{13}C cross section in JUNO and IsoDAR@Yemilab at low energies might help testing the reactor flux models with the assistance of excellent particle identification.

Primary authors: SHIN, Chang Sub (Institute for Basic Science); RAJAE, Meshkat (JBNU); PARK, Min-Gwa (Jeonbuk National University); BAKHTI, Pouya (JBNU); Prof. SHIN, Seodong (Jeonbuk National University)

Presenter: PARK, Min-Gwa (Jeonbuk National University)

Session Classification: Contributed talks I

Contribution ID: 15

Type: **not specified**

Analyzing light sterile neutrino at DUNE and the role of beam tune, neutral current and near detector

Tuesday, June 4, 2024 3:20 PM (20 minutes)

The Deep Underground Neutrino Experiment (DUNE) is an upcoming long baseline neutrino experiment. In addition to exploring the yet unknown parameters in the standard three flavor neutrino sector, an ancillary goal of DUNE is to probe the subdominant effects induced by new physics such as a light eV-scale sterile neutrino. DUNE utilizes a wide band beam and provides us with an opportunity to utilize different beam tunes. We demonstrate that combining information from different beam tunes (low energy and medium energy) available at DUNE impacts its ability to probe some of the sterile parameters and modifies the allowed regions. We also perform a comparative analysis with different configurations including the addition of neutral current channels and using the simulated near detector data. We illustrate how using these various configurations can help us in exploring the sterile neutrino parameter space.

Primary authors: MASUD, Mehedi (IBS-CTPU); MEHTA, Poonam (Jawaharlal Nehru University); PARVEEN, Sabila (Jawaharlal Nehru University); BISHAI, Mary (Brookhaven National Laboratory)

Presenter: MASUD, Mehedi (IBS-CTPU)

Session Classification: Contributed talks I

Contribution ID: 16

Type: **not specified**

Beyond the Standard Model Physics at DUNE

Monday, June 3, 2024 9:40 AM (30 minutes)

Precision measurements of neutrino properties necessary for modifying the Standard Model requires a unique combination of the high-intensity LBNF proton beams with a highly-capable precision DUNE near detector, and massive LArTPC far detector modules at a 1300 km baseline. This capability enables a variety of opportunities for Beyond the Standard Model (BSM) physics, either novel or with unprecedented sensitivity which were impossible to conceive in traditional neutrino experiment. The near detector system is critical in controlling systematic uncertainties. The near detector plays an essential role in taking full advantage of the LBNF beam in most of the BSM physics topics. In this talk, I will discuss BSM physics topics DUNE can make contributions and will briefly summarize how DUNE can make leading contributions in this arena, taking advantage of the capable near detector.

Presenter: YU, Jaehoon (The University of Texas at Arlington)

Session Classification: Plenary 1

Contribution ID: 17

Type: **not specified**

BSM Opportunities at Beam-Dump Experiments

In this talk, I will discuss various BSM opportunities available at beam-dump-type experiments including beam-produced neutrino experiments. Due to the weakly interacting nature of neutrinos, high-intensity beam-based experiments are well-motivated. Inside the beam target of these experiments, plenty of MeV-scale mesons and MeV-to-GeV scale electromagnetic particles such as electrons, positrons, and photons are produced and they can be good sources of MeV-range BSM physics. As concrete example studies, I will discuss MeV-scale light dark matter and light mediator searches in these experiments. I will then motivate very short baseline experiments in the context of mediator searches and introduce the concept of proposed “portable” DAMSA experiments.

Presenter: Dr KIM, Doojin (Texas A&M University)

Session Classification: Plenary 1

Contribution ID: **18**

Type: **not specified**

TBA

Presenter: NG, Kenny (Chinese University of Hong Kong)

Session Classification: Plenary 2

Contribution ID: 19

Type: **not specified**

BSM probes from Supernovae

Presenter: YUN, Seokhoon (IBS-CTPU)

Session Classification: Plenary 2

Contribution ID: 20

Type: **not specified**

BSM in JUNO

Monday, June 3, 2024 2:00 PM (30 minutes)

Presenter: LI, Yufeng (Institute of High Energy Physics)

