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摘要集

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Probing Inelastic Dark Matter at the LHC, FASER and STCF

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In this talk, we explore the potential of probing the inelastic dark matter (DM) model with an extra (1) gauge symmetry at the Large Hadron Collider, ForwArd Search ExpeRiment and Super Tau Charm Factory. To saturate the observed DM relic density, the mass splitting between two light dark states has to be small enough, and thus leads to some distinctive signatures at these colliders. By searching for the long-lived particle, the displaced muon-jets, the soft leptons, and the mono-photon events, we find that the inelastic DM mass in the range of 1 MeV to 210 GeV could be tested.

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Discriminating Higgs production mechanisms via jet charge at the LHC

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Discriminating the Higgs production mechanisms plays a crucial role in directly measuring the couplings of Higgs to gauge bosons for probing the nature of the electroweak symmetry breaking. We propose a novel method to distinguish the Higgs production mechanisms at the LHC by utilizing the jet charge asymmetry of the two leading forward jets in Higgs plus two jets production. This novel observable provides a way to disentangle the W-fusion from the Z-fusion and gluon fusion processes for the first time, due to the electric charge correlation of the two leading jets in the events. We show that the Higgs couplings to gauge bosons can be well constrained and its conclusion does not depend on the other possible new physics effects which modify the Higgs total or partial width. We also discuss the complementary roles between the proposed jet charge asymmetry measurement and the Higgs signal strength measurements at the HL-LHC in determining the Higgs couplings.

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NNNLO QCD predictions for heavy quark decays

We present the first analytic results of N3LO QCD corrections to the top-quark decay width. We focus on the dominant leading color contribution, which includes light-quark loops. At NNLO, this dominant contribution accounts for 95% of the total correction. By utilizing the optical theorem, the N3LO corrections are related to the imaginary parts of the four-loop self-energy Feynman diagrams, which are calculated with differential equations. The results are expressed in terms of harmonic polylogarithms, enabling fast and accurate evaluation. The third-order QCD corrections decrease the LO decay width by 0.667%, and the scale uncertainty is reduced by half compared to the NNLO result. The most precise prediction for the top-quark width is now 1.321 GeV for mt = 172.69 GeV. Additionally, we obtain the third-order QCD corrections to the dilepton invariant mass spectrum and decay width in the semileptonic b ⟶ u transition.

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Recent Dark Matter combination summary from ATLAS

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Science Bulletin (accepted) Ref: https://arxiv.org/abs/2306.00641

Results from a wide range of searches targeting different experimental signatures with and without missing transverse momentum (E_T^{miss}) 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 EmissT 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.

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Latest Dark Matter Results of the PandaX-4T Experiment

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PandaX-4T experiment is a deep-underground dark matter direct search experiment that employs a dual-phase time projection chamber with a sensitive volume containing 3.7 tonnes of liquid xenon. Along with a series of exotic dark matter model tests, a blind analysis was applied to the full exposure of PandaX-4T recorded data. In this talk, I will discuss the latest dark matter search results of the PandaX-4T experiment.

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Dark Matter Annihilation via Breit-Wigner Enhancement with Heavier Mediator

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We propose a new scenario that both the dark matter freeze-out in the early Universe and its possible annihilation for indirect detection around a supermassive black hole are enhanced by a Breit-Wigner resonance. With the mediator mass larger than the total initial dark matter mass, this annihilation is almost forbidden at late times. Thus, the stringent cosmic microwave background and indirect detection constraints do not apply. However, a supermassive black hole can accelerate the dark matter particles to reactivate this resonant annihilation whose subsequent decay to photons leaves a unique signal. The running Fermi-LAT and the future COSI satellites can test this scenario.

