IBS and KMI Joint Workshop 2022

Report of Contributions

https://indico.ibs.re.kr/e/504

Contribution ID: **0** Type: **not specified**

NEON Status

Presenter: Dr LEE, hyunsu (IBS)

Contribution ID: **1** Type: **not specified**

Low temperature crystal detector development at CUP

Presenter: Dr KIM, Seung Cheon (IBS CUP)

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

Dark Photon Search at Yemilab

Presenter: Dr SEO, Sunny (IBS)

Contribution ID: **3** Type: **not specified**

Cosmogenic energetic dark matter: new dark world beyond WIMP

Presenter: Dr SHIN, Seodong (Jeonbuk Natl. University/IBS CTPU)

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

Beam-induced energetic dark matter: new dark-matter search strategy

Presenter: Dr PARK, Jong-Chul (Chungnam National University)

Contribution ID: **5** Type: **not specified**

CAPP-8TB: Axion Dark Matter Search around 6.7 μeV

Presenter: Dr LEE, Soohyung (IBS/CAPP)

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

Development of Josephson Parametric Amplifiers for CAPP's Axion Dark Matter Search Experiments

Presenter: Dr UCHAIKIN, Sergey (Institute for Basic Science)

Contribution ID: **7** Type: **not specified**

Revisiting the detection rate for axion haloscopes

Presenter: Mr KIM, Dongok (IBS CAPP/KAIST)

Contribution ID: **8** Type: **not specified**

Portraying Double Higgs Events to Probe Higgs Couplings

Wednesday, 3 August 2022 13:00 (40 minutes)

The Higgs potential is vital to understand the electroweak symmetry breaking mechanism, and probing the Higgs self-interaction is arguably one of the most important physics targets at current and upcoming collider experiments. In particular, the triple Higgs coupling may be accessible at the HL-LHC by combining results in multiple channels, which motivates to study all possible decay modes for the double Higgs production. In this talk, we revisit the double Higgs production at the HL-LHC, and focus on the performance of various neural network architectures with different input features: low-level (four momenta), high-level (kinematic variables) and image-based.

Summary

Presenter: KIM, Jeong Han (CBNU)

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

A new physics interpretation of the W-boson mass anomaly with B anomaly

Wednesday, 3 August 2022 13:40 (40 minutes)

Summary

Presenter: KITAHARA, Teppei (Nagoya U. KMI)

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

NaI detector for dark matter and neutrino searches

Wednesday, 3 August 2022 14:40 (30 minutes)

A thallium doped sodium iodide (NaI(Tl)) crystal is a conventional detector with a very long history and is still widely used for a particle detector. In particular, since the DAMA/LIBRA experiment claimed an observation of dark matter with the NaI(Tl) detector, low background and high light yield detectors have been developed. In Korea, the COSINE-100 experiment to verify the DAMA/LIBRA signal is being operated at the Yangyang Underground Laboratory using high-purity NaI detectors, which is developed at CUP/IBS. In addition, COSINE collaboration is preparing for a next phase COSINE-200 experiment by developing the world's best performing high-purity NaI detector. Based on successful development of high light yield and low-background NaI(Tl) detectors, the NEON experiment to observe the neutrino-nucleus coherent scattering from the electron antineutrinos in a nuclear power plant was launched. In this presentation, I will discuss various efforts and achievements on the development of high-purity NaI detectors for dark matter and neutrino experiments in Korea.

Summary

Presenter: LEE, Hyun Su (IBS CUP)

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

AMoRE Experiment

Wednesday, 3 August 2022 15:10 (30 minutes)

Finding neutrinoless double beta decays would establish the Majorana nature of neutrinos. The AMoRE experiment aims at searching for neutrinoless double beta decay of 100Mo using a simultaneous heat and scintillation detection technique with crystals operating at mK temperatures. We planned the AMoRE experiment in a three-stage program, AMoRE-pilot, AMoRE-I, and AMoRE-II. Currently, the AMoRE-I runs using 6.2 kg of molybdate crystal detectors at the Yangyang underground laboratory. We are preparing for the AMoRE-II phase, which will be conducted at Yemilab, Jeongseon, South Korea. In this presentation, the overall status of the AMoRE experiment is covered.

