PPC 2024: XVII International Conference on Interconnections between Particle Physics and Cosmology

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Book of Abstracts

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Parallel - Cosmology / 5

Unveiling the dynamics of reheating in modified chaotic and mutated hilltop inflation

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The Reheating era of inflationary Universe can be parameterized by various parameters like reheating temperature $T_{\rm re}$, reheating duration $N_{\rm re}$ and average equation of state parameter $\overline{\omega}_{\rm re}$, which can be constrained by observationally feasible values of scalar power spectral amplitude and spectral index. In our work, we have done the single phase reheating study of a modified form of quadratic chaotic potential in order to put limits on parameter space of model. By investigating the reheating epoch using Planck+BK18+BAO observational data, we show that even a slight modification in basic chaotic model can make it consistent with latest cosmological observations. We also find that the study of reheating era helps to put much tighter constraints on model and effectively improves accuracy of model.

Track type:

Cosmology

Parallel - Collider & BSM / 6

Electroweak Multi-Higgs Production: A Smoking Gun for the Type-I 2HDM

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In the Type-I 2HDM, all the five new physical Higgs states can be fairly light, $\mathcal{O}(100)$ GeV or less, without conflicting with current data from the direct Higgs boson searches and the B-physics measurements. In this talk, I will discuss how the new neutral and the charged Higgs bosons of the model can be simultaneously observable in the $multi-b$ final state, resulting from the electro-weak (EW) production. Since the parameter space configurations where this is achievable are precluded in the other, more extensively pursued, 2HDM Types, experimental validation of our findings would be a clear indication that the true underlying Higgs sector in nature is the Type-I 2HDM.

Track type:

Collider and BSM Physics

Parallel - ASP & GW / 8

Gravitational waves from quasi-stable cosmic strings and PTA data

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We discuss the stochastic gravitational wave background emitted from a network of 'quasi-stable' strings (QSS) and its realization in grand unified theories. A symmetry breaking in the early universe produces monopoles that suffer partial inflation. A subsequent symmetry breaking at a lower energy scale creates cosmic strings that are effectively stable against the breaking via Schwinger monopole-pair creation. As the monopoles reenter the horizon, we will have monopole-antimonopoles connected by strings, and further loop formation essentially ceases. Consequently, the lower frequency part of the gravitational wave spectrum will be suppressed compared to that of topologically stable cosmic strings. The gravitational radiation emitted in the early universe by QSS with a dimensionless string tension $G\mu \sim 10^{-6}$, is compatible with the exciting evidence of low-frequency gravitational background in PTA data, as well as the recent LIGO-VIRGO constraints, provided the superheavy strings and monopoles experience a certain amount of inflation.

Track type:

Gravitational waves

Plenary / 10

The first result from InDEx dark matter direct search experiment at JUSL

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The InDEx (**In**dian **D**ark matter search **Ex**periment) is aimed to search the dark matter directly by the recoil nucleus formed due to the elastic scattering of WIMP with the nuclei of superheated droplet detector. The superheated droplet detector has been installed at Jaduguda Underground Science Laboratory (JUSL) at UCIL, Jaduguda mine, Jharkhand at 555m deep underground. The active liquid is tetra-fluoro-ethane (C2H2F4). The detectors have been fabricated at laboratory along with the FPGA based data acquisition systems. A feasibility study with C2H2F4 target shows that the detector is sensitive to sub-GeV mass of dark matter while operated at low threshold. The detector ran at JUSL for an effective period of 48.8 days with an exposure of 2.47 kg-days at 5.87 keV threshold. After fabrication, the calibration experiments were performed with the standard 241Am-Be radioactive source and with the neutrons generated by the (p,n) reactions at Cyclotron. The radiation backgrounds and the noise level at JUSL have been measured by different workers prior to the above run. The results show the upper limit on the spin-independent cross section as [6.655 + (+0.314 − 0.314)statistical + (+2.360 − 1.356)systematic] × 10−34 cm2 for the carbon at a WIMP mass of 15.83 GeV/c2. It shows the spin-dependent cross section as [1.137 + (+0.053 − 0.054)statistical + (+0.308−0.187)systematic]×10-37 cm2 for fluorine nuclei at 24.90 GeV/c2. The first result from InDEx at JUSL is reported in this abstract. The future run with larger exposure and lower thresholds are in progress.

Track type:

Dark Matter

Parallel - Neutrino / 11

Constraining the mass-spectra in the presence of a light sterile neutrino from absolute mass-related observables

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The framework of three-flavor neutrino oscillation is a well-established phenomenon. However, results from short-baseline experiments, such as the *Liquid Scintillator Neutrino Detector (LSND)* and *MiniBooster Neutrino Experiment (MiniBooNE)*, suggest the potential existence of an additional light neutrino state characterized by a mass-squared difference of approximately $1, \mathrm{eV}^2$. This new neutrino state as it devoid of all Standard Model (SM) interactions, is commonly referred to as a "sterile" state. Additionally, a sterile neutrino with a mass-squared difference of 10^{-2} eV^2 has been proposed to reduce the tension between the results obtained from the *Tokai to Kamioka (T2K)* and the *NuMI Off-axis* ν_e *Appearance (NOνA)* experiments. Furthermore, the absence of the predicted upturn in the solar neutrino spectra below 8 MeV can be explained by postulating an extra light sterile neutrino state with a mass-squared difference around $10^{-5}, \mathrm{eV}^2$. The hypothesis of an additional light sterile neutrino state introduces four distinct mass spectra depending on the sign of the mass-squared differences. The implications of these scenarios on observables dependent on the absolute mass of neutrinos, namely, the sum of the light neutrino masses (Σm_ν) from cosmology, the effective mass of the electron neutrino from beta decay (m_β), and the effective Majorana mass $(m_{\beta\beta})$ from neutrinoless double beta decay. It is interesting that some scenarios are already disfavored by current constraints on the above variables. Furthermore, the implications for the projected sensitivity of experiments such as the *Karlsruhe Tritium Neutrino Experiment (KATRIN)* and future experiments like *Project-8* and the *next Enriched Xenon Observatory (nEXO)* will be very interesting.

Track type:

Neutrino Physics

Parallel - Dark Matter / 18

Faint light of old neutron stars and detectability at the James Webb Space Telescope and exploring the analytics of multiple scattering of dark matter.

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Isolated ideal neutron stars (NS) of age $> 10^9$ yrs exhaust thermal and rotational energies and cool down to temperatures below $\mathcal{O}(100)$ K. Accretion of particle dark matter (DM) by such NS can heat them up through kinetic and annihilation processes. This increases the NS surface temperature to a maximum of $\sim$ 2550 K in the best case scenario. The maximum accretion rate depends on the DM ambient density and velocity dispersion, and on the NS equation of state and their velocity distributions. Upon scanning over these variables, we find that the effective surface temperature varies at most by $\sim 40\%$. Black body spectrum of such warm NS peak at near infrared wavelengths with magnitudes in the range potentially detectable by the James Webb Space Telescope (JWST). Using the JWST exposure time calculator, we demonstrate that NS with surface temperatures
$gtrsim 2400$ K, located at a distance of 10\,pc can be detected through the F150W2 (F322W2) filters of the NIRCAM instrument at SNR\,
$gtrsim 10$ (5) within 24 hours of exposure time. Independently of DM, an observation of NS with surface temperatures
$gtrsim 2500$ K will be a formative step towards testing the minimal cooling paradigm during late

evolutionary stages.
Further, we explored the analytics of scattering probability and capture rate for the multiscatter case if the DM is heavy
$gtrsim 10^6$ GeV. We analyse this scenario with different opacity.

Track type:

Dark Matter

Parallel - ASP & GW / 21

First Search for High-Energy Neutrino Emission from Galaxy Mergers

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The exact sources of high-energy neutrinos detected by the IceCube neutrino observatory still remain a mystery. For the first time, this work explores the hypothesis that galaxy mergers may serve as sources for these high-energy neutrinos. Galaxy mergers can host very high-energy hadronic and photohadronic processes, which may produce very high-energy neutrinos. We perform an unbinned maximum-likelihood-ratio analysis utilizing the galaxy merger data from six catalogs and 10 years of public IceCube muon-track data to quantify any correlation between these mergers and neutrino events. First, we perform the single source search analysis, which reveals that none of the considered galaxy mergers exhibit a statistically significant correlation with high-energy neutrino events detected by IceCube. Furthermore, we conduct a stacking analysis with three different weighting schemes to understand if these galaxy mergers can contribute significantly to the diffuse flux of high-energy astrophysical neutrinos detected by IceCube. We find that upper limits (at 95% c.l.) of the all flavour high-energy neutrino flux, associated with galaxy mergers considered in this study, at 100 TeV with spectral index $\Gamma = -2$ are 2.57×10^{-18}, 8.51×10^{-19} and 2.36×10^{-18} $\mathrm{GeV}^{-1}\,\mathrm{cm}^{-2}\,\mathrm{s}^{-1}\,\mathrm{sr}^{-1}$ for the three weighting schemes. This work shows that these selected galaxy mergers do not contribute significantly to the IceCube detected high energy neutrino flux. We hope that in the near future with more data, the search for neutrinos from galaxy mergers can either discover their neutrino production or impose more stringent constraints on the production mechanism of high-energy neutrinos within galaxy mergers.

Track type:

Astroparticle Physics

Parallel - Dark Matter / 22

Neutrinos from the Sun can discover dark matter-electron scattering

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Dark matter (DM) particles can get captured inside the Sun due to DM-electron interaction. As the number of these captured DM particles increases, they can annihilate and produce different Standard Model (SM) final states. Neutrinos and anti-neutrinos produced from these final states can escape the Sun and reach ground-based neutrino telescopes. The latest data-sets from IceCube and DeepCore show no such excess of high energy neutrinos from the solar direction. Using these data-sets, we put stringent constraints on DM-electron scattering cross sections in the DM mass range 10 GeV to 10^5 GeV. Thus, near-future observations of the Sun by neutrino telescopes can potentially discover DM-electron interaction.

Track type:

Dark Matter

Parallel - Cosmology / **24**

Impact of Finite Temperatures and Ultrastrong Magnetic Fields on Anisotropic Magnetized White Dwarfs in γ-metric formalism

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This study investigates the impacts of both finite temperature and strong magnetic field on Anisotropic Deformed Magnetized White Dwarfs within the parameterized γ-metric formalism. We have considered a relativistic free Fermi gas of electrons embedded in strong quantizing magnetic fields and at finite temperatures. Due to the anisotropy in the pressures parallel and perpendicular to the direction of the magnetic field, these magnetized white dwarfs become oblate spheroids. This deformation is accounted in the presence of a deformed Schwarzschild metric known as the γ-metric. Stable super-Chandrasekhar masses ($> 5M_{\odot}$) are found. We also see that increasing central magnetic field leads to decreased masses and increased equatorial radii, with maximum mass occurring at higher central densities. Conversely, increasing the temperature leads to increase in both mass and radius, counteracting magnetic field effects by stiffening the Equation of State (EoS) and decreasing the anisotropy. This work highlights the interplay between temperature and magnetic fields, impacting the compactness and anisotropy of magnetized hot white dwarfs.

Track type:

Astroparticle Physics

Plenary / **29**

Primordial Black Hole probes of Heavy Neutral Leptons

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If produced in the early Universe with an initial mass of ~ 10ˆ15 g, PBHs are expected to evaporate at the present time producing sizable fluxes of particles in their last instants. These "exploding"black holes will emit bursts of Standard Model particles as well as new degrees of freedom, if present. We explore the possibility that HNLs mixing with the active neutrinos are emitted in the final evaporation stage of PBHs. We evaluate the active neutrino fluence expected from such an explosion, to which the decays of the heavy sterile neutrinos contribute through a secondary emission. We estimate the expected number of muon-neutrino events at IceCube and we infer sensitivities on the active-sterile neutrino mixing and the sterile neutrino mass.

Track type:

Astroparticle Physics

Parallel - ASP & GW / 30

Detecting dark energy using X-ray telescope

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Chameleon dark energy models are a popular alternative to the standard cosmological constant model. These models consist of a new light degree of freedom, called chameleon, with a density dependent mass and a non-trivial coupling to both matter and photons. Owing to these couplings, chameleons can be produced inside the sun. However due to their density dependent mass, the chameleons produced in the solar core are screened whereas those produced outside the solar core can escape from the sun. In this work we show that chameleons can be abundantly produced in the solar tachocline and they can escape the sun resulting in a solar chameleon flux. Furthermore in order to detect these chameleons, we propose a *light shining through wall* (LSW) type of experiment in which the Earth acts as a wall stopping all the photons while allowing a fraction of the chameleons to pass directly through the Earth and exit from the night side. Here these chameleons interact with the geomagnetic field and convert into X-ray photons. A space based X-ray telescope orbiting the Earth can detect these X-ray photons, while passing through the night side, thereby acting as a detector in this LSW type experiment. We show that such a kind of setup can be complementary to other terrestrial experiments looking for chameleons.

Track type:

Astroparticle Physics

Parallel - Cosmology / 33

LADDER: Revisiting the Cosmic Distance Ladder with Deep Learning Approaches and Exploring its Applications

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I'll present the prospect of reconstructing the ''cosmic distance ladder" of the Universe using our novel deep learning framework called LADDER - Learning Algorithm for Deep Distance Estimation and Reconstruction. LADDER was trained on the apparent magnitude data from the Pantheon Type Ia supernovae compilation, incorporating the full covariance information among data points, to produce predictions along with corresponding errors. After employing several validation tests with several deep learning models, LADDER was picked as the best-performing one. I'll demonstrate some applications of this framework in the cosmological context, which include serving as a model-independent tool for consistency checks for other datasets like baryon acoustic oscillations, calibration of high-redshift datasets such as gamma-ray bursts, use as a model-independent mock catalogue generator for future probes, etc. Our analysis advocates for interesting yet cautious consideration of machine learning applications in these contexts. This would be based on the work presented in https://www.arxiv.org/abs/2401.17029.

Track type:

Cosmology

Plenary / **35**

The KM3NeT Neutrino Telescope: Results from First Data

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KM3NeT is a multi-purpose neutrino observatory under construction in the Mediterranean Sea. It is composed of two Cherenkov detectors with different designs: ORCA, a compact and dense detector optimised for the high-statistic measurement of atmospheric neutrino physics in the 1-100 GeV energy range, and ARCA, instrumenting a cubic kilometre to catch fluxes of extraterrestrial neutrinos from 100 GeV to 10 PeV. The two detectors have a final configuration comprising 115 and 230 detection lines, respectively. With its modular layout, partial configurations of KM3NeT take data promptly upon deployment. An overview of the first results will be presented. ORCA observes muon neutrino disappearance with more than 6 standard deviations and performs a precision measurement of atmospheric oscillation parameters. ARCA surveys the sky in search for sources of extraterrestrial neutrinos, also participating in a prompt multi-messenger program including the search for correlations of neutrinos with gravitational waves. The KM3NeT science case also comprehends indirect search for physics beyond the Standard Model. Both the ARCA and ORCA detectors search for neutrinos produced in pair annihilations of dark matter, thanks to their view of the Milky Way Centre. Other new physics effects are studied through modifications induced to the oscillation probabilities: results on non-standard interactions, neutrino decay and quantum decoherence as measured by a ORCA are discussed here.

Track type:

Neutrino Physics

Plenary / **36**

Searching for axion dark matter from dwarf spheroidal galaxies and the Sun

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The coupling of axion and axion-like particles (ALPs) to two photons leads to radiative decays of axion dark matter and axion-photon conversion in an external magnetic field. We discuss two methods to search for these signals exploiting astrophysical data. The first is based on MUSE spectroscopic optical observations of a sample of five classical and ultra-faint dwarf spheroidal galaxies.
We present world-leading limits on ALPs radiative decays for ALPs masses in the range of 2.7-5.3 eV.
The second strategy relies on the radio emission produced from the conversion of ALPs in the Sun' s magnetic field, including conversion in sunspots. We demonstrate that near-future low-frequency radio telescopes, such as the SKA Low, may access regions of unexplored parameter space for masses below the micro-eV range.

Track type:

Dark Matter

Parallel - Dark Matter / **37**

Breaking into the window of primordial black hole dark matter with x-ray microlensing

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Primordial black holes (PBHs) in the mass range $10^{-16} - 10^{-11}\ M_{\odot}$ may constitute all the dark matter.
We show that gravitational microlensing of bright x-ray pulsars provide the most robust and immediately implementable opportunity to uncover PBH dark matter in this mass window.
As proofs of concept, we show that the currently operational NICER telescope can probe this window near $10^{-14}\ M_{\odot}$ with just two months of exposure on the x-ray pulsar SMC-X1, and that the forthcoming STROBE-X telescope can probe complementary regions in only a few weeks.
These times are much shorter than the year-long exposures obtained by NICER on some individual sources.
We take into account the effects of wave optics and the finite extent of the source, which become important for these subatomic size PBHs.
We also provide a spectral diagnostic to distinguish microlensing from transient background events and to broadly mark the PBH mass if true microlensing events are observed.
In light of the powerful science case, i.e., the imminent discovery of dark matter searchable over multiple decades of PBH masses with achievable exposures, we strongly urge the commission of a dedicated large broadband telescope for x-ray microlensing.
We derive the microlensing reach of such a telescope by assuming sensitivities of detector components of proposed missions, and find that with hard x-ray pulsar sources PBH masses down to a few $10^{-17}\ M_{\odot}$ can be probed.

Track type:

Dark Matter

Poster Session / **40**

S-wave Doubly Heavy Flavored Baryon Mass Spectra Using a Potential Model Incorporating Screening and O(1/m) Corrections.

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S-wave mass spectra of Ξ_{cc}^{++} baryon is determined by utilizing a non-relativistic potential model. In this analysis, Ξ_{cc}^{++} is considered as a bound state of cc diquark and a u quark. The central potential considered in this work is a short-range one-gluon coulomb-like potential and a screened confinement potential in the long-range along with the $O(1/m)$ correction terms predicted from pNRQCD and lattice studies. The non-relativistic Schrodinger equation is solved numerically for the diquark-quark system, and the masses of ground and radially excited states are evaluated. The mass of the ground state Ξ_{cc}^{++} baryon obtained from our analysis is 3621 MeV which agrees well with the experimental value 3621.6 ± 0.4 MeV.

Track type:

Flavour Physics

Poster Session / 41

Regge Trajectories of Heavy Flavored Mesons

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In this work, the Regge trajectories of heavy quarkonia ($c\bar{c}, b\bar{b}$ and $b\bar{c}$) are investigated. Using a relativistic model along with a screened confining potential, the spectra of these heavy quarkonia are evaluated. Using the obtained masses, the Regge trajectories are constructed for $(J \to M^2)$ and $(n_r \to M^2)$ planes. The results show that the parent trajectories have considerable nonlinearity in the low mass area. The daughter trajectories are linear for charmonium, bottomonium, and B_c mesons, and are parallel only for bottomonium and B_c mesons.

Track type:

Flavour Physics

Parallel - Dark Matter / 42

Search for dark matter decay and annihilation using observation by Tibet AS$_\gamma$ and LHAASO

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Recently, Tibet AS$_\gamma$ and LHAASO have observed very high energy diffuse gamma rays in the Galactic place between 10 TeV and 1 PeV energies. In our work, we utilize these observations to search for dark matter decay or annihilation signals to Standard Model particles. In addition to the primary gamma-ray originating from various Standard Model particles, we also include secondary gamma-rays generated in these processes. We also consider the effects of dark matter substructures and tidal disruption. We place constraints on dark matter annihilation cross-section and decay lifetime for a wide range of dark matter masses. Future observation of these high-energy gamma rays can further help us either discover particle dark matter or better constrain its properties.

Track type:

Dark Matter

Plenary / 43

Investigating Dark Matter Electromagnetic Moments Using the Migdal Effect

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Recently, the Migdal effect has been used along with nuclear direct detection experiments to constrain dark matter models in the sub-GeV region, providing a complementary approach to electron and standard nucleus scattering analyses. By utilizing the Migdal effect with data from the XENON1T and DarkSide-50 experiments, we constrained the electromagnetic interactions of dark matter with visible matter. Our findings show that these limits set the strongest constraints on dark matter at the GeV scale. Additionally, we calculated the electromagnetic interactions of a fermionic dark matter candidate in a leptophilic model and used direct detection data to set limits on the underlying parameter space, highlighting the complementarity between collider and direct detection searches.

Track type:

Dark Matter

Parallel - Flavour / 44

Study of angular observables in exclusive semi-leptonic B_c decays

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In this work, we focus on the angular observables such as longitudinal polarization of final leptons, τ-polarization, and forward-backward asymmetry, also including the study of the lepton flavor violating observables, the $\mathcal{R}$ Ratios in the decay channels $B_c \to \eta_c(J/\psi)\tau\nu_\tau$ & $B_c \to D(D^*)\tau\nu_\tau$ in the entire q^2 region. Our investigation is conducted within the Relativistic Independent Quark Model, emphasizing the potential model-dependent analysis of these observables. We compared our model predictions with the existing Lattice predictions encompassing strong applicability of RIQM framework in describing B_c decays. Considering the upcoming experimental upgrades & Run 3 data results on B_c meson decays, the rapid confirmation of these quantities could signify a significant detection of physics beyond the Standard Model, opening up new avenues to understand the non-trivial flavor dynamics in heavy meson decays.

Track type:

Flavour Physics

Poster Session / 45

Probing U(1) Lmu- Ltau Extra-Dimensional Model via electron-neutrino Elastic Scattering

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Extra dimensions (ED) offer a valuable tool for constructing intricate models and exploring potential new physics phenomena. Our focus is to extand Standard Model (SM) by introducing an U (1) Lμ −Lτ gauge group in the framework of ED, which serves as a compelling initiative aimed at addressing the muon (g - 2) anomaly. In this model, only the Kaluza-Klein (KK) modes of the extra dimensional gauge boson traverse the bulk, while Standard Model particles remain localized on the SM brane assuming a
compactification 'radius'of order Rˆ−1 form 1 to 1000 MeV. We present constraints on the mnKK − g ′ , where mnKK is the mass of the extra-dimensional gauge boson for a particular KK mode, and g ′ is the interaction coefficient between the extra-dimensional gauge boson and SM fermions. These constraints are derived from ν − e elastic scattering measurements at DUNE ND (Future based experiment) and compare them with those from other ν − e elastic scattering experiments, CHARM II, TEXONO and BOREXINO. Our results indicate that the DUNE Near Detector can provide the most stringent bounds for extra-dimensional gauge boson masses in the range of 1 to 1000 MeV.

Track type:

Parallel - Cosmology / 46

Reappraisal of Hemispherical Power Asysmmetry in CMB temperature data after Planck PR4

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In this work we present our analysis of one of the prominent "anomalies" of CMB sky, the "hemispherical power asymmetry (HPA)", from the latest fullsky CMB maps from Planck satellite mission's Public Release 4. The data is analyzed from various perspectives to understand the nature of HPA better viz., a re-estimation of the magnitude and direction of HPA and the corresponding significance, consistency of the recovered amplitude and direction. We do so using the Local variance estimator (LVE) method. We find that the CMB hemispherical power asymmetry, phenomenologically modeled as a dipole modulation of an otherwise statistically isotropic CMB sky, is robust against all these tests and appears indeed to be a cosmic signal.