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Precise measurement of SM-EWK Zγ+jets and constraints on neutral triple gauge couplings at ATLAS and future collider with EFT approach

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This talk will present the latest results from ATLAS in the measurement of SM-EWK multiboson production process in the Zγ+jets final states including the 1st observation of VBS Zγ+2j at ATLAS. Also the neutral gauge boson coupling BSM phenomena is probed in such final states utilizing LHC-ATLAS Run-2 proton-proton collision dataset (ref: JHEP 07 (2023) 72 & Phys. Lett. B 846 (2023) 138222) and prospective studies for future lepton colliders (ref: arXiv:1902.06631 & arXiv:2308.16887)

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Axion-like Particle Dark Matter and the Baryon Asymmetry

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In this talk, I will present new mass generation mechanisms for axion-like particles (ALP), and discuss the evolution of these ALP in the early universe. I will also show that the observed baryon asymmetry of the universe can be addressed in this mechanism with the help of the spontaneous baryogenesis mechanism.

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宇宙相变引力波理论和实验进展

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本次报告中我将会介绍宇宙相变引力波相关研究领域方面的进展，包括唯象学研究、相变动力学运动学及引力波计算、相变的新观测量如原初黑洞原初磁场，以及相变引力波的实验探测方面的进展。

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Freeze-in bino dark matter in high scale supersymmetry

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We explore a scenario of high scale supersymmetry where all supersymmetric particles except gauginos stay at a high energy scale $M_{\rm SUSY}$ which is much larger than the reheating temperature $T_{\rm RH}$. The dark matter is dominated by bino component with mass around the electroweak scale and the observed relic abundance is mainly generated by the freeze-in process during the early universe. Considering the various constraints, we identify two available scenarios in which the supersymmetric sector at an energy scale below $T_{\rm RH}$ consists of: a) bino; b) bino and wino. Typically, for a bino mass around 0.1-1 TeV and a wino mass around 2 TeV, we find that $M_{\rm SUSY}$ should be around 10^{13-14} GeV with $T_{\rm RH}$ around 10^{4-6} GeV.

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Heavy neutrino and lepton number violation at high-energy muon collider

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The search of heavy Majorana neutrino is a long-standing topic in the field of high-energy physics and BSM physics. High-energy muon colliders are potentially ideal machines in both energy and precision frontiers. We proposed a clear lepton-number-violating signature through vector boson scattering to search for heavy Majorana neutrino at both ⊠ˆ+ ⊠ˆ− and ⊠ˆ+ ⊠ˆ+ colliders (JHEP 09 (2023) 131, arXiv: 2306.17368).

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Search for Higgs Boson Pairs in the bb⊠⊠ Final State with the ATLAS Experiment

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This talk will present the latest search for the non-resonant production of Higgs boson pairs in the $HH \to bb\tau^+\tau^-$ channel. The search is performed using 140 fb^{-1} of proton-proton collisions at a centre-of-mass energy of 13 TeV recorded by the ATLAS detector at the LHC. The analysis strategy is optimized to probe anomalous values of the Higgs boson (H) self-coupling modifier κ_λ and of the quartic $HHVV$ ($V = W, Z$) coupling modifier κ_{2V}. No significant excess above the expected background from Standard Model processes is observed. An observed (expected) upper limit $\mu_{HH} < 5.9$ (3.1) is set at 95% confidence-level on the Higgs-boson pair production cross-section normalized to its Standard Model prediction. The coupling modifiers are constrained to an observed (expected) 95% confidence interval of $-3.2 < \kappa_\lambda < 9.1$ $(-2.4 < \kappa_\lambda < 9.2)$ and $-0.5 < \kappa_{2V} < 2.7$ $(-0.2 < \kappa_{2V} < 2.4)$, assuming all other Higgs boson couplings are fixed to the Standard Model prediction.

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Search for T-odd mechanisms beyond the standard model in transversely polarized $p\vec{e}$ elastic scattering?

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Within the standard model, transverse single spin asymmetries in electron elastic scatterings can only arise from multi-photon exchanges. The A4@MAMI collaboration has measured the beam transverse single spin asymmetry in electron-proton elastic scattering from 315 to 1508 MeV (Phys. Rev. Lett. 124, 122003 (2020)). The data are significantly different from theoretical calculations based on chiral perturbation (Phys. Rev. C 70, 054003 (2004)), unitarity (Phys. Rev. C 70, 045206 (2004)) and optical theorem (Phys. Rev. C 73, 055201 (2006)). Comparing with the unitary calculation, one may attribute the discrepancy to heavier intermediate states in two-photon exchanges (TPE) which are not included in the calculation. On the other hand, it requires the virtual photon to have large energy to excite high-energy/heavy states, one would expect contributions due to these intermediate states are small. From this point of view, the discrepancy is puzzling. Similar discrepancies were also observed at other laboratories, in both electron-proton and electron-lead scatterings, such as SAMPLE at MIT-Bates (Phys. Rev. C 63, 064001 (2001)), Qweak at JLab (Phys. Rev. Lett. 125 112502 (2020)) and PREX-II at JLab (Phys. Rev. Lett. 128, 142501 (2022)).

