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Book of Abstracts

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Searching for Dark Photon Tridents Through Primordial Black Hole Signatures

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The detection of gamma-ray signals from primordial black holes (PBHs) could provide compelling evidence for their role as a dark matter candidate, particularly through the obser- vation of their Hawking radiation. Future gamma-ray observatories, such as e-ASTROGAM, and the next-generation telescopes, are poised to explore this possibility by measuring both Standard Model (SM) and beyond-the-SM particle emissions. A particularly promising avenue involves production of dark photons by PBHs, which is a hypothetical particle that decays into photons. In this work, we investigate the trident decay of dark photons focusing on their primary emission from PBHs. We assume that the dark photons produced via Hawking radiation decay into photons well before reaching Earth, thereby enhancing the detectable gamma-ray flux. The energy spectrum of the photons decaying from the dark photons is dis- tinct from that of direct Hawking-radiated photons due to higher degree of freedom, leading to observable modifications in the gamma-ray signal. Using the asteroid-mass PBHs as a case study, we demonstrate that future gamma-ray missions could detect dark-photon signatures and distinguish them from conventional Hawking radiation. This approach enables the explo- ration of previously inaccessible parameter spaces in dark photon mass mA′ and their coupling to photons, offering a novel pathway to uncover the properties of dark sectors and the nature of PBHs.

Parallel session 1 / 5

A Quantum Description of Wave Dark Matter

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In this talk, I will outline a fundamentally quantum description of bosonic dark matter. Following a quantum optics-inspired approach, I will show the density matrix of dark matter, which takes a mixed Gaussian form over a coherent state basis. This formalism also allows a precise description of quantities related to dark matter coherence. I will further give a continuous description of dark matter through the wave-particle transition, where the density fluctuation in various scales evolves between the two limits, showing a unique behavior near the boundary of these descriptions.

Parallel session 6 / 6

Gravitational wave signatures of dark sector portal leptogenesis

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We study the possibility of probing leptogenesis via stochastic gravitational waves (GW) arising from a dark sector assisted first-order electroweak phase transition. The same dark sector, with non-trivial transformation under an unbroken Z_2 symmetry is also responsible for providing the only source of CP asymmetry via one-loop interference with the tree level decay of a heavy right-handed neutrino into lepton and Higgs doublets. The new Yukawa and scalar portal couplings enhance the CP asymmetry allowing TeV scale leptogenesis without any resonant enhancement. Light neutrino masses arise from a combination of type-I and one-loop contributions with vanishing lightest neutrino mass. While the new degrees of freedom in sub-TeV range keep the detection prospects at terrestrial experiments promising, the new scalars enhance the strength of the electroweak phase transition keeping the GW signals within reach of near future experiments like LISA.

Parallel session 6 / 7

Leptogenesis from a Phase Transition in a Dynamical Vacuum

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We show that a phase transition may take place in the early Universe at a temperature T_* resulting a temperature dependent mass for right handed neutrinos (RHN) which finally relaxes to a constant value after electroweak symmetry breaking (EWSB). As a result, a requisite amount of lepton asymmetry can be produced near T_* satisfying the observed baryon asymmetry of the Universe via sphaleron process even when zero temperature masses of the RHNs fall below the electroweak scale enhancing the detection possibility of RHNs. Interestingly, the framework is also capable of predicting a primordial lepton asymmetry (generated after EWSB) as hinted by helium abundance measurements, indicating a correlation with early phase of leptogenesis.

Parallel session 2 / 8

Impact of the electroweak Weinberg operator on the electric dipole moment of electron

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Recent progress in the electric dipole moment (EDM) measurements of the electron using the paramagnetic atom or molecule is remarkable. In this paper, we calculate a contribution to the electron EDM at three-loop level, introducing the CP-violating Yukawa couplings of new $SU(2)_L$ multiplets. At two-loop level, the Yukawa interactions generate a CP-violating dimension-six operator, composed of three $SU(2)_L$ field strengths, called the electroweak-Weinberg operator. Another one-loop diagram with this operator inserted induces the electron EDM. We derive the matching condition and find that even if new $SU(2)_L$ particles have masses around the TeV scale, the electron EDM may be larger than the Standard Model (SM) contribution to the paramagnetic atom or molecule EDMs.

Parallel session 6 / 9

Thermal leptogenesis in SO(10)× U(1)_A GUT

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In this study, we show that thermal leptogenesis can be realized within the framework of the $SO(10)\times U(1)_A$ grand unified theory(GUT). Furthermore, by including flavor effects, we have found that the second-lightest right-handed neutrino makes a significant contribution. As a result, the mass derived in this study is approximately six times larger than the mass predicted for the right-handed neutrino by the $SO(10) \times U(1)_A$ GUT. This also implies that the mass of the left-handed neutrino becomes approximately one-sixth of the value predicted by the same symmetry.

Parallel session 5 / 10

Searching for ways to probe pseudo-Nambu-Goldstone-Boson dark matter

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This study explores a dark matter model in which a pseudo-Nambu-Goldstone boson arises as a viable dark matter candidate from the spontaneous and soft breaking of global $U(1)$ symmetries and stabilized by a residual $\mathbb{Z}_3$ discrete symmetry. The model introduces three complex scalar fields, singlets under the Standard Model gauge group, and charged under a dark $U(1)_V$ gauge symmetry together with a permutative exchange symmetry among three scalars. These features naturally suppress the dark matter–nucleon scattering cross section by its Nambu-Goldstone boson nature. In addition to conventional annihilation channels, the $\mathbb{Z}_3$ structure allows semi-annihilation processes, potentially leading to new phenomenological signatures. We analyze theoretical and experimental constraints, including relic abundance, Higgs invisible decays, and perturbative unitarity, and evaluate the elastic scattering cross section for boosted dark matter.

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Photon Proliferation Effect from N-body ultralight DM annihilation

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I will demonstrate a general photon proliferation effect from N-body ultralight dark matter (DM) annihilation in the early Universe, which can induce a drastic photon-temperature shift after neutrino decoupling. For pseudoscalar DM mass below the eV scale, I will show that the photon proliferation effect becomes significant as the mass approaches the ultralight end, presenting the leading constraints on the DM-photon coupling, DM self-interaction, and DM-electron coupling.

Parallel session 2 / 13

A triple Z'signal via light scalar interaction in Z-factories

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We discuss triple Z' boson signatures via the decay chain of $Z \to Z'\phi \to Z'Z'Z'$, with a new light scalar ϕ, at future Z factories such as CEPC and FCC-ee. These new bosons ϕ and Z' naturally appear in models with a new $U(1)$ gauge symmetry which is spontaneously broken and introduced in various new physics scenarios. The branching ratio of $Z \to Z'\phi \to Z'Z'Z'$ can be larger than 10^{-12}, which gives $O(1)$ events at Tera-Z experiments, when a product of g_X (new gauge coupling) and ζ (Z-Z' mixing) is larger than around 10^{-6}. We find that the search for $Z \to Z'Z'Z'$ can significantly improve the current bound on a kinetic mixing parameter ϵ in the dark photon case, where $e\epsilon$
$gtrsim\mathcal{O}(10^{-5})$ with $g_X = calO(1)$ can be explored at Tera-Z experiments. We also show that a sufficiently large number of events with multi-lepton plus hadronic jets can be obtained in benchmark points, which cannot be realized by the usual decay of Z in the standard model.