Session Classification: Plenary 3

Contribution ID: 21

Type: **not specified**

Liquid Scintillator Counter at Yemilab

Presenter: WON, Eunil (Korea University)

Session Classification: Plenary 3

Contribution ID: 22

Type: **not specified**

BSM at KamLAND

Presenter: Prof. HATA, Kazumi (Tohoku University)

Session Classification: Plenary 4

Contribution ID: 23

Type: **not specified**

Status of RENE

Monday, June 3, 2024 4:00 PM (30 minutes)

Presenter: Prof. YANG, Byoungsu (Chonnam National University)

Session Classification: Plenary 4

Contribution ID: 24

Type: **not specified**

Status of NEON and NEOS II

Presenter: KO, Young Ju (IBS)

Session Classification: Plenary 4

Contribution ID: 25

Type: **not specified**

BSM at T2SK/HK near detectors

Tuesday, June 4, 2024 9:30 AM (30 minutes)

Presenter: Mr LI, Weijun (Oxford University)

Session Classification: Plenary 5

Contribution ID: 26

Type: **not specified**

Status of JSNS2

Presenter: PARK, Jungsic (Kyungpook National University)

Session Classification: Plenary 5

Contribution ID: 27

Type: **not specified**

BSM at SND/FASERnu/FPF

Presenter: Dr JEONG, Yu Seon (Chung-Ang University)

Session Classification: Plenary 5

Contribution ID: 28

Type: **not specified**

BSM at SK/HK far detectors

Tuesday, June 4, 2024 11:30 AM (30 minutes)

Presenter: TAKHISTOV, Volodymyr (QUP, KEK & Kavli IPMU)

Session Classification: Plenary 6

Contribution ID: 29

Type: **not specified**

BSM at IceCube

Tuesday, June 4, 2024 12:00 PM (30 minutes)

Presenter: ROTT, Carsten (Sungkyunkwan University)

Session Classification: Plenary 6

Contribution ID: 30

Type: **not specified**

Halo-independent bounds on Inelastic Dark Matter

Wednesday, June 5, 2024 9:30 AM (20 minutes)

I will discuss halo-independent constraints on the Inelastic Dark Matter (IDM) scenario, in which a Weakly Interaction Massive Particle (WIMP) state interacts with nuclear targets by upscattering to a heavier state with a mass splitting δ . Such constraints are obtained adopting the single-stream method, that exploits the complementarity of Direct Detections and Neutrino Telescopes (searching for the annihilation signal of WIMPs captured in the Sun) in probing the full range of incoming WIMP speeds. I will show that a non-vanishing mass splitting δ modifies this picture, and that for particular combinations of WIMP mass and δ the complementarity between the two detection techniques required by the method is lost. I will also discuss the issue of thermalization of IDM within the Sun and show the corresponding effect on our results.

Primary authors: Prof. SCOPEL, Stefano (CQUeST, Sogang University); Dr KAR, Arpan (CQUeST, Sogang University); Dr KANG, Sunghyun (CQUeST, Sogang University)

Presenter: Dr KAR, Arpan (CQUeST, Sogang University)

Session Classification: Contributed talks II

Contribution ID: 31

Type: **not specified**

BeamHNL, a GENIE-based general heavy neutral lepton generator

Tuesday, June 4, 2024 5:00 PM (20 minutes)

Heavy Neutral Leptons (HNL) are a compelling target for discovery searches at accelerator experiments. The GENIE BeamHNL module is an experiment-agnostic, configurable simulation of HNL produced in the decays of particles that are made in neutrino beamlines. Applicable to HNL with mass less than the kaon's mass, BeamHNL produces a detailed record of decay events in an arbitrarily complex detector at a user-specified location, by calculating the neutrino energy and acceptance probability event-by-event. It accepts flexible user input in the form of flat flux tuples, a ROOT geometry file, and a configuration file where desired decay channels (implemented from an effective field theory valid at Intensity Frontier neutrino energies) are specified. Deliverables include a dynamic flux calculation, HNL decay timing distributions for background reduction, an implementation of HNL polarisation, and a robust distribution of decay vertices in 3D space according to the position and size of the supplied detector.