Another possible origin of these discrepancies could be T-odd mechanisms beyond the standard model, such as a novel T-violating interaction or an unanticipated two-boson exchange involving one virtual photon and one unknown T-conserving boson. However, the hadronic/nuclear uncertainties (such as possible intermediate states in TPE) in the theoretical calculations hamper us from investigating new physics via the transverse single spin asymmetry. In view of this, we propose to measure the transverse spin asymmetry in proton-electron ($p\vec{e}$) scattering instead of electron-proton ($\vec{e}p$) scattering using an unpolarized proton beam and polarized electrons in a polarized hydrogen gas target, which is planned at the hadronic accelerator HIAF, currently under construction at IMP, CAS. In pe scatterings, the effective energy (or Q^2) is 2∼3 orders smaller than in ep scattering, only elastic intermediate state (i.e., proton) will be involved in two-photon exchanges. As a result, theory based on unitarity can provide calculations with little theoretical uncertainties. In experiments with polarized electron beams, asymmetries are usually very small due to relativistic effects. In scatterings between an unpolarized proton beam and a polarized electron target, no such effects present, as a result, the asymmetry will be larger by 4 orders, compared with $\vec{e}p$ experiments with electron beams of 1∼2 GeV. Consequently, systematical errors in the experiment will be reduced significantly. Given the above advantages, the transversely polarized $p\vec{e}$ scattering could be an attractive approach to search for new physics.

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Detecting Quadratically Coupled Ultra-light Dark Matter with Stimulated Annihilation

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Ultra-light Dark Matter (ULDM) is one of the most promising DM candidates. Due to the Bose enhancement, we find the annihilation rate of the ULDM in the presence of background photon radiation can be greatly enhanced and produce a distinctive reflected electromagnetic wave with an angular frequency equal to the ULDM mass. We propose to utilize such stimulated annihilation to probe the ULDM with the electromagnetic quadratic coupling by emitting a beam of radio into space. With a power of 50 MW emitter, we forecast the sensitivity of quadratic coupling in different local halo models for low-frequency radio telescopes, such as LOFAR, UTR-2 and ngLOBO.

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Sterile Neutrino Portal Dark Matter with Z3 Symmetry

In this paper, we consider the sterile neutrino portal dark matter with Z_3 symmetry. This model further extends the canonical type-I seesaw with a fermion singlet χ and a scalar singlet ϕ. Under the Z_3 symmetry, the dark sector transforms as $\chi \to e^{i2\pi/3}\chi, \phi \to e^{i2\pi/3}\phi$, while the standard model particles and the sterile neutrino N transform trivially. Besides the interactions as $y_N \phi \bar{\chi} N$ and $\lambda_{H\phi}(H^+H)(\phi^+\phi)$ allowed in the Z_2 symmetry, the Z_3 symmetry also introduces two new terms, i.e., $y_\chi \phi \overline{\chi^c}\chi$ and $\mu\phi^3/2$. These new interactions induce additional semi-annihilation processes as $\chi\chi \to N\chi$ and $\phi\phi \to h\phi$ for the WIMP dark matter. We then perform a comprehensive analysis of the phenomenology of this Z_3 symmetric model. Viable parameter space is explored under the constraints from dark matter relic density, Higgs invisible decay, indirect and direct detection for both fermion and scalar dark matter. We find that the semi-annihilation channels $\chi\chi \to N\chi$ and $\phi\phi \to N\chi$ can lead to quite different phenomena from the Z_2 symmetric model, which provides a viable pathway to distinguish these two kinds of model.