Summary

Presenter: JEON, Eunju (IBS CUP)

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

Probing new physics behind flavor anomalies at the LHC

Wednesday, 3 August 2022 16:10 (30 minutes)

Summary

Presenter: IGURO, Syuhei (Karlsruhe U)

Contribution ID: **13** Type: **not specified**

Glueball Dark Matter

Wednesday, 3 August 2022 15:40 (30 minutes)

Presenter: YAMANAKA, Nodoka (KMI Nagoya U.)

Contribution ID: **14** Type: **not specified**

XENONnT Experiment

Thursday, 4 August 2022 13:00 (40 minutes)

Presenter: KOBAYASHI , Masatoshi (ISEE Nagoya U.)

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

Dynamics of a sub-component dark matter

Thursday, 4 August 2022 13:40 (40 minutes)

We revisit the role of a sub-component dark matter in well motivated multi-component dark matter scenarios beyond WIMP. When the sub-component is a messenger between the dark sector and the SM sector, especially in boosted dark matter scenarios, it can provide distinctive signatures in various dark matter and neutrino experiments. In addition, we show the dynamics of a sub-component dark matter during the cosmological evolution, which is often ignored, and show that it can provide unprecedented signals in various astrophysical and cosmological observations.

Summary

Presenter: SHIN, Seodong (Jeonbuk Natl. U.)

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

LHC lifetime frontier and visible decay searches in composite asymmetric dark matter models

Thursday, 4 August 2022 15:40 (30 minutes)

Presenter: KUWAHARA, Takumi (CHEP)

Contribution ID: **17** Type: **not specified**

Renormalization group effects in non-universal DFSZ axion models

Thursday, 4 August 2022 16:10 (30 minutes)

Summary

Presenter: OKAWA, Shohei (Barcelona U.)

Contribution ID: **18** Type: **not specified**

Axion Searches at IBS-CAPP

Thursday, 4 August 2022 14:40 (30 minutes)

The axion is a hypothetical particle arising from the Peccei-Quinn mechanism which was proposed to solve the strong CP problem. It is also one of the most popular candidates for dark matter since it barely interacts with ordinary matter and is thought abundant in the universe. Therefore, the discovery of the axion can be referred to as a hunt for two birds (the strong CP and dark matter problems) with one stone (the axion).

The Center for Axion and Precision Physics Research (CAPP) of the Institute for Basic Science (IBS) is searching for the axion mainly using the cavity haloscope technique in the microwave region. We have built a flagship experiment for the Dine-Fischler-Srednicki-Zhitnitsky (DFSZ) axions and three experiments for the Kim-Shifman-Vainshtein-Zakharov (KSVZ) axions. In this talk, these experiments at IBS-CAPP are described and their recent results are presented. Experimental strategies for improving search performance are also discussed.

Summary

Presenter: LEE, Soohyung (IBS CAPP)

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

Probing non-standard neutrino interactions with a light boson from next galactic and diffuse supernova neutrinos

Thursday, 4 August 2022 15:10 (30 minutes)

Non-standard neutrino interactions with a massive boson can produce the bosons in the core of core-collapse supernovae (SNe). After the emission of the bosons from the SN core, their subsequent decays into neutrinos can modify the SN neutrino flux. We show future observations of neutrinos from a next galactic SN in Super-Kamiokande (SK) and Hyper-Kamiokande (HK) can probe flavor-universal non-standard neutrino couplings to a light boson, improving the previous limit from the SN 1987A neutrino burst by several orders of magnitude. We also discuss sensitivity of the flavor-universal non-standard neutrino interactions in future observations of diffuse neutrinos from all the past SNe, known as the diffuse supernova neutrino background (DSNB). According to our analysis, observations of the DSNB in HK, JUNO and DUNE experiments can probe such couplings by a factor of ~2 beyond the SN 1987A constraint. However, our result is also subject to a large uncertainty concerning the precise estimation of the DSNB.

