The 3rd International Workshop on BSM Frontiers: Where to Next?

Monday, 19 August 2024 - Thursday, 22 August 2024

Beihang University

Book of Abstracts

Contents

Parallel talks (2) / **1**

Lam-Tung relation breaking in Z boson production as a probe of SMEFT effects

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The violation of Lam-Tung relation in the high-$p_T^{\ell\ell}$ region of the Drell-Yan process at the LHC presents a long-standing discrepancy with the standard model prediction at $\mathcal{O}(\alpha_s^3)$ accuracy. In this Letter, we employed a model-independent analysis to investigate this anomaly within the framework of the Standard Model Effective Field Theory (SMEFT). Our findings revealed that the leading contributions from SMEFT to this violation appear at the $1/\Lambda^4$ order with $\mathcal{O}(\alpha_s)$ accuracy in QCD interaction. Notably, we demonstrated that the quadratic effect of dimension-6 dipole operators, associated with the Z boson, dominates the breaking effects induced by various dimension-6 and dimension-8 operators. This provides a compelling explanation for the observed discrepancy with the Standard Model predictions at the LHC without assuming other new physics operators, and thereby offers the potential to extract valuable information about the underlying physics at the TeV scale.

Parallel talks (1) / **2**

Cosmic phase transition in the strongly coupled regime

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We discuss ways to extend the Standard Model quantum chromodynamics theory (QCD) theory and realize a first-order phase transition at high temperatures above 1 GeV without running into current constraints from heavy ion colliders and early cosmology. The phase transition is from a non-perturbative effect of the QCD. It can greatly impact the early universe, including gravitational wave signals detectable for future space interferometers.

Parallel talks (2) / **3**

Recent progress of Dark SHINE R&D

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Dark SHINE is a fixed-target experiment initiative to search for light Dark Matter and mediators at SHINE (Shanghai high repetition rate XFEL and extreme light facility, being the 1st hard X-ray FEL in China) under construction targeting completion in 2026. Dark SHINE aims to search for the new mediator, Dark Photon, bridging the Dark sector and the ordinary matter. In this work and presentation, we present the idea of this new project and 1st prospective study in search for Dark

Photon decaying into light dark matter. It also provides the opportunity to incorporate broader scope of BSM search ideas such as ALP, utilizing the fixed-target experiment of this type.

Parallel talks (2) / **4**

Recent ATLAS results of Dark Matter and Dark Photon combinations, and Dark Higgs searches

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Ref: https://arxiv.org/abs/2306.00641
Results from a wide range of searches targeting different experimental signatures with and without missing transverse momentum () are used to constrain a Two-Higgs-Doublet Model (2HDM) with an additional pseudo-scalar mediating the interaction between ordinary and dark matter (2HDM+a). The analyses use up to 139 fb^{-1} of proton-proton collision data at a centre-of-mass energy $\sqrt{s}$ = 13 TeV recorded with the ATLAS detector at the Large Hadron Collider between 2015-2018. The results from three of the most sensitive searches are combined statistically. These searches target signatures with large EmissT and a leptonically decaying Z boson; large [redacted] and a Higgs boson decaying to bottom quarks; and production of charged Higgs bosons in final states with top and bottom quarks, respectively. Constraints are derived for several common as well as new benchmark scenarios within the 2HDM+a.

Ref. https://arxiv.org/abs/2406.01656
A combination of searches for Higgs boson decaying into a visible photon and a massless dark photon ($H \to \gamma_d$) is presented using 139 fb^{-1} of proton–proton collision data at a centre-of-mass energy of $\sqrt{s}$ = 13 TeV recorded by the ATLAS detector at the Large Hadron Collider. The observed (expected) 95% confidence level upper limit on the Standard Model Higgs boson decay branching ratio is determined to be $Br(H \to \gamma_d) < 1.3\%$ (1.5%). The search is also sensitive to higher-mass Higgs bosons decaying into the same final state. The observed (expected) 95% CL limit on the cross section times branching ratio ranges from 16 fb (26 fb) for m_H = 400 GeV to 1.0 fb (1.5 fb) for m_H = 3 TeV. Results are also interpreted in the context of a minimal simplified model.

