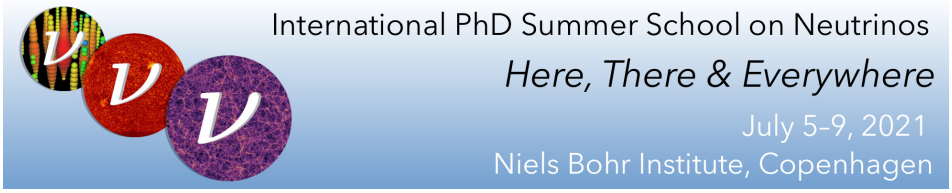
NBIA Summer School on Neutrinos: Here, There & Everywhere



Report of Contributions

https://indico.nbi.ku.dk/e/NBIA_Neutrino_2021

Contribution ID: **4** Type: **not specified**

Welcome

Contribution ID: **6** Type: **Oral**

Flavoured leptogenesis and type-II seesaw mechanism with two Higgs triplet scalars

Monday 5 July 2021 14:00 (15 minutes)

Type-II seesaw mechanism has been widely studied already as the link between neutrino mass generation beyond Standard Model (SM) and leptogenesis. In this study, the SM is minimally extended by two triplet Higgs scalars (with hypercharge $Y = 2$), with one triplet having complex vacuum expectation value (vev). The triplet vevs are bounded by the ρ-parameter constraint as, ω_1, $\omega_2 \ll v$, where v is the vev of the SM Higgs doublet. The neutrino mass gets generated by two massive triplet Higgs in this model. On the other hand, purely flavoured leptogenesis is achieved when the triplet Higgs scalar of mass $M_T \sim 10^9$ GeV, undergoes out-of-equilibrium bi-lepton decay, specially through lepton loop. The lepton asymmetries further get converted into baryon asymmetry via nonperturbative sphaleron process. This study shows the efficiency of type-II seesaw mechanism with two triplet scalars, to estimate the baryon asymmetry through fully flavoured leptogenesis. Here, baryon asymmetry of the order $\sim 10^{-10}$ is achieved, which falls within the observed range. The dependence of the baryon asymmetry on the branching ratios of triplet scalar is also studied here. To further increase the predictability of the mechanism, two-zero texture- B_2 is introduced in the neutrino mass matrix. The neutrino mass matrix elements are bounded by the latest neutrino oscillation parameter data and the sum of neutrino mass is taken to be $\Sigma_i m_i < 0.16$ eV. The efficacy of two-zero texture B_2 in two Higgs triplet scenario is mentioned.

Primary author: CHONGDAR, Sreerupa (National Institute of Technology, Rourkela)

Presenter: CHONGDAR, Sreerupa (National Institute of Technology, Rourkela)

Session Classification: Student Talks

Contribution ID: **7** Type: **Oral**

Neutrino masses from simple scoto-seesaw model with spontaneous CP violation

Monday 5 July 2021 13:45 (15 minutes)

I will discuss our recent work on a simple scoto-seesaw model that accounts for dark matter and neutrino masses with spontaneous CP violation. This is achieved with a single horizontal $\mathcal{Z}_8$ discrete symmetry, broken to a residual $\mathcal{Z}_2$ subgroup responsible for stabilizing dark matter. CP is broken spontaneously via the complex vacuum expectation value of a scalar singlet, inducing leptonic CP-violating effects. We find that the imposed $\mathcal{Z}_8$ symmetry pushes the values of the Dirac CP phase and the lightest neutrino mass to ranges already probed by ongoing experiments.