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Dark matter from hot big bang black holes

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If the temperature of the hot thermal plasma in the Early Universe was within a few orders of magnitude of the quantum gravity scale, then the hoop conjecture predicts the formation of microscopic black holes from particle collisions in the plasma. These black holes may evaporate and produce the dark matter relic abundance observed today for a wide variety of dark matter masses. We study the production of dark matter in standard cosmology and in the scenario of low-scale quantum gravity

such as large extra dimensions. In the former case black holes evaporate instantly, while in the latter case dark matter may accrete and become macroscopic, leading to rich phenomena in the late Universe.

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Non-perturbative Effect on DM Electromagnetic Moment

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Effective field theory (EFT) provides a model-independent framework for interpreting the results of dark matter (DM) direct detection experiments. In this study, we demonstrate that two fermionic DM-quark tensor operators ($(\bar{\chi} i\sigma^{\mu\nu}\gamma^5\chi)(\bar{q}\sigma_{\mu\nu}q)$ and $(\bar{\chi}\sigma^{\mu\nu}\chi)(\bar{q}\sigma_{\mu\nu}q)$) can contribute to the DM electric and magnetic dipole moments via non-perturbative QCD effect, in addition to the well-studied contact DM-nucleon operators. We then investigate the constraints on these two operators by translating the existing bounds on DM dipole operators from various direct detection experiments. For $m_\chi < 1$ GeV, our results significantly extend the reach of constraints on DM-quark tensor operators to masses as low as 3 MeV, with the bound exceeding that of obtained by the Migdal effect by an order of magnitude or so.In particular, for the operator $(\bar{\chi}\sigma^{\mu\nu} i\gamma_5\chi)(\bar{q}\sigma_{\mu\nu}q)$ with DM mass $m_\chi > 10$ GeV, the latest PandaX constraint on the DM electric dipole moment puts more stringent bounds as compared to the previous direct detection limit.

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Feeble Sterile Neutrino Portal Dark Matter with Z_2 or Z_3 symmetry

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We study the feeble sterile neutrino portal dark matter under the Z_2 or Z_3 symmetry. And summarizing the differences between Z_2 and Z_3 symmetry, which are mainly reflected in the generation, transformation, and various phenomenology.

Parallel 2 / 20

Single Transverse Spin Asymmetry as a New Probe of SMEFT Dipole Operators

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Electroweak dipole operators in the Standard Model Effective Field Theory (SMEFT) are important indirect probes of quantum effects of new physics beyond the Standard Model (SM), yet they remain poorly constrained by current experimental analyses for lack of interference with the SM amplitudes in constructing cross section observables. In this Letter, we point out that dipole operators flip fermion helicities so are ideally studied through single transverse spin asymmetries. We illustrate this at a future electron-positron collider with transversely polarized beams, where such effect exhibits as azimuthal $\cos\phi$ and $\sin\phi$ distributions which originate from the interference of the electron dipole operators with the SM and are linearly dependent on their Wilson coefficients. This new method can improve the current constraints on the electron dipole couplings by one to two orders of magnitude, without depending on other new physics operators, and can also simultaneously constrain both their real and imaginary parts, offering a new opportunity for probing potential CP-violating effects.

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Long-lived Searches of Vector-like Lepton and Its Accompanying Scalar at Colliders

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Recently, the vector-like leptons (VLLs) as a simple extension to the standard model (SM) have attracted widespread attention both in theory and experiments. The present collider searches mainly focus on the studies of their prompt decays, which prefer a relatively large coupling. In this paper, we concentrate on searches for long-lived signatures of the singlet VLLs F or their accompanying scalar particles ϕ both in the hadronic and electronic colliders. The long-lived signatures are naturally induced from small chiral mass mixing between VLLs and SM leptons. Two specific models distinguished by whether the VLLs couple to scalar particles are introduced to realize the aforementioned features. For long-lived VLLs case, we find that with the kink track method the sensitivities at future HL-LHC with $\sqrt{s} = 13$ TeV can reach the regions for VLL mass $m_F \in [200, 950]$ GeV and the mass mixing parameter $\theta_L \in [10^{-10}, 10^{-7}]$. For the long-lived accompanying scalar particle case, by fixing VLLs or scalar mass, or the mass ratio between VLL and the accompanying scalar, we explore the projected sensitivities through the time delay and displaced vertex strategies, which can probe the regions for $m_F \in [200, 1200]$ GeV and coupling $y\theta_L \in [10^{-11}, 10^{-6}]$. Furthermore, we also explore the long-lived accompanying scalars at the future CEPC provided that the VLLs can couple to the SM first-generation leptons. We find that CEPC has good performances for $m_\phi < 70$ GeV and $m_F < 1000$ GeV. These long-lived searches are complementary to previous studies, which opens the door towards the smaller coupling regions.

