Grad School Physics Seminar 2022/23

Report of Contributions

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

Welcoming talk of the Graduate School director

Thursday, 6 October 2022 09:15 (20)

Presenter(s) : Prof. SPALLIŃSKI, Michał (NCBJ)

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

Constraints on U(1)‘ solutions to the flavor anomalies with trans-Planckian asymptotic safety

Thursday, 13 October 2022 09:15 (60)

The Standard Model is a very successful theory. However, few of the observed phenomenon is at odds with the current fundamental theory. One such discrepancy is observed in the rare decays of B-meson decays which are referred as flavor anomalies. In this talk, I will discuss flavor-anomaly solutions with U(1)‘ extensions in the framework of asymptotically safe quantum gravity. The universal contribution of quantum gravity to renormalization group equations (RGEs) of all the gauge and the Yukawa couplings, beyond the Planck scale, ensues interdependent boundary conditions between the Standard Model and the New Physics (NP) couplings during the flow of RGEs from an interactive UV fixed point. As a result, precise measurements of low-energy SM couplings fix the exact values of the NP couplings, and accordingly, the NP mass range can be significantly narrowed down. We confront the models parameter space with the various LHC searches for VL fermions and the new gauge boson Z’. We find a viable parameter space with a potential to probe entirely in LHC Run 3.

Presenter(s) : CHIKKABALLI, Abhishek

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

Trouble in the early Universe: why is it so dusty out there?

Thursday, 20 October 2022 09:15 (60)

An increase in the observation facilities in the last two decades, from the UV to far-infrared and sub-millimeter, has motivated a multi-wavelength approach to studying the Universe. With higher resolution and in-depth surveys of the sky, we are now able to study distant galaxies and estimate their physical parameters, e.g. star formation Rate (SFR), stellar mass and dust mass by "looking back in time". In this work, we build a catalog of Dusty Star-Forming Galaxies (DSFGs) located at a redshift of $1.9 < z < 6.9$, when the Universe was between 0.8 and 3.5 Giga years old, by cross-matching the existing data from the UV to the far-infrared, and we derive their physical parameters. The information derived allows us to probe the baryon evolution of these galaxies by using chemical evolution models. In particular, we test the hypothesis of different Initial Mass Functions (IMFs) of stars, which affect the chemical enrichment of the interstellar medium of galaxies as well as the derivation of the physical parameters of galaxies.

Presenter(s) : Mr SAWANT, Prasad (National Centre for Nuclear Research, Poland)

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

Vector-Like fermions and Z' as candidates for New Physics

Thursday, 3 November 2022 09:15 (60)

The pursuit for physics beyond the Standard Model (BSM) follows a twofold path. On the experimental side, a great effort was put in developing research strategies that go beyond the original LHC paradigm based on the missing transverse energy. On the theoretical side, various BSM models can be proposed to address phenomena observed in nature. Among many extensions of the Standard Model, scenarios with vector-like (VL) fermions and Z' have long been enjoying a lot of interest. In this presentation I will talk about two different models with VL-fermions and Z'. In the first model I use the framework of Trans-Planckian Asymptotic-Safety to reduce the number of free parameters of a minimal model with VL-fermions and Z'. In the second model I scan the parameter space of a slightly modified version of the type-II next-to-2HDM. One of the main features of this second model is that masses for SM particles are generated via the so-called Seesaw mechanism.

Presenter(s) : RIZZO, Daniele (National Center for Nuclear Research (NCBJ), Warsaw, Poland)

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

Nuclear chirality & lifetime experiment

Thursday, 27 October 2022 09:15 (60)

Chirality in nuclear excited states involves spontaneous symmetry breaking of time-reversal T operation. This phenomenon is quite new as the first experimental proof of existence of chirality was given in 2006 by Warsaw team and only in 7 isotopes with chiral states have been found so far. The tool to detect and trace chirality is experimental nuclear gamma spectroscopy. On the seminar I will introduce chirality phenomenon, show experimental ways to detect it, and tell about the experiment held in the Warsaw Heavy Ion Laboratory in July 2022 titled “Search for chiral to not chiral transition by lifetime measurement of I=10+ state in 128Cs with a PLUNGER technique.