Ref. https://arxiv.org/abs/2407.10549 & ATLAS-CONF-2024-004
A first dedicated search is performed for dark matter particles produced in association with a resonantly produced pair of b-quarks with m(bb) < 150 GeV using 140 fb^{-1} of proton-proton collisions recorded by the ATLAS detector at a center-of-mass energy of 13 TeV. This signature is expected in extensions of the Standard Model predicting the production of dark matter particles, in particular those containing dark Higgs bosons. This search uses a novel experimental method to extend the experimental reach to lower bb-pair invariant masses, considers a wider range of dark Higgs boson interpretations and excludes new regions of parameter space for this model. For dark Higgs boson masses between 30 and 150 GeV, Z' mediator masses up to 3.4 TeV and 4.8 TeV are excluded for benchmark scenarios.

Parallel talks (1) / **5**

Mediator Decay through Mixing with Degenerate Spectrum

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The decay of the mediator particle into standard model (SM) particles
plays a significant role in exploring the dark sector scenario. We consider such a decay, taking the dark photon mediator as an example that mixes with the SM photon. We find that it requires a careful analysis of the decay rate in the presence of an SM vector boson
(e.g., Z boson, hadronic resonances, etc.) nearly degenerate with the mediator particle in mass. The decay rate of the mediator particle calculated in the mass eigenstate basis does not agree with the correct result, given by the imaginary parts of the poles for the vector boson propagators, when the mixing parameter is smaller than a specific value. In such a case, the decay rate calculated by treating the mixing as a perturbative parameter is in agreement with the correct result. We clarify specific values for the mixing parameter quantitatively using several concrete examples of the SM vector bosons degenerate with the dark photon. When the mass mixing between the vector boson and dark photon is smaller (larger) than the decay width of the vector boson, the latter (former) method to calculate the decay rate of the mediator particle gives the correct result.

Plenary talks (1) / **6**

The SKA radio telescope probes on dark matter beyond WIMP

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We explore the sensitivity of the radio telescope to the light dark matter such as sub-GeV dark matter and axion-like particles. We specifically analyze the impact of these light dark matter candidates on the formation of large-scale structures and the resultant 21 cm radio signals that the SKA is poised to detect. We will also discuss the complementarity of these forthcoming radio signal bounds with current experimental constraints from other investigations, highlighting the synergistic potential of multi-messenger astronomy in understanding dark matter.

Parallel talks (2) / **7**

Spontaneous CP violation in supersymmetric QCD

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The strong CP problem is one of the most important problem in the standard model. One plausible approach is spontaneous CP violation, where CP is an exact symmetry but is spontaneously broken to introduce the observed Cabibbo-Kobayashi-Maskawa (CKM) phase without producing large strong CP phase. In this talk, we present a composite model of spontaneous CP violation in supersymmetric QCD. The scalar components of the meson chiral superfields obtain complex vacuum expectation values to break CP symmetry. Then, wavefunction renormalization for the quark kinetic terms induces the CKM phase, while the strong CP phase is protected by nonrenormalization of the superpotential (This mechanism is based on the mechanism invented by G. Hiller and M. Schmaltz). In our model, the right-handed down-type quark multiplets appear as composite states, whose large couplings to CP breaking fields naturally generate the observed CKM phase.

Plenary talks (3) / **8**

New Directions in Dark Matter Searches

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As the theoretical and experimental studies have entered the precision era, I will discuss some of the most well-motivated dark matter models in direct and indirect searches, with special focus on light dark matter.

Parallel talks (1) / **9**

Binary Evaporation by Dark Solitons

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An analytic calculation is given for binary star evaporation under the tidal perturbation from randomly distributed, spatially extended dark objects. In particular, the Milky Way's wide binary star population is susceptible to such disruption from dark matter solitons. We identify high-probability 'halo-like' wide binaries in GAIA EDR3 with separations larger than 0.1 parsec. Survival of the farthest-separated candidates will provide a novel gravitational probe to dark matter in the form of solitons. In the case of dilute axion-like boson stars, the observational sensitivity extends into the axion mass range $m_a \sim 10^{-17} - 10^{-15}$ eV.

