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Book of Abstracts

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分会场三 / 8

Dynamics of the conserved net-baryon density near QCD critical point within QGP profile

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Searching the QCD critical point is one of the most important goals of the relativistic heavy-ion collisions. It is essential to build a realistic dynamical model near the QCD critical point and predict the characteristic signature induced by critical fluctuations in experimental measurements. By studying the dynamics of the conserved net-baryon density near critical point, it was found that both second- and fourth-order multiplicity fluctuations behave non-monotonically with respect to the increasing rapidity acceptance [1,2]. However, these works base on the assumption that the QGP fireball is homogenous with constant temperature and chemical potential in the coordinate space, which is not the case in realistic contexts. In this talk, we will present the dynamics of conserved net-baryon density near the critical point within the inhomogeneous temperature and chemical potential background, borrowing from hydrodynamic simulations [3]. We found that a pronounced enhancement of various orders of multiplicity fluctuations at large rapidity due to the inhomogeneous hydro background. We will also present the non-trivial behavior of multiplicity fluctuations across the freeze-out hyper surface implemented by the hydro background.

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[2] Grégoire Pihan, Marcus Bluhm, Masakiyo Kitazawa,Taklit Sami,Marlene Nahrgang. Phys.Rev.C 107 (2023) 1, 014908
[3] Shanjin Wu and Huichao Song. In preparation.

分会场四 / 9

Black Hole Superradiance and Gravitational Wave Beats

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Ultralight bosons can extract energy and angular momentum from a Kerr black hole (BH) due to superradiant instability, resulting in the formation of a BH-condensate system. We carefully investigate the evolution of this system numerically with multiple superradiant modes. We find the BH still evolves along the Regge trajectory of the $n = 0$ modes even with the presence of the $n > 0$ modes. On the other hand, the BH-condensate system emits monochromatic gravitational waves (GWs) with a unique beat signature, which could be directly observed by GW detectors.

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Angular correlation and deformed Hellings-Downs curve by spin-2 ultralight dark matter

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The pulsar timings are sensitive to both the nanohertz gravitational-wave background and the oscillation of ultralight dark matter. The Hellings-Downs angular correlation curve provides a criterion to search for stochastic gravitational-wave backgrounds at nanohertz via pulsar timing arrays. We study the angular correlation of the timing residuals induced by the spin-2 ultralight dark matter, which is different from the usual Hellings-Downs correlation. At a typical frequency, we show that the spin-2 ultralight dark matter can give rise to the deformation of the Hellings-Downs correlation curve induced by the stochastic gravitational wave background.[2402.03984]

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Collective flow in asymmetric collisions of deformed nuclei

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In this research, we investigate the influence of nuclear structure parameters on the collective flow observed in symmetric and asymmetric nuclear collisions at ultra-relativistic energies. Our approach involves introducing an approximate yet realistic analytical model for the collision process, which allows us to emphasize the pivotal role played by the structural characteristics of the colliding ions. This versatile model facilitates exploring a broad range of collision scenarios, spanning from light to heavy nuclei.

We leverage the connections between N-particle correlations in the final stages of nuclear collisions and N-nucleon density distributions within the colliding nuclei to discern the impacts. Notably, multi-particle correlations in the final stages of high-energy nucleus-nucleus collisions prove to be sensitive indicators of the collective correlations among nucleons in the wave functions of the colliding nuclei.

Our work sheds light on the intricate interplay between nuclear structure and collision dynamics, offering exciting prospects for advancing our understanding of these fundamental processes.

分会场三 / 13

Exploring the Nuclear Shape Phase Transition in Ultra-Relativistic Xe+Xe Collisions at the LHC

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The shape phase transition for certain isotope or isotone chains, associated with the quantum phase transition of finite nuclei, is an intriguing phenomenon in nuclear physics. A notable case is the Xe isotope chain, where the structure transits from a γ-soft rotor to a spherical vibrator, with the second-order shape phase transition occurring in the vicinity of $^{128-130}$Xe. In this work, we focus on investigating the γ-soft deformation of ^{129}Xe associated with the second-order shape phase transition by constructing novel correlators for ultra-relativistic ^{129}Xe+^{129}Xe collisions. In particular, our iEBE-VISHNU model calculations show that the $v_2^2-[p_T]$ correlation ρ_2 and the mean transverse momentum fluctuation Γ_{p_T}, which were previously interpreted as the evidence for the rigid triaxial deformation of ^{129}Xe, can also be well explained by the γ-soft deformation of ^{129}Xe. We also propose two novel correlators $\rho_{4,2}$ and $\rho_{2,4}$, which carry non-trivial higher-order correlations and show unique capabilities to distinguish between the γ-soft and the rigid triaxial deformation of ^{129}Xe in ^{129}Xe+^{129}Xe collisions at the LHC. The present study also provides a novel way to explore the second-order shape phase transition of finite nuclei with ultra-relativistic heavy ion collisions.

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高能水下中微子望远镜 (HUNT) 的研究进展

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针对 LHAASO 发现的河内众多的超高能伽马射线源，LHAASO 团队提出了建设超大规模的高能水下中微子望远镜项目 (HUNT)，以期探测相关源的高能中微子信号。目前，在探测器模拟，核心器件研发，样机试验，国际合作等各方面都有不少的工作进展。

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A real-time monitor on extragalatic tranisents with the LHAASO-WCDA

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With high duty cycle and wide aperture, the Large High Altitude Air Shower Observatory - Water Cherenkov Detector Array (LHAASO-WCDA) can conduct an unbiased gamma-ray sky survey in the energy range from a few hundred GeV to 100 TeV. The sensitivity of WCDA is as high as a few percent of Crab units, which allows us to monitor the VHE variability of blazars. The LHAASO Collaboration has developed an online monitoring program to monitor the extragalactic VHE flare in the WCDA’s field of view. Once a flare exceeding the threshold is detected, an alert will be sent to other instruments automatically, and a follow-up multiwavelength observation could be carried out. After the entire system was set up by the end of 2023, a number of flares from the direction of active galactic nucleus source 1ES 1959+650 and IC 310 have been detected. These events have also attracted widespread attention and subsequent observations within the community. In this talk, I

will introduce the system operation, including candidate sources, the methods, and current status of the monitor, as well as some astrophysical implications.

分会场一 / 17

UV divergences of loops, the Higgs boson’s low mass and the graviton loop in quantizing Einstein gravity

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For loops with UV divergences, finite physical results obtained via infinity – infinity mean the physical transition amplitudes of loops are not mathematically well-defined. In this talk, a new method of UV-free scheme will be introduced to derive loop results without UV divergences. It provides a new perspective to the hierarchy problem of Higgs mass without fine-tuning within the Standard Model. In addition, how to describe loop corrections is a fundamental challenge in the quantization of Einstein gravity. Here we give it a try, and the result seems to be effective for graviton loops. This indicates that both loops of the renormalizable Standard Model and the non-renormalizable Einstein gravity can be described by the new method.

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Locating a Super PeVatron at Cygnus Region

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LHAASO is a large hybrid extensive air shower observatory started operation since 2021. A PeV photo with energy of 1.4PeV was reported by LHAASO at first. Recently a very large ultra-high energy gamma ray bubble with energy up to PeV was detected at Cygnus region. The emission is positionally correlated with the distribution of clouds, which strongly supports a hadronic origin scenario. In this report, I will report the recent results from Cygnus region with LHAASO.

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LHAASO-KM2A 精确测量 0.3 到 30PeV 的宇宙线全粒子能谱和平均对数质量

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We present the measurements of all-particle energy spectrum and mean logarithmic mass of cosmic rays in the energy range of 0.3-30 PeV using data collected from LHAASO-KM2A between September 2021 and December 2022, which is based on a nearly composition-independent energy reconstruction method, achieving unprecedented accuracy. Our analysis reveals the position of the knee at 3.67 $\pm$ 0.05 $\pm$ 0.15 PeV. Below the knee, the spectral index is found to be -2.7413 $\pm$ 0.0004 $\pm$ 0.0050, while above the knee, it is -3.128 $\pm$ 0.005 $\pm$ 0.027, with the sharpness of the transition measured with a statistical error of 2\%. The mean logarithmic mass of cosmic rays is almost heavier than helium in the whole measured energy range. It decreases from 1.7 at 0.3 PeV to 1.3 at 3 PeV, representing a 24\% decline following a power law with an index of -0.1200 $\pm$ 0.0003 $\pm$ 0.0341. This is equivalent to an increase in abundance of light components. Above the knee, the mean logarithmic mass exhibits a power law trend towards heavier components, which is reversal to the behavior observed in the all-particle energy spectrum. Additionally, the knee position and the change in power-law index are approximately the same. These findings suggest that the knee observed in the all-particle spectrum corresponds to the knee of the light component, rather than the medium-heavy components.

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Measurement of cosmic muon flux and cosmogenic neutron production at CJPL

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China JinPing Underground Laboratory (CJPL) is an underground laboratory with 2800 meters rock overburden and is ideal to carry out experiment for rare-event searches. Cosmic muons and muon-induced neutrons present an irreducible background to neutrino experiment and dark matter experiment at CJPL. A precise measurement of the cosmic-ray background of CJPL would play an important role in the future experiments. Using a 1-ton liquid scintillator detector for the Jinping Neutrino Experiment (JNE), we give a measurement of cosmic muon flux and cosmogenic neutron production in liquid scintillator detector at CJPL. This study provides a clear understanding of cosmic-ray background at deep underground laboratory.

分会场五 / 21

Ultra-high light yield scintillation crystal detector based on low-temperature CsI and SiPMs for CEνNS detection

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The first experimental measurement of coherent elastic neutrino-nucleus scattering (CEνNS) was successfully conducted using a CsI(Na) scintillation crystal detector. Recognizing that a higher light yield in scintillation crystal detectors correlates with greater physical sensitivity for CEνNS detection, we introduced a novel low-temperature CsI detector design employing SiPMs readout. This design capitalizes on the exceptional brightness of low-temperature CsI crystals combined with the ultra-high photon detection efficiency of SiPMs, thereby significantly improving the light yield and elevating CEνNS detection sensitivity to unprecedented levels. Positioned as a formidable contender for forthcoming CEνNS experiments, this innovative approach has been substantiated by our experimental group's development of a kilogram-scale low-temperature CsI detector [1]. This detector,

notable for its leading international standards in light yield and energy resolution, serves as a preliminary proof of concept for the technical feasibility of our proposed scheme. This presentation delineates the detector scheme's characteristics, elucidating the principal prototype's performance metrics, including light yield, energy resolution, and the influence of SiPMs noise and optical crosstalk on detector performance

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Muon induced Li9/He8 and Fast-N & Muon-X Background in Dayabay Reactor Neutrino Experiment

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In Dayabay reactor neutrino experiment, muon will induced correlated background: Li9/He8, Fast-neutron and Muon-X background. This talk will report
1. How to estimate these backgroud
2. Background rate with full dataset in nH sample.

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面向暂现源的超广角大气切伦科夫望远镜研究

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高海拔天体辐射探测实验 (High Altitude Detection of Astronomical Radiation, HADAR) 是一个基于大气切伦科夫成像技术的地面望远镜阵列，采用大口径折射式水透镜系统来收集大气切伦科夫光信号以实现对 10GeV-10TeV 能量的宇宙线和伽马射线的观测，这样的一个位于极高海拔观测站的超广角、大口径大气切伦科夫望远镜阵列有望实现大视场和低阈能的目标。大视场 (或广角) 和低阈能是未来地基甚高能伽马射线望远镜的重要指标，特别是对伽马暂现源时变和能谱的测量尤为关键，如爆发源（伽马射线暴，GRB) 甚高能辐射、时变源 (活动星系核，AGN) 甚高能辐射、可能的引力波甚高能波段电磁对应体等。1 米口径的原理样机已成功观测到宇宙线大气切伦科夫光信号，实现了广角观测的可行性。模拟结果显示，HADAR 实验具有与主流切伦科夫望远镜阵列，如 H.E.S.S.、MAGIC 等相当的有效面积，但视场却远远大于上述窄视场的成像大气切伦科夫望远镜阵列，HADAR 实验预期在 GRB 瞬时/余辉、Blazar 以及稳定点源/扩展源等在甚高能辐射观测上具有巨大优势。

分会场三 / 24

Quenching of polarized jets

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The longitudinal spin transfer represents the probability density of producing longitudinally polarized hadrons from longitudinally polarized quarks or circularly polarized gluons. It thus was usually measured in polarized reactions or high-energy collisions where weak interaction dominates. In this work, we propose the dihadron polarization correlation as a novel probe of this quantity. Such an observable does not require the fragmenting partons to be polarized and therefore can be measured in the currently available experimental facilities, such as Belle, RHIC, Tevatron, and the LHC. We make quantitative predictions for these experiments. In light of the data already harvested, the experimental investigation of this observable provides more opportunity for the quantitative study of the longitudinal spin transfer. In particular, the measurements in pp collisions can significantly constrain the fragmentation function of a circularly polarized gluon.

Furthermore, by applying this approach to the relativistic heavy-ion collisions, we can investigate the spin effect in the context of jet quenching.

References

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[2] Xiaowen Li, Zhao-Xuan Chen, Shanshan Cao, Shu-Yi Wei; Correlations of dihadron polarization in central, peripheral, and ultraperipheral heavy-ion collisions; Phys.Rev.D 109 (2024) 014035.

分会场一 / 25

An SU(8) theory of SM quarks and leptons

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We describe the origin of the hierarchical SM quark/lepton Yukawa couplings with the single SM Higgs doublet in an SU(8) theory, where three-generational SM fermions are non-trivially embedded.

分会场一 / 26

高圈多外线费曼积分的解析计算

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费曼积分是高能物理精确理论预言的基本计算工具。传统高圈多外线费曼积分的解析计算非常困难。运用动量 twistor 变量和多对数函数字母表新搜索算法，我们在高圈多外线费曼积分解析计算领域取得了突破。我们将介绍维数正规化下双圈六点费曼积分的解析结果，该成果可用于 4 jets 产生过程的 NNLO 截面计算。这一发展也是迄今为止维数正规化下，含标度最多的双圈费曼积分解析结果。

分会场五 / 27

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.

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A proposed PKU-Muon experiment for muon tomography and dark matter search

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We propose here a set of new methods to directly detect light mass dark matter through its scattering with abundant atmospheric muons or accelerator beams. Firstly, we plan to use the free cosmic-ray muons interacting with dark matter in a volume surrounded by tracking detectors, to trace possible interaction between dark matter and muons. Secondly, we will interface our device with domestic or international muon beams. Due to much larger muon intensity and focused beam, we anticipate the detector can be made further compact and the resulting sensitivity on dark matter searches will be improved. Furthermore, we will measure precisely directional distributions of cosmic-ray muons, either at mountain or sea level, and the differences may reveal possible information of dark matter distributed near the earth. Specifically, our methods can have advantages over ‘exotic’ dark matters which are either muon-philic or slowed down due to some mechanism, and sensitivity on dark matter and muon scattering cross section can reach as low as microbarn level.

分会场三 / 29

Baryon-Strangeness Correlations in Au+Au Collisions at RHIC-STAR

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Fluctuations and correlations of conserved charges are sensitive observables to study QCD phase structure. In particular, the baryon-strangeness correlations may be used to study the change of phases in the matter created in heavy-ion collisions.

In this work, we present the measurement of baryon-strangeness correlations in Au+Au collisions from beam energy scan program at STAR. This is the first systematic analysis of baryon-strangeness correlations on the collision energy and centrality dependence including strange hadrons K^+, Λ and Ξ^- along with their corresponding anti-particles. Physics implications will be discussed by comparing these new results with calculations from Lattice Gauge Theory, functional renormalization group as well as a hadronic transport model.

分会场三 / 30

Spin polarization、phase transition and Transportation of QGP at finite temperature in the presences of magnetic field and rotation

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We investigate the magnetized QCD matter and chiral phase transition in a (2 + 1)-flavor Nambu–Jona- Lasinio (NJL) model at finite temperature and chemical potential by comparing the contributions from the tensor spin polarization (TSP) and anomalous magnetic moment (AMM) of quarks. On the other hand, we study the properties of the shear viscosity coefficient of quark matter near the chiral phase transition at finite temperature, chemical potential and strong magnetic field. If the magnetic field is strong enough, it will interfere with significant QCD phenomena, such as the generation of dynamic quark mass, which may affect the transport properties of quark matter. On the other hand, the chiral and deconfinement phase transitions under rotation have been simultaneously investigated in the Polyakov-Nambu-Jona-Lasinio (PNJL) model. An interesting observation has been found that the chiral phase transition is catalyzed and the deconfinement phase transition is decelerated by rotation, therefore a chiral symmetric but confined quarkyonic phase is induced by rotation, which indicates that chiral dynamics and gluon dynamics can be split by rotation.

分会场一 / 31

Potential search for direct slepton pair production in √s = 360 GeV at CEPC

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The center-of-mass energy of Circular Electron Positron Collider (CEPC) could be upgrade to 360 GeV level (CEPC@360GeV) after its ten-year running at 240 GeV. Besides SM precision measurements, CEPC@360GeV also has good potential for BSM physics searches, which is a good complementary for hadron colliders. This paper presents the sensitivity study of direct stau and smuon pair production at CEPC with √s = 360 GeV by full Monte Carlo (MC) simulation. With 1.0 ab−1 integrated luminosity and the assumption of flat 5% systematic uncertainty, the CEPC@360 GeV has the potential to discover the production of combined left-handed and right-handed stau up to 168.5 GeV if exists, or up to 159 GeV for the production of pure left-

handed or right-handed stau; the discovery potential of direct smuon reaches up to 174 GeV with the same assumption. Given the similar nature of the facilities and detectors, the results can be a good reference for other electron positron colliders with the same center-of-mass energies and target luminosities, such as Future Circular Collider e+e– (FCC-ee) and the International Linear Collider (ILC).

墙报展及评选 / 34

Measurement of d-Lambda correlation in 3 GeV Au+Au collisions at STAR

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Heavy-ion collisions offer a new way to understand hypernuclei structure and hyperon-nucleon (Y-N) interaction. Recent hypernuclei measurements have focused on lifetime, binding energy, production yield, and collective flow in heavy-ion collisions. These measurements have increased interest in studying the structure of hypernuclei and their production mechanisms.

Meanwhile, femtoscopy has been extensively employed to investigate the interaction and collision dynamics of mesons and nucleons, providing crucial insights into the space-time evolution of the emission source and final state interaction effects. Thus, the application of this technique to the study of the correlation between nuclei and hyperons, such as the deuteron and Λ, represents a novel approach to comprehending the structure of light hypernuclei, as well as to improving our understanding of the inner structure and equation of state of neutron stars through heavy-ion collision experiments.

In this talk, we present the first measurement of d-Λ correlation in the heavy-ion collision experiments with $\sqrt{s_{\rm NN}} = 3$ GeV Au+Au collisions from Beam Energy Scan II by the STAR experiment at RHIC. The correlation functions are analyzed within the Lednicky-Lyuboshitz formalism in order to characterize the emission source size, the scattering length, and the effective range of d-Λ interactions. Physics implications on the hypernuclei structure (e.g. binding energy) will be discussed.

墙报展及评选 / 35

Light nuclei production in isobaric $^{96}_{44}$Ru + $^{96}_{44}$Ru and $^{96}_{40}$Zr + $^{96}_{40}$Zr collisions at $\sqrt{s_{\rm NN}}$ = 7.7 - 200 GeV from a multiphase transport model

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The production of light nuclei in isobaric $^{96}_{44}$Ru + $^{96}_{44}$Ru and $^{96}_{40}$Zr + $^{96}_{40}$Zr collisions, ranging from $\sqrt{s_{NN}}$ =7.7 to 200 GeV, are studied using the string melting version of A Multi Phase Transport (AMPT) model combined with a coalescence approach to light nuclei production. From the calculated yields, transverse momentum (p_T) spectra, and rapidity dependences of light nuclei (p, n, d, t, ^{3}He), we find that the Ru+Ru/Zr+Zr ratios for yields of these particles exceed unity with the inclusion of a quadrupole deformation β_2 and octupole deformation β_3 as well as the neutron skins. We also find that heavier particles exhibit a greater deviation from unity. Furthermore, we find that the impact of isospin effects on light nuclei production in isobar collisions gradually diminishes as increasing the collision energy, while the influence of nuclear structure becomes more significant at higher energies.

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Problem of cosmic ray origin and precise measurements

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The last decade enters an era of precise measurements on cosmic rays. The space based AMS02, DAMPE and the ground based LHAASO, Auger all give very precise measurements of the cosmic rays spectra and its components. These precise data change our traditional picture of cosmic rays origin and propagation. We show the important implications on the problem of origin of cosmic rays.

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Constraints on the properties of dark matter by astronomical observations

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Some astronomical observations observed a few astronomical systems which seem hard to be explained by the standard cold dark matter scenario. For example very diffuse and extremely dark matter deficit systems are observed. Dark matter properties beyond CDM are studied to explain these systems, such as dark matter with large self-interaction, or very light wave dark matter scenarios.

墙报展及评选 / 38

Measurement of Ξ_c^0 and Ξ_c^+ production as a function of multiplicity in pp collision at $\sqrt{s} = 13$ TeV

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Measurements of the production of heavy-flavour hadrons in proton–proton (pp) collisions provide an important test of quantum chromodynamics (QCD).
The heavy-flavour production cross section can be calculated using the factorisation approach as a convolution of three factors: the parton distribution functions (PDFs), the partonic cross section calculated with perturbative QCD calculations, and the fragmentation functions (FFs). Recent measurements of the baryon-to-meson (Λ_c^+/D^0, $\Sigma_c^{0,++}/D^0$, $\Xi_c^{0,+}/D^0$ and BRx ${}^0_c/D^0$) p_T-differential yield ratios in pp collisions are inconsistent with measurements in e^+e^- collision, indicating that the hadronization of charm quarks is not a universal process among different collision systems. The p_T-differential yield ratio of ${}^+_c/D^0$ shows a significant multiplicity dependence, which implies that the modification of the hadronization mechanisms is multiplicity dependent. Therefore the measurement of the multiplicity dependence of ${}^0_c/D^0$ yield ratio can provide further constraints on the study of charm hadronization.

分会场一 / 39

A new framework on global analysis of fragmentation functions

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We present FMNLO, a framework to combine general-purpose Monte Carlo generators and fragmentation functions (FFs).

It is based on a hybrid scheme of phase-space slicing method and local subtraction method, and accurate to next-to-leading order (NLO) in QCD.

The new framework has been interfaced to MadGraph and made publicly available in this work.

We perform a simultaneous global analysis of hadron fragmentation functions (FFs) to various charged hadrons ($\pi^{\pm}$, $K^{\pm}$ and $p/\bar{p}$) at next-to-leading order in QCD.

The world data includes results from electron-positron single-inclusive annihilation, semi-inclusive deep inelastic scattering, as well as proton-proton collisions including jet fragmentation measurements for the first time which lead to strong constraints on the gluon fragmentations.

By carefully selecting hadron kinematics to ensure the validity of QCD factorization and the convergence of perturbative calculations, we achieve a satisfying best fit with $\chi^2/\text{d.o.f.} = 0.90$.

The total momentum of u, d quarks and gluon carried by light charged hadrons have been determined precisely, urging precision determinations of FFs to neutral hadrons for test of fundamental sum rules in QCD fragmentation.

分会场三 / 40

Relativistic second-order spin hydrodynamics from Zubarev's non-equilibrium statistical operator

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We present a new derivation of relativistic second-order spin hydrodynamics for quantum systems using Zubarev’s non-equilibrium statistical-operator formalism. This is achieved by a systematic expansion of the energy-momentum tensor, the spin tensor and the charge current to second order in deviations from equilibrium. As a concrete example, we obtain the relaxation equations for the shear-stress tensor, the bulk-viscous pressure, the charge-diffusion currents and the dissipative currents appearing in the spin tensor required to close the set of equations of motion for relativistic second-order spin hydrodynamics. We also identify new transport coefficients which describe the relaxation of dissipative processes to second-order and express them in terms of equilibrium correlation functions, thus establishing new Kubo-type formulas for second-order transport coefficients.

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Prospects for observing neutrino sources with the High-energy Underwater Neutrino Telescope

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The Large High Altitude Air Shower Observatory (LHAASO) has observed tens of gamma-ray sources with significant emission above 100 TeV, which are promising PeV cosmic-ray accelerator (PeVatron) candidates. The High-energy Underwater Neutrino Telescope (HUNT), with the instrumented volume around 30 km^3, will play a pivotal role in identifying PeVatrons through neutrino observations exceeding 100 TeV. This report provides updates on the effective area of HUNT and the corresponding discovery potential for neutrino sources. The gSeaGen code, the KM3NeT GENIE-based neutrino event generator, is applied in the calculation of effective area for comparison with the previous analytical approximation. Both the track and cascade events are considered in the estimation of discovery potential.

分会场三 / 44

相对论重离子碰撞中 QCD 相结构的实验研究

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理解强相互作用物质的性质及其相结构对于我们深入认识宇宙演化和可见物质结构具有重要科学意义。近二十年来，高能重离子碰撞实验中观测到了许多间接证据表明强相互作用夸克-胶子等离子体（sQGP）的存在。因此，探索高重子密度下的量子色动力学（QCD）相结构，特别是寻找一阶相变边界和 QCD 临界点在相图中的位置，成为高能核物理研究的重要目标之一。从 2010 年到 2021 年，RHIC-STAR 实验分两个阶段完成了能量扫描计划，收集了质心

能量从 200 GeV 到 3 GeV 下金核-金核碰撞实验数据。本报告将讨论在 RHIC 能量扫描计划中 (BES-I&BES-II) 关于 QCD 相图和相变临界点的实验研究进展。

墙报展及评选 / 45

Momentum and angular correlations in Z/γ-hadron production in relativistic heavy-ion collisions

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We carry out a detailed study of medium modifications on momentum and angular correlations between a large transverse momentum hadron and a Z/γ trigger in relativistic heavy-ion collisions within a perturbative QCD parton model improved by the Sudakov resummation technique. The total energy loss of a hard parton propagating inside the medium is employed to modify the fragmentation function, while the medium-induced transverse momentum broadening is included in the resummation approach, and both of them are related to the jet transport parameter and obtained by the high-twist formalism. We obtain good agreements with the existing data on transverse momentum and azimuthal angular correlations for the Z/γ-hadron pairs in pp and AA collisions, and predict the correlations for the γ-hadron in central PbPb collisions at 5.02 TeV. The numerical analyses for the Z/γ-hadron in central PbPb collisions show that the normalized angular distribution is decorrelated due to the medium-induced transverse momentum broadening, however, the angular correlation is enhanced due to the parton energy loss, namely anti-broadening. The observed modification of the angular correlation is a result of the competition between the broadening and the anti-broadening. This work provides a reliable theoretical tool for a comprehensive and precise study of jet quenching in relativistic heavy-ion collisions.

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Sterile neutrinos as a Window to New Physics

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The minimal left-right symmetric model offers a natural solution to the origin of neutrino masses and the strong CP problem, and has drawn considerable theoretical and experimental attention. In this presentation, I will discuss recent progress in exploring sterile neutrinos within this model, specifically focusing on the mass range from MeV to TeV. This will include an examination of neutrinoless double beta decay, collider searches, and their connection with the strong CP theta parameter.

分会场一 / 47

Complementary LHC searches for UV resonances of 0νββ decay operators

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

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Progress of the Giant Radio Array for Neutrino Detection (GRAND) Project

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The origins of Ultra-high-energy cosmic rays (UHECRs) remain mysterious. Nevertheless, the observation of UHE neutrinos offers a pivotal means to uncover the distant sources of these most energetic particles, as neutrinos can traverse the universe unimpeded, even beyond the Greisen-Zatsepin-Kuzmin (GZK) horizon.
The Giant Radio Array for Neutrino Detection (GRAND) is a proposed extensive observatory aimed at detecting and studying the sources of UHECRs by employing a dual approach: amassing unprecedented UHECR data and searching for accompanying UHE gamma rays and neutrinos. Envisioned to consist of 200,000 radio antennas distributed across 200,000 km² in approximately 20 sub-arrays of around 10,000 km² each, GRAND is designed to achieve a neutrino sensitivity of approximately for energies above eV, coupled with sub-
degree angular precision.
The GRANDProto300, a pathfinder 300-antenna prototype array, is currently under construction in Xiao Dushan, Gansu province, China, and data collection is expected to begin in 2024. Its objectives include autonomous radio detection of inclined air showers and investigation into cosmic rays around the transition between Galactic and extragalactic origins. Presently, a 13-antenna demonstrator array is operational. We will present the preliminary designs, simulated performance of GRAND, and the preliminary results from GRANDProto300.

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Search for WIMP DM in 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.

分会场三 / 50

Unraveling collisional energy loss of a heavy quark in quark-gluon plasma

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At leading order in QCD coupling constant, we compute the energy loss per traveling distance of a heavy quark dE/dz from elastic scattering off thermal quarks and gluons at a temperature T, including the thermal perturbative description of soft scatterings ($-t < -t^*$) and a perturbative QCD-based calculation for hard collisions ($-t > -t^*$). Within this soft-hard factorization model, we find that the full results of dE/dz show a mild sensitivity to the intermediate cutoff t^*, supporting the validity of the soft-hard approach within the temperature region of interest. We re-derive the analytic formula for dE/dz in the high-energy approximation, $E_1 \gg m_1^2/T$, where E_1 is the injected heavy quark energy and m_1 is its mass. It is realized that the soft logarithmic contribution, $dE/dz \propto ln(-t^*/m_D^2)$, arises from the t-channel scattering off thermal partons,
while the hard logarithmic term, $dE/dz \propto ln[E_1T/(-t^*)]$, stems from the t-channel scattering off thermal partons, and the one $dE/dz \propto ln(E_1T/m_1^2)$ comes from the s- and u-channel scattering off gluons. The sum of these contributions cancels the t^*-dependence as observed in the full result. The mass hierarchy is observed as $dE/dz(charm) > dE/dz(bottom)$.
Our full results are crucial for a better description of heavy quark transport in QCD medium, in particular at low and moderate energy. We also calculate the energy loss by imposing Einstein's relationship. The related results appear to be systematically larger than that without imposing Einstein's relationship.

墙报展及评选 / 51

The cryogenics and purification for the next generation liquid xenon detector

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The next generation liquid xenon detector will have about ˜50T liquid xenon, the new designed powerful cryogenics and purificaton will be introduced, the results of the prototype will be given.

分会场一 / 52

An Explicit Expression of Generating Function for One-Loop Tensor Reduction

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Physics is an empirical discipline, so any theory, no matter how elegant, must be tested through experiments. The scattering amplitude, as a physical quantity, serves as a bridge between theory and experiment. With the current precision of accelerators and experiments, the leading-order calculation of tree-level amplitude is insufficient in terms of experimental precision. Therefore, loop-level calculations constitute the fundamental components required for computing all physical processes. Consequently, investigating methods for computing loop diagrams and understanding their analytical structures is essential. This work introduces an explicit expression for the generating function for the reduction of an n-gon to an (n – k)-gon. A novel recursive relation of generating function is formulated based on Feynman Parametrization in projective space, involving a single ordinary differential equation. The explicit formulation of generating functions provides crucial insights into the complex analytic structure inherent in loop amplitudes.