Primary authors: BARREIROS, D. (CFTP/IST, U. Lisboa); JOAQUIM, F. (CFTP/IST, U.Lisboa); SRIVASTAVA, R. (Indian Institute of Science Education and Research); VALLE, J. (Institut de Física Corpuscular –C.S.I.C./Universitat de Valencia)

Presenter: BARREIROS, D. (CFTP/IST, U. Lisboa)

Session Classification: Student Talks

Contribution ID: **9** Type: **Oral**

Chiral EFT Treatment of Neutrinoless Double Beta Decay with Majoron Emission

Monday 5 July 2021 13:30 (15 minutes)

Lepton number conservation is an accidental symmetry of the Standard Model. However, lepton flavour is violated by the prominent example of neutrino oscillations. Therefore it is reasonable to investigate whether lepton number is truly conserved in nature. A popular test for this is neutrinoless double beta decay ($0\nu\beta\beta$) which physicists have been investigating for a long time already. A variation of this is $0\nu\beta\beta$ with additional emission of a scalar, the so-called Majoron ϕ. This is the case that will be presented in this talk. We are aiming to treat this case using chiral effective field theory (chiral EFT). I will give an introduction to work that has already been performed on this topic for both $0\nu\beta\beta$ with Majoron emission ($0\nu\beta\beta\phi$) and $0\nu\beta\beta$ in chiral EFT. Then I will present the current state of our work of using chiral EFT methods to investigate $0\nu\beta\beta\phi$.

Primary author: VOLMER, Nele (Max-Planck-Institut für Kernphysik)

Presenter: VOLMER, Nele (Max-Planck-Institut für Kernphysik)

Session Classification: Student Talks

Contribution ID: **10** Type: **Oral**

Mass hierarchy and CP violation in neutrino oscillation experiments

Wednesday 7 July 2021 14:00 (15 minutes)

Mass hierarchy and leptonic CP violation are the most sought questions in the ongoing and upcoming neutrino oscillation experiments. In this context, the latest results of T2K and NOνA is briefly discussed. The combined sensitivity of the extended run of T2K and NOνA, referred to as T2K-II and NOνA-II corresponding to the total exposures of 20×10^{21} and 7.2×10^{21} POT respectively, and with a reactor-based medium baseline experiment JUNO to the above problems have been explained. The results are based on our recent work **(https://arxiv.org/abs/2009.08585)**.

Primary author: NATH, Ankur (Tezpur University)

Presenter: NATH, Ankur (Tezpur University)

Session Classification: Student Talks

Contribution ID: **11** Type: **Oral**

Physics studies for ND280 upgrade at T2K experiment

Wednesday 7 July 2021 13:30 (15 minutes)

Neutrino oscillation physics has now entered the precision era. In parallel with needing larger detectors to collect more data with, future experiments further require a significant reduction of systematic uncertainties with respect to what is currently available. In the neutrino oscillation measurements from the T2K experiment the systematic uncertainties related to neutrino interaction cross sections are currently the most dominant. To reduce this uncertainty a much improved understanding of neutrino-nucleus interactions is required. In particular, it is crucial to better understand the nuclear effects which can alter the final state topology and kinematics of neutrino interactions in such a way which can bias neutrino energy reconstruction and therefore bias measurements of neutrino oscillations. The upgraded ND280 near detector of T2K will directly confront our naivety of neutrino interactions using a new detector configuration with full polar angle acceptance and a much lower proton tracking threshold. Furthermore, neutron tagging capabilities in addition to precision timing information will allow the upgraded detector to estimate neutron kinematics from neutrino interactions. Such improvements permit access to a much larger kinematic phase space which correspondingly allows techniques such as the analysis of transverse kinematic imbalances (TKI) to offer remarkable constraints of the pertinent nuclear physics for T2K analyses. In this talk we quantitatively demonstrate ND280's upgraded sensitivity to key nuclear effects such as removal energy and 2p2h. To this end, we present a fit of a parameterised interaction and flux model to simulated measurements of TKI and neutrino energy from the upgraded ND280.

Primary author: NGUYEN, Quoc Viet (LPNHE, Paris)

Presenter: NGUYEN, Quoc Viet (LPNHE, Paris)

Session Classification: Student Talks

Contribution ID: **12** Type: **Oral**

Multi-wavelength and multi-messenger studies of extragalactic high-energy particle sources

Thursday 8 July 2021 16:00 (15 minutes)