Track type:

CMBR

Parallel - Neutrino / 49

Establishing Earth's Matter Effect in Atmospheric Neutrino Oscillations at IceCube DeepCore

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The discovery of non-zero θ13 has opened an exciting opportunity for probing the Earth's matter effect in three-flavor neutrino oscillations. This phenomenon depends upon the energy of neutrinos and the density distribution of electrons they encounter during their propagation. It holds significant relevance for advancing our understanding regarding neutrino mass ordering, complementary and independent information about the internal structure of Earth, and new physics beyond the Standard Model. In this talk, we present how well the DeepCore detector, a densely instrumented sub-array of the IceCube neutrino observatory at the South Pole, can observe these matter effects in atmospheric neutrino oscillations by rejecting vacuum oscillation solutions and aligning with the Preliminary Reference Earth Model (PREM). We further present the improvement in the Asimov sensitivity to reject the vacuum oscillations using the IceCube Upgrade, a new extension of the DeepCore with seven additional strings that will be deployed in the polar season of 2025-26 within DeepCore fiducial volume.

Track type:

Neutrino Physics

Parallel - Neutrino / 50

Validating Layered Structure Inside Earth Using Atmospheric Neutrino Oscillations at IceCube DeepCore

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The IceCube DeepCore detector, with its denser central arrangement, can detect sub-GeV atmospheric neutrinos. The oscillation pattern of neutrinos is altered due to interactions with ambient matter as they travel. The changes in these patterns are influenced by the amount of matter and its specific arrangement. As neutrinos propagate, they retain information about the densities they encounter. Our study demonstrates that IceCube DeepCore can utilize the Earth's matter effects to distinguish between a homogeneous matter density profile and a layered structure density profile. In this talk, we show that using 9.3 years of IceCube DeepCore data, IceCube DeepCore rejects the homogeneous matter density profile with a confidence level of 1.4⊠. Additionally, we will discuss the potential improvements in Asimov sensitivity with the upcoming IceCube Upgrade, an extension of the IceCube DeepCore detector setup.

Track type:

Neutrino Physics

Parallel - Neutrino / **52**

Measuring the mass of Earth and mass of Core using neutrino oscillations at IceCube DeepCore

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The information about the mass of Earth and its internal structure has been obtained mainly using gravitational measurements and seismic studies, which depend upon gravitational and electromagnetic interactions, respectively. Neutrinos provide an independent way of exploring the interior of Earth using weak interactions through Earth's matter effects in neutrino oscillations. Since these matter effects depend upon the number density of electrons, neutrino oscillations can be used to measure the amount of electrons and their distribution inside Earth. The electron number density can then be interpreted in terms of matter density inside Earth. In our study, we utilize atmospheric neutrinos at DeepCore, a densely instrumented sub-detector at the center of the IceCube Neutrino Observatory, to estimate the mass of Earth and the mass of Earth's core. Further, we have also evaluated the potential enhancement in our results with the upcoming Upgrade, which is an extension of the DeepCore, with more denser instrumentation. Our investigation not only provides valuable insights into Earth's composition but also showcases how neutrino oscillations enable new perspectives in probing the fundamental properties of our planet.

Track type:

Neutrino Physics

Parallel - Collider & BSM / 53

Renormalization-group improved Higgs to two gluons decay rate

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We investigate the renormalization-group scale and scheme dependence of the $H \to gg$ decay rate at the order N^{4}LO in the renormalization-group summed perturbative theory, which employs the summation of all renormalization-group accessible logarithms including the leading and subsequent four sub-leading logarithmic contributions to the full perturbative series expansion. Moreover, we study the higher-order behaviour of the $H \to gg$ decay width using the asymptotic Pad\'e approximant method in four different renormalization schemes. Furthermore, the higher-order behaviour is independently investigated in the framework of the asymptotic Pad\'e-Borel approximant method where generalized Borel-transform is used as an analytic continuation of the original perturbative expansion. The predictions of the asymptotic Pad\'e-Borel approximant method are found to be in agreement with that of the asymptotic Pad\'e approximant method. Finally, we provide the $H \to gg$ decay rate at the order N^{5}LO using the asymptotic Pad\'e approximant and the asymptotic Pad\'e-Borel approximant methods in the fixed-order as well as in the renormalization-group summed perturbative theories.

Track type:

SM and Higgs Physics

Parallel - Dark Matter / 54

Hunting Primordial Black Hole Dark Matter in Lyman-alpha forest

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The question that what constitutes Dark Matter (DM) is one of the most pressing ones in contemporary physics, and one that has not been answered to any degree so far. Primordial Black Holes (PBHs) are one of the most well-motivated dark matter candidates. PBHs which are light enough that the Hawking radiation is substantial have been constrained by either the non-detection of the radiation itself, or by the non-observation of any measurable effects of the radiation on astrophysical and cosmological observables. In this work, we constrain the existence of such PBHs by the effect their Hawking radiation would have had on the temperature of the intergalactic medium (IGM). We use the latest deductions of IGM's temperature from the Lyman-alpha forest observations. We put constraints on the fraction of dark matter that PBHs can constitute with masses in the range 5 x 10ˆ15 g –10ˆ17 g, separately for spinning and non-spinning black holes. We derive the constraints by dealing with the heating effects of the astrophysical reionization of the IGM in two ways. In one way, we completely neglect this heating due to astrophysical sources, thus giving us relatively weak constraints, but which are completely robust to the reionization history of the universe. In the second way, we use some modelling of the ionization and temperature history and use them to derive more stringent constraints. We find that for PBHs of mass 10ˆ16 g, the current measurements can constrain the PBH-density to be less than 0.1% of the total dark matter density, both for spinning and non-spinning black holes. Thus, we find that these constraints from the Lyman-alpha measurements are competitive, and hence provide a new observable to probe the nature of dark matter.

Track type:

Dark Matter

Parallel - Collider & BSM / 57

Assisted baryon number violation in 4k+2 dimensions

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Proton decay in six-dimensions orbifolded on T2/Z2 is highly suppressed at tree level. This is because baryon number violating operators containing only the zero mode of bulk fermions must satisfy a selection rule emerging from the remaining symmetry of the orbifold. Here we show that this relation can be evaded with operators made up of Kaluza Klein partners of the Standard Model fermions. Together with the interaction of spinless adjoint scalar partner of the hypercharge gauge boson, these novel operators generate dark matter assisted protons decay at mass dimension 8. Similarly, dark matter assisted proton proton annihilation and hydrogen-antihydrogen oscillation are also predicted by the model.

Track type:

Collider and BSM Physics

Parallel - Dark Matter / 59

The dynamics and detection possibility of a pseudo FIMP in presence of a thermal Dark Matter

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Interaction between two dark matter (DM) components plays a crucial role in DM production, dynamics and phenomenology in multicomponent DM scenarios. We propose and study a new kind of DM, called pseudo-FIMP (pFIMP), which can be realised in a two-component DM setup. pFIMP is feebly connected to the visible sector but remains in thermal equilibrium by sufficient interaction with a thermal DM partner, before freezing out to achieve under abundance. Although it has no direct connection with the visible sector, pFIMP comes under the detector scanner via thermal DM loop. In this talk, we discuss the dynamics of pFIMP and its loop-induced detection possibilities in the presence of a thermal DM, when both are rendered stable under $\mathbb{Z}_2 \otimes \mathbb{Z}_2'$ symmetry. However, under a single discrete symmetry, a heavy dark sector particle 'naturally'becomes pFIMP when the lifetime is enhanced to that compared to the age of the universe, while the pFIMP partner component acts as thermal DM. This provides a rich phenomenology and larger available parameter space. We briefly discuss such possibility for $\mathbb{Z}_N$ symmetry, highlighting the cases of $\mathbb{Z}_2$ and $\mathbb{Z}_3$ symmetries specifically.

References: PhysRevD.108.L111702, PhysRevD.109.095031.

Track type:

Dark Matter

Parallel - Dark Matter / 61

Viability of Boosted Light Dark Matter in a Two-Component Scenario

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We study the boosted dark matter (BDM) scenario in a two-component model. We consider a neutrinophilic two-Higgs doublet model (ν2HDM), which comprises of one extra Higgs doublet and a light right-handed neutrino. This model is extended with a light ($\sim$ 10 MeV) singlet scalar DM ϕ_3, which is stabilized under an extra dark $Z_2^{\rm DM}$ symmetry and can only effectively annihilate through the CP even scalar H. While the presence of a light scalar H modify the oblique parameters to put tight constraints on the model, introduction of vectorlike leptons (VLL) can potentially salvage the issue. These vectorlike doublet N and vectorlike singlet χ are also stabilized through the dark $Z_2^{\rm DM}$ symmetry. The lightest vectorlike mass eigenstate ($\chi_1 \sim 100$ GeV) is the second DM component of the model. Individual scalar and fermionic DM candidates have Higgs/Z mediated annihilation, restricting the fermion DM in a narrow mass region while a somewhat broader mass region is allowed for the scalar DM. However, when two DM sectors are coupled, the annihilation channel $\chi_1\chi_1 \to \phi_3\phi_3$ opens up. As a result, the fermionic relic density decreases, and paves way for broader fermionic DM mass region with under-abundant relic: a region of $[30-70]$ GeV compared to a narrower $[40-50]$ GeV window for the single component case. On the other hand, the light DM ϕ_3 acquires significant boost from the annihilation of χ_1, causing a dilution in the resonant annihilation of ϕ_3. This in turn increases the scalar DM relic allowing a smaller mass region compared to the individual case. The exact and underabundant relic is achievable in a significant parameter space of the two-component model where the total DM relic is mainly dominated by the fermionic DM contribution. The scalar DM is found to be sub-dominant or equally dominant ($\sim 5\% - 55\%$ of total DM) with significant boost which can be detected in experiments.

Track type:

Dark Matter

Poster Session / 62

Study of Neutrinoless Double Beta Decay in Standard Model extended with Sterile Neutrinos

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The existence of non-interacting fermion singlets, known as sterile neutrinos, is contextualized in beyond Standard Model physics. They have become a key element in various scenarios, ranging from explaining oscillation anomalies to accounting for the neutrino mass generation mechanism via the type-I seesaw. Motivated by this, we study a model in which the Standard Model is augmented with three sterile neutrino states. For the mixing matrix of active and sterile neutrinos, we adopt a particular parametrization of a (6×6) unitary matrix. In this context, we derived the masses of the added sterile states analytically using the exact seesaw relation in terms of active-active and active-sterile mixing angles and CP-violating phases. As both active and sterile states can mediate the neutrinoless double beta decay $(0\nu\beta\beta)$ process, their contributions to the effective mass of the electron neutrino,
$lvertm_{ee}$
$rvert$, become a function of the mass of the lightest active neutrino state and active-active and active-sterile mixing angles and phases. We explore the parameter space of
$lvertm_{ee}$
$rvert$, keeping in mind the present and future sensitivity of $0\nu\beta\beta$ decay searches. By incorporating constraints from charged lepton flavor violation (cLFV) processes and non-unitarity, we examined the impact of additional CP-violating phases and values of active-sterile mixing angles. The numerical values thus obtained for
$lvertm_{ee}$
$rvert$ can vary from as low as $\mathcal{O}(10^{-4})$ to saturating the present experimental limit. To validate our findings, we also assessed the branching ratio of $\mu \to e\gamma$, a significant cLFV process, and considered non-unitarity implications within this theoretical framework.

Track type:

Neutrino Physics

Parallel - Flavour / 63

Purely leptonic decays of heavy-flavored charged mesons

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We study the purely leptonic decays of heavy-flavored charged pseudoscalar (P) and vector (V) mesons $(D^{(*)+}_{(s)}, B^{(*)+}_{(c)})$ in the relativistic independent quark (RIQ) model based on an average flavor-independent confining potential in equally mixed scalar-vector harmonic form. We first compute the mass spectra of the ground-state-mesons and fix the model parameters necessary for the present analysis. Using the meson wave functions derivable in the RIQ model, and model parameters so fixed from hadron spectroscopy. Our results: ($f_{D^+}, f_{D_s^+}$)=($219.58^{+10.72+8.76}_{-11.49-9.33}$, $253.50^{+13.12+9.46}_{-14.03-10.06}$), ($f_{D^{*+}}, f_{D_s^{*+}}$)=($256.09^{+7.49+12.45}_{-7.79-13.03}$, $285.97^{+9.92+12.75}_{-10.38-13.37}$), ($f_{B^+}, f_{B_c^+}$)=($161.34^{+7.42+5.8}_{-7.81-6.14}$, $249.50^{+10.68+9.29}_{-11.45-9.85}$) and ($f_{B^{*+}}, f_{B_c^{*+}}$)=($172.61^{+4.9+8.54}_{-5.06-8.93}$, $258.66^{+9.85+10.1}_{-10.47-10.68}$) in MeV are in good agreement with the available experimental data and other model predictions including those obtained from the LQCD calculations. The ratios of decay constants: f_V/f_P, f_{P_1}/f_{P_2}, f_{V_1}/f_{V_2} and the branching fractions (BFs): $calB(P(V) \to l^+\nu_l), l = e, \mu, \tau$ are also obtained in reasonable agreement with the available experimental data and other Standard Model (SM) predictions. For the unmeasured decay constants especially in the purely leptonic decays of the charged vector mesons, our predictions could be tested in the upcoming Belle-II, SCTF, CEPC, FCC-ee and LHCb experiments in near future.

Track type:

Flavour Physics

Parallel - Dark Matter / 65

Emergence of dark symmetry as well as neutrino mass scales from A_4 flavor symmetry

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We worked on a model for hybrid neutrino mass generation, wherein scotogenic dark sector particles, including dark matter, are charged non-trivially under the A_4 flavor symmetry. The spontaneous breaking of the A_4 group to the residual Z_2 subgroup results in the "cutting"of the radiative loop. As a consequence the neutrinos acquire mass through the hybrid "scoto-seesaw"mass mechanism, with the residual Z_2 subgroup ensuring the stability of the dark matter. The flavor symmetry also leads to several predictions including the normal ordering of neutrino masses and "generalized $\mu-\tau$ reflection symmetry"in leptonic mixing. Additionally, it gives testable predictions for neutrinoless double beta decay and a lower limit on the lightest neutrino mass. The model allows only scalar dark matter, whose mass has an upper limit of $\sim$ 600 GeV, with viable parameter space satisfying all dark matter constraints, available only up to about 80 GeV. Conversely, fermionic dark matter is excluded in our model due to constraints from the neutrino sector. Various aspects of this highly predictive framework can be tested in both current and upcoming neutrino and dark matter experiments.

Track type:

Dark Matter

Parallel - Neutrino / 67

Exploring Flavor Dependent Long-Range Interactions in Atmospheric Neutrino Oscillation at IceCube DeepCore

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The IceCube experiment is a 1 km³ neutrino observatory instrumenting an array of Digital Optical Modules (DOMs) deep inside the ice at the South Pole. DeepCore, a densely-spaced subarray of DOMs at the bottom central region of IceCube, enables the detection of atmospheric neutrinos with an energy threshold in the GeV range. With a wide range of energies over a large range of baselines, the high statistics data of DeepCore provides a unique opportunity to perform standard neutrino oscillation studies as well as explore various sub-leading Beyond the Standard Model (BSM) physics signatures. We consider a well-motivated minimal extension of the Standard Model by an additional anomaly-free, gauged lepton-number symmetry, such as L_e – L_μ or L_e – L_τ. These symmetries give rise to flavor-dependent long-range interaction, mediated through a very light neutral gauge boson. For instance, a huge electron number density inside the Sun can generate this long-range potential, which may lead to significant modifications in atmospheric neutrino oscillation probabilities. In this talk, we present the sensitivity of the IceCube DeepCore detector to search for this flavor-dependent long-range interaction potential with a runtime of 9.3 years.

Track type:

Neutrino Physics

Parallel - Flavour / 68

Implications of SMEFT for semileptonic processes

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The $SU(2)_L \times U(1)_Y$ invariance of the Standard Model Effective Field Theory (SMEFT) predicts multiple restrictions in the space of Wilson coefficients of $U(1)_{em}$ invariant effective lagrangians such as the Low-energy Effective Field Theory (LEFT), used for low-energy flavor-physics observables, or the Higgs Effective Field Theory (HEFT) in unitary gauge, appropriate for weak-scale observables. In this work, we derive and enumerate all such predictions for semileptonic operators up to dimension 6. We find that these predictions can be expressed as 2223 linear relations among the HEFT/LEFT Wilson coefficients, that are completely independent of any assumptions about the alignment of the mass and flavor bases. These relations interconnect a wide array of experimental searches, including high-p_T dilepton searches, top decays, Z-pole observables, charged lepton flavor violating observables, non-standard neutrino interaction searches and semileptonic decays of B, K and D mesons. We illustrate how these relations can be utilized to impose stringent indirect constraints on several Wilson coefficients that are currently weakly constrained or entirely unconstrained by direct experiments. Moreover, these relations imply that any evidence of new physics in a specific search channel must generally be accompanied by correlated anomalies in other channels.

Track type:

Flavour Physics

Parallel - Cosmology / 70

Foreground removal and angular power spectrum estimation of 21 cm signal using harmonic space ILC method

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Mapping the distribution of neutral atomic hydrogen (HI) in the Universe through its 21 cm emission line provides a powerful cosmological probe to map the large-scale structures and shed light on various cosmological phenomena. The Baryon Acoustic Oscillations at low redshifts can potentially be probed by sensitive HI intensity mapping experiments and constrain the properties of dark energy. However, the 21 cm signal detection faces formidable challenges due to the dominance of various astrophysical foregrounds, which can be several orders of magnitude stronger. Our current work introduces a novel and model-independent Internal Linear Combination (ILC) method in harmonic space using the principal components of the 21 cm signal for accurate foreground removal and power spectrum estimation. We estimate the principal components by incorporating prior knowledge of the theoretical 21 cm covariance matrix. We test our methodology by detailed simulations of radio observations, incorporating synchrotron emission, free-free radiation, extragalactic point sources, and thermal noise. We estimate the full sky 21 cm angular power spectrum after application of a mask on the full sky cleaned 21 cm signal by using the mode-mode coupling matrix. These full sky estimates of angular spectra can be directly used to measure the cosmological parameters. For the first time, we demonstrate the effectiveness of a foreground model-independent ILC method in harmonic space to reconstruct the 21 cm signal.

Track type:

Cosmology

Parallel - Cosmology / 71

The correlations between galaxy properties in different environments of the cosmic web

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The cosmic web observed in the present universe is an intricate network of galaxies. According to the standard cosmological model, the tiny density fluctuations that existed in the early universe were gravitationally amplified, giving rise to the observable cosmic web or the large-scale structures. To enhance our comprehension of the cosmos and gain valuable insights on galactic evolution it is essential to explore the cosmic web. The analysis of the characteristics of various galaxy properties and their inter-relationships across different parts of the cosmic web is an effective way to address this. In our work, we utilize data from the Sloan Digital Sky Survey (SDSS) and classified a total

of 24146 galaxies into 4 categories based on their cosmic-web environments, using a tidal tensor based analysis. We investigate the correlations between a number of galaxy properties in different geometric environments by employing the Pearson correlation coefficient (PCC) and the normalized mutual information (NMI). A two-tailed t-test assesses the statistical significance of the observed differences between these relations in different geometric environments and shows that in most of the cases the scaling relations between the observable galaxy properties are susceptible to the geometric environments with a $> 99.99\%$ confidence level.

Track type:

Cosmology

Parallel - Collider & BSM / **73**

Large lepton number violation at colliders in linear seesaw

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In the simplest linear seesaw picture the neutrino mass mediators can be accessible to colliders. Novel charged Higgs and heavy neutrino production mechanisms can be sizeable at e^+e^-, $e^-\gamma$, pp, or muon colliders. The associated signatures may shed light on the Majorana nature of neutrinos and the significance of lepton number non-conservation.

Track type:

Collider and BSM Physics

Parallel - Cosmology / **74**

Magnetic field amplification and decay in cosmic string wakes

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We do a detailed study on vortex formation in a magnetized plasma within the spacetime of a moving cosmic string using analytical and numerical methods. The conical spacetime around the cosmic string causes the frozen-in magnetic field to deform due to the fluid flow. We find that the overdensity in the wake region amplifies the magnetic field. This amplification depends on the direction and the lengthscale of the magnetic perturbations. Alfven's theorem of flux conservation explains this result.

However, our study also shows that the magnetic field can decay depending on the perturbation lengthscale, due to the breakdown of Alfven's theorem at a certain lengthscale. This lengthscale is the gyroradius of the charged particles in the plasma. Our findings are significant for understanding magnetic reconnection in cosmic string wakes.

Track type:

Cosmology

Parallel - ASP & GW / 75

Probing flavor violation and baryogenesis via primordial gravitational waves

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We show that observations of primordial gravitational waves of inflationary origin can shed light into the scale of flavor violation in a flavon model which also explains the mass hierarchy of fermions. The energy density stored in oscillations of the flavon field around the minimum of its potential redshifts as matter and is expected to dominate over radiation in the early universe. At the same time, the evolution of primordial gravitational waves acts as bookkeeping to understand the expansion history of the universe. Importantly, the gravitational wave spectrum is different if there is an early flavon dominated era compared to radiation domination expected from a standard cosmological model and this spectrum gets damped by the entropy released in flavon decays, determined by the mass of the flavon field m_S and new scale of flavor violation $\Lambda_{\rm FV}$. We derive analytical expressions of the frequency above which the spectrum is damped, as-well-as the amount of damping, in terms of m_S and $\Lambda_{\rm FV}$. We show that the damping of the gravitational wave spectrum would be detectable at BBO, DECIGO, U-DECIGO, $\mu-$ARES, LISA, CE and ET detectors for $\Lambda_{\rm FV} = 10^{5-10}$ GeV and $m_S = \mathcal{O}(\rm TeV)$. Furthermore, the flavon decays can source the baryon asymmetry of the universe. We identify the $m_S - \Lambda_{\rm FV}$ parameter space where the observed baryon asymmetry $\eta \sim 10^{-10}$ is produced and can be tested by gravitational wave detectors like LISA and ET. We also discuss our results in the context of the recently measured stochastic gravitational background signals by NANOGrav.