墙报展及评选 / 53

Production of light nuclei in Au+Au collisions with the STAR BES-II program

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The production mechanism of light (anti-)nuclei in heavy-ion collisions can be either by the thermal model or the coalescence model. By studying the yields and ratios of light (anti-)nuclei, we can gain insight into their production mechanism and physical properties of the expanding system at freeze-out. Furthermore, the enhancement in the light nuclei compound ratios such as $\mathrm{N_t} \times \mathrm{N_p}/\mathrm{N_d^2}$ and $\mathrm{N_{^3He}} \times \mathrm{N_p}/\mathrm{N_d^2}$ from the coalescence baseline, has been suggested as a potential probe to search for the critical phenomena in the QCD phase diagram. This enhancement might be a consequence of the enhanced baryon density fluctuations when the system is in vicinity of the critical point or the first-order phase transition. In the first phase of the Beam Energy Scan (BES-I) program at RHIC, an enhancement relative to the coalescence baseline of the light nuclei yield ratio ($\mathrm{N_t} \times \mathrm{N_p}/\mathrm{N_d^2}$) is observed in the most central Au+Au collisions at $\sqrt{s_{\mathrm{NN}}}$ = 19.6 and 27 GeV with a combined significance of 4.1 σ. The large datasets ($\sim$ 10$\times$BES-I) taken by the STAR BES-II with enhanced detector capabilities will greatly improve the precision of the new measurements.
In this talk, we will present the centrality and energy dependence of transverse momentum (p_{T}) spectra of p, p, d, d, and $^3\mathrm{He}$ in Au+Au collisions at BES-II energies of $\sqrt{s_{\mathrm{NN}}}$ = 7.7 –27 GeV. We will also report the centrality and energy dependence of integrated particle yields ($\mathrm{dN/dy}$) and mean p_{T} ($\langle p_{\mathrm{T}} \rangle$) of light nuclei. We will discuss the centrality and pT dependence of the coalescence parameters ($B_2(\mathrm{d})$ and $B_3(^3\mathrm{He})$). The physics implications of these results will be discussed.

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Neutrino Oscillation Physics in JUNO

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The Jiangmen Underground Neutrino Observatory (JUNO) is a multipurpose neutrino detector located 700 m underground and about 53 km away from six nuclear rectors in Southern China. It is currently under construction and will be deployed with ˜17k 20-inch photomultiplier tubes (PMTs) and ˜25k 3-inch PMTs surrounding 20 kton liquid scintillator. With an unprecedented 3% energy

resolution at 1MeV, the primary physics goals of JUNO are to determine the neutrino mass ordering and measure the neutrino oscillation parameters sinˆ2θ_12, △mˆ2_21 and |△mˆ2_32| to a sub-percent precision.
This talk will cover the neutrino oscillation physics in JUNO, including the sensitivity analysis and the results based on the most recent understanding of the detector.

分会场一 / 56

A Comparative Study of Searching for Charged Lepton Flavor Violation at future lepton colliders

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Interest in searches for Charged Lepton Flavor Violation (CLFV) has persisted over the past few decades, as the observation of CLFV would indicate new physics beyond the Standard Model (BSM). Several future high-luminosity lepton colliders have been proposed, which will enable CLFV searches to reach unprecedented precision. This work performs a detailed comparative study of CLFV searches at future lepton colliders using both extra Z′ gauge boson model and R-parity-violating (RPV) Minimal Supersymmetric Standard Model (MSSM) . We conduct Monte Carlo simulations for CLFV processes at a 240 GeV circular electron-positron collider (CEPC) and a TeV-scale muon collider. Our results show that future colliders will significantly improve the sensitivity of τ-related CLFV couplings, surpassing current constraints from low-energy and high-energy experiments.

墙报展及评选 / 57

Visualizing BESIII Events with Unity

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In high-energy physics experiments, visualization software is essential for tasks such as detector design, offline data processing, and enhancing physics analysis. Detailed detector geometries and architectures, formatted in GDML or ROOT, are integrated into platforms like Unity for three-dimensional modeling. In this study, focusing on the BESIII spectrometer, Unity is used to display BESIII events in both three-dimensional and animated formats. This approach vividly illustrates the collisions and tracks within the detector. Employing this event display system through software improves analysis, encourages interdisciplinary applications, and expands educational opportunities.

分会场一 / 58

基于未来电子缪子对撞机的带电轻子味道破坏过程研究

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带电轻子味道破坏（cLFV）过程在标准模型内受中微子质量影响被严重压低，而在多种新物理模型中却可能被提高到实验可观测的量级，因此是新物理模型研究的重要信号之一。考虑到电子缪子相互作用的独特优势，我们研究了未来电子缪子对撞机上由额外引入的中性规范玻色子Z'传播的 cLFV 过程。基于蒙特卡洛计算和检测器快速模拟，我们对 cLFV 信号和可能的本底的特征进行了研究，并给出了信号在 90% 置信水平下的截面上限和对应耦合常数$\lambda_{e\mu}$和$\lambda_{e\tau}$的结果。对比当前实验上限与未来实验预期，电子缪子对撞在含陶子末态的耦合常数灵敏度上表现出显著优势。与此同时，轻子对撞实验还可对当前缺乏研究的$\lambda_{\mu\mu}\times\lambda_{e\mu}$过程进行测量，且具备较好的灵敏度。

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JUNO 实验的数据质量监控系统

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江门地下中微子实验（JUNO）是以测定中微子质量排序为首要科学目标的大科学装置。数据质量监控系统（DQM）用于监控采集数据过程正确、平稳运行，在高能物理实验的数据采集中起重要作用。JUNO 的 DQM 系统从数据获取系统（DAQ）重建原始数据，生成直方图并使用部署在网页上的可视化工具显示探测器性能，以保证高质量的数据采集。

墙报展及评选 / 60

高能物理探测器描述到 FBX 建模的通用转化接口与可视化开发

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探测器描述是高能物理实验离线软件中的重要组成部分。Unity 等专业的可视化平台拥有目前工业界最先进的可视化技术与软硬件支持，可以帮助实现复杂探测器的可视化，为实验中的

探测器设计、模拟重建、事例显示等工作带来便利。本项工作重点在于开发一个通用的自动接口，能够高效地将高能物理实验离线软件中目前以 GDML, DD4hep, ROOT, Geant4 等格式描述的探测器自动转化为工业界流行的 FBX 格式，并在 Unity 等软件中导入从而实现探测器自动建模。该转化接口已成功应用于 BESIII、JUNO、EicC、CEPC、STCF、CLIC 等多个实验中不同类型的探测器描述，将其转换成 FBX 格式三维模型并导入到 Unity 中实现显示。该自动转化接口能够为现有和未来高能物理实验中的探测器设计、离线软件开发、物理分析乃至教育科普等起到辅助作用，同时也为事例显示、虚拟现实等进一步的可视化应用开发提供了良好的基础。

墙报展及评选 / 62

BESIII 上强子的飞行时间修正

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BESIII 实验的物理目标是对 ⊠-粲能区进行精确测量。准确可靠的粒子鉴别系统对于提高信噪比，尤其是 K/π 鉴别至关重要。基于塑料闪烁体的飞行时间探测器是 BESIII 实验用于粒子鉴别的重要工具。测量时间利用 BhaBha 事例作为刻度样本，通过对依赖于时幅和击中位置的经验公式修正得到，预期时间通过径迹外推得到，测量时间与预期时间差值即为时间差Δt。实验观察到带电强子的时间差存在系统性偏移。这种依赖于动量和粒子种类的系统性时间偏移已被多个使用塑料闪烁体型探测器的实验报道。类似的现象也出现在蒙特卡罗模拟中，但偏移量与真实数据不同。本研究利用不同粒子种类的强子样本作为控制样本，系统地研究了时间差偏移与脉冲幅度和击中位置的依赖关系。通过对测量时间进行飞行时间修正，时间差的偏移得到显著减小，接近于零。同时真实数据和蒙特卡罗样本的粒子鉴别效率得到提高，粒子鉴别的系统误差也得到改善。本研究提供了研究塑料闪烁体型探测器中时间偏移的新视角，为提高探测器精度提供了有益参考。

墙报展及评选 / 64

从 DD4hep 到 FBX 探测器描述自动转换的新方法

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DD4hep 是一个通用的探测器描述工具包，已被推荐用于下一代高能物理实验中的离线软件开发。FBX 是一种流行的 3D 建模文件格式，广泛应用于工业 3D 建模与可视化软件中。我们研究了一种新方法，能够自动将复杂的高能物理探测器描述从 DD4hep 格式自动转化为 FBX 格式的 3D 建模文件。该方法经测试可用于紧凑型直线对撞机 CLIC、超级陶粲装置 STCF、环形正负电子对撞机 CEPC 等多个未来实验中基于 DD4hep 的探测器描述。自动的 DD4hep-FBX 探测器转换接口为下一代高能物理实验中的应用开发提供了便利，如探测器设计、模拟、可视化、数据监控和科普宣传等。

分会场五 / 65

Visualization for physics analysis improvement and applications in BESIII

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Modern particle physics experiments usually rely on highly complex and large-scale spectrometer devices. In high energy physics experiments, visualization helps detector design, data quality monitoring, offline data processing, and has great potential for improving physics analysis. In addition to the traditional physics data analysis based on statistical methods, visualization provides unique intuitive advantages in searching for rare signal events and reducing background noises. By applying the event display tool to several physics analyses in the BESIII experiment, we demonstrate that visualization can benefit potential physics discovery and improve the signal significance. With the development of modern visualization techniques, it is expected to play a more important role in future data processing and physics analysis of particle physics experiments.

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Observation of the MGRO J1908+06 Region with LHAASO

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The gamma-ray source MGRO J1908+06 is esteemed as one of the primary Galactic sites for cosmic-ray acceleration, although its nature remains unrevealed. We report the detection of gammarays from this region spanning energies from 1.6 TeV to 1.3 PeV, with a spectrum exhibiting gradual steepening and yielding an index $\Gamma = (2.51\pm0.01) + (0.28\pm0.02)\times\log10(E/20TeV)$ through log-parabola model fitting. Considering a two-dimensional Gaussian template, the intrinsic extension is about $\sigma ext = 0.36^\circ \pm 0.01^\circ$ which is consistent with previous experimental measurements. Additionally, in its vicinity, we discovered a more extended gamma-ray source with a standard deviation of $\sigma ext = 1.24^\circ \pm 0.01^\circ$. The morphology of these two sources dose not exhibit significant changes with energy, suggesting a common origin that shares notable similarities with the star-forming region Cygnus X. This morphological feature is challenging to explain through a purely leptonic origin. In contrast, the hadronic model could reproduce the observed spectrum and morphology by assuming a proton spectrum with a cutoff energy of approximately 1 PeV.

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A ROOT based detector geometry and event visualization system for JUNO-TAO

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The Taishan Antineutrino Observatory (TAO or JUNO-TAO) is a satellite experiment of JUNO and located near the Taishan Nuclear Power Plant. TAO will measure the energy spectrum of reactor antineutrinos with unprecedented precision, which will benefit both of reactor neutrino experiments and nuclear database. A detector geometry and event visualization system is developed for TAO. The software is based on ROOT packages and embedded in the TAO offline software framework. It provides an intuitive tool to visualize the detector geometry, tune the reconstruction algorithm, scan the rare events in data analysis, understand the neutrino physics and monitor the operation of reactors at nuclear power plant. The further applications of the visualization system in the experimental operation of TAO and its future development are also discussed.

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JUNO 实验上的探测器 ID 和几何管理系统

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在 JUNO 实验的离线软件中，探测器 ID 和几何管理系统在确保对探测器数据进行准确和高效处理方面发挥着至关重要的作用。探测器 ID 为每个光电倍增管（PMT）提供唯一的编号，使得离线软件中的不同应用程序可以轻松引用和识别 PMT，为数据分析和重建保驾护航。ID 映射服务的开发将使不同 ID 系统，诸如（离线、数据采集、电子、调试等）之间产生关联，这促进实验各个组件之间的无缝集成和通信，并确保数据处理过程的一致性。在离线软件中，基于 GDML 的几何管理系统旨在准确和全面地描述探测器的几何结构和形状，其能够实现对探测器组件的高效数据处理、分析和可视化，以及确保实验数据的准确性和可靠性。

分会场三 / 70

Baryon density dependence of viscosities of the QGP at hadronization

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The Phi meson and Omega baryon provide unique probes of the properties of the quark-gluon plasma (QGP) at hadronization in relativistic heavy-ion collisions. Using the quark recombination model with the quark phasespace information parameterized in a viscous blast wave, we perform Bayesian inference of the shear and bulk viscosities of the QGP at hadronization with a temperature of T ≈ 160 MeV by analyzing the phi and Omega data in Au+Au collisions at √sNN = 19.6–200 GeV and Pb+Pb collisions at √sNN = 2.76 TeV, corresponding to a baryon chemical potential variation from μB ≈ 0 to 200 MeV. We find that the shear viscosity to enthalpy ratio of the QGP at hadronization decreases as μB increases, while the corresponding specific bulk viscosity is essentially constant for μB < 200 MeV. Our results suggest that the QGP at hadronization (T ≈ 160 MeV) with finite baryon density is more close to perfect fluid than that with zero baryon density.

分会场一 / 72

软定理与树图振幅

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在高能物理中，散射振幅连结着理论与实验，扮演着极重要的角色。如何超越传统费曼图，建立新的原理和方法，更好地计算和理解振幅，是振幅现代研究的核心问题之一。在这个报告中，我将给出一种逆用无质量粒子的软行为来构造树图振幅的新方法。这是一种在壳方法，避免了费曼规则的规范冗余度。相比其他逆用软行为的方法，这种新方法不需要假设软因子为已知，只假设软行为的普遍性，因而增大了方法的适用范围，同时也避免了振幅与软因子谁决定谁的逻辑混乱。我将介绍如何用这种方法构造 Yang-Mills-scalar 与 Yang-Mills 树图振幅，给出任意点振幅的普遍表达式，并通过 double copy 结构推广到含引力子的情况。同时，我也会讨论将这种方法推广到有效理论，构造含高阶导数相互作用的胶子振幅，及非线性 sigma 模型等标量有效理论的振幅。

墙报展及评选 / 73

Measurements of two-pion femtoscopy in Au+Au Collisions at $\sqrt{s_{\rm NN}}$ = 3.0, 3.2, 3.5, and 3.9 GeV from RHIC-STAR

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Femtoscopic measurements are sensitive to the spatial and temporal characteristics of the particle emitting-source, allowing us to probe the properties of the matter created in heavy-ion collisions. In case of a first-order phase transition, the duration of pion emission is expected to increase. Therefore, measuring the energy dependence of the pion femtoscopy will help us to understand the nuclear matter phase structure.

In this talk, we present the results on two-pion femtoscopy measurements in Au+Au collisions at $\sqrt{s_{\rm NN}}$ = 3.0, 3.2, 3.5, and 3.9 GeV from the STAR experiment. The extracted correlation strength (λ) and HBT radii ($R_{\rm out}, R_{\rm side}, R_{\rm long}, R^2_{\rm out-long}$) from the 3D correlation functions will be presented as a function of collision energy, centrality, rapidity, and pair transverse momentum. We will compare the measurements with the results from transport model calculations. Finally, the implications for the properties of QCD matter at high baryon density will be discussed.

分会场一 / 74

Fragmentation functions at future lepton colliders

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Fragmentation functions (FFs) are essential non-perturbative inputs for precision calculations of hadron production cross sections in high energy scattering from first principle of QCD. They are

usually extracted from global analysis on world data from single inclusive hadron production at lepton colliders, semi-inclusive DIS and pp collisions, e.g., as in recent NPC23 analysis. Future lepton colliders operated at several center of mass energies will provide high-quality hadron multiplicity data from Z boson to W boson pair as well as Higgs boson production, and ensure an accurate and precise determination of FFs based solely on data from lepton colliders. Projection for several scenarios of future leptons colliders are considered and compared to FFs from most recent global determination.

分会场一 / 76

Probing the quirk particle at the LHC forward detectors

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Quirk particles are charged under both the Standard Model gauge group and a new confinement gauge group. The confinement scale of the new confining group is much smaller than quirk masses. Thus a TeV scale quirk can be copiously produced at the LHC and traveling with anomalous trajectories. There will be a significant amount of quirk events traveling in the forward direction. The timing information recorded by the scintillators of the forward detector can help to identify the quirk signal with very low SM backgrounds.

分会场五 / 77

BESIII 上基于机器学习的粒子鉴别方法研究

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北京谱仪（BESIII）实验是目前国际上唯一运行在 𝜏- 粲能区的大型粒子物理实验装置，为 𝜏- 粲能区的物理课题提供了重要的研究平台。𝜏- 粲能区的物理过程，末态中含有较多的强子成分，因此粒子鉴别非常重要。
目前 BESIII 实验通过联合 dE/dx 和飞行时间实现粒子鉴别，由于没有切伦科夫探测器，因此在高动量区域的粒子鉴别效率较低，不能充分满足物理需求。所以，如何最大程度获取粒子鉴别能力，是一个关键科学问题。
实际上 BESIII 四个子探测器都具有一定程度的粒子鉴别能力，但由于不同探测器信息之间的关联十分复杂，传统方法处理起来极其困难，不能获得最佳的粒子鉴别性能。而机器学习方法在解决这种复杂关联问题时具有强大的优势。
因此，我在 BESIII 实验上利用机器学习方法开展了粒子鉴别的研究。
我选用深度神经网络（DNN）方法，通过参数调试和模型训练，得到适用于 BESIII 实验 𝜏,𝜏,𝜏 强子鉴别的机器学习模型。目前模型已经实现了在 BESIII 软件算法中的部署。与传统方法相比，基于深度神经网络的粒子鉴别算法在高动量区域的粒子鉴别效率得到显著提高，而时间消耗基本没有增加。同时，通过分开训练真实数据和模拟数据，系统误差也有较大的改善。更高效的粒子鉴别效率和更小的系统误差，将有效提升信号显著性，改善物理精度。

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Xe134 2□□□/0□□□ Search in PandaX-4T Experiment

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^{134}Xe is a candidate isotope for neutrinoless double beta decay˜($0\nu\beta\beta$) search. In addition, the two-neutrino case ($2\nu\beta\beta$) allowed by the standard model of particle physics has not yet been observed.With the 656-kg natural xenon in the fiducial volume of the PandaX-4T detector, which contains 10.4\% of ^{134}Xe, and its initial 94.9-day exposure, we have established the most stringent constraints on $2\nu\beta\beta$ and $0\nu\beta\beta$ of ^{134}Xe half-lives, with limits of 2.8×10^{22}˜yr and 3.0×10^{23}˜yr at 90\% confidence level, respectively. The $2\nu\beta\beta$ ($0\nu\beta\beta$) limit surpasses the previously reported best result by a factor of 32 (2.7), highlighting the potential of large monolithic natural xenon detectors for double beta decay searches.

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Neutrinoless Double Beta Decay in Multiple Isotopes for Fingerprints Identification of Operators and Models

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Neutrinoless double beta ($0\nu\beta\beta$) decay is the most promising way to determine whether neutrinos are Majorana particles. There are many experiments based on different isotopes searching for $0\nu\beta\beta$ decay. Combining the searches of $0\nu\beta\beta$ decay in multiple isotopes provides a possible method to distinguish operators and different models. The contributions to $0\nu\beta\beta$ decay come from standard, long-range, and short-range mechanisms. We analyze the scenario in which the standard and short-range operators exist simultaneously within the framework of low-energy effective field theory. Five specific models are considered, which can realize neutrino mass and can contribute to $0\nu\beta\beta$ decay via multiple mechanisms. A criterion to evaluate the possibilities of future experiments to discriminate operators and models is built. We find that the complementary searches for $0\nu\beta\beta$ decay in different isotopes can distinguish the cases that contain the low-energy effective operators $O_{1,2,5}$ and R-parity violating supersymmetry model. For other cases and models, the experimental searches within multiple isotopes can also more effectively constrain the parameter region than with only one isotope.

分会场一 / 80

NNNLO QCD predictions for heavy quark decays

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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.

分会场三 / 81

Imaginary potential of heavy quarkonia from thermal fluctuations in rotating matter from holography

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Using AdS/CFT correspondence, we study the imaginary part of heavy quarkonia potential from thermal fluctuations in a strongly coupled plasma. We perform the analysis in a rotating deformed AdS black-hole background. It is shown that the presence of angular velocity decreases the onset of imaginary potential thus
enhancing quarkonia dissociation, in agreement with previous findings of the entropic force.

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在 PandaX-4T 实验中搜寻宇宙线电子加速暗物质

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Sub-MeV 暗物质粒子被诸多理论模型选为暗物质的候选者，但受限于直接探测实验的阈值，使得热平衡态 (速度 ~$10^{-3}c$) 的本地 sub-MeV 暗物质粒子流难以在实验中被观测到。然而暗物质粒子可能会被高能的宇宙线粒子碰撞而获得更高的能量。此前，我们利用暗物质粒子与核子的散射机制，通过 PandaX-II 实验数据搜寻宇宙线加速 Sub-GeV 暗物质。考虑暗物质和电子的相互作用同样重要，我们利用 PandaX-4T 试运行实验数据寻找宇宙线电子加速轻质量暗物质，最终将质量范围在现有实验结果基础上向下扩展了两个数量级以上，并对尚未被探测的参数空间，即暗物质质量小于 3 keV 且低至 10 eV 的区间设定了新的约束，达到地球附近暗物质密度允许的最小费米子暗物质质量。

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Neutrino Oscillation Analysis with Combined Data from Super-Kamiokande and T2K

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The CP-violating phase (δ_{CP}) and the ordering of the neutrino mass states (MO) remain among several open questions surrounding PMNS matrix in neutrino oscillation. However, these issues can't be solved by a single experiment so far. Atmospheric neutrino data at Super-Kamiokande (Super-K) and accelerator neutrino data at T2K offer complementary sensitivity to these puzzles. The joint measurement of neutrino oscillation parameters from both experiments can help to break the degeneracy between the δ_{CP} and MO observed in T2K. In addition, as both neutrino sources are observed at the same detector (Super-K) and their neutrino interactions with materials share the same models

at low energy, there is a clear benefit to analyzing the data sets together.
This presentation will report the first joint oscillation analysis from both experiments, which uses a common interaction model for events overlapping in neutrino energy and correlated detector systematic uncertainties between the two datasets. Using 3244.4 days of atmospheric data and a beam exposure of 19.7(16.3) × 10^{20} protons on target in (anti)neutrino mode, this study finds a 1.9σ exclusion of CP-conservation and a preference for the normal mass ordering.

分会场三 / 84

Investigation of charm-quark hadronisation in proton–proton collisions with ALICE

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Measurements of charm-strange meson and charm-baryon production in pp and heavy-ion collisions at the LHC are fundamental to investigate the charm-quark hadronisation across collision systems.

In this contribution, the final results of the ALICE Collaboration on the production of strange (D_s^+, $\Xi_c^{0,+}$, Ω_c^0) and non-strange (D^0, D^+, D^{*+}, Λ_c^+, $\Sigma_c^{0,+,++}$) charm hadrons in pp, p–Pb and Pb–Pb collisions collected in Run 2 by the ALICE experiment are shown.
The production measurements of D_s^+ mesons are compared to those of non-strange mesons, and the comparison between the measured baryon-to-meson ratios with novel theoretical calculations will be discussed. To conclude, the first studies of charm-hadron reconstruction using the large data sample of pp collisions at √s = 13.6 TeV harvested from the start of LHC Run 3 are presented.

墙报展及评选 / 87

Hyperon polarization along the beam direction in pPb collision at CMS

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The observation of hyperon polarization along beam direction (P_z) in nucleus-nucleus collisions has opened a new way to study the complex vortical structures of the QGP. With the high-statistics data collected by the CMS experiment, we present the first P_z results for Λ and $\bar{\Lambda}$ particles in pPb collision at $\sqrt{s_{NN}} = 8.16$ TeV over a wide transverse momentum and multiplicity range. The measured P_z signal can shed light on the origin of collectivity in small collision systems as well as the mechanism of spin polarization in heavy ion collisions.

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Review of θ_{13} measurements and latest results from Daya Bay

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The neutrino oscillation is described by six independent parameters: three mixing angles θ_{23}, θ_{12}, and θ_{13}), two mass-squared splittings, and one CP-violating phase ($\delta_{\rm cp}$). As of 2010, only θ_{13} and $\delta_{\rm cp}$ remained unknown. However, a non-zero value of θ_{13} is crucial for exploring CP violation in the lepton sector. In 2011, the T2K and Double Chooz experiments provided evidence of a non-zero θ_{13}. From 2012 to the present, the Daya Bay reactor experiment has pushed the precision of θ_{13} down to 2.8%. Recently, Daya Bay achieved a 6.5% precision of θ_{13} in an independent measurement using the new capture-on-hydrogen sample. Although θ_{13} is currently the most precisely known mixing angle, it is expected to become the least precise with the next-generation experiments such as JUNO.

In this report, I will review the history and current status of θ_{13} measurements. The latest results from Daya Bay will be highlighted. The potential for further improving the precision of θ_{13} measurements will also be discussed. These high-precision measurements will constrain the PMNS neutrino mixing matrix to within 1% precision, opening the door to high-precision Unitarity tests in neutrino physics.

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伽马射线暴等暂现源观测及其研究 @GXU 地基天文观测平台

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伽马射线暴（简称伽马暴，GRB）是典型的短时标暂现源，是研究恒星形成和演化、相对论性喷流、高能粒子加速和辐射机制等前沿物理的重要天体，很多高能瞬变天体都与伽玛暴相关，如与致密天体相关的快速射电暴、超新星激波暴等，我们基于广西大学时域天平台（GXU）开展 GRB 等暂现源多波段联测和分析。在伽马暴方面，与 HXMT 等联合观测，我们开展了伽马暴全过程、多波段研究，包括瞬时辐射、余辉及寄主星系的研究，探测到极早期光学及完整光变曲的伽马暴；研究与伽马暴成协的超新星，目前观测到最高能量的伽马暴 GRB 221009A 存在被伽马暴掩盖的超新星 SN 2022xiw；快速射电暴的光学对应体一直还没有观测到，一方面利用国际光学联测网联合 FAST、HXMT, 开展快速射电暴多波段联测，另一方面在 HXMT、GWAC 等巡天归档数据寻找快速射电暴的等对应体，一共对 14 个重复快速射电暴进行观测，得到较好的光学和 X 射线约束。

分会场一 / 90

The Quantum Simulation on a (1+1)D Sphaleron Model

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This study focuses on quantum simulation of the sphaleron configurations in a 1+1-dimensional field theory model, achieved by introducing linear additional terms into the action of the $O(3)$ nonlinear sigma-model. We discretize the Lagrangian of the aforementioned (1+1)D model and construct a Hamiltonian representation based on unitary quantum gate forms, enabling the construction of quantum-simulated sphaleron. Subsequently, we devise a sophisticated adiabatic simulation method based on the field space properties of quantum-bits and the corresponding structure of the model

field, obtaining the quantum-simulated 1D sphaleron states. Additionally, we theoretically construct the decay of sphaleron states and the corresponding effects on the fermion number in the model and CP violation for further quantum simulations on this model.

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Search for Neutrinoless Double-Beta Decay of Xe-136 with the PandaX-4T Detector

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The search for neutrinoless double-beta decay (NLDBD) provides insights to the Majorana or Dirac nature of neutrinos, as well as their mass. PandaX-4T experiment, located at the China Jinping Underground Laboratory, uses a dual-phase xenon time projection chamber with 3.7-tonne natural xenon (8.9% Xe-136 abundance) in the sensitive volume. In this talk, I will present the optimization of data processing and background modeling in the MeV energy region of PandaX-4T, and report the search for Xe-136 NLDBD based on dataset from commissioning run and science run.

分会场三 / 94

Measurements of jet quenching using semi-inclusive hadron+jet distributions in pp and central Pb–Pb collisions at 5.02 TeV with ALICE

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The measurement of jets recoiling from a trigger hadron provides unique probes of medium-induced modification of jet production. Jet deflection via multiple soft scatterings with the medium constituents or single-hard Moli\'ere scatterings off quasi-particles in the medium are expected to modify the azimuthal correlation between the trigger hadron and recoiling jet. The R-dependence of recoil jet yield also probes jet energy loss and intra-jet broadening. In this talk, we present measurements of the semi-inclusive distribution of charged jets recoiling from a trigger hadron in pp and Pb-Pb collisions at $\sqrt{s_{\rm NN}}$ = 5.02 TeV with ALICE. We employ precise, data-driven subtraction of the large uncorrelated background contaminating the measurement in Pb-Pb collisions, enabling the exploration of medium-induced modification of jet production and acoplanarity over a wide phase space, including the low jet $p_{\rm T}$ region for large jet resolution parameter R. Hadron-jet acoplanarity in pp collisions will also be presented, which provides a sensitive test of pQCD calculations and a crucial data reference for in-medium jet deflection studies in Pb-Pb collisions. We observe that the jet yield at low $p_{\rm T}$ and at large azimuthal angle between the trigger hadron and jet is significantly enhanced in Pb-Pb collisions to pp collisions. Comparison to theoretical calculations incorporating jet quenching will also be discussed.

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GeV neutrino interaction study

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The Jiangmen Underground Neutrino Observatory (JUNO) is a 20 kton liquid scintillator detector currently under construction in an underground laboratory in Southern China. JUNO is designed to achieve a remarkable energy resolution of 3% at 1 MeV, a large detector volume, and exceptional background control. With these capabilities, JUNO will become a flagship experiment in the forthcoming decades, primarily focusing on determining the neutrino mass ordering, and precise measurements of the neutrino oscillation parameters using reactor antineutrinos. Furthermore, it will study interesting phenomena involving neutrinos from various sources. The understanding of GeV-neutrino interactions inside the JUNO detector relies on the modeling of nuclear medium effects. These effects are crucial ingredients for the neutrino mass ordering measurement using atmospheric neutrinos and the searches for rare phenomena like diffuse supernova neutrino background and nucleon decay. This talk will delve into the study of neutrino interactions in the few-GeV regime at JUNO, with an active pursuit of a better understanding of the relevant systematic effects.

分会场三 / 96

Jet-induced Enhancement of Deuteron Production at the LHC Energies

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The recent observation of jet-associated deuteron production in pp collisions at $\sqrt{s}$ = 13 TeV by the ALICE Collaboration opens a new window to study the production mechanism of light nuclei as well as the phase-space structure of jets produced in high-energy nuclear collisions. Here, we investigate jet effects on deuteron production in both pp and p-Pb collisions at the LHC energies, using the nucleon coalescence model for light nuclei production with the nucleon phase-space information obtained from A Multi-Phase Transport (AMPT) Model. In the low transverse momentum (pT) region (pT /A < 1.5 GeV/c), covered by current measurements, the in-jet deuteron coalescence parameter B2 is found to be enhanced by factors of about 10 in pp collisions and 25 in p–Pb collisions, which are consistent with the recent ALICE measurements. In the higher pT region (pT /A > 2GeV/c), we find that both the yield ratio of deuteron to proton (d/p) and B2 are significantly larger in the Toward region than in the Transverse region, which is in line with the sharper two-nucleon angular distribution inside the jet cone, reflecting a genuine effect of jets.