The detection of high energy astrophysical neutrinos at hundreds of TeV is an important step towards the understanding of cosmic-rays origin. However, the origin of such energetic neutrinos is still an open issue. Among the potential extragalactic neutrino sources, blazars are particularly interesting, as suggested by the detection of a high-energy neutrino in the direction of the flaring Blazar TXS 0506+056 in 2017. My PhD research project is focused on the computation and characterization of the broadband spectral energy distribution (SED) of blazar sources, with particular attention to very high energies (VHE). Part of my work is dedicated to the drawing of proposals for simultaneous and multiwavelength observations of interesting sources, together with the data analysis from raw data up to high-level products such as SEDs and lightcurves. The analyses I am working on focus on high energies (Fermi/LAT data) and VHE (MAGIC and LST-1 data). Then, a substantial part of my PhD will comprise a phenomenological description of the SEDs through the development of lepto-hadronic emission models further developing an already existing python code to include all hadronic radiative processes. They will be tested on the candidates in order to better understand the origin of the jet emission and the possible neutrino emission and cosmic-ray acceleration.

Primary author: VIALE, Ilaria (University and INFN Padova)

Presenter: VIALE, Ilaria (University and INFN Padova)

Session Classification: Student Talks

Contribution ID: **13** Type: **Oral**

Exploring the extension of IceCube's supernova observational reach using HE neutrinos from CCSNe ejecta-CSM interaction

Monday 5 July 2021 16:15 (15 minutes)

IceCube monitors for supernovae using low energy neutrinos (tens of MeV), observing our galaxy up to the large Magellanic cloud. Using the shock between the ejecta and the circumstellar material from the progenitor star, a high flux of high-energy neutrinos in the order of TeV and above can be created. These neutrinos would reach Earth 0.1 day –1 year after the low-energy neutrinos. I will explore how IceCube's observation reach can be extended using these high-energy neutrinos.

Primary author: VALTONEN-MATTILA, Nora

Presenter: VALTONEN-MATTILA, Nora

Session Classification: Student Talks

Contribution ID: **14** Type: **Oral**

Heavy decaying dark matter at future neutrino radio telescopes

Tuesday 6 July 2021 16:00 (15 minutes)

In the next decade, ultra-high-energy neutrinos in the EeV energy range will be potentially detected by next-generation neutrino telescopes. Although their primary goals are to observe cosmogenic neutrinos and to gain insight into extreme astrophysical environments, they have the great potential of indirectly probing the nature of dark matter. In this talk, we study the projected sensitivity of up-coming radio neutrino telescopes, such as RNO-G, GRAND and IceCube-gen2 radio array, to decaying dark matter scenarios. We investigate different dark matter decaying channels and masses, from 10^7 to 10^{15} GeV. By assuming the observation of cosmogenic or newborn pulsar neutrinos, we forecast conservative constraints on the lifetime of heavy dark matter particles. We find that these limits are competitive with and highly complementary to previous multi-messenger analyses.

Primary authors: Mr FIORILLO, Damiano F. G. (University of Naples "Federico II"); Prof. MIELE, Gennaro (University of Naples "Federico II"); Dr CHIANESE, Marco (University of Naples "Federico II"); Dr SAVIANO, Ninetta (INFN Naples); HAJJAR MUÑOZ, Rasmi Enrique; Prof. MORISI, Stefano (University of Naples "Federico II")

Presenter: HAJJAR MUÑOZ, Rasmi Enrique

Session Classification: Student Talks

Contribution ID: **15** Type: **Oral**

Coherent Elastic Neutrino-Nucleus Scattering and its implications in the search of new Physics

Thursday 8 July 2021 16:15 (15 minutes)

The process of Coherent Elastic Neutrino-Nucleus Scattering (CEvNS) has now been measured by the COHERENT collaboration with two different technologies, including CsI and LAr as detection materials. In this work, we use the results from these experiments to constrain parameters of the Standard Model at low energies, such as the weak mixing angle and nuclear physics parameters, through the determination of the neutron rms radius of the target material. We also use the experimental data to constrain new physics parameters in the Non-Standard Interactions approach. We show that data from the latest measurement with LAr, allow to significantly improve the constraints obtained with the results from the first measurement with CsI. In addition, we discuss the results from future measurements with reactor antineutrino sources. We show that they can be combined with accelerator data to get more robust constraints on these parameters, as long as the systematic errors are under control.