Track type:

Gravitational waves

Parallel - ASP & GW / 76

Inflationary Gravitational Wave Spectral Shapes as test for Low-Scale Leptogenesis

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We study thermal and non-thermal resonant leptogenesis in a general setting where a heavy scalar ϕ decays to right-handed neutrinos (RHNs) whose further out-of-equilibrium decay generates the required lepton asymmetry. Domination of the energy budget of the Universe by the ϕ or the RHNs alters the evolution history of the primordial gravitational waves (PGW), of inflationary origin, which re-enter the horizon after inflation, modifying the spectral shape. The decays of ϕ and RHNs release entropy into the early Universe while nearly degenerate RHNs facilitate low and intermediate scale leptogenesis. We show that depending on the coupling y_R of ϕ to radiation species, RHNs can achieve thermal abundance before decaying, which gives rise to thermal leptogenesis. A characteristic damping of the GW spectrum resulting in two knee-like features or one knee-like feature would provide evidence for low-scale thermal and non-thermal leptogenesis respectively. The resulting novel features compatible with observed baryon asymmetry are detectable by future experiments like LISA and ET. By estimating signal-to-noise ratio (SNR) for upcoming GW experiments, we investigate the effect of the scalar mass M_ϕ and reheating temperature T_ϕ, which depends on the $\phi - N$ Yukawa couplings y_N.

Track type:

Gravitational waves

Plenary / **77**

The neutrino roof

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I identify the maximum cross sections probed by single-scatter "WIMP" searches in dark matter direct detection. Due to Poisson fluctuations in scatter multiplicity, these ceilings scale logarithmically with mass for heavy dark matter and often lie in regions probed by multiscatter searches. I will present a generalized formula for single-scatter event rates, and use it to recast WIMP searches by the quintal-to-tonne scale detectors
XENON1T, XENONnT, LZ, PANDAX-II, PANDAX-4T, DarkSide-50 and DEAP-3600 to obtain ceilings and floors up to a few 10^{17} GeV mass and 10^{-22} cm^2 per-nucleus cross section. Future large-exposure detectors would register an almost irreducible background of atmospheric neutrinos that would determine a dark matter sensitivity ceiling that I dub the "neutrino roof", in analogy with the well-studied "neutrino floor". Accounting for this background, I will show the reaches of the $10-100$ tonne scale DarkSide-20k, DARWIN/XLZD, PANDAX-xT, and Argo, which would probe many decades of unconstrained parameter space up to the Planck mass, as well as of $10^3 - 10^4$ tonne scale noble liquid detectors that have been proposed in synergy with neutrino experiments. I will round up with ideas on how to raise single-scatter ceilings by orders of magnitude.

Track type:

Dark Matter

Parallel - Cosmology / **80**

Short-Duration GRBs from Magnetic Reconnection in Cosmic String Wakes

Author: DILIP KUMAR[1]

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Magnetic reconnection in the magnetized wakes of cosmic strings results in the release of a large amount of energy. This energy is released in a short period of time. In this work, we show that this sudden release of energy can result in a Gamma-Ray Burst (GRBs) of short duration. Since the magnetic reconnection occurs due to the shock collisions in the cosmic string wake, we use a modified internal shock model to calculate the fluence, burst duration and light curves for the resulting GRB. The BATSE data indicates that short GRBs can be related to a large energy release from an extremely compact emission region. We show that the characteristics of short duration GRB's originating from magnetic reconnection in cosmic string wakes are consistent with the BATSE data.

Keywords: cosmic strings, wakes, magnetic reconnection, GRBs.

Track type:

Cosmology

Parallel - Flavour / 81

Study of exclusive nonleptonic decay of $B_s \to \psi(\eta_c)(nS)K_s$

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We analyze the exclusive two-body nonleptonic decays of B_s^0 meson to ground as well as radially ecited $2S$ charmonium states and a light meson K_s, induced by the $b \to c\bar{c}d$ transition. Within the framework of relativistic independent quark (RIQ) model based on a flavor-independent interaction potential in scalar-vector harmonic form, we calculate the weak form factors from the overlapping integrals of meson wave function obtained in this model. Using the factorization approximation, we predict the branching fraction for the $B_s \to \psi(\eta_c)(nS)K_s$, which can be compared with future theoretical predictions. Branching fraction for $B_s \to J/\psi K_s$ decay is found to be in good agreement with the data from LHCb Collaboration, whereas for $B_s \to \psi(2S)K_s$, it is found to be within the detection ability of the CMS Collaboration. We also predict the ratio: $calR\left(\frac{calB(B_s\to\psi(nS)K_s)}{calB(B_d\to\psi(nS)K_s)}\right)$ which is in broad agreement with the data from LHCb and CMS Collaborations. These results indicate that the present approach works well in the description of exclusive nonleptonic B_s decays within the framework of the RIQ model.

Track type:

Flavour Physics

Parallel - Flavour / 84

Rare b to sll decays at 13 TeV by CMS Detector

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Recent results on the rare b ⟶ sll decays are presented by the CMS experiment at 13 TeV. The individual branching fraction results of B± ⟶ K±μ+μ− and B± ⟶ K±e+e− decays are shown along with the lepton flavor universality (LFU). The effective lifetime of B0s ⟶ J/ψK0S decay is discussed. Finally, the CP averaged (Fl) and CP Asymmetry (A6) angular observables of Bs0 to phi mu mu decay is presented as a function of a square of dimuon invariant mass (q2) using the toy MC samples.

Track type:

Flavour Physics

Poster Session / 85

Study of Thermodynamic Quantities in O+O collisions at √(S_NN)=7 TeV using the Color String Percolation Model at the LHC

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The Large Hadron Collider (LHC) at CERN has a plan to have Oxygen-Oxygen (O+O) collisions at √(S_NN)=7 TeV in the forthcoming run. As the system size of O+O collisions have the final state multiplicity overlap with those produced in Pb+Pb, p+Pb, and pp collisions, it becomes exciting to study thermodynamic quantities using the Color String Percolation Model (CSPM). The thermodynamic quantities like temperature, energy density, speed of sound, shear viscosity to entropy density ratio, and trace anomaly are obtained from the soft region of the transverse momentum spectra of O+O collisions at √(S_NN)=7 TeV. The percolation approach within CSPM can effectively describe the initial stages of high energy heavy ion collisions in the soft region. The obtained results for O+O collisions are compared with the published results from pp and A-A collisions using ALICE data.

Track type:

Collider and BSM Physics

Parallel - Neutrino / 86

On Exploring Leptogenesis in an Extension of the Scotogenic Model

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We investigate the potential for low-scale leptogenesis and WIMP dark matter within the singlet-triplet scotogenic model (STScM). First, we examine the scenario with two heavy right-handed fermion (HRF) fields, N and Σ, which exhibit a moderate mass hierarchy. In this setup, the out-of-equilibrium decays of both HRFs generate a lepton asymmetry. Our analysis shows that the leptogenesis scale in this case is similar to that of standard thermal leptogenesis, with $M_{N,\Sigma} \sim 10^9$ GeV, as seen in the Type-I seesaw mechanism. In the second scenario, we conduct a detailed study with three HRFs (N_1, N_2, Σ), where the mass hierarchy $M_{N_1} < M_\Sigma \ll M_{N_2}$ significantly lowers the scale of leptogenesis, bringing it down to the TeV range. In this model, the dark matter candidate is the real component of the neutral part of the inert scalar (η).

Track type:

Neutrino Physics

Parallel - Dark Matter / 87

Complementary probe of two-component Dark Matter and Gravitational waves in a scalar Singlet-Triplet extended model with a Dirac Fermion

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Strong first-order phase transitions (SFOPT), a necessary ingredient for the Electroweak Baryogenesis (EWBG) to incorporate the observed baryon asymmetry, can give rise to stochastic Gravitational Waves (GW). Understanding the sources of such primordial waves can complement the collider searches of new physics Beyond the Standard Model (BSM). In this work, we investigate the GW production from a two-component Dark Matter (DM) scenario by extending the Higgs sector of the Standard Model (SM) with a real scalar singlet and a hyperchrageless ($Y = 0$) scalar triplet where the neutral part of the triplet acts as a DM candidate under a Z_2 symmetry. This setup is further extended with a Dirac fermion which transforms non-trivially under a Z_2' symmetry making it the second DM candidate. We find that the two DM particles can have masses that range from around $m_h/2$ to over the TeV scale, and significantly the $Y = 0$ scalar triplet DM can be below TeV, which is otherwise ruled out as a single component DM unless its mass > 1.9 TeV. We highlight the interplay between cosmological and collider constraints, illustrating that a substantial portion of the parameter space, which eludes current limitations, is within the sensitivity range of future and current detectors such as Xenon1T, LZ-2022, or Darwin. Next, we investigate the FOPT dynamics in our current framework, and we find regions favouring a successful EWBG in the model parameter space that escapes all phenomenological constraints and remains consistent with DM relic and Direct Detection (DD) limits. We further estimate the gravitational wave signals arising from such SFOPT and observe that space-based future GW detectors such as LISA, BBO, DECIGO, and DECIGO-corr can probe the predicted GW spectrum. Our investigation complements the collider searches of BSM new physics at the DM and GW detector frontiers.

Track type:

Dark Matter

Parallel - Cosmology / 88

Synchrotron radiation from accelerated electrons in the magnetized cosmic string wakes.

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Magnetic fields in cosmic string wakes generate magnetohydrodynamic shock waves. The reletivistic charged particles in the wake will get accelerated and emit synchrotron radiation. We assume that the overall magnetic field is homogeneous over the width of the wake. Using a one-zone leptonic model, we obtain the sprectrum of synchrotron radiation emitted by these non-thermal relativistic electrons in the wake of a cosmic string. We find that the overall spectrum has a broad peak and spans over a wide range of frequencies due to multiple scatterings of the electrons. We found that there are some unidentified sources in different catalogues detected by current all-sky surveys in the frequency range of the synchrotron spectrum we have obtained. We discuss how this can be another signature for cosmic string wakes.

Track type:

Cosmology

Parallel - Collider & BSM / 89

Exclusive photon and lepton production in ultraperipheral PbPb collisions at CMS

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Ultraperipheral (UPC) lead-lead collisions produce very large photon fluxes, allowing for the study of fundamental quantum-mechanical processes and serving as a very good probe for physics beyond the standard model (BSM). In this talk, measurements of the light-by-light scattering (LbL, $\gamma\gamma \to \gamma\gamma$) and the Breit–Wheeler (B–W, $\gamma\gamma \to \mathrm{e}^+\mathrm{e}^-$) processes are reported in UPC at 5.02 TeV using the 2018 CMS lead-lead data sample of $1.65\ \mathrm{nb}^{-1}$. Limits on the production of axion-like particles coupling to photons are set over the mass range $m_\mathrm{a} = 5$–100 GeV, including the most stringent limits in 5–10 GeV. We will also report the latest measurements of the anomalous magnetic moment of the τ lepton using UPC PbPb collisions recorded by the CMS experiment.

Track type:

Collider and BSM Physics

Parallel - Cosmology / 91

Dynamical system analysis of DBI scalar field cosmology in general symmetric teleparallel gravity.

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In this presentattion, we offer the dynamical system analysis of the DBI (Dirac-Born-Infeld) scalar field in a modified f(Q) gravity context. We have taken a polynomial form of modified gravity and used two different kinds of scalar potential, i.e., polynomial and exponential, and found a closed autonomous dynamical system of equations. We have analyzed the fixed points of such a system and commented on the conditions under which deceleration to late-time acceleration happens in this model. We have noted the similarity of the two models and have also shown that our result is indeed consistent with the previous work done on Einstein's gravity. We have also investigated the phenomenological implications of our models by plotting the EoS (⊠), Energy density (Ω), and deceleration parameter (⊠) w.r.t. to e-fold time and comparing with the present value. Finally, we conclude the paper by observing how the dynamical system analysis differs in modified f(Q) gravity, and we also provide some of the future scope of our work.

Track type:

Cosmology

Parallel - Collider & BSM / 92

Search for BSM Physics in High-Mass Diphoton Events with the CMS Detector at √s = 13 TeV

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The quest for new physics beyond the Standard Model (BSM) remains a cornerstone of contemporary particle physics, driving the pursuit of new particles. We present the recent results from an extensive search for BSM particle states in 'high-mass diphoton events', a signature indicative of various SM extensions such as Supersymmetry, extra dimensions, and non-minimal Higgs sectors.
Searches for both spin-0/2 particles, in resonant as well as non-resonant scenarios, were carried out using the full luminosity of the LHC Run-II in proton-proton collisions at $\sqrt{s} = 13$ TeV with the CMS detector. We place constraints on the production of heavy Higgs bosons and the continuum clockwork mechanism, setting the most stringent limits to date on ADD extra dimensions and RS gravitons, excluding coupling parameters greater than 0.1.
This talk will highlight salient results and analysis methodology, with particular emphasis on the complementary techniques employed to model signals and backgrounds, thereby enhancing the BSM sensitivity.

Track type:

Collider and BSM Physics

Parallel - Collider & BSM / 93

Search for dark matter in Higgs decays to two taus + MET channel using full Run-2 data

Author: Bisnupriya Sahu[1]

Co-author: Bhawna Gomber [2]

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The search for dark matter is performed in association with a Higgs boson decaying into a pair of tau leptons and significant missing transverse momentum in proton-proton collisions data of CMS detector at CERN LHC at a center-of-mass energy of 13 TeV. The results are interpreted in the framework of the 2HDM+a model and baryonic Z'model by using data collected by the CMS experiment during Run-2.

Track type:

Collider and BSM Physics

Parallel - Cosmology / 94

CMB Constraints on Natural Inflation with Gauge Field Production

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The natural inflation model with a periodic cosine potential is ruled out by recent Planck 2018 data for the decay constant f
$lesssim 5.5\ M_{\rm Pl}$. If the Planck data is combined with the BICEP Keck array and BAO data, the model is excluded (at 2-σ) for all values of f. In this context, we revisit the model when the pseudoscalar inflation ϕ is coupled with a gauge field via a coupling of the form $\frac{\alpha}{f}\phi F\tilde{F}$, where $F(\tilde{F})$ denotes the gauge field (dual) strength tensor, and α is the coupling constant. The back-reactions associated with the gauge field production during the later stages of inflation extend the duration of inflation. We numerically evaluate the dynamics of the fields while neglecting the effects due to the perturbations in the inflaton field. It allows us to determine the scalar and tensor power spectra leading to the calculations of observables at the Cosmic Microwave Background (CMB) scales. We find that the natural inflation model survives the test of the latest data only for a certain range of the coupling constant α. Our analysis shows that the latest constraints coming from the scalar spectral index are more stringent than the ones arising from the non-gaussianities and the running of the scalar spectrum. This leads to lower and upper bounds on ξ_*, the parameter that controls the growth of the gauge field.

Track type:

Parallel - Neutrino / 95

Latest Three-Flavor Neutrino Oscillation Results from NOvA

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NOvA, is a two-detector, long-baseline neutrino oscillation experiment located at Fermilab, Batavia, IL, USA. It aims to constrain neutrino oscillation parameters by analyzing $\nu_\mu(\bar{\nu}_\mu)$ disappearance and $\nu_e(\bar{\nu}_e)$ appearance data. The experiment uses the Neutrinos at Main Injector (NuMI) beamline at Fermilab, which delivers a high-purity 900 KW beam of neutrinos and anti-neutrinos. The detectors are functionally identical finely granulated liquid tracking calorimeters, both situated 14.6 mrad off-axis to the beam direction. The NOvA Near Detector (ND), situated 100 meters underground and 1 kilometer from the beam source, detects the un-oscillated $\nu_\mu(\bar{\nu}_\mu)$ and beam $\nu_e(\bar{\nu}_e)$ events. The Far Detector (FD), located in Ash River, MN, USA, 809 kilometers from the ND, records the oscillated $\nu_e(\bar{\nu}_e)$ and the un-oscillated $\nu_\mu(\bar{\nu}_\mu)$ events. NOvA employs an extrapolation technique to predict the expected events at the Far Detector based on the Near Detector data, thereby providing a significant constraint on systematic uncertainties in the oscillation analyses. As NOvA accumulates more data, controlling these systematic uncertainties becomes increasingly important. This talk will detail the NOvA neutrino oscillation analysis framework and its approach to minimizing dominant systematic uncertainties using Near Detector data. The latest three flavor neutrino oscillation results based on a neutrino-beam exposure of 26.60×10^{20} POT and an anti-neutrino beam exposure of 12.50×10^{20} POT and a novel low energy ν_e sample, will also be presented.

Track type:

Neutrino Physics

Parallel - Flavour / **96**

Flavour phenomenology and collider signatures of the flavon of $\mathcal{Z}_{\mathrm{N}} \times \mathcal{Z}_{\mathrm{M}}$ flavour symmetry

Author: Neelam Singh[1]

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We investigate the flavour and collider phenomenology of the flavon of the novel and unique $\mathcal{Z}_{\mathrm{N}} \times \mathcal{Z}_{\mathrm{M}}$ flavour symmetry, which is capable of addressing the flavour problem of the standard model through the Froggatt-Nielsen (FN) mechanism. In addition to the conventional approach relying on soft-symmetry breaking of the $\mathcal{Z}_{\mathrm{N}} \times \mathcal{Z}_{\mathrm{M}}$ flavour symmetry, we employ a novel symmetry-conserving mass mechanism for the axial flavon to explore its phenomenology. We first examine the constraints on the flavon parameter space using current and projected measurements of various quark and leptonic flavour violating observables. Furthermore, we analyze the characteristic collider signatures of the flavon of the different $\mathcal{Z}_{\mathrm{N}} \times \mathcal{Z}_{\mathrm{M}}$ flavour symmetries through its decay and production channels, discussing the accessibility of these signatures to the reach of the high-luminosity LHC, high energy LHC, and a 100 TeV collider.

Track type:

Flavour Physics

Parallel - Cosmology / 97

Boosting HI-galaxy cross-clustering signal through higher-order cross-correlations

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In the post-reionization universe (z 6), large-scale structure (LSS) is traced by dense, self-shielded clumps of neutral hydrogen (HI) within galaxies. Line-Intensity-Mapping of 21cm is an effective method to probe LSS and constrain cosmology. However, auto-clustering studies of HI are hampered by survey systematics, making HI detection challenging. Cross-correlation analysis between HI and galaxies helps mitigate these systematics. Traditional two-point correlation functions (2PCFs) capture Gaussian information but miss non-Gaussian aspects, which are crucial due to the non-linear clustering of dark matter at small scales in a low redshift universe. Therefore, higher-order statistics are necessary to fully extract cosmological information from upcoming surveys.
Recently, k-nearest neighbor cumulative distribution functions (kNN-CDFs) have emerged as improved, easy-to-calculate higher-order statistics, sensitive to all N-point functions of the underlying field. The kNN-Field framework is particularly effective in identifying cross-clustering patterns even in noisy data. Despite a few direct detections of HI clustering around galaxies using 2PCFs, a more robust technique is needed due to the weak HI signal and significant foreground and thermal noise contamination.
In this talk, I'll present our work on developing a pipeline for robust HI clustering detection around galaxies. Using Illustris TNG300 simulation data, we found that the kNN-Field framework offers significantly higher detection rates than 2PCFs. Additionally, we demonstrate its reliability in capturing clustering patterns from a realistic T_b field, considering foreground and thermal noise effects. The results are promising for HI detection using the kNN-Field framework, even with information loss due to foreground filtering and thermal noise. Our next step involves applying this framework to the observational data (CHIME for HI and eBOSS, DESI galaxy catalogs) for robust detection and modeling the HI-galaxy cross-clustering signal in order to do cosmology.

Track type:

Cosmology

Parallel - Cosmology / 98

Can self-interaction in supernova neutrinos cause changes in gravitational wave memory signals?

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Gravitational wave memory is a persistent non-oscillatory shift in the gravitational wave amplitude. Such effects are ubiquitous in astrophysical and cosmological cataclysmic events involving gravitational radiation. In this talk, we turn our attention to the case of a supernova neutrino burst generating the gravitational radiation. Previous studies along this line have demonstrated that a neutrino burst in such scenarios gives rise to a gravitational memory signal. Here, we specifically inquire about the alterations to the memory signal when neutrinos emitted from a supernova undergo self-interaction, presenting an avenue for indirectly detecting neutrino self-interaction.

Track type:

Gravitational waves

Parallel - Flavour / 99

Searches for dark sector particles at Belle and Belle II

Author: Rajesh Kumar Maiti[None]

The Belle and Belle II experiment have collected samples of e^+e^- collision data at centre-of-mass energies near the $\Upsilon(nS)$ resonances. These data have constrained kinematics and low multiplicity, which allow searches for dark sector particles in the mass range from a few MeV to 10˜GeV. Latest results are presented.

Track type:

Collider and BSM Physics

Parallel - Flavour / 100

Studies of radiative and electroweak penguin decays of B mesons at Belle and Belle II

Author: Nadiia Maslova[1]

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The Belle and Belle II experiments have collected a 1.1 ab^{-1} sample of $e^+e^- \rightarrow B\bar{B}$ collisions at the $\Upsilon(4S)$ resonance. These data, with low particle multiplicity and constrained initial state kinematics, are an ideal environment to search for rare B meson decays proceeding via electroweak and radiative penguin processes. Results include those of the decay $B \rightarrow K^+\nu\bar{\nu}$ using an inclusive tagging technique. We also present results on radiative decays $B^0 \rightarrow \gamma\gamma$, $B \rightarrow \rho\gamma$ and $B \rightarrow K^*\gamma$. CP and isospin asymmetries are presented for the latter two decays. We also present results from decays related to $b \rightarrow s\ell^+\ell^-$ and $b \rightarrow d\ell^+\ell^-$ transitions, where ℓ is an electron or muon.

Track type:

Flavour Physics

Parallel - Collider & BSM / 101

A Minimal model for Cosmological Selection of the Electroweak scale

Author: Susobhan Chattopadhyay[1]

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In this talk, I will present a minimal model for cosmological selection of the electroweak scale that can resolve the hierarchy problem. Our model consists of a Pseudo Nambu Goldstone Boson (PNGB) and an extra Higgs doublet along with the Standard Model, with a cutoff that can be taken almost as high as the Planck scale. We consider a landscape of vacua with varying Higgs sector parameters. In our model, we show that the vacuum energy peaks when the Higgs has a non-zero vacuum expectation value (vev) that is much smaller than the cutoff. These regions of the landscape, with a small Higgs vev, thus expand at an exponentially higher rate than the other regions during inflation, eventually dominating in volume. This minimal model has robust predictions in the 2HDM parameter space which can be tested in present and future colliders. Moreover, the PNGB may contribute to the observed dark matter relic density.

Track type:

Collider and BSM Physics

Parallel - Flavour / 104

Connecting leptoquarks to the B meson missing energy anomaly

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Leptoquarks, hypothesized as particles of scalar or vector nature, interact with both quarks and leptons. Building on recent measurements from B factories, we investigate how leptoquark couplings influence the rare decays of B mesons involving missing energy. We systematically explore all possible scalar and vector leptoquarks that are invariant under the Standard Model gauge group, conducting a comprehensive analysis to fit their couplings and masses using the latest experimental data. This study focuses on assessing the specific impact of each leptoquark on the rare semileptonic B meson decays with missing energy.