Parallel session 6 / 14

Decoherence of primordial perturbations in the view of a local observer

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We study quantum decoherence of curvature perturbations at superhorizon scales caused by the gravitational nonlinearities. We show that cubic gravitational couplings, constrained by the spatial diffeomorphism invariance, lead to infrared (IR) and ultraviolet (UV) divergences in the decoherence rate at one loop. These divergences arise from fluctuations of deep IR modes which look like a background mode for a local observer and violent zero-point fluctuations in the deep UV, respectively. We argue that these divergences are unobservable, as they vanish when considering proper observables. We consider correlators defined using the geodesic distance for IR divergences and time-averaged correlators for UV divergences. To account for these observer's perspectives, we propose to consider an effective quantum state, defined in terms of actual observables, as a more appropriate probe of the quantum coherence of the system measured by an observer. We then evaluate the finite decoherence rate induced by superhorizon environment during inflation and at late universe. This talk is based on the paper arXiv:2504.10472.

Parallel session 2 / 15

Pseudo NG bosons from finite modular symmetry

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Pseudo Nambu-Goldstone (pNG) bosons can play important roles in particle physics, such as being a light dark matter (DM), the QCD axion to solve the strong CP problem, and so on. I point out that such a pNG boson is naturally realized by the finite modular symmetry, which may originate from the geometry of extra dimensions in the superstring models. An accidental global U(1) symmetry arises due to the residual Z_N symmetry, when the modulus is stabilized near a fixed point of the finite modular symmetry. To illustrate, I will show the realization of the KSVZ axion model to solve the strong CP problem, where the modulus is stabilized by the radiative potential generated by the vector-like quarks, based on arXiv:2402.02071 (JHEP) and 2405.03996 (JHEP). Since the finite modular symmetries were originally used to explain the flavor structure of the quarks and leptons, this observation suggests that there are non-trivial connections between the pNG mode, which may be the DM, and flavor physics. If time permits, I will discuss the existence of such pNG mode in other stabilization mechanisms and possible applications to particle physics based on 2409.19261 (JHEP) and 2412.18435 (JHEP).

Parallel session 6 / 16

Detectability of the phase transition gravitational waves in the DFSZ axion model

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In recent years, an increasing number of studies have focused on using gravitational waves to explore axions and the dynamics of Peccei-Quinn symmetry breaking at high energy scales in the early universe. To accurately quantify the capability of specific gravitational wave experiments to probe the axion properties, it is crucial to perform precise calculations of gravitational wave signals based on given axion models and to conduct detailed detectability analysis tailored to the experimental configurations. Therefore, in this work, we consider the widely-studied DFSZ axion model and, for the first time, perform precise calculations of the phase transition dynamics parameters and associated gravitational wave signals. Our results demonstrate that the DFSZ model allows a strong first-order phase transition for the Peccei-Quinn symmetry-breaking process at high energy scales exceeding 10^9 GeV. Moreover, by calculating the signal-to-noise ratio of the gravitational waves and comparing it with the thresholds of the Cosmic Explorer detector, we find that these signals are observable by the Cosmic Explorer with the energy scale range from 10^9 GeV to 10^{12} GeV. Notably, through Fisher Matrix analysis, we find that if Cosmic Explorer detectors observe these gravitational waves, the bubble wall velocity will be the first parameter to be determined. This study demonstrates that gravitational wave detection offers a powerful approach to investigating axion dynamics complementary to other experiments.

Parallel session 6 / 17

Refining Gravitational Wave and Collider Physics Dialogue via Singlet Scalar Extension

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Employing effective field theory techniques, we advance computations of thermal parameters that enter predictions for the gravitational wave spectra from first-order electroweak phase transitions. Working with the real-singlet-extended Standard Model, we utilize recent lattice simulations to confirm the existence of first-order phase transitions across the free parameter space. For the first time, we account for several important two-loop corrections in the high-temperature expansion for determining thermal parameters, including the bubble wall velocity in the local thermal equilibrium approximation. We find that the requirement of completing bubble nucleation imposes stringent bounds on the new scalar boson mass. Moreover, the prospects for detection by LISA require first-order phase transitions in a two-step phase transition, which display strong sensitivity to the portal coupling between the Higgs and the singlet.
Interestingly, signals from di-Higgs boson production at the HL-LHC probe parameter regions that significantly overlap with the LISA-sensitive region, indicating the possibility of accounting for both signals if detected. Conversely, depending on the mixing angle, a null result for di-Higgs production at the HL-LHC could potentially rule out the model as an explanation for gravitational wave observations.

Parallel session 5 / 18

Multi-component dark matter from Minimal Flavor Violation

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Minimal Flavor Violation (MFV) offers an appealing framework for exploring physics beyond the Standard Model. Interestingly, within the MFV framework, a new colorless field that transforms non-trivially under a global $\mathrm{SU}(3)^3$ quark flavor group can naturally be stable. Such a new field is thus a promising dark matter candidate, provided it is electrically neutral. We extend the MFV framework for dark matter and demonstrate that dark matter can naturally be multi-component across a broad parameter space. For illustration, we consider a gauge singlet, flavor triplet scalar field and identify parameter spaces for multi-component dark matter, where only the lightest flavor component is absolutely stable and heavy flavor components are decaying with lifetimes sufficiently longer than the age of the universe. Phenomenological, cosmological and astrophysical aspects of multi-component flavored dark matter are briefly discussed.

Parallel session 1 / 19

New realisation of light thermal dark matter with enhanced detection prospects

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Light dark matter (DM) with mass around the GeV scale faces weaker bounds from direct detection experiments. If DM couples strongly to a light mediator, it is possible to have observable direct detection rate. However, this also leads to a thermally under-abundant DM relic due to efficient annihilation into light mediators. We propose a novel scenario
where a first-order phase transition (FOPT) occurring at MeV scale can restore GeV scale DM relic by changing the mediator mass sharply at the nucleation temperature. The MeV scale FOPT predicts stochastic gravitational waves with nano-Hz frequencies within reach of pulsar timing array (PTA) based experiments like NANOGrav. In addition to enhancing direct detection rate, the light mediator can also give rise to the required DM self-interactions necessary to solve the small scale structure issues of cold dark matter. The existence of light scalar mediator and its mixing with the Higgs keep the scenario verifiable at different particle physics experiments.

Poster session / 20

Probing PBH dark matter scenarios with IceCube diffuse neutrino data

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We study the signature of the final stage of the evaporation of primordial black holes (PBH), focusing on high energy neutrinos and gamma-rays. For distributions of PBH with finite widths in mass spectrum, we derive a new upper limits f_{PBH}
$lesssim10^{-4}-1$ for $M_{\mathrm{PBH}} = 10^{15-20}$ g by utilizing the IceCube latest data set of diffuse neutrinos for $E_\nu \geq 30$ TeV. We note that a transient signature involving high-energy neutrinos at the final stage of primordial black hole (PBH) evaporation could offer a potential explanation for the recently reported ultra-high-energy (UHE) neutrino event by the KM3NeT collaboration. We also examine the sensitivity limit for detecting a single PBH burst as the origin of KM3NeT UHE event.