Parallel talks (1) / **10**

Baryogenesis via QCD preheating with nonadiabatic baryon chemical potential

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The chiral phase transition in QCD can be supercooled in the thermal history of the universe to be instantaneously out-of equilibrium, if QCD is coupled to a dark QCD sector exhibiting the dark chiral phase transition of the first order. In that case the QCD sigma meson field (as the chiral order parameter, or the light quark condensate) starts to roll in a nonadiabatic way down to the true QCD vacuum. Meanwhile a dynamic baryonic chemical potential can be generated solely within QCD, which is governed by the dynamic motion of the QCD sigma meson field, analogously to the spontaneous baryogenesis or the leptogenesis via the Higgs or axionlike relaxation scenario. When QCD is further allowed to communicate with a dark fermion with mass of order of 1 GeV and the baryon number violating coupling to neutron, the nonadiabatic QCD sigma motion along with the nonadiabatic baryon chemical potential can trigger the preheating and produce the baryon number asymmetry. We discuss this scenario in details to find that the QCD-induced dynamic baryon chemical potential plays a significant role for the QCD preheating and the baryogenesis, which yields the desired amount of the asymmetry today consistently with current astrophysical, cosmological, and

terrestrial experimental constraints. Cosmological and phenomenological consequences characteristic to the present scenario are also addressed.

Parallel talks (1) / 11

Probing Inflationary Reheating with Graviton Bremsstrahlung

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Reheating is a theory explaining the transition of the Universe from the end of inflation to the radiation phase before Big Bang nucleosynthesis (BBN). Many beyond the Standard Model (BSM) phenomena, such as dark matter production, baryogenesis, and phase transitions, may have occurred before BBN. Probing the physics before BBN is challenging because the background is not transparent to usual messengers like photons or neutrinos. However, using gravitational waves (GWs) is a promising method. In this talk, I will discuss the inevitable stochastic GW spectrum resulting from graviton bremsstrahlung during inflationary reheating. We will focus on an inflaton, denoted as ϕ, oscillating around a generic monomial potential $V(\phi) \sim \phi^n$, while considering two different reheating scenarios: (i) inflaton decay and (ii) inflaton annihilation. I will demonstrate the dependence of GWs on the shape of the inflaton potential as well as the type of inflaton-matter coupling. Finally, I will highlight the novel potential of future high-frequency GW detectors in probing the dynamics of reheating, which could potentially shed light on the BSM physics preceding BBN.

Parallel talks (2) / 13

Exploring nTGCs by ZZ Pair Production at Future Lepton Colliders

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This study investigates Neutral Triple Gauge Couplings (nTGCs) through ZZ production at future Electron Positron Colliders. We compare the signals and backgrounds associated with five different ZZ decay channels and present our event selection strategies for different collision experiments. We provide numerical results for the coefficient constraints and derive final constraints by combining results from the different decay patterns.

Parallel talks (2) / 14

Probing Anomalous Gauge Couplings in Multi-Boson Physics with Machine Learning

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Anomalous gauge couplings provide unique insights into dimension-8 physics, which can be studied in great detail through multi-boson processes at high-energy colliders. In this talk, I will review our recent studies on anomalous gauge couplings in multi-boson physics. This includes tri-boson and vector boson scattering productions, probes on anomalous couplings, and the applications of machine learning techniques.

Parallel talks (1) / **15**

Ladder top-quark condensation imprints in supercooled electroweak phase transition

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The electroweak (EW) phase transition in the early Universe might be supercooled due to the presence of the classical scale invariance involving Beyond the Standard Model (BSM) sectors and the supercooling could persist down till a later epoch around which the QCD chiral phase transition is supposed to take place. Since this supercooling period keeps masslessness for all the six SM quarks, it has simply been argued that the QCD phase transition is the first order, and so is the EW one. However, not only the QCD coupling but also the top Yukawa and the Higgs quartic couplings get strong at around the QCD scale due to the renormalization group running, hence this scenario is potentially subject to a rigorous nonperturbative analysis. In this work, we employ the ladder Schwinger-Dyson (LSD) analysis based on the Cornwall-Jackiw-Tomboulis formalism at the two-loop level in such a gauge-Higgs-Yukawa system. We show that the chiral broken QCD vacuum emerges with the nonperturbative top condensate and the lightness of all six quarks is guaranteed due to the accidental U(1) axial symmetry presented in the top-Higgs sector. We employ a quark-meson model-like description in the mean field approximation to address the impact on the EW phase transition arising due to the top quark condensation at the QCD phase transition epoch. In the model, the LSD results are encoded to constrain the model parameter space. We then observe the cosmological phase transition of the first-order type and discuss the induced gravitational wave (GW) productions. We find that in addition to the conventional GW signals sourced from an expected BSM at around or over the TeV scale, the dynamical topponium-Higgs system can yield another power spectrum sensitive to the BBO, LISA, and DECIGO, etc.