分会场一 / 97

Partial NLO electroweak corrections to Higgs pair production in gluon fusion

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We calculated the contributions of partial NLO electroweak corrections to the gluon-gluon fusion process for producing Higgs pairs, which are proportional to higher powers of the Higgs self-coupling lambda. Using these results, we obtained the form of the cross section varying with kappa lambda. Combined with the results of QCD NNLO FTapprox, this can be used to provide new ranges for the values of kappa lambda in experiments.

分会场一 / 98

Measurement of the total and differential production cross-sections of ttW at 13TeV in 140fb−1 of data with the ATLAS detector

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I will present ttW differential cross-section measurement using 140fb-1 proton-proton collision data recorded from 2015 to 2018 with the ATLAS detector at the Large Hadron Collider. The inclusive ttW production cross-section is measured to be 880+80fb, in agreement with predictions within 2 standard deviations. This result is a very important input for the ongoing ttH measurement.
Differential cross-section measurements characterize this process in detail for the first time. Several particle-level observables are compared to a variety of theoretical predictions which are in good agreement with the normalized differential cross-section results.
The report will focus on the following contents:

1. Analysis strategies
2. Main background estimation
3. Inclusive cross-section measurement
4. Differential cross-section measurement

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Extraction of fissile isotope antineutrino spectra using deep learning

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Extensive experimental evidence has confirmed significant discrepancies between the reactor fission isotope antineutrino spectra predicted by the Huber-Mueller model and the data observed in experiments, leading to the phenomenon known as the Reactor Antineutrino Anomaly (RAA). Therefore, accurately measuring the isotope antineutrino spectra is crucial to addressing the RAA issue. Based on the theories and techniques of reactor neutrino physics and deep learning, we have developed a novel statistical analysis technique that utilizes neural network models to extract isotope antineutrino spectra from the observed antineutrino event energy spectra in neutrino detectors. By analyzing and discussing simulated data from a virtual short-baseline reactor neutrino experiment, we found that the spectrum extraction performance of deep learning techniques is superior to traditional

chi-squared analysis methods, demonstrating their promising technical potential and prospects. Additionally, the neural network model used in this study is a white-box model, which can be widely accepted by particle physicists and extended to other research topics in physics.

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反应堆中微子能谱：大亚湾实验最新结果与 JUNO-TAO 实验

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大亚湾实验自 2011 年投入运行至 2020 年停止取数，积累了庞大的反应堆中微子样本。基于近点探测器采集的全数据集，即约 470 万个反贝塔衰变候选事例，大亚湾实验精确测量了反应堆中微子能谱。在此基础上，基于反应堆燃料演化信息，测量的总能谱被分解成 235U 与 239Pu 核素能谱。大亚湾对反应堆中微子能谱的测量达到世界领先精度。然而，包括大亚湾在内的现有反应堆中微子实验，其能量分辨率不足以测量可能的能谱精细结构。江门中微子实验的近点卫星实验——台山实验（JUNO-TAO）将以前所未有的能量分辨率，即 2%@1MeV，高精度测量反应堆中微子能谱。从而，为江门实验提供有效约束精细结构的高精度能谱输入。JUNO-TAO 探测器距离台山反应堆堆芯 44m，将采用在低温（-50℃）条件下运行的掺钆液闪，与高覆盖率（94%）和高探测效率（50%）的硅光电倍增管阵列，预计 2025 年投入运行。
本报告将介绍大亚湾实验对反应堆中微子能谱测量的最新结果，以及 JUNO-TAO 实验物理目标与最新进展。

分会场三 / 102

Chiral Kinetic Theory in Curved Space Revisited and Radiative Corrections

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It is usually believed that physics in off-equilibrium state can be equivalently studied using equilibrium state with suitable metric perturbation. We point out it is not the case for spin polarization phenomena: the exisiting chiral kinetic theory in curved space fails to recover all the couplings between spin and hydrodynamic gradients [1]. We present a new form of chiral kinetic theory in curved space, in which the equivalence is established [2]. The equivalence allows us to formulate spin polarization in hydrodynamic medium as a scattering problem, which is then studied using in-medium form factors [3,4]. We find radiative corrections to all couplings between spin and hydrodynamic gradients. Implications for local spin polarization of Lambda hyperon will be discussed.

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分会场三 / 103

Open-charm production in pPb collisions with the LHCb experiment

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Within proton-lead collisions collected by the LHCb detector at nucleon-nucleon center-of-mass energy of 5 and 8.16 TeV, a rich set of open charm hadrons is observed with abundant statistics. Thanks to the LHCb forward acceptance that is complementary to general purpose detectors and excellent performance in particle reconstruction and identification, these charm states are studied down to zero p_{T} with overwhelming precision in heavy ion data. Presented in this talk is the measurements of production of charm mesons and baryons reconstructed in exclusive hadronic final states. The results on nuclear modification factors will give stringent test on the nuclear parton distribution function and parton saturation models. The hadronization mechanism of charm quarks are also studied. The production ratio of stranged Ξ_c^+ and D_s^+ over D^+ or D^0 will be presented, in order to search for possible strangeness enhancement in small-system collisions.

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Searching for Solar Boron-8 Neutrinos via Coherent Elastic Neutrino-Nucleus Scattering with PandaX-4T Experiment

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The PandaX-4T experiment employs a liquid xenon detector to probe rare signals from both dark matter and neutrinos. Based on the dataset from science runs, we perform search for the coherent elastic neutrino-nucleus scattering (CEvNS) signals induced by solar neutrinos from Boron-8 decays. In this talk, I will present the analysis strategy and latest progress of CEvNS searches using PandaX-4T data.

墙报展及评选 / 105

Tracking system at the DarkSHINE experiment

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The DarkSHINE experiment proposes a novel approach to single-electron-on-fixed-target exploration, focusing on the search for dark photons through its invisible decay to dark matter particles. Central to its design is the tracker detector, engineered to deliver exceptional sensitivity in detecting light dark matter candidates. Leveraging advancements in detector technology, particularly the

emergence of AC-coupled Low Gain Avalanche Diode (AC-LGAD), this paper investigates the performance of several prototype AC-LGAD strip sensors tailored for the DarkSHINE tracking detector. The study evaluates the electrical characteristics of these sensors across two batches of wafers with varying n+ doses. The spatial and time resolution are also measured with infrared laser source. The measured spatial resolutions range from 6.5 μm to 8.2 μm and from 8.8 μm to 12.3 μm for AC-LGAD sensors from two different dose batches, featuring a 100 μm pitch size. Furthermore, time measurement resolutions of 8.3 ps and 11.4 ps are achieved which underscores the promising performance of AC-LGAD technology in advancing the capabilities of DarkSHINE's tracking system.

分会场一 / 106

Photon Identification Calibration using electrons from Z decays

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Photons are important particles in collider physics. They play a crucial role in Standard Model (SM) processes, Higgs decays, or any potential new interactions that beyond the Standard Model. Therefore, photon identification efficiency is indispensable for many interesting physical analyses in collider physics. This poster presents the electron extrapolation method for photon identification efficiency measurement in ATLAS experiment. Electrons from $\boxtimes \rightarrow \boxtimes+\boxtimes-$ decays were selected by a tag-and-probe method, and transformed to photon-like samples based on the similarities between the shower shapes of electrons and photons in the electromagnetic calorimeter to extract the photon identification efficiency. Efficiencies are measured in regions of pseudorapidity in $0 < |\boxtimes| < 2.37$ except for the crack regions $1.37 < |\boxtimes| < 1.52$ and transverse momentum across the range $25 < \boxtimes < 250$ GeV. Comparisons were made with corrected direct-photon MC, and scale factors were calculated.

分会场一 / 107

The resummation of large logarithms at subleading power in loop-induced processes

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One kind of the large logarithm at subleading power appears in the loop-induced processes. In the prosses of Higgs boson dedcay H -> γγ via a bottom quark loop, we have developed a method with soft-collinear effective theory to extract and resum these large logarithms.

分会场三 / 108

Semi-Inclusive DIS in the Target Fragmentation Region

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We report our recent progress on the study of semi-inclusive deep inelastic scattring in the target fragmentation region with a polarized lepton beam and polarized nucleon target. In this region, the nonperturbative effects are factorized into fracture functions. We derive the results of structure functions up to twist-3 at the tree level of pQCD, and up to one loop level at twist-2. At the tree level, there are four structure functions at twist-2 and eight structure functions at twist-3. At one loop and twist-2, another six structure functions become nonzero in which four are generated uniquely by the gluon fracture functions. By combining the results, all eighteen structure functions for the process are predicted. Azimuthal and spin asymmetries are discussed in connection with relevant experiments.

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分会场五 / 110

CEPC 顶点探测器原型样机的预研制

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Co-authors: Wei WEI [2]; Zhijun Liang [1]; Jun Hu [3]; Ziyue Yan [1]; Xiaoxu Zhang [4]; Tianya Wu ; Xinghui Huang [1]; Shuqi Li ; Hongyu ZHANG [3]; Xiaomin Wei [5]; Xiaoting Li [2]; Liang ZHANG [6]; Lei Zhang [7]; MING QI [8]; Joao Guimaraes da Costa

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高能环形正负电子对撞机（Circular Electron Positron Collider, CEPC）的顶点探测器，对于重味夸克重建与分辨至关重要。为了实现高精度的物理测量，对内层顶点探测器的物质量、空间分辨率、读出速度以及功耗等方面的性能提出了严苛的要求。为研制顶点探测器原型样机，研发团队研发一款名为 TaichuPix 的单片式像素探测器芯片，旨在实现优于 5 微米的空间分辨率，抗总剂量辐照能力超过 1 Mrad，并兼顾 CEPC 顶点探测器的最高击中率需求。TaichuPix 芯片基于 180 nm CMOS 工艺研制，目前已经完成两版小规模原型芯片 (25 mm2) 和一版全尺寸原型芯片（~ 4 cm^2）的设计和验证。本报告将介绍 TaichuPix 芯片的设计方案和全尺寸芯片的测试结果。项目组基于全尺寸 TaichuPix 芯片研制了 6 层束流望远镜系统，并在 DESY 电子束流上开展了芯片的束流测试，经验证单芯片可以达到优于 5 微米的空间分辨率，并同时实现高于 99% 的探测效率。本报告还将介绍探测器模块（ladder）读出电子学的设计及测试结果。最后介绍第一版 3 层双面桶状顶点探测器原型样机的设计和安装，及其电子束流测试的结果。

分会场一 / 111

Measurement of Higgs boson mass and width with LHC run2 data at the ATLAS experiment

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The Higgs Boson plays a fundamental role in Standard Model, and the precise measurement of its mass and width is one of the most important tasks of particle physics experiments. The mass measurement benefits from the processes where Higgs Boson decays into four leptons and two photons due to their excellent mass resolution, while Higgs boson width is measured indirectly by combining the on-shell and off-shell production processes. This talk presents the recent Higgs boson mass and width measurement with ATLAS detector using the full Run 2 dataset of pp collisions at the LHC collected at 13 TeV.

分会场一 / 112

Some Novel Probes for Chirality-Flip Interactions at Colliders

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To reveal hidden NP effects on the top of SM, it is SMEFT that provides a powerful systematic bottom-up approach to parameterize them. Among them the chirality-flip operators, which flip fermion helicities, remain poorly constrained by current experimental analyses for lack of interference with the SM amplitudes in traditional observables with leading effect starting at $\mathcal{O}(1/\Lambda^4)$. Moreover, things goes much worse for light-quark relevant operators due to the QCD confinement. None direct measurement on quark can be carried out, and the knowledge on quark spin and nucleon structure is still foggy in mess. To address these issues, we novelly propose several unique and efficient probes for such chirality-flip interactions, which originate from the interference of them and the SM with leading effect beginning at $\mathcal{O}(1/\Lambda^2)$. These novel approaches among the future lepton, hadron and lepton-ion colliders are linearly dependent on their Wilson coefficients without any contamination from the SM and other NP operators. As a result, nontrivial azimuthal behavior can be exhibited and serves as specific asymmetry observables. These new methods can improve the current constraints and can also simultaneously determine both their real and imaginary parts, offering a new opportunity for probing potential CP-violating effects arising from these operators. Therefore, our work opens up a new avenue to utilize spin physics for exploring the NP effects from the chirality-flip operators.

分会场一 / 113

Status of SCEP experiment

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磁单极子是被大统一理论预言的基本粒子，其在解释电荷量子化, 宇宙暴涨模型等问题上具有重要理论意义, 但已有的在地面或者深地开展的物理实验未发现其存在的可靠证据。随着航天技术的飞速发展, 深空粒子探测实验为磁单极子的搜寻提供了新的可能，但考虑到深空严峻的本底环境, 在深空开展稀有物理事例搜寻需要探测器具备极佳的事例判选能力。为此,SCEP 实验组提出利用感应信号以及塑料闪烁体之间的偶然符合方式在深空环境中对磁单极子进行搜寻。本报告将阐述 SCEP 实验组在探测系统预研过程中的模拟, 实验测试等工作, 并给出这套探测系统能达到预期磁单极子通量探测的灵敏度。

分会场一 / 114

Dark matter searches at neutrino experiments

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Millicharged particles can be created in the atmosphere when high energy cosmic rays collide with nuclei, resulting in potentially observable signals at neutrino detectors. We analyse the resulting single scatter and multiple scatter signals at SuperK and JUNO. Searches for low energy coincident signals at JUNO will be sensitive to MCPs with masses between 2 GeV and 10 GeV with milli-charges up to an order of magnitude beyond current constraints. Similarly, the decay of asymmetric dark matter (ADM) can lead to distinct neutrino signatures characterized by an asymmetry between neutrinos and antineutrinos. We examine the neutrino signal stemming from ADM decay and set the first stringent constraints on ADM lifetime based on the current observation of Glashow resonance at IceCube.

分会场五 / 115

位置灵敏的塑料闪烁光纤探测器研制

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随着塑闪光纤工艺和具备单光子探测能力的硅光电倍增器 (Silicon photomultipliers, SiPM) 的发展，基于 SiPM 阵列读出的塑料闪烁光纤探测器在设计制造上的成本和复杂度降低，可实现多种尺寸和形状的制备，甚至能够提供与传统硅微条探测器相当的高位置分辨率，因而在空间和地面的粒子物理实验中具有广泛的应用前景。该报告将从探测器模拟、器件测试、模块制备以及读出电子学等方面，介绍大尺寸、高位置分辨的塑料闪烁光纤探测器设计原理和研究进展。

墙报展及评选 / 116

Measurement of Proton-Xi Correlation Functions in Au+Au and Isobar Collisions with the STAR Detector

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Femtoscopy is a powerful technique used to investigate the emission source and interaction potential between pairs of particles. The two-particle correlation function, which reveals valuable information about the space-time evolution of the emitting source and final state interaction, is the primary observable of interest. A detailed knowledge of hyperon-nucleon (Y-N) interaction is important for understanding the equation of state of neutron star. In high energy heavy-ion collisions, a large number of particles including hyperons are produced, which offers the great opportunity to study those interactions via femtoscopic measurements.
In this talk, we present the measurements of p-Ξ^- correlations with high statistics in Isobar collisions (Ru+Ru, Zr+Zr) at $\sqrt{s_{\rm NN}}$ = 200 GeV by the STAR experiment. By employing Lednicky-Lyuboshitz approach, the scattering length (f_0) and effective range (d_0) of proton and Ξ^- interactions are extracted. Results from Au+Au collisions at the same energy will be used for comparison. In addition, these parameters will be compared to those from Lattice QCD calculations.

分会场三 / 117

RHIC-STAR 实验上超子自旋极化测量

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非对心相对论重离子碰撞中产生的系统具有极强的涡旋结构，垂直于反应平面方向的轨道角动量可导致末态超子的整体极化 (global polarization)，而沿着束流方向的集体流涡旋效应则导致超子的局域极化现象 (local polarization)。超子的自旋极化效应作为探索强相互作用物质流体性质的新方法，目前已取得了丰富的实验测量和理论研究结果，同时也存在一些亟需解决的问题，如末态磁场的影响、整体极化的碰撞系统尺寸依赖性、低能区的局域极化性质等。

本次报告中，我们将介绍 RHIC-STAR 实验上 BES-II 能区金核-金核碰撞以及 200 GeV 同质异位素碰撞中$\Lambda(\bar{\Lambda})$ 超子的整体极化和局域极化测量结果。这些测量结果将为相对论重离子碰撞中磁场的影响、涡旋场精细结构及自旋极化物理机制的研究提供更加丰富的数据支撑，对于解决理论模型中的磁场、涡旋场、剪切黏滞效应等物理问题提供关键实验证据。

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Study on high-energy neutrinos with LHAASO-KM2A

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The study of neutrinos with energy greater than 10ˆ14eV is of the important and challenging tasks in multi-messenger astrophysics. Detectors must operate in well shielded laboratories. An alternative is provided by observations of horizontal air showers (HAS) produced by neutrinos. With this technique the background of showers induced by cosmic rays is heavily reduced due to the large atmospheric depth.
In this talk we show the results of HAS with the LHAASO-KM2A, including the footprint and the neutrino identification, and a search for electron neutrino induced HAS in temporal and spatial coincidence with GRB 221009A, etc.

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Search for Coherent Elastic Scattering of Solar B8 Neutrinos in the XENONnT

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Solar neutrinos can interact with liquid xenon (LXe) dark matter detectors through coherent elastic neutrino-nucleus scattering (CEvNS), producing signals similar to DM-nucleus interactions. Known as the 'neutrino fog,' this phenomenon significantly challenges direct dark matter detection efforts. The XENONnT detector, noted for its substantial exposure and low background, provides a prime opportunity to probe this interaction.
This presentation will detail the analysis of the first and second science runs of XENONnT to search for Solar B8 CEvNS signals.. We employed novel low-threshold analysis techniques, including suppression of the dominant accidental coincidence backgrounds and modeling of the multidimensional signal and backgrounds in statistical inference, to significantly enhance the sensitivity to solar B8 neutrinos.

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DESI Y1: Cosmological Constraints from the Measurements of Baryon Acoustic Oscillations

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The Baryon Acoustic Oscillations (BAO) is a powerful large-scale structure probe that is used to constrain dark energy models, and is the main goal of the latest large cosmology survey, eBOSS and Dark Energy Spectroscopic Instrument (DESI). I will present DESI first-year Data Release (Y1) cosmological results with a particular focus on the measurement of BAO from Lyman-α forest. We measure the expansion of the universe at zeff = 2.33 with 2% precision, H(zeff) = (239.2 ± 4.8) (147.09 Mpc/rd) km/s/Mpc, and the transverse comoving distance with 2.4% precision, DM(zeff) = (5.84 ± 0.14) (rd/147.09 Mpc) Gpc. Together with other DESI BAO measurements using galaxies or quasars at lower redshifts, these results are used to constrain cosmological parameters.

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氯化锂水基液闪与重建算法的研发

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氯化锂水基液闪在作为新型中微子探测器探测介质方面显现出巨大潜力。其中 Li-7 核素与 MeV 尺度的太阳中微子发生高截面的带电电流相互作用，为太阳中微子谱的测量提供了可能性。研究团队制备并提纯了一种饱和氯化锂水基液闪，其含盐量为 45.3%w/w，并对其光学特性和光产额进行了测量。结果表明，在光电倍增管的敏感波长范围内，该液闪几乎没有吸收。在 430 nm 波长处的衰减长度可达 50 米。此外，研究还在氯化锂水基液闪中加入了一种闪烁剂 carbostyril-124，并验证了其兼容性和提高光产额的效果，从而促进了切伦科夫增强型富锂探测器的开发。针对这类水基液闪，研究团队还开发了一套重建算法。该算法能够在 MeV 尺

度上重建带电粒子的方向、位置和能量，其中对于 4 MeV 动能电子，其角分辨率可达到 34 度（包含 68% 的事例）。此外，该重建算法利用电子、γ 射线和质子产生切伦科夫光的能力不同，实现了对这些粒子的鉴别，这对于来自地球、超新星和大气中微子的测量至关重要。

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CICENNS: 300-kg CsI(Na) Detector for Coherent Elastic Neutrino-Nucleus Scattering (CEvNS)

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A recent observation of CEvNS has opened a new avenue for probing extremely low-energy neutrino interactions, via neutrino wave scattering with the entire nucleons in a nucleus coherently. The CICENNS detector under construction expects to provide a sufficient CEvNS signal from neutrinos produced by the Chinese Spallation Neutron Source. This project aims to make a precise measurement of the CEvNS cross section and the mean radius of neutron distribution inside a nucleus. It will also explore new physics phenomena including searches for non-standard neutrino interactions and new particles. In this presentation, we report the status of detector construction efforts and physics sensitivities.

分会场五 / 125

CMS MTD ETL detector in the Phase-2 upgrade

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The Compact Muon Solenoid (CMS) detector at the CERN Large Hadron Collider (LHC) is undergoing an extensive upgrade program to prepare for the challenging conditions of the High-Luminosity LHC (HL-LHC). A new timing detector in CMS will measure minimum ionizing particles (MIPs) with a time resolution of ~40-50 ps per hit and coverage up to |η|=3. The precision time information from this MIP Timing Detector (MTD) will reduce the effects of the high levels of pileup expected at the HL-LHC and will bring new and unique capabilities to the CMS detector. The endcap region of the MTD, called the endcap timing layer (ETL), must endure high fluences, motivating the use of thin, radiation tolerant silicon sensors with fast charge collection. As such, the ETL will be instrumented with silicon low-gain avalanche diodes (LGADs), covering the high-radiation pseudo-rapidity region $1.6 < |\eta| < 3.0$. This talk will present the physics motivation, current status and progress made for the ETL detector.

墙报展及评选 / 126

未来 HL-LHC 上 ATLAS 实验 ITk 探测器的四维径迹重建模拟研究

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为了提高 LHC 的物理研究潜力，LHC 将升级为高亮度大型强子对撞机（HL-LHC），束流亮度的提高将使质子-质子碰撞的堆积度提高到约 200。由于高亮度导致的辐射损伤，ATLAS 探测器中内径迹探测器（ITk）的最内两层硅像素探测器将在积分亮度达到 2000 fb^{-1} 时进行更换，同时我们也有机会利用这次更换研究新的探测器技术，对硅像素探测器的读出加入时间信息。径迹重建是处理探测器数据的重要环节。通用径迹重建软件（ACTS）是一个用于高能物理和核物理实验带电粒子径迹重建的软件包，它不依赖于具体的实验装置。为了应对 HL-LHC 高堆积度的复杂环境，以 HL-LHC 运行过程中 ATLAS 实验 ITk 硅像素探测器更换为契机，本研究使用 ACTS 独立的 ITk 模拟和径迹重建框架，初步研究了时间信息的加入对 ITk 探测器底层径迹重建效果和精度的影响。本报告将给出基于 Fatras 快模拟和 Geant4 全模拟的 ITk 四维径迹重建结果，并比较其相比不加时间信息的径迹重建在效果上的改善。

分会场五 / 128

新型钼酸盐低温晶体量热器研制进展

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基于声子探测的新型荧光-热量两维读出低温晶体量热器因其高能量分辨率、独特粒子鉴别能力等优势成为寻找无中微子双贝塔衰变最有竞争力的探测技术之一。报告主要介绍新型钼酸盐晶体生长、小尺寸钼酸盐低温晶体量热器研制及 10mK 深冷低温读出测试、以及地面测试系统与屏蔽体设计等。

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锦屏百吨中微子探测器本底屏蔽设计

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屏蔽结构设计是锦屏百吨中微子探测器设计过程中的重要一环，因为屏蔽结构设计能够使其在基坑空间限制下，增大有效探测体积，从而增加对物理信号——太阳中微子、无中微子双贝塔衰变——的曝光量。
在本报告中，我们估计本底的事例率和能谱，提出了一些屏蔽方案，用 Geant4 模拟评估它们的效用，并最终选择了其中一个。
在计算本底事例率时，我们分别考虑了直接放射性衰变本底和中子相关本底。放射性衰变本底由模拟计算；而中子相关本底又分为两类：U238 自裂变附带中子和 (alpha, n) 过程产生的中子，它们被分别计算并累加。
锦屏百吨探测器将放置与较狭窄的空间中，我们的屏蔽计划致力于用不锈钢薄层屏蔽放射性衰变产生的 beta, gamma，用掺杂硼的聚乙烯屏蔽中子本底。
我们使用模拟测试了几个屏蔽方案，比较有无它们的情况下本底事例率和信号事例率的相对大小，进而选出最好的一个。最后我们用模拟结果来估计最佳屏蔽方案下探测器的有效探测体积。

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无中微子双贝塔衰变实验中计数法与拟合法的对比

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在寻找无中微子双贝塔衰变 ($0\nu\beta\beta$) 的实验中，大部分实验都在限定的 RoI 范围内使用计数法获取$0\nu\beta\beta$ 的半衰期灵敏度，也有诸如 KamLAND-Zen 等实验使用能谱拟合法来完成这一工作，而通过这两种方法获得的$0\nu\beta\beta$ 半衰期灵敏度存在差异。
本研究基于中国锦屏地下实验室（CJPL）内的本底条件，通过模拟确认了一差异的存在。模拟显示拟合法给出的半衰期灵敏度约为计数法的 1.25 倍，本研究讨论了这一差异可能的源头。这些结论可以为未来的$0\nu\beta\beta$ 实验选择数据分析方式提供选择依据。

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RELICS 实验标定系统的设计与测试

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RELICS 实验将采用两相型液态氙时间投影室（LXeTPC），寻找由核反应堆发出的约 MeV 量级的中微子在氙原子核上的相干散射信号（CEνNS）。由于 CE νNS 信号会在液氙中产生 keV 甚至更低的能量沉积，因此需要在相关能量范围内进行能量标定。为实现这一目标，我们将利用^{137}Cs，^{60}Co 以及$^{83}Kr^{m}$ 源来标定探测器中的电子反冲事件，同时将利用^{241}AmBe 和 D-D 中子发生器来标定探测器的核反冲事件以及 CEνNS 信号。本报告将介绍基于 GEANT4 模拟，根据各标定源在探测器内响应的情况，初步给出 RELICS 实验的标定系统方案。

分会场一 / 134

Subtraction of top pair events in tWb production at one-loop level

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We present the calculation of QCD one-loop correction for tWb production. In particular, due to the well-known interference between tWb and top pair production, we introduce a new method to subtract the anti-top resonance at loop level. This method is implemented by extracting the leading-order (LO) of the resonance expansion, employing the idea of effective theory.

分会场一 / 135

Combination of searches for Higgs boson pair production in ATLAS

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This talk would present a combination of searches for Higgs boson pair production using the ATLAS Run2 data sets. The upper limit on the production rate at 95% confidence level(CL) is 2.9 times the Standard Model (SM) prediction, with an expected limit of 2.4 assuming no Higgs boson pair production. Constraints on the Higgs boson self-coupling modifier,$\kappa_\lambda = \lambda_{HHH}/\lambda^{SM}_{HHH}$, and quartic HHVV coupling modifier,$\kappa_{2V} = g_{HHVV}/g^{SM}_{HHVV}$, are derived individually, fixing the other parameter to its SM value. The observed constraints are $-1.2 < \kappa_\lambda < 7.2$ and $0.57 < \kappa_{2V} < 1.48$ at 95% CL, with expected values of $-1.6 < \kappa_\lambda < 7.2$ and $0.41 < \kappa_{2V} < 1.65$ in SM case. Strongest constraints to date are provided on several effective interactions within the Higgs Effective Field Theory, offering insights into potential deviations from SM predictions.

分会场一 / 136

Studies of new Higgs boson interactions through nonresonant HH production in the $b\bar{b}\gamma\gamma$ final state in ATLAS

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Search for nonresonant Higgs boson pair production in the $b\bar{b}\gamma\gamma$ final state 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 CERN Large Hadron Collider. This analysis supersedes and expands upon the previous nonresonant ATLAS results in this final state based on the same data sample. The analysis strategy is optimised to probe anomalous values not only of the Higgs (H) boson self-coupling modifier κ_λ but also 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 upper limit $\mu_{HH} < 4.0$ is set at 95% confidence level on the Higgs boson pair production cross-section normalised to its Standard Model prediction. The 95% confidence intervals for the coupling modifiers are $-1.4 < \kappa_\lambda < 6.9$ and $-0.5 < \kappa_{2V} < 2.7$, assuming all other Higgs boson couplings except the one under study are fixed to the Standard Model predictions. The results are interpreted in the Standard Model effective field theory and Higgs effective field theory frameworks in terms of constraints on the couplings of anomalous Higgs boson (self-)interactions

墙报展及评选 / 137

CEPC 束流本底研究和对撞区优化设计

Authors: Dou WANG[1]; Haoyu SHI[1]; Feipeng NING[1]; Hongbo ZHU[1]; Quan JIN[one]; Sha BAI[2]; Suen Hou[3]; UNKNOWN 朱应顺 [2]; Wei XU[2]; Yiwei WANG[1]; 张祥镇 ZHANG Xiangzhen[2]; 海静王 [2]; 瑜冬刘 [2]

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机器-探测器接口（MDI）区域的设计和优化是环形电子正电子对撞机（CEPC）中最复杂和具有挑战性的课题之一。对 MDI 相关问题的全面理解对于实现加速器和探测器的最佳整体性能

至关重要。由于机器将在不同的束流能量下运行，因此需要一个灵活的相互作用区设计，以适应大范围的束流能量。该设计必须提供对物理研究所需的高亮度，同时保持探测器可以容忍的辐射背景。这需要在加速器和探测器的需求之间进行仔细的平衡。

本报告将基于 CEPC 技术设计报告（TDR）的最新 CEPC MDI 设计，介绍包括束流管在内的整体对撞区设计、、束流引起的背景估算、本底影响的控制和屏蔽方案，以及我们针对 CEPC 探测器参考技术设计报告（Ref-TDR）的计划和研究进展。

分会场一 / 138

Search for new Higgs bosons via same-sign top quark pair production in association with a jet at CMS

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A search is presented for new Higgs bosons in proton-proton (pp) collision events in which a same-sign top quark pair is produced in association with a jet, via the pp → tH/A → tt¯c and pp → tH/A → tt¯u processes. Here, H and A represent the extra scalar and pseudoscalar boson, respectively, of the second Higgs doublet in the generalized two-Higgs-doublet model (g2HDM). The search is based on pp collision data collected at a center-of-mass energy of 13 TeV with the CMS detector at the LHC, corresponding to an integrated luminosity of 138 fb−1. Final states with a same-sign lepton pair in association with jets and missing transverse momentum are considered. New Higgs bosons in the 200-1000 GeV mass range and new Yukawa couplings between 0.1 and 1.0 are targeted in the search, for scenarios in which either H or A appear alone, or in which they coexist and interfere. No significant excess above the standard model prediction is observed. Exclusion limits are derived in the context of the g2HDM.