Parallel session 1 / 21

Indirect detection of dark matter annihilation using gamma-ray data of Fermi-LAT

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Dark matter (DM) plays an important role in modern high-energy physics and indirect signals can provide evidence of DM interactions with Standard model (SM) particles. Among various of SM channels, gamma-rays are one of the most prominent channel because they head directly to the Earth unlike other charged cosmic-ray particles. Using gamma-ray data of Fermi-LAT, a space telescope that is cable of gamma-rays from 0.1 GeV to above 500 GeV. In this talk, we will discuss about analysis of Galactic Center Excess (GCE) which is known to be well explained by DM annihilation, and strong bounds on $\langle\sigma v\rangle$ from dwarf spheroidal galaxies (dSphs). And combining the results, we will investigate possibility of hadronic/leptonic annihilation channel of DM into SM.

Parallel session 1 / 22

Quantum entanglement of ions for light dark matter detection

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A detection scheme is explored for light dark matter, such as axion dark matter or dark photon dark matter, using a Paul ion trap system. We first demonstrate that a qubit, constructed from the ground and first excited states of vibrational modes of ions in a Paul trap, can serve as an effective sensor for weak electric fields due to its resonant excitation. As a consequence, a Paul ion trap allows us to search for weak electric fields induced by light dark matter with masses around the neV range. Furthermore, we illustrate that an entangled qubit system involving N ions can enhance the excitation rate by a factor of N^2. The sensitivities of the Paul ion trap system to axion-photon coupling and gauge kinetic mixing can reach previously unexplored parameter space.

Parallel session 5 / 23

Effects of electroweak phase transition on dark matter relic abundance

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The true identity of dark matter (DM) is an unsolved problem in physics. Among the various DM candidates, weakly interacting massive particles (WIMP) are attractive because their abundance can be explained thermally. The WIMP abundance can be estimated using the Boltzmann equation, and particle masses at zero temperature are usually adopted. In this study, we take into account the electroweak phase transition, i.e., the particle masses should change with temperature through a varying vacuum expectation value of Higgs. We compare the DM abundance obtained using the conventional calculation method with our results using the temperature-dependent particle masses.

Parallel session 2 / 24

Explosive production of Higgs particles and implications for heavy dark matter

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In this talk, we propose a new Higgs-portal dark matter scenario considering the Higgsplosion effect, which is a hypothesis of the significant production rate of high multiplicity of Higgs particles at high $\sqrt{s}$. Our scenario allows heavy Higgs-portal dark matter of m_χ
$gtrsimcalO(1)$ TeV, while the typical scenario indicates the order of $calO(10 - 100)$ GeV. We show that the multiplicity can be as large as $calO(200)$ for the parameters of the Standard Model Higgs, independently of the kinematics of the particle production process. Our result is applicable to a wider class of models with other scalar fields, opening a new window for heavy DM.

Parallel session 8 / **25**

Analysis of inflationary models in higher-dimensional uniform inflation

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We consider higher-dimensional uniform inflation, in which the extra dimensions expand at the same rate as three-dimensional non-compact space during inflation. We compute the cosmological perturbation in $D + 4$ dimensions and derive the spectral index n_s and the tensor-scalar ratio r. We analyze five inflationary models: chaotic inflation, natural inflation, quartic hilltop inflation, inflation with spontaneously broken SUSY, and R^2 inflation. By combining the results from these models with the Planck 2018 constraints, we discuss that it is not desirable for the extra-dimensional space to expand at the same rate as the three-dimensional non-compact space, except for the case of one extra dimension.

Parallel session 7 / **26**

Cosmological Roles of Dark Photons in Axion-induced Electroweak Baryogenesis

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An axion coupled to both the Higgs field and electroweak gauge fields can generate the observed matter-antimatter asymmetry via electroweak baryogenesis, if its decay constant lies between 10^5 and 10^7 GeV. However, the axion remains constrained by astrophysical and cosmological bounds. In this talk, we introduce the intriguing possibility that the axion is also coupled to dark photons. Depending on their roles, these dark photons can be categorized into three types: (i) alleviating constraints on the axion by suppressing its decay into Standard Model sector; (ii) serving as dark matter if sufficiently massive and stable; (iii) and contributing to dark radiation if ultralight. Building on this, we propose a model that simultaneously explains both the observed matter-antimatter asymmetry and dark matter.

Poster session / 27

General Pseudo Scalar Dark Matter and Direct Detection

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n the WIMP framework, the Higgs portal has a relatively small Higgs–nucleon interaction compared to other mechanisms, and, since the mediator is the Higgs boson, it is subject to fewer theoretical constraints. However, recent improvements in the precision of direct detection experiments have placed increasing pressure on Higgs-portal dark matter models. In simple models, the preferred DM mass is typically pushed into the TeV range. O. Lebedev et al. propose a simple Higgs-portal model with softly broken symmetry (S^2+h.c.) in which the direct-detection amplitude is automatically canceled. This mechanism demonstrates that an electroweak-scale WIMP can satisfy all constraints without fine-tuning. However, in Cartesian coordinates, the cancellation mechanism is not apparent. We therefore formulate the theory in polar coordinates to make the mechanism explicit. Extending their setup, we consider a more general breaking term of the form (S^n+h.c.) and investigate the cancellation condition in this broader context.

Parallel session 2 / 28

Dynamical Up Quark Mass Generation in QCD-like Theories

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The possibility that the up quark mass is generated entirely through nonperturbative dynamics offers an elegant solution to the strong CP problem. In this talk, I will present a controlled calculation of the dynamically generated up quark mass in a class of QCD-like theories, based on supersymmetric QCD deformed by anomaly mediated supersymmetry breaking (AMSB). By matching the low-energy chiral Lagrangian of these models to standard QCD chiral perturbation theory at next-to-leading order, we identify the contributions responsible for additive quark mass renormalization. Remarkably, we find that for three flavors and three colors ($F = N = 3$), the dynamical up-quark mass can be of order one in units of the strange quark mass, potentially accounting for the full observed mass. I will discuss the parameter dependence of this effect, its behavior at large N, and the implications for the strong CP problem.

Poster session / 29

Higgs pole inflation in light of ACT results

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Cosmic inflation was introduced to address several shortcomings of the standard Big Bang cosmology. The observed red tilt of the CMB power spectrum and potential future detection of primordial gravitational waves could provide valuable clues to reconstructing the inflaton potential. Recent small scale CMB measurements from the Atacama Cosmology Telescope (ACT), combined with Planck data, suggest an increased spectral index, creating tension with predictions of some well-studied inflationary models.

In this work, we investigate pole inflation in the presence of one-loop Coleman–Weinberg corrections arising from Standard Model or additional fields, focusing on both Higgs pole inflation and PQ pole inflation. We parametrize these loop effects as a running quartic coupling for the inflaton and study how the inflationary predictions change with different two-loop beta function coefficients of the running coupling.