Presenter(s) : NAŁĘCZ-JAWECKI, Adam (NCBJ)

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

Lighting up the black box - explainable ML in Astrophysics

Thursday, 10 November 2022 09:15 (60)

The development of new all-sky and large-area astronomical surveys gives a chance for new insights in astrophysics. However, these recent generation surveys are flooding astronomers with data, giving an exponential growth - with respect to previous surveys - of data collected per night (for instance, 90 TB/night for the Thirty Meter Telescope). For some tasks, i.e. object detection, classical methods or human detection need to be faster to cover the totality of the data collected. At the same time, Machine learning (ML) keeps showing the scientific community its ability to solve astrophysical problems.
In this talk, I will show some ML applications on astrophysical data in different domains: time and frequency domain gravitational waves (GW) data, strong lenses detection (images), and astronomical text interpretation. The emphasis will be put on analysis related to Strong gravitational lensing and on the importance of having explainable Artificial Intelligence. Strong gravitational lensing is useful to constrain cosmological parameters, even though it is a rare phenomenon in astrophysics. For this reason, strong lens seekers are training their ML models on simulations. We will show how simulation-trained models behave with survey data, interpret the results and discuss techniques that might help us research new candidates. Finally, I will discuss possible applications of Interactive ML for object detection.

Presenter(s) : GRESPAN, Margherita (NCBJ)

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

Hyperon non-leptonic decays in χPT, revisited

Thursday, 17 November 2022 09:15 (60)

Though weak non-leptonic decays of hyperons - strange baryons - have been investigated before, an update is urgently needed in view of recent significant measurements from the BESIII collaboration. Only with such an update, future high-precision data of weak non-leptonic decays can be properly interpreted. Such hadronic decays are characterized by two distinct contributions to the decay amplitude, called S- and P-wave.
Within the framework of chiral perturbation theory (χPT), such L-wave amplitudes can be computed: we do so up to one-loop corrections, noting also that in recent years their relative size to the tree-level contributions was differently interpreted. The general consensus is that weak non-leptonic hyperon decays are characterized by two contributions with polar behavior under approximate SU(3) symmetry.
This project aims at reviewing such calculations in the light of the recent updates on the measurement of the decay parameter αΛ, directly connected to the above-mentioned spherical-wave amplitudes. A recalculation of such lowest order contributions and their corrections is hence needed, since it might lead to a new level of agreement with experiment. As an additional bonus, our aspiration is to reduce the numerous different approaches to the best fitting description of such decays.

Presenter(s) : SALONE, Nora

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

Discussion about the goals and organization of the PhD seminar

Thursday, 6 October 2022 09:35 (20)

Presenter(s) : WAGNER, Jakub (National Centre for Nuclear Research)

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

Exclusive processes, factorization and parton distributions

Thursday, 24 November 2022 09:15 (60)

For a long time, it was believed that the fundamental constituents of atoms were electrons and nucleons until experiments conducted in the 1960s at Standford Linear Accelerator Center (SLAC) proved the existence of internal degrees of freedom in the nucleons. These ones are called quarks and gluons, or collectively partons. With QCD as the fundamental theory for strong interactions, we can describe hadronic structure via correlators of partons giving rise to the so-called parton distribution functions (PDFs) and generalized parton distributions (GPDs). The non-elementary nature of hadrons makes these correlators perturbatively unsolvable so we can only measure or model them. On top of this, PDFs and GPDs appear when studying two different types of QCD processes: inclusive and exclusive. Among all known processes of these two types, there is an exclusive scattering named double deeply virtual Compton scattering (DDVCS) that allows to measure GPDs in their whole domain.

In this seminar, I review the differences between inclusive and exclusive processes with special attention to DDVCS for which my group and I have obtained a new analytical formulae useful to study its feasibility in JLab and EIC experiments.

Presenter(s) : MARTINEZ-FERNANDEZ, Victor

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

A family tree of galaxies

Thursday, 1 December 2022 09:15 (60)

In my talk, I will present work on identifying mergers of galaxies using astronomical data in optical bands. The current models of galaxy formation and evolution, in the context of the Lambda-CDM cosmological model, are based on dark matter haloes that host a galaxy. Merging galaxies are one crucial aspect of the galactic life-time whose effect is still not fully understood. Identifying them is therefore the research first step. Two projects will be presented: first the use of image recognition methods with a Convolutional Neural Network (CNN) together with morphological parameters on the North Ecliptic Pole (Pearson, Suelves et al. 2022). This provided the community with a catalogue of mergers in one region of the sky with a wealth of data across the electromagnetic spectrum. The second is the application of a Neural Network (NN) applied on photometric information (Suelves, Pearson \& Pollo 2022). This NN provided us with a previously unknown tracer of merging processes, the error in the sky background calculation. With it, we aim to make merger finding techniques more efficient and less prone to mistakes due to the complexity of the night sky.