分会场一 / 140

Systematic investigations on dark matter direct detection in effective field theories

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We systematically investigate dark matter direct detection in effective field theories, including nuclear recoil signal, electron recoil signal, and Migdal effects.

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PandaX4T run0+run1 信号响应模型

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WIMP 是最热门的暗物质候选粒子之一，近年来国际上有多个大型深地探测实验致力于 WIMP 的直接探测，包括位于我国四川锦屏地下实验室的 PandaX。PandaX-4T 是基于吨量级的氙的两相型 TPC 探测器，其低阈值、低本底、大灵敏体积、高探测效率等特点，使之跻身于 WIMP 探测前列。本报告将介绍 PandaX-4T 实验在 WIMP 暗物质的搜寻中信号响应模型，讨论模型的构建以及应用。

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The GAPS Experiment for Indirect Dark Matter Searches with Low-energy Cosmic-Ray Antinuclei

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The General Antiparticle Spectrometer (GAPS) is a balloon-borne experiment, firstly optimized to identify low-energy (⊠ 0.25 GeV/n) cosmic antinuclei from dark matter annihilation or decay. With a novel detection approach that uses the uniquely characterized atomic X-rays and charged particles from the decay of exotic atoms, the GAPS program will deliver an unprecedented sensitivity to cosmic antideuterons, an essentially background-free signature of various dark matter models. In addition, GAPS will deliver a precise antiproton spectrum with high statistics in an unexplored energy range and leading sensitivity to cosmic antihelium.
The GAPS project is currently completing its on-ground commissioning and preparing for the first Antarctic balloon flight from the McMurdo Station in late 2024 while two follow-up flights are planned. This talk will cover the overview and the recent status of the GAPS mission.

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Investigating Dark Matter in Antiproton Cosmic Rays and Searching for Antimatter in Cosmic Rays with DAMPE

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Using antimatter cosmic rays to search for dark matter is an important approach in dark matter research. However, there is still debate over whether dark matter is needed to explain the antiproton energy spectrum observed by AMS-02. The main research challenges lie in the difficulty of determining the solar modulation of antiprotons and the uncertainties in proton-proton collision cross-sections. We have studied whether the antiproton energy spectrum requires dark matter explanation based on various charge-dependent solar modulation models and updated proton-proton collision cross-sections. Additionally, I will report on the current progress of using DAMPE to search for antimatter. DAMPE is China's first space science satellite, which has been in orbit for eight and a half years, accumulating over 150 billion high-energy cosmic ray events, providing a possible opportunity for antimatter searches.

分会场一 / 145

Testing Lepton Flavor Universality at the EIC

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Lepton flavor universality(LFU), as one of the most important hypotheses in the Standard Model(SM), deserves a high precision test at colliders. Any deviation, if probed, may show us the evidence of the underlying new physics(NP). The Electron-Ion Collider(EIC) has drawn much attention recently. In this work, we will explore the potential of the LFU test and NP search at the EIC. Concretely, we focus on semi-leptonically decayed b-hadrons generated from DIS processes, and compare between tau-mode decays and the other two generations of leptons, where, as reported in many colliders, generally anomalies exist. Different decay channels are taken into account, including $B_c \to J/\psi\ell\nu$, $B_s \to D_s^{(*)}\ell\nu$, $\Lambda_b \to \lambda_c\ell\nu$ and $B_c \to \ell\nu$. We would like to report the possible sensitivity of measurements, and show how these altogether constrain NP parameters.

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CEE（csr external experiment）TPC 全流程进展介绍

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正在建设的 CSR 外靶实验（CEE）时间投影室（TPC）用于研究高密度核物质的设计和构建。CEE TPC 是在 CEE 进行的实验研究中至关重要的探测器，将用于研究核物质的相结构和超饱和密度下的冷非对称核物质状态方程。TPC 的设计旨在为带电粒子提供轨迹信息，包括三维位置、动量、电荷和能量损失。
TPC 是高能和核物理实验中常用的探测器。它由一个充满气体或液体的敏感体积组成，粒子电离产生的电子可以在电场中漂移。通过观察电子到达读出平面的位置，可以确定电离位置的二维信息，而第三维信息（漂移长度）可以通过漂移时间计算得出。CEE TPC 计划成为中国迄今为止最大的 TPC，体积约为 1 立方米。
CEE TPC 采用了多项技术来解决重离子碰撞带来的挑战，例如高效率和动量分辨率（<5%）下重建多达 200 个带电粒子的问题。它利用四层大型气体电子倍增器（GEM）进行电子倍增放大，并采用名为 SAMPA 的现代读出芯片。SAMPA 芯片直接连接到 TPC 的读出垫上，每个 SAMPA 芯片集成了 32 个通道的电荷灵敏放大器、半高斯形状器和 10 位 ADC。本次报告主要介绍 csr external experiment 的 TPC 探测器设计以及目前的进展情况。主要涉及触发模式介绍，电子学读出芯片以及读出模式介绍，以及整套的重建流程（包括集团重建以及径迹重建）和对应的模拟流程。

分会场三 / 148

Production of the heavy-flavour decay lepton in high-energy nuclear collisions

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In this talk, We will present a theoretical study on the production of the heavy-flavour decay lepton (HFL) in high-energy nuclear collisions at the LHC. The pp-baseline is calculated by the FONLL program, which matches the next-to-leading order pQCD calculation with the next-to-leading-log large-p_T resummation. The in-medium propagation of heavy quarks is driven by the modified Langevin equations, which consider both the elastic and inelastic partonic interactions. We propose a method to separate the respective influence of the five factors, such as pp-spectra, the cold nuclear matter (CNM) effects, in-medium energy loss (E-loss), fragmentation functions (FFs), and decay channels, which may contribute to the larger R_{AA} of HFL $\leftarrow b$ compared to that of HFL $\leftarrow c$ in nucleus-nucleus collisions. Based on quantitative analysis, we demonstrate that different decay channels of charm- and bottom-hadrons play an essential role at p_T <5 GeV, while the mass-dependent E-loss dominates the higher p_T region. It is also found that the influences of the CNM effects and FFs are insignificant. At the same time, different initial pp-spectra of charm and bottom quarks have a considerable impact at $p_T > 3$ GeV. Furthermore, we explore the path-length dependence of jet quenching by comparing the HFL R_{AA} in two different collision systems. Our investigations show smaller HFL R_{AA} in Pb+Pb than in Xe+Xe within the same centrality bin, consistent with the ALICE data. The longer propagation time and more effective energy loss of heavy quarks in Pb+Pb collisions play critical roles in the stronger yield suppression of the HFL compared to that in Xe+Xe. In addition, we observe a scaling behaviour of the HFL R_{AA} in Xe+Xe and Pb+Pb collisions.

分会场一 / 149

On-Shell Massless-Massive Correspondence: A Framework to Construct Massive Amplitudes

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In the high-energy limit, the massive amplitudes can be expanded in v/E. The power counting suggests that the term with v^l corresponds to the massless amplitudes with l extra Higgs bosons. Once we know the massless amplitudes, we can use this correspondence to determine the massive amplitudes, in both renormalizable theory and effective theory with spontaneouly symmetry breaking.

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Properties of Forbush decreases of electrons and positrons revealed by the Dark Matter Particle Explorer

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The Forbush Decrease (FD) is a rapid decline in the observed intensity of galactic cosmic rays following intense solar activity, such as a coronal mass ejection (CME). This phenomenon occurs due to fast solar wind sweeping away cosmic rays propagating in the space near the Earth. The Dark Matter Particle Explorer (DAMPE) is a satellite-based cosmic ray experiment with high precision in detecting electrons and positrons, providing a unique opportunity to study electron and positron FDs, which have been rarely studied before. In this contribution, we present the results of a study on the properties of electron and positron FDs from 2016 to 2023. WSA-Enlil is a large-scale, physics-based model that predicts solar wind structures and Earth-directed CMEs. Our study offers new insights into the relationship between FD recovery time and observed CME data, as well as the WSA-Enlil simulations.

分会场一 / 153

Higgs boson pair production and decay to $b\bar{b}\gamma\gamma$ at NLO in QCD

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We calculate the total cross-section and differential distribution of Higgs boson pair production and decay to $b\bar{b}\gamma\gamma$ at NLO in QCD

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Probing the Initial State and Directed Flow of Charged Hadrons in Asymmetric Collisions

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The directed flow in asymmetric collisions, such as Cu+Au, offers a valuable window into understanding the energy deposition mechanisms in heavy ion collisions, yet this remains an open challenge. In this work, we delve into the directed flow of charged hadrons in Cu+Au collisions at a center-of-mass energy of $\sqrt{s_{NN}} = 200$ GeV. We develop a refined three-dimensional (3D) TRENTo initial condition model, incorporating a tilted deformation geometry of both energy density and net baryon density along the longitudinal axis, along with a non-zero longitudinal flow velocity gradient. By integrating this TRENTo initial condition with the (3+1)-D viscous hydrodynamic model CLVisc,

we obtain a comprehensive and satisfactory description of the p_{T}-spectra and directed flow (v_1) of charged hadrons in Cu+Au collisions. Our analysis first reveals that the directed flow in asymmetric collisions is highly sensitive to the longitudinal flow velocity gradient in the initial state. Additionally, we present the global polarization of $\Lambda/\bar{\Lambda}$ hyperons as a function of rapidity, p_{T} and centrality bins, offering further insights of the initial state. Our findings provide tighter constraints on the initial conditions of asymmetric nuclear collisions in relativistic heavy-ion collisions.

分会场三 / 156

The fluctuation-enhanced jet quenching in d-Au collisions at $\sqrt{s_{\mathrm{NN}}}$ = 200 GeV

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PHENIX experiment group points out that in the measurements of the π^0 nuclear modification factor $R^{\pi^0}_{dAu}$, $\langle N_{\mathrm{coll}}\rangle$ can be biased by the event-selection [1], which can be effectively reduced by using the direct γ yield at large p_{T} to determine the $\langle N^{\gamma}_{\mathrm{coll}}\rangle = \mathrm{Y}^{\gamma^{\mathrm{dir}}}_{dAu}/\mathrm{Y}^{\gamma^{\mathrm{dir}}}_{pp}$ [2]. Utilizing the $\langle N^{\gamma}_{\mathrm{coll}}\rangle$ provided by PHENIX, the π^0 suppression is studied within a next-to-leading-order perturbative QCD parton model [3] incorporating the medium-modified parton fragmentation functions [4]. This study is under the assumption that the quark-gluon plasma (QGP) is produced, and its evolution can be described by hydrodynamics in d-Au collisions at $\sqrt{s_{\mathrm{NN}}}$=200 GeV. The initial conditions and space-time evolution of the matter created in d-Au collisions are provided by the superSONIC hydrodynamic model simulations [5,6] and parton energy loss in such a small medium is described by the high-twist (HT) approach [7]. The jet transport coefficient $\hat{q}/T^3(T)$ in this HT approach is extracted with the information field (IF)-Bayesian inference approach from all existing experimental data on single-inclusive hadron, dihadron, and γ-hadron spectra in heavy-ion collisions at RHIC and the LHC energies [8,9]. When only including the cold nuclear matter effect, the $\langle R^{\pi^0}_{dAu}\rangle$ averaged over $7.5 < p_{\mathrm{T}} < 18$ GeV is almost unity. When accounting for the jet energy loss and using the smooth hydro profile, the π^0 production has a suppression of about 15% in 0-5% d-Au collisions. While with the event-by-event (EbyE) hydro profiles, the π^0 production is suppressed by about 25%, which is consistent with the experimental measurement [2]. We find that the fluctuation enhances the jet quenching in d-Au collisions at $\sqrt{s_{\mathrm{NN}}} = 200$ GeV. The elliptic anisotropy v_2 is further studied with the EbyE hydro, and it is about 0.05 with a large uncertainty caused by fluctuation. Such suppression and elliptic anisotropy may suggest the formation of QGP in d-Au colliding small system.

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Observation of the BOAT GRB from LHAASO

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The brightest gamma-ray burst of all time, GRB 221009A, occurred within the field of view of LHAASO at a zenith angle of approximately 28 degrees. LHAASO collected over 65,000 very-high-energy (VHE) photons from the burst and detected the onset of the GRB afterglow process in the VHE band for the first time. The light curve exhibits four stages, consisting of two rises and two decays. The rapid rise is a novel feature in GRB phenomena, and the steep decay helps uncover the reasons behind the exceptional brightness of this GRB. The maximum energy of photons from the GRB exceeds 10 TeV, setting a new world record. Utilizing the unprecedented data from LHAASO, various topics, including Lorentz invariance violation, were studied.

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Latest results of the DArk Matter Particle Explorer

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The DArk Matter Particle Explorer (DAMPE) is a satellite-based cosmic ray and gamma ray detector. It has been operating smoothly in space since December 2015. The main scientific objectives of DAMPE are (1) indirect detection of possible dark matter signatures, (2) studying the origins, acceleration and propagation mechanisms of cosmic rays, and (3) gamma-ray physics. In this contribution, we first give an overview of the DAMPE mission and its on-orbit operational status. Then, highlight scientific results are presented, including the measurements of the cosmic-ray electron-plus-positron spectrum, the spectra of primary cosmic-ray species, the secondary to primary flux ratio and more. Finally, the ongoing efforts for lepton, light, and heavy hadron cosmic rays are briefly discussed along with the new data analysis techniques.

分会场五 / 159

基于监督学习和迁移学习的电离计数重建方法研究

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原初电离计数方法是具有突破性的下一代粒子物理实验探测器方法，它通过测量带电粒子在气体径迹探测器中的原初电离数目（dN/dx），实现带电强子的鉴别。与传统电离能损（dE/dx）方法相比规避了测量中的多项涨落，理论分辨率有潜力比 dE/dx 好两倍，是下一代先进探测器技术的有力候选。对于漂移室的 dN/dx 方法，原初电离簇团的重建存在着巨大的挑战。其一，原初电离簇团常常在电流波形上形成高堆积、高噪声的信号；另外，次级电离会对初级电离的测量造成严重污染。传统算法难以对上述问题进行有效地解决。

深度学习算法近些年在工业界和高能物理界都取得了重大突破，其性能在很多领域远超传统算法。经典的深度学习算法利用大量有标注数据（仿真数据），利用监督学习的方法，可以学

习到数据中的复杂规律。但对于真实实验数据，通常难以获得高质量的标注，经典的监督学习则面临困难。领域自适应是迁移学习的一种，它通过建立仿真数据与真实数据之间的关联，对信息进行迁移，从而将大统计量仿真数据的信息应用到数据的训练中。

本研究对于仿真数据样本，开发了基于长短记忆网络（LSTM）和动态图神经网络（DGCNN）的监督模型。在 K 介子与 π 介子的粒子鉴别区分能力方面，相比传统算法取得了 10% 的显著改进。该结果相当于在相同的性能下，将探测器的尺寸减少 20%，从而节省了巨大的成本。对于在 CERN 收集的束流实验数据样本，由于缺少标注、以及和仿真数据存在差异，我们开发了基于最优传输的半监督领域自适应模型。该模型的性能优于传统方法，且与监督模型接近。

已经有两篇相关论文投递给了期刊：2402.16270 和 2402.16493。其中，关于迁移学习的论文已在《Computer Physics Communications》上发表（CPC 300, 109208 (2004)）。

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Latest result on searching for fractionally charged particles with the DAMPE

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The existence of fractionally charged particles (FCP) is foreseen in extensions of or beyond the Standard Model of particle physics. Most of the previous studies of cosmic-ray FCP are based on observations by underground experiments, searching for FCP with the energy of hundreds of GeV. On-orbit experiments are able to look for FCP above a few GeV, but up to now the investigation in this field has been carried out only by the AMS-01 detector on-board of the Space Shuttle and the balloon-borne experiment BESS.
The DArk Matter Particle Explorer (DAMPE) is a space telescope launched on December 17th, 2015. One of the main goals of DAMPE is the measurement of galactic cosmic rays with energy up to several tens of TeV and beyond. In this work, we will introduce the results of searching for 2/3 FCP in space obtained from the analysis of on-orbit data collected by the DAMPE detector. The FCP is assumed to be a heavy lepton, and the Geant4 simulations toolkit is adopted to investigate FCP’s behavior in the DAMPE detector. No positive evidence for such particles is observed in five years of observation. Thus, we drive an FCP flux upper limit of 6.2×10-10 cm-2sr-1s-1. Our result refreshes the record in sensitivity among similar-type experiments by three orders of magnitude, which also more stringently restricts the conditions for the existence of FCP in primary cosmic rays

分会场一 / 161

Hybrid type-II and type-III seesaw solution for the muon g-2 anomaly

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The muon (⊠–2) anomaly is a longstanding puzzle in particle physics. Both the theoretical prediction and experimental measurement are expected to be improved in the near future. It may be a signal of new physics, and tremendous amount of new physics models are proposed to explain this anomaly. However, many papers focus on the singlet and doublet vector-like lepton extended models without paying much attention to the triplet lepton. Besides, the contributions are negative in the pure triplet scalar extended model. In this talk, we consider a triplet scalar and triplet lepton extended model. This model is well motivated, because it incorporates the type-II and type-III seesaw mechanisms. In this model, there are contributions from the neutral, singly, and doubly charged scalars. Chiral

enhancements from the heavy lepton can appear, which are controlled by the SM lepton and triplet lepton mixing angles. After considering the perturbative unitarity and experimental constraints, we find that the muon (g-2) can be explained naturally.

分会场五 / 162

马尔科夫链蒙特卡洛方法在中微子实验事例重建方面的应用研究

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液体闪烁体是中微子实验中最常用的探测介质，精确重建液闪中事例的能量和位置对于粒子鉴别和提高信噪比等至关重要。我们引入对暗噪声的考虑，建立了点源响应与暗噪声的混合模型，未来也可以推广到闪烁光与切伦科夫光的混合、多个点源的混合模型。基于该混合模型，利用马尔可夫链蒙特卡罗方法（MCMC）将光电子和顶点位置及时刻的后验分布采样进行链式对接，将波形分析和事例重建联合起来。这种联合重建方法能够更精确地估计光电子数和位置，从而显著提高能量分辨率。我们的方法已经在锦屏中微子实验（JNE）的事例重建上取得了初步结果。通过采用这种重建方法，可以推动我们对中微子物理的理解，并提高未来实验的准确性。

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Measurement of Iron Spectrum in Cosmic Rays with DAMPE

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Iron nuclei are the most abundant heavy nuclei in cosmic rays beyond silicon, and they interact much more with the interstellar medium during propagation compared to lighter nuclei, promoting the significance of precision measurement of the cosmic ray spectrum of iron nuclei, which is crucial for understanding the origin, acceleration, and propagation mechanisms of heavy cosmic ray.
The Dark Matter Particle Explorer (DAMPE) , with broadest observational energy range among the space-based cosmic ray detectors in operation at present, could play an important role in measurement of the feature of energy spectrum of Iron up to hundred TeV. Recently, DAMPE collaboration develops a machine learning-based algorithm for track reconstruction to reduce the efficiency decrease caused by the common-mode noise of the electronics above hundred GeV. With ML track mentioned above, we will present the latest progress on the direct measurement of cosmic ray iron nuclei, using 7 years of data collected by DAMPE.

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Measurements of the boron-to-carbon and boron-to-oxygen flux ratios in cosmic rays with DAMPE

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DAMPE (DArk Matter Particle Explorer) is the first Chinese satellite-borne experiment searching for dark matter and exploring the origin of the cosmic rays. It has been taking data for more than 8 years since its successful launch in December 2015. Spectral measurements of secondary nuclei such as lithium, beryllium, and boron, are mainly produced by the fragmentation of heavier nuclei, such as carbon and oxygen. The boron-to-carbon flux ratio (B/C) and the boron-to-oxygen flux ratio (B/O) are fundamental to improve our understanding of cosmic ray acceleration and propagation. In this work, the direct measurements of B/C and B/O at the energy from 10 GeV/n to a few TeV/n will be presented.

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Phenomenological study of the angle between jet axes in heavy-ion collisions

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This work presents a phenomenological study on the angle between the Standard and the Winner-Take-All (WTA) jet axes (ΔR) in high-energy nuclear collisions. Our theoretical results calculated by the LBT model show that the ΔR distribution in Pb+Pb at $\sqrt{s} = 5.02$ TeV is narrower than that in p+p, which agrees well with the recent ALICE measurements. The narrowing of ΔR seems to violate the p_T-broadening nature of the jet quenching effect, usually explained by the influence of "selection bias". However, the physical details still need to be fully understood. Utilizing a matching-jet method to track the jet evolution in the QGP to remove the selection bias in the Monte Carlo simulations, we observe that the ΔR distribution becomes broader due to the jet-medium interactions. At the same time, by rescaling the quark/gluon-jet fractions in Pb+Pb collisions to be the same as that in p+p, we find that the fraction change may not significantly influence the modification pattern of jet ΔR. On the other hand, the selected jet sample in A+A collisions has a significantly narrower initial ΔR distribution than the p+p baseline, and such a biased comparison between p+p and A+A conceals the actual jet-broadening effect in the experimental measurements. The investigations presented in this work will deepen our understanding of the relationship between the actual intra-jet modifications in the QGP and the experimental observations.

分会场一 / 166

Search for Pair Production of Boosted Higgs Bosons via Vector-Boson Fusion in the $b\bar{b}b\bar{b}$ Final State Using pp Collisions at $\sqrt{s}$ = 13 TeV with the ATLAS Detector

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A search for Higgs boson pair production via vector-boson fusion is performed in the Lorentzboosted regime, where a Higgs boson candidate is reconstructed as a single large-radius jet, using 140 fb^{-1} of proton–proton collision data at $\sqrt{}$ = 13 TeV recorded by the ATLAS detector at the Large Hadron Collider. Only Higgs boson decays into bottom quark pairs are considered. The search is particularly sensitive to the quartic coupling between two vector bosons and two Higgs bosons relative to its Standard Model prediction, κ_{2V}. This study constrains κ_{2V} to 0.55 < κ_{2V} < 1.49 at 95% confidence level. The value κ_{2V} = 0 is excluded with a significance of 3.8 standard deviations with other Higgs boson couplings fixed to their Standard Model values. A search for new heavy spin-0 resonances that would mediate Higgs boson pair production via vector-boson fusion is carried out in the mass range of 1–5TeV for the first time under several model and decay-width assumptions. No significant deviation from the Standard Model hypothesis is observed and exclusion limits at 95% confidence level are derived.

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Silk damping of secondary gravitational-wave background due to dissipation of cosmic fluid

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Silk damping is well known in the study of cosmic microwave background (CMB) and accounts for suppression of the angular power spectrum of CMB on large angular multipoles. We study the effect of Silk damping on the scalar-induced gravitational waves (SIGWs). Resulting from the dissipation of cosmic fluid, the Silk damping notably suppresses the energy-density spectrum of SIGWs on scales comparable to a diffusion scale at the decoupling time of feebly-interacting particles. The effect offers a novel observable for probing the underlying particle interaction, especially for those mediated by heavy gauge bosons beyond the standard model of particles. We anticipate that pulsar timing arrays are sensitive to gauge bosons with mass ~10^3–10^4GeV, while space- and ground-based interferometers to those with mass ~10^7–10^12GeV, leading to essential complements to on-going and future experiments of high-energy physics.

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基于全数据集的大亚湾反应堆中微子实验中缪子事例率的季节变化

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初级宇宙射线进入大气会与大气分子相互作用产生介子。次级介子在传播过程中有相互竞争的两个过程，衰变为缪子和进一步发生相互作用。大气温度的降低引起的大气分子数密度的减少使得介子和大气分子相互作用的机会减少。有更多的介子衰变而来的缪子产生。因此，地下缪子通量和实验室上方的大气温度有正向的关联，这已被许多实验所观测到。大亚湾实验用两年统计量的数据测量了有效温度和缪子事例率的关联系数。随着大亚湾实验更多数据的获取，期待得到具有更低的统计误差的关联系数。伴随着得到更高水平统计量的数据，有

效温度和缪子事例率之间非线性的关联关系被观察到。这一报告将报道大亚湾实验对这一测量的当前的状态。

墙报展及评选 / 169

Deep learning on jet modification in the presence of the QGP background

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Jet interactions with the color-deconfined QCD medium in relativistic heavy-ion collisions are conventionally assessed by measuring the modification of the distributions of jet observables with respect to their proton-proton baselines. Deep learning methods allow us to evaluate the modification of jets on a jet-by-jet basis, and therefore significantly improve the capability of using jets to probe the QGP properties. In this work, we first explore the fractional energy loss of each jet through the QGP using the Convolutional Neural Network (CNN) method. The initial jets are generated by Pythia, and their subsequent evolution through the QGP is simulated using a linear Boltzmann transport (LBT) model that incorporates both elastic and inelastic scatterings between jet partons and the QGP. By mixing jet partons with the QGP background generated by a thermal model, and then training the neutral network with jets obtained using the constituent subtraction method, we show the neural network can provide a good prediction on the fractional energy loss of jets in the presence of the QGP background. We further apply the Dense Neural Network (DNN) method and the aforementioned CNN method to the background subtraction in constructing jets. Although the recoil partons from the LBT simulation, scattered out of the QGP background but belonging to jets, can inevitably lead to over-subtraction of the background, we obtain better accuracy of background subtraction by using the deep learning methods than by using the traditional constituent subtraction method and area-based method adopted in many experimental measurements.

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AMS 实验正负电子、反质子流强谱最新测量结果与暗物质的间接寻找

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Precision measurements by AMS reveal unique properties of cosmic charged elementary particles. In the absolute rigidity range ~60 to ~500 GV, the antiproton flux and proton flux have nearly identical rigidity dependence. This behavior indicates an excess of high energy antiprotons compared with secondary antiprotons produced from the collision of cosmic rays. More importantly, from ~60 to ~500 GV the antiproton flux and positron flux show identical rigidity dependence. The positron-to-antiproton flux ratio is independent of energy and its value is determined to be a factor of 2 with percent accuracy. This unexpected observation indicates a common origin of high energy antiprotons and positrons in the cosmos.

分会场三 / 171

Nucleon Energy Correlators for the Color Glass Condensate

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We demonstrate the recently proposed nucleon energy-energy correlator (NEEC) fEEC (x, θ) can unveil the gluon saturation in the small-x regime in eA collisions. The novelty of this probe is that it is fully inclusive just like the deep-inelastic scattering (DIS), with no requirements of jets or hadrons but still provides an evident portal to the small-x dynamics through the shape of the θ-distribution. We find that the saturation prediction is significantly diferent from the expectation of the collinear factorization.

分会场一 / 173

DM search at Belle II

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We propose a new “disappearing positron track” channel at Belle II to search for dark matter, in which a positron that is produced at the primary interaction vertex scatters with the electromagnetic calorimeter to produce dark matter particles. Such scatterings can occur via either annihilation with atomic electrons, or the bremsstrahlung process with target nuclei. The main backgrounds are due to photons and neutrons that are produced in the same scatterings and then escape detection. We require a large missing energy and further veto certain activities in the KLM detector to suppress such backgrounds. To illustrate the sensitivity of the new channel, we consider a new physics model where dark matter interacts with the standard model via a dark photon, which decays predominantly to dark matter; we find that our proposed channel can probe some currently unexplored parameter space, surpassing both the mono-photon channel at Belle II and the NA64 constraints.

分会场一 / 174

Summary studies of the ATLAS Run2 SUSY searches at the LHC

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Serval summary studies of the ATLAS Run 2 SUSY searches at the LHC are presented in this talk, including the recent results on the constraints from the searches performed by the ATLAS Collaboration on the 19-parameter phenomenological minimal supersymmetric standard model (pMSSM-19), statistical combinations of searches for the SUSY particles in various decay channels, and the reinterpretations of the SUSY searches in R-parity-conserving (RPC) scenarios with variable R-parity-violating (RPV) coupling strength models. A novel technique, recastable analysis using a common

workflow method, and a new platform, reana (reusable analysis platform), are applied within these summary activities, enabling the publication and realization of the above results. These two technologies also hold broader future applications and can help bridge the gap between theorists and experimentalists.

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Tau reconstruction, identification and calibration of the ATLAS experiments at the LHC

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The tau lepton is the heaviest known lepton with a relatively long lifetime and approximately 65% hadronically decays, including undetectable neutrinos, leaving characteristic displacement, multiplicity, and kinematic properties, making the reconstruction, identification, and calibration very challenging. But the final states with hadronically decaying tau leptons play an important part in the physics programme of the ATLAS experiment, such as the precision measurement of the Yukawa coupling between the Higgs and the tau leptons, extended Higgs sector searches, and searches for new physics phenomena such as supersymmetry, new heavy gauge bosons, and leptoquarks, making the tau reconstruction, identification, and calibration very important in the ATLAS experiment. In this talk, we will give an overview of the ideas and methods used to reconstruct, identify, and calibrate the hadronically decaying tau leptons in the ATLAS experiment for Run 3 and the reprocessed full Run 2 dataset of the LHC, highlighting the recent progress and improvements using modern machine learning techniques, and summarize the possible future for tau reconstruction, identification, and calibration in the ATLAS experiment.

分会场一 / 176

Search for the direct production of supersymmetric particles in final states with light leptons and tau leptons with the ATLAS detector

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Recent SUSY searches in final states with light leptons or taus using 139 fb^{-1} of pp collision data at $\sqrt{s} = 13$ TeV collected with the ATLAS detector at the Large Hadron Collider will be presented.
Both R-parity conserving and violating scenarios will be covered, including the direct pair production of squarks, gluinos, gauginos, higgsinos, and staus.
In general, the gluino (squark) mass up to 2.2 (1.7) TeV has been excluded. Gaugino and higgsino masses up to several hundred GeV to 1 TeV have been excluded depending on the production and decay scenarios. The stau exclusion limit is weaker, with masses up to several hundred GeV.

分会场一 / 179

Generic EFT for all Masses and Spins

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We propose a theory to systematically construct a complete set of on-shell effective operator bases involving massive particles with any spins. The amplitude bases involving massive fields can be factorized into two charged and neutral parts under the little groups of massive particles, respectively. The complete bases of these two parts can be constructed by the Young diagrams of Lorentz subgroup $SU(2)_R$ and global symmetry $SU(N)$ (N is the number of external particles), respectively, without any redundancies. The corresponding effective field theory bases with the lowest dimension can be obtained by eliminating the linear correlation bases from a complete but redundant set of bases with all possible polarization tensors. Based on this theory, the amplitude bases involving identical particles can be constructed by a matrix projection method. A generic massive effective field theory can thus be constructed automatically by computer programs.