Parallel session 2 / 30

Lepton number violation in future lepton colliders and neutrinoless double beta decay

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We investigate the origin of neutrino masses, focusing on theoretical models in which neutrinos are massive Majorana fermions.
Such neutrinos naturally lead to processes that violate the lepton number which is strictly conserved in the Standard Model.
We discuss the current constraints on such models from lepton number violating processes, such as neutrinoless double beta decays.
Especially, we consider a model extended by right-handed neutrinos with the seesaw mechanism, and discuss the impacts on the lepton number violating search for right-handed neutrinos in future lepton collider experiments.
The lepton number violating processes provide crucial insight into the fundamental nature of neutrinos and offer potential signatures of physics beyond the Standard Model.

Poster session / 31

Exploring Electroweak Phase Transition and Collider Signatures in Two-Higgs-Doublet Models

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We investigate the electroweak phase transition (EWPT) and collider phenomenology in the Two-Higgs-Doublet Models (2HDM). The interplay between the thermal properties of the scalar potential and experimental constraints offers a promising framework to explore beyond the Standard Model physics. We analyze scenarios that may realize a strong first-order phase transition (SFOPT), which is essential for electroweak baryogenesis, and examine their possible signatures at current and future colliders.

Parallel session 5 / 32

A Z4 symmetric model for self-resonant dark matter

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Models of multi-component dark matter can explain small-scale problems through the presence of self-interaction. We propose a model where DM consists of two scalar fields stabilized by a Z4 symmetry and which can take part in annihilation or semi-annihilation processes. Some of these scatterings can be Sommerfeld enhanced through the u-channel without the need of a light mediator. The semi-annihilation, in particular, can produce boosted DM particles that can be detected by neutrino or direct detection experiments, as well as dark photons or dark Higgs that can give signals in indirect detection searches. In this work, we analyze the standard limits for this model and also the consequences of the u-channel resonance in small-scale data, the calculation of relic abundance, and the signals relevant for direct and indirect detection experiments.

Parallel session 1 / 33

Evading the Current Direct Detection Bound through Metastable Particle-Assisted Freeze-Out

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In this work, we have explored the conversion-driven freeze-out scenario, where the next-to-lightest stable particle (NLSP) sets the dark matter (DM) abundance through the process "NLSP SM ↔ DM SM". Although DM is produced via freeze-out mechanism, its interaction strength with the visible sector can range from weak-scale to feeble-scale couplings. This leads to a vast, largely unexplored parameter space that remains beyond the reach of current direct, indirect, and collider searches with possibility of detection in near future.
We have studied this mechanism in the context of an alternative $U(1)_{B-L}$ model, where four chiral fermions are required to cancel gauge anomalies, in contrast to the usual case with three right-handed neutrinos. The observed relic abundance, as measured by Planck, is successfully reproduced within this framework. The viable parameter space can be probed by future direct detection experiments, while remaining inaccessible to indirect searches in near future.
Our results show that the DM relic density is highly sensitive to both the NLSP's interaction strength with the visible sector and the mass difference between the NLSP and DM but not on the DM interaction strength with the visible sector.

When the NLSP decays to DM via a two-body process involving an extra gauge boson, the decay can be long-lived, outside the CMS or ATLAS detector at LHC.
In contrast, if the NLSP decays via a CP-odd Higgs, it decays promptly inside the detector.
We have investigated the prospects for detecting such long-lived NLSP signatures at the proposed MATHUSLA detector, with similar conclusions applying to the ongoing FASER experiment. Finally, we find that choosing arbitrarily small values for the gauge coupling and the BSM fermionic mixing angle can violate successful BBN predictions.

Parallel session 4 / 34

Exploring chirality structure in nucleon decay

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proposal): The search for baryon number violation offers a promising path to uncovering new physics. In this talk, we examine how measurements of different nucleon decay channels can shed light on the underlying theory. We first investigate the chirality structure of baryon-number-violating interactions through lifetime measurements of strangeness-conserving nucleon decay modes. Using an effective field theory framework, we show that the ratio of partial decay widths—specifically, Γ(p⟶ηℓ+)/Γ(p⟶π0ℓ+), where ℓ+ denotes a positron or anti-muon—is sensitive to this chirality structure. Moreover, we find that in certain new physics scenarios, decay channels involving both anti-leptons and anti-neutrinos can provide complementary insights into their structures. These results underscore the importance of searching for various decay modes in future nucleon decay experiments.

Parallel session 4 / 35

Future beam dump experiments constraint on light bosons with lepton flavor violating couplings

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We consider charged lepton flavor violation (CLFV) via a light and weakly interacting boson and discuss the detectability by future proton and lepton beam dump experiments. We focus on three types of CLFV interactions, i.e., the scalar-, pseudoscalar-, and vector-type interactions, and calculate the sensitivities of beam dumps to each CLFV interaction. We show that a wide region of the parameter space can be explored. Particularly, it is found that future beam dump experiments have sensitivities to very small coupling regions in which the rare muon decays, such as $\mu \to e\gamma$, cannot place bounds, and that there is a possibility to detect CLFV decays of the new light bosons.

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Reconstruction of DBI Scalar field using Gauassian Process

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In this talk, I will provide an overview of our work on cosmology in the presence of scalar fields, focusing on symmetric teleparallel gravity. Using dynamical system analysis, we investigate the late-time evolution of the universe within this framework.

I will begin with a concise introduction to symmetric teleparallel gravity, tracing its conceptual development from Weyl geometry to modern observational applications. After outlining the essentials of dynamical system analysis, I will present our findings on scalar fields and DBI fields in modified $f(Q)$ gravity. Additionally, I will discuss our approach to curvature perturbations in a dynamical system context, extending beyond the conventional conformal Newtonian gauge.

Finally, I will conclude with a brief look at our ongoing work on observational tests and phenomenological implications of these models

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A Study of warm holographic inflation in the context of teleparallel based $f(T)$ gravity

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In this talk, we will explore warm inflation in the early universe using two frameworks: Barrow holographic dark energy and teleparallel-based $f(T)$ gravity. Warm inflation assumes continuous interaction between radiation and the inflaton field, allowing for a sustained thermal bath during inflation and naturally solving the graceful exit problem. In our work, warm inflation is realized in a highly dissipative regime, successfully driving inflation and aligning with observational data. We construct a warm Inflationary scenario in $f(T)$ gravity, without additional scalar fields and in a holographic fluid background. We have analysed the inflationary dynamics through the reconstruction of the Hubble parameter, slow-roll parameters, and a temperature-dependent dissipative coefficient. Both models ensure a smooth transition from inflation to radiation domination and satisfy key conditions for warm inflation. The predicted scalar spectral index and tensor-to-scalar ratio are consistent with observational data, confirming the viability of both warm inflationary scenarios.

Parallel session 7 / 38

Can AI understand Hamiltonian mechanics?

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With recent breakthroughs in deep learning, particularly in areas like natural language processing and image recognition, AI has shown remarkable abilities in understanding complex patterns. This

raises a fundamental question: Can AI grasp the core concepts of physics that govern the natural world?
In this talk, as a first step towards addressing this question, we will discuss the possibility of AI understanding Hamiltonian mechanics. We will first introduce the concept of operator learning, a novel technique that allows AI to learn mappings between infinite-dimensional spaces, and its application to Hamiltonian mechanics by reformulating it within this framework. Then, we will test whether AI can derive trajectories in phase space given an arbitrary potential function, without relying on any equations or numerical solvers. We will then showcase our findings, demonstrating AI's capability to predict phase space trajectories under certain constraints. Finally, we will discuss the limitations, future research directions, and the potential for AI to contribute to scientific discovery.