Presenter(s) : SUELVES, Luis Eduardo (NCBJ)

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

In search of precision in QCD at high energy physics: beyond eikonal order

Thursday, 8 December 2022 09:15 (60)

Studying high-energy hadronic scattering processes to understand the interior of atoms has been the focus of experimental and theoretical studies for more than three decades now. During this period, the Color Glass Condensate(CGC) effective field theory has been utilised to analyse specifically high-energy proton-nucleus (pA) collisions. One of the main approximations used in the CGC is the so-called eikonal approximation, which amounts to neglecting power-suppressed corrections in high-energy limits. For high-energy colliders like LHC, this is a good enough approximation. But the corrections beyond eikonal approximation can be sizable at intermediate energies, in particular at relativistic heavy ion collider (RHIC) and upcoming electron ion collider (EIC). In this talk, I will briefly review the eikonal approximation and present the computation of a gluon propagator through the target at next-to-eikonal accuracy.

Presenter(s) : MULANI, Swaleha (National Centre for Nuclear Research(NCBJ), Warsaw, Poland)

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

Studying CPT with Neutral Mesons - Standard Model Extension Approach (SME)

Thursday, 15 December 2022 09:15 (60)

The Standard Model of particle physics (SM) is the embodiment of our current understanding of the sub-atomic Universe and describes all fundamental forces except gravity. Despite its success, the SM has a few shortcomings. Apart from not including the description of gravity, it fails to explain the scale of the observed matter-antimatter imbalance and does not give the rationale behind the apparent non-zero neutrino masses. These problems are at the core of particle physics research today, as even a minor deviation from the SM (such as CPT violation) would be a breakthrough suggesting the existence of a more fundamental theory beyond the SM (BSM). The BSM effects are expected to be very small, for example at the Planck scale.

Fortunately, physics at the scale approaching the Planc scale can be tested with existing technology through the search for spacetime-symmetry violation. The realisation of this fact brought about the development of a comprehensive framework, known as the Standard Model Extension (SME). It was set up for studying deviations from exact Lorentz and CPT symmetries. This framework can be successfully applied to studies of CPT violation (CPTV) in neutral meson oscillations. Where the order of magnitude of results of CPTV measurements with neutral kaons approaches an interesting region of m^2_{K}/M_Planck=2*10^{-20} GeV. In my talk, I will try to outline the basic notions regarding the theoretical description of neutral meson oscillations, as well as, the key concepts behind the analysis regarding the search for CPT breaking in the charm sector.

Presenter(s) : KMIEĆ, Mateusz (NCBJ)

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

Gravitational wave lensing in General Relativity and beyond

Thursday, 12 January 2023 09:15 (60)

Gravitational lensing has been considered as a rare phenomenon, however recent advancements in technology lead to the discovery of many lensed events. Now it has become an unavoidable tool in astronomy. Like electromagnetic waves, gravitational waves could also be lensed leading to the formation of magnified multiple signals and many more. The increasing sensitivity of current detectors and planned next-generation detectors makes the future of gravitational wave astronomy looks promising. In this talk, I will present some of the interesting predictions of lensed gravitational waves and how such lensed events can be used to test modified theories of gravity.

Presenter(s) : HARIKUMAR, Sreekanth (National Centre for Nuclear Research(NCBJ))

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

Estimating detector systematics at T2K's far detector: A neutrino oscillation adventure

Thursday, 19 January 2023 09:15 (60)

T2K is a long-baseline neutrino experiment that measures neutrino oscillations. Oscillation of the muon (anti)neutrino beam to electron (anti)neutrinos is sensitive to the leptonic CP violating phase. In this talk, I will discuss the addition of a new electron neutrino signal sample at T2K's far detector, which can improve T2K's sensitivity to the CP-violating phase. I will also talk about how the systematic errors at T2K's far detector are estimated using Markov Chain Monte Carlo techniques, along with some outlook to future studies.