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Study of low energy cosmic-ray muons with a spin spectroscopy array

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Cosmic-ray muons represent secondary particles produced by high-energy cosmic rays interacting with the Earth's atmosphere. Cosmic-ray muons as a natural source of muons with a wide energy range, and their polarization is an important feature. Muon spin spectroscopy, known as muon spin rotation/relaxation/resonance (μSR), allows for accurate measurement of muon polarization. The research group at Sun Yat-sen University (SYSU) develop a prototype Cosmic-Ray Muon Spin Spectroscopy (CRmuSR), aiming to measure the polarization of cosmic-ray muons. The system is instrumented with plastic scintillators coupled with SiPM readout by 512-channel electronics. The first round of tests exhibits a time resolution of better than 2ns. CRmuSR has achieved stable operation for a cumulative time exceeding 500 hours. Meanwhile, the Geant4 simulation and analysis tool is ready. Preliminary results will be reported in the talk. CRmuSR can help us measure the cosmic-ray muon polarization and explore the feasibility of constructing μSR apparatus. In the future, we wish that CRmuSR could be deployed in an array and potentially aid in the assessment of low-energy cosmic-ray muon properties. Combined analysis with atmospheric neutrinos can be expected.

分会场五 / 181

含时间信息的粒子束流望远镜系统的模拟研究

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在高亮度对撞环境下，未来的粒子物理实验将面临前所未有的空间兼时间上的高堆积率和高本底率。例如，在 HL-LHC 上，质子质子对撞的平均堆积水平（pile-up）将达到 200，是 LHC

上的三倍多。通过联合的高精度位置和时间测量信息对堆积的物理信号和本底信号进行精确“拆分”，是未来高亮度对撞机实验的谱仪系统的关键技术之一。例如，在 HL-LHC 阶段，ATLAS 将在径迹探测器端盖外侧安装基于高时间分辨的时间探测器（HGTD），利用径迹的时间信息来去掉仅利用空间信息无法区分的堆积本底。在桶部部分，人们也在探讨未来将内层硅像素探测器替换成含时间测量的 4D 硅像素探测器的可能性和物理潜力。

在探测器研发阶段，用于粒子径迹探测的束流望远镜是在真实环境下验证探测器原型的分辨和效率等性能的重要工具。为了避免多径迹引起的击中匹配错误，传统的束流望远镜的触发事例大多数为单径迹事例，以确保束流望远镜径迹与被测试探测器模块击中能精确匹配，但这大大影响了束流实验取数的速度。基于国际上新兴的通用径迹重建软件 ACTS, 我们研究了将含有时间信息的硅像素探测器应用于束流望远镜系统以提高可处理的径迹数/事例和最终的取数速度的可能性。同时，束流望远镜系统本身作为一个径迹探测器，其在含时间测量信息下的效率、分辨等径迹重建性能的改善，也为未来对撞机上的 4D 径迹重建研究提供了重要参考。

本报告将简单回顾国际上常用的粒子束流望远镜系统，并介绍基于 ACTS 的束流望远镜系统的全模拟和径迹重建，最后着重展示在含有不同分辨的时间测量信息情况下的 4D 束流望远镜的径迹重建性能的改善和在多径迹情况下的稳健性。

分会场五 / 182

正反缪子素转化实验（MACE）研发进展

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缪子素是正缪子和电子形成的类氢原子束缚态，正反缪子素转化实验（MACE）旨在寻找缪子素到反缪子素的自发转化过程。该过程是破坏两个单位轻子味的带电轻子味破坏（cLFV）过程，可探索 TeV 能标的超越标准模型的新物理。基于高流强缪子束流、高分辨率米歇尔电子谱仪、高精度正电子传输螺线管和高空间接收度的正电子谱仪，MACE 有望对该 cLFV 过程的灵敏度从当前的最优结果进一步提高两个数量级以上。本报告将介绍 MACE 的设计方案及相关研发进展，包括探测器系统及各子探测器设计、缪子素产生方法和靶设计、物理灵敏度估计及其他潜在物理目标的可能性。MACE 有望依托国内未来建成的缪子源取得世界领先的结果，并对超越标准模型的新物理提供更多实验依据。

分会场一 / 183

Initial Results on Higgs Pair Production in Multi-Lepton Channels with the ATLAS Experiment

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This talk presents the first comprehensive search for non-resonant Higgs boson pair (HH) production in multiple-lepton decay channels, including VVVV, VVtautau, tautautautau, yyVV, and yytautau, where V is W or Z boson. The analysis also explores decays of HH to bbZZ with the Z bosons decaying into leptons. Data is derived from proton-proton collisions at 13 TeV, captured by the ATLAS detector during LHC's Run 2, with an integrated luminosity of 140 fbˆ-1. While no evidence of HH production is observed, an upper limit is set on the signal strength, and 2sigma constraints are determined for the HHH coupling modifier, kappa_lambda.

分会场一 / 185

The Status of Muon g-2 Experiment at Fermilab and Slow Term Effect Study in Muon Anomalous Frequency Analysis

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In 2023, the Fermilab Muon g-2 collaboration reported the Run-2/3 results, achieving a precision measurement of the muon's anomalous magnetic moment at 0.20 ppm. The analysis for the combined dataset from Run-4/5/6 is nearing completion, aiming to surpass previous precision levels. The slow term effects, which have been identified as significant contributors to systematic uncertainties in earlier runs, are now being rigorously investigated to understand and minimize their impact. This presentation will focus on the recent status of the experiment and the study of slow term effects with the datasets from Run-4/5/6.

分会场三 / 186

Recent Progress in Electromagnetic Probes in Heavy-Ion Collisions

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分会场一 / 187

long-lived scalar search

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The ForwArd Search ExpeRiment (FASER,), is a recently installed detector at the LHC that can detect light, long lived particles. In this work we study the prospect of detecting light CP-even and CP-odd scalars at the FASER. We develop the general formalism for the scalar production and decay from mesons at LHC, given modified couplings of the scalars to the SM particles, as well as summarizing the relevant GeV-scale experiment constraints.

分会场一 / 188

Observation of Four-top-quark Production and Improving Top Quark Reconstruction Efficiency Using Machine Learning Method

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The recent observation of four-top-quark production at the ATLAS experiment in 2023 has highlighted the complexities involved in the reconstruction of heavy particles like the top quark. This process is particularly challenging due to issues such as missing momentum and the extensive permutations of jets. To address these challenges, we apply SPA-Net, a machine learning method, which significantly enhances jet-parton assignment accuracy and neutrino momentum prediction compared to traditional methods. The improvement in top quark reconstruction efficiency not only bolsters our understanding of the four-top-quark process but also opens avenues for extending SPA-Net's application to additional multi-lepton top quark channels.

分会场五 / 189

大型强子对撞机上 ATLAS 实验高颗粒度时间探测器

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将报告中国组在大型强子对撞机上 ATLAS 实验高颗粒度时间探测器的总体研制情况。LHC 将迎来高亮度升级。ATLAS 实验计划研制高颗粒度时间探测器，用于压制高亮度对撞带来的堆积本底。该探测器有 300 万个读出通道，每个通道对单个带电粒子的时间测量精度达到 30-50 皮秒，可以承受高亮度 LHC 升级的辐照量。中国组承担了该探测器 100% 的 LGAD 硅传感器的研制（高能所承担 90% 份额，科大承担 10% 的份额），这是国产硅传感器首次在 CERN 对撞机实验上使用。其中，高能所 LGAD 传感器在与日本滨松与意大利 FBK 研究所竞争中胜出。赢得欧洲核子中心的国际招标的全部份额（超过 1.5 万个全尺寸传感器，6 平方米）。另外，高能所与南大团队承担 100% 的外围电子学板的研制任务；高能所与科大团队承担 44% 探测器模块研制任务（高能所 34%，科大 10%）；高能所与山东大学合作承担高压电源模块的研制任务；山东大学承担了柔性电缆的研制任务。

分会场五 / 190

Development of LGAD for ATLAS HGTD and CEPC TOF out-tracker

Authors: Mei Zhao[1]; 梁志均 LIANG ZhijunN[one]; Mengzhao LI[2]; Yunyun Fan（樊云云）[3]; Weiyi SunN[one]; 田园张 N[one]

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Low- Gain Avalanche Detector (LGAD) with time resolution better than 50ps has been chosen as the sensors for HGTD project. The most important requirement of sensors for the project is radiation hardness, the sensor should collect more than 4fC charges and reach less than 50ps timing resolution at voltage(safe voltage for SEB) lower than 550V after irradiation(2.5e15neq/cm2). IHEP has developed the carbon enriched LGAD sensors, which show good radiaiton hardness.This talk will show the researches of irradiation-resistant LGAD for ATLAS HGTD.
The AC-coupled LGAD (AC-LGAD) is designed as detector with a 100% fill factor for high precision 4D-tracking. AC-LGAD can be used for the construction of time-track detectors in collider experiments such as CEPC. IHEP has also conducted extensive research on AC-LGAD. The strip-type AC-LGAD been fabricated with a lower than 0.2 P n+ layer dose to improve the spatial resolution, and different pad-pitch structures can also be fabricated and studied. This talk will also show the development of AC-LGAD for TOF out-tracker system.

分会场五 / 191

用于 Muon 系统的闪烁体探测器的研发

Authors: XiaoLong Wang[1]; 世明邹 [2]; 曦阳王 [3]; 鸿玉张 [4]

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基于日本 BEllE II 探测器的升级，其用于探测K_L 强子以及μ 子的 KLM 子探测器由 RPC 替换为塑料闪烁体，解决了 RPC 探测器长死时间在高亮度对撞实验中不适用的问题。目前 BELLE II KLM 探测器的方案为塑料闪烁体内嵌波长位移光纤与 SiPM(硅光电倍增管）进行耦合，这样的结构具有高的探测效率，并能保证 1.5 ns 的时间分辨。这样的结构同样适用于 CEPC 中的缪子探测系统。为了进一步提高时间分辨，我们对 TOF-like 的塑料闪烁体探测系统进行了研究，采用了新的耦合方式并升级了电子学系统，对于长塑料闪烁体可达到 70 ps 以下的时间分辨。

分会场一 / 192

Hightlights of recent diboson measurements in ATLAS

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This talk will discuss a few recent results from diboson sector in the ATLAS experiment, focusing on novelty and impact of these results. Propects will also be breifly discussed.

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The development and beam test result of high granularity crystal calorimeter prototype of VLAST

Authors: 研硕张 [1]; 乾陈 [1]; 云龙张 [1]; 一鸣胡 [2]; 灯意陈 [2]

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Very Large Area gamma ray Space Telescope (VLAST) is the next generation of flagship space observatory, which has a high acceptance of up to 10 m ˆ 2 · sr in the GeV - TeV range and strong detection capability in the MeV - GeV range. Its comprehensive performance is expected to be more than 10 times higher than that of the Fermi Large Area Telescope (Fermi-LAT). VLAST has four subdetectors: plastic scintillators as an anti-coincidence detector, silicon strip tracker with low energy gamma-ray convertors which are made of CsI (Tl) crystal, and a high energy 3D imaging calorimeter. The radiation length is about 20, and its sensitive area is close to 10 m ˆ 2 level. One option of this 3D calorimeter is designed by cubic BGO crystals with size of 3 × 3 × 3 cm ˆ 3. We have designed and developed a small calorimeter prototype which has 10 layers with 5 × 5 BGO crystal cubes per layer. Two avalanche photodiodes are coupled with every BGO crystal to achieve a 10 ˆ 6 high dynamic range. The cosmic ray test results show the MIPs signals are much clearer. The prototype assembled with other sub-detectors have been tested in CERN SPS and PS beam using high energy electrons and hadrons. The performance of the cubic calorimeter will be shown, include the energy linearity, resolution, and particle identification ability.

分会场一 / 194

Search for the non-resonant production of Higgs boson pairs in the bb⌧⌧ final state with the ATLAS detector

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This talk will present the latest search for the non-resonant production of Higgs boson pairs in the $HH \to b\bar{b}\tau^+\tau^-$ 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 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 $\mu_{HH} < 5.9$ (3.3) 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 $-3.1 < \kappa_\lambda < 9.0$ ($-2.5 < \kappa_\lambda < 9.3$) 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.

墙报展及评选 / 195

Detecting highly collimated photon-jets from Higgs boson exotic decays with deep learning

Authors: Chih-Ting LuN[one]; Ke LI[1]; Shih-Chieh HsuN[one]; William FengN[one]; Xiaocong Ai[2]

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Recently, there has been a growing focus on the search for anomalous objects beyond standard model (BSM) signatures at the Large Hadron Collider (LHC). This study investigates novel signatures involving highly collimated photons, referred to as photon-jets. These photon-jets can be generated from highly boosted BSM particles that decay into two or more collimated photons in the final state. Since these photons cannot be isolated from each other, they are treated as a single jet-like object rather than a multi-photon signature. The Higgs portal model is utilized as a prototype for studying photon-jet signatures.

In this paper, we will present the studies of photon-jet signatures in an ATLAS-like electromagnetic calorimeter with a full simulation of the electromagnetic showers using GEANT4. In particular, we will focus on the implementation of the three machine learning techniques: Boosted Decision Trees (BDT), Convolutional Neural Networks (CNN), and Particle Flow Networks (PFN) , and their identfication efficiency for photon-jet signatures from single photons and neutral pions within the SM backgrounds. The sensitivities for searching photon-jet signatures from the Higgs boson exotic decays at the High-Luminosity LHC will be also discussed.

分会场三 / 196

In-jet heavy Flavor Bayron-to-Meson yield ratios in p+p and Pb+Pb

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In-jet production is a useful tool to separate the contribution from the hard processes and the underlying events. In this letter, we find the in-jet requirement enhances the heavy flavor baryon-to-meson ratio more when a color re-connection mechanism (CR mode2) describes hadronization in p+p, which is opposite to the light flavor case. It indicates the hard process contribution alone will lead to an enhancement of the heavy flavor baryon-to-meson ratio using CR mode2 while the light flavor baryon-to-meson ratio enhancement is mainly coming from underlying events. When the hot and dense medium is involved in Pb+Pb collisions, the in-jet $^{+}_{c}/\mathrm{D}^{0}$ ratio also enhances at intermediate $\mathrm{p_T}$ when a coalescence + fragmentation hybrid approach is used to describe in-medium hadronization. To distinguish the mechanism of two types of enhancement, $^{+}_{c}/\mathrm{D}^{0}$ ratios as functions of particle-jet axis distances R for different jet $\mathrm{p_T}$ intervals are also been computed. The results indicate the enhancement described by the color re-connection mechanism is dominated by low $\mathrm{p_T}$ (< 2 GeV) enhancement and that described by a coalescence mechanism is dominated by intermediate $\mathrm{p_T}$ ($2 - 4$ GeV) enhancement. The detailed measurement of the in-jet $^{+}_{c}/\mathrm{D}^{0}$ ratios in p+p collisions at lower $\mathrm{p_T}$ will help constrain the baryon hadronization mechanism in the small system.

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江门中微子实验探测器技术研发及现状

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江门中微子实验（JUNO）是一个地下深达 700 米的低本底多物理目标实验，旨在利用反应堆中微子源测量中微子的质量顺序，并实现更高精度的中微子振荡参数测量。同时，JUNO 还具有探测超新星中微子、太阳中微子、大气中微子、质子衰变等领域的潜力。JUNO 的中心探测器是一个装有 2 万吨液体闪烁体的有机玻璃球，被浸泡在 3.5 万吨水切伦科夫探测器中。探测器共装有 20012 个 20 英寸光电倍增管和 25600 个 3 英寸光电倍增管，用于探测物理事例信号。JUNO 预期的能量分辨率将达到 3%/√E(MeV)，创造前所未有的精度。此外，顶部径迹探测器由塑料闪烁体构成，安装在水池顶部，旨在抑制宇宙线引起的本底信号。JUNO 探测器在设计和安装方面面临着巨大的技术挑战，目前正在紧张进行安装工作，预计于 2024 年底完成安装并开始数据采集。

分会场五 / 198

LGAD 探测器研发进展与展望

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LGAD 是一种新型半导体定时探测器。通过优化灵敏区厚度和内部增益，可以实现几十皮秒的时间分辨率。自提出以来，LGAD 技术得到了广泛的关注，发展非常迅速。目前，LGAD 已经成为较为成熟的探测器技术，被大型强子对撞机（LHC）的 CMS 和 ATLAS 实验 phase 2 升级项目采用。采用交流感应的方式引出信号，可以实现更灵活的电极排布，减小无增益区域，在保持高时间分辨率的基础上，进一步提高位置分辨率。本报告将综述国内外 LGAD 探测器的研发近期的进展情况，并展望未来可能的发展方向和应用场景。

分会场五 / 199

CEPC Ref-TDR 电子学-TDAQ 系统初步设计考虑

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环形正负电子对撞机（Circular Electron Positron Collider, CEPC）探测器系统设计当前正计划完成探测器参考技术设计报告（Reference Technical Design Report，Ref-TDR）。其中，电子学-TDAQ 系统计划依据本底模拟、子探测器基准设计完成总体框架设计。我们将基于通用型后端电子学、通用性触发系统设计，实现电子学-TDAQ 系统整体设计。基于通用数据-光纤接口、通用抗辐照电源模块，实现前端电子学系统的框架性设计。进一步的，基于各子探测器系统的基准方案，为其提出了针对性的前端电子学设计，将实现前端无触发的全后端触发架构。本报告将介绍 CEPC 电子学-TDAQ 系统的设计考虑、通用电子学框架，和各子探测器电子学读出方案。

分会场一 / 200

Search for a resonance decaying into a scalar particle and a Higgs

boson in final states with leptons and two photons in proton–proton collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector

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A search for a hypothetical heavy scalar particle, X, decaying into a singlet scalar particle, S, and a Standard Model Higgs boson, H, using 140 fb^{-1} of proton–proton collision data at the centre-of-mass energy of 13 TeV recorded with the ATLAS detector at the LHC is presented. The explored mass range is $300 \leq m_X \leq 1000$ GeV and $170 \leq m_S \leq 500$ GeV. The signature of this search is one or two leptons (e or μ) from the decay of vector bosons originating from the S particle, $S \to W^{\pm}W^{\mp}/ZZ$, and two photons from the Higgs boson decay, $H \to \gamma\gamma$. No significant excess is observed above the expected Standard Model background. The observed (expected) upper limits at the 95% confidence level on the cross-section for $gg \to X \to SH$, assuming the same $S \to WW/ZZ$ branching ratios as for a SM-like heavy Higgs boson, are between 530 (800) fb and 120 (170) fb.

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用于微结构气体探测器读出的多通道模数混合芯片研究

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微结构气体探测器（MPGD）由于其具有高位置分辨、便于大面积制作等优点而得到广泛关注，并逐渐被应用于新一代高能粒子探测实验中。然而，MPGD 探测器由于其电荷量较小、收集时间较长以及高颗粒度的特性，对读出电子学性能和集成度提出了新的挑战。同时，鉴于波形数字化技术能够提供最详尽的信息，可根据不同的应用需求选择最佳的信号处理模式。因此，有必要针对 MPGD 探测器的需求研究新型高精度波形全数字化读出芯片。

本研究描述了一款用于 MPGD 探测器的波形数字化读出原型芯片的设计与初步测试工作。该芯片的每个通道内包含模拟信号调理电路、可配置阈值的有效信号鉴别器、高速采样电容阵列以及并行量化模块。芯片包含 48 fC 至 10 pC 多个可选择的动态范围以适应不同的探测器增益，70 ns~1000 ns 共五个不同的成形时间以适应不同的输入信号与探测需求，每通道 8 bits 可配置甄别器阈值以适应不同的应用环境。该芯片已经流片，并完成了初步测试，核心性能达到设计目标。测试结果表明其单通道死时间小于 15 μs；在 20 pF 输入电容下，等效输入电荷噪声好于 0.5 fC，并同时具备时间测量能力。

分会场一 / 202

Combination of searches for Higgs boson decays into a photon and a massless dark photon using pp collisions at 13 TeV with the ATLAS detector

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A combination of searches for Higgs boson decaying into a visible photon and a massless dark photon(H->yyd) is presented using 139fb-1 of proton-proton collision data at a centre-of-mass energy of sqrt(s)=13TeV recorded by the ATLAS detector at the Large Hardron Collider. The ob-

served(expected) 95% confidence level upper limit on the Standard Model Higgs boson decay branching ration is determined to be B(H->yyd) < 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 imit on the cross section times branching ratio ranges from 16 fb (26 fb) for mH = 400 GeV to 1.0 fb (1.5 fb) for mH = 3 TeV. Results are also interpreted in the context of a minimal simplified model.

分会场五 / 203

CEE 多丝漂移室读出电子学系统设计

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国家自然科学基金重大仪器专项低温高密核物质测量谱仪 (CSR External-target Experimen，CEE) 是我国第一台运行于 GeV 能区、完全自主研制大型核物理实验装置。CEE 谱仪由若干子探测器系统构成, 其中前角区带电粒子的三维径迹测量采用多丝漂移室 (Multi Wire Drift Chamber，MWDC) 来实现，包含 3188 个读出通道。CEE 中的 MWDC 探测器对读出电子学的计数率、集成度、分辨率等指标都提出了更高的要求。基于分立元件的传统读出电子学存在功耗和集成度等弊端已无法满足要求。电子学系统包括前放模块，波形数字化模块和后端数字处理模块三部分。前放模块放置在探测器附近，基于 ASIC 芯片 FEAM(Front-End Amplifier for MWDC) 实现 32 通道探测器信号读出。波形数字化模块以子板形式放置于后端 CPCI 机箱内，基于 ASIC 芯片 GERO(GEneral ReadOut) 实现 32 通道探测器信号的波形数字化。后端数字处理模块设计为 CPCI 6U 载板，放置 3 个波形数字化模块，实现 96 通道探测器波形数据的在线时间和电荷信息提取。电子学系统实现能量分辨率好于 2%@300fC，时间分辨好于 500ps@300fC，并在束流测试中实现径迹残差约 301±2 μm，铁源能量分辨率约 22%，满足 CEE 实验需求

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CEPC 的时间飞行时间及外层径迹探测器研究

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CEPC 的现有气体探测器在 1-2 GeV 低能区的 k/pi、k/p 分辨能力下降明显，这将严重影响味物理研究的潜能，模拟发现使用飞行时间探测器提供的飞行时间信息将可极大提高其分辨能力。因此 CEPC 决定选择基于 AC-LGAD 技术为粒子提供 50 皮秒的时间分辨，CEPC 将在桶部和端盖处放置飞行时间探测器。设计成条状的单层 AC-LGAD 还将为粒子提供在 Phi 方向 10 微米的位置分辨，z 方向 1 微米位置分辨。即为 CEPC 提供带电粒子的时间和位置信息的 4 维探测能力，对 CEPC 上的味物理研究有重要意义。

分会场五 / 206

带电轻子味道破坏实验的缪子束流监测探测器研制进展

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COMET 实验致力于使用高强度缪子束流寻找 μ-e 转换这一带电轻子味破坏过程，并预期将现有结果提升两到四个数量级。COMET 合作组进行了 Phase-alpha 阶段的预研，为了对缪子束斑的结构进行监测，我们开发了一款基于塑料闪烁光纤和硅光电倍增器的缪子束流监测探测器，对缪子束流的时间和束斑结构进行了测量。为适应后续实验中更高强度的缪子束流，探测器目前正在进行升级开发。

分会场三 / 207

Probing jet evolution with energy correlators in a deconfined QCD matter

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Energy correlators have shed light on the properties of QCD splitting in vacuum, which should be modified due to nuclear effects in a deconfined QCD matter such as the quark-gluon plasma. By employing the recently developed multi-stage jet evolution framework JETSCAPE, we have investigated the nuclear modification of energy correlators for inclusive jets in heavy-ion collisions. We find energy correlators are significantly influenced by the splitting behaviors in the small angle region, and by the medium response in the large angle region. We also provide the theoretical predictions of energy correlators for ALICE and CMS measurements.

分会场五 / 208

STCF 上基于机器学习的粒子鉴别算法

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超级陶粲装置（STCF）是中国正在筹划的新一代正负电子对撞机，是研究宇宙中正反物质不对称、探索强子内部结构、寻找奇特态强子和新物理的独特平台。粒子鉴别（PID）作为 STCF 实验中各种物理研究中最基本的工具之一，对于实现 STCF 的各种物理目标至关重要。在最近几十年中，机器学习（ML）逐步成为高能物理实验中粒子鉴别的强大替代方法。ML 算法，例如神经网络和提升决策树，在处理复杂和多维数据方面表现出卓越性能，所以它们非常适合整合来自多个子探测器系统的粒子鉴别信息。在这项工作中，我们提出了一种基于 ML 技术的强大 PID 软件，包括一个全局 PID 算法用于合并所有子探测器信息实现带电粒子鉴别，以

及一个基于量能器响应区分中性粒子的深度 CNN 算法。初步结果显示基于 ML 的 PID 算法取得了出色的粒子鉴别性能，极大地提升了 STCF 的物理潜力。

分会场一 / 209

Low energy supernova constraints on new light particles

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We compute low energy supernova constraints on new light particles.

分会场五 / 210

Application GNN/QAOA on Jet-Origin-Identification/Jet-Clustering

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The rapid development of Deep Learning and Quantum Computing has benefited or potentially will benefit high-energy physics experiments. To enhance the scientific discovery power of high-energy collider experiments, we propose and realize the concept of jet-origin identification, which categorizes jets into five quark species (b, c, s, u, d), their corresponding antiquarks, and the gluon. We uniquely solve jet clustering using the Quantum Approximate Optimization Algorithm (QAOA). For small-scale jet clustering problems, the QAOA has achieved performance similar to the classical jet clustering algorithm, ee_kt.

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STCF 上的桶部粒子鉴别探测器 RICH 研究

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超级 τ-粲装置（STCF）是中国粒子物理学界提出的一种工作在 2~7GeV 质心能量下的电子-正电子对撞机。它将为探索 τ-粲物理、奇特强子态和超出标准模型的物理提供一个平台。对于该装置，在整个动量范围内进行粒子鉴别（PID）是至关重要的。STCF 的 PID 系统位于电磁量能器和主漂移室之间，并专注于高动量的带电强子，从约 0.7GeV/c 到 2GeV/c。环形成像切伦科夫（RICH）探测器是可以在圆筒区域满足这些要求的技术之一。

本报告给出了 PIDB RICH 探测器的结构设计，研究了 RICH 探测器的预期性能。其将使用全氟己烷作为切伦科夫辐射体，碘化铯作为光阴极；并使 Micro-Megas 联合 AGET 电子学进行信号读出。通过 Geant4 模拟给出的结果显示该设计下 RICH 重建方法可以满足 STCF 对于强

子 PID 的要求。此外，本报告还将介绍探测器原理样机的制作，性能测试及宇宙线实验的最新结果。

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STCF 模拟和离线事例重建软件

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With an electron-positron collider operating at center-of-mass-energy 2~7 GeV and a peak luminosity above 0.5 × 1035 cm−2 s−1, the STCF physics program will provide an unique platform for in-depth studies of hadron structure and non-perturbative strong interaction, as well as probing physics beyond the Standard Model at the τ-Charm sector suceeding the present Being Electron-Positron Collider II (BEPCII). A performant, extendable and maintenable offline event processing software to reconstruct and identfiy particles and events is very crucial to the design and construction of the detectors, and to eventually fulfill the physics targets and to further maximize the physics potential at the STCF.
In this talk, I will give an overview of the STCF offline event processing software, focusing on the event reconstruction algorithms and physics analysis tools implemented for STCF and their performance. Innovative algorithms such as machine learning techniques which are exploited to maximize the overall performance will be highlighted.

分会场五 / 214

ML for fast calorimeter simulation

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Generative networks, such as ChatGPT, have recently gained significant popularity. There are also many applications of generative networks in the field of particle physics. One area of active research focuses on the development of fast simulation methods for calorimeters. This research is primarily driven by the experiments conducted at the LHC. In the upcoming HL-LHC phase, a substantial volume of experimental data will be collected. For MC simulation, it is necessary to generate samples with statistics that exceed those of the experimental data, which consumes a significant amount of computational resources. Without conducting relevant research and development, there is a risk of facing a shortage of computational resources.

In traditional Geant4 simulation methods, the simulation of calorimeters is the most time-consuming part. By employing fast simulation methods based on machine learning, it can greatly accelerate this process, thereby addressing the issue of limited computational resources. This presentation will introduce the use of machine learning for fast calorimeter simulation and explore its applications in different experiments.

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阿尔法磁谱仪（AMS）宇宙线原子核能谱最新测量结果

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阿尔法磁谱仪（AMS）安装在国际空间站上，自 2011 年 5 月运行以来，已收集了超过 2360 亿个宇宙线事例。目前 AMS 在 GV 至 TV 的刚度范围内，精确测量了质子（电荷 Z=1）到硅（Si，Z=14）以及硫（S，Z=16）、铁（Fe，Z=26）等原子核的流强。本报告将介绍 AMS 关于初级、次级以及第三类宇宙线原子核能谱测量的最新结果，讨论这些原子核在 GV 至 TV 能量范围内的能谱特征与结构，以及 AMS 使用模型无关的方法所得到的宇宙线源的元素丰度。这些实验结果为研究宇宙线的起源提供了独特的实验数据。

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Physics potential of Lepton beams: muon source neutrino oscillation and Quantum entaglement search in a Muon Collider

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In this talk I will present our recent work on determination of Charge-Parity violation in neutrino oscillation and search for quantum entanglement in a Muon Collider.
Using GeV-scale muon beams produced from electron-positron collision, we have neutrino sources rich in flux that can be used for long-base line neutrino oscillation experiments such as DEUN, NOvA and T2K.

Up to 1000 pseudo experiments are conducted by simulating muon collider with CM energy of 1 TeV to probe quantum entanglement and evaluate the value of Bell inequality for two qutrits composed of massive vector boson.

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Estimate the magnetic field in heavy-ion collisions by virtual photon polarization and dilepton anisotropy

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The measurement of the magnetic field created in high-energy heavy-ion collisions is challenging, due to the fact that the magnetic field decays so drastically that in a thermalized quark-gluon plasma the field strength becomes rather weak. By incorporating the weak magnetic effect into the medium, and especially into the production formalism of dileptons from the quark-gluon plasma, the effect of dilepton polarization is studied through the dilepton angular distribution. We find that the anisotropic coefficients in the dilepton spectrum are quite sensitive to the orientation and strength of the weak field. Accordingly, these coefficients provide ideal probes for the magnetic field in realistic experiments.

分会场五 / 219

Pattern recognition at CEPC AHCAL prototype using test beam data at CERN

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A particle flow oriented high granularity Analog Hadronic Calorimeter (AHCAL) has been designed for the Circular Electron Positron Collider (CEPC). An AHCAL prototype consisting of 40 longitudinal layers with a transverse granularity of , using scintillator tiles as active material and stainless steel as absorber, has been constructed and tested at the CERN SPS H2 beam line. About 30 millions of test-beam data corresponding to muon, electron, and charged pion events are collected.