Parallel talks (1) / **16**

Walking-dilaton hybrid inflation with B - L Higgs embedded 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 $U(1)_{B-L}$. 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 $U(1)_{B-L}$ 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 $U(1)_{B-L}$ Higgs as a waterfall field.
We find that observed inflation parameters tightly constrain the $U(1)_{B-L}$ breaking
scale as well as the walking dynamical scale to be $\sim 10^9$ GeV and $\sim 10^{14}$ 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.

Plenary talks (2) / **17**

Exciting potential of neutrino neutral current interaction with 13C

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In this talk, I will discuss the excellent potential of neutrino neutral current interaction with 13C in neutrino experiments. The interaction induces the excited state 13C*subsequently emitting a 3.685 MeV photon from the de-excitation into the ground state. The probe of this distinctive signal can shed light in identifying the origin of the 5 MeV bump observed in reactor anti-neutrino spectra in the inverse beta decay process. For a detector that has a capability of 95% level photon and electron separation and small thorium contamination below 0.05 femtogram/gram located in a site with an overburden of about a few hundred m.w.e, such as the location of near detectors of RENO and Daya Bay will have a great sensitivity to resolve the 5 MeV bump. In addition, we propose a novel approach to track the time evolution of reactor isotopes by analyzing our 13C* de-excitation signal shedding light on the contributions from 235U or 239Pu to the observed bump. This provides an extra powerful tool in both discriminating the flux models and testing any new physics possibilities for the 5 MeV bump at 3σ to 5σ
level with much less systematic uncertainties and assuming 10 kt.year of data collection. Our detector requirements are realistic, aligning well with recent studies conducted for existing or forthcoming experiments.

Plenary talks (1) / **18**

One-point correlators of conserved and non-conserved charges in QCD

One-point correlators of conserved charges are argued to be perturbatively IR safe in QCD, which includes not only the density of energy, but also those of electric charge, isospin and baryon number. Theoretical and phenomenological aspects of the density matrix of one-point correlators will be discussed in the context of the states produced by a chiral current, as in the decay of a polarized electroweak boson. Densities of some non-conserved charges such as energy with arbitrary non-negative powers, despite their incalculability, will be shown to obey an infinite set of consistency constraints. QCD seems to live near a kink in the allowed parameter space of one-point correlators.

Plenary talks (1) / **19**

Pulsar Polarization Arrays

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As one of the major dark matter candidates, the ultralight Axion-Like Dark Matter (ALDM) exhibits a pronounced wave nature on astronomical scales and offers a promising solution to small-scale structure issues within local galaxies. While the linearly polarized pulsar light travels through the ALDM galactic halo, its position angle (PA) can be subject to an oscillation induced by the ALDM Chern-Simons coupling with electromagnetic field. The Pulsar Polarization Array (PPA) is thus especially suited for the detection of the ultralight ALDM, by correlating polarization data across the arrayed pulsars. We conduct the first-ever PPA analysis to detect the ultralight ALDM, using the polarization data of 22 millisecond pulsars from the third data release of Parkes Pulsar Timing Array. To accomplish this task, we develop a Bayesian framework dedicated to analyzing the time series of PA residuals of these pulsars. We find that the PPA provides the most stringent constraints on the ALDM Chern-Simons coupling so far for the relevant mass range. We also demonstrate the crucial role of cross-correlation analysis in recognizing the nature of the derived limits.

Parallel talks (1) / **24**

Illuminating Black Hole Shadow with Dark Matter Annihilation

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The Event Horizon Telescope (EHT) has revolutionized our ability to study black holes by providing unprecedented spatial resolution and unveiling horizon-scale details. With advancements leading to the next-generation EHT, there is potential to probe even deeper into the black hole's dark region, especially the inner shadow characterized by low-intensity foreground emissions from the jet, thanks to a significant enhancement in dynamic range by two orders of magnitude. We demonstrate how such enhanced observations could transform supermassive black holes into powerful probes for detecting annihilating dark matter, which can form a dense profile in the vicinity of supermassive black holes, by examining the morphology of the black hole image.