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Optimizing Fictitious States for Bell Inequality Violation in Bipartite Qubit Systems

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There is a significant interest in testing quantum entanglement and Bell inequality violation in high-energy experiments. Since the analyses in high-energy experiments are performed with events statistically averaged over phase space, the states used to determine observables depend on the choice of coordinates through an event-dependent basis and are thus not genuine quantum states, but rather "fictitious states." We prove that if Bell inequality violation is observed with a fictitious state, then it implies the same for a quantum sub-state. We further show analytically that the basis which diagonalizes the spin-spin correlations is optimal for constructing fictitious states, and for maximizing the violation of Bell's inequality.

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Broadband Search Strategies through Hybrid Spin Systems in the Quest for Axion Dark Matter

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Recent advances in tabletop quantum sensor technology have enabled searches for nongravitational interactions of DM. Traditional axion dark matter experiments rely on sharp resonance, resulting in extensive scanning time to cover the wide mass range. In contrast, our study (named ChangE) introduces a novel method of actively tuning alkali and noble gas spins to the same Larmor frequency, where we identify a strongly-coupled hybrid spin-resonance (HSR) regime that enhances the bandwidth of ^{21}Ne nuclear spin by three orders of magnitude while maintaining ultrahigh sensitivity. In combination with a self-compensating mode (SC) for low frequencies, we present a comprehensive broadband search for axion-like dark matter with Compton frequencies in the range of $[0.01, 1000]$\,Hz. We set new constraints on the DM interactions with neutrons and protons, accounting for the effects of DM stochasticity. For the axion-neutron coupling, our results reach a low value of $|g_{ann}| \leq 3 \times 10^{-10}$ in the frequency range $[0.02, 4]$\,Hz surpassing astrophysical limits and provide the strongest laboratory constraints in the $[10, 100]$\,Hz range. For the axion-proton coupling, we offer the best terrestrial constraints for the frequency $<$100\,Hz.

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Complementary LHC searches for UV resonances of 0νββ decay operators

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$\Delta L = 2$ lepton number violation at the TeV scale connects $0\nu\beta\beta$ decay (intensity frontier), LHC searches (energy frontier), and leptogenesis (cosmic frontier). I will focus on some progress on the promising UV completions of $0\nu\beta\beta$ decay operators, which can be diagnosed with complementary searches at the HL-LHC and HE-LHC.

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The Effective Operator Basis of the HEFT

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The Higgs effective field theory (HEFT) is an effective field theory in the broken phase, providing a more general realization of the EW symmetry breaking, which includes the SMEFT as a particular case. There are more effective operators than the SMEFT and can be matched to the latter ones. I will discuss the HEFT, especially its effective operators basis. The key points are

- A general method to construct effective operators utilizing the Young diagrams and its applications to the HEFT, including the management of the Nambu-Goldstone bosons and the spurions;
- The Hilbert series method extended to the nonlinear symmetry and the discrete symmetries such as the parity and charge conjugation, and its applications to the HEFT to count effective operators.

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Disentangling the Neutrino Electromagnetic Properties with Atomic Process

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The neutrino electromagnetic properties was first studied by Pauli in his famous letter of proposing the very existence of neutrino. Altough neutrinos are neutral and hence does not have electric charge, it is perfectly OK for them to have electric and magnetic dipole moments as well as charge radius and anapole. Nevertheless, existing terrestrial experiments and celestial observations can only probe complicated combinations of neutrino electromagnetic properties and various mixing matrix elements. In other words, even if neutrino electromagnetic interactions are evenly established, it is difficult to identify the individual elements. I will present a unique probe with radiative emission of neutrino pair (RENP) which is an atomic process to disentangling various elements. This could be a ultimate way of probing the neutrino electromagnetic properties.