Primary authors: G. SANCHEZ GARCIA (Cinvestav); O. G. MIRANDA; D. K. PAPOULIAS; O. SANDERS; M. TÓRTOLA; J. W. F. VALLE

Presenter: G. SANCHEZ GARCIA (Cinvestav)

Session Classification: Student Talks

Contribution ID: **16** Type: **Oral**

Neutrinoless double beta decay search with GERDA and LEGEND

Thursday 8 July 2021 14:00 (15 minutes)

The GERDA and LEGEND-200 experiments were designed to search for the neutrinoless double beta decay of 76-Ge (0νββ: 76Ge →76Se+2e−) in high-purity germanium detectors operated in ultra-pure liquid argon. Their ultimate goal is to shed light on the as-yet-unknown nature of neutrinos and possibly explain the matter-antimatter asymmetry in the universe that would be induced in case neutrinos are their own antiparticles. The most stringent limit on the half-life of 0νββ-decay has been recently set by GERDA, which ended in late 2019 to allow for the construction of its successor, LEGEND-200. The aim of LEGEND-200 is to increase the sensitivity to 0νββ-decay by one order of magnitude. To achieve this goal, an excellent energy resolution and enhanced background vetoing efficiency are crucial. In this talk, I will show the latest results of GERDA and the R&D work for LEGEND, focusing on the construction and characterization of its liquid argon veto.

Primary author: RODRIGUES ARAUJO, Gabriela (University of Zurich)

Presenter: RODRIGUES ARAUJO, Gabriela (University of Zurich)

Session Classification: Student Talks

Contribution ID: **17** Type: **Oral**

The effect of muons production and neutrino trapping on Binary Neutron Star merger remnants

Monday 5 July 2021 16:00 (15 minutes)

A deep understanding of the dynamics of Binary Neutron Star (BNS) mergers requires a detailed treatment of the relativistic hydrodynamics of the merger, as well as of the microphysics governing the underlying electromagnetic, strong, and weak interactions. Accurate numerical simulations are pivotal to correctly interpret the data collected through the detection of gravitational waves and electromagnetic counterparts.
State-of-the-art simulations do not include muons in the microphysics of the system, even though physical muon creation is possible in such conditions. As a consequence, muonic neutrinos are not distinguished by tauonic ones. Moreover, the contribution of trapped neutrinos to the thermodynamic quantities characterizing the remnant is usually neglected. During my talk, I will discuss the consequences of muons creation and neutrino trapping on the properties of BNS merger remnants.

Primary author: LOFFREDO, Eleonora (Gran Sasso Science Institute and INFN)

Presenter: LOFFREDO, Eleonora (Gran Sasso Science Institute and INFN)

Session Classification: Student Talks

Contribution ID: **18** Type: **Oral**

Detection of Tau Neutrinos at the Super-Kamiokande Experiment

Wednesday 7 July 2021 16:00 (15 minutes)

The Super-Kamiokande experiment (SK) is the famed water Cherenkov detector which discovered the oscillation of atmospheric neutrinos. As a result of the oscillation of atmospheric muon neutrinos, tau neutrinos are expected to appear. Therefore, direct detection of tau neutrinos in the atmosphere provides unambiguous confirmation of the phenomenon of neutrino oscillation. Moreover, identifying and reducing tau neutrino background in the atmospheric oscillation analysis would increase the mass hierarchy sensitivity of SK.

In 2018, SK excluded the hypothesis of no tau appearance with a significance level of 4.6σ. SK used machine learning techniques of neural networks (NNs) to classify the tau charged-current interactions from the interactions of the atmospheric muon and electron neutrinos. The present NN of SK is a multilayer perceptron, with a single hidden layer. My research involves upgrading the NN for better classification, such as with the implementation of the more sophisticated algorithms of convoluted NNs.

In particular, the signatures to classify these interactions are expected to be seen in neutrons, which are copiously produced in the particle showers arising from the tau and atmospheric neutrino interactions. So far, information related to neutrons has never been used at SK for discerning tau neutrinos. The prospect of expanding the NN with new inputs about neutron captures is under consideration, owing to the enhanced detection of neutrons with the addition of gadolinium in SK. Preliminary results show that this additional information shall improve the NN classification, and hence, the detection of tau neutrinos.