Presenter(s) : S. PRABHU, Yashwanth (NCBJ Warsaw)

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

Quark-gluon plasma in magnetic fields

Thursday, 26 January 2023 09:15 (60)

The impact of the electromagnetic field in the presence of strong interactions is usually not considered, as it plays a negligible role. However, the electromagnetic field becomes visible when its size is characteristic for strong interactions ($eB \sim m_\pi^2$). It is not accessible experimentally to create such strong magnetic field. Nevertheless, it is expected that a field of a very large amplitude can briefly arise in relativistic heavy ion collisions, and be sustained by induced electric currents in the quark-gluon plasma created during the collision of ions. The project aims to analyze the electromagnetic field generated in relativistic heavy ion collisions and understand why its influence on various observables is not observed experimentally. The research project will include a discussion of aspects that have not been analyzed so far, such as formulating the problem of generating an electromagnetic field as an initial value problem, and analyzing the behavior of the quark-gluon plasma in said field. The main goal is to take into account non-equilibrium effects by properly setting the initial conditions.

Presenter(s) : SŁOŃ, Patrycja

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

Extragalactic Universe: Star formation activity of galaxies

Thursday, 2 March 2023 09:15 (60)

Star formation is one of the main mechanisms of energy production in the universe and one of the essential processes linked to galaxies' evolution. Over the past two decades, we have witnessed an explosion of data from local and distant galaxies across the entire electromagnetic spectrum. These observations gave us an unprecedented picture of those objects (e.g. gas content, physical conditions in the interstellar medium, and dynamical state of galaxies) and their evolution over cosmic time. But the main problem of proper and homogeneous estimation of the star formation rate (SFR) is still open.
The common denominator in all these studies is the use of diverse techniques for quantifying the recent star-forming activity in different environments. This talk aims to introduce the methods used to measure the intensity of star-forming activity in galaxies (their star-formation rates), focusing on spectral energy distribution (SED) fitting methods and star formation rate evaluation from the galaxy X-ray emission. In this context, I will discuss my PhD project, dividing it into three parts: 1) Is it possible to estimate proper SFR for normal star-forming galaxies for the upcoming optical Legacy Survey of Space and Time (LSST) data from the Vera C. Rubin Observatory? 2) How does the emission from low-mass X-ray binaries contribute to galaxies' total X-ray emission, and how does it influence the SFR measurement? 3) How the X-ray emission modeling can help us probe the X-ray luminosity-SFR scaling relation

Presenter(s) : RICCIO, Gabriele (National Centre of Nuclear Research, Warsaw)

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

κ-deformed complex scalar field: from theory to phenomenology

Thursday, 9 March 2023 09:15 (60)

It is commonly expected that the usual description of spacetime as a smooth manifold is no longer reliable as we approach the Planck scale when quantum effects of the geometry can no longer be neglected. Noncommutativity of spacetime has been advocated as a possible way to effectively model quantum gravitational effects in regimes of negligible curvature. A widely studied incarnation of this idea suggests that the scale of noncommutativity should be seen as an observer-independent length scale and that, in order to accommodate such a fundamental scale, ordinary relativistic symmetries should be deformed (keeping in mind that they should reproduce the usual Poincaré algebra in the limit of vanishing noncommutativity). The κ-Poincaré algebra is an example of such deformation.

In this talk I will briefly describe a construction of a κ-deformed complex scalar field theory, while at the same time shedding light on the behaviour of discrete and continuous symmetries in this formalism. This in turn will open the way to the study of the application of this formalism to actual physical processes. I will then conclude with some comments and prospects for the future.

Presenter(s) : BEVILACQUA, Andrea (NCBJ Warsaw)

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

Inverse Uncertainty Quantification in nuclear engineering

Thursday, 16 March 2023 09:15 (60)

In the past, modeling of some of the nuclear reactors' operational parameters was done using conservative input values in cases where the uncertainty of inputs was not available or easily quantifiable. This approach led to deteriorated economical performance of the reactors, as conservative modeling outputs strayed far from actual operational conditions. Modern computing resources combined with Inverse Uncertainty Quantification (IUQ) methods allow quantifying uncertainties in input parameters for which previously only point estimates were known. IUQ is conducted by assimilating data from appropriate experiments or previously operated nuclear reactors. Quantifying inputs' uncertainty allows for switching from a conservative modeling style to the Best Estimate Plus Uncertainty (BEPU) standard in which we estimate the most likely value of the experimental result plus its uncertainty. BEPU methodology adheres to nuclear reactor licensing requirements while making the reactors' design more economical.
In this seminar, I introduce IUQ in the context of nuclear reactor engineering, focusing on the Bayesian IUQ methods.