Summary

Presenter: AKITA, Kensuke (IBS CTPU)

Contribution ID: **20** Type: **not specified**

Revealing the local cosmic web from galaxies by Deep Learning

Friday, 5 August 2022 13:00 (40 minutes)

The 80% of the matter in the Universe is in the form of dark matter that comprises the skeleton of the large-scale structure called the Cosmic Web. As the Cosmic Web dictates the motion of all matter in galaxies and inter-galactic media through gravity, knowing the distribution of dark matter is essential for studying the large-scale structure. However, the Cosmic Web's detailed structure is unknown because it is dominated by dark matter and warm-hot inter-galactic media, both of which are hard to trace. Here we show that we can reconstruct the Cosmic Web from the galaxy distribution using the convolutional-neural-network-based deep-learning algorithm. We find the mapping between the position and velocity of galaxies and the Cosmic Web using the results of the state-of-the-art cosmological galaxy simulations, Illustris-TNG. We confirm the mapping by applying it to the EAGLE simulation. Finally, using the local galaxy sample from Cosmicflows-3, we find the dark-matter map in the local Universe. We anticipate that the local dark-matter map will illuminate the studies of the nature of dark matter and the formation and evolution of the Local Group. High-resolution simulations and precise distance measurements to local galaxies will improve the accuracy of the dark-matter map.

Summary

Presenter: JEONG, Donghui (Pennsylvania State University)

Contribution ID: **21** Type: **not specified**

Machine learning application in cosmology

Friday, 5 August 2022 13:40 (40 minutes)

General Relativity predicts that photons emitted from distant sources can be deflected by intervening gravitational potential between the sources and us. This effect is known as gravitational lensing effect, causing a coherent distortion in the shapes of observed galaxies with a large separation. The lensing effects also provide a powerful means of mapping cosmic mass density distributions and studying invisible dark matter over large length scales. Modern galaxy imaging surveys aim at measuring the lensing effects on shapes of millions of galaxies and reconstructing a map of underlying matter density field from statistical analyses of galaxy's shapes. Because the intrinsic shape of each galaxy is unknown, it can be a noise in the reconstruction of cosmic mass density with lensing measurements in practice.

To remove such noises, we have examined a deep-learning approach of Generative Adversarial Networks (GANs) so far. We trained the GANs with a set of numerical simulations of gravitational lensing effects, and performed stress tests to validate the performance of de-noising by our GANs. We also applied our GANs to real observational data taken from a galaxy imaging survey by Subaru Hyper Suprime Cam. In this talk, I will report our results when applying our GANs to the Subaru data, and briefly touch on future prospects of deep-learning-based noise reduction.

Summary

Presenter: SHIRASAKI, Masato (The Institute of Statistical Mathematics)

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

Constraints on WDM using machine learning

Friday, 5 August 2022 14:40 (30 minutes)

In this talk, we use machine learning to analyze 21cm intensity map images of the universe after reionization to explore the dark matter mass. Since dark matter mass affects the matter distribution in the universe at small scale, we can obtain information on dark matter mass by analyzing the distribution of neutral hydrogen in the 21cm intensity map.

In this study, we use hydrodynamic simulations to generate mock data for future observations with the Square Kilometer Array (SKA). We will compare the analysis of this data by machine learning with the one by two-point statistics and show that machine learning is a superior method for analyzing the matter distribution for dark matter mass survey.

The hydrodynamic simulation code used in this study can simulate physical processes such as star formation, supernova feedback, the ultraviolet background, self-shielding effect, and metal-line cooling. Since these physical processes affect the distribution of neutral hydrogen, we will explore these effects and discuss their impact on the dark matter search by machine learning.

Summary

Presenter: MURAKAMI, Koya (Nagoya U.)