Primary author: MANDAL, Maitrayee

Presenter: MANDAL, Maitrayee

Session Classification: Student Talks

Contribution ID: **19** Type: **Oral**

Development of a multi-ring ν_e sample at the T2K far detector

Thursday 8 July 2021 13:45 (15 minutes)

The T2K experiment is a long-baseline accelerator neutrino experiment that measures ν_e appearance and ν_μ disappearance from the ν_μ beam by observing neutrino events at the near and far detectors. The near detector (ND280) stands 280 metres, and the far detector (Super Kamiokande) stands 295 km away from the beam production target. Super Kamiokande (SK) is a 50 kton water-Cherenkov detector that observes Cherenkov rings from charged particles produced in neutrino interactions with water.

In the present oscillation analyses, T2K uses only single-ring events at SK which are mostly CCQE. Charged-current single π^+ events form the second most dominant signal events in ν_e appearance studies. Thus, the addition of a two-ring CC1π^+ sample which consists of 1e-like ring and 1π^+-like ring can increase the statistics. These events will also help in studying δ_{CP} and the octant of θ_{23}. In my studies, I will explore the properties and selection of 2-ring CC1π^+ events and how they will impact the statistics of ν_e appearance in T2K analysis.

Primary author: S. PRABHU, Yashwanth (NCBJ Warsaw)

Presenter: S. PRABHU, Yashwanth (NCBJ Warsaw)

Session Classification: Student Talks

Contribution ID: **20** Type: **Oral**

Neutrino flavor conversions in the remnants of binary neutron star mergers

Neutrino-neutrino interactions dominate the flavor evolution in core-collapse supernovae and binary neutron star mergers. Remarkably, neutrino self-interactions lead to intriguing "fast"flavor conversions that can develop on the nanosecond timescale in the core of core-collapse supernovae and compact binary mergers. Due to the nature of neutrino self-interactions, non-linear solutions to the flavor are realizable in such astrophysical environments posing great challenges for modern large-scale simulations. Inevitably, since neutrinos are copiously produced in the merger of two neutron stars, fast neutrino conversions are predicted to be ubiquitous in these environments with potentially major implications on the nucleosynthesis of the elements heavier than iron. If the imprint of neutrino flavor conversions on the binary environment is significant, the related kilonova electromagnetic emission could be strongly affected.

We present the first multi-dimensional numerical modeling of the neutrino flavor evolution above the merger remnant disk. Although neutrino fast conversions are predicted to be ubiquitous in neutron star merger remnants, our findings suggest that the flavor unstable regions in the disk of the remnant do not lead to substantial neutrino mixing. This work opens the question on the role of neutrino self-interactions in the outflows of neutron star merger remnants and constitutes a major step forward in the numerical modeling of neutrino collective oscillations in dense media.

Primary author: PADILLA GAY, Ian (Niels Bohr Institute)

Co-authors: Prof. TAMBORRA, Irene (Niels Bohr Institute); Dr SHALGAR, Shashank (Niels Bohr Institute)

Presenter: PADILLA GAY, Ian (Niels Bohr Institute)

Session Classification: Student Talks

Contribution ID: **21** Type: **Oral**

Sterile neutrino dark matter: detection perspectives in ground based experiments

What if the dark matter content of the universe was made up of sterile neutrinos with a mass of the order of keV?
Currently, constraints from the measured relic abundance of dark matter and from observations in the X-ray band threaten the possibility of finding in terrestrial experiments a signal of such sterile neutrinos produced through oscillation and collisions in the early universe.
We look at two scenarios in which the simple hypothesis of

- a low reheating temperature
- a new contribution to the sterile neutrino decay process

naturally relax these constraints and give new vigor to the hope of getting in the near future a proof of the existence of these elusive Dark Matter candidates in experiments such as KATRIN and ECHo.