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Probing quirk signal at the LHC far detectors

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Quirk is a BSM particle carrying both the SM gauge charge and a new confining gauge charge. The produced quirk pair at the LHC can be long-lived and potentially be probed by several far detectors.

We will talk about the probing prospect of FASER2, MATHUSLA, ANUBIS, SND@LHC, and FACET detectors to a few simplified quirk scenarios. A timing analysis at the FASER2 will be discussed in detail.

Parallel 5 / 28

Probing levitodynamics with multi-stochastic forces and the simple applications on the dark matter detection in optical levitation experiment

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If the terrestrial environment is permeated by dark matter, the levitation experiences damping forces and fluctuations attributed to dark matter. This paper investigates levitodynamics with multiple stochastic forces, including thermal drag, photon recoil, feedback, etc., assuming that all of these forces adhere to the fluctuation-dissipation theorem. The ratio of total damping to the stochastic damping coefficient distinguishes the levitodynamics from cases involving only one single stochastic force. The heating and cooling processes are formulated to determine the limits of temperature change. All sources of stochastic forces are comprehensively examined, revealing that dark matter collisions cannot be treated analogously to fluid dynamics. Additionally, a meticulous analysis is presented, elucidating the intricate relationship between the fundamental transfer cross-section and the macroscopic transfer cross-section. While the dark damping coefficient is suppressed by the mass of the levitated particle, scattering can be coherently enhanced based on the scale of the component microscopic particle, the atomic form factor, and the static structure factor. Hence, dark damping holds the potential to provide valuable insights into the detection of the macroscopic strength of fundamental particles. We propose experimental procedures for levitation and employ linear estimation to extract the dark damping coefficient. Utilizing current levitation results, we demonstrate that the fundamental transfer cross section of dark matter can be of the order σ_T^{D} $lsimcalO(10^{-26})\mathrm{cm}^2$.

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Soft photon theorem in QCD with massless quarks

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Working to all orders in dimensionally-regularized QCD, we study the radiation of a photon whose energy is much lower than that of external partons, but much larger than the masses of some quarks. We argue that the conventional soft photon theorem receives corrections at leading power in the photon energy, associated with soft virtual loops of massless fermions. These additive corrections give an overall factor times the non-radiative amplitude that is infrared finite and real to all orders in αs. Based on recent calculations of the three-loop soft gluon current, we identify the lowest-order three-loop correction.

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Z Portal to the Dark Sector Through Z' Mediation

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The exotic Z decays to a QCD-like dark sector provide unexplored opportunities at colliders. In this talk, we explore the region where the Z portal is generated via the mixing with a dark Z′. The phenomenological signatures of light Z ’ are studied, with both dark shower signals in Z(Z’) decays and exotic decays of B hadrons taken into account. The generated dark hadrons may serve as long-lived particles and leave their footprints at colliders.

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Type II seesaw Leptogenesis

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Type II seesaw Leptogenesis

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Probing the four-fermion operators via the transverse double spin asymmetry at the Electron-Ion Collider

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The transverse spin effects can be measured at upcoming Electron-Ion Collider (EIC) and proposed Electron-Ion Collider at China (EicC) with polarized electrons or/and protons. The corresponding observables, single-spin asymmetry (SSA)/double-spin asymmetry (DSA), are suppressed in the Standard Model. We investigate the enhancement of DSA under new physical effects. We parameterize such contributions of new physics in the framework of standard model effective field theory (SMEFT). Assume the electrons and protons are polarized in the same direction, we demonstrate that the interference between the scalar/tensor type four-fermion operators and SM leads to nontrival azimuthal $\cos 2\phi$ and $\sin 2\phi$ distributions and are linearly dependent on the Wilson coefficients associated with these operators at the $calO(1/\Lambda^2)$, without any suppression from the electron and quark masses. Furthermore, the results are not significantly affected by the presence of other NP operators in DIS process.