Primary author: Mr PLOWS, John (University of Oxford)

Presenter: LI, Weijun (University of Oxford)

Session Classification: Contributed talks I

Contribution ID: 32

Type: **not specified**

Status and New Physics searches in JSNS2

Presenter: PARK, Jungsic (Kyungpook National University)

Session Classification: Plenary 1

Contribution ID: 33

Type: **not specified**

Neutrino mass models

Presenter: CHUN, Eung Jin (KIAS)

Session Classification: Plenary7

Contribution ID: 34

Type: **not specified**

Effects of NSI on neutrino oscillation parameters measurements

Tuesday, June 4, 2024 2:30 PM (30 minutes)

In this talk I will discuss Non-Standard neutrino Interaction (NSI) at its effect on neutrino oscillation parameters. I will explain the LMA-Dark solution, degeneracies induced by NSI of δ_{CP} measurement. Moreover, I will discuss the effect of NSI on solar and atmospheric neutrinos.

Presenter: BAKHTI, Pouya (JBNU)

Session Classification: Plenary7

Contribution ID: 35

Type: **not specified**

Liquid Scintillator Counter at Yemilab

Monday, June 3, 2024 2:30 PM (30 minutes)

In September 2022, a new underground laboratory, Yemilab, was finally completed in Jeongseon, Gangwon Province, with a depth of 1,000 m and an exclusive experimental area spanning 3,000 m³. The tunnel is encased in limestone and accommodates 17 independent experimental spaces.

Among

them, Yemilab includes a cylindrical pit with a volume of approximately 6,300 m³, designed as a multipurpose laboratory for next-generation experiments involving neutrinos, dark matter, and related research.

We discuss physical potential and R&D strategy for a future program at this site.

Primary author: WON, Eunil (Korea University)

Presenter: WON, Eunil (Korea University)

Session Classification: Plenary 3

Contribution ID: 36

Type: **not specified**

Status of NEON and NEOS

Monday, June 3, 2024 4:30 PM (30 minutes)

Nuclear reactors produce a huge amount of neutrinos from the beta decay that occurs during fission. An excellent detection channel for electron antineutrinos, called inverse beta decay, has led to numerous neutrino experiments using reactor neutrino. The Hanbit Nuclear Power Plant in Yeonggwang has six units with a thermal power of 2.8 GW, and each unit has a Tendon Gallery that is accessible 24 meters away from the reactor core. NEOS had been conducted an experiment in the Tendon Gallery from 2015 to search for sterile neutrinos, one hypothesis to explain the reactor antineutrino anomaly. Meanwhile, the combined experience of NEOS and COSINE, an underground experiment to search for dark matter, has led to attempts to observe coherent elastic neutrino-nucleus scattering, and the NEON collaboration was formed to conduct the experiment at the Tendon Gallery. As well as neutrinos, nuclear reactors are also very rich gamma sources, and NEON has carried out a search for dark sector particles that can be produced from nuclear gamma. This talk will include an overview of both experiments and recent results.

Primary author: KO, Young Ju (IBS)**Presenter:** KO, Young Ju (IBS)**Session Classification:** Plenary 4

Contribution ID: 37

Type: **not specified**

Neutrion mass models: Seesaw and DM

Tuesday, June 4, 2024 2:00 PM (30 minutes)

I will sketch several ideas on neutrino mass models associated with dark matter of the Universe, each of which based on the feature of Dodelson-Widrow mechanism, scotogenic model and neutrion-portal scheme.

Primary author: CHUN, Eung Jin (KIAS)

Presenter: CHUN, Eung Jin (KIAS)

Session Classification: Plenary7

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

Status of the JSNS2 experiment

Tuesday, June 4, 2024 10:00 AM (30 minutes)

The JSNS2 experiment is formulated to investigate sterile neutrinos while also aiming to directly verify the LSND experiment's results as a primary objective in physics. The approach involves utilizing muon decay-at-rest neutrinos and observing the appearance of anti-electron neutrinos at the J-PARC Material and Life Science Facility. The neutrino target comprises 17 tonnes of gadolinium-loaded liquid scintillator combined with 10 percent diisopropylnaphthalene (DIPN), surrounded by 31 tonnes of unloaded liquid scintillator that includes gamma-catcher and veto layers. This presentation offers a brief overview of the potential opportunities for exploring Beyond Standard Model (BSM) physics using the JSNS2 detector, along with the current status of the experiment.