Primary authors: BENSO, Cristina (Max-Planck-Institut für Kernphysik in Heidelberg); Prof. LINDNER, Manfred (Max-Planck-Institut für Kernphysik); Dr BRDAR, Vedran (Fermilab and Northwestern U.); Dr RODEJOHANN, Werner (Max-Planck-Institut für Kernphysik)

Presenter: BENSO, Cristina (Max-Planck-Institut für Kernphysik in Heidelberg)

Session Classification: Student Talks

Contribution ID: **22** Type: **Oral**

Decaying dark matter

Tuesday 6 July 2021 13:45 (15 minutes)

In this presentation I will go through the goals of my PhD project, what I am working on at the moment, and how this relates to neutrinos. I will present some analytical results (recently published) relating standard sterile neutrinos through $\Delta N_{\rm eff}$ to very short-lived decaying cold dark matter, and I will describe how the decay of massive dark neutrinos can help to relieve the Hubble tension along with the numerical aspect of this problem. During my PhD, I will investigate different cases of direct and two-body decays with increasing numerical difficulty. I will present the ideas and possible outcomes of these different cases.

Primary author: NYGAARD, Andreas (Aarhus University)

Presenter: NYGAARD, Andreas (Aarhus University)

Session Classification: Student Talks

Contribution ID: **23** Type: **Oral**

Exploration of Directionality Capabilities with PROSPECT

Thursday 8 July 2021 13:30 (15 minutes)

The Precision Reactor Oscillation and Spectrum Experiment (PROSPECT) is an above-ground antineutrino experiment at short baselines located at the High Flux Isotope Reactor (HFIR) at Oak Ridge National Laboratory (ORNL). The PROSPECT detector comprises 4-tons of Li-6 doped liquid scintillator (6LiLS) divided into an 11x14 array of optically separated segments. This experiment's physics goals include searching for the existence of sterile neutrinos and precisely measuring the antineutrino energy spectrum. Antineutrinos are detected via the inverse beta decay (IBD) interaction which provides a near-unique space-time correlated signal pair consisting of a positron energy deposition and a delayed neutron capture in the liquid scintillator. The correlation between prompt and delayed pulses/signals is an excellent handle for background suppression. The highly segmented nature of the PROSPECT detector, as well as the double-ended readout structure in each segment, provides good position reconstruction for both prompt and delayed signals. In this talk, I will give an overview of the experiment, as well as current efforts to use the position resolution of the detector and the kinematics of the IBD reaction to study the neutrino directional reconstruction capabilities of PROSPECT.

Primary author: VENEGAS VARGAS, Diego (University of Tennessee Knoxville/ Oak Ridge National Laboratory)

Presenter: VENEGAS VARGAS, Diego (University of Tennessee Knoxville/ Oak Ridge National Laboratory)

Session Classification: Student Talks

Contribution ID: **24** Type: **Oral**

Exploring neutrino-nucleon cross sections at the EeV level in upcoming neutrino telescopes

Wednesday 7 July 2021 13:45 (15 minutes)

Measuring neutrino interactions with matter is arduous but rewarding. To date, experiments have measured the neutrino-nucleon cross section in the MeV-PeV range, using terrestrial and astrophysical neutrinos. We endeavor to push that measurement to the EeV scale, in order to test competing expectations of the deep structure of nucleons and possibly reveal new neutrino interactions. Cosmogenic neutrinos, long-sought but still undiscovered, provide the only feasible way forward. However, because their flux is low, they have evaded detection so far. Fortunately, upcoming in-ice radio-detection neutrino telescopes, like RNO-G and the radio component of IceCube-Gen2, have a real chance of discovering them in the next 10-20 years. In preparation, we perform the first detailed study of their sensitivity to the deep-inelastic-scattering neutrino-nucleon cross section at EeV energies, extracted from the attenuation of the cosmogenic neutrino flux as it traverses the Earth across different directions. We use up-to-date predictions and tools at every step: in the flux of cosmogenic neutrinos—predicted using recent ultra-high-energy cosmic-ray measurements—in their propagation inside the Earth—computed using leading and subleading neutrino interactions—and in their detection in radio-based neutrino telescopes—based on advanced simulated detector responses.