We developed a pattern recognition algorithm based on fractal dimension and average hit energy. The FD serves as a characteristic property of a fractal, providing a quantitative descriptor of the complexity of the shower shape, and is designed for high granularity calorimeters with good separation power. Using this algorithm, we quantified the PID efficiency with Monte Carlo samples. The noise, MIP, EM, hadronic components and other interesting events in the data are observed and separated by artificial cuts. The fractions of these components as a function of beam energy are estimated. This algorithm performed a good purity analysis of the test beam data.

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Performance studies of a SiPM-readout system with a pico-second timing chip

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A pico-second timing (PIST) front-end electronic chip has been developed using $55\ \mathrm{nm}$ CMOS technology for future electron-positron collider experiments (namely Higgs factories). Extensive tests have been performed to evaluate the timing performance of a dedicated SiPM-readout system equipped with a PIST chip. The results show that the system timing resolution can achieve $30\ \mathrm{ps}$ for SiPM signals corresponding to minimum-ionizing particles (MIP) level ($200\ \mathrm{p.e.}$) and better than $10\ \mathrm{ps}$ for signals larger than $800\ \mathrm{p.e.}$, while the PIST intrinsic timing resolution is $4.76 \pm 0.09\ \mathrm{ps}$. The time-over-threshold (ToT) response of the PIST ASIC has been attained, which can cover the SiPM response spanning from $560\ \mathrm{p.e.}$ to $25,000\ \mathrm{p.e.}$

分会场五 / 223

NvDEx 读出与数据获取系统研究进展

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NvDEx（No Neutrino Double-beta-decay Experiment）是基于高压气体时间投影室（Time Projection Chamber，TPC）新型无雪崩放大电荷测量技术来寻找六氟化硒无中微子双贝塔衰变现象的实验。实验气腔的端盖处可容纳一个直径为 0.9 米的读出平面，大约由 10000 个 Topmetal-S 传感器组成。本报告将介绍其读出电子学与数据获取系统的方案，及相关芯片和电子学的研究进展。前端芯片包括 Topmetal-S 传感器、波形数字化与读出控制芯片。前者实现电荷收集，并集成片内电荷灵敏放大、输出缓冲、偏压设置等模块，后者完成波形数字化及芯片间的数据路由。报告也将介绍基于 Topmetal-S 与商用芯片的 19 像素前端读出电子学原型样机研制。该样机被用于芯片的集成测试及前端读出模块的方案验证。与负压离子 TPC 的集成测试表明，其具备径迹测量能力。目前的测试与优化则集中于电荷的收集效率、能量的测量。

分会场五 / 224

Automatic module assembly and loading system development for ATLAS HGTD

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The ATLAS HGTD detector has 8032 modules, which consists of a module flex and two bare modules(LGAD sensor bump-bonded to an ASIC).About 33% of the modules will be assembled at IHEP. A high-precision robotic pick-and-place system is developed, with camera locating and robotic arm for picking and placing. This system is also used for detector unit loading, which is to place the modules into array and be glued to a PEEK support unit. Now the assembly rate reaches assemble >10 modules/day, 20modules/day in maximum. The assembled modules and detector units are tested locally to make sure they are well working. Thermal simulation and other simulation are performed to study the results from thermal and mechanical performance.

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Leptogenesis assisted by scalar decays

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We present a pragmatic approach to lower down the mass scale of right-handed neutrinos in leptogenesis by introducing a scalar decaying to right-handed neutrinos. The key point of our proposal is that the out-of-equilibrium decays of the scalar provide an additional source for right-handed neutrinos and hence the lepton asymmetry. This mechanism works well at low temperatures when the washout of the generated lepton asymmetry is suppressed. Thus, the lepton asymmetry can be effectively produced despite the washout effect is strong or not. Through a comprehensive analysis, we demonstrate that such a scalar-assisted leptogenesis can typically decrease the viable right-handed neutrino mass scale by two to four orders of magnitude.

分会场一 / 227

Probing Neutral Triple Gauge Couplings via Zγ(ℓ+ℓ−γ) Production at e+e− Colliders

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Neutral triple gauge couplings (nTGCs) are absent in the Standard Model (SM) and at the dimension-6 level in the Standard Model Effective Field Theory (SMEFT), arising first from dimension-8 operators. As such, they provide a unique window for probing new physics beyond the SM. These dimension-8 operators can be mapped to nTGC form factors whose structure is consistent with the spontaneously-broken electroweak gauge symmetry of the SM. In this work, we study the probes of nTGCs in the reaction $e^+e^- \to Z\gamma$ with $Z \to \ell^+\ell^-(\ell = e,\mu)$ at an e^+e^- collider. We perform a detector-level simulation and analysis of this reaction at the Circular Electron Positron Collider (CEPC) with collision energy $\sqrt{s} = 240$ GeV and an integrated luminosity of 5 ab^{-1}. We present the sensitivity limits on probing the new physics scales of dimension-8 nTGC operators via measurements of the corresponding nTGC form factors.

分会场一 / 228

Combination of searches for heavy spin-1 resonances with the ATLAS detector

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A combination of searches for new heavy spin-1 resonances decaying into different pairings of W, Z, or Higgs bosons, as well as directly into leptons or quarks, is presented. The data sample used corresponds to 139 fb−1 of proton-proton collisions at $\sqrt{s}$ = 13TeV collected during 2015–2018 with the ATLAS detector at the CERN Large Hadron Collider. Analyses selecting quark pairs (qq, bb, tt, and tb) or third-generation leptons (τν and ττ) are included in this kind of combination for the first time. A simplified model predicting a spin-1 heavy vector-boson triplet is used. Cross-section limits are set at the 95% confidence level and are compared with predictions for the benchmark model. These limits are also expressed in terms of constraints on couplings of the heavy vector-boson triplet to quarks, leptons, and the Higgs boson. The complementarity of the various analyses increases the sensitivity to new physics, and the resulting constraints are stronger than those from any individual analysis considered.

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Combination of searches for Higgs boson decays into a photon and a massless dark photon using pp collisions at √s = 13 TeV with the ATLAS detector

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Ref. https://arxiv.org/abs/2406.01656

A combination of searches for Higgs boson decaying into a visible photon and a massless dark photon ($H \to \gamma\gamma_d$) is presented using 139 fb^{-1} of proton–proton collision data at a centre-of-mass energy of √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 $Br(H \to \gamma\gamma_d) < 1.3\%$ (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.

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Fiducial and differential cross-section measurements of electroweak Wγjj production in pp collisions at √s = 13 TeV with the ATLAS detector

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Ref. https://arxiv.org/abs/2403.02809

The observation of the electroweak production of a W boson and a photon in association with two jets, using pp collision data at the Large Hadron Collider at a centre of mass energy of √s = 13 TeV, is reported. The data were recorded by the ATLAS experiment from 2015 to 2018 and correspond to an integrated luminosity of 140 fb^{-1}. This process is sensitive to the quartic gauge boson couplings via the vector boson scattering mechanism and provides a stringent test of the electroweak gauge symmetry breaking of the Standard Model. Events are selected if they contain one electron or muon, missing transverse momentum, at least one photon, and two jets. Multivariate techniques are used to distinguish the electroweak Wγjj process from irreducible background processes. The observed significance of the electroweak Wγjj process is well above six standard deviations, compared to an expected significance of 6.3 standard deviations. Fiducial and differential cross sections are measured in a fiducial phase space close to the detector acceptance, which are in reasonable agreement with leading order Standard Model predictions from MadGraph5+Pythia8 and Sherpa. The results are used to constrain new physics effects in the context of an effective field theory.

分会场一 / 231

Search for pair production of boosted Higgs bosons via vector-boson fusion in the bbbb final state using pp collisions at √s = 13 TeV with the ATLAS detector

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Ref. https://arxiv.org/abs/2404.17193

A search for Higgs boson pair production via vector-boson fusion is performed in the Lorentz-boosted regime, where a Higgs boson candidate is reconstructed as a single large-radius jet, using 140 fb^{-1} of proton-proton collision data at $\sqrt{s}$ = 13 TeV recorded by the ATLAS detector at the Large Hadron Collider. Only Higgs boson decays into bottom quark pairs are considered. The search is particularly sensitive to the quartic coupling between two vector bosons and two Higgs bosons relative to its Standard Model prediction, κ_{2V}. This study constrains κ_{2V} to $0.55 < \kappa_{2V} < 1.49$ at 95% confidence level. The value $\kappa_{2V} = 0$ is excluded with a significance of 3.8 standard deviations with other Higgs boson couplings fixed to their Standard Model values. A search for new heavy spin-0 resonances that would mediate Higgs boson pair production via vector-boson fusion is carried out in the mass range of 1-5 TeV for the first time under several model and decay-width assumptions. No significant deviation from the Standard Model hypothesis is observed and exclusion limits at 95% confidence level are derived.

墙报展及评选 / 233

R&D of Dark SHINE Electromagnetic Calorimeter

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DarkSHINE, a fixed-target experiment leveraging the SHINE facility for light dark matter (LDM) detection, utilizes an 8 GeV electron beam with a 1-10 MHz repetition rate. Dark SHINE ECAL plays a crucial role in the precise measurement of recoil electron energies. This ECAL, featuring a homogeneous LYSO crystal scintillator structure, is designed for exceptional energy resolution, rapid response, and high radiation tolerance. Radiation background within the ECAL has been estimated using Geant4 simulations, revealing an equivalent 1MeV neutron flux of approximately 10^{13} for the most irradiated cell. Many laboratory experiments have been conducted to evaluate the light yield, uniformity, and dynamic range of the crystal units. Moreover, a LYSO ECAL prototype has been developed and subjected to a beam test with a 4-channel LYSO unit to assess its high-energy beam response. Future efforts will focus on constructing a larger-scale detector prototype to thoroughly validate the proposed design.

分会场五 / 234

Particle Flow Algorithm for Long Crystal Bar ECAL

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The precise measurements of the Higgs, W and Z boson properties at future electron-positron collider will provide critical tests of the Standard Model (SM) and are essential in the exploration of new physics beyond the SM (BSM). To distinguish the hadronic decays of W and Z bosons, a 3-4% jet energy resolution for two-jet systems is required. The particle flow approach, which aims to

measure individual particles in jets using imaging calorimeter system, is a very promising method to achieve the unprecedented jet energy resolution.

A novel electromagnetic calorimeter (ECAL) with orthogonally arranged crystal bars has been proposed. The crystal bar design is expected to provide optimal intrinsic energy resolution and three-dimensional shower information for the particle flow algorithm (PFA). Additionally, the long bar design will significantly reduce the cost of electronics. However, the crystal bar ECAL also presents challenges, such as the potential ambiguity problem for multiple particles due to the perpendicular arrangement of crystal bars in adjacent layers and increased shower overlap from different particles caused by the larger R_M and X_0/λ_I for crystals.

This report presents recent progress on the new PFA dedicated to the crystal bar ECAL. The ambiguity problem has been addressed through the implementation of multiple optimized pattern recognition approaches, while the issue of shower overlap has been mitigated by an energy splitting module. The development of the PFA takes into account various aspects including electronics, heat dissipation, mechanical support, and digitization processes of ECAL. The algorithm's performance, including a boson mass resolution of approximately 3.9%, will be demonstrated. These results underscore the potential of the proposed ECAL design and the PFA in enhancing detector capabilities and reconstruction methodologies for future electron-positron collider experiments.

分会场五 / 235

A Design of Hadronic Calorimeter for Dark SHINE Experiment

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Ref. https://arxiv.org/abs/2311.01780

The sensitivity of the dark photon search through invisible decay final states in low background experiments significantly relies on the neutron and muon veto efficiency, which depends on the amount of material used and the design of detector geometry. This paper presents an optimized design of a hadronic calorimeter (HCAL) used for the DarkSHINE experiment, which is studied using a GEANT4-based simulation framework. The geometry is optimized by comparing a traditional design with uniform absorbers to one that uses different thicknesses at different locations of the detector, which enhances the efficiency of vetoing low-energy neutrons at the sub-GeV level. The overall size and total amount of material used in HCAL are optimized to be lower due to the load and budget requirements, while the overall performance is studied to meet the physical objectives.

分会场一 / 236

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 □□□□□□ 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. 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.

分会场五 / 237

高能宇宙辐射探测设施 (HERD) 离线数据处理软件

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高能宇宙辐射探测设施 (HERD) 是计划部署在中国空间站上的科学装置，它的主要科学目标包括间接探测暗物质、精确测量宇宙线能谱以及高能伽马射线巡天观测。HERD 离线软件 (HERDOS) 是整个实验的重要组成部分，主要负责离线数据处理，包括蒙特卡洛模拟、刻度、重建和物理分析等。HERDOS 以我国自主研发的轻量级的 SNiPER 软件框架为基础，同时利用了一些高能物理中最先进的第三方软件，例如 DD4hep、podio、TBB 等。
本文将概述 HERDOS 的设计和实现细节，具体将讨论以下内容：
1. 基于 podio 设计的事例数据模型 (EDM)，以及通过整合 SNiPER 和 podio 实现的数据管理系统 (DMS)。
2. 基于 SNiPER 和 TBB 实现的并行化的数据管理系统，包括基于 podio 开发的 GlobalStore，以实现并发数据访问和数据输入输出。
3. 基于 MT-SNiPER 开发的并行化的探测器模拟系统，包括事例级别和径迹级别的并行模拟。
4. 基于 DD4hep 开发的几何管理系统，可以提供一致的的探测器描述以及获取探测器描述信息的接口。
目前，HERDOS 已经在探测器设计等方面实现有效运行，同时在物理研究上也有着巨大潜力。

墙报展及评选 / 238

Studies on timing performance of BGO crystal scintillator

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The future Circular Electron-Positron Collider (CEPC) is envisioned as a large-scale Higgs factory. For the CEPC detector system, a highly granular crystal electromagnetic calorimeter has been proposed to provide 5D information, incorporating x, y, z, E, and t dimensions. This calorimeter features a homogeneous structure with long crystal scintillator bars as the active material, with BGO and SiPM being the preferred components. Time information plays an increasingly critical role in calorimeters. It not only helps to distinguish pile-up effects but also aids in particle identification, shower reconstruction, and enhances the energy resolution of the calorimeter. Consequently, optimizing and understanding the timing performance of this detector design is essential.
The timing resolution of the detector unit, which consists of a BGO crystal and two SiPMs, was optimized using various methods through cosmic ray experiments. The best time resolution at the 1-MIP level for a 40 cm BGO crystal coupled with a specific SiPM is around 1 ns. In beam tests conducted in 2023, the timing resolution of BGO crystal bars under high-energy electron showers was studied, achieving a resolution of 200 ps for signals exceeding 12 MIPs. The study also found that shorter crystals exhibited better time resolution, and the long crystal bars demonstrated good timing resolution uniformity. Additionally, simulations were conducted to investigate the impact of various factors on timing resolution, such as crystal length, decay time, and light yield, as well as the timing characteristics of new materials like BSO.

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AMS 实验测量宇宙线粒子流强随时间变化最新结果

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阿尔法磁谱仪（AMS）是安装在国际空间站上的大型精密磁谱仪实验，能够同时精确测量物质和反物质能谱。带电宇宙线进入日球层后因太阳调制而发生流强的改变，太阳活动则导致宇宙线流强随时间而变化。精确测量不同种类、不同能量的宇宙线粒子流强随时间的变化是认识宇宙线日球层传播过程，研究太阳调制效应的重要实验手段。本报告将介绍 AMS 实验宇宙线质子、反质子、氦核、电子、正电子流强时间结构测量的最新结果，展现宇宙线太阳调制与电荷符号等因素的相关性。

分会场五 / 240

STCF DTOF 上基于经典/量子卷积神经网络的 PID 算法研究

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超级陶粲装置（STCF）是中国未来的正负电子对撞机，其质心能量范围为 2-7 Gev，峰值亮度可达$0.5 \times 10^{35}\ \mathrm{cm}^{-2}\ \mathrm{s}^{-1}$。在 STCF 中，许多物理过程的末态粒子动量较高，这便对高动量粒子的鉴别提出了更高的要求。比如在动量达 2Gev/c 时，需要对π 的鉴别效率超过 97%，同时K 的误鉴别率低于 2%。因此，STCF 设计了两个切伦科夫探测器（RICH 和 DTOF）来提高粒子鉴别（PID）性能。
针对 STCF 中的π/K 鉴别问题，我们在 DTOF 探测器上开发了一个基于卷积神经网络（CNN）

的 PID 算法，该算法主要利用了切伦科夫光子在多阳极微通道板光电倍增管处的击中通道和到达时间。目前，CNN 算法在绝大部分动量和角度范围内，对π 的鉴别效率达到了 99%，充分满足了 STCF 的物理需求。此外，基于经典 CNN，我们还进行了量子卷积神经网络（QCNN）的概念验证研究，以探索其可行性和潜在的量子优势。初步结果表明 QCNN 在相同数据集上具有优于经典 CNN 的潜力。

墙报展及评选 / 241

Productions of light nuclei and hyper-nuclei in heavy-ion collisions at the LHC

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We extend an analytical coalescence model to include the hyperon coalescence besides the nucleon coalescence to simultaneously study production properties of light nuclei and hyper-nuclei in heavy ion collisions at the LHC. We derive the formula of the momentum distribution of two baryons coalescing into deuteron-like states and that of three baryons coalescing into triton-like states. We explain the centrality-dependent behaviors of the coalescence factors B_2 and B_3, the transverse momentum spectra, averaged transverse momenta, yield rapidity densities and yield ratios of the deuteron, anti-helium-3, anti-triton and hypertriton measured by the ALICE collaboration. We give predictions of different Ω-hypernuclei, e.g., $H(n\Omega)$, $H(\Omega\Omega)$, $H(nn\Omega)$ and $H(n\Omega\Omega)$, for further experimental measurements.

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Neutrino Mass Measurement with Cosmic Gravitational Focusing

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We thoroughly explore the cosmic gravitational focusing of cosmic neutrino fluid (CvF) by dark matter (DM) halo using both general relativity for a point source of gravitational potential and Boltzmann equations for continuous overdensities. Derived in the most general way for both relativistic and non-relativistic neutrinos, our results show that the effect has fourth power dependence on the neutrino mass and temperature. With nonlinear mass dependence which is different from the cosmic microwave background (CMB) and large scale structure (LSS) observations, the cosmic gravitational focusing can provide an independent cosmological way of measuring the neutrino mass and ordering. We take DESI as an example to illustrate that the projected sensitivity as well as its synergy with existing terrestrial neutrino oscillation experiments and other cosmological observations can significantly improve the neutrino mass measurement.

墙报展及评选 / 243

CEPC 漂移室模拟与径迹重建算法

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环形电子正电子对撞机（CEPC）旨在精确测量希格斯玻色子的性质，研究 W 和 Z 玻色子的电弱相互作用，并寻找超出标准模型范围的新物理。作为 CEPC 第四种概念探测器设计方案的子探测器之一，漂移室有助于精确测量带电粒子的动量和径迹。本次报告将介绍基于 Geant4 的模拟和径迹重建在 CEPC 漂移室中的实现，主要包括：
1. CEPC 漂移室的模拟和重建软件的开发。
2. 对漂移室设计进行的详细的探测器模拟。
3. 用于径迹寻找和拟合的专用算法的开发。
4. 分别使用单粒子和物理事件进行性能研究。
结果显示，动量分辨和径迹效率均满足 CEPC 实验的要求。

分会场一 / 244

Quantum Simulations for Lattice QCD

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Quantum simulation of High Energy Physics (HEP) has seen remarkable growth in recent years. Nevertheless, there is a continuous need for advancements in the overall simulation framework. In my talk, I will first motivate the critical need for quantum computing in HEP and discuss recent developments. Then I will explore the roles of gauge redundancies in simulating field theories on a quantum computer, focusing on a specific element - digitization, the step to encode field variables into qubits. This is particularly relevant for gauge theories with local symmetries and field variables of infinite dimension. I will present the existence of error thresholds below which gauge-redundant digitizations combined with error correction provide higher fidelity than removing these redundancies.

墙报展及评选 / 245

Measurement of alpha contamination of Po210 using a BGO cryogenic bolometer

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基于声子探测的新型荧光-热量两维读出低温晶体量热器技术，具有高能量分辨率和独特粒子鉴别能力，在低本底测量、稀有核衰变寻找等领域极具竞争力。
报告主要介绍以 BGO 为核心吸收体的光-热两维读出晶体量热器研制，通过 mK 深冷低温测试，介绍针对 BGO 低温晶体量热器的最佳工作点的选取，基线的稳定性修正以及光热符合分析等；结果给出 BGO 晶体内 Po210 等 alpha 放射性污染含量、探测器能量分辨、以及 alpha v.s. beta/gamma 粒子鉴别能力。

分会场五 / 246

基于 GNN 的漂移室径迹重建算法

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径迹重建是对撞机实验离线数据处理中最重要和最具挑战性的任务之一。针对漂移室的径迹重建先前已有了大量成功的研究工作，例如用于径迹寻找的模式识别（PAT）、径迹段寻找（TSF）以及霍夫变换（Hough transform），用于径迹拟合的最小二乘法、龙格库塔拟合和卡尔曼滤波等。然而，传统的径迹重建算法在处理低动量径迹、来自次级顶点的径迹和高噪声水平的情况下仍存在一定的局限性。为了克服这些挑战，本研究提出了一种基于图神经网络的新型漂移室径迹重建算法，旨在提高寻迹性能。首先，利用大量的 MC 样本建立了表示漂移单元之间相邻关系的模式库，并设计了相应的构图方法，然后训练了一个边分类的图神经网络来区分径迹上的击中和噪声击中。接下来，通过 DBSCAN 联合 RANSAC 算法在参数空间对筛选出的击中进行聚类，聚类出的候选径迹经过 GENFIT2 拟合，最终得到径迹参数。将该方法用于处理 BESIII MC 样本和 STCF MC 样本，均取得了良好的初步结果，并展现出了在其他含漂移室实验（如 CEPC 和 BELLE II）中的潜力。

分会场五 / 247

CSR 外靶实验零度角量能器的研制及其物理性能

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低温高密核物质测量谱仪，即兰州重离子加速器冷却储存环外靶实验（CSR External target Experiment，简称 CEE），将是我国第一台运行于 GeV 能区的完全自主研制的大型核物理实验装置。CEE 实验通过对重离子碰撞产物的近全空间测量，对低温高密相区的核物质状态的结构和性质开展深入研究。在 CEE 谱仪下游方向的束流线附近设计零度角量能器（Zero-Degree Calorimeter，简称 ZDC），测量前角区带电粒子在探测器中的沉积能量和位置分布，用于重建碰撞事件平面和确定事件中心度。ZDC 可实现 500 MeV 铀-铀碰撞的事件平面重建和事件中心度区分，物理模拟结果表明一阶事件平面分辨率可达 90%，基于机器学习方法，在 95% 纯度条件下对中心碰撞和边缘碰撞的分类效率分别为 41% 和 94%。ZDC 采用“塑闪 + 光导 + 真空光电倍增管”的探测器设计方案，并采用“多通道电荷灵敏前放 + 波形数字化”的电子学读出方案，在电子学性能、宇宙线和束流（350 MeV 的 Kr 束轰击铁靶）测试中运行稳定，各项性能达到了设计要求。本文将从 CEE/ZDC 探测器的设计、研制和物理性能等方面进行汇报。

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大型超高能伽马源立体跟踪装置（LACT）项目进展

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LHAASO has found more than 40 UHE cosmic accelerators within the Milky Way, with the highest energy photon reaching 1.4 quadrillion electron-volts, the highest energy photon ever observed. Most of these sources are extended sources that require telescopes with higher angular resolution and sensitivity to observe and study their morphology. Therefore, we propose a new project: Large Array of imaging atmospheric Cherenkov Telescopes (LACT). LACT is designed to have 32 telescopes and achieve the angular resolution better than 0.05° above 10 TeV. 32 telescopes will be placed in the LHAASO detector array, the LHAASO muon detector array can provide huge gamma proton discrimination power, increasing the gamma ray observation sensitivity above 10 TeV. Above 100TeV, the sensitivity, with a 500-hour exposure on a single gamma-ray source, is designed to match the sensitivity of LHAASO for one year. This allows us to identify the gamma ray sources in PeVatrons and measure their morphology in detail, which can help us to reveal the mechanism of the gamma ray emission and then deeply explore the origin of the high energy cosmic rays. Each LACT telescope has a FoV of 8° with pixel size of 0.2°. This talk will introduce the design and properties of the LACT, construction plan, as well as the information of prototypes.

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CDEX 实验研究进展与展望

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CDEX 合作组使用高纯锗半导体探测器在位于四川西昌的中国锦屏地下实验室（CJPL）开展暗物质探测和无中微子双贝塔衰变实验研究。本报告将总结 CDEX-1 和 CDEX-10 两个实验阶段的物理成果，并介绍目前正在建设的 CDEX-50 暗物质实验和 CDEX-300v 无中微子双贝塔衰变实验，以及面向未来大型高纯锗阵列实验的一系列关键技术预研。

分会场五 / 250

新一代超高亮度正负电子对撞实验触发系统设计与性能研究

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正负电子对撞实验是开展粒子物理前沿研究的重要平台。高亮度意味着更多有效物理数据，实现更高的峰值亮度和积分亮度是取得新的物理突破的有效手段。触发系统是整个数据获取与处理流程的第一步。随着亮度和物理事例率的提升，实验对触发率、本底水平、触发延迟的需求也不断升高，需结合超高亮度实验环境设计并实现全新的高性能触发系统。超级陶粲装置是我国提出研究的 GeV 能区超高亮度正负电子对撞实验，我们基于此平台设计了新的触发系统并通过模拟、实验等方式研究其性能优化方向，以期为下一代高亮度正负电子对撞实验的触发系统开拓新的研究方向。

分会场一 / 251

A review of Higgs physics results from ATLAS

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A review of Higgs property measurement from ATLAS including both the di-Higgs and single Higgs measurement.

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RELICS 探测器的电场设计和光学模拟

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中微子-原子核相干弹性散射 (CEνNS) 为研究中微子性质和寻找超标准模型物理提供了一种独特的探测手段。RELICS 实验利用液氙时间投影室 (LXeTPC) 探测核反应堆中微子与氙原子核之间的 (CEνNS) 过程，LXeTPC 技术通过同时探测瞬发闪烁光 (S1) 和电离电子的正比闪烁光 (S2) 来测量粒子沉积能量。我们的研究主要集中在提高 TPC 内部漂移电场的均匀性，进而提高信号事件的三维位置重建精度；通过光模拟评估 S1 信号的光采集效率，优化底部 PMT 阵列的设计。在本报告中，我们将详细介绍 RELICS TPC 的漂移电场模拟和优化方法，以及 S1 光模拟和底部 PMT 阵列的优化工作。

分会场五 / 253

CEE 中飞行时间探测器读出电子学研制进展

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飞行时间探测器是大型核与粒子物理实验的重要组成部分。正在建设的低温高密核物质谱仪（CEE）中，飞行时间探测器包括内部飞行时间探测器（iTOF）和端盖飞行时间探测器（eTOF），二者均采用气隙电阻板室（MRPC）技术制造。对于电子学，要求实现最高 ~10 ps 的时间测量精度。本报告将介绍基于放大甄别结合高精度时间数字变换技术的高精度时间测量电子学系统设计、电子学与探测器联合测试以及束流测试等最新进展。

墙报展及评选 / 255

RELICS 液氙反应堆中微子探测器原型机的测试进展

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中微子-原子核相干弹性散射（CEvNS）是标准模型预言的物理过程，对反应堆中微子 CEvNS 过程的精确测量是对现有中微子实验的良好补充。反应堆中微子液氙相干散射实验（RELICS）计划基于 50 kg 量级液氙探测器（LXeTPC），借助反应堆的高中微子流强，在地面实现对反应堆中微子 CEvNS 信号的探测。为验证 RELICS 实验原理和技术，我们搭建了一个灵敏体积包含 0.56 kg 液氙的探测器原型机，并配备了制冷、纯化和数据采集等实验系统。此次报告将介绍 RELICS 原型机的开发、运行和测试工作，尤其是近期测试的 Ar-37、Kr-83m 等低能区信号特性，以及原型机单电子读出的进展和对 RELICS 低阈值探测原理的验证。这些进展有助于探索 RELICS 实验在低能区的响应特性，也可以用于测量低能区电子反冲情形下液氙和气氙的闪烁与电离参数。

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RELICS: 基于液氙双相时间投影室的反应堆中微子相干弹性散射测量

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精确测量相干弹性中微子-核散射（CEvNS）截面对于理解中微子的性质和标准模型之外的新物理具有重要意义。在低本底暗物质探测实验具有突出表现的液氙时间投影室（LXeTPC）是探测 CEvNS 信号最有前景的技术之一。然而由于低能区的背景噪声，探测核反冲能量低于 1keV 的反应堆中微子 CEvNS 信号仍然具有挑战性。反应堆中微子液氙相干散射实验（RELICS）将利用 LXeTPC 来探测反应堆中的中微子引起的 CEvNS 信号，预期每年曝光量下在 120-240PE 的 S2 能区中获得 4902.4 个 CEvNS 事件以及 1318.4 个背景信号。本次报告将对 RELICS 实验的总体规划，实验本底以及预期灵敏度进行介绍。

分会场五 / 257

AI assistant for HEP data analysis - Dr. Sai

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The data processing and analyzing is one of the main challenges at HEP experiments, normally one physics result can take more than 3 years to be conducted. To accelerate the physics analysis and drive new physics discovery, the rapidly developing Large Language Model (LLM) is the most promising approach, it have demonstrated astonishing capabilities in recognition and generation of text while most parts of physics analysis can be benefitted. In this talk we will discuss the construction of a dedicated intelligent agent, an AI assistant at BESIII based on LLM, the potential usage to boost hadron spectroscopy study, and the future plan towards a AI scientist.

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Latest results from the CUORE experiment

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The Cryogenic Underground Observatory for Rare Events (CUORE) is the first bolometric experiment searching for $0\nu\beta\beta$ decay that has successfully reached the one-tonne mass scale. The detector, located at the LNGS in Italy, consists of an array of 988 TeO_2 crystals arranged in a compact cylindrical structure of 19 towers. CUORE began its first physics data run in 2017 at a base temperature of about 10 mK and has been collecting data continuously since 2019, reaching a TeO_2 exposure of 2 tonne-year in spring 2023. This is the largest amount of data ever acquired with a solid state cryogenic detector, which allows for further improvement in the CUORE sensitivity to $0\nu\beta\beta$ decay in ^{130}Te. In this talk, we will present the new CUORE data release, based on the full available statistics and on new, significant enhancements of the data processing chain and high-level analysis.