Plenary talks (1) / **25**

TBA

Plenary talks (3) / 27

Wess-Zumino-Witten Interactions of Axions

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We present a consistent derivation of the complete Wess-Zumino-Witten interactions of axions, including the counter-term necessary to guarantee the gauge invariance of the Standard Model. By treating the derivative of the axion field as a background gauge field and incorporating auxiliary chiral rotation phases, we ensure consistency in the axion-interaction Lagrangian. This approach allows us to derive basis-independent physical interactions of axions with gauge bosons and vector mesons. As an example, we explore the interaction of a-ω-γ to illustrate the potential for searching for axion-like particles at colliders.

Parallel talks (2) / 28

The neutral scalars under the LHC

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The 2HDM+S is the singlet extension of 2HDM, which can accommodate more physics potential beyond the SM. We summarize the type II 2HDM+S model with various Higgs potential structures, and discuss several scenarios with different mass hierarchy. In this study, we concentrate on the mass eigenstate of the 2HDM+S, and test the parameter space of Higgs mixing angles and masses against the experimental constraints, including 125 GeV Higgs measurements, BSM Higgs direct searches, STU and B-physics observables. In particular, we study the exotic channels of $h_{125} \to A_S A_S$ and $h_{125} \to h_S h_S$ decays for the light singlet-like Higgs scenarios $m_{h_S/A_S} < 62.5$ GeV, and determine the limit of Higgs mixing angles. Furthermore, we study the phenomenological distinction between 2HDM+S and 2HDM, and explore the indirect impact of the singlet admixture on the parameter space of $\cos(\beta - \alpha_1)$, $\tan\beta$ and m_A.

Plenary talks (2) / 29

New perspective of QCD cosmology with Beyond the Standard Model

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This talk plans to introduce a couple of recent new phenomenologies and cosmology related to the QCD phase transition epoch, coupled to Beyond the Standard Model, in the thermal history of the universe. Baryogenesis, strong CP problem, and gravitational wave predictions will be covered in scenarios of this class, which can also be embedded into the scalegenesis to address the dynamical

origin of mass based on the classical scale invariance. Typical new physics accessible at the upcoming collider experiments are to be a dark eta-prime with mass of sub GeV and leptoquarks with mass of sub GeV, or sub TeV, which depends on the type of baryogenesis. Possible issues left necessary to persist in the future will also be addressed.

Plenary talks (1) / **30**

First Scan Search for Dark Photon Dark Matter with a Tunable Superconducting Radio-Frequency Cavity

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Dark photons have emerged as promising candidates for dark matter, and their search is a top priority in particle physics, astrophysics, and cosmology. We report the first use of a tunable niobium superconducting radio-frequency cavity for a scan search of dark photon dark matter with innovative data analysis techniques. We mechanically adjusted the resonant frequency of a cavity submerged in liquid helium at a temperature of 2 K, and scanned the dark photon mass over a frequency range of 1.37 MHz centered at 1.3 GHz. Our study leveraged the superconducting radio-frequency cavity ' s remarkably high quality factors of approximately 1010, resulting in the most stringent constraints to date on a substantial portion of the exclusion parameter space on the kinetic mixing coefficient ϵ between dark photons and electromagnetic photons, yielding a value of $\epsilon < 2.2 \times 10{-}16$
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Plenary talks (2) / **31**

Introduction to the Very Large Area gamma-ray Space Telescope (VLAST)

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The Very Large Area gamma-ray Space Telescope (VLAST) is a mission concept proposed to detect gamma-ray photons through both the Compton scattering and electron-positron pair production mechanisms, enabling the detection of photons with energies ranging from MeV to TeV. VLAST is designed to have an acceptance of 10 mˆ2 sr which is four times larger than Fermi-LAT, an energy resolution of ˜2% at 10 GeV, and an angular resolution of ˜0.2 degrees at 10˜GeV. The VLAST project is expected to make significant contribution to the field of gamma-ray astronomy and the exploration of new physics.

Plenary talks (1) / **32**

Probing Particle Physics with the Cosmological Collider

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It’s generally believed that the energy scale of cosmic inflation is much higher than that of the current particle physics colliders. Cosmological collider makes use of the extremely high energy scale of inflation, to determine the features of particles excited by the inflationary background, independent of the details of inflation models. In this talk, we will overview how to use the cosmological collider method to extract the mass, spin, party and lifetime of these particles, and how to relate these features to the particle physics Standard Model and beyond.