Poster session / 39

Gravitational Waves from Superconducting Cosmic Strings

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Cosmic strings are one-dimensional topological defects that arise from the spontaneous symmetry breaking in the early universe. In particular, superconducting cosmic strings, which have attracted attention from an astrophysical perspective, are characterized by their interactions with matter fields and are thought to have formed during the grand unification epoch. Cosmic strings have been proposed as a potential source of primordial gravitational waves and may provide insights into new physics associated with grand unified theories. In this workshop, we will present research findings on gravitational waves induced by superconducting cosmic strings, based on numerical simulations of field dynamics.

Parallel session 4 / 40

VBF for Higgs to BSM at the future Muon Collider

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In this talk, we discuss the direct coupling of the Higgs boson to BSM particles at the future Muon Collider (MuC). At high-energy MuC, the processes we consider are naturally dominated by vector boson fusion (VBF), which emits high-rapidity muon pairs. Thus, by studying forward muon pairs, we can probe the coupling. Furthermore, due to the characteristics of VBF, we can determine whether the process is Higgs-mediated.

Parallel session 1 / 41

Neutrino masses and mixed dark matter from doublet and singlet scalars

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We consider the extension of the Standard Model with an inert scalar doublet, three right-handed neutrinos, and singlet scalar fields, φ and S. In this model, neutrino masses are zero in the limit of the unbroken Z4 discrete symmetry. We show that when the singlet scalar field φ gets a VEV, the Z4 symmetry is broken to Z2, and neutrino masses are generated at one-loops due to the mixings between the neutral components of the inert scalar doublet and the singlet scalar field S. There is a dark matter candidate from the lightest neutral scalar field, which is a mixture of the inert scalar doublet and the singlet scalar field S, in general. The Z4 breaking mass terms are constrained by electroweak precision data and direct detection (DD) bounds for dark matter, favoring small mixings or almost degenerate masses for the DM scalars. We discuss the implications of the results for small neutrino masses and DD-safe dark matter.

Parallel session 5 / **42**

Composite Dark Matter with Forbidden Annihilation

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A dark matter model with QCD-like SU(N) gauge symmetry and electroweakly interacting dark quarks is discussed. In this model, the lightest G-parity odd dark pion is a main component of dark matter. I will discuss the relation between the mass spectrum of dark pions and annihilation channels which mainly contribute to the relic abundance. When the masses of dark matter and heavier dark pions are degenerate, dark matter mainly annihilates into the heavier dark pions and realizes heavy dark matter whose mass is $calO(1\text{-}10)$ TeV. I will also discuss the Sommerfeld effect of the annihilation channels.

Parallel session 3 / **43**

The oscillation formula of Majorana neutrino in Quantum Field Theory

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We derive the oscillation formula of Majorana neutrinos based on quantum field theory. Since the Hamiltonian under the Majorana mass term does not conserve lepton number, the eigenstates of lepton number change complexly over time. With the Bogoliubov transformation, we successfully

relate the lepton number eigenstates at different times. This method enables us to understand the time evolution of lepton number induced by neutrino oscillations phenomena in terms of transition probabilities. We also present the physical picture that emerges through the Majorana mass term.

Poster session / **44**

OSPREY(Operator learning for Secondary Primordial black hole Radiation Emission Yield)

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BlackHawk is a widely used tool for computing the secondary spectra of particles emitted via Hawking radiation from evaporating black holes. In order to account for particle hadronization and decay processes, it employs different computational backends—such as Hazma, PYTHIA, and HDMSpectra—depending on the energy scale of the initial emission. While effective in separate regimes, this hybrid approach introduces inconsistencies and interpolation ambiguities in the overlapping energy regions where the validity of multiple methods overlaps. To address this limitation, we develop a unified framework based on operator learning techniques, OSPREY(Operator learning for Secondary Primordial black hole Radiation Emission Yield). By training a neural operator on the combined datasets, we construct a surrogate model that consistently captures the secondary spectrum over the entire energy range. Our approach improves the continuity and accuracy of the spectrum, making it suitable for precision studies in both astrophysical and phenomenological applications involving Hawking radiation.

Poster session / **45**

More is Different: Multi-Axion Dynamics Changes Topological Defect Evolution

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We study topological defects in multi-axion models arising from multiple Peccei-Quinn (PQ) scalars. Using a simplified two-axion system, we reveal fundamental differences in the evolution of these defects compared to single-axion scenarios. This finding is particularly significant because, despite the fact that integrating out heavier axions reduces these models to an effective single PQ scalar theory at low energies, the actual physical behavior of topological defects differs markedly from single-axion predictions. Unlike single-axion models where conventional cosmic strings form, multi-axion scenarios with post-inflationary or mixed initial conditions generically produce networks of strings interconnected by high-tension domain walls. This results in a severe cosmological domain wall problem. We determine string-wall network instability conditions and discuss cosmological implications including the application to the QCD axion and gravitational wave generation. Our findings highlight that multi-axion dynamics can lead to qualitatively different outcomes for topological defects, challenging the conventional picture of cosmic evolution of topological defects based on single-axion models.

Poster session / 46

Vector Dark Matter From Hidden Gauge Symmetry : U(1)_D and SU(2)_D

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We present a unified study of vector dark matter (VDM) from hidden gauge symmetries U(1)D or SU(2)D. Starting from the renormalizable Higgs-portal UV theory for VDM with a dark Higgs field, we integrate out the radial mode of the dark Higgs to derive the leading low-energy interactions for Higgs-portal VDM, which are constrained into the validity domain in the UV theory. We also make the VDM stability realized: for U(1)D, a dark charge-conjugation (residual Z2) forbids VDM from decaying; for SU(2)D, a residual/custodial symmetry similarly stabilizes the lightest state of VDM. While the Higgs-portal EFT for VDM looks similar in both cases, non-abelian self-interactions of SU(2)D qualitatively modify the thermal history relative to U(1)D. Finally, we show how the isospin representation of the dark Higgs that breaks SU(2) controls the VDM mass spectrum and the VDM–dark-Higgs interactions, and how this feeds into the relic density and phenomenology, highlighting the representation-dependent signatures.

Parallel session 5 / 47

Superheavy Supersymmetric Dark Matter for the origin of KM3NeT Ultra-High Energy signal

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We propose an explanation for the recently reported ultra-high-energy neutrino signal at KM3NeT, which lacks an identifiable astrophysical source. While decaying dark matter in the Galactic Center is a natural candidate, the observed arrival direction strongly suggests an extragalactic origin. We introduce a multicomponent dark matter scenario in which the components are part of a supermultiplet, with supersymmetry ensuring a nearly degenerate mass spectrum among the fields. This setup allows a heavy component to decay into a lighter one, producing a boosted neutrino spectrum with energy $E_\nu \sim 100$ PeV, determined by the mass difference. The heavy-to-light decay occurs at a cosmological redshift of $z \sim$ a few or higher, leading to an isotropic directional distribution of the signal.