Presenter(s) : JĘDRZEJCZYK, Michał (National Centre for Nuclear Research)

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

The time problem and primordial perturbations

Thursday, 23 March 2023 09:15 (60)

The problem of time in physics arises from the conceptual discrepancies between non-relativistic and relativistic time.
The principle of general covariance in general relativity gives us the freedom to choose an arbitrary clock for our theory. In quantum mechanics, however, different choices of internal time variables are known to produce unitarily inequivalent quantum models.
In my presentation I will propose a fully analytical model of primordial gravitational waves propagating in a Friedman-Lemaitre-Robinson-Walker background with different clocks to study what are (if any) the dynamical predictions of quantum gravity models for large classical universes, which do not depend on the employed time variable.
Solving the Hamiltonian constraint of the model and fixing the internal time variable prior to quantization, we are able to study all the existing clocks and quantize them in a way that ensures a fixed 'operator ordering'.
Hence, any quantum ambiguity found is safely ascribed to the different choice of clock.

Presenter(s) : BOLDRIN, Alice (NCBJ)

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

Statistical methods used in neutrino oscillation experiments

Thursday, 30 March 2023 09:15 (60)

Many analyses in particle physics are trying to determine for which set of systematic parameters Monte Carlo (MC) predictions are in the best agreement with the collected data. To describe this agreement we use the likelihood function. There are several likelihoods suggested by statisticians each with different assumptions. Another important issue is the treatment of MC statistical uncertainty, which can be incorporated into the likelihood. The seminar will discuss the impact of several likelihood functions, like Conway's or Dembinski-Abdelmotteleb in T2K near detector analysis.

Presenter(s) : SKWARCZYŃSKI, Kamil (National Centre for Nuclear Research, Poland)

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

The fundamental metallicity relation: from z~0.8 (VIPERS) to z~0 (SDSS)

Thursday, 13 April 2023 09:15 (60)

The chemical evolution of galaxies is the direct product of the whole history of star formation. This relation is encoded in the so-called "fundamental metallicity relation" (FMR), a three-dimensional relation that connects stellar mass, star formation rate, and metallicity.
The FMR is mainly studied for star-forming galaxies at low redshift, z~0 with the Sloan Digital Sky Survey (SDSS). Very low statistics are available at higher redshift but the FMR shows no evolution with cosmic time.
In my talk, I will present the analysis of the FMR at intermediate redshift, 0.5<z<0.8, using VIMOS Public Extragalactic Redshift Survey (VIPERS) data. I will focus on: i) how the comparison of samples at different redshifts, and the conclusions about the evolution of the FMR, can be affected by different biases introduced during the data selection and the observations or ii) the method of comparison; iii) the search for footprints left on the FMR by galaxy evolution.

Presenter(s) : PISTIS, Francesco (National Centre for Nuclear Research)

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

Can a quantum mixmaster universe undergo a spontaneous inflationary phase?

Thursday, 20 April 2023 09:15 (60)

We study asemi-classical model of the mixmaster universe. We first derive the quantum model and then introduce its semi-classical approximation. We employ a general integral quantization method that respects the symmetries of the model given by the affine and the Weyl-Heisenberg groups, and can produce a wide class of quantum models. The semi-classical approximation is based on the coherent states. The semi-classical dynamics is complex and can not be solved by analytical methods. We focus on a key qualitative feature of the dynamics, namely, we investigate whether the primordial anisotropic universe can undergo a spontaneous inflationary phase driven by the anisotropic energy combined with semi-classical corrections. The answer to this question provides a useful perspective on the inflationary paradigm as well as on alternative bouncing models.