Track type:

Flavour Physics

Parallel - Dark Matter / 105

The Dark Hyper-Charge Symmetry

Authors: HEMANT KUMAR PRAJAPATI[1]; Rahul Srivastava[2]

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$U(1)$ extension of the Standard Model is well motivated, where the charges of SM fermions are fixed by gauge anomaly cancellations and Yukawa interactions. While the literature extensively discusses anomaly cancellation solutions in which SM fermions are vector-like under new symmetry, allowing the Yukawa structure to remain invariant, chiral solutions in which SM fermions are chiral under new symmetry are not well explored. In this work, we venture into these relatively unexplored chiral solutions, presenting a comprehensive set of solutions for gauge anomaly cancellation through the inclusion of three right-handed dark fermions. We will focus on a particularly intriguing chiral solution and demonstrate, in a model-independent manner using only the Z' interaction channel, that the lightest dark fermion, denoted as F_1, is a viable Dark Matter candidate, and it can meet all current Dark Matter constraints with a mass of M_{F_1}
$gtrsim 150$ GeV.

Track type:

Dark Matter

Parallel - Cosmology / 109

Fall of Casimir energy in the non-commutative space-time.

Author: Suman Kumar Panja[1]

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Non-commutative geometry as a possible paradigm to understand quantum gravity is gaining more attention in last decades. Non-commutativity of the space-time breaks the Lorentz invariance and one uses Hopf algebra structure to regain consistent particle interpretation. It is thus of importance to study the status of equivalence principle in the non-commutative space- time.

We examine how the Casimir energy in the κ-space-time falls under the action of gravity. This is done by calculating the scalar field in the background of κ-deformed space-time. We set up the Casimir plates in a gravitational field using κ-deformed Rindler coordinates and compute the total force acting on the Casimir apparatus in a weak gravitational field. We show that the Casimir energy, including the divergent part (self-energies of the plates), gravitates like a conventional mass. This result implies that the mass-energy equivalence principle is upheld in κ-deformed space-time, even with the incorporation of a fundamental length scale due to space-time non-commutativity.

Track type:

Dark Energy and Modified Gravity

Parallel - Dark Matter / 111

Search for dark matter with the monophoton final state using full Run2 data at CMS

Authors: Bhawna Gomber[1]; Shriniketan Acharya[2]

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A search is conducted for dark matter pair-production using the Dark Matter simplified model and for graviton production predicted by the ADD large extra dimensions model in a final state with a photon and missing transverse energy in pp collisions at sqrt(s) = 13 TeV. Data taken by the CMS experiment at the CERN LHC in Full Run2, corresponding to an integrated luminosity of 137.2 fb-1, is analyzed. We find no deviation from the Standard Model prediction for this final state and achieve an extension of the current limits on parameter space.

Track type:

Dark Matter

Parallel - Collider & BSM / 114

Measurement of the ttH production cross-section in multi-leptonic final states in pp collisions at a centre-of-mass energy of 13 TeV with the CMS detector

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The Yukawa coupling of the Higgs boson to the top quark is a pivotal parameter in the Standard Model, providing insights into fundamental particle interactions. This coupling is investigated through the production processes of Higgs bosons in association with top quarks, including tH and ttH. Utilizing proton-proton collision data at a centre-of-mass energy of 13 TeV, this study encompasses an integrated luminosity of up to 137 fb^{-1} from the data period 2016 to 2018. Advanced machine learning methods enhance the sensitivity of distinguishing signals from the background and separating tH and ttH signals. The observed production rates for these processes are analyzed, with tH showing a significance of 1.38σ and ttH demonstrating a significance of 4.73σ. The coupling yt is constrained at a 95% confidence level within specific intervals. The sensitivity results will be presented, focusing on final states involving multi-lepton configurations.

Track type:

SM and Higgs Physics

Parallel - Collider & BSM / 115

Status of (e)GM model in the light of NLO unitarity and latest Run II data from LHC

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The most general two-triplet extension of the Standard Model demanding custodial symmetry gives rise to the extended Georgi-Machacek (eGM) model. Via computing one-loop corrections to all $2 \rightarrow 2$ scattering amplitudes in the eGM model, we place NLO unitarity bounds on the quartic couplings. On top of that, we derive stringent conditions on the quartic couplings ensuring there exists no field direction that leads to an unbounded potential. Finally, we perform a global fit for eGM model using HEPfit to these theoretical bounds together with the latest Run II LHC data on Higgs signal strengths. We delineate the allowed ranges for the heavy Higgs boson masses and their mass differences. We re-analyse the conventional GM model by including NLO unitarity bounds for the first time. The global fit for GM model, with these improved theoretical and latest experimental constraints significantly refines the allowed ranges of the quartic couplings and heavy Higgs masses present in the literature.

Track type:

SM and Higgs Physics

Poster Session / 117

GPU based track finding for muon g-2/EDM experiment at J-PARC

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The quest for precise measurements of the muon's magnetic moment, prompted by the observed discrepancy between theoretical and experimental results by other experiments worldwide, is the motivation of the upcoming muon g-2/EDM experiment at J-PARC. The precise reconstruction of the positron tracks from muon decays plays a vital role, which is currently accomplished by a Hough transformation technique. However, due to the track-finding bottleneck in the reconstruction pipeline, a 40-fold reduction in computational time is essential. Here, we present the overview and status of a GPU-based approach to address this problem. The basic idea is to leverage GPU's (Graphics Processing Units) capability to optimize the track finding through parallel execution utilizing multiple GPU threads, allowing for significant acceleration in computation. Initial studies have shown encouraging results but also indicate additional refinements are required for high pileup conditions.

Track type:

Flavour Physics

118

Probing Particle Physics Frontiers with CMB S4: Unveiling Cosmic Secrets

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The Cosmic Microwave Background Stage 4 (CMB-S4) experiment represents the next leap forward in the cosmology of the early universe, promising unprecedented precision in our understanding of the universe's fundamental properties. This talk will explore the anticipated improvements in the particle physics frontier, focusing on its potential to address some of the most pressing questions in cosmology and particle physics. Key objectives of CMB-S4 include the precise measurement of primordial gravitational waves through the detection of CMB B-modes, which can provide insights into the physics of inflation and the early universe; the mapping of the matter distribution of the universe through CMB lensing measurements, enhancing our understanding of dark matter and dark energy; and the detailed characterization of cosmic neutrinos, offering constraints on neutrino mass and mass hierarchy, energy density, and possible neutrino self-interactions. Additionally, CMB-S4 aims to explore new physics beyond the Standard Model, such as the existence of extra light relics. By improving the sensitivity and resolution of CMB observations, CMB-S4 will play a crucial role in testing and refining our cosmological models, potentially uncovering new phenomena that could revolutionize our understanding of the cosmos.

Track type:

CMBR

Parallel - Flavour / **119**

Search for radiative Ds decays

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The study of weak radiative decays of charmed mesons is still in its developing stage. The weak decays of D mesons pose challenges due to significant final-state interactions. However, decays mediated by $c \to u\gamma$ transitions can be affected by potential contributions coming from the non-minimal supersymmetry, which is an new physics scenario. The ratio of branching fractions for radiative D^0 decays could be violated already in the SM framework, while a similar ratio for D_s^+ radiative decays offers much better prospects for new physics. We present herein the first sensitivity study of the radiative charm decays $D_s^+ \to \rho^+\gamma$ and $D_s^+ \to K^{*+}\gamma$ with data collected by the Belle experiment.

Track type:

Flavour Physics

Poster Session / **120**

Dark connection of muon (g – 2)

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The gap between the experimental average and standard model value for the muon anomalous magnetic moment is a direct hint of fields beyond the standard model. In this work, we investigate the contribution of heavy right-handed neutrino for muon (g - 2) in left-right symmetric model. Simultaneously, we checked the dominance(type-I and type-II) patterns for the Majorana type Yukawa coupling matrix and found the effective ones. Our study shows two energy range solutions for right-neutrino, one at low energy (1 Gev) and another at high energy (around 5 TeV to 100 TeV) both giving viable contributions in the gap Δa_μ . Study shows that two of the included right-handed neutrinos may be the possible candidates for dark matter as they satisfy the 3.55 keV line spectra.

Track type:

Neutrino Physics

Parallel - Dark Matter / 121

From Bar Formation to Dark Matter Detection: Implications of Inner Halo Spin Distribution

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Several studies have shown that dark matter halo properties like concentration, triaxiality, and spin play an important role in bar instability dynamics. Building on these insights, we investigated the role of the inner (within the disk region) halo angular momentum distribution on bar formation and evolution processes. We conducted a series of high-resolution N-body simulations of Milky Way-type disk galaxies. These models began with similar disks but with progressively increasing inner halo angular momentum in the surrounding dark matter halo. The bar formed earlier in the model with higher inner halo angular momentum compared to those with lower values, similar to studies suggesting the influence of halo spin. However, the bar's secular evolution, which refers to its long-term development, exhibited growth in all models regardless of inner halo angular momentum. This contradicts earlier claims that high halo spin dampens the bar's secular evolution. The model with the highest inner angular momentum displayed more pronounced box/peanut/x-shaped bulges compared to the model with the lowest. Finally, using multiple approaches, we show that dynamical friction exerted by the dark matter halo on bars reduces when most of the dark matter particles are rotating in the same direction as the disk (net prograde rotation). This finding can potentially explain the short bars with high pattern speeds observed in Low Surface Brightness galaxies with larger halo angular momentum. Additionally, the dark matter wakes in the Milky Way, caused by strong dynamical friction, enhance the density of dark matter along the bar region. This potentially creates observable line-of-sight signatures for dark matter detection experiments.

Track type:

Dark Matter

Poster Session / 122

Warm Inflation with Barrow Holographic Dark Energy

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In this work, we study the warm inflation mechanism in the presence of the Barrow holographic dark energy model. Warm inflation differs from other forms of inflation primarily in that it makes the assumption that radiation and inflaton exist and interact throughout the inflationary process. After the warming process, energy moves from the inflaton to the radiation as a result of the interaction, keeping the cosmos warm. Here we have set up the warm inflationary mechanism using Barrow holographic dark energy as the driving agent. Warm inflation has been explored in a high dissipative regime and interesting results have been obtained. It is seen that the Barrow holographic dark energy can successfully drive a warm inflationary scenario in the early universe. Finally, the model has been compared with the observational data and compliance has been found.

Track type:

Cosmology

Parallel - Flavour / 124

Minimal Z' for Radiative generation of fermion masses

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We discuss a mechanism in which the masses of the third, second, and first generation charged fermions are generated at tree level, 1-loop, and 2-loop levels, respectively. In this mechanism, loop-generated masses are obtained through fermionic self-energy corrections induced by heavy gauge bosons of a new flavorful $U(1)_F$ symmetry, which have flavor-violating interactions with Standard Model fermions. Phenomenologically, the flavor-violating couplings Q_{ij} are desired to have $|Q_{12}| < |Q_{23}|, |Q_{13}|$ because constraints from K^0-$\overline{K}^0$ mixing and μ-e conversion in nuclei, involving first and second family fermions, are more stringent than others. We establish a framework to achieve this condition and quantify the optimal flavor violations required to implement the radiative mass generation mechanism. This framework lowers the new physics scale by nearly two orders compared to other radiative mass models. We present an explicit anomaly-free model based on a flavor non-universal $U(1)_F$, incorporating the mechanism and predicting a lower bound on the new physics scale at 10^3 TeV. Additionally, we discuss the possibility of light neutrino masses within this class of models.

Track type:

Flavour Physics

Parallel - ASP & GW / 126

Probing non-standard cosmology through sub-earth halos

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The existence of an early matter-dominated epoch prior to the big bang nucleosynthesis (BBN) may lead to a scenario where thermal dark matter cools faster than the plasma before the onset of reheating. This extra cooling reduces the free-streaming horizon of the dark matter compared to the usual radiation-dominated cosmology. Enhanced matter perturbations for scales entering the horizon before reheating, together with the reduced free-steaming horizon of the dark matter boosts the number density of sub-earth mass halos.

In this talk, I will illustrate how this enhancement in the number density of sub-earth halos can be utilized to probe various non-standard cosmological scenarios prior to the BBN.

Track type:

Astroparticle Physics

Poster Session / 128

Effect of dark matter on neutron star properties

Author: Payaswinee Arvikar[1]

Co-authors: Sakshi Gautam [2]; Anagh Venneti [3]; Sarmistha Banik [3]

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Dark matter (DM) is a fascinating subject in Astrophysics and Cosmology. While its exact nature remains elusive, its presence in the universe is inferred through various observational evidences such as galaxy rotation curves, velocity dispersions, gravitational lensing etc. Dark matter halos develop in the universe and subsequently facilitate galaxy formation by accumulating protons. Neutron stars (NS) and other compact astrophysical objects are promising candidates for investigating the presence of dark matter due to their dense and highly gravitating environments.
The dense interior of NS, whose density exceeds a few times saturation density, may consist of an admixture of DM along with the normal nuclear matter. In this work, we use the Relativistic Mean Field (RMF) model [1] for constructing the Nuclear Matter Equation of State (EoS) and the standard scalar and vector interactions model for the DM EoS [2-4]. Using the two-fluid approach, where DM interacts with baryonic matter only via gravity, we investigate the influence of dark matter via DM particle mass and DM fraction in NS properties. We observe that EoS of DM admixed NS may soften or stiffen depending on various DM parameters. The nature of EoS can be directly linked to NS observational data of mass, radius, tidal deformability, quasi-normal oscillation frequencies etc.

Thus we may further constrain the DM parameters using recently observed structural properties of NS such as mass-radius and tidal deformability values reported by GW170817, NICER and LIGO-VIRGO collaborations.

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Track type:

Dark Matter

Plenary / 131

LEGEND –200: A look at one year of physics data

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Whether the neutrino is a Majorana particle, i.e., whether it is its own antiparticle, remains an important open problem in modern physics. The observation of the hypothesized second order weak decay, Neutrinoless Double Beta Decay ($0\nu\beta\beta$) would conclusively establish the Majorana nature of neutrinos. It would also demonstrate lepton number violation and could provide insight into the absolute neutrino mass scale. The LEGEND (Large Enriched Germanium Experiment for Neutrinoless $\beta\beta$ Decay) experimental program aims to have an ultimate discovery sensitivity to a $0\nu\beta\beta$ half-life beyond 10^{28} years for ^{76}Ge. Currently, the first phase of the experiment, LEGEND-200 has acquired a year of stable data with 142 kg of enriched germanium detectors. In this talk, we'll discuss the performance of LEGEND-200, and look at the first year of physics data. We'll conclude with the status of the second phase of the experiment LEGEND-1000.

This work is supported by the U.S. DOE and the NSF, the LANL, ORNL and LBNL LDRD programs; the European ERC and Horizon programs; the German DFG, BMBF, and MPG; the Italian INFN; the Polish NCN and MNiSW; the Czech MEYS; the Slovak RDA; the Swiss SNF; the UK STFC; the Russian RFBR; the Canadian NSERC and CFI; the LNGS and SURF facilities.

Track type:

Neutrino Physics

Parallel - Flavour / 132

Time-dependent CP violation measurements in radiative penguin decays of B mesons at Belle and Belle II

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The left-handed chiral structure of the W boson in the Standard Model implies that CP violation parameters measured in radiative penguin decays of B mesons should be close to zero due to the suppression of right-handed polarised photon in the final state. Hence these decays are sensitive to physics beyond the standard model through new particles in the loop that can enhance the right-handed contribution. Measurements of time-dependent CP violation parameters in these decays can thus be an excellent probe for new physics. We present the latest results from the Belle and Belle II experiments on these CP violation parameters in radiative penguin B decays.

Track type:

Flavour Physics

Parallel - ASP & GW / 133

Search for fast magnetic monopole with NOvA Far Detector

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The search for magnetic monopoles has intrigued physicists for centuries. The NOvA Far Detector (FD), primarily used for studying neutrino oscillations, possesses a unique potential to search for exotic subluminal particles such as magnetic monopoles. With its extensive surface area of over 4,000 m^2, its location near the earth's surface, and minimal overburden, the 14 kt FD is highly sensitive to a broad range of magnetic monopole masses and velocities. We have developed a novel data-driven trigger that continuously monitors the data stream, which is predominantly composed of 150 kHz of cosmic rays, for signals resembling a magnetic monopole. This ensures that any monopole crossing the detector is recorded for further analysis. In this presentation, I will share the preliminary results of the NOvA fast magnetic monopole search, highlighting our novel approach and its effectiveness.

Track type:

Astroparticle Physics

Poster Session / 134

Vector-like quarks: status and new directions at the LHC

Author: Avik Banerjee[1]

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LHC searches for vector-like quarks have so far only considered their decays into Standard Model particles. However, various new physics scenarios predict additional scalars, allowing vector-like quarks to decay into new channels. These new channels reduce the branching ratios into Standard Model final states, significantly impacting current mass bounds. In this talk, I will review the post-Moriond 2024 status of these models in light of available LHC data. I will demonstrate the relevance and observability of single and pair production processes of vector-like quarks, followed by decays into both standard and exotic final states. I will highlight the importance of large widths and the

relative interaction strengths with Standard Model particles and new scalars. Finally, I will discuss potential future strategies to enhance the scope of vector-like quark searches, with illustrative examples.

Track type:

Collider and BSM Physics

Parallel - Neutrino / 135

A 17 MeV pseudoscalar and the LSND, MiniBooNE and ATOMKI anomalies

Author: Samiran Roy[1]

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In the absence of any new physics signals at the Large Hadron Collider (LHC), anomalous results at low energy experiments have become the subject of increased attention and scrutiny. We focus on three such results from the LSND, MiniBooNE (MB), and ATOMKI experiments. A 17 MeV pseudoscalar mediator (a') can account for the excess events seen in ^{8}Be and ^{4}He pair creation transitions in ATOMKI. We incorporate this mediator in a gauge invariant extension of the Standard Model (SM) with a second Higgs doublet and three singlet (seesaw) neutrinos ($N_i, i = 1, 2, 3$). $N_{1,2}$ participate in an interaction in MB and LSND which, with a' as mediator, leads to the production of e^+e^- pairs. The N_i also lead to mass-squared differences for SM neutrinos in agreement with global oscillation data. We first show that such a model offers a clean and natural joint solution to the MB and LSND excesses. We then examine the possibility of a common solution to all three anomalies. Using the values of the couplings to the quarks and electrons which are required to explain pair creation nuclear transition data for ^{8}Be and ^{4}He in ATOMKI, we show that these values lead to excellent fits for MB and LSND data as well, allowing for a common solution.

Track type:

Neutrino Physics

Parallel - Flavour / 137

Observation of double J/psi in pPb collisions

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The first observation of the concurrent production of two J/ψ mesons in proton-nucleus collisions will be presented. The analysis is performed using a dataset recorded by the CMS experiment at the LHC with the nucleon-nucleon center-of-mass collision energy at 8.16 TeV. The integrated luminosity is 174.6 nb^{-1}. The measured inclusive fiducial cross section $\sigma(\mathrm{pPb} \rightarrow \mathrm{J}/\psi \mathrm{J}/\psi + \mathrm{X})$ is compared with theoretical predictions at next-to-leading-order accuracy. The contributions from SPS and DPS are separated by a fit on the kinematic variables, and the effective DPS cross section σ_{eff} is extracted.

Track type:

Flavour Physics

Poster Session / 138

Probing the Triplet Extended Higgs Sector Models at the Large Hadron Collider

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The $SU(2)_L$ triplet scalar extension of the Standard Model offers interesting collider phenomenology. The minimal extension with custodial symmetry demands one real triplet scalar with a hypercharge quantum number zero, and one complex triplet scalar with a hypercharge quantum number one, in addition to the Standard Model Higgs doublet. This model is dubbed as extended Georgi-Machacek (eGM) model. In this presentation, I will discuss the theoretical bounds on the model parameter space, such as next-to-leading order unitarity and state-of-the-art bounded from below conditions on the potential. I will present the maximal mass splitting among the exotic Higgs bosons in the eGM model from the Bayesian fit with Markov Chain Monte Carlo simulations. Finally, I will discuss the possibility of studying new decay modes in the eGM model, that could potentially be observed at the LHC and other future colliders.

Track type:

SM and Higgs Physics

Poster Session / 139

Search for the decay $\mathrm{B}\rightarrow\mathrm{D}^{*}\eta\pi$ at Belle and Belle II

Author: VISMAYA V S[1]

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We present a search for the yet-unobserved B⟶D*ηπ decay at Belle and Belle II. This search aims to provide insights into the semileptonic gap, which refers to the deficit in the sum of the branching fractions of known exclusive decays compared to the measured inclusive b⟶cℓν branching fraction. Common models addressing this deficit suggest the existence of B⟶D*ηℓν decays with a branching fraction of 4 x 10ˆ{-3}, which could imply a branching fraction of B⟶D*ηπ around 2 x 10ˆ{-4} based on a naive prediction derived from the ratio of branching fractions of B⟶D*π and B⟶D*ℓν. Utilizing the ˜1.1 abˆ{-1} of data collected at Belle and Belle II combined, we are initiating a preliminary search to investigate and potentially observe this decay for the first time. This search is also expected to significantly enhance our understanding of the B hadronic sector.

Track type:

Flavour Physics

Parallel - Neutrino / 141

Sensitivity study of next generation neutrino detectors to supernova neutrinos with varied flux models

Author: Riya Gaba[1]

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Supernova neutrinos are weakly interacting particles which are produced when a massive star collapses to form a compact object losing 99% of the gravitational binding energy of the remnant in the form of neutrinos with energies of a few tens of Mev in a few tens of seconds. Supernova neutrinos have promising potential to address particularly interesting HEP and astrophysics issues , and provide insights into phenomena such as neutrino mass hierarchy, the dynamics of the collapsing core, the mechanism of the supernova explosion as well as to probe BSM physics. There are various flux models available that describe the flux (rate and energy distribution) of neutrinos produced in supernovae. Each model may have different assumptions about the physics of supernova explosions, the behavior of neutrinos within the collapsing star, and their interactions as they propagate through space. In this work, we are using 3 such flux models namely Bollig, Tamborra and Nakazato for big future detectors like Hyper-Kamiokande (Hyper-K), Deep Underground Neutrino Experiment (DUNE), and Jiangmen Underground Neutrino Observatory (JUNO) to evaluate the sensitivity of these detectors to the supernova neutrinos for the mass hierarchy.

Track type:

Neutrino Physics

Parallel - Collider & BSM / 142

Realtime Auto encoder based Anomaly Detection to trigger for new physics at the CMS experiment

Author: Varun Sharma[1]

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The Compact Muon Solenoid (CMS) experiment at the Large Hadron Collider (LHC) features a sophisticated two-level triggering system composed of the Level 1 (L1), instrumented by custom-design hardware boards, and the High-Level software based trigger (HLT). The CMS L1 Trigger receives information from calorimeters and muon detectors. Recently, a new system, called CICADA (Calorimeter Image Convolutional Anomaly Detection Algorithm), was deployed. The CICADA system was added to existing calorimeter trigger system and is implemented on Xilinx's Virtex7 based FPGAs. Its decision based on anomaly detection algorithm consisting of auto encoders and is aimed to trigger on event signatures consistent with new physics. The algorithm is working in extremely challenging environment selecting events in real time. We present the status of CICADA commissioning and its preliminary physics results.