Parallel session 8 / 48

Leptogenesis in the PQ pole inflation

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We propose a leptogenesis scenario where baryon asymmetry is generated from the rotation of the QCD axion in the PQ pole inflation scenario. The rotation originating from PQ explicitly breaking terms corresponds to the asymmetry of the PQ charge and is converted into the baryon asymmetry by the inverse decay of a right-handed neutrino. We show the correlation between the reheating temperature, mass of the right-handed neutrino, initial velocity of the axion, and the axion decay constant, realizing the axion kinetic misalignment for the correct relic density.

Poster session / 49

Mass spectrum and symmetry breaking in Non-Abelian gauge theory with extra dimensions of two-dimensional sphere

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In the standard model, the mechanism for gauge symmetry breaking and the theoretical origin of the Higgs boson remains unclear.
Non-Abelian gauge theories in higher dimensions are good candidates to address this issue.
We have constructed a Non-Abelian gauge theory with extra dimensions of two-dimensional sphere.
In this model, compared to conventional models such as those with S^1 and T^2, curvature of the extra dimensions and the non-commutative nature of the gauge group result in different features in gauge symmetry breaking process and the origin of scalar fields.
We will report the gauge symmetry breaking observed in the Kaluza-Klein expansion of four-dimensional gauge fields, as well as the mass spectrum obtained from the Kaluza-Klein expansion of the extra-dimensional gauge fields, which appear as scalar fields in our four-dimensional spacetime.

Parallel session 3 / 50

PQ quality and scale hierarchy of extra-dimensional axions

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Axions provide a compelling solution to the strong CP problem and a viable candidate for dark matter. We explore their realization in a minimal five-dimensional $M_4 \times S^1/\mathbb{Z}_2$ orbifold framework. An explicit one-loop Casimir energy calculation reveals that the irreducible axion potential induced by worldline instantons is exponentially suppressed, thereby ensuring a high-quality Peccei–Quinn (PQ) symmetry. We further investigate how warped geometry, $\mathbb{Z}_2$-odd gauge couplings, and fixed-point interactions influence the PQ symmetry quality and determine the hierarchy of the axion decay constant.

Parallel session 8 / 51

Dark photon-photon resonance conversion of GRB221009A through extra dimension

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The recently observed very high energy (VHE) photons,GRB221009A, require a physics explanation beyond the standard model. Such energetic gamma ray bursts, originating from yet unknown very distance source at redshift z = 0.1505, would be directly scattered by extragalactic background lights (EBL) rendering its improbable detection at the earth. We show that dark photon which resides in extra dimension would be able to resolve this issue when it oscillates resonantly with the photon in similar fashion with neutrino oscillation.

Parallel session 7 / 52

Stable dark matter from Pauli blocking in the degenerate fermion background with Quantum Field Theory

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We study a mechanism to make dark matter stable based on the Pauli blocking in the fermion background. In the background where fermions occupy the states, the decay of dark matter to those final states is not allowed, as a result, DM becomes stable.
We derive the evolution equations of the distribution function in the quantum field theory and compare it with the Boltzmann equation.
We apply this mechanism to a realistic model of neutrino and dark matter.

Parallel session 3 / 53

Phenomenology of Neutrino-Dark Matter Interaction in DSNB and AGN

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We investigate a neutrino-scalar dark matter (DM) $\nu\phi$ interaction encountering distinctive neutrino sources, namely Diffuse Supernova Neutrino Background (DSNB) and Active Galactic Nuclei (AGN). The interaction is mediated by a fermionic particle F , in which the $\nu\phi$ scattering cross section characterizes different energy dependent with respect to the kinematic regions, and manifests itself through the attenuation of neutrino fluxes from these sources. We model the unscattered neutrino flux from DSNB via core-collapse supernova (CCSN) and star-formation rate (SFR), then incorporate the present Super-Kamionkande and future DUNE/Hyper-Kamiokande experiments to set limits on

DM-neutrino interaction. For AGNs, NGC 1068 and TXS 0506+056, where the neutrino carries energy above TeV, we select the kinematic region $m_F^2 \gg E_\nu m_\phi \gg m_\phi^2$ such that the $\nu\phi$ scattering cross section features an enhancement at high energy. Furthermore, taking into account the DM spike profile at the center of AGN, we constrain on m_ϕ and scattering cross section via computing the neutrino flux at IceCube, where the $\phi\phi^*$ annihilation cross
section is implemented to determine the saturation density of the spikes.

Parallel session 4 / 54

Constraints on MeV Axions from Kaon Decays

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The QCD axion is a compelling mechanism for solving the strong CP problem. Most studies have focused on axion models with a large decay constant, $(f_a$
$gtrsim 10^9$ GeV). However, recent work has pointed out that viable axion models may also exist for $(f_a \sim 1\,\text{GeV})$. In our research, we derive stringent constraints on this axion scenario from kaon decay measurements.

Parallel session 8 / 55

Interaction between cosmic strings in higher-dimensional models

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Many recent studies of cosmic strings highlight the importance of investigating them within the framework of field theory to better understand their properties. In this talk, we show how the shape of scalar potential influences the interaction between strings. Although many works of cosmic strings assume that the Mexica-hat potential to break $U(1)$ symmetry, various types of potentials are considered in models that aim to describe physics beyond the Standard Model. As one of the examples, we have investigated the interactions between strings in higher-dimensional models. We have found that they exhibit a novel distance dependence, which is absent in the case of the Mexican-hat potential. We also propose a conjecture to explain the emergence of this distance-dependent interaction. This presentation is based on https://inspirehep.net/literature/2835186.

Parallel session 4 / 56

Trilinear Higgs Coupling as a Probe for Extended Higgs Sectors

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Although the Higgs boson has been discovered, its couplings to Standard Model (SM) particles may deviate from SM predictions. Such deviations can arise in extensions of the SM, including those that modify the Higgs sector. In particular, extended Higgs models often exhibit different shapes of the Higgs potential depending on their structure. In this work, we focus on near-aligned extended Higgs models, which can be well described as a classical field. The shape of the Higgs potential in these models can be characterized by the trilinear Higgs boson coupling, providing a powerful classification tool. Precise measurements of this coupling at future collider experiments could serve as an efficient way to discriminate between different extended Higgs scenarios. In this talk, we calculate the trilinear Higgs coupling, including one-loop corrections from top quarks and new particles, for several representative nearly-aligned Higgs models. We also discuss the potential to constrain model-dependent parameters based on expected sensitivities at future colliders. This work is a work in progress.

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Neutralino dark matter in gauge mediation

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We explore the potential of neutralino dark matter within the framework of gauge-mediated supersymmetry (SUSY) breaking. Gauge mediation offers an advantage over gravity mediation, as SUSY CP/flavor problems are avoided more easily, leading to significantly milder fine-tuning for electroweak symmetry-breaking compared to gravity mediation. In our models, the lightest neutralino, as the lightest SUSY particle (LSP), is a viable dark matter candidate, assuming a gravitino mass of O(100) TeV. The models are formulated in five-dimensional space-time, where the SUSY breaking field and the matter fields are placed on separate branes to avoid issues related to flavor and CP violation. Four distinct neutralino dark matter scenarios are studied: bino-wino coannihilation, higgsino dark matter, wino dark matter, and entropy-diluted bino dark matter. For each case, we determine the allowed parameter spaces and evaluate their consistency with existing experimental limits. Additionally, we examine the potential for testing these models through future investigations at the High-Luminosity Large Hadron Collider (HL-LHC) and through dark matter direct detection experiments.