Primary author: PARK, Jungsic (Kyungpook National University)

Presenter: PARK, Jungsic (Kyungpook National University)

Session Classification: Plenary 5

Contribution ID: 39

Type: **not specified**

BSM search in KamLAND

Monday, June 3, 2024 3:30 PM (30 minutes)

KamLAND-Zen is an experiment that searches for neutrino less double-beta decay of ^{136}Xe with xenon loaded liquid scintillator.

Other BSM searches in KamLAND include the emission of majoron in neutrino less double-beta decay and the excited states of dark matter.

In this talk, I will talk these three BSM searches in KamLAND.

Primary author: HATA, Kazumi (Tohoku University)

Presenter: HATA, Kazumi (Tohoku University)

Session Classification: Plenary 4

Contribution ID: 40

Type: **not specified**

Dark Matter search in neutrino detectors

Monday, June 3, 2024 11:10 AM (30 minutes)

I will discuss the current status and future prospects of dark matter searches with neutrinos, and provide some thoughts on possible new ideas on this topic.

Primary author: NG, Kenny Chun Yu (The Chinese University of Hong Kong)

Presenter: NG, Kenny Chun Yu (The Chinese University of Hong Kong)

Session Classification: Plenary 2

Contribution ID: 41

Type: **not specified**

BSM Opportunities at Beam-Dump Experiments

Monday, June 3, 2024 10:10 AM (30 minutes)

In this talk, I will discuss various BSM opportunities available at beam-dump-type experiments including beam-produced neutrino experiments. Due to the weakly interacting nature of neutrinos, high-intensity beam-based experiments are well-motivated. Inside the beam target of these experiments, plenty of MeV-scale mesons and MeV-to-GeV scale electromagnetic particles such as electrons, positrons, and photons are produced and they can be good sources of MeV-range BSM physics. As concrete example studies, I will discuss MeV-scale light dark matter and light mediator searches in these experiments. I will then motivate very short baseline experiments in the context of mediator searches and introduce the concept of proposed “portable” DAMSA experiments.

Primary author: Dr KIM, Doojin (Texas A&M University)

Presenter: Dr KIM, Doojin (Texas A&M University)

Session Classification: Plenary 1

Contribution ID: 42

Type: **not specified**

Search for BSM physics at the forward experiments of the LHC

Tuesday, June 4, 2024 10:30 AM (30 minutes)

At the LHC, new experiments, SND@LHC and FASER/FASER ν , have started to investigate neutrinos and BSM physics in the forward region of the beam collision point. In addition, the Forward Physics Facility (FPF) was proposed to house a suite of forward experiments in the High Luminosity stage (HL-LHC). These experiments can provide opportunities to search for many interesting physics potentials in the standard model and beyond the standard model (BSM). In this talk, I will introduce several physics cases that can be explored at such forward experiments of the LHC focusing on BSM physics.

Primary author: JEONG, Yu Seon

Presenter: JEONG, Yu Seon

Session Classification: Plenary 5

Contribution ID: 43

Type: **not specified**

BSM probes from stars

Monday, June 3, 2024 11:40 AM (30 minutes)

Stars can be used as a valuable source for investigating new physics beyond the Standard Model, particularly light and feebly-interacting particles such as axions and dark photons. Among the various types of stars, supernovae and the Sun could be one of the most relevant objects for these searches, given their neutrino signals detected in experiments. In this talk, I will provide an overview of some approaches to search for new physics beyond the Standard Model, as implied by neutrino detection from supernovae and the Sun.

Primary author: YUN, Seokhoon (IBS-CTPU)

Presenter: YUN, Seokhoon (IBS-CTPU)

Session Classification: Plenary 2

Contribution ID: 44

Type: **not specified**

Welcoming remark

Monday, June 3, 2024 9:30 AM (10 minutes)

Presenter: Prof. SHIN, Seodong (Jeonbuk National University)

Session Classification: Welcome remark

Contribution ID: 45

Type: **not specified**

Dinner

Primary author: CHOI, Koun (IBS)

Presenter: CHOI, Koun (IBS)