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海铃计划进展与展望

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南海中微子望远镜计划，即“海铃计划”，将在中国南海 3500 米深海建造高能中微子望远镜，通过捕捉天体及地球大气中核反应过程产生的高能（>100 GeV）中微子，开展探索极端宇宙，揭秘宇宙射线起源，寻找新物理规律。海铃望远镜阵列将以高性能光学混合舱为基础，在海底建设超过 1000 根串列的非均匀阵列，覆盖大约 8 立方千米的海水体积，建成后能够全天候、全时段连续工作 20-30 年。
海铃团队在 2021 年完成探路者项目，在中国南海选定海域完成选址，验证了所选海域洋流平缓、海水透光度好，适合建造大型的中微子望远镜，并发布了大阵列概念设计。
海铃一期正在开展中，计划于 2026 年在选定海域布放 10 根串列，组成小型阵列，预计能探测到大气中微子并完成全技术链条的验证。本报告将介绍海铃计划最新进展以及未来规划。

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CEE 实验中的通用流处理数据获取系统架构：D-Matrix

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低温高密核物质测量谱仪（CEE）是我国第一台运行于 GeV 能区的、自主研制的大型核物理实验装置，其中数据获取系统是 CEE 实验的重要组成部分。在 CEE 实验中，数据获取系统需要负责传输、处理并存储多个子系统约 20000 个电子学通道的数据，预期峰值数据率和触发率分别高达 36Gbps 和 10kHz。为此，我们基于自主开发的通用流处理数据获取系统架构：D-Matrix，通过通用流处理节点的级联来构建 CEE 数据获取系统。
在硬件架构上，CEE 数据获取系统采用两款自主设计的 FPGA 通用读出板卡，通过光纤通信与 PCIe 接口负责硬件部分的数据传输，后端的服务器集群通过名为 Fabric 的全交换通信网络进行数据的定向分发。整个数据处理由 FPGA 内和服务器集群上的分布式通用流处理模块逐级完成，并在完成事例组装后将数据存入存储集群中。
未来，D-Matrix 架构还计划将 GPU 纳入数据处理框架中，并将架构用于超级陶粲装置（STCF）中的数据获取系统搭建。

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Measurement of K0s-K0s correlation function in Au+Au collisions at the high baryon density region

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Two-particle correlation analyses are often used to study the spatial and temporal extension of particle-emitting source in high-energy nuclear collisions. Precise information on the final state interactions amongst the particles under study can also be extracted from the measurement. It is particularly interesting to study the energy dependence of the extracted source size at the moment of freeze-out. Two-kaon correlations are an important supplement to those of pions, as they are less affected by resonance decays and they have smaller hadronic cross-sections.
%And neutral kaon can help one to understand the property of final state interaction.

In this talk, the measurements of $\mathrm{K^0_S} - \mathrm{K^0_S}$ correlations in Au+Au collisions with the fixed-target mode at $\sqrt{s_{\mathrm{NN}}}$ = 3.0, 3.2, 3.5, 3.9 and 4.5 GeV, by the STAR experiment will be presented. This is the first measurements of $\mathrm{K^0_S} - \mathrm{K^0_S}$ femtoscopic correlations at the high baryon density region. Energy dependences of particle-emitting source parameters and Kaon abundance asymmetry are extracted, and will be compared with transport model calculations.

分会场三 / 264

Hadron spectra and elliptic flow in Pb-Pb collisions at the LHC energies from the (3+1)-dimensional non-extensive hydrodynamic model

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A non-extensive (3+1)-dimensional hydrodynamic model for multi-particle production processes, NEX-CLVisc, is developed in the framework of the CLVisc package where the viscous corrections are turned off. It is based on non-extensive statistics and assumes that non-extensive effects exist in the initial conditions, the equation of state and the hadron kinetic freeze-out procedure. The model is then applied to investigate the pseudo-rapidity (η) distribution, the transverse momentum (p_{T}) spectra and the p_{T}-differential elliptic flow (v_2) of charged particles in Pb-Pb collisions at $\sqrt{s_{NN}} =$ 2.76 TeV and 5.02 TeV. It is found that the model can reasonably reproduce the η distribution and the charged-particle spectra in a p_{T} range up to 6–8 GeV/c. When compared with the ideal hydrodynamic model, the p_{T}-differential v_2 of charged particles is reduced in the NEX-CLVisc model, which is similar to that observed in the viscous hydrodynamic model. Moreover, the extension of the applicable range for p_{T}-differential v_2 is not as large as that indicated by the particle p_{T} spectra.

分会场一 / 266

Probing second generation Yukawa couplings and rare decays of Higgs boson from ATLAS

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Higgs boson couplings to second generation fermions and rare decays of the Higgs boson are an active field of study and are an important pillar to the Higgs boson physics at the LHC. This talk will present the latest results on second-generation Yukawa couplings from the ATLAS experiment. It will also include the latest results on the Higgs boson decaying to a Z boson and a photon.

分会场三 / 267

Measurements of ϕ production in Au+Au collisions at $\sqrt{s_{NN}}$ = 19.6, 14.6 and 7.7 GeV

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ϕ has relatively small hadronic interaction cross sections and it can be used to study the properties of nuclear medium at the early stage. The recombination model indicates that the Ω/ϕ ratio will be enhanced at low and medium transverse momentum (p_{T}), where thermal strange quarks dominate the production of Ω and ϕ in the QGP. Therefore, the multi-strange baryon-to-meson ratio $\Omega(sss)/\phi(s\bar{s})$ is proposed to be a sensitive probe for studying the onset of deconfinement. Because the STAR Beam Energy Scan Phase II (BES II) program has 10 times larger data size than BESI and explore the QCD phase diagram in a region which may cover the potential critical point, it offers us a great opportunity to investigate collision energy and system size dependence of ϕ production in heavy-ion collisions.

In this report, we present new measurements on p_{T} spectra, centrality dependence of ϕ production yields (dN/dy), resonance to non-resonance yield ratio (ϕ/K^{-}), nuclear modification factor (R_{CP}), the rapidity spectra and $\Omega(sss)/\phi(s\bar{s})$ ratio in Au+Au collisions at $\sqrt{s_{NN}}$ = 7.7, 14.6 and 19.6 GeV. Physics implications of these measurements will be discussed.

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Preliminary studies for a STXS simplified fiducial decay volume for the four lepton final state of the Higgs boson.

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To describes a preliminary simplified fiducial decay selection for the H to 4l channel to be used with STXS measurements in order to reduce acceptance corrections needed in the presence of BSM contributions in the H to 4l decay. The simplified fiducial decay selection is Lorentz invariant in order to have a production mode and boost independent acceptance. The reconstruction fraction as function of critical H to 4l decay observables shows the same behavior for the SM and BSM samples which should largely avoid the need for acceptance corrections for BSM interpretations of the H to 4l STXS measurements.

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基于 FPGA-ADC 技术的 SiPM 读出系统

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可重构 ADC（time-to-digital converter, ADC) 系统具有灵活可重构与高集成度的特点，通过进行编程，便可使该系统应用于新的实验场景，因此这种电子学读出系统受到了高度的关注。我们将描述一种新型的可重构 ADC 系统，该系统是一种基于时间数字转换器（time-to-digital converter, TDC）的软核 ADC 系统。其中 ADC 功能是在 FPGA 中实现的。
在硬件设计中，基于 FPGA 的 ADC（FPGA-ADC）只需要一个额外的电阻和一块 FPGA。FPGA-ADC 允许用户对其采样率进行编程，并只需通过小的修改（调整电阻值）来调整 ADC 的输入电压范围。这种 FPGA-ADC 设计具有灵活可重构和高密度的特点，可以极大减小读出电路的尺寸。
探测器部分使用了两个测试单元。每个单元包含一个 1.535 mm×1.535 mm x 20 mm 硅酸钇镥晶体条和一个 SiPM。FPGA-ADC 是数据采集（Data Acquisition,DAQ）系统的主要组成部分。FPGA-ADC 将对 SiPM 的原始信号执行全波形采样，在电荷积分后，得到测试单元的能量与时间分辨率。实验得到测试单元的能量分辨率约为 15.3%，时间分辨率约为 470 ps。

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AMS 同位素测量最新结果

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宇宙线是极端天体物理过程的重要信使，宇宙线的起源、加速和传播是跨越世纪的重大科学问题。宇宙线中的锂原子核（Li）和铍原子核（Be）是初级宇宙线在银河系传播过程中碎裂产生的次级宇宙线，它们的流强包含着关于宇宙线起源和传播的重要信息。次级宇宙线和初级宇宙线的流强比可以用于测量宇宙线在银河系传播过程中穿越的物质量，Li 和 Be 的同位素组分则可以为研究宇宙线传播过程提供重要的补充信息：^{7}Li/^{6}Li 可用于检验初级 Li 宇宙线是否存在，放射性同位素^{10}Be 可用于测量宇宙射线在银河系中的传播年龄。当前对^{6}Li/^{7}Li 和^{10}Be/^{9}Be 流强比的测量分别局限于低于 1 GeV/n 和 2 GeV/n 的能量，并且受到有限测量精度的限制。Li 同位素以及 Be 同位素的流强则只在 0.3 GeV/n 和 0.4 GeV/n 以下被测量过。我们将介绍基于阿尔法磁谱仪实验（AMS）在国际空间站上运行的头 12.5 年中收集的数据，在 0.4 GeV/n 到 12 GeV/n 的能量范围内对 Li 和 Be 原子核同位素流强及流强比的测量结果。

分会场三 / 271

Collision Energy Dependence of Hypertriton Production in Au+Au Collisions at RHIC

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Despite extensive measurements on the production yields of light nuclei in heavy-ion collisions, a consensus on their formation mechanism remains elusive. In contrast to normal nuclei, hypernuclei carries strangeness and can offer an additional dimension for such studies. In particular, the hypertriton ${}^{3}_{\Lambda}\mathrm{H}$, a bound state consisting of a proton, neutron and Λ hyperon, is the lightest known hypernucleus with a very small binding energy of ~ 130 keV. Currently, published measurements of the ${}^{3}_{\Lambda}\mathrm{H}$ yield are scarce and are limited to low ($\sqrt{s_{\mathrm{NN}}} < 5$ GeV) or high collision energies ($\sqrt{s_{\mathrm{NN}}} \geq 200$ GeV). Precise measurements on the energy dependence of ${}^{3}_{\Lambda}\mathrm{H}$ production will give invaluable information on hypernuclei production mechanisms due to its unique intrinsic properties.

In this presentation, we will present comprehensive measurements of the collision energy dependence of ${}^{3}_{\Lambda}\mathrm{H}$ transverse momentum p_{T} and p_{T} -integrated yield at mid-rapidity in Au+Au collisions at ten collision energies between $\sqrt{s_{\mathrm{NN}}} = 3$ and 27 GeV. It is found that thermal model calculations overestimated the ${}^{3}_{\Lambda}\mathrm{H}$ yield and the ${}^{3}_{\Lambda}\mathrm{H}/\Lambda$ ratio by a factor of ~ 2 in the reported energy region, while coalescence calculations are closer to data. We will also present the mean p_{T} of ${}^{3}_{\Lambda}\mathrm{H}$ as a function of collision energy. The mean p_{T} of ${}^{3}_{\Lambda}\mathrm{H}$ is observed to be lower than the Blast-Wave expectation using the same freeze-out parameters from light hadrons. These observations suggest that similar to light nuclei, hypertritons are formed at a later stage than light hadrons possibly through nucleon/hyperon coalescence during these collisions.

墙报展及评选 / 272

Electrical testing in ITk module assembly

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The ATLAS experiment is planning a complete replacement of its inner detector with a new all-silicon inner tracker (ITk), consisting of a pixel detector in the region closest to the beam pipe, and a strip detector at higher radii for the high luminosity phase of the LHC.

In order to facilitate a multi-site construction effort, the ITk strip detector employs a highly modular design: the smallest structures (modules) are built into larger structures (staves and petals), which are built into the still larger structures (cylinders and disks) that make up the detector.

Individual modules are planned to be operated in a long term test setup in order to study long term effects from prolonged operation under detector-like conditions, i.e. cold, dry and high voltage. Here we introduce a series of electrical testing involving sensor, powerboard, hybrid and module in the quality control of ITk strip module assembly. We also present utilizing container technology for quickly deploying software between different computers and detailed testing procedures embodied in IHEP standard operating procedure webpage.

分会场五 / 273

The Study of High Counting Rate and High Precision Electromagnetic Calorimeter for STCF

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The Super Tau-Charm Facility (STCF) is the next generation high luminosity e^+e^- collider focusing on the tau-charm physics. STCF will achieve a luminosity of over $0.5 \times 10^{35} cm^{-2} s^{-1}$ at 4 GeV, resulting in a high event rate and a high beam background for the detector system. The background count rate of over 1 MHz per module places new demands on the electromagnetic calorimeter (EMC): maintaining good energy and position resolution under severe pileup conditions. Meanwhile, the development of event timing and particle identification capability is also an important aspect of calorimeter R&D, where a time resolution of better than hundreds of picoseconds is expected.

The STCF EMC is based on a fast pure CsI crystal and is read out by avalanche photodiodes (APD). By considering the effect of crystal and electronics response, as well as the pileup condition, a complete chain of simulation and reconstruction is implemented in the Offline Software of Super Tau-Charm Facility (OSCAR). The architecture and module geometry of EMC are designed by optimizing the physical performance under OSCAR. Based on the module design, a novel wavelength shifter (WLS)-enhanced prototype is fabricated, which features fast time response and good signal-to-noise ratio at a reasonable cost. The comprehensive test results on the prototype, especially on the radiation hardness of the prototype, the uniformity of the light collection and the cosmic ray-timing performance of the prototype, are also presented.

分会场五 / 275

用于大型粒子对撞机实验的 TPC 读出电子学研制进展

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时间投影室（TPC：Time Projection Chamber）可以提供精确的带电粒子三维径迹的测量，同时具有低物质量和 dE/dx 粒子鉴别能力，因此在高能粒子物理实验中得到广泛的应用。比如在环形正负电子对撞机（CEPC）实验中，TPC 成为主径迹探测器的首选探测器。为了实现百微米的径迹分辨，TPC 通常采用较小的读出焊盘，使得读出电子学密度和通道数目急剧增加。针对 TPC 探测器高密度读出需求，本文开展低功耗、高集成度读出电子学的研制工作，主要包括：1）一款基于 65nm 的低功耗波形采样和数字滤波前端 ASIC 芯片及可扩展读出电子学系统的研制；2）高粒子鉴别能力的像素型 TPC 原型读出电子学的研制。

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The ATLAS ITk Strip Detector for the LHC Phase-II Upgrade

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The Inner Tracker (ITk) of the ATLAS phase-II upgrade is aimed for function in future HL-LHC, where the particle density and radiation levels will exceed current level by a factor of ten. An all-silicon design was adopted to be faster and more spatial segmented, which requires much greater power for the front-end system. The new design is also targeting higher irradiation resistance, while the radiation length of the ITk remains reasonably low. The upgraded ITk will consist of multiple layers of silicon detectors. The silicon pixel detectors will be installed on innermost layers, while the silicon strip detectors on outer layers. This contribution focus on the strip region of the ITk. The central region (barrel) consists of 4 cylindrical shaped layers, composed of rectangular short strip (˜2.5 cm) and long strip (˜5 cm) sensors. The forwards region (end-cap) consists of 6 disk shaped layers per side, which covered by trapezoidal shaped strip sensors of various lengths and strip pitches.

After the completion of final design reviews, the collaboration initialized a massive prototyping program and several pre-production phases before commence the production. We will summarize the current status of ITk upgrade pre-production and production on detector components, and an emphasis on detector module assembly procedures, as well as QA/QC criteria.

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AMS-02 Layer0 Tracker Upgrade

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The Alpha Magnetic Spectrometer (AMS-02) detector operates on the International Space Station. It performs high-precision measurements of cosmic ray composition and fluxes, and searches for antimatter and dark matter. To increase the cosmic-ray detection acceptance and improve the heavy ion identification performance, the AMS collaboration plans to add a new layer (L0) of silicon tracker on top of the existing AMS-02 detector. The new detector layer consists of 2 planes, which include 72 silicon strip detector ladders. Each ladder has 8, 10, or 12 silicon strip detector sensors (SSDs) connected in serial, producing an effective strip length of about 0.6 to 1 meter. The total sensitive area is about 8⊠ˆ2. All the ladders are assembled in IHEP, China.

We will present the system design of the L0 layer, the assembly procedures of ladders, and QA/QC criteria. To study the detector ladder in cosmic rays and particle beams, and calibrate the L0 tracker with particle beams before launching to space, a beam monitor has been produced. Details of the L0 layer ladder and beam monitor's performance will be described.

分会场五 / 278

应用于 STCF ECAL 的全数字输出混合信号前端读出芯片研究进展

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超级陶粲装置（STCF）作为下一代超高亮度正负电子对撞机，其设计亮度达到 0.5×10ˆ35 (cm)ˆ(-2) sˆ(-1)，高亮度设计对其探测器系统提出了新的要求与挑战。STCF 电磁量能器（ECAL）需要在高事例率环境下，对粒子的能量、位置、时间等进行精确测量。针对 STCF ECAL 需求，开展了低噪声、高计数率、能量时间同时测量的全数字输出混合信号前端读出 ASIC 设计与研究，提出了针对大输入端电容的前端读出电路噪声优化方法、一种支持事件触发的可达兆赫兹的高计数率前端读出电路架构。采用标准 CMOS 工艺设计实现了多款原型验证芯片，测试结果表明，等效噪声电荷小于 0.4fC @CIN=270pF；在模拟探测器输出信号特征下，时间测量精度优于 270 ps @QIN>200fC；单通道可接收事件率大于 400k，最高计数率可达 4MHz/ch。

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基于六边形像素几何结构的智能化 CMOS 像素探测器研究探索

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CMOS 像素探测器（CPS）已经广泛应用于粒子物理实验的带电粒子检测等领域，包括 STAR 实验、ALICE 实验等，也是国际直线对撞机（International Linear Collider, ILC）顶点探测器方案的有力竞争者。在 ILC 中，大量来自背景束带电粒子在 CPS 中形成额外命中，增加了探测器系统的输出数据量。
研究团队拟通过研发片上集成人工神经网络的智能化 CMOS 像素探测器专用集成电路，实现背景束粒子命中的标记和片上筛除，完成海量数据的压缩，降低探测器系统的数据量。研究团队完成了该方案的 FPGA 级设计验证，开发了针对 CMOS 像素探测器片上集成的 Clustering、特征提取等关键模块的算法及电路架构。另一方面，考虑到六边形像素几何结构在相邻像素数目等方面的优势，团队同步开展了相关的设计研究。

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应用于高能物理实验的多通道、高分辨率 TDC 芯片设计与实现

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正在我国进行建设的超级陶粲装置（STCF）中需要实现一种全新的、具有较好时间测量能力的电磁量能器（ECAL），以满足背景噪声抑制、中子-γ 甄别等物理需求。对时间测量电子学的需求包括：不低于 100-ps 的分辨率、2-μs 以上的动态范围以及可多通道集成。因此，我们提出了一种 3 级量化结构的时间数字转换器（TDC），其中粗量化由可达到较大动态范围的计数器实现；细量化则是基于一种改进的游标延迟环，利用两种延迟锁相环实现了亚门级延迟的高分辨率。所提出的游标延迟环采用了自动复位机制来实现连续事件的测量，还可利用滑动尺度测量原理显著提高其测量线性度。采用 180-nm 标准 CMOS 工艺实现了该 TDC 原型芯片，共集成了 8 个测量通道，在 100-MHz 参考时钟频率下可实现 41.7-ps 的分辨率和 2.56-μs 的动态范围。测试结果显示，该 TDC 的单射精度可达到 46.0-ps，DNL 不超过 0.5-LSB，INL 不超过 1-LSB，且各通道性能一致性较好。

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基于多极性 QDC 的 PET 探测器评估

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伴随着 SiPM 探测器在 PET 探测器发展中的应用越来越广泛，PET 对读出电子学的小型化和低能耗提出了新的要求。我们提出了一个可以提供 128 通道的多极性电荷数字转换器 (dQDC)

的前端电子学方案。整个前端板包括模拟电路板和数字电路板，其中每一个通道仅包含模拟电路板中两个电阻，一个运算放大器，一个电容，数字电路板中一个电压输入和放电的两个FPGA I/O 接口。数字电路板采用了一个低功耗的 FPGA 作为整个电子学的数据采集系统，使用 SSTL Ⅱ 标准作为输入电压的比较端口，因此可以节省 FPGA 的 I/O 接口数量，提供更多通路集成的可能。通过对前端板每个通道的噪声，线性度和均匀度进行测试，证明前端板的作为 PET 读出系统的可靠性。两个 SiPM 阵列耦合一个 15*15 的 LYSO 晶体阵列组成双端读出的 PET 探测器使用本读出系统得到了清晰的晶体分辨图，峰谷比为 6.02 的剖视图和 13.2% 的能量分辨率。并且目前已经调试出基于 FPGA 的时间数字转化器 (TDC)，时间分辨率能达到 18 ps，为 PET 的时间分辨率和互作用深度测试做了准备。

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Development of highly granular hadronic calorimetry with glass scintillator tiles

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To achieve precise measurements of the Higgs, W, Z bosons, and the top quark, the future electron-positron colliders, such as the Circular Electron Positron Collider (CEPC), require their detector systems to have an unprecedented high jet energy resolution. Based on the particle flow algorithms (PFA), the CEPC team has proposed a new detector concept named “the 4th detector concept”. As one of the key sub-detectors, a novel design of highly granular sampling hadronic calorimetery (HCAL) has been proposed, which major motivation is to significantly improve the hadronic energy resolution using high-density glass scintillator tiles to achieve a higher energy sampling fraction. The Geant4 full simulation was used to evaluate the hadronic performance with single hadrons and the physics potential of the PFA performance for HCAL with glass scintillator tiles (GSHCAL). In addition, the R&D of new glass scintillator materials are ongoing within a collaboration with an aim to achieve high density, high light yield and low cost. We developed a dedicated test system and conducted the beamtest to assess the performance of an individual glass scintillator tile. This contribution will introduce the design and optimization of GSHCAL in simulation, and will also include some experimental results.

分会场五 / 286

40GHz TES 探测器的仿真优化与加工

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宇宙微波背景辐射（CMB）是宇宙大爆炸后早期冷却过程产生的遗留辐射，保留了丰富的宇宙早期信息。目前 CMB 实验的主要观测目标已经变为极其微弱的 B 模式极化，在大尺度上测量 CMB 的 B 模式偏振是探测在暴涨时期产生的张量扰动（原初引力波）的最主要方式。这需要在观测中使用极低噪声等效功率的探测器。超导转变边沿探测器（Transition Edge Sensor,TES）是以超导薄膜作为温度计的一种热平衡探测器，具有极低的噪声和极高的灵敏度，是当前主流的 CMB 望远镜探测器。TES 探测器可探测低频、中频和高频的 CMB 信号，低频范围的探测主要是在 40GHz 附近观测。通过 TES 探测器来探测 CMB 的 B 模式极化，微波信号被耦合到电路当中，通过平面正交模耦合器、共面波导、微带线、滤波器、交叉器等微波链路结构，进行频率选通后传输到 TES 探测器。因此需要首先对前端微波器件进行仿真设计，通过修改微波器件的结构尺寸以及优化材料可以对其性能进行优化。我们选用了低损耗的富硅衬底重新开展了 40GHz TES 探测器前端微波链路的设计，对平面正交模耦合器、共面波导转微带线的阻抗匹配段、滤波器以及交叉器结构的仿真设计与计算，通过仿真优化，在 30GHz~50GHz

范围内，微波信号最小透过率在 88% 以上。通过微纳加工手段来进行 TES 探测器芯片的加工，芯片结构是按层生长的。我们选用定制的已长有低应力 SiNx 的硅片作为起始硅片，整个工艺流程包括 9 次光刻、5 次干法刻蚀、1 次湿法刻蚀、3 次剥离、3 次磁控溅射和 4 次电子束蒸发。我们测量了最后整体的加工误差大约有 1um 的偏移，但由于提前预留的余量充足，所以 1um 的偏移不影响 TES 的性能。加工的重难点主要在于 Nb 的高选择比刻蚀、氮化硅及 AlMn 的生长，工艺的均匀性以及稳定性，以及最后一步的深硅刻蚀。目前采用了新的 Nb 线层刻蚀配方，在保证高刻蚀选择比的前提下，降低刻蚀侧壁的垂直度，使薄层金属更容易搭接，目前的工艺已经可以保证有比较高的成功率。现在在做的新一版 TES 加工，等最后一步深硅工艺摸索出来以后有望得到完整的符合要求的 TES 单像素芯片，进而可以对 TES 整体进行光学测试，为后续 TES 阵列的加工提供保证。

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基于感应线圈的磁单极子探测方案设计

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磁单极子作为大统一理论预言的基本粒子，在解释电荷量子化和宇宙暴胀模型等方面扮演着至关重要的角色。SCEP 实验组提出了一种基于室温线圈和塑料闪烁体的符合探测手段，用以探测磁单极子。其中利用线圈探测的基本原理是通过探测磁单极子穿过线圈时产生的感应信号，这对信噪比有着严格的要求。为此，SCEP 实验组提出了两种探测感应信号的方案——ADC 读出方案和磁力仪读出方案。本报告将围绕这两种方案展开，介绍它们的基本结构，并详细阐述感应信号及各部分噪声的特征。为了提高信噪比，我们进行了初步的优化设计，并给出了最终的预期信噪比。

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AMS 反氘测量

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宇宙线反氘是暗物质湮灭的潜在信号之一，其特征是具有很低的天体物理学背景。阿尔法磁谱仪 (AMS) 是目前唯一运行在太空中的磁谱仪，能够精确分辨宇宙线中的正反粒子，我们将报告使用 AMS 进行宇宙线反氘测量的最新进展。

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利用国际空间站上的 AMS 实验测量宇宙线电子、正电子的各向异性

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通过对高能宇宙线在全天区分布的各项异性研究可以帮助我们理解宇宙线的起源、传播和加速过程。我们利用国际空间站上的阿尔法磁谱仪（Alpha Magnetic Spectrometer，AMS）实验所收集的宇宙线数据研究了 16GeV-500GeV 的宇宙线电子、正电子在银河坐标系中方向分布的各向异性。报告将展示 AMS 电子、正电子偶极各向异性的测量结果，并讨论该结果的物理意义。

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AMS 实验测量宇宙线氘同位素的最新结果

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本报告将介绍 AMS 实验关于宇宙线氘原子核流强和成分测量的最新结果。AMS 实验基于收集的 2100 万宇宙线氘（D）原子核，精确测量了 1.9 GV 至 21 GV 刚度范围内的 D 流强。在整个刚度范围内，D 与质子（p）、氦-3（He3）、氦-4（He4）的流强展现出几乎相同的时间变化关系。在 4.5 GV 以上，D/He4 流强比不随时间变化，其刚度依赖性可以用指数为-0.108+/-0.005 的单一幂律谱描述。这与 He3/He4 流强比的幂律谱指数（-0.289+/-0.003）显著不同。在 13 GV 以上，D 与 p 具有相同的刚度依赖性，D/p 流强比为常数 0.027+/-0.001。这些现象意味着宇宙线氘核存在初级成分。通过一种模型无关的方式，我们得到初级 D 成分相当于（9.4+/-0.5）% 的 He4，次级 D 成分相当于（58+/-5）% 的 He3。

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宇宙线原子核能谱的时间变化测量

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测量宇宙线原子核能谱随时间的变化是研究太阳活动的关键手段。安装在国际空间站上的阿尔法磁谱仪（AMS）是一个大接受度，长周期观测（预计将覆盖两个太阳活动 11 年周期）的空间磁谱仪实验设备，能够以前所未有的精度对 GeV 至 TeV 能量区间内的宇宙线能谱进行测量。本报告将介绍基于 AMS 实验所测量的宇宙线锂、铍、硼、碳、氮、氧等原子核能谱在 2011 年 5 月至 2023 年 11 月期间（完整覆盖一个太阳活动周期）随时间的变化，同时讨论不同电荷的宇宙线受到太阳调制效应的差异。

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Analytical solution of the nonlinear QCD evolution equations using the homogeneous balance method

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The QCD evolution equations serve as both a theoretical cornerstone and an experimental foundation in high-energy nuclear physics, which are powerful for studying quantum chromodynamics, understanding hadron structure and interaction between hadrons. QCD predicts that the gluon density inside hadrons will increase rapidly in high-energy collisions, and eventually form a high gluon density saturation state. This saturation effects can be described by the nonlinear BK and GLR-MQ equations. In order to provide a more intuitive physical picture and analyze the saturation property of these nonlinear evolution equations, we employ the homogeneous balance method for the first time to obtain the analytical solutions of the BK equation and the GLR-MQ equation. It is found that the analytical solutions can naturally obtain the geometric scaling properties observed in high-energy physics experiments. By fitting the experimental data, we determine the free parameters in the analytical solution and obtain the exact solution of the evolution equation, which is in good agreement with the numerical solution. We also predict the J/ψ meson production by using the exact solution. The numerical results show that the exact solution can describe the J/ψ meson production well.
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分会场五 / 293

High-granularity Crystal ECAL R&D for Future Higgs Factories

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Following the demand for precise measurements of the Higgs, Z/W bosons and the top quark, future lepton colliders, e.g. the Circular Electron Positron Collider (CEPC), are required to meet stringent requirements on the calorimetry systems to achieve unprecedented jet energy resolutions. As part of CEPC’s “4th detector concept”, a novel high-granularity crystal electromagnetic calorimeter (ECAL) has been proposed, with an optimal EM resolution of $2-3\%/\sqrt{E(GeV)}$ and sufficiently low detection limit of photons. By utilising the Particle Flow Approach (PFA) with other optimised sub-detectors, this new ECAL design concept is expected to improve the Boson Mass Resolution (BMR) from 4% in the CEPC CDR to 3% level.

Significant R&D efforts have been undertaken in the design of this crystal ECAL. Geant4 full simulations have been carried out to assess the impact of light yield and time response of the crystal. Laboratory measurements with characterisations of crystal, silicon photo-multipliers (SiPMs) and readout electronics have been conducted, providing validation of the simulations and evidence on the hardware feasibility. Besides, a small-scale crystal module has been developed and tested under beam conditions for performance studies and system-level investigations.

This report introduces the design of the novel high-granularity crystal ECAL, outlines its physics potential, and presents the latest progress on hardware activities.