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Probing Inert Scalar Dark Matter via Vector Boson Fusion at a Future Muon Collider

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The Inert Doublet Model (IDM) and Inert Triplet Model (ITM) feature a neutral scalar dark matter candidate along with inert charged scalars. In the ITM, the charged scalars exhibit a compressed mass spectrum, while in the IDM, the mass splittings among scalar components arise from electroweak symmetry breaking. Recent constraints from direct and indirect dark matter searches push these models toward the TeV scale, making their production challenging at current and future LHC runs. However, a future Muon Collider provides a promising alternative via Vector Boson Fusion (VBF), which significantly enhances the production cross-section. In the ITM, the compressed mass spectrum leads to disappearing track signatures from long-lived charged scalars, whereas the IDM predominantly exhibits missing transverse momentum. Both models yield energetic forward muons from VBF, a distinctive feature at a Muon Collider. We analyze these signatures and present discovery prospects based on luminosity projections.

Parallel session 3 / 59

Solar neutrinos and future experiments

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In this talk, I will discuss future solar neutrino observatories and their role in measuring solar neutrino oscillation parameters. These observatories will also contribute to determining the structure of the Sun and the Earth through the study of day-night asymmetry. Solar neutrinos, produced via the pp-chain and CNO cycle, travel directly from the solar core to the Earth. Detecting these neutrinos provides crucial insights into the thermonuclear reactions occurring in the solar core, enhancing our understanding of both the Sun and the standard stellar model.

Poster session / 60

Surface Treatment of NaI(Tl) Crystals for Reducing Surface Contamination

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COSINE-100 is an experiment designed to search for dark matter interactions using an array of scintillating NaI(Tl) crystals, which serve as both the WIMP interaction target and detector. We have found that contamination on the crystal surface affects the energy range of the dark matter signal. To improve the performance of detectors, we have developed cleaning methods using organic solvents to reduce surface contamination for the next-phase experiment, COSINE-200. In this poster, we present a new method for minimizing crystal surface contamination and discuss the corresponding results.

Parallel session 3 / 61

IWCD-PRISM for Dark Matter Direct Detection

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Dark matter (DM) is one of the main components of the universe and strongly related to the evolution of the universe. In order to understand the nature of DM, numerous direct and indirect search experiments are on-going or planned. The Intermediate Water Cherenkov Detector (IWCD), a near detector planned for Hyper-Kamiokande, is equipped with a vertically movable capability that enables the implementation of the PRISM technique. This feature, originally designed to provide off-axis measurements for neutrino studies, may also offer advantages for DM direct detection. We obtain DM direct detection sensitivity of IWCD-PRISM with optimized kinematic cuts and realistic detector effects. We find that the expected sensitivity of IWCD-PRISM is comparable to that of DUNE-PRISM.

Parallel session 4 / 62

Quantum entanglement in top quark pair production at a photon collider

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We explore quantum entanglement in top quark pair production at a photon collider realized via laser backscattering at an electron linear collider. By analyzing the $\gamma\gamma \to t\bar{t}$ process within the density matrix formalism, we quantify spin correlations and entanglement using concurrence and entropy-based measures. The high degree of control over photon polarization in this setup enables precise tests of quantum coherence and sensitivity to possible new physics effects. Our results demonstrate that such photon colliders provide a promising platform for probing fundamental aspects of quantum information in high-energy processes.

Poster session / 63

Emerging Photon Jets in the Hadronic Calorimeter: A Novel Signature of Neutral Long-Lived Particles at the LHC

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We propose a new collider signature for neutral long-lived particles (LLPs): an emerging photon jet in the hadronic calorimeter (HCAL), from LLP decays to photons with no ECAL activity or tracks. Using the ultralight fermiophobic Higgs h_f in the Type-I 2HDM as a benchmark, we study

$pp \to H^{\pm} h_f \to W^{\pm} h_f h_f$

where one h_f decays in the ECAL and the other in the HCAL. Fast simulation shows this signature enables discovery-level sensitivity at the HL-LHC and opens a new direction in LLP searches.

Parallel session 8 / 64

Modern Computational Approaches to Post-Inflationary Reheating and Dark Matter Production

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While analytical methods remain fundamental in physics, many phenomena require computational approaches to be fully understood. In early universe cosmology, this necessity becomes paramount: understanding post-inflationary dynamics—including resonant particle production, backreaction, and rescattering—demands numerical solutions beyond perturbative methods.
We employ lattice simulations on high-performance computing (HPC) systems to study non-linear inflaton dynamics and subsequent matter production. Recent advances in HPC accessibility enable us to explore previously intractable parameter spaces, particularly for models that connect inflation to dark matter production through mechanisms such as gravitational particle creation or inflaton decay chains.
However, fully simulating the thermal universe remains a significant challenge for future work. Current simulation tools are optimized for the very short timescales of initial particle production, making it computationally prohibitive to evolve the system through the entire thermalization process. Additionally, these lattice simulations, being semiclassical, struggle to capture quantum effects crucial for complete thermalization. Fortunately, strongly-interacting turbulent thermalization systems exhibit universal scaling behaviors during the energy redistribution phase. We are leveraging machine learning techniques to exploit this universality and develop predictive models for the thermalization process. By combining these learned patterns with subsequent Boltzmann calculations, we aim to develop a comprehensive framework that bridges the gap between early-time particle production and the eventual thermal equilibrium of the universe.

Poster session / 65

Reconciling Cosmological Tensions with Inelastic Dark Matter and Dark Radiation in a U(1)D Framework

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We propose a novel and comprehensive particle physics framework that addresses multiple cosmological tensions observed in recent measurements of the Hubble parameter, S8, and Lyman-α forest data. Our model, termed '{\bf SIDR+zt}' (Self Interacting Dark Radiation with transition redshift), is based on an inelastic dark matter (IDM) scenario coupled with dark radiation, governed by a U(1)D gauge symmetry. This framework naturally incorporates cold dark matter (DM), strongly interacting dark radiation (SIDR), and the interactions between these components. The fluid-like behavior of the dark radiation component which originates from the self-quartic coupling of the U(1)D breaking scalar can suppress the free-streaming effects. Simultaneously, the interacting DM-DR system can attenuate the matter power spectrum at small scales. The inelastic nature of DM provides a distinct temperature dependence for the DM-DR interaction rate determined by the mass-splitting

between the inelastic dark fermions which is crucial for resolving the Ly-α discrepancies. We present a cosmologically consistent analysis of the model by solving the relevant Boltzmann equations to obtain the energy density and number density evolution of different species of the model. The DR undergoes two "steps" of increased energy density when the heavier dark species freeze out and become non-relativistic, transferring their entropy to the dark radiation and enhancing ΔNeff. The analysis showcases the model's potential to uphold the Big Bang Nucleosynthesis (BBN) prediction of ΔNeff but dominantly producing additional contributions prior to recombination, while simultaneously achieving correct relic density of DM though an hybrid of freeze-in and non-thermal production.