Primary authors: VALERA BACA, Victor (Niels Bohr Institute); BUSTAMANTE, Mauricio (Niels Bohr Institute, University of Copenhagen)

Presenter: VALERA BACA, Victor (Niels Bohr Institute)

Session Classification: Student Talks

Contribution ID: **25** Type: **Oral**

Two-Dimensional Air Shower Development with MCEq

Wednesday 7 July 2021 16:15 (15 minutes)

An accurate atmospheric neutrino flux is crucial for a multitude of physics studies with modern neutrino telescopes; as a signal for neutrino oscillation measurements, and as a background for searches of astrophysical neutrino sources. We seek to advance in the low-energy neutrino flux calculations (up to a few GeV) using the MCEq (Matrix Cascade Equations) code that numerically solves the one-dimensional cascade equations. For precision calculations at energies below a few GeV, which are well within reach of the IceCube Upgrade and KM3NeT-ORCA, the lateral component of hadronic cascades becomes important, requiring three-dimensional calculation schemes. We present a new study on the two-dimensional development of air showers within the MCEq framework as a necessary initial step towards a full 3D calculation, comparing our numerical solutions to those obtained with the Monte Carlo cascade codes.

Primary author: KOZYNETS, Tetiana (Niels Bohr Institute)

Co-author: Dr FEDYNITCH, Anatoli (ICRR)

Presenter: KOZYNETS, Tetiana (Niels Bohr Institute)

Session Classification: Student Talks

Contribution ID: **26** Type: **Oral**

Neutrino Mixing by modifying the Yukawa coupling structure of constrained sequential dominance

Tuesday 6 July 2021 16:15 (15 minutes)

In the constrained sequential dominance (CSD), tri-bimaximal mixing (TBM) pattern in the neutrino sector has been explained, by proposing a certain Yukawa coupling structure for the right-handed neutrinos of the model. However, from the current experimental data it is known that the values of neutrino mixing angles are deviated from the TBM values. In order to explain this neutrino mixing, we first propose a phenomenological model where we consider Yukawa couplings which are modified from that of CSD. Essentially, we add small complex parameters to the Yukawa couplings of CSD. Using these modified Yukawa couplings, we demonstrate that neutrino mixing angles can deviate from their TBM values. We also construct a model, based on a flavor symmetry, in order to justify the modified form of Yukawa couplings of our work.

Primary authors: GANGULY, Joy (Indian Institute of Technology Hyderabad); Mr HUNDI, Srkanth (Indian Institute of Technology Hyderabad)

Presenter: GANGULY, Joy (Indian Institute of Technology Hyderabad)

Session Classification: Student Talks

Contribution ID: **27** Type: **Oral**

Neutrino Energy from Thermal Processes in Very Massive Stars

For massive and very massive stars, neutrinos become the main contributor of energy loss through thermal processes that occurred at the center of the star. There are five thermal neutrino processes being produced during the evolution of very massive star (VMS); plasma neutrino, photoneutrino, pair neutrino, Bremsstrahlung and recombination process. We use the realistic conditions of temperature, density, electron number density and element abundances of the VMS. The energy loss of neutrinos from the very massive star of 150M_solar and 300 M_solar with Z = 0.002 is presented and the dominant processes that are involved will be discussed.

Primary author: AHMAD, Nor Sofiah

Presenter: AHMAD, Nor Sofiah

Session Classification: Student Talks

Contribution ID: **28** Type: **Oral**

Welcome

Monday 5 July 2021 09:45 (15 minutes)

Contribution ID: **29** Type: **Oral**

Farewell

Friday 9 July 2021 12:45 (15 minutes)

Contribution ID: **30** Type: **Oral**

Neutrino Theory & Phenomenology: Lecture I

Monday 5 July 2021 10:00 (1 hour)

Presenter: KOPP, Joachim (CERN and JGU Mainz)

Session Classification: Neutrino Theory & Phenomenology

Contribution ID: **31** Type: **Oral**

Neutrino Astrophysics & Astronomy: Lecture I

Presenter: OIKONOMOU, Foteini (Norwegian University of Science and Technology)

Session Classification: Neutrino Cosmology

Contribution ID: **32** Type: **Oral**

Neutrino Astrophysics & Astronomy: Lecture II

Tuesday 6 July 2021 10:00 (1 hour)

Presenter: OIKONOMOU, Foteini (Norwegian University of Science and Technology)