Presenter(s) : DE CABO MARTIN, Jaime (NCBJ)

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

Tau Neutrino Appearance in the Flux of Atmospheric Neutrinos

Thursday, 27 April 2023 09:15 (60)

The flux of atmospheric neutrinos comprises of muon and electron neutrinos. Below 10 GeV, we do not expect to see a significant number of tau neutrinos in the atmosphere, unless they appear from the oscillation of atmospheric muon neutrinos. The Super-Kamiokande experiment (Super-K) is a water Cherenkov detector in Japan. Super-K is capable of directly detecting these oscillated tau neutrinos - which would be an unambiguous confirmation of the phenomena of neutrino oscillations. The last study at Super-K, in 2018, excluded the hypothesis of no tau neutrino appearance at 4.6 sigma. This seminar presents the latest analysis on the subject.

Presenter(s) : MANDAL, Maitrayee

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

Forward photon+jet production in pA collisions at next-to-eikonal accuracy

Thursday, 11 May 2023 09:15 (60)

One very promising observable to study gluon saturation effects at high energy is photon+jet production at forward rapidity in proton-nucleus collisions. Since the produced photon does not rescatter on the target, this observable provides a clean environment to study the interaction of the quark probe with the dense target.
In this talk, we will present the results for the photon-quark production cross-section (as a proxy for photon+jet) at next-to-eikonal accuracy taking into account finite-width target effects, dynamics of the target and the interaction with the subleading components of the background field. Moreover, we will also discuss the link between the high-energy Color Glass Condensate (CGC) formalism and the TMD factorization for this specific process. We will argue that next-to-eikonal corrections change the pattern of photon-jet correlations.

Presenter(s) : TYMOWSKA, Arantxa (NCBJ)

Contribution ID : **26** Type : **not specified**

From prototypes to large scale detectors with Monte Carlo simulations

Thursday, 15 June 2023 09:15 (60)

Current and future experiments in high-energy physics rely on advanced simulation software that is key to the interpretation of physics measurements, as well as the design and performance of new detectors. In order to be able to produce all the necessary simulated samples, new simulation techniques and software technologies are needed, also requiring careful evaluation already at prototype level. In this talk, I will present Gaussino - a new simulation experiment-independent framework that provides generic core components to build a complete simulation application: generation, detector simulation, geometry, monitoring, saving persistent simulated data, as well as interfaces to various fast simulations and machine learning libraries. I will also show how Gaussino can be used to explore new detector ideas, and then seamlessly integrated in experiment's production-ready simulation setup developed within the scope of the same simulation framework.

Presenter(s) : MAZUREK, Michał (NCBJ)

Contribution ID : **27** Type : **not specified**

Effects of Dust at High Redshift Dusty Star-Forming Galaxies

Thursday, 25 May 2023 09:15 (60)

Despite its low contribution to the total mass of the interstellar medium, dust plays a crucial role in the evolution of galaxies, and it has the biggest impact on the shape of their total spectral energy distribution. Dust attenuates the stellar light by absorbing the short wavelength photons incoming from the newly-formed stars, and emits them thermally in the infrared. To account for dust attenuation in models, one should assume a dust attenuation law which describes how stellar emission is absorbed by dust. Despite the growing knowledge in the field of extragalactic astronomy, key questions remain unanswered: What dust attenuation law one should use at high redshift? What are the physical conditions on which dust attenuation curves depend?
In this talk, I will present the key physical processes that affect the curve of dust attenuation, in a large study of dusty star-forming galaxies from the early Universe until the present times.

Presenter(s) : HAMED, Mahmoud (NCBJ)

Contribution ID : **28** Type : **not specified**

Direct photons in high energy proton-proton and nucleus-nucleus collisions

Thursday, 1 June 2023 09:15 (60)

Direct photons serve as unique probes in high-energy proton-proton and nucleus-nucleus collisions, interacting weakly with the dense and hot quark-gluon medium formed during these events. These photons escape freely, providing undistorted information about the collision's evolution. The Quark-Gluon Plasma (QGP), comprising deconfined quarks and gluons, is believed to have existed in the Universe shortly after the Big Bang. As the QGP cools, it transitions into the hadronic matter that we observe today. In laboratory settings, small-scale "Big Bangs" are artificially created through high-energy heavy-ion collisions, which heat the hadronic matter to temperatures of approximately 150 MeV, leading to the formation of the QGP. By studying prompt, pre-equilibrium, and thermal photons emitted during these collisions, we can estimate the effects of cold and hot nuclear matter and gain insights into the temperature, correlations, and collective phenomena within the QGP.