Poster session / 66

Echoes of Self-Interacting Dark Matter from Binary Black Hole Mergers

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Dark matter (DM) environments around black holes (BHs) can influence their mergers through dynamical friction, causing gravitational wave (GW) dephasing during the inspiral phase. While this effect is well studied for collisionless dark matter (CDM), it remains unexplored for self-interacting dark matter (SIDM) due to the typically low DM density in SIDM halo cores. In this work, we show that SIDM models with a massive force mediator can support dense enough DM spikes, significantly affecting BH mergers and producing a distinct GW dephasing. To incorporate the feedback of the BH orbital motion that can significantly modify the DM profiles, we use N-body simulations to analyze GW dephasing in binary BH inspirals within CDM and SIDM spikes. By tracking the binary's motion in different SIDM environments, we show that the Laser Interferometer Space Antenna (LISA) can distinguish DM profiles shaped by varying DM interaction strengths, revealing detailed properties of SIDM.

Poster session / 67

Dark gauge-mediated supersymmetry breaking

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We investigate dark gauge-mediated supersymmetry breaking with an unbroken U(1) gauge symmetry and a massless dark photon. Messengers charged under both Standard Model and dark gauge groups generate new soft SUSY-breaking terms via gauge kinetic mixing. Large mixing significantly alters superpartner spectra compared to standard GMSB, reduces the μ parameter, and predicts a relatively light Higgsino detectable at the LHC. Simple messenger scenarios yield a very light bino-dark photino state observable in exotic Higgs decays at future colliders. The cosmological and phenomenological effects of stable, fractionally charged messenger states are also explored.

Poster session / 68

Exploring the Degree of Freedom Beyond Standard Model via Primordial Black Hole Evaporation with Memory Burden Effect

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Primordial black holes (PBHs) formed during the early universe provide a unique probe of physics beyond the Standard Model. In this study, we investigate the impact of additional degrees of freedom from supersymmetry (SUSY) particles and the memory burden effect (MBE) on the evaporation process of PBHs formed via first-order phase transitions. By analyzing how these factors influence the PBH lifetime, we aim to provide insights into potential new physics and constraints on early universe phase transitions. Our findings may offer indirect evidence supporting the existence of first-order phase transitions, contributing to a deeper understanding of high-energy physics and cosmology.

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Leptogenesis from magnetic helicity of gauged U(1)_{B − L}

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If the B −L symmetry is gauged with the addition of right-handed neutrinos, the standard model B −L current is anomalous with respect to the B −L gauge field itself. Then, the anomaly relation implies that the magnetic helicity of the B −L gauge field is related to the standard model B −L charges, although the whole universe is B −L neutral with right-handed neutrinos. Based on this, we propose a new leptogenesis scenario with the gauged B −L symmetry as follows. First, the magnetic helicity of the B −L gauge field is generated, e.g., by the axion inflation, together with the standard model and right-handed neutrino B −L charges, with the net B −L charge kept zero. The B −L charges in the standard model and right-handed neutrino sectors are then subject to washout effects from the interactions between them. After the washout effects decouple, the B −L gauge symmetry is Higgsed and the magnetic helicity of the B −L gauge field decays and generates B −L charges in the both sector; thanks to the washout effects, we obtain a non-zero B −L asymmetry. We show that the baryon asymmetry of the universe can be generated in this scenario, discussing the decay of the magnetic helicity of the B −L gauge field and the interactions between the right-handed neutrinos and the standard model particles. [JHEP 02 (2025) 192]

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Walking-dilaton hybrid inflation in dynamical scalegenesis

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We propose a hybrid inflationary scenario based on eight-flavor hidden QCD with the hidden colored fermions being in part gauged under U(1) B-L symmetry. This hidden QCD is almost scale-invariant, so-called walking, and predicts the light scalar meson (the walking dilaton) associated with the spontaneous scale breaking, which develops the Coleman-Weinberg (CW) type potential as the consequence of the nonperturbative scale anomaly, hence plays the role of an inflaton of the small-field inflation. The B-L Higgs is coupled to the walking dilaton inflaton, which is dynamically induced from the so-called bosonic seesaw mechanism. We explore the hybrid inflation system involving the walking dilaton inflaton and the B-L Higgs as a waterfall field. We find that observed inflation parameters tightly constrain the B-L breaking scale as well as the walking dynamical scale to be 10^9 GeV and 10^{14} GeV, respectively, so as to make the waterfall mechanism worked. The lightest walking pion mass is then predicted to be around 500 GeV. Phenomenological perspectives including embedding of the dynamical electroweak scalegenesis and possible impacts on the thermal leptogenesis are also addressed.

Poster session / 71

Changing 21cm Signal History of Boosted Dark Matter

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We consider the boosted dark matter(BDM) model that consists of two-component dark matter with the boost effect from the annihilation of heavier DM into lighter one and the self-heating effect from the self-interaction of lighter DM. These effects suppress the formation of small-scale structures, and this suppression affects 21cm signal. We expect that BDM model will change 21cm signal and reionization history, and that these change may detectable in Square Kilometer Array (SKA), a future 21cm hydrogen line observatory.

Special seminar 1 / 72

Super-Kamiokande Physics

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Lecture 1 / 73

Light BSM particles from the astrophysical objects I

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Lecture 3 / 74

Light BSM particles from the astrophysical objects II

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Lecture 5 / 75

Light BSM particles from the astrophysical objects III

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Lecture 2 / 76

Cosmological phase transition and gravitational wave I

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Lecture 4 / 77

Cosmological phase transition and gravitational wave II

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Lecture 6 / 78

Cosmological phase transition and gravitational wave III

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Special seminar 3 / 79

Yemilab Physics

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Lecture 7 / 80

AI in HEP/COSMO/ASTRO I

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Future colliders I

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Cosmological collider physics and activities in IBS-CTPU-CGA

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JUNO Physics

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Special seminar 4 / 88

Neutrino in astrophysics

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Special seminar 6 / 89

AI in cosmology

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Realizing Non-Singular Cosmologies within Horndeski Gravity

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We present a minimal setup within the framework of Horndeski gravity that describes a nonpathological Genesis scenario. Our setup allows for a fully stable transition to the kination epoch, during which General Relativity (GR) is restored. This Genesis scenario circumvents the no-go theorem, albeit at the cost of encountering the risk of strong coupling in the past. Interestingly, our scenario admits two distinct regimes for the background evolution of the Hubble parameter during the Genesis phase: one with power-law behavior and one with manifestly non-power-law behavior. We explicitly show that, in both regimes, our model remains within unitarity bounds. However, in most cases, the resulting tensor spectrum is blue-tilted. We then investigate an alternative model in which the Genesis phase is followed by Starobinsky inflation. We find that corrections from the Genesis phase to Starobinsky inflation can account for the ACT data.

Opening remarks / 91

Opening remarks

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Closing remarks & Poster awards

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