Plenary talks (2) / **33**

TBA

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Plenary talks (3) / **34**

Probing positivity bounds at colliders

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Certain dimension-8 operator coefficients are subject to positivity bounds, derived from the fundamental principles of Quantum Field Theory, including unitarity, locality, analyticity and Lorentz invariance. In the first part of the talk, I will discuss how these positivity bounds can be probed by LHC or future lepton colliders. In the second part of the talk, I will discuss some of the subtleties in the interpretation of positivity bounds that arises at the one-loop level.

Plenary talks (3) / **35**

Relative entropy and effective field theory

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Relative entropy quantifies the difference between two probability distribution functions, which is connected with key properties of physics, such as the second law of thermodynamics. In this talk, one of the most attractive features of relative entropy, non-negativity, is briefly reviewed. Then, I consider the relative entropy between two theories with and without interaction between heavy and light degrees of freedom. I explain connections between the non-negativity of the relative entropy and various phenomena, e.g., the positive magnetic susceptibility in the Ising model, the positivity bounds on the SMEFT SU(N) gauge bosonic operators, etc.

Parallel talks (2) / **36**

Lepton flavor of four-fermion operator and fermion portal dark matter

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arXiv: 2407.06523 [hep-ph]:
We study the ultraviolet completion of semileptonic four-fermion operator $O_{ledq}^{\alpha\beta 11}$ that incorporates Majorana dark matter (DM) in both lepton-flavor-conserving (LFC) and lepton-flavor-violating (LFV) scenarios at the one-loop level via box diagram, which effectively alleviates the lower bounds on the new physics scale. The interplay between the model-independent constraints on the Wilson coefficients and DM direct detection, relic density, and collider searches in the context of fermion portal DM model with two mediators is investigated. We find that both the projected future constraint on the LFC Wilson coefficient $C_{ledq}^{2211}/\Lambda^2 < (12.3\ \text{TeV})^{-2}$ from the measurements of neutrino non-standard interaction in the next-generation neutrino oscillation experiments, and LFV constraint $C_{ledq}^{1211}/\Lambda^2 < \left(2.2 \times 10^3\ \text{TeV}\right)^{-2}$ from ongoing charged-lepton-flavor-violation searches, provide a complementary exploration of the parameter space encompassing the DM mass and scalar mass. With the colored mediator mass typically around 2 TeV, the sensitivity of the indirect constraints on the four-fermion operator could surpass those of collider searches and DM direct detection, in scenarios where the masses of the DM and scalar are close. By ensuring the correct DM relic density, however, we obtain that the collider searches and DM direct detection are more sensitive to the electroweak scale DM and scalar compared to the indirect constraints.

Plenary talks (3) / **37**

Detecting exceptions of thermal dark matter

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We will discuss the remaining parameter space for WIMP-like dark matter with thermal relic density, focusing on two scenarios: the small interaction rate region and the small mass region. In the small interaction rate region, we reanalyze the prospects of detecting dark matter annihilation signals in the Galactic Center, particularly near the supermassive black hole (Sgr A*), by examining three annihilation processes—p-wave, resonance, and forbidden annihilation—under semi-relativistic velocities, using gamma-ray data from the Fermi and DAMPE telescopes. In the small mass region, we explore a minimal renormalizable dark matter model involving sub-GeV Majorana dark matter and a singlet scalar particle.

Plenary talks (2) / **38**

TBA

Plenary talks (3) / **39**

TBA

Plenary talks (2) / **42**

Welcome Remarks

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Welcome Remarks

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Photo Session

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Matter asymmetry from Z_N symmetric dark matter-companion

Plenary talks (1) / 47

Detecting exceptions of thermal dark matter

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We will discuss the remaining parameter space for WIMP-like dark matter with thermal relic density, focusing on two scenarios: the small interaction rate region and the small mass region. In the small interaction rate region, we reanalyze the prospects of detecting dark matter annihilation signals in the Galactic Center, particularly near the supermassive black hole (Sgr A*), by examining three annihilation processes—p-wave, resonance, and forbidden annihilation—under semi-relativistic velocities, using gamma-ray data from the Fermi and DAMPE telescopes. In the small mass region, we explore a minimal renormalizable dark matter model involving sub-GeV Majorana dark matter and a singlet scalar particle.