Track type:

Collider and BSM Physics

Poster Session / **143**

Searches for dark sectors at CMS

Author: Varun Sharma[1]

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Determination of the nature of dark matter and dark sector is one of the most fundamental problems of particle physics and cosmology. This talk presents recent searches for dark matter particles in mono-X final states from the CMS experiment at the Large Hadron Collider and highlights from the recently submitted paper "Dark sector searches with the CMS experiment". The results are based on proton-proton collisions recorded at sqrt(s) = 13 TeV with the CMS detector.
EXO-23-005: Highlights from Physics Reports that includes all DM and Dark Sector Searches from CMS
SUS-23-017: Search for dark matter with a light-Z' jet ('pencil jet')
Mono-H(bb): Search for dark sector in mono-H(bb) final state at CMS

Track type:

Dark Matter

Parallel - Flavour / **144**

{New Physics investigation in the semileptonic decay $\bar{B}_s \to K^{*+}(\to K\pi)l^-\bar{\nu}_l$}

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Co-author: DINESH KUMAR [1]

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In this study, we investigate the new physics effects in semileptonic decay $\bar{B}_s \to K^{*+}(\to K\pi)l^-\bar{\nu}_l$ which is induced by the $b \to ul\nu$ quark level transition. This decay process serves as an important probe for testing the Standard Model predictions and searching deviations that might indicate new physics. The new physics wilson coefficients are constrained by using the available experimental branching ratio meaurements of leptonic decay $B \to \mu\nu$ and semileptonic decays $B \to (\pi, \rho, \omega)l\nu$. We provide q^2-dependence of branching ratio, forward-backward asymmetry and longitudinal polarization of K^* meson for the allowed new physics parameters.

Track type:

Flavour Physics

Parallel - Dark Matter / 145

Thermal correction to dark matter annihilation processes through real photon emission and absorption

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In a dark matter (DM) annihilation process $\chi\bar{\chi} \to f\bar{f}\gamma$, real photon emission and absorption processes along side with virtual correction $\chi\bar{\chi} \to f\bar{f}$, contribute to annihilation cross section. We present thermal correction at NLO of annihilation cross section of DM through real photon emission and absorption processes utilizing techniques of thermal field theory (TFT). We utilize generalized Grammer and Yennie technique (GYT) in order to deal with Infrared divergences encountered in annihilation cross section calculations. Our calculations are relevant near electroweak phase transition.

Track type:

Dark Matter

Parallel - Dark Matter / 148

Neutrino masses and mixing from milli-charged dark matter

Authors: Luca Paolo Wiggering[1]; Michael Klasen[None]; Sudip Jana[2]; Vishnu Padmanabhan Kovilakam[3]

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In this talk, we present a model for the radiative neutrino mass mechanism in which the particles within the loops are characterized by milli-charges. Unlike the conventional scotogenic model, our approach avoids imposing a discrete symmetry or expanding the gauge sector. The minuscule electric charges ensure the stability of the lightest particle within the loop as a viable dark matter candidate. Our investigation systematically scrutinizes the far-reaching phenomenological implications arising from these minuscule charges.

Track type:

Dark Matter

Parallel - Flavour / 149

Invisible decay of baryons post Belle-II results

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The Belle-II has recently presented the evidence for $B^+ \to K^+\bar{\nu}\nu$ decay for the first time. The result is in excess of the Standard Model prediction and could be a hint for physics beyond the Standard Model. In this work, we explore the implications of the Belle-II results on the $\Lambda_b \to \Lambda^{(*)}\nu\bar{\nu}$ decays. We make Standard Model predictions of the $\Lambda_b \to \Lambda^{(*)}\nu\bar{\nu}$ decay observables, as well as obtain limits under different new physics scenarios. We further study the possibility that the discrepancy is due to a dark sector and discuss the sensitivity of $\Lambda_b \to \Lambda^{(*)}\nu\bar{\nu}$ decays to dark matter.

Track type:

Flavour Physics

Parallel - ASP & GW / 153

Constraints on leptophobic models and dark matter from gravitational waves to colliders

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A minimally extended version of the Standard Model where baryon number is promoted as a gauged $U(1)_B$ symmetry can be made anomaly-free by adding a set of vector-like fermions. Such a scenario can evade the spin-dependent direct detection bounds on vector-like fermions. Additionally, the lightest component of the exotic fermion sector behaves as a viable dark matter candidate. We show that the spontaneous breaking of $U(1)_B$ symmetry can produce gravitational waves via bubble dynamics resulting from a first-order phase transition, which can be detected in future gravitational wave experiments like LISA and DECIGO. Such gravitational wave signatures can be used as a probe to constrain the model in future observations. We show that dark matter relic density can have one-to-one correspondence with the frequency of the gravitational waves.

Track type:

Gravitational waves

Parallel - Cosmology / 155

Effects of Quantum Gravity in the Kerr Black Hole Paradigm

Author: Suryakanta Swain[1]

Co-authors: Bibekananda Nayak [2]; Gourishankar Sahoo [1]

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Black Hole is a region of space time where the gravity is strong enough that, there is no predictable connection between the interior and the exterior region. A Kerr black hole can be explained only in terms of mass, spin and angular momentum. LQG is completely non-perturbative, explicit background independent approach to quantum gravity theories. Generally, the application of LQG on cosmology for the study of our universe is called as Loop Quantum Cosmology. In the present work, we try to describe the evolution of Kerr black holes by considering accretion of dark energy in the framework of loop quantum cosmology. Our investigation focuses on the impact of angular momentum and accretion efficiency on the evolution of Kerr black holes. Here we found that black holes formed in the early radiation dominated era evaporated quickly than the black holes formed in the later time period. Also we successfully found that Supermassive black hole having mass greater than equal to 10ˆ48 gm. they all would be evaporated by the present time.

Track type:

Dark Energy and Modified Gravity

Parallel - Cosmology / 156

Astrophysical Constraints on Black Hole Formation in Interacting Dark Energy Model

Author: Debasis Sahu[1]

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Black holes are the current puzzles in modern cosmology. Devoid of concrete knowledge beyond event horizon make them rigid enough not to be soaked by many languages and approaches. However our imagination is inclined towards them to a large extent. Dark energy being an accepted reason for the accelerating universe can be an active factor of most of the phenomenon in the cosmic history. We here assumed an interaction of the dark energy and matter content of the universe and in that environment we have gone through different cosmological parameters. Further we have discussed accretion and evaporation of the black holes in different conditions taking into account the maximum initial mass and the accretion efficiency, hence making prediction on the fate of such black holes. The formation of black holes are restricted by many observational phenomena like the present matter density of the universe, the present photon spectrum, Distortion in CMB spectrum, the Helium abundance constraint, Deuterium photodisintegration constraint and nucleosynthesis constraints. Within the frame work of the interacting dark sector, we evaluated these constraints and found quite interesting results.

Track type:

Dark Energy and Modified Gravity

Plenary / 159

The Indian Pulsar Timing Array: An overview

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On June 29, 2023, the five regional PTAs, including the Indian pulsar timing array (InPTA) announced the evidence for the presence of gravitational waves (GWs) in the nano-Hz frequency regime. This was the first evidence for GWs outside the frequency range of those detected by the ground-based observatories. Currently the international PTA community is gearing towards the analysis of the data pooled from all the individual PTAs under the umbrella of the International Pulsar Timing Array (IPTA) which will be released next year. This is expected to improve the detection threshold of the GW signal as well as bring out exciting science results. Moreover, the InPTA is preparing its second data release that consists of more than five years of observations with the upgraded GMRT and its analysis for the detection of GWs. In this talk, I will give a brief about pulsar timing arrays and discuss the new results that have emerged in the past year. I will talk about the current efforts of the InPTA collaboration in the upcoming IPTA data release as well as other exciting endeavours.

Track type:

Gravitational waves

Poster Session / 161

Study of $c \to d\mu^+\nu_\mu$ decay with right-handed neutrinos

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We present a model-independent study of $c \to d\mu^+\nu_\mu$ transitions to search new physics in the presence of right-handed neutrinos. We have adopted the effective field theory approach for the low-energy effective Hamiltonian comprising the dimension-six operators. The New Physics Wilson coefficients are determined through a χ^2 fit by using the Miniut package to available experimental data of leptonic $D^+ \to \bar{\mu}\nu$ and semileptonic decays $D^0 \to \pi^-\bar{\mu}\nu$, $D^+ \to \pi^0\bar{\mu}\nu$, $D^0 \to \rho^-\bar{\mu}\nu$, $D^+ \to \rho^0\bar{\mu}\nu$. The differential decay width is derived to study the $B_c^+ \to B_d\bar{\mu}\nu_\mu$ decay for the effect of right-handed neutrinos. We also make the predictions of q^2 spectra and forward-backward asymmetry (A_{FB}) for the mode $B_c^+ \to B_d\bar{\mu}\nu_\mu$ to inspect the effect of the allowed new physics in $c \to d$ sector through right-handed neutrinos to motivate the future measurements.

Track type:

Flavour Physics

Parallel - Dark Matter / 162

Dark matter phenomenology in presence of vector like quarks

Authors: Prasanta Kumar Das[1]; Santosh Kumar Rai[2]; Saumyen Kundu[2]; Shyamashish Dey[None]

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Dark matter(DM) has been studied with consideration of many different symmetries and particle content. But it's detection has stayed as ever illusive. In this talk I will present a work where we considered an addition of vector like quark(VLQ) to a very well known DM model, Inert Doublet Model(IDM). The addition of VLQ not only enrich the freeze out mechanism of IDM dark matter but the also has interesting collider signature as a candidate for long lived particle.

Track type:

Dark Matter

Parallel - Neutrino / 165

Constraining Systematic Uncertainties for Future Sterile Neutrino Analysis at NOvA Experiment

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With detectors at both Fermilab and Ash River, Minnesota, in the United States, NOvA was built to investigate the intricate properties of neutrinos, with a principal emphasis on active three-flavour neutrino mixing phenomena. Comprising two functionally identical detectors, with the Near Detector located 1 km at Fermilab and the Far Detector, located 810 km away and 14 mrad off the beam axis in Northern Minnesota, NOvA capitalizes on the expansive distance to scrutinize neutrino behaviour.

NOvA not only probes active neutrino mixing but also explores exotic oscillations, including sterile neutrinos. Uncertainties on the neutrino flux, cross-section, and detector systematics significantly contribute, complicating the disentanglement of genuine physics events from background noise. This talk presents the impact of systematic reduction via near detector neutral current samples and its implications on oscillation parameters, leveraging results primarily from Monte Carlo simulations. We aim to enhance the active-sterile neutrino oscillation by constraining the systematics.

Track type:

Neutrino Physics

Parallel - Flavour / 166

Lepton flavor and number violating $K \to \pi\nu\bar{\nu}$ decays

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The rare decays $K \to \pi\nu\bar{\nu}$ are crucial for exploring physics beyond the Standard Model. Our investigation focuses on these decays in the context of scalar leptoquarks, exploring both lepton flavor conserving and violating channels. Furthermore, we explore the potential to detect lepton number violating operators in $K \to \pi\nu\bar{\nu}$ decays.

Track type:

Flavour Physics

Parallel - Collider & BSM / 167

Composite Higgs models: bridging collider, phase transition, and lattice studies

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Composite Higgs models provide a promising way to address both the hierarchy problem and the heavy top quark mass. I will discuss a class of models involving a new strongly coupled confining gauge theory, which lead to dynamical electroweak symmetry breaking by generating a composite pseudo-Nambu-Goldstone Higgs boson and a partially composite top quark. I will emphasize the pivotal role of partial compositeness in breaking electroweak symmetry, presenting a novel point of view. I will highlight the significant challenges to address the flavor hierarchy in the quark sector in this setup, and indicate where lattice gauge theory results will be crucial. Composite Higgs models are ideal candidates for inducing first-order phase transitions in the early universe, leading to gravitational wave production detectable by upcoming detectors like LISA, AEDGE, and AION-km. I will demonstrate how a complementary approach between collider experiments and gravitational wave detection can probe the microscopic details of this class of models.

Track type:

SM and Higgs Physics

Parallel - ASP & GW / 168

Tick-Tock: a supermassive black hole binary?

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Recently, Pulsar Timing Array (PTA) collaborations around the world have found evidence for a stochastic gravitational waves (GWs) background at the nanohertz frequencies. One of the possible sources for these low-frequency GWs are the supermassive black hole binaries (SMBHBs). Despite having several hundreds of SMBHB candidates, none of them are confirmed till date. In 2022, Ning Jiang et. al. proposed the Tick-Tock (SDSSJ143016.05+230344.4) galaxy to host a highly eccentric SMBHB based on the variability in its optical lightcurve and postulated that the binary will merge in the next few years. In this work, we use an accurate post-Keplarian model and Bayesian inference to authenticate the presence of a binary in this galaxy and determine its orbital parameters. High eccentricity of this source indicates that this galaxy has undergone a recent major merger and we are using high-resolution uGMRT HI observations to probe its merger history. If this galaxy is found to host an SMBHB as proposed, it can have major implications for PTA to search for the GW memory effect.

Track type:

Parallel - Neutrino / 169

Degeneracies in presence of invisible decay of Neutrinos

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The observation of neutrino oscillation means the presence of massive neutrinos in the Standard Model. The well-established framework of standard three-flavor neutrino oscillation sets us for the goal of looking for new physics beyond SM. The heavier neutrino states can decay into lighter ones, first proposed to explain the zenith angle dependence observed in the first data of atmospheric neutrinos in Super-Kamiokande. The decay of the Dirac neutrinos will produce a SU(2) singlet and a complex scalar φ with lepton number -2 and zero weak isospin and hypercharge. In our work, we explore how the presence of decay of the heaviest neutrino mass eigenstate will affect the degeneracies of octant-mass-hierarchy-δ_{CP} in the future long baseline experiments. We consider two proposed experiments, Deep Underground Neutrino Experiment (DUNE) and Portvino to ORCA (P2O), with baselines of 1300 km and 2588 km (bi-magic baseline).

Track type:

Neutrino Physics

Parallel - Dark Matter / 171

Exploring DSNB boosted sub-GeV dark matter: insights from XENONnT and LZ experiments

Author: Anirban Majumdar[1]

Co-authors: Dimitrios Papoulias [2]; Rahul Srivastava [1]; Valentina De Romeri [3]

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Various cosmological observations suggest that 85% matter of the Universe is cold dark matter (DM), a non-luminous substance that does not interact with photons and interacts only "weakly"with ordinary matter. Despite no conclusive DM discovery, various experiments, including direct and indirect detection experiments and collider searches, have imposed very tight constraints on its properties. However, these experiments primarily explore the DM parameter space within the GeV-TeV mass range. Recently, interest in detecting sub-GeV DM has increased. However, their low momenta make detection challenging, as they fail to induce recoils above the thresholds of conventional direct detection experiments. Even strongly interacting DM within this mass range has been suggested to elude all observational bounds.

We explore a scenario where sub-GeV cold DM particles are accelerated to semi-relativistic velocities through their scattering with the diffuse supernova neutrino background (DSNB) in the galaxy |1|. This mechanism introduces a high-energy DM component capable of interacting with both electrons and nuclei in the detector, triggering a detectable recoil signal. We analyze data from the most advanced direct detection facilities in the contemporary world, namely the XENONnT |2| and LUX-ZEPLIN (LZ) |3| experiments, to derive constraints on the scattering cross-sections of sub-GeV boosted DM with both electrons and nucleons. Additionally, we emphasize the imperative nature of considering Earth's attenuation effects for both electron and nuclei interactions. Lastly, we present a comparison of our findings with existing constraints, illuminating the complementarity and significance of the LZ and XENONnT data in probing the sub-GeV DM parameter space.

|1| V. De Romeri, **A. Majumdar**, D. K. Papoulias and R. Srivastava, "XENONnT and LUX-ZEPLIN constraints on DSNB-boosted dark matter,"JCAP 03 (2024) 028, arXiv:2309.04117 [hep-ph].

|2| E. Aprile *et al.* **[XENON Collaboration]**, "First Dark Matter Search with Nuclear Recoils from the XENONnT Experiment,"Phys. Rev. Lett. **131** (2023) no. 4, 041003, arXiv:2303.14729 [hep-ex].

|3| J. Aalbers *et al.* **[LZ Collaboration]**, "First Dark Matter Search Results from the LUX-ZEPLIN (LZ) Experiment,"Phys. Rev. Lett. **131** (2023) no.4, 041002, arXiv:2207.03764 [hep-ex].

Track type:

Dark Matter

Poster Session / 172

Study of Radiative Decays of the Exotic State X(3872) using the Belle and the Belle II Experiments

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The resonance state $X(3872)$, also known as $\chi_{c1}(3872)$ was discovered by the Belle collaboration in 2003 in the decay $B^+ \to X(3872)K^+$ where $X(3872) \to J/\psi\pi^+\pi^-$. Still its nature is not well known in spite of a lot of studies carried out on this state. Currently,$X(3872)$ is a strong contender for tetraquark, $D^0\bar{D^{*0}}$molecule, admixture of $\chi_{c1}(2P)$ and $D^0\bar{D^{*0}}$ molecule state. Radiative decays of $X(3872)$, $X(3872) \to \psi(2S)\gamma$ and $X(3872) \to J\psi\gamma$ can shade light on the structure of the state. Recently LHCb has measured the ratio of branching fractions of these two modes, $R_{\psi\gamma}$ and supported Belle measurement over BaBar. However, there is still some conflict between LHCb and BESIII. Belle and Belle II combined study can help in solving this conflict. We plan to present a preliminary Monte Carlo (MC) study of signal and background for these decay modes.

Track type:

Flavour Physics

Plenary / **173**

Latest KATRIN results on neutrino mass and sterile neutrino search.

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Neutrinos are known to have non-zero masses, as shown by oscillation observations, but their absolute mass scale remains unknown. Observational cosmology and neutrinoless double beta decay experiments derive sub-eV upper limits. Complementing these efforts with a model-independent approach based on beta-decay kinematics, the Karlsruhe Tritium Neutrino (KATRIN) experiment provides the most direct bound at 0.45 eV/c^2 (90% CL). The ongoing data-taking targets a sensitivity of better than 0.3 eV. The experiment combines a high-intensity gaseous tritium source with high-resolution spectroscopy of the molecular tritium beta decay spectrum. KATRIN also explores the potential for eV-scale sterile neutrinos, complementary to short-baseline neutrino oscillation experiments. The analysis of five KATRIN science runs highlights the experiment's sensitivity to a fourth mass eigenstate m_4 up to 40 eV and an active-to-sterile mixing amplitude $|U_{e4}|^2$ ≤0.5. This talk discusses the improved bounds on the neutrino mass from analyzing 25% of the KATRIN data and details on sensitivity to light sterile neutrinos

Track type:

Astroparticle Physics

Parallel - Flavour / **174**

Hadronic B decays at Belle and Belle~II

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The Belle and Belle II B-factories have collectively gathered an extensive 1.1~ab^{-1} dataset of e^+e^- collisions at the $\Upsilon(4S)$ resonance, resulting in the production of numerous $B\bar{B}$ pairs. This allows for precise measurements of hadronic B decays, which is essential to test Quantum Chromodynamics (QCD) and refine theoretical models. This also helps improve simulation accuracy. We present

results for the B to hadronic decays such as $B^- \to D^0\rho^-$, $B \to DK^*K_{(s)}^{(*)(0)}$, $B^0 \to \eta' K_S^0$ and $B \to \pi^0\pi^0$. These decays provide deep insights into absolute branching fractions and angular distributions of decay products and help measure CKM elements.

Track type:

Flavour Physics

Plenary / 175

TEXONO and Neutrino-Nucleus Coherent Scattering - Results and Status

Author: Venktesh Singh[1]

Co-authors: H T Wong [2]; Lakhwinder Singh [3]

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The TEXONO collaboration has been producing world-class results related to reactor neutrinos and dark matter for more than two decades. In this conference, I will discuss the results obtained by the TEXONO experiment based on neutrino-nucleus coherent scattering and will discuss in detail the current status and future plans of the collaboration.

Track type:

Neutrino Physics

Parallel - Dark Matter / 176

Comprehensive Phenomenology of the Dirac Scotogenic Model

Authors: Rahul Srivastava[1]; Salvador Centelles Chulia[None]; Sushant Yadav 2020504[None]

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The Dirac scotogenic model provides an elegant mechanism which generates small Dirac neutrino masses at the one loop level with a single symmetry, the so-called chiral $U(1)_{B-L}$, simultaneously protecting the "Diracness" of the neutrinos, the smallness of their mass and the stability of the dark matter candidate. Despite being chiral, this symmetry is also anomaly-free and thus could be gauged. Here we thoroughly explore the phenomenological implications of such a construction in the Dark Matter (DM) sector, charged Lepton Flavor Violation (cLFV) and ElectroWeak (EW) vacuum stability.

Track type:

Dark Matter

Parallel - Neutrino / 177

Effect of large extra dimension in future long baseline neutrino experiments

Author: Papia Panda[None]

Co-authors: Monojit Ghosh [1]; Rukmani Mohanta [2]; Samiran Roy [2]

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The upcoming long-baseline experiments, like P2SO, DUNE, T2HK, T2HKK, etc. are highly promising experiments concerning the accurate measurement of various neutrino oscillation parameters. At present, we are looking for a tangible explanation for neutrino masses that are not zero, something that the Standard Model cannot provide. The Large Extra Dimension (LED) theory is one of the strong arguments with regard to the neutrino masses. Historically, LED has been used to explain gravity and the hierarchy problem in particle physics. In the context of neutrinos, the LED model proposes the presence of a right-handed neutrino in a fifth dimension to account for small, non-zero neutrino masses. In this work, we have shown the effect of LED parameters, the LED compactification radius (R_{ED}) and smallest neutrino mass m_0 in the future experiments like P2SO, and the combination of DUNE, T2HK and P2SO. Our results indicate that P2SO provides a stronger constraint on R_{ED} at the 90% confidence level (C.L.) compared to DUNE and T2HK. Furthermore, the synergy between DUNE, T2HK, and P2SO yields even tighter bounds on R_{ED} at the 90% C.L. than P2SO alone. Furthermore, we have demonstrated how systematic uncertainty affects the bound, demonstrating an exponentially declining variation up to 20% systematic uncertainty before remaining unchanged thereafter. In our work, we have also shown the effect of R_{ED} on the sensitivity of CP violation, mass hierarchy and octant of atmospheric angle. The result shows a significant difference in the sensitivities which can be probed in future long baseline experiments.