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

Capture of Electroweak Multiplet Dark Matter in Neutron Stars

Friday, 5 August 2022 15:10 (30 minutes)

If Dark Matter (DM) has a sizable scattering cross section with nucleons, it can efficiently be captured by a neutron star. Its energy is then transferred to the neutron star as heat through the scattering and annihilation inside the star. This heating effect may be detectable via dedicated temperature observations of nearby old pulsars, providing an alternative method for DM searches. We show that, for electroweak multiplet DM, this search strategy can probe the parameter region that is out of reach of future DM direct detection experiments. To see this systematically, we classify such DM candidates in terms of their electroweak charges and investigate the effect of ultraviolet physics using higher-dimensional effective operators. We then show that if the effect of ultraviolet physics is sizable, the DM-nucleon elastic scattering cross section becomes sufficiently large, whilst if it is suppressed, then the mass splittings among the components of the DM multiplet get small enough so that the inelastic scattering processes are operative. In any case, the electroweak multiplet DM particles are efficiently captured in neutron stars, making the search strategy with the temperature observation of old neutron stars promising.

Summary

Presenter: FUJIWARA, Motoko (U. of Tokyo)

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

Evolution of resonant self-interacting dark matter halos

Friday, 5 August 2022 15:40 (30 minutes)

The persistent discrepancies between observationally-inferred structures and the predictions of collisionless CDM-only simulations at small scales continue to challenge our understanding of galaxy formation. In the past twenty years, new observations and simulation studies have been suggesting that the small-scale issues may be ameliorated by taking into account the physical effects of the new physics of dark matter and baryonic physics, or systematical issues/bias in observations. The former aspect demonstrates that the impact of various dark matter/baryonic physics on galaxy evolution can appear to be degenerate. Therefore, to discriminate the physical effects from observations, it is important to sharpen the predictions and find the distinctive observables for each scenario. In this talk, we discuss the structural evolution of resonant self-interacting dark matter (rSIDM) halos, where the self-interaction among dark matter particles is enhanced at a specific scattering velocity by a resonant intermediate state. We focus on the rSIDM parameters motivated by the observations of ultra-faint dwarfs of the Milky Way and dwarf/LSB galaxies in the field. By employing the gravothermal fluid method, we show that rSIDM halos exhibit distinctive halo structures at present at a specific halo mass range. Such a feature can serve as a smoking-gun signature of rSIDM. Outside the mass range, although the present-day halo structures may be indistinguishable from other SIDM scenarios, we highlight the possible distinctive impact of the structural evolution of rSIDM halos on the orbits of stars in a specific age range.

Summary

Presenter: KIM, Hee Jung (IBS CTPU)

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

Axion Dark Matter from Frictional Misalignment

Friday, 5 August 2022 16:10 (30 minutes)

We study the impact of sphaleron-induced thermal friction on the axion dark-matter abundance due to the interaction of an axion-like particle (ALP) with a dark non-abelian gauge sector in a secluded thermal bath. Thermal friction can either enhance the axion relic density by delaying the onset of oscillations or suppress it by damping them. We derive an analytical formula for the frictional adiabatic invariant, which remains constant along the axion evolution and which allows us to compute the axion relic density in a general set-up. Even in the most minimal scenario, in which a single gauge group is responsible for both the generation of the ALP mass and the friction force, we find that the resulting dark-matter abundance from the misalignment mechanism deviates from the standard scenario for axion masses ma⊠100 eV. We also generalize our analysis to the case where the gauge field that induces friction and the gauge sector responsible for the ALP mass are distinct and their couplings to the axion have a large hierarchy as can be justified by means of alignment or clockwork scenarios. We find that it is easy to open up the ALP parameter space where the resulting axion abundance matches the observed dark-matter relic density both in the traditionally over- and underabundant regimes. This conclusion also holds for the QCD axion.

Summary

Presenter: PAPAGEORGIOU, Alexandros (IBS CTPU)