Presenter(s) : MANDAL, Sushobhan (NCBJ)

Contribution ID : **29** Type : **not specified**

No seminar

Thursday, 8 June 2023 09:15 (60)

Contribution ID : **30** Type : **not specified**

Salil Joshi's talk

Thursday, 22 June 2023 09:15 (60)

Out of all the unexpected elementary particles discovered in the past two decades, the 30 or so observed exotic hadrons candidate i.e., ones that do not fit into the paradigms of either bosonic or fermionic baryons. A new era in the study of QCD exotica began in 2003 with the accidental discovery of the X(3872) by the Belle Collaboration, noticed a narrow peak in the invariant mass spectrum of the pi+pi-J/psi system. Most of these states discovered have masses in the same region as conventional charmonium states (charmonium-like) or bottomonium-like. Although being the most unambiguous candidates for exotic hadrons observed to date, no scientific consensus has yet emerged to explain all of them and their formation, properties, structure by means of a single, universal theoretical principle. The LHCb announced in 2022 the discovery of a new penta-quark particle and a doubly electrically charged tetra-quark with its neutral counterpart, with a staggering statistical significance of 7.3 sigma and 6.5 sigma, respectively. It is this pattern of one unexpected result after another, with the emergence of desperately few connections, that has characterized the last 20 years of experimental studies in this field. This presentation is aimed at introducing this rapidly expanding field of QCD exotica, theoretical aspects and experimental techniques used for studying these incredible anomalies.

Presenter(s) : JOSHI, Salil (NCBJ)

Contribution ID : **34** Type : **not specified**

Illuminating the Low Surface Brightness Galaxies in Dark Energy Survey with Transformers.

Thursday, 18 May 2023 09:15 (60)

Low surface brightness galaxies (LSBGs) are defined as galaxies that are fainter than the night sky (μ(g) > 22 mag arcsec−2). LSBGs are hypothesized to be dominated by dark matter halos and contain a significant fraction of the missing baryons, making them an ideal laboratory to test cosmological models. Upcoming large-scale surveys like Rubin Observatory Legacy Survey of Space and Time (LSST) and Euclid are expected to observe approximately 10^9
astronomical objects. In this context, using semi-automatic methods to identify LSBGs while rejecting artefacts would be highly challenging and time-consuming. Therefore, alternative approaches such as automated or machine learning-based methods will be necessary to overcome this challenge. We study the use of transformers or, more generally, the self-attention-based machine learning models in separating LSBGs from artefacts from the Dark Energy Survey (DES). In addition, we also searched for the presence of new LSBGs from DES that the previous searches may have missed. Using an ensemble model, we identified 4083 LSBGs from the DES data release 1 (DR1), adding an additional ~17% LSBGS to the know LSBGs. We analyze the properties of these new LSBGs and the general properties of LSBGS in DES.

Presenter(s) : THURUTHIPILLY, Hareesh (National Center for Nuclear Research (NCBJ))

Contribution ID : **35** Type : **not specified**

Strong gravitational lensing applications on cosmology and galactic evolution

Thursday, 29 June 2023 09:15 (60)

Gravitational lensing, as predicted by Einstein's General Relativity, is the bending of light from distant sources via the gravitational field of massive objects. This phenomenon provides a valuable opportunity for unique studies. In this presentation, I will discuss the applications of strong gravitational lensing in the realms of cosmology and galaxy evolution.

Using the most extensive current sample of early-type galaxies (ETGs) lensing systems, we probe the velocity dispersion function (VDF) and trace its evolution at redshift z ~ 1. Our findings align with the SDSS survey results, revealing a halving of number density and a 20% increase in characteristic velocity dispersion for ETGs at z ~ 1, supporting the Cold Dark Matter (CDM) paradigm. We've used model-independent methods to reconstruct distance ratios and time-delay distances by lensing systems, which help us limit the parameters of various cosmological models. The derived Hubble constant (H0) is in agreement with the SH0ES collaboration findings from the cosmic distance ladder. And the zero spatial curvature is supported by the current observations of time delays due to strong lensing and cosmic chronometers. The forthcoming LSST survey, with its expected larger sample, could enhance the precision of redshift evolution constraints of ETGs by a factor of twenty. Furthermore, it can estimate the matter density parameter Ωm with an accuracy of $\Delta\Omega$~0.015 in the ΛCDM model, offering constraints comparable to Planck 2015's results.

Presenter(s) : GENG, Shuaibo (National Center for Nuclear Research)