Track type:

Neutrino Physics

Parallel - ASP & GW / 178

Search for GeV Gamma-Ray Emission from SPT-SZ selected Galaxy Clusters with 15 years of Fermi-LAT data

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Galaxy clusters could produce gamma rays from inverse Compton scattering of cosmic ray electrons or hadronic interactions of cosmic ray protons with the intracluster medium. It is still an open question on whether gamma-ray emission (> GeV energies) has been detected from galaxy clusters. We carry out a systematic search for gamma-ray emission based on 300 galaxy clusters selected from the 2500 deg^2 SPT-SZ survey after sorting them in descending order of M_{500}/z^2, using about

15 years of Fermi-LAT data in the energy range between 1-300 GeV. We were able to detect gamma-ray emission with significance of about 6.1σ from one cluster, viz SPT-CL J2012-5649. The estimated photon energy flux from this cluster is approximately equal to 1.3×10^{-6} MeV cm^{-2} s^{-1}. The gamma-ray signal is observed between 1–10 GeV with the best-fit spectral index equal to -3.61 ± 0.33. However, since there are six radio galaxies spatially coincident with SPT-CL J2012-5649 within the Fermi-LAT PSF, we cannot rule out the possibility this signal could be caused by some of these radio galaxies. Six other SPT-SZ clusters show evidence for gamma-ray emission with significance between 3–5σ. None of the remaining clusters show statistically significant evidence for gamma-ray emission.

Track type:

Astroparticle Physics

Parallel - ASP & GW / 181

Single pulsar noise analysis efforts by the Indian Pulsar Timing Array experiment

Authors: Aman Srivastava[1]; Indian Pulsar Timing Array Collaboration[None]

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Pulsar timing array experiments (PTAs) aim to detect ultra-low-frequency (~1–100 nHz) gravitational waves (GWs) by monitoring an ensemble of millisecond pulsars (MSPs) distributed across the Galaxy. The intrinsic wander of the rotation rate of the constituent pulsars, variations in dispersion measure (DM), scatter-broadening, and instrumental noise of radio telescopes often correlate with the slowly varying GW signature in the data and act as sources of chromatic and achromatic noise. Consequently, the detection and characterization of GWs heavily rely on accurate noise modeling, which may require custom approaches for each pulsar. In this presentation, I will discuss the recent efforts of single-pulsar noise analysis by the Indian Pulsar Timing Array experiment. In this study, we focus on modeling white noise, achromatic red noise, dispersion measure variations, and scattering variations. We employ Bayesian model selection techniques to determine the most appropriate noise models for each pulsar.

Track type:

Gravitational waves

Parallel - Collider & BSM / 182

Fermionic decay of charged Higgs boson in low mass region in Georgi Machacek Model

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At the Large Hadron Collider (LHC), ATLAS and CMS collaborations observed various decay modes of the light charged Higgs bosons produced by top (anti)quark decays. In this talk, I am interested in the subsequent decay of the light charged Higgs boson into a charm and a strange quark-antiquark pair and into a tau and a tau-neutrino pair, separately, in the context of the Georgi-Machacek model,

which offers a large triplet vacuum expectation value (vev) preserving custodial symmetry. These experimental observations constrain the triplet vev from above. The model parameter space consistent with the theoretical constraints, the latest Higgs data and the experimental data for light charged Higgs decaying to cs and τ ντ will be explored.

Track type:

Collider and BSM Physics

Parallel - Neutrino / 183

Leptogenesis and Muon (g-2) from vector like fermion triplet.

Authors: B. C. Chauhan[1]; Devabrat Mahanta[2]; Simran Arora[1]

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We propose extension of minimal Scotogenic model with discrete Z_4 symmetry. The model is extended with a fermion triplet and a scalar singlet. The Yukawa coupling of triplet fermion with inert doublet gives positive contribution to muon's anomalous magnetic moment. The decay of fermion triplet also generates net lepton asymmetry only in muonic sector due to Z_4 charges. Involvement of the Yukawa coupling both in Leptogenesis and in the anomalous magnetic moment of the muon results in a strong correlation between Leptogenesis and the recent Fermilab's result.

Track type:

Neutrino Physics

Parallel - Flavour / 185

Explaining Fermions Mass and Mixing Hierarchies through $U(1)_X$ and Z_N Symmetries

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For understanding the hierarchies of fermion masses and mixing, we extend the standard model gauge group with $U(1)_X$ and Z_N symmetry. The field content of the Standard model is augmented by three heavy right-handed neutrinos and two new scalar singlets. $U(1)_X$ charges of different fields are considered after satisfying anomaly cancellation conditions. In this scenario, the fermion masses are generated through higher dimensional effective operators. The small neutrino masses are obtained through type-1 seesaw mechanism using the heavy right handed neutrino fields. We discuss the flavor-changing neutral current processes which is originated due to the sequential nature of $U(1)_X$ symmetry. We have written effective higher dimensional operators in terms of renormalizable dimension four operators by introducing vector like fermions.

Track type:

Flavour Physics

Poster Session / 186

Coherent Squeezed Vacuum State and Validity of Semi-classical Theory of Gravity

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A non-classical inflaton which is minimally coupled to the semiclassical theory of gravity in the flat Friedmann-Robertson-Walker (FRW) universe. Using a Coherent Squeezed Vacuum State, we analyzed the validity of the semiclassical theory of gravity by computing density fluctuations in the oscillatory phase of the inflaton. The current study is for density fluctuations of non-classical inflaton of coherent squeezed vacuum state due to the coherent and squeezing effects using the operator method in the semiclassical theory of gravity.

Track type:

Cosmology

Parallel - Neutrino / 187

Probing Scalar Nonstandard Interactions: Insights from the Protvino to Super-ORCA Experiment

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We have investigated the non-standard interaction mediated by a scalar field at the upcoming long-baseline neutrino experiments, Protvino to Super-ORCA (P2SO) and Deep Underground Neutrino Experiment (DUNE). Specifically, we have studied the sensitivity of these two experiments to constrain the diagonal Scalar Non-standard interaction (SNSI) parameters η_{ee}, $\eta_{\mu\mu}$ and $\eta_{\tau\tau}$ and how the measurements of mass hierarchy, octant of θ_{23} and CP violation (CPV) sensitivity is affected in the presence of SNSI. Our key finding is that Δm^2_{31} has a very non-trivial behavior in the presence of $\eta_{\mu\mu}$ and $\eta_{\tau\tau}$ when we consider SNSI does not exist in nature. Both the experiments are very sensitive to these SNSI parameters, but for η_{ee}, DUNE provides a stringent bound compared to P2SO. Mass hierarchy and CPV sensitivity are affected mainly by η_{ee} compared to the other two parameters. In contrast, octant sensitivity is mainly affected by $\eta_{\mu\mu}$ and $\eta_{\tau\tau}$ if we consider, SNSI to exist in nature. The sensitivity of the measurements is either higher or lower than that of the standard case, depending on the relative sign of these parameters.

Track type:

Neutrino Physics

Poster Session / 188

Measurements of the Higgs boson production cross section and couplings in the W boson pair decay channel in pp collisions at a centre-of-mass energy of 13 TeV with the CMS detector

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The production cross sections of the Standard Model Higgs boson decaying into a pair of W bosons have been measured in proton-proton collisions at a center-of-mass energy of 13 TeV. The analysis targets Higgs bosons produced through gluon-gluon fusion, vector boson fusion, and in association with a vector boson. Candidate events were selected based on the presence of at least two charged leptons and moderate missing transverse momentum, focusing on scenarios where at least one leptonically decaying W boson is originating from the Higgs boson. The results are presented as both inclusive and differential cross sections within the simplified template cross section framework, and include measurements of the Higgs boson's couplings to vector bosons and fermions. Data collected by the CMS detector from 2016 to 2018, corresponding to an integrated luminosity of 138 fb^{-1}, were utilized for this analysis. The signal strength modifier, defined as the ratio of the observed production rate in a specific decay channel to the Standard Model expectation, was measured and found to be consistent with the Standard Model within uncertainties.

Track type:

SM and Higgs Physics

Parallel - ASP & GW / 189

Observing the unseen: Faraday rotation signatures and Parker bounds on primordial magnetic black holes

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Primordial black holes with magnetic charges may evade constraints from Hawking radiation, leading to their significant population even for masses below 10^{15}g, a range previously considered improbable. They could, therefore, potentially contribute to a component of dark matter in the universe. This talk will focus on establishing Parker-type bounds on the population of primordial magnetic black holes (MBHs) while also examining their intriguing Faraday rotation signatures. We will present stringent constraints on the fraction of dark matter contained in them emanating from intergalactic magnetic fields in cosmic voids ($f_{\rm DM}$
$lesssim 10^{-8}$) and cosmic web filaments ($f_{\rm DM}$
$lesssim 10^{-7}$). These bounds notably surpass prior estimates.
By analyzing Faraday rotation effects, we observe substantial rotation measure values for extremal MBHs with charge $Q^{\rm Ex.}_{\rm BH}$

$gtrsim 10^{22}$ A-m or mass $M_{\rm BH}^{\rm Ex.}$
$gtrsim 10^{-6}$
$textup M_{\odot}$, making them detectable with current Earth-based observations. In a comparative analysis, we will find that the Faraday effect is significantly large compared to that of a neutron star. Additionally, the polarization angle maps exhibit unique characteristics that differentiate them from other astrophysical objects. In this context, we have established inequalities to provide a quantitative measure for discriminating between the sources of Faraday rotation.

Preprint: Primordial magnetic relics and their signatures \[2406.08728\]

Track type:

Astroparticle Physics

Parallel - Neutrino / 190

Physics opportunities with kaon decay-at-rest neutrinos: search for sterile neutrino and non-standard interactions

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The decay-at-rest of charged kaons produces monoenergetic muon neutrinos with an energy of 236 MeV. The study of these neutrinos at short baselines allows us to constrain new neutrino interactions. In this work, we study kaon decay-at-rest (KDAR) neutrinos at the \jsns experiment where the J-PARC Spallation Neutron Source (JSNS) will produce such types of neutrinos with decay-at-rest processes of pions, muons, and kaons. We use KDAR neutrino data from the experiment to probe the non-standard interactions of leptons with strange particles and demonstrate for the first time that \jsns can put very stringent bounds on the source NSI parameter $\epsilon^s_{\mu e}$; i.e. $|\epsilon^s_{\mu e}| < 0.03\ (0.005)$ at 99% C.L. with current (future) statistics. We also explore the reach of the \jsns experiment to constrain the sterile neutrino parameters using KDAR neutrinos and compare our results with the other oscillation experiments. We find that the constraint on active sterile mixing can be as small as $|U_{\mu 4}|^2 \sim 10^{-3}$ for $\Delta m^2_{41} > 2\ \mathrm{eV}^2$.

Track type:

Neutrino Physics

Poster Session / 191

Oscillatory phase of inflaton and Semiclassical Einstein equations for Coherent Squeezed Number State and Squeezed Number State

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Cosmology provides detailed analysis of origin and evolution of FRW Universe. The Big Bang theory effectively explains the structure and expansion of the universe, incorporating the theory of inflation.. We are using non-classical homogeneous scalar inflaton with number state evolution of oscillatory phase of inflaton. For that we used coherent squeezed number state and squeezed number states formalisms to study the inflation minimally coupled to the semiclassical gravity in flat Friedmann-Robertson-Walker (FRW) universe. In this work we have determined and demonstrated the Oscillatory phase of inflaton and Semiclassical Einstein euquations for coherent squeezed number state and squeezed number state.

Track type:

Cosmology

Poster Session / **193**

FSI Uncertainties in DUNE-PRISM at various off-axis angles.

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Neutrino experiments often utilize heavy nuclear targets to achieve high-statistics neutrino-nucleus interaction event rates. However, this approach introduces systematic uncertainties in oscillation parameters due to nuclear effects and cross-section uncertainties. A precise understanding of neutrino-nucleus interactions is thus crucial for accurately determining oscillation parameters. The Deep Underground Neutrino Experiment Precision Reaction-Independent Spectrum Measurement (DUNE-PRISM) is an advanced component of the DUNE experiment, designed to provide precise measurements of neutrino interactions and enhance the sensitivity to oscillation parameters. DUNE-PRISM employs a movable near detector that samples neutrino interactions at various off-axis angles, enabling the measurement of a wide range of neutrino energy spectra from the same beamline. This study investigates the uncertainty in neutrino energy reconstruction of quasi-elastic (QE) events at different off-axis positions using the calorimetric method. As we move away from the on-axis beam position, the uncertainties in the reconstruction increase in the QE region (˜1 - 2 GeV), resulting in significant uncertainties at 41.81 and 52.26 milliradian off-axis beam positions. We quantify the uncertainties due to nuclear effects at these off-axis angles. Our findings indicate that final state interaction (FSI) effects create substantial uncertainties in the same energy region at these two off-axis angles. These results underscore the importance of accounting for FSI effects in neutrino energy reconstruction to enhance the precision of oscillation parameter measurements in future neutrino experiments.

Track type:

Neutrino Physics

Parallel - Neutrino / 194

Understanding the Quasi-Elastic Neutrino Energy Reconstruction.

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In neutrino oscillation experiments, heavy nuclear targets are used to increase the number of neutrino interactions and improve statistical accuracy, but this introduces systematic uncertainties due to the complex nuclear environment. The interaction of neutrinos with nuclear targets results in an imprecise neutrino energy reconstruction and cross-sectional uncertainties, which affect the measurement of oscillation parameters. Therefore, understanding the neutrino-nucleus interaction and accurately reconstructing the neutrino energy are crucial for the precise measurement of oscillation parameters. In this work, we studied these uncertainties in the Quasi-elastic (QE) interactions by analyzing events with one proton, zero pions, and multiple neutrons for DUNE and MicroBooNE experiments. Using these specific interactions, we applied the kinematic methods for neutrino energy reconstruction. Our analysis shows that the kinematic method can achieve an energy resolution within 100 MeV, which is the essential energy resolution to study the region between the first and second oscillation maxima. The shift of around 100 MeV is observed for both the DUNE and MicroBooNE experiments, using the GENIE and NuWro Monte Carlo event generators. These results show the critical role of proper event selection for accurate neutrino energy reconstruction and the potential of kinematic methods for precision physics in neutrino experiments. In addition to this, a comparison with the calorimetric method will be presented.

Track type:

Neutrino Physics

Parallel - Flavour / 195

Understanding $b \to c\tau\nu$ mediated baryonic decays in SMEFT

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We study the interrelation among the B decays mediated by $b \to c\ell\nu_\ell$, $b \to s\nu_\ell\nu_\ell$ and $b \to s\ell\ell$ ($\ell = e, \mu, \tau$) quark level transitions in the context of six-dimesional SMEFT operators such as $\mathcal{Q}_{\ell q}^{(3)}$,˜$\mathcal{Q}_{\ell edq}$, $\mathcal{Q}_{\ell equ}^{(1)}$, $\mathcal{Q}_{\ell equ}^{(3)}$, $\mathcal{Q}_{\phi q}^{(3)}$ and $\mathcal{Q}_{\ell q}^{(1)}$. We constraint the new physics parameter space using the current experimental observations of the observables R_D, R_{D^*}, $P_\tau(D)$, $P_\tau(D^*)$, $F_L(D^*)$, $\mathcal{B}(B_0 \to K^*\nu\nu)$, $\mathcal{B}(B \to K^+\nu\nu)$, $\mathcal{B}(B \to K^+\tau^+\tau^-)$ and $\mathcal{B}(B_s \to \tau^+\tau^-)$. We then explore the impact of the new physics couplings on several observables such as the branching ratio, forward-backward asymmetry, longitudinal polarisation asymmetry, convexity parameter, and the lepton flavor non-universality observable of $\Sigma_b \to \Sigma_c^{(*)}\tau^-\bar{\nu}_\tau$ and $\Xi_b \to \Xi_c\tau^-\bar{\nu}_\tau$ processes.

Track type:

Flavour Physics

Parallel - Flavour / 196

Connecting the $b \to s\ell\ell$ decays with dark sector in the light of scalar leptoquark $\tilde{R}_2$

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We make a correlative study of B-meson anomalies and fermionic dark matter in an extended standard model framework with $U(1)_{L_e - L_\mu}$ gauge symmetry. With three heavy neutral fermions and scalar double leptoquark $\tilde{R}_2$, we realize the $b \to s$ transition. On top, an additional singlet spontaneously breaks the new $U(1)$ and an inert scalar doublet to obtain neutrino mass at one loop. We then focus on the dark matter relic density and direct detection cross-section in scalar and gauge portals. The new physics contribution for $b \to s$ transition comes from penguin diagrams with Z', leptquark, and new fermions. We then constrain the model parameter space from the dark sector and also the well-established observables such as Br($B_s \to \phi, K^{(*)})\mu\mu$ and P_5' processes. Utilizing the allowed parameter space consistent with both sectors, we discuss the impact on several observables such as branching ratio, forward-backward asymmetry, and polarisation asymmetry. We also explore the lepton non-universality of $\Lambda_b \to \Lambda^*(1520)(\to pK)\ell\ell$ process.

Track type:

Flavour Physics

Parallel - Collider & BSM / 197

Hunting for Inert Triplet Scalars at a Muon Collider

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The Inert Triplet Model (ITM) is a popular scenario with a neutral scalar Dark Matter (DM), along with an inert charged scalar in a compressed mass spectrum. The DM constraints corner the ITM to high TeV-scale mass range, the production of which is inefficient at the present and future iterations of the LHC. However, Vector Boson Fusion (VBF) at a future Muon Collider promises high production rate for the inert triplet scalars. The compressed mass spectrum leads to disappearing tracks for the charged scalars, which can be efficiently reconstructed over the beam-induced background (BIB). Exploiting the high-momentum Forward Muons from the VBF processes along with these disappearing tracks, we present a detailed analysis of signatures of the model, as well as luminosity projections for 5σ discovery.

Track type:

Collider and BSM Physics

Poster Session / 198

A test of MOND and Emergent Gravity with SMACS J0723.3-7327 using eROSITA observations

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We implement a test of MOND and Verlinde's Emergent Gravity using the galaxy cluster SMACS J0723-7327, which has been recently imaged using the eROSITA X-ray telescope as well as with JWST. We test MOND using two independent methods. The first method involves comparing the dynamical MOND mass and baryonic mass, while the second method entails a comparison of the MOND-estimated temperature with the observed temperature. We then compare the unseen mass predicted by Emergent Gravity with the estimated dark matter mass. We find that MOND is able to explain the mass discrepancy at large radii but not in the central regions. The observed temperature profile is also in slight disagreement with that in the MOND paradigm. Likewise the Emergent Gravity Theory shows a marginal discrepancy in accurately accounting for the dynamical mass in the inner regions. Our results are qualitatively consistent with the earlier tests on other clusters.

Track type:

Dark Energy and Modified Gravity

Parallel - Neutrino / 199

Scalar-NSI: An unique tool to probe New Physics

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In the current precision era of neutrino physics, the subdominant new physics scenarios, such as non-standard interactions (NSIs) are of great interest for exploring physics beyond the standard model (BSM). Scalar NSI (SNSI), which is mediated by a scalar field, has been a fascinating area of study in recent times. Unlike vector NSI, SNSI modifies the standard neutrino mass matrix through the Yukawa couplings and appears as an additional mass matrix consisting of real and complex elements. We investigate the effect of complex off-diagonal SNSI parameters, which are characterised by their magnitudes $\eta_{\alpha\beta}$ and new phases $\phi_{\alpha\beta}$. The linear scaling of matter density with the SNSI motivates its study in the long baseline (LBL) experiments. Thus, we have considered two future LBL experiments, DUNE and P2SO, to constrain these SNSI parameters. We also checked their effect on the measurement of various standard oscillation parameters. We then demonstrated the correlation between different oscillation parameters and the SNSI parameters $\eta_{\alpha\beta}$ and found that the new CP phases ($\phi_{\alpha\beta}$) can have significant impact on the sensitivity to determine the unknowns of the neutrino sector. We found that the oscillation parameter Δm^2_{31} exhibits non-trivial behaviour

when SNSI parameters are present. Additionally, we noticed that $\phi_{\mu\tau}$ plays an important role for the determination of various oscillation parameters.

Track type:

Neutrino Physics

Poster Session / 201

Non-standard interactions and environmental decoherence at DUNE

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In this work, we study the collective impact of non-standard interactions (NSIs) and environmental decoherence on different neutrino oscillation channels at DUNE experiment. DUNE is a long baseline neutrino oscillation experiment of 1300km baseline, with broad band beam and advanced particle identification facility favourable to search for new physics (NP) effects. Considering these advantages, we simulate DUNE experimental data assuming the presence of NP (NSI and decoherence) and investigate the sensitivity of DUNE to differentiate among NSI and decoherence.

Track type:

Neutrino Physics

Poster Session / 202

Exploring Higher-Order Modes in Gravitational Wave Astronomy: Insights from LISA

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The Laser Interferometer Space Antenna (LISA) is a groundbreaking gravitational wave astronomy project that aims to uncover the secrets of the universe by detecting low-frequency gravitational waves. While LISA's primary focus is on studying massive black hole mergers, its capability to explore higher-order modes (HOMs) opens new frontiers in astrophysics. This abstract investigates the collaborative synergy between LISA's detection expectations, numerical relativity simulations, and advanced visualization techniques, shedding light on the complex dynamics of HOMs.

LISA's sensitivity to lower frequencies enables it to detect subtle signatures of asymmetries in astrophysical sources such as black hole binaries. Leveraging simulations, we delve into the theoretical foundations of HOMs, illuminating expected gravitational wave signals.

Our Python-based Visualization toolkit is critical for analyzing numerical relativity-generated gravitational wave data. These visualisations effectively capture the spatial and temporal complexities of higher-order modes, improving qualitative understanding and facilitating the widespread dissemination of scientific findings.

This study aims to improve our understanding of higher-order modes in gravitational waves and their profound implications for astrophysics and fundamental physics by taking a multidisciplinary approach. This abstract highlights LISA's transformative potential, paving the way for groundbreaking insights into the universe.

Track type:

Gravitational waves

Parallel - Cosmology / 205

Large Blue Spectral Index from a Conformal Limit of a Rotating Complex Scalar

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A well-known method for generating a large blue spectral index for axionic isocurvature perturbations involves a flat direction without a quartic potential term for the axion field's radial partner. In this work, we demonstrate how a large blue spectral index can be achieved even with a quartic potential term linked to the Peccei-Quinn symmetry breaking radial partner. We utilize the fact that a large radial direction with a quartic term can naturally induce a conformal limit, producing an isocurvature spectral index of 3. This conformal representation differs intrinsically from the conventional equilibrium axion scenario or massless fields in Minkowski spacetime. Alternatively, this limit can be seen as the angular momentum of the initial conditions slowing the radial field or as a superfluid limit. The quantization of the non-static system, where the derivatives of the radial and angular fields do not commute, is meticulously treated to determine the vacuum state. We also discuss the parametric region consistent with axion dark matter and isocurvature cosmology.

Track type:

Inflation

Parallel - Flavour / 206

Sommerfeld effect and bound state formation for Dark Matter with colored mediators: a computational framework

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In the universal framework of simplified t-channel dark matter models, the relic abundance is dominated by mediator annihilation in most of parameter space, which gets considerably enhanced by the Sommerfeld effect and bound state formation. We provide an intuitive and easy to use add-on package to micrOMEGAs, allowing for an automated inclusion of these effects for a generic t-channel dark matter model. Albeit their effect is subdominant in the coannihilation regime, excited bound state levels are included as well. We analyze representative models with scalar and fermionic mediators and highlight the differences and
common features between the two.