Session Classification: Neutrino Astrophysics & Astronomy

Contribution ID: **33** Type: **Oral**

Neutrino Cosmology: Lecture I

Tuesday 6 July 2021 11:15 (1 hour)

Presenter: MENA, Olga (IFIC (CSIC-UV))

Session Classification: Neutrino Cosmology

Contribution ID: **34** Type: **Oral**

Neutrino Theory & Phenomenology: Lecture II

Wednesday 7 July 2021 10:00 (1 hour)

Presenter: KOPP, Joachim (CERN and JGU Mainz)

Session Classification: Neutrino Theory & Phenomenology

Contribution ID: **35** Type: **Oral**

Neutrino Cosmology: Lecture II

Presenter: MENA, Olga (IFIC (CSIC-UV))

Session Classification: Neutrino Astrophysics & Astronomy

Contribution ID: **36** Type: **Oral**

Neutrino Theory & Phenomenology: Lecture III

Thursday 8 July 2021 10:00 (1 hour)

Presenter: KOPP, Joachim (CERN and JGU Mainz)

Session Classification: Neutrino Theory & Phenomenology

Contribution ID: **37** Type: **Oral**

Neutrino Astrophysics & Astronomy: Lecture III

Presenter: OIKONOMOU, Foteini (Norwegian University of Science and Technology)

Session Classification: Neutrino Cosmology

Contribution ID: **38** Type: **Oral**

Neutrino Cosmology: Lecture III

Presenter: MENA, Olga (IFIC (CSIC-UV))

Session Classification: Neutrino Astrophysics & Astronomy

Contribution ID: **39** Type: **Oral**

Effective field theory

Wednesday 7 July 2021 15:30 (30 minutes)

Presenter: CORBETT, Tyler (NBI)

Session Classification: Topical Seminar

Contribution ID: **40** Type: **Oral**

Neutrino oscillations in ice

Monday 5 July 2021 14:15 (30 minutes)

Presenter: KOSKINEN, D. Jason (niels bohr institute)

Session Classification: Topical Seminar

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

Neutrinos as a key to a unified theory of particle physics and cosmology

Thursday 8 July 2021 11:30 (30 minutes)

Presenter: Dr RUCHAYSKIY, Oleg (Niels Bohr Institute)

Session Classification: Topical Seminar

Contribution ID: **42** Type: **Oral**

Insights into coherent forward scattering of neutrinos

Friday 9 July 2021 11:15 (30 minutes)

Presenter: SHALGAR, Shashank (NBIA)

Session Classification: Topical Seminar

Contribution ID: **43** Type: **Oral**

Neutrinos in the early Universe

Friday 9 July 2021 11:45 (30 minutes)

Presenter: HANSEN, Rasmus S.L. (Niels Bohr Institute)

Session Classification: Topical Seminar

Contribution ID: **44** Type: **Oral**

Neutrino oscillations and new physics with IceCube

Tuesday 6 July 2021 14:00 (30 minutes)

Presenter: STUTTARD, Tom (Niels Bohr Institute, IceCube)

Session Classification: Topical Seminar

Contribution ID: **45** Type: **Oral**

Neutrino Cosmology: Lecture II

Tuesday 6 July 2021 14:30 (1 hour)

Presenter: MENA, Olga (IFIC (CSIC-UV))

Session Classification: Neutrino Cosmology

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

Neutrino Astrophysics & Astronomy: Lecture III

Friday 9 July 2021 10:00 (1 hour)

Presenter: OIKONOMOU, Foteini (Norwegian University of Science and Technology)

Session Classification: Neutrino Astrophysics & Astronomy

Contribution ID: **47** Type: **Oral**

Neutrino Astrophysics & Astronomy: Lecture I

Monday 5 July 2021 11:15 (1 hour)

Presenter: OIKONOMOU, Foteini (Norwegian University of Science and Technology)

Session Classification: Neutrino Astrophysics & Astronomy

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

Neutrino Cosmology: Lecture III

Wednesday 7 July 2021 11:15 (1 hour)

Presenter: MENA, Olga (IFIC (CSIC-UV))

Session Classification: Neutrino Cosmology