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Dynamical realization of the small field inflation in the post supercooled universe

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The small field inflation (SFI) of Coleman-Weinberg (CW) type suffers from precise tuning of the initial inflaton field value to be away from the true vacuum one. We propose a dynamical trapping mechanism to solve this problem: an ultra-supercooling caused by an almost scale-invariant CW potential traps the inflaton at the false vacuum, far away from the true vacuum dominantly created by the quantum scale anomaly, and allows the inflaton to dynamically start the slow-roll down due to a classical explicit-scale breaking effect. To be concrete, we employ a successful CW-SFI model and show that the proposed mechanism works consistently with the observed bounds on the inflation parameters. The proposed new mechanism thus provides new insights for developing small field inflation models.

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Testing Bell inequalities in W boson pair production at future e+e− colliders

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We show that testing Bell inequalities in $W^{\pm}$ pair systems by measuring their angular correlation suffers from the ambiguity in kinetical reconstruction of the di-lepton decay mode. We further propose a new set of Bell observables based on the measurement of the linear polarization of the W bosons, providing a realistic observable to test Bell inequalities in $W^{\pm}$ pair systems for the first time. In this work, we analyze the prospects of testing the violation of Bell inequalities at $e^{+}e^{-}$ colliders.

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Bootstrapping One-loop Inflation Correlators with the Spectral Decomposition

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Phenomenological studies of cosmological collider physics in recent years have identified many 1-loop inflation correlators as leading channels for discovering heavy new particles around or above the inflation scale. However, complete analytical results for these massive 1-loop correlators are currently unavailable. In this work, we embark on a program of bootstrapping inflation correlators with massive exchanges at 1-loop order, with the input of tree-level inflation correlators and the techniques of spectral decomposition in dS. As a first step, we present for the first time the complete and analytical results for a class of 4-point and 3-point inflation correlators mediated by massive scalar fields at the 1-loop order. Using the full result, we provide simple and reliable analytical approximations for the signals and the background in the squeezed limit. We also identify configurations of the scalar trispectrum where the oscillatory signal from the loop is dominant over the background.

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Search for nearly-degenerate higgsinos using forward detectors at the LHC

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Supersymmetric models with nearly-degenerate light higgsinos provide a consistent solution to the naturalness problem under rigorous constraints from current experimental searches for sparticles. However, it is challenging to probe the compressed scenarios at collider experiments due to the hard-to-detect soft final states. To overcome this issue, strategies have been proposed to take advantage of the photon fusion along the ultraperipheral collision at the Large Hadron Collider, which are feasible with the forward detectors installed at the ATLAS and CMS detectors. In this report, I will present our recent work that demonstrated a search strategy for the chargino pair production via photon fusion at the 13 TeV LHC, realizing a good sensitivity that can exclude $m_{\tilde{\chi}_1^\pm}$ up to 270 GeV (308 GeV) for a mass splitting $\Delta m(\tilde{\chi}_1^\pm, \tilde{\chi}_1^0) \in [1, 15]$ GeV with an integrated luminosity of 100 fb^{-1} (3 ab^{-1}) at 95\% C.L.

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Nonanalyticity and On-Shell Factorization of Inflation Correlators

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The dynamics of quantum fields during cosmic inflation can be probed through their late-time boundary correlators. The analytic structure of these boundary correlators contains rich physical information about bulk dynamics and their relationship to cosmological collider observables. In this talk, I will focus on a distinctive nonanalytic behavior known as the nonlocal signal, which emerges at the boundary of the physical region. To facilitate analytic calculations, I will first introduce the partial Mellin Barnes representation (PMB), which allows us to study this type of nonanalyticity at both the tree and loop levels. With the utility of PMB, we propose a signal-detection algorithm to identify all potential sources of nonlocal signals in arbitrary graphs and provide an “on-shell” factorization

theorem for the leading signal. Additionally, we derive a "cutting rule" for the nonlocal signal as a byproduct, applicable to arbitrary graphs. I should emphasize that our theorem can be understood from a boundary OPE viewpoint, but is also applicable to dS-boost-breaking cases. Notably, for certain simple yet nontrivial loop graphs, such as the 4pt triangle and box diagrams, we are able to derive analytic expressions for the leading nonlocal signal and easily extend the calculations to higher orders of squeezeness.