Track type:

Astroparticle Physics

Poster Session / 207

Exploring Dark QCD Dark Matter Models with Heavy Quarks

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We investigate different classes of models, in which the dark matter candidate arises as a hadronic state of dark constituent quarks, which are charged under both the new confining dark gauge group and the standard model. Specifically, we focus on the case of quarks in the fundamental representation of SU(N), which are heavier than the dark QCD confinement scale. Recent literature has demonstrated that this class of models can lead to a first order phase transition of the dark sector, which effectively results in a significant depletion of the dark matter relic abundance, due to a second annihilation stage after the usual freeze-out. In this study, we assess the distinctive thermal history associated with this type of models and perform a comprehensive study of the relevant parameter space - spanned by the dark QCD scale and the dark matter mass –beyond what was considered so far and discuss phenomenological consequences.

Track type:

Dark Matter

Poster Session / 208

Generalised CP Symmetry and Texture Zero in Trimaximal Mixing Matrix

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In this study, we explore the impact of texture zero on the neutrino mass matrix, focusing on their ability to constrain unknown parameters such as mixing angles, Dirac and Majorana phases, and mass eigenstates. We investigate one-zero texture within the framework of generalized CP symmetry associated with the complex tribimaximal matrix. By combining these approaches, we derive predictive neutrino mass matrices and neutrinoless double beta decay in the context of texture zero, considering the implications for current and future experimental searches. Our findings highlights the enhanced predictability and testability of neutrino mass models that incorporate generalized CP symmetry.

Track type:

Neutrino Physics

Parallel - Dark Matter / **212**

Neutrino floor in the light dark matter sector with isospin violating interactions

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The neutrino floor is a theoretical lower limit on dark matter-nucleon scattering cross-section computed in WIMP-like dark matter models that are being probed in direct detection experiments. Neutrino floor, which defines the extent of the neutrino background, can be modified in a BSM set up that is important from the DM detection perspective. We work in a BSM set up which is very natural like a SM-type isospin violating set up, albeit in the dark sector. Here both the dark matter and neutrino interaction happen through isospin violating interactions. In a significant portion of the parameter space, we observe the neutrino nucleus scattering cross section goes down, eventually lowering the neutrino floor in this setup. This reduction of the neutrino floor opens up a new window for the DM direct detection in future experiments.

Track type:

Dark Matter

Parallel - Neutrino / **214**

Probing new physics with high energy appearance events @ NOvA

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NuMI Off-axis ν_e Appearance (NOvA) experiment is an on-going long baseline neutrino oscillation experiment. In addition to the ν_μ, $\bar{\nu}_\mu$ disappearance events, it analyses the ν_e and $\bar{\nu}_e$ appearance events within the energy range of $1 < E < 4$ GeV. In this work, we consider the high energy ν_e and $\bar{\nu}_e$ appearance events in the range $4 < E < 20$ GeV and investigate their impact on the sensitivity of the experiment to constrain the new physics parameters in non-standard neutrino interactions and environmental decoherence.

Track type:

Neutrino Physics

Parallel - Neutrino / 215

Neutrino Phenomenology in A_4 Modular Symmetry with Scoto Seesaw Mechanism

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The innovative aspect of this study is the introduction of a hybrid scoto-seesaw model based on A_4 discrete modular symmetry, which has many intriguing phenomenological implications. Using the type-I seesaw mechanism at the tree level, the scoto-seesaw framework generates one mass square difference ($\Delta m^2_{\rm atm}$). Furthermore, a clear explanation of the two distinct mass square differences is provided by the scotogenic contribution, which is essential in deriving the other mass square difference ($\Delta m^2_{\rm sol}$) at the loop level. Under the A_4 modular symmetry, Yukawa couplings undergo a non-trivial transformation that facilitates the investigation of neutrino phenomenology with a specific flavor structure of the mass matrix. Along with predicting neutrino mass ordering, mixing angles, and CP phases, this framework also provides precise predictions for $\sum m_i$ and $|m_{ee}|$. Specifically, the model predicts $\sum m_i \in (0.073, 0.097)$ eV and $|m_{ee}| \in (3.15, 6.66) \times 10^{-3}$ eV, which are within the reach of forthcoming experiments. Moreover, our model appears promising in addressing lepton flavor violations, including $\ell_\alpha \to \ell_\beta \gamma$, $\ell_\alpha \to 3\ell_\beta$, and $\mu - e$ conversion rates, while remaining consistent with current experimental limits.

Track type:

Neutrino Physics

Parallel - Dark Matter / 216

Vector Dark Matter with Higgs Portal in Type II Seesaw framework

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We study the phenomenology of a vector dark matter (VDM) in a U(1)X gauged extension of the Standard Model (SM) which is connected to the type II seesaw framework via the Higgs portal. When this U(1)X symmetry is spontaneously broken by the vacuum expectation value (VEV) of a complex scalar singlet, the gauge boson Z′ becomes massive. The stability of the dark matter (DM) is ensured by the introduction of an exact charge conjugation symmetry. On the other hand, the SU(2)_L triplet scalar generates light neutrino masses through the type II seesaw mechanism. We have studied the phenomenology of the usual WIMP DM considering all possible theoretical and experimental constraints that are applicable. Due to the presence of triplet scalar, our scenario can accommodate the observed 2σ deviation in h⟶Zγ decay. We have also briefly discussed the possibility of non-thermal production of DM from the decay of the same complex scalar that is responsible for the breaking of this U(1)_X symmetry.

Track type:

Dark Matter

Parallel - Neutrino / 217

Implications of Long-Range Forces in P2SO and T2HKK Experiments.

Author: Rudra Majhi[None]

Co-authors: Monojit Ghosh ; Priya Mishra ; Rukmani Mohanta ; Sambit Kumar Pusty [1]

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Neutrino oscillations can be affected by the presence of Earth-matter through charged and neutral current (NC) interactions, which are mediated by W and Z bosons, respectively. To investigate beyond Standard Model NC interactions, an additional gauge boson (Z') can facilitate interactions between matter and neutrinos. In our study, we investigate a lightweight Z' with a mass order of 10^{-16} eV or below, which could potentially mediate interactions between solar matter and neutrinos reaching Earth, known as the long-range force (LRF). We explore how future long-baseline neutrino experiments like P2SO and T2HKK can contribute to constraining the LRF parameters. Our specific goals are to investigate the following: the impact of LRF on the measurement of standard oscillation parameters and the capacity to impose limits on the LRF parameters. Also, we obtain the constraint on the mass of the new gauge boson and the value of the new coupling constant responsible for LRF due to the Sun's matter density. According to our study, the P2SO experiment is putting stringent constraints on the LRF parameters including the new gauge boson's mass and the value of new coupling constant. Furthermore, our findings reveal that LRF has a substantial impact on determining standard neutrino oscillation parameters θ_{23}, $\delta_{\rm CP}$, and Δm^2_{31}. Notably, we observe that the precision of Δm^2_{31} remains robust and unaffected by the presence of LRF in both P2SO and T2HKK experiments.

Track type:

Neutrino Physics

Parallel - Collider & BSM / 218

Twin Anomaly in a minimal Extension of Inert 2HDM

Authors: Ashok Goyal[1]; Hrishabh Bharadwaj[2]; Mamta Dahiya[3]; Sukanta Dutta[3]

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The W boson mass and the anomalous magnetic moment of muon are two most notable anomalies that provide a stringent test of the SM and should be explained by any proposed model beyond SM. We shall address these observed discrepancies in a minimal extension of the inert two Higgs doublet model(I2HDM). Using the model parameters constrained by various theoretical considerations and experimental observables, we shall show that a large parameter space of the model can accommodate both experimental observations simultaneously.

Track type:

Collider and BSM Physics

Parallel - Cosmology / 219

Impacts of Z3 symmetric dark matter models on global 21-cm signal

Author: Debarun Paul[1]

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$\mathbb{Z}_3$ symmetric dark matter models have demonstrated remarkable potential in addressing various (astro-)particle physics challenges. In this presentation, I will discuss the diverse ways in which this model can successfully explain the different cosmological observations. We have considered two such promising models: semi-annihilating dark matter (SADM) and Co-SIMP $2 \to 3$ interaction, and investigated their effects on the global 21-cm signal. We found that the SADM model has a lesser impact on explaining the EDGES dip, while the Co-SIMP model can successfully explain the absorption dip measured by EDGES experiment by virtue of its intrinsic cooling effect. Additionally, given the ongoing debate between EDGES and SARAS 3 experiments regarding the global 21-cm signal, we demonstrate that our chosen models can still remain viable in this context, even if the EDGES data requires reassessment in future. Furthermore, we have explored the impacts of these models during the Dark Ages and conducted a consistency check with CMB and BAO observations using the Planck 2018(+BAO) datasets. All of these scenarios should have signatures on the 21-cm power spectrum which can be detected at the other detectors.

This talk is based on: JCAP11(2023)015 (arXiv:2308.04955).

Track type:

Cosmology

Parallel - Cosmology / 220

Self-interactions of ultralight spinless dark matter to the rescue?

Author: Gaurav Goswami[1]

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Numerous observations on astrophysical and cosmological scales can be interpreted to mean that, in addition to the familiar kind of matter well described by the standard model of elementary particle physics, there exists Dark Matter (DM). The fundamental properties of the elementary particles which make up the DM e.g. particle mass, spin, couplings etc are currently being observationally constrained. In particular, if DM particles have spin zero, there exist recent constraints which suggest a lower limit on its mass which is often a couple of orders of magnitude larger than 10^{-22} eV. In this talk, we will (a) argue that these limits are based on the assumption that the self coupling of the spinless DM particles is negligible, and, (b) show how some of these lower limits will get modified in the presence of incredibly feeble self interactions.

Track type:

Astroparticle Physics

Parallel - Collider & BSM / 223

Deciphering the Mysteries of the Long-Lived Particles at the colliders

Author: CHANDRIMA SEN[None]

Co-authors: Eung Jin Chun ; Mariana Frank [1]; Priyotosh Bandyopadhyay [2]; Snehashis Parashar [3]

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Conventional searches at the LHC operate under the assumption that Beyond the Standard Model particles undergo immediate decay upon production. However, this assumption lacks inherent a priory justification. This talk delves into the exploration of displaced decay signatures across various collider experiments. Combining insights from several studies, we show how small Yukawa couplings, compressed mass spectra, and collider boosts lead to distinctive displaced decays, observable at the CMS, ATLAS and proposed future detectors. These phenomena, manifesting within both Type-I and Type-III seesaw mechanisms, and the Vector-like lepton model with non-zero hypercharge, provide a unique insight into the behaviors of neutrinos and dark matter. The seminar highlights the technical challenges and breakthroughs in detecting and interpreting these signatures, emphasizing their significance in probing the depths of the extensions of the Standard Model.

Track type:

Collider and BSM Physics

Poster Session / 224

Likelihood and Deep Learning Analysis of the electron neutrino event sample at Intermediate Water Cherenkov Detector of the Hyper-Kamiokande experiment

Author: Tanima Mondal[1]

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The Hyper-Kamiokande (Hyper-K) is a next-generation long baseline neutrino experiment. One of its primary physics goals is to measure neutrino oscillation parameters precisely, including CP-asymmetry measurement. As the conventional νμ beam from the J-PARC neutrino production baseline contains only 1.5% of the electron neutrino interaction of the total, it is very challenging to measure electron (anti)neutrino scattering cross-section on nuclei. To address these challenges and mitigate systematic uncertainties associated with background events, an Intermediate Water Cherenkov detector (IWCD) will be built at a distance of about 1 km from the J-PARC, which will study neutrino interaction rate peaked at different energies with higher accuracy. The presented, simulated data comprises νeCC0π as the main signal, and NCπ0 and νμCC are major background events. To reduce this background contamination, initially, a log-likelihood-based reconstruction algorithm to select candidate events was used, which, however, sometimes struggles to distinguish π0 events properly from electron-like events. Therefore, a Machine Learning-based framework has been developed to enhance the purity and signal efficiency rate of electron neutrino events. It was found that implementing it notably enhances both the efficiency and purity of νe signals compared to the conventional approach.

Track type:

Neutrino Physics

Poster Session / 225

Constraints on monopole-dipole potential from the tests of gravity

Authors: Debashis Pachhar[1]; Tanmay Poddar[2]

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Ultralight Axion Like Particles (ALPs) can mediate a macroscopic force with long-range monopole-dipole interactions between the Earth and the Sun, if the Earth is treated as a polarized source. Due to the geomagnetic field, there exists an estimated 10^{42} polarized electrons within the Earth. These electrons, in a polarized state, can interact with the unpolarized nucleons in the Sun, giving rise to a monopole-dipole potential between the Sun-Earth system. This phenomenon ultimately influences the trajectories of light and celestial bodies, resulting in observable effects such as gravitational light bending, Shapiro time delay, and perihelion precession of planets. There are two scenarios for constraining the monopole-dipole coupling strength. In the first scenario, constraint on the monopole-dipole strength based on a single astrophysical observation, treating the Earth as a source of polarized electrons is established. The perihelion precession of Earth sets an upper limit on the monopole-dipole coupling strength as $g_S g_P$
$lesssim 1.75 \times 10^{-16}$ for the ALP of mass m_a
$lesssim 1.35 \times 10^{-18}$ eV. This bound surpasses the limits obtained from gravitational light bending and Shapiro time delay. In the second scenario, constraints on monopole-monopole coupling

strength g_S $\left(lesssim 3.51 \times 10^{-25}\right)$ arises from the perihelion precession of the planet Mars, while the limit on dipole-dipole coupling strength g_P $\left(lesssim 1.6 \times 10^{-13}\right)$ is taken from the measurement of the tip of the red giant branch in ω Centauri using Gaia DR2 data. Together, they yield a hybrid constraint on the monopole-dipole coupling strength as $g_S g_P$
$lesssim\, 5.61 \times 10^{-38}$. The hybrid bound is three orders of magnitude more stringent than the Eot-Wash experiment and one order of magnitude stronger than the current hybrid $(\mathrm{Lab})^{\mathrm{N}}_{\mathrm{S}} \times (\mathrm{Astro})^{\mathrm{e}}_{\mathrm{P}}$ limit.

Track type:

Astroparticle Physics

Parallel - ASP & GW / 226

Gravitational Waves as a Probe of Heavy Non-Annihilating Dark Matter

Author: Sulagna Bhattacharya[1]

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Galactic Dark Matter (DM) particles can get captured inside celestial bodies if they have some non-zero but weak interaction with the nucleons. Due to their significant size and lifetime, these celestial bodies can capture huge amounts of DM particles, and eventually, an overly dense dark core is created. This core can further collapse and form a minuscule Balck Hole (BH) that can eat up the whole celestial body in the course of time and form a similar mass BH. Depending on the DM-nucleon interaction cross-section, this theory can be studied in non-compact stars like the Sun, and Jupiter, and compact objects like Neutron stars (NS). We show constraints on DM parameter space using gravitational wave detectors like LIGO (ground-based) and LISA (space-based), by studying low-mass (1-2.5 M_{solar}) compact object mergers and close stellar binaries in their inspiral phase respectively. We will argue how these gravitational wave experiments can work as a direct detection experiment for
DM searches.

Track type:

Astroparticle Physics

Parallel - Cosmology / 227

Extended Bose-Einstein condensate dark matter in f(Q) gravity

Author: Raja Solanki[1]

Co-authors: Aaqid Bhat [2]; P. K. Sahoo [2]

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In this article, we attempt to explore the dark sector of the universe i.e. dark matter and dark energy, where the dark energy components are related to the modified $f(Q)$ Lagrangian, particularly a power law function $f(Q) = (\frac{Q}{Q_0})^n$, while the dark matter component is described by the Extended Bose-Einstein Condensate (EBEC) equation of state for dark matter, specifically, $p = \alpha\rho + \beta\rho^2$. We find the corresponding Friedmann-like equations and the continuity equation for both dark components along with an interacting term, specifically $\mathcal{Q} = 3b^2 H\rho$, which signifies the energy exchange between the dark sector of the universe. Further, we derive the analytical expression of the Hubble function, and then we find the best-fit values of free parameters utilizing the Bayesian analysis to estimate the posterior probability and the Markov Chain Monte Carlo (MCMC) sampling technique corresponding to CC+Pantheon+SH0ES samples. In addition, to examine the robustness of our MCMC analysis, we perform a statistical assessment using the Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC). Further from the evolutionary profile of the deceleration parameter and the energy density, we obtain a transition from the decelerated epoch to the accelerated expansion phase, with the present deceleration parameter value as $q(z=0) = q_0 = -0.56^{+0.04}_{-0.03}$ (68% confidence limit), that is quite consistent with cosmological observations. In addition, we find the expected positive behavior of the effective energy density. Finally, by examining the sound speed parameter, we find that the assumed theoretical $f(Q)$ model is thermodynamically stable.

Track type:

Dark Energy and Modified Gravity

Parallel - Dark Matter / 229

WIMPy Leptogenesis in Non-Standard Cosmologies

Author: Dr. Devabrat Mahanta[None]

Co-author: Debasish Borah [1]

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We study the possibility of generating baryon asymmetry of the universe from dark matter (DM) annihilations during non-standard cosmological epochs. Considering the DM to be of weakly interacting massive particle (WIMP) type, the generation of baryon asymmetry via leptogenesis route is studied where WIMP DM annihilation produces a non-zero lepton asymmetry. Adopting a minimal particle physics model to realise this along with non-zero light neutrino masses, we consider three different types of non-standard cosmic history namely, (i) fast expanding universe, (ii) early matter domination and (iii) scalar-tensor theory of gravity. By solving the appropriate Boltzmann equations incorporating such non-standard history, we find that the allowed parameter space consistent with DM relic and observed baryon asymmetry gets enlarged with the possibility of lower DM mass in some scenarios. While such lighter DM can face further scrutiny at direct search experiments, the non-standard epochs offer complementary probes on their own.

Track type:

Parallel - Flavour / 230

Measurement of the time-integrated CP asymmetry of D→ KSKS decay with Belle and Belle II

Author: Kavita Lalwani[1]

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The decay D ⟶ KSKS is among the most interesting modes for the understanding of CP violation in charm decays. It is a singly Cabibbo suppressed transition that involves the interference between cu (bar) ⟶ ss (bar) and cu (bar) ⟶ dd (bar) amplitudes, mediated by the exchange of a W boson at the tree level, that can generate CP asymmetries at the 1% level, even if the Cabibbo-Kobayashi-Maskawa phase is the only source of CP. Current experimental measurements of the CP asymmetry in D ⟶ KSKS decays are still limited by the statistical precision, with the best measurement performed by Belle experiment at an integrated luminosity of 921 fb−1: ACP (D ⟶ KSKS) = (−0.02 ± 1.53 ± 0.02 ± 0.17)%, where the first uncertainty is statistical, the second systematic and the third due to the CP asymmetry of the reference D ⟶ KS π0. ACP in D ⟶ K+K− is measured with 0.11% precision, Therefore, using D ⟶ K+K- as the control mode reduces the uncertainty due to the control mode and makes the analysis simpler. In this talk, we present the CP asymmetry in D ⟶ KSKS, using D ⟶ K+K− as the control mode with Belle and Belle II experiments. The full Belle data sample is used at integrated luminosity of 980 fb-1. For Belle II, the data collected before Long Shutdown 1 (LS1) is used and corresponds to an integrated luminosity of 420 fb−1.

Track type:

Collider and BSM Physics

Parallel - Dark Matter / 231

A New Window into Multi-component Dark Matter

Author: Amit Dutta Banik[1]

[1] *ISI Kolkata*

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We explore a case of multi-particle dark matter with symmetric and asymmetric dark matter components in a model-independent approach. Starting from the Boltzmann equations for the multi-particle system, we focus on scenarios where one of the DM candidates is hidden from the visible sector. We also comment on the effect of non-standard expansion of the universe on the dark matter relic abundance.

Track type:

Dark Matter

Plenary / 232

Particle-Astrophysics: The Road Ahead

Author: Dan Hooper[1]

[1] *University of Wisconsin, Madison*

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I will discuss the state and of high-energy and multi-messenger astrophysics, and consider the exciting prospects for this field moving forward.

Track type:

Astroparticle Physics

Plenary / 233

Efficient cosmological model selection with Bayesian Optimisation

Author: Jan Hamann[1]

[1] *The University of New South Wales*

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How can we decide which cosmological model is the most probable? In a Bayesian approach to statistics, this question can be readily answered using the framework of Bayesian model selection: namely by calculating a model's evidence. However, the numerical evaluation of the evidence can be a numerically difficult task.
I will introduce a new, efficient machine-learning approach to this problem –based on Gaussian Process Regression and Bayesian Optimisation and designed to minimise the number of likelihood evaluations required –and demonstrate its efficiency on a number of examples.

Track type:

Cosmology

Parallel - Cosmology / 236

Cosmology with Photometric SNIa in the LSST Era

Author: Ayan Mitra[1]

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The Vera C. Rubin Observatory Legacy Survey of Space and Time (Rubin LSST) is expected to achieve its first system light by late 2025. An initial data preview, drawn from early commissioning phases, is set for 2025-26, exciting the scientific community as they prepare to explore the Rubin LSST data. In this context, we have been working on developing the DESC Time Domain (TD) pipeline with a focus on SNIa cosmology and dark energy estimation. In this work, I present a rigorous cosmology analysis with type Ia supernova performed with the DESC TD pipeline and study the improvement from using a photometrically classified SNIa sample, and with host galaxy photo-z availability over cosmology results from spectroscopically obtained redshift 'only' SNIa sample. We use two different SN datasets: the ELAsTiCC (Extended LSST Astronomical Time-series Classification Challenge) and the PLAsTiCC (Photometric LSST Astronomical Time-Series Classification Challenge) supernova sample [2210.07560]. For identifying non type Ia contaminations, we use a photometric classifier, SCONE (Supernova Classification with a Convolutional Neural Network). We show that with the use of photometric SNIa sample there is a significant improvement in dark energy estimation quantified via the Figure of Merit (FoM), over spectroscopic only SNIa sample. More details on the analysis and results shall be shared during the talk, as the analysis is not yet complete.

Track type:

Cosmology

Plenary / **237**

Recent Measurements of Galactic Cosmic Rays with the GRAPES-3 Experiment

Author: Pravata Kumar Mohanty[1]

[1] *Tata Institute of Fundamental Research*

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The GRAPES-3 experiment setup at an altitude of 2200 m in Ooty, India, employs a dense array of plastic scintillator detectors complemented with a large-area tracking muon detector. It is designed to observe shower particles which mostly include gamma rays, electrons and muons produced by interactions of primary cosmic rays and gamma rays in Earth's atmosphere. Recently, GRAPES-3 successfully measured the cosmic ray proton spectrum in the energy range of 50 TeV to 1.3 PeV, overlapping with space-based detectors and bridging the gap between space and ground-based observations. The experiment discovered a spectral hardening beyond 166 TeV, challenging the single power-law model that applies below the knee energy (at ~ 3 PeV). Furthermore, GRAPES-3 identified two significant small-scale anisotropic structures in cosmic ray arrival distributions at a median energy of 16 TeV, confirming the observations from the HAWC and ARGO-YBJ experiments. This presentation will highlight these results and discuss the future outlook.

Track type:

Astroparticle Physics

238

Neutrino astronomy with dark matter - neutrino interactions

Author: Subhendu Rakshit[1]

Co-authors: Siddhartha Karmakar [1]; Sujata Pandey [1]

[1] *IIT Indore*

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Ultralight dark matter can form a core-like structure in the dark matter density profile in astrophysical objects. Neutrinos emerging from these objects might bring out valuable information about this profile through neutrino oscillations if they have interactions with dark matter.

Track type:

Neutrino Physics

Parallel - Neutrino / **239**

Weak mixing angle at direct detection

Author: Tarak Nath Maity[1]

Co-author: Celine Boehm [2]

[1] *Indian Institute of Science*

[2] *The University of Sydney*

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Current ton-scale direct detection experiments have begun observing solar neutrinos. We probe the weak mixing angle using existing direct detection data. Leveraging recent measurements of B solar neutrinos via coherent neutrino-nucleus scattering by PandaX-4T and XENONnT, we demonstrate that these experiments can probe the weak mixing angle in a region complementary to that of dedicated neutrino experiments. Furthermore, we show that the current XENONnT electron recoil data can probe the weak mixing angle through neutrino-electron scattering, in a momentum transfer region over an order of magnitude smaller than that explored by atomic parity violation experiments. Our findings reveal significant potential for probing a key Standard Model parameter in a completely new energy regime through the observation of neutrinos in future direct detection experiments.

Track type:

Astroparticle Physics

241

Anisotropy and the missing rest frame of the Universe falsify standard dark cosmology

Author: Mohamed Rameez[1]

[1] *Tata Institute of Fundamental Research*

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In the standard cosmological model the universe is assumed to be statistically isotropic & homogeneous when averaged on large scales. The dipole anisotropy of the CMB is ascribed to our peculiar motion due to local inhomogeneity. There should then be a corresponding dipole in the sky map of high redshift sources. Using catalogues of radio galaxies and quasars we find that this expectation is rejected at $>5\sigma$. This undermines the standard practice of boosting to the 'CMB frame'to analyse cosmological data, in particular for inferring an isotropic acceleration of the Hubble expansion rate which is interpreted as due to Λ.

Track type:

Cosmology

Parallel - Collider & BSM / 242

Mind the gap: exclusion limits and unconventional searches for leptoquarks

Author: Tanumoy Mandal[1]

[1] *IISER Thiruvananthapuram*

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To search for physics beyond the Standard Model at colliders like the Large Hadron Collider (LHC), experimentalists often rely on simple phenomenological models. So far, these searches have not yielded positive results. Nevertheless, there are compelling reasons to believe that new physics should exist at the TeV scale, within the LHC's reach. In this talk, I will demonstrate how one can reinterpret LHC results to establish exclusion limits on leptoquark models by incorporating various production mechanisms. I will also highlight examples of intriguing and unexplored leptoquark signatures that are predicted by several well-motivated models but have not yet been considered by experimentalists.

Track type:

Collider and BSM Physics

243

New Approaches in Search for Light Dark Matter

Author: Jong-Chul Park[1]

[1] *Chungnam National University (KR)*

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In the absence of a confirmed dark-matter signal in traditional dark-matter search experiments, advances in theory and experiment have opened up various new possibilities of searching for dark-matter particles even lighter than GeV, e.g. boosted dark matter, direct detection with novel materials and sensors, and beam dump experiments. In this talk, I will focus on recent advancements in energetic dark-matter searches. First, I will provide a short summary of various dark-matter boosting mechanisms and explain their direct searches with some potential issues. Next, I will very briefly mention the importance of cosmological side studies of boosted dark matter.

Track type:

Dark Matter

Parallel - Dark Matter / 244

Dark-Matter Mass from Angular Dependence

Author: Jong-Chul Park[1]

Co-author: Doojin Kim [2]

[1] *Chungnam National University (KR)*

[2] *University of South Dakota*

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We propose a novel method to determine the mass scale of ambient dark matter that can be generally applied to the (at least effectively) two-dimensional direct detection experiments allowing for directional observables. Due to the motions of the solar system and the Earth relative to the galactic center and the Sun, the dark-matter flux carries a directional preference. We first formulate that dark-matter event rates have a non-trivial dependence on the angle between the associated detection plane and the overall dark-matter flow and that the curvature of this angular spectrum encrypts the mass

information. For proof of principle, we take the recently-proposed Graphene-Josephson-Junction-based superlight dark-matter detector (named as GLIMPSE) as a concrete example and demonstrate these theoretical expectations through numerical analyses.

Track type:

Dark Matter

245

Latest KATRIN results on neutrino mass and sterile neutrino search.

Author: Shailaja Mohanty[1]

[1] *IAP, KIT*

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Neutrinos are known to have non-zero masses, as shown by oscillation observations, but their absolute mass scale remains unknown. Observational cosmology and neutrinoless double beta decay experiments derive sub-eV upper limits. Complementing these efforts with a model-independent approach based on beta-decay kinematics, the Karlsruhe Tritium Neutrino (KATRIN) experiment provides the most direct bound at 0.45 eV/c^2 (90% CL). The ongoing data-taking targets a sensitivity of better than 0.3 eV. The experiment combines a high-intensity gaseous tritium source with high-resolution spectroscopy of the molecular tritium beta decay spectrum. KATRIN also explores the potential for eV-scale sterile neutrinos, complementary to short-baseline neutrino oscillation experiments. The analysis of five KATRIN science runs highlights the experiment's sensitivity to a fourth mass eigenstate \(m_{4}\) up to 40 eV and an active-to-sterile mixing amplitude \(|U_{e4}|^2 \leq 0.5\). This talk discusses the improved bounds on the neutrino mass from analyzing 25\% of the KATRIN data and details on sensitivity to light sterile neutrinos

Track type:

Neutrino Physics

246

Uncovering tau-neutrino-philic secret interactions in DUNE

Authors: Pouya Bakhti[1]; Seodong Shin[2]; meshkat rajaee[1]

[1] *JBNU*

[2] *Jeonbuk National University*

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In this talk, I would like to investigate the excellent potential of future tau neutrino experiments in probing non-standard interactions and secret interactions of neutrinos. I would like to first discuss so-called secret neutrino interactions of tau neutrinos including their possible effects in cosmology and astroparticle physics. Then, the sensitivities of probing such interactions in various tau neutrino experiments such as DUNE, SHiP, SND@LHC, FASERnu, and future experiments in FPF will be discussed. Due to its ability of identifying and reconstructing the tau lepton decay products, DUNE far detector can have excellent sensitivity beyond the existing cosmological and astrophysical bounds by observing downward-going atmospheric neutrinos. Also pros and cons of other experiments will be discussed.

Track type:

Plenary / 247

Strongly interacting dark matter: from colliders to cosmology

Author: Suchita Kulkarni[1]

[1] *University of Graz*

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I will take a brief overview of the recent developments in the field of strongly interacting dark matter. I will discuss new ways to generate dark matter relic density as well as discuss associated detection strategies.

Track type:

Dark Matter

Parallel - ASP & GW / 248

Exploring cosmological gravitational wave backgrounds through the synergy of LISA and ET

Authors: Alisha Marriott-Best[None]; Anish Ghoshal[1]; Debika Chowdhury[2]; Gianmassimo Tasinato[3]

[1] *University of Warsaw, Poland*

[2] *Indian Institute of Astrophysics*

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The Gravitational Wave (GW) interferometers LISA and ET are expected to be functional in the next decade(s). In this talk, I shall discuss about possible synergies between these two detectors, with the aim of a multi-band detection of a cosmological stochastic GW background. I shall illustrate that LISA and ET operating together will have the opportunity to effectively assess the characteristics of the GW spectrum produced by a cosmological source, but at separate frequency scales. The two experiments in tandem can be sensitive to features of the early-universe cosmic expansion that might not be possible to detect otherwise. I shall also discuss several examples of early-universe scenarios to explain the advantages of such a synergy.

Track type:

Cosmology

Plenary / 250

Laudau-Zener production of heavy sterile neutrino DM

Author: Eung Jin Chun[1]

[1] *Korea Institute for Advanced Study*

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We propose a scenario where a heavy RHN DM can be produced by a thermal effect undergoing a resonance at high temperature in the early Universe

Track type:

Dark Matter

Plenary / 251

Latest results and BSM searches from Belle II

Author: Shohei Nishida[None]

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Belle II is a flavor physics experiment at the asymmetric electron-positron collider SuperKEKB at KEK in Japan. Belle II aims to record an order of magnitude more data than the previous Belle experiment. Belle II started operation in 2019 and has accumulated 530 fb^{-1} of data to date. I will present recent results from Belle II with a focus on BSM searches, including the first evidence for the $B^+ \to K^+\nu\bar{\nu}$ decay, search for a lepton-flavor violating tau and B decays and tests of lepton flavor universality.

Track type:

Plenary / 252

The Pierre Auger Observatory: Results and Prospects

Author: Qader Dorosti Hasankiadeh[1]

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The Pierre Auger Observatory, the world's largest cosmic-ray detector, continues to make significant advances in the study of ultra-high-energy cosmic rays (UHECRs). By utilizing a hybrid detection system of surface and fluorescence detectors, the Observatory has made substantial contributions to our understanding of UHECR origins, composition, and energy spectrum, offering a consistent picture of these characteristics. In this talk, I will highlight recent findings, including refined measurements of the UHECR energy spectrum, evidence for anisotropies at the highest energies, and new insights into cosmic-ray composition. Recent studies of hadronic interactions at energies beyond the reach of terrestrial accelerators will also be discussed, providing valuable insights into particle physics. The ongoing AugerPrime upgrade is poised to significantly enhance the Observatory's ability to distinguish between different primary particles and improve sensitivity to photons and neutrinos. These advancements will expand the Observatory's capability to investigate UHECRs, their sources, and propagation mechanisms, offering exciting opportunities for future discoveries in the coming decade.

Track type:

Astroparticle Physics

Plenary / 253

LHCb highlights plenary

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The Large Hadron Collider beauty (LHCb) experiment has played a pivotal role in advancing our understanding of particle physics, particularly in the study of heavy quarks and their interactions. This talk will present the latest highlights from LHCb, including groundbreaking results in the areas of flavor physics, CP violation, and rare decays. We will discuss recent measurements that challenge the Standard Model and explore potential signals of new physics. Key upgrades to the LHCb detector and their impact on future data-taking will also be covered.

Track type:

Plenary / 254

Electromagnetic Properties of Neutrinos

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After a brief introduction to neutrino electromagnetic properties, I will focus on the correlation between neutrino magnetic moment and neutrino mass mechanism. Then, I will discuss that the models that induce large neutrino magnetic moments while maintaining their small masses naturally also predict observable shifts in the charged lepton anomalous magnetic moment by showing that the measurement of muon g−2 by the Fermilab experiment can be an in-direct and novel test of the neutrino magnetic-moment hypothesis, which can be as sensitive as other ongoing-neutrino/dark matter experiments. The promising new possibilities for probing neutrino electromagnetic properties in future experiments from terrestrial experiments and astrophysical considerations will also be discussed.

Track type:

Neutrino Physics

Plenary / 255

Probing New Physics with Double Beta Decay

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NA

Track type:

Neutrino Physics

Parallel - Neutrino / 256

Probing Heavy Neutrino Magnetic Moments at the LHC Using Non-Pointing Photons

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In this talk, I will discuss how long-lived particle (LLP) searches using non-pointing photons can be used to probe transition magnetic moments of heavy sterile neutrinos. Active-to-sterile and sterile-to-sterile transition magnetic dipole moments are examined in the Standard Model effective field theory extended with right-handed neutrinos (NRSMEFT) and in a simplified UV-complete scenario. We find that LLP searches at the LHC can probe sterile-to-sterile transition magnetic moments two orders of magnitude below the current best constraints from LEP. In the UV complete model, we find synergy between searches for charged lepton flavour violating (cLFV) processes and LLP searches, which could provide valuable insights into the lepton flavour structure of the new physics couplings.

Track type:

Neutrino Physics

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Whither inflation?

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The Indian Pulsar Timing Array: An overview

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Recent results from the ATLAS experiment

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LHCb highlights

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Status of the muon g-2/EDM experiment at J-PARC

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Recent NOvA Results and Prospects

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Search for BSM Physics via Gravitational Waves

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Recent Measurements of Galactic Cosmic Rays with the GRAPES-3 Experiment

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The first result from InDEx dark matter direct search experiment at JUSL

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LEGEND –200: A look at one year of physics data

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Latest KATRIN results on neutrino mass and sensitivity of sterile neutrino search

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The KM3NeT Neutrino Telescope: Results from First Data

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TEXONO and Neutrino-Nucleus Coherent Scattering - Results and Status

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The Neutrino Landscape

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Probing New Physics with Double Beta Decay

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Neutrino Astrophysics to Particle Physics with IceCube

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Pushing the limits in dark matter production

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Shedding Light on Neutrinos through Electromagnetic Properties

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Effective Field Theory approach to Lepton and Baryon Number violation

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Dark matter - neutrino interactions help neutrino astronomy

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Probing strong gravity and the densest objects in the cosmos with gravitational waves

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Status and plans of the ADMX experiment

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DESI-Y1 cosmological results from BAO measurements with galaxies and quasars

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Probing BSM Physics using Multi-Messenger Astronomy

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Cogenesis by majoron

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Efficient cosmological model selection with Bayesian Optimisation

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Accelerated fully-coherent search for compact binary coalescences

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Results from CMS

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Overview of CMB Experiments and Plans

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Probing Particle Physics Frontiers with CMB S4: Unveiling Cosmic Secrets

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Cosmology and collider implications of strongly interacting dark matter

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Primordial Black Hole probes of Heavy Neutral Leptons

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Dark matter explanations of the excess in B+->K+ + invisible

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Hearing the Universe Boil: GW from phase transition and PBH as probe of minimal SM extensions

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Flavor in Finite Grand Unified Theories

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Latest results and BSM searches from Belle II

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Compact Colliders of Tomorrow for Particle Physics

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Primordial power spectrum in light of JWST observations of high redshift galaxies

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Testing the quantum nature of gravity in a laboratory

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Closing

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The KM3NeT Neutrino Telescope: Results from First Data

Poster Session / 307

On Perturbative and other constraints for the BSM scenarios

Author: Pram Milan P Robin[1]

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We investigate two most popular beyond standard Model scenarios explaining neutrino mass and dark matter. These scenarios can potentially explain the first order phase transitions, which is required for electroweak baryogenesis. The first scenario is Type-II seesaw, and we show that perturbative constraints can be strong enough to rule out most of the parameters for the first order phase transitions. In the second scenario, we consider Type-I seesaw extension of NSSM, which is supersymmetric. In principle it can explain the dark matter and neutrino masses. However, the bounds from different sectors can really constrain the parameter space.

Track type:

Parallel - Cosmology / 308

Cosmology with Vision Transformer

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One of the recently proposed machine learning techniques in image processing that surpasses (in some cases) the accuracy of a traditional Convolutional Neural network (CNN) is the Vision Transformer. In this technique, one divides an entire image into different patches and then uses a Transformer-like algorithm to understand different features of the image. For the first time, we use this novel technique on the CAMELS data suit (consisting of 1000 hydrodynamical simulations) to constrain different cosmological and astrophysical parameters. In this talk, I will discuss the results of this study and compare these results with the traditional CNN method.

Track type:

Cosmology

Parallel - Neutrino / 309

Revisiting two-zero texture in the light of gauged Type-II seesaw

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In neutrino oscillation experiments, it was discovered more than twenty years ago that neutrinos have nonzero masses. Till then the values of two mass-squared differences have been measured with an unprecedented accuracy without revealing the absolute mass scale for neutrinos. On the other hand, the underlying symmetry that can generate the appropriate neutrino-mixing pattern also remains undetermined. Although there exist many possibilities, among them the two-zero texture is one of the attractive choices since it has less number of free parameters in the neutrino mass matrix and thereby provides definite predictions on other parameters of the PMNS matrix, which will be probed in the near future. In this talk, I will first revisit the two-zero texture and show its predictions on the Dirac CP phase and effective Majorana mass, the latter one being the key quantity for neutrino-less double beta decay. Thereafter, I will demonstrate how the two-zero texture can be realised in a gauged Type-II seesaw model and will indicate some of the consequences.

Track type:

Neutrino Physics

Poster Session / 310

Measurement of branching fraction, direct CP asymmetry, and longitudinal polarisation of decay B+ -> K*+ omega at Belle and Belle II

Authors: BIPUL BHUYAN[1]; Rajesh pramanik[2]

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We present preliminary results from a search for the decay $B^+ \to K^{*+}\omega$ using the data collected by the Belle and Belle II detector at the SuperKEKB asymmetric-energy e^+e^- collider, operating at the $\Upsilon(4S)$ resonance. This analysis focuses on the decay of B meson into two non-leptonic charmless vector mesons. The production of vector mesons in different polarization states leads to distinct polarization fractions. An enhancement in the transverse polarization fraction has been observed in penguin-dominated decays, which still remains to be understood. Investigating this decay mode experimentally is crucial, as it can significantly advance our understanding of these processes. The current experimental upper limit on the branching ratio of $B^+ \to K^{*+}\omega$ is 7.4×10^{-6} at 90% confidence level (CL), which was set by the BaBar collaboration. The collaboration also measured the longitudinal polarization fraction of this decay to be 0.41 ± 0.18. This analysis will be the first attempt to search for this decay mode and aim to measure the branching fraction, direct CP asymmetry, and longitudinal polarization using the Belle and Belle II dataset.

Track type:

Flavour Physics

Poster Session / 311

Aspects of transitivity in quantum field theory and its possible consequences

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Tracing out degrees of freedom is a standard technique in quantum field theory to isolate the relevant aspects of a system. In this study, we investigate cases where different approaches to tracing out degrees of freedom lead to non-trivial results and implications. Specifically, we consider the vacuum state of a massless scalar field in Minkowski spacetime, partitioned into two Rindler wedges, labeled Rindler-1 and Rindler-2, separated by a finite distance. From a set-theoretic perspective, this configuration treats Minkowski spacetime as the universal quantum field, with Rindler-1 and Rindler-2 as subsystems. Note: Rindler-2 is also a subset of Rindler-1.
To investigate the transitivity, we have calculated the reduced state of the field in Rindler-2 in two independent ways. The first approach is straightforward: We took the vacuum state in Minkowski and found the reduced state in Rindler-2 by tracing out the degrees of freedom of the left wedge, giving a Planckian spectrum. Similarly, in the second case, we first evaluated the reduced state in Rindler-1 from the vacuum of Minkowski, which yielded a thermal density matrix, and then the reduced density matrix in Rindler-2 from Rindler-1. We found that these independent paths of calculations do not yield the same reduced state in Rindler-2.
This variation in reduced state calculations indicates that there are quantum field theoretic systems in which the reduced quantum state of a subsystem can be path-dependent and, hence, not unique. Therefore, transitivity is violated, but it is still unclear whether this is a desirable property for a quantum field theory

Track type:

Cosmology

Plenary / **312**

LEGEND –200: A look at one year of physics data

Plenary / **313**

Searching for Sub-GeV dark matter using the Migdal effect

Plenary / **315**

Uncovering tau-neutrino-philic secret interactions in DUNE

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Cogenesis by Majoron

Special Lecture / **317**

Discovery of Neutrino Oscillations

Parallel - Cosmology / 318

PBH formation from an aborted phase transition

Plenary / 319

Dark Hypercharge Symmetry

Plenary / 320

Latest KATRIN results on neutrino mass and sensitivity of sterile neutrino search

Plenary / 321

Cosmology and collider implications of strongly interacting dark matter

Plenary / 322

Cogenesis by majoron

Plenary / 323

Neutrino Astrophysics to Particle Physics with IceCube

Author: Sanjib Kumar Agarwalla[1]

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The IceCube Neutrino Observatory is a flagship cubic-kilometer neutrino detector made up of transparent, natural Antarctic ice at the South Pole, which is instrumented with digital optical modules to detect Cherenkov light emitted during interactions of neutrinos with energies spanning more than 10 orders of magnitude. It is a unique multidisciplinary facility that has produced several outstanding results over the past decade in neutrino astrophysics to particle physics, including the first observation of high-energy astrophysical neutrinos as well as the detection of an event at the Glashow resonance. In this talk, I will provide an overview of the latest results from IceCube, with a special emphasis on the first observation of the Galactic Plane via neutrinos, multi-messenger study of a flaring blazar - TXS 0506+056, first point source of steady high-energy neutrino emission - NGC 1068, detection of long-awaited Glashow-resonance event, and recent progress in measuring the flavor composition of the astrophysical neutrino flux, including the latest observation of seven astrophysical tau neutrino candidates. I will also highlight how the DeepCore array in the central region of

IceCube enables the detection and reconstruction of atmospheric neutrinos with energies as low as a few GeV, providing high-precision measurements of oscillation parameters and first glimpse of Earth matter effects. I will end my talk with a summary of the extensions of IceCube namely IceCube Upgrade (under construction) and IceCube-Gen2 (in the planning stage).

Track type:

Plenary / 324

Hearing the Universe Humm with Pulsar timing array: Gravitational Waves and Primordial Black Holes from beyond SM

Author: Anish Ghoshal[None]

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We will discuss interpretation of the nHz stochastic gravitational wave background (SGWB) seen by NANOGrav and other Pulsar Timing Array (PTA) Collaborations in the context of supermassive black hole (SMBH) binaries. The frequency spectrum of this stochastic background is predicted more precisely than its amplitude. We will discuss how Dark Matter friction can suppress the spectrum around nHz frequencies, where it is measured, allowing robust and significant bounds on the Dark Matter density, which, in turn, controls indirect detection signals from galactic centers.
Next we will discuss alternative cosmological interpretations including cosmic strings, phase transitions, domain walls, primordial fluctuations and axion-like physics. We will discuss how well these different hypotheses fit the NANOGrav data, both in isolation and in combination with SMBH binaries, and address the questions: which interpretations fit the data best, and which are disfavoured.
We also discuss experimental signatures that can help discriminate between different sources of the PTA GW signals with complementary probes using CMB experiments and searches for light particles in DUNE, IceCUBE-Gen2, neutrinoless double beta decay, and forward physics facilities at the LHC like FASER nu, etc. and with Primordial Black Hole formation and its constraints.

Track type:

Gravitational waves

Plenary / 325

PPC-2025 and WHEPP-2025

Closing / 326

PPC-2025 and WHEPP-2025