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On-Shell Construction of Effective Field Theories

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In this talk, I will review the on-shell method of constructing the operator bases of effective field theories. The first task is to eliminate all the operator redundancies and obtain an independent basis, which is accomplished by adopting the Young Tensor method. Then a special basis of operators organized by representations of the symmetry groups, named J-basis, is introduced. Applications of the J-basis will be demonstrated, including the loop level selection rules and the correspondence with the UV origins of the effective operators.

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Gravitational waves produced by domain walls during inflation

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CPV double-aligned 2HDMs at the LHC

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We consider two Higgs doublet models (2HDMs) with both the Higgs potential and Yukawa interactions being aligned, which we call "double-aligned 2HDMs". In this scenario, coupling constants of the discovered Higgs boson to the Standard Model (SM) particles are identical to those of the SM Higgs boson, and flavor changing neutral currents via neutral Higgs bosons do not appear at tree level. We investigate current constraints and future prospects of the model by using measurements from flavor experiments and data of multi-lepton final states at LHC. Especially, we focus on the electroweak pair production of the additional Higgs bosons with their masses below 2mt. We find that the most of the parameter space are already excluded by the current LHC data when the leptonic decays of the additional Higgs bosons are dominant, which can be interpreted to the scenario in the Type-X THDM as a special case. We also clarify the parameter region where the high-luminosity LHC can explore, and demonstrate the reconstruction of the masses of additional Higgs bosons from the $b\bar{b}\tau^+\tau^-$ final states in a few benchmark points.

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Global Symmetries and Effective Potential of 2HDM in Orbit Space

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We extend the framework of analyzing the 2HDM in its orbit space to study the one-loop effective potential before and after electroweak symmetry breaking in this work. We generalize the bilinear notation around the vacuum to study the global symmetries of the effective potential and present a geometric view of the scalar mass matrix and on-shell renomalization conditions.

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Alternative Froggatt-Nielsen like mechanism in modular flavor models

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We propose an alternative realization of Froggatt-Nielsen like mechanism in modular flavor models. The realization of mass and mixing hierarchies in the quark and charged lepton sectors can be realized, possibly without additional flavon field.

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First-order phase transition during inflation and the gravitational wave signals

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Phenomenology of Heavy Neutral Gauge Boson at Future Lepton Collider

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Heavy neutral gauge boson Z' is proposed in many new physics models. It has rich phenomena at the future muon collider. We study the properties of Z' boson with the process of $\mu^+\mu^- \to q\bar{q}$, $\mu^+\mu^- \to l^+l^-$, $\mu^+\mu^- \to ZH$ and $\mu^+\mu^- \to W^+W^-$.

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Neutrino CP Measurement in the Presence of RG Running with-Mismatched Momentum Transfers

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ATLAS new physics search highlights

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CMS new physics search highlights

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New physics searches in the LHCb experiment

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Super Tau Charm Facility: Physics and Challenges

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Neutrino phenomenology: recent progress

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Probing dark matter particles with astronomical observations

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暗物质直接探测实验进展

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Dark SHINE –a Dark Photon Search Experiment initiative at SHINE facility

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The status of light dark matter

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SRF Cavity Searches for Dark Photon Dark Matter: First Scan Results

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Axion Haloscopes Meet the E Field

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Long-lived dark photons at the LHC

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Quark masses and low energy constants in the continuum from Lattice QCD

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The Circular Electron Positron Collider - Physics, Status and the Perspectives

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Neutrinoless double beta decay and related searches in PandaX

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Cosmological implications of large galaxy surveys

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Non-Gaussianity in the primordial black hole formation

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Quantum Computing for High Energy Physics

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Progress on perturbative QCD at the LHC

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Workshop summary

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Probe axion-like particles at the electron-ion collider

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Dark matter candidates from U(1) hidden sectors

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利用 LHAASO 伽马暴数据限制洛伦兹对称性破坏

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Electroweak corrections to double Higgs production at the LHC

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用机器学习方法探测对撞机中的重狄拉克中微子

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