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基于 AMPT 模型对 isobar 实验中手征磁效应及其椭圆流关系的研究

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对手征磁场效应 (Chiral Magnetic Effect, CME) 的测量在近十年的高能核物理实验领域是一个热门方向。通常的实验手段包括寻找带电粒子及其来源的部分子 (parton) 由于受磁场影响而产生的各向异性运动，尤其是在相对于碰撞反应平面 (Reaction Plane, RP) 垂直方向。为此需要分离 CME 驱动的信号和作为相对背景的集体事件流 (flow) 尤其是其二阶部分即椭圆流 (elliptic flow)，具体实验过程为通过电荷同号和异号的带电强子对与 RP 关联，测量各自的 flow 相关数值 γ，再通过二者差值定义出 Δγ 作为核心观测量，并扣除统计波动和其它非流 (non-flow) 物理机制影响。
基于以上原理，STAR 实验组提议并实施了 isobar 实验，对比 Ru+Ru 和 Zr+Zr 两个碰撞系统。由于两者具有相同的核子数和不同的质子数，理论上预期产生相同的椭圆流背景和不同的 CME 信号。然而，实验结果表明它们的流背景亦存在差异，因此需要仔细排除椭圆流比较过程可能引入的偏差，特别是对 RP 测量的不同快度区自关联，和实际参与碰撞的核子数 (number of participants, N_{part}) 的测量手段差异，以及随之产生的碰撞区域中心度划分 (centrality)。
为此，我们利用 AMPT 模型，模拟和对比 STAR isobar 实验的碰撞系统对椭圆流测量，并详细给出不同 RP 和 centrality 测量导致的 Ru+Ru 和 Zr+Zr 椭圆流差异。由于 AMPT 模型未考虑磁场效应，因此我们期待以上模型给出的 isobar 椭圆流差异能够为实验测量排除相应的手段偏差提供一定启示。

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CEPC 液闪-钨薄片型电磁量能器设计和初步测试

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CEPC 量能器采用粒子流算法来准确测量 higgs 和 WZ 玻色子，需要具备优秀的三维空间分辨率和能量分辨率。取样型量能器由于能够提供良好的颗粒度和较低的成本，成为 CEPC 量能器的首选。然而，由于结构限制，与全吸收量能器相比，采样量能器的能量分辨率较差。Shashlik 量能器由交替层次的塑料闪烁体和铅组成，能够提供良好的能量分辨率以弥补这一缺点，并已被 KOPIO 和 NICA 实验采用。基于这些考虑，我们提出了一种新颖的取样型电磁量能器设计，用于 CEPC 实验，即液体闪烁体钨片 ECAL。该量能器由百微米厚的液体闪烁体和钨片交替排列而成，采用极为精细的取样策略来优化量能器单元结构，使量能器单元具有良好能量分辨性能。为了评估我们提出的量能器方案的性能，我们使用 Geant4 模拟其物理和光学特性。预计该方案将在 1 GeV 时实现优于 5% 的能量分辨率和优于 100 p.e./MIP 的光产额，这与现有的 CEPC 取样量能器方案相比具有明显的改进。此外，采用快发光的液体闪烁体作为灵敏材料，使其成为潜在的 5D 量能器设计方案，这对于 CEPC 电磁量能器来说具有巨大潜力，有望成为一个良好的备选方案。

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应用于高亮度电子对撞机内径迹探测器的 MAPS 芯片设计

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MAPS 是高能物理实验中内径迹探测器重要的实现方式之一，其具有物质量低、空间分辨高等特点。兼具时间测量和能量测量功能的 MAPS 通常被称作 5D MAPS，有利于进一步提高径迹重建效率，但也给芯片设计带来了更大的挑战。本研究面向下一代高亮度电子对撞机内径迹探测器，基于不同工艺和优化方案开展低功耗 5D MAPS 的设计工作。其中在 GSMC130 nm 工艺下，像素单元尺寸为 33.2 μm×33.2 μm，通过对多个像素单元的数字输出错位做”或”并编码的方式合并读出通道，并基于超级像素进行数据读出，从而降低数字功耗。同时，超级像素内集成 500 MHz 启停型 VCO 用于细时间计数，使时间测量精度大幅降低到 2ns，且不产生额外静态功耗。外围电路包含击中信息的读出、时间戳校准、汇总、缓存、组帧、编码和高速串行化等功能。预计芯片总功耗小于 60 mW/cm²。

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Non-Abelian Chiral Kinetic Theory

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We derive the chiral kinetic equation in non-Abelian gauge field with consistent semiclassical expansion. Within new expansion scheme, we disentangle the Wigner equations up the second order and find that Wigner equations do not lead to constraint equations. We integrate the covariant chiral kinetic equations in eight-dimensional phase space and obtain the chiral kinetic equations in seven-dimensional phase space.

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Looking for CEP using Deep-learning quasi-particle model

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Exploring the location of the critical end point (CEP) in the Quantum Chromodynamics (QCD) phase diagram is an important scientific problem that has remained unsolved for decades. Recent studies suggest that the CEP may exist within the QCD matter produced in the beam energy scan project of heavy ion collisions at $\sqrt{s_{NN}} = 3 - 7.7$ GeV. First-principle Lattice QCD calculations are hindered by the well-known sign problem at such high baryon chemical potential. We have developed a quasi-particle model for hot and dense QCD matter, where three artificial neural networks are constructed to represent the masses of quasi-particles as functions of temperature T and baryon chemical potential μ_B. This model is calibrated using data from lattice QCD and hadron resonance gas at zero μ_B. The equations of state derived from our quasi-particle model are in good agreement with Lattice QCD results at small μ_B, using Taylor expansion. Moreover, through susceptibility analysis, the quasi-particle model predicts that the CEP is approximately located at $(\mu_B, T) = (630, 116)$ MeV.

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Determine the neutron skin thickness of Pb208 by relativistic semi-isobaric collisions

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The neutron skin thickness of the benchmark nuclei 208ˆPb is crucial for our understanding of the equation of state of nuclear matter. Several observables in relativistic heavy ion collisions are found to be sensitive to the neutron skin, and the uncertainties from the bulk evolution can be canceled out by the collision of its isobaric partner. In this talk, we discuss the effect of the neutron skin on the ratio observables in semi-isobaric collisions, i.e., 208ˆPb + 208ˆPb collisions and 197ˆAu + 197ˆAu collisions. Our results indicate that the 208ˆPb and 197ˆAu have similar magnitude of neutron skin thickness, as the two isobaric collision systems follow the same scaling behavior. Our results can shed light on the determinations of neutron skin and nuclear symmetry energy in relativistic heavy ion collisions.

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基于 CDEX 实验的加速暗物质研究

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暗物质及其直接探测是当代物理学的重大基础前沿课题。暗物质直接探测实验向更低阈值和更高灵敏度的区间发展。宇宙空间中的暗物质可以与高能粒子发生碰撞，被加速到极高的动能，这种暗物质被称为加速暗物质。加速暗物质有很高的动能，使得质量低于 1GeV 的轻暗物质也有足够多的动能在探测器中产生超出阈值的信号，从而大大拓展暗物质研究的质量灵敏区间。CDEX 合作组利用低阈值低本底的高纯锗暗物质实验数据，对宇宙线加速暗物质、耀变体加速暗物质和太阳反射暗物质开展了系统研究，得到了多项国际领先的物理结果。此外，CDEX 合作组还开发了包含 CJPL 附近精确山形的地球屏蔽蒙特卡洛模拟软件包，并支持加速暗物质地球屏蔽效应计算。未来 CDEX 合作组将进一步对更多加速暗物质情景，以及相关调制效应开展研究。

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Massive Scattering Amplitudes for Standard Model: On-shell Massless-Massive Correspondence and the On-shell Higgsing

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We present a comprehensive exploration of the on-shell Higgs mechanism using the massless-massive correspondence (MMC) applied to scattering amplitudes in the Standard Model. The MMC, integrated with power counting based on the v/E expansion (where v denotes the electroweak vacuum

expectation value (VEV)), is derived from spinor splitting and energy scaling of massive amplitudes. For an n-point massive amplitude $\mathcal{M}_n$, its energy scaling is categorized as $[\mathcal{M}_n]_l \sim E^{4-n}(v/E)^l$, aligning it with an $(n+l)$-point massless amplitude $\mathcal{A}_{n+l} \sim [\mathcal{M}_n]_l$. The Higgs mechanism is reflected in all order matching ($l \geq 0$). Notably, when $l > 0$, the additional l Higgs bosons in $\mathcal{A}_{n+l}$ manifest as VEVs in the infrared (IR), thereby matching $\mathcal{A}_{n+l}$ to $[\mathcal{M}_n]_l$. This transition, elucidating how the surplus Higgs bosons at high energy contribute to VEVs at low energy, is called the on-shell Higgsing mechanism.

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TRACCC 在 CEPC 顶点探测器中的应用

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环形正负电子对撞机（Circular Electron Positron Collider, CEPC）实验，主要用于精确测量希格斯玻色子的性质，并寻找超越标准模型的新物理。CEPC 的顶点探测器（VTX detector）位于探测器最内层，在确定碰撞事件的顶点方面起着主导作用, 对碰撞事件重建与分辨至关重要。顶点探测器还负责为后续重建算法提供种子，以在外部探测器中寻找径迹。TRACCC 是 ACTS 的研发线之一，旨在开发出能在异构设备上加速运行的、通用的径迹重建算法。

本报告将介绍：基于 TRACCC 开发 CEPC 顶点探测器种子寻找算法，并将其集成到 CEPC 软件（CEPC software, CEPCSW）环境中。CEPCSW 采用 Gaudi 作为底层框架，使用 DD4hep 作为探测器描述工具、EDM4hep 作为事件数据模型。CEPC 顶点探测器有三层，每层的两侧都安装有硅像素传感器。为适应这种特定的探测器结构，TRACCC 中的默认种子寻找算法（使用三个空间点组成一个种子）已被扩展为使用六个空间点组成种子的算法。此外，报告还介绍了一种在种子寻找算法中优化内存使用的方法，通过使 EDM4hep 和 VecMem 共享内存，避免了数据复制带来的额外开销。最后，报告将展示上述工作的物理性能和计算性能测试结果，并进行评估和分析。

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CDEX 实验中新型暗物质相互作用研究

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弱相互作用大质量粒子（WIMPs）作为最著名的暗物质候选粒子之一，已有大量直接探测实验对其进行探测，目前对 WIMPs 的参数空间的排除区域几乎就要达到中微子地板。许多新的轻质量暗物质候选粒子如轴子类暗物质、暗光子暗物质、费米子暗物质近年来逐渐成为研究热点。这些轻质量暗物质候选粒子对直接探测实验的本底及能量阈值提出了更高的要求。
本报告将介绍目前 CDEX 实验组对轴子类暗物质、暗光子暗物质、费米子暗物质的探测结果。

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RECODE：高纯锗反应堆中微子相干散射实验

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中微子与原子核的相干性弹性散射（CEvNS）是粒子物理标准模型下 MeV 量级中微子与物质的主要相互作用过程之一。利用 CEvNS 测量中微子，不仅是对传统中微子探测方法的有力补充，同时也使得中微子探测器的小型化成为可能。RECODE 实验基于低阈值的点电极高纯锗探测器技术，在三门核电开展反应堆中微子相干性弹性散射过程测量。本报告将介绍 RECODE 高纯锗反应堆中微子 CEvNS 实验计划及最新进展。

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Revisiting primordial neutrino asymmetries, spectral distortions and cosmological constraints with full neutrino transport

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The primordial neutrino asymmetries leave significant imprints on the evolution of the universe and can therefore be constrained by cosmological observations of Big Bang Nucleosynthesis (BBN), the Cosmic Microwave Background (CMB), and Large Scale Structure (LSS).
In this paper, we present a systematic study of the implications and corresponding constraints of the primordial neutrino asymmetries under a precise and accurate treatment of neutrino decoupling.
For the neutrino decoupling process, we solve the full quantum kinetic equations (QKEs) for neutrinos and antineutrinos, which are derived from the closed-time-path (CTP) formalism, and evaluate the resulting effective number of neutrinos $N_{\rm eff}$ and the spectral distortions for neutrinos and antineutrinos.
We then study the implications of the primordial neutrino asymmetries on the BBN, CMB and LSS using the resulting neutrino density matrices from the QKEs.
In comparison with the traditional treatments using the Fermi-Dirac distribution for neutrinos, we find that the actual density matrices are important to obtain accurate results of the implications, especially for the helium abundance in the BBN and the free-streaming effects of massive neutrinos.
We also find the dependence of the Baryon Acoustic Oscillations (BAO) on the primordial neutrino asymmetries, suggesting its potential to constrain the primordial neutrino asymmetries.
This is confirmed by the MCMC analysis with the data from EMPRESS, Planck and BOSS. We find that the combined constraint on the neutrino degeneracy parameter from EMPRESS, Planck and BOSS is $\xi_\nu = 0.024^{+0.012}_{-0.013}$, deviating from zero by $1.8\,\sigma$, which is $0.4\,\sigma$ smaller than the constraint without the BOSS data.

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Mass production of RPC readout panels for ATLAS Phase-II upgrade and R&D on thin gas gap production at USTC

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In order to cope with the High-Luminosity Large Hadron Collider, the current ATLAS Muon system foresees a significant upgrade during the Long Shutdown-3. For the muon trigger, three layers of thin-gap Resistive Plate Chambers (RPC) will be added to the BI (Barrel Inner) region. This new generation of RPC benefits from the thin-gap structure to achieve the required higher rate capability. At the same time, it is also very challenging for detector production, quality assurance, and quality control.

Our Chinese ATLAS group undertook the construction of 912 readout panels, the fabrication of 72 BI gas gaps, and the assembly of 360 singlets for the upgrade. To fulfill the BI-RPC project in China, we have established and optimized the vacuum-bag-based method for honeycomb readout panel production in our laboratory at USTC.The same method is also applied to the production of readout panels in the industry. The speed and quality of readout panel production have been significantly accelerated. The production procedures of the gas gap prototypes at USTC are presented. The gas gaps are oiled at a room temperature of 40℃ and flushed with heptane before applying the Linseed oil. This process can significantly enhance the quality of linseed oiling on the inner surfaces of the Bakelite RPC. The quality of those gas gap prototypes are checked and the results are very promising.

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利用 AMS02 宇宙线周期性能谱对太阳调制模型进行研究

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近年来，AMS02 实验发布了质子、氦核及氦核同位素的周期性能谱，这些数据显示出与太阳调制有关的时间结构。基于这些实验数据，我们采取了一种不依赖宇宙线星际能谱的方法，利用基准 t1 时刻的测量数据来预测任意 t2 时刻的宇宙线能谱。结合最小 chi2 方法，我们在力场近似及其他解析模型中，采用与磁刚度无关的调制参数 ϕ，验证了传统模型在太阳活动极大期与观测数据产生较大偏差。进一步地，我们在不同磁刚度区间内估算出调制参数 ϕ 的最佳拟合值，探索了太阳调制模型的刚度依赖性。

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高能重离子碰撞中夸克自旋关联和自旋 3/2 重子的张量极化

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2023 年 STAR 合作组对重离子碰撞中矢量介子整体自旋排列的测量结果 [1] 表明，碰撞产生的夸克胶子等离子体 (QGP) 中的夸克不仅存在整体极化，还存在整体自旋关联，进而使得对碰撞系统中夸克自旋关联的研究成为了高能自旋物理领域新的增长点。在文献 [2] 中，我们提出了一种系统描述碰撞系统中夸克关联的方法，并证明了矢量介子的矢量极化和两夸克自旋关联之间有紧密联系。进一步地，在文献 [3] 中，我们利用相同的理论框架，发现自旋 3/2 重子的二阶和三阶张量极化，分别依赖于夸克系统中的两夸克和三夸克关联，并且计算了具体的极化分量与相应的夸克自旋关联之间的关系。本报告的主要目的是介绍自旋 3/2 重子张量极

化和对应夸克关联之间的关系，以及如何通过测量自旋 3/2 粒子的级联衰变来确定相应的极化分量和夸克的自旋关联。

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重离子碰撞过程中夸克整体自旋关联

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STAR 合作组在《自然》杂志上发表了他们对高能重离子碰撞中Λ 超子整体极化和ϕ，K^{*0} 矢量介子整体自旋排列的实验结果 [1,2]，不仅证实了夸克物质整体极化这一新现象 [3,4]，使自旋极化的研究成为高能核物理前沿新方向，而且表明在相对论性重离子碰撞中，夸克和反夸克在反应平面法线方向上可能存在很强的自旋关联，从而使夸克自旋关联的研究成为当前该方向新的增长点。在文献 [5] 中，我们提出了一种系统性的方法来描述夸克物质中的这种关联，并将其分类为局域和长程夸克自旋关联。我们的研究表明有效的夸克自旋关联包括直接源于动力学过程的真正自旋关联，以及考虑其它自由度平均引起的诱导关联。我们还展示了如何通过测量矢量介子的自旋密度矩阵以及超子-超子和超子-反超子的自旋关联来研究这种关联，并阐明了这些可观测量与夸克和反夸克自旋关联之间的关系。本报告的目标是系统介绍 [5] 中关于夸克自旋关联的研究，并对未来发展进行讨论。

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分会场五 / 311

LHCb 实验超快电磁量能器的研发

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为了充分利用高亮度大型强子对撞机为味物理带来的机遇，LHCb 实验计划在 2032 年左右对整个探测器进行二期升级，以应对高事例堆积、高辐照剂量等极端运行环境带来的一系列挑战。在 LHCb 探测器二期升级中，电磁量能器 PicoCal 最靠近束流管区域计划采用基于高精度致密钨栅格和超快 GAGG 晶体的 SPACAL 技术，LHCb 中国组正在主导相关技术的研发。本报告将重点介绍 LHCb 电磁量能器升级的整体设计，中国组在高性能闪烁晶体（GAGG 晶体）的研制，高精度致密钨吸收体开发，原型机研制，以及相关的模拟、测试和束流实验等。

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基于 LHAASO-KM2A 对宇宙线大尺度各向异性的观测

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宇宙线的到达方向呈现微弱的各向异性分布，强度在万分之几到百分之几的量级。随着能量的增加，宇宙线的大尺度各向异性强度和分布形态呈现明显的变化。宇宙线各向异性的起因尚未明确，可能与宇宙线的传播、源的分布以及局部磁场扰动等有关。测量宇宙线的各向异性，特别是对高能宇宙线以及宇宙线成分的测量，对宇宙线的传播等理论提供重要依据。LHAASO 海拔 4410 米，覆盖面积超过一平方公里，采用多种探测手段，具有很宽的能量测量范围和良好的粒子鉴别能力。LHAASO 能够实现对高能宇宙线（PeV 能量级）各向异性的精确测量，解决现有实验在高能区域测量精度有限的问题。能够实现对宇宙线轻、重成分的测量，填补目前对宇宙线成分各向异性实验观测的空白。

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The effect of baryon conservation and nucleon-nucleon correlation on the light nuclei production at $\sqrt{s_{NN}} = 3\ GeV$

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The yield ratio of light nuclei produced in heavy-ion collisions, defined as $N_t \times N_p/N_d^2$, is a promising probe for the critical endpoint in the QCD phase diagram. In the coalescence model of light nucleus production, the triton yield N_t and deuteron yield N_d are sensitive to the relative distance Δr between each pair of nucleons in the Wigner function. However, the effect of the two-nucleon distribution $\rho(\Delta r)$ in the colliding nucleus on the yield ratio has not been extensively investigated. In this work, we developed a method to sample nucleons in the ^{197}Au nucleus satisfying both the single-particle distribution $f(r)$ and the two-nucleon distribution function $\rho(\Delta r)$. Using these sampled ^{197}Au nucleus, we calculated the proton, deuteron and triton yields in Au+Au collisions at $\sqrt{s_{NN}} = 3GeV$ using the SMASH transport model simulations. The calculated yield ratios, differential p_T distributions and mean transverse momentum $\langle p_T \rangle$ different centrality regions and rapidity windows agree well with experimental measurements from the STAR experiment. Our results suggest that initial nucleon-nucleon correlations have a visible effect on light particle production, indicating that the yield ratio of light nuclei in heavy ion collisions might provide a good probe for nucleon-nucleon correlation in the nuclear structure.

墙报展及评选 / 314

使用核碰撞模拟与机器学习研究原子核内两核子关联

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早期的相对论重离子碰撞模拟程序通常忽略原子核的复杂内部结构，但先前的研究表明原子核形变显著影响椭圆流和带电粒子多重数分布。为了深入理解初态核结构的影响，我们在模拟中加入了核子-核子关联效应。在碰撞能量为 3Gev 的条件下，我们发现初态的核子-核子关联对快度、横动量分布以及各向异性流的影响并不显著，且这些物理量与初态核子关联的类型之间相关性较弱。为了进一步揭示影响末态分布的关键因素，我们采用点云神经网络学习核碰撞末态粒子间的关联和多事件的统计信息，从末态粒子分布提取初态核结构信息，并利用可解释性分析来识别对神经网络预测结果有显著影响的特征。

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11 年太阳周期中的 AMS 宇宙线反质子测量

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基于一整个太阳周期（11 年）的 AMS 数据，我们测量了宇宙线反质子流强随时间的变化，时间粒度 27 天，刚度范围 1-41.9GV。

测量结果显示，宇宙线反质子流强具有独特的性质：反质子流强随着刚度增加先升后降，在大约 3GV 达到最大，而质子、电子、正电子的流强则是一直下降。反质子流强随时间变化的幅度明显比其他粒子要小。反质子和质子流强之间具有变化迟滞关系，而反质子与电子流强之间是线性关系。值得注意的是，在一个 11 年的太阳周期内，流强随时间变化幅度与流强的能谱形状有明显的相关性。

对于理解宇宙线反质子起源，以及理解太阳调制及其与粒子质量、电荷及能谱形状的关系，AMS 的流强随时间的测量结果提供了至关重要的信息。

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Online event classification in JUNO

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The Jiangmen Underground Neutrino Observatory (JUNO) has been primarily designed to determine the neutrino mass ordering by measuring the energy spectrum of neutrinos from two nuclear power plants, utilizing its exceptional energy resolution. JUNO employs a 20 kton liquid scintillator as the target substance in the central detector, with tens of thousands of 20-inch PMTs applied to achieve high photocathode coverage. Waveform from PMTs is a huge amount of data to deal with. Online

event classification is necessary to reduce the data volume pressure. In this talk we will introduce the general design and selection strategy of online event classification.

分会场五 / 317

Precision test of the weak interaction with slow muons

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We propose to use slow muons facilities combined with cyclotron radiation detection for precision test of the weak interaction in the muon decays. Slow positive muon bunches are first injected into a cylindrical superconducting vacuum chamber with uniform strong axial magnetic fields to radially confine the muons. The positrons resulting from muon decays can be detected by their cyclotron radiation, which can be transported to low-noise electronic devices through waveguides coupled to the chamber. The decay positron's energy can be precisely measured down to eV level in the low energy region, which is sensitive to new physics effects such as Majorana neutrinos and new structures of weak interactions.

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CICENNS: 300-kg CsI(Na) Detector for Coherent Elastic Neutrino-Nucleus Scattering (CEvNS)

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A recent observation of CEvNS has opened a new avenue for probing extremely low-energy neutrino interactions, via neutrino wave scattering with the entire nucleons in a nucleus coherently. The CICENNS detector under construction expects to provide a sufficient CEvNS signal from neutrinos produced by the Chinese Spallation Neutron Source. This project aims to make a precise measurement of the CEvNS cross section and the mean radius of neutron distribution inside a nucleus. It will also explore new physics phenomena including searches for non-standard neutrino interactions and new particles.
In this presentation, we report the status of detector construction efforts and physics sensitivities.It involves a lot of specific hardware and testing.

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江门中微子实验天文学中微子研究

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江门中微子实验（JUNO）是目前正在建设中的多功能中微子实验。JUNO 的中心探测器是一个装有 2 万吨液体闪烁体的有机玻璃球，其被浸泡在 3.5 万吨水切伦科夫探测器中。该试验配备有 17612 个 20 英寸光电倍增管和 25600 个 3 英寸光电倍增管，用于探测物理事例信号。

JUNO 预期的能量分辨率将达到 3%/√E(MeV)，创造前所未有的精度。其主要物理目标是确定中微子质量排序并实现振荡参数的精细测量，具有探测反应堆中微子，超新星中微子、太阳中微子、大气中微子、质子衰变等领域的潜力。本次报告将介绍 JUNO 实验在中微子天文学方向的研究，涵盖探测核子衰变，太阳中微子，超新星中微子爆发，弥散超新星中微子背景和地球中微子等方向的物理潜力。

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Carbon, Oxygen and CNO combined spectra measurement with DAMPE

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Carbon and Oxygen are among the most abundant intermediate species in cosmic rays, which originate from the evolution of stars and their final explosive phases at the end of their life cycles. The DArk Matter Particle Explorer (DAMPE) boasts excellent charge resolution and energy resolution for these types of cosmic rays, ranging from a few tens of GeV to hundreds of TeV. Notably, DAMPE has the largest acceptance among all operational cosmic-ray detectors in orbit. Detailed measurements and extensions up to higher energies are crucial for understanding the acceleration and propagation of galactic cosmic rays. In this talk, we will present the latest progress from our collaboration.

分会场一 / 321

Electroweak Precision Measurements of the nearly degenerate Z-Z' system

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The case that a Z' hidden inside a Z resonance was neglected in the literature, maybe for the complicated mixing and interference effects of the nearly-degenerate system. We aimed at filling in this gap and discussed the possibility of the existence of such a system, and the possibility of searching this Z' particle at a lepton collider.

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Global spin polarization of Λ hyperons in fixed target Au+Au collisions in STAR experiment at RHIC

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In non-central heavy ion collisions, large angular momentum is generated, leading to the creation of significant vorticity and subsequent spin polarization of particles with finite spin. The global polarization of Λ hyperons (P_Λ) measured along the direction of global angular momentum can serve as an effective probe of vorticity as well as spin degrees of freedom. Recently, global Λ polarization has been measured over a wide collision energy range. The Fixed-Target program at the STAR experiment at RHIC provides a unique opportunity to study P_Λ in regions of high baryon density.

In this talk, we report the measurements of global Λ polarization, at $\sqrt{s_{NN}} = 3.0, 3.2, 3.5, 3.9$ and 4.5 GeV in fixed-target Au+Au collisions. The dependence on collision energy, centrality, rapidity and transverse momentum of the measured P_Λ will be discussed.

分会场五 / 324

CMS MTD BTL timing detector in Phase2 upgrade

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The LHC will resume operations in 2026, entering the High Luminosity (HL-LHC) era. MTD (MIP Timing Detector) is a pivotal component in the HL-LHC CMS upgrade, promising a remarkable enhancement in time resolution to 30 ps. In the part of the BTL (Barrel Timing Layer), we have formulated a comprehensive research and development plan, along with an assembly and testing strategy for the Sensor Module. Readout Units testing is nearly complete, with large-scale production set to commence soon. Peking University, along with other institutions, has played an important role in this work. Our contributions mainly encompass the optimization of the sensor module coupling tool and the implementation of the sensor module QA/QC system through production, construction, and testing. Additionally, we participated in specific test beam projects, collaboratively determining specifications for SiPM and LYSO. In large-scale production, our responsibilities will extend to assembling a quarter of the modules while also undertaking other associated tasks.

分会场一 / 325

基于《强子作为非拓扑孤立子的 SU(5) 大统一模型》对一个新实验现象的解释

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按 SU(5) 大统一模型 [1]、[2]，对称性破缺方式是 SU（5）→SU（3）×SU(2)×U(1)→U(1)。在强子内部有近似的 SU(3)×U(1) 定域对称性，强子作为非拓扑孤粒子存在；在强子中的夸克与胶子具有近似已知夸克与胶子的性质；在强子外部，夸克具有整数电荷，只有 U(1) 定域对称性。强子内部夸克与胶子的质量远小于强子外部夸克与胶子的质量，自由夸克与胶子能够存在，但将很快衰变为强子和轻子；轻子进入强子中的质量显著大于轻子在强子外部时的质量，因此轻子不能存在于强子内部。按本模型，没有夸克禁闭问题，自然地解释了宇宙中正反重子不对称现象，μ 子磁矩反常（比标准模型预言的更大），Xe 原子的电子受到的反常作用，B 介子的反常衰变。最近超出标准模型的一个新实验是
Σˆ+⟶pˆ++μˆ-+μˆ+, (1)
截面偏离标准模型的预言（稍大）。本文基于模型 [1] 给出的耦合项，适当地选择耦合常数 f_A、f_B 、ξ_B 与 Higgs 场真空期望值 ⟨H_Bˆ5⟩_0 、⟨H_Bˆ5⟩_0，借助于 Feymann 图 1，（1）偏

离标准模型的截面能够得到解释。
[1] 陈世浩强子作为非拓扑孤粒子的 SU(5) 大统一模型（I），高能物理与核物理，1994，18（4），317.
[2] 陈世浩强子作为非拓扑孤粒子的 SU(5) 大统一模型（II），高能物理与核物理，1994，18（5），409.

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Spectral Analysis of Lithium, Beryllium and Boron Nuclides with DAMPE

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The secondary nuclides lithium, beryllium, and boron in cosmic rays are primarily produced through the fragmentation of primary nuclides such as carbon and oxygen with the interstellar medium. The spectral measurements of these secondary nuclides are crucial for understanding the propagation mechanisms of cosmic rays. With the high charge resolution and large geometric factor, DAMPE (Dark Matter Particle Explorer) is expected to measure the energy spectra of these secondary cosmic-rays in a wide energy range from 10 GeV/n to a few TeV/n. In this work, we will provide the latest progress of the spectral analysis and the updated results.

分会场三 / 327

Jet-flow coupling in heavy-ion collisions

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Particles associated with the jet will be deflected from their initial direction due to the scatterings with the thermal partons flowing in the QGP fluid. Such deflections depend on the energy of the jet, the local energy gradient, and the local flow velocity. In general, the soft particles will drift towards the direction of the flowing medium, away from the center of the jet cone where the hard particles are located, leading to an intra-jet asymmetry coupled with flow, which can be used to extract the properties of the QGP medium. In this work, we first calculate the intra-jet asymmetry distribution in both transverse and longitudinal directions and investigate their dependence on path length, viscosity, and jet multiplicity. Such asymmetry is also observed in the jet chemical structure. We then extract the average radial flow velocity distribution via the intra-jet asymmetry distribution and compared it with the hydrodynamic simulation results. Our approach can be further used to localize the initial production position of the jet without specified requirements of the jet direction. As we apply jet localization to gamma-jet and dijet events, we find an improvement in the localization accuracy of dijet events due to the interplay between QGP flow and the diffusion wake induced by the backside jet.

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Measurement of very-high-energy diffuse gamma-ray emission from |☒| < 5☒ of the Galactic plane with LHAASO-WCDA

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Galactic diffuse gamma-ray emission (GDE) is produced by the galactic cosmic rays (CR) interacting with the interstellar medium (ISM) and radiation fields (ISRF). The GDE is a very important probe of CR propagation and interaction. Different from the measurements of CR particles in the local vicinity, the GDE enables a direct measurement of CR distribution in the Milky Way, and can thus provide much more important information of the production and propagation of CRs. LHAASO-WCDA, with a large area of 78000 mˆ2, can study VHE gamma-ray astronomy and GDE. In this talk, We will report the measurements of the diffuse emission from the Galactic plane in energy range from 1 TeV to 20 TeV with LHAASO-WCDA.

分会场五 / 329

基于 MAPS 的 LHCb 上游径迹探测器升级

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位于磁场上游的径迹探测器 Upstream Tracker（UT）是 LHCb 探测器重要组成部分，对提高长寿命粒子重建效率和长径迹匹配速度至关重要。为发掘高亮度 LHC 上重味物理研究潜力，LHCb 计划在 2033 年前后进行二期升级，以实现在$1.5 \times 10^{34} cm^{-2} s{-}1$ 亮度下运行的目标。现有 UT 须升级为颗粒度更高、抗辐照性能更强的像素型探测器。本报告将介绍目前可行的 MAPS 技术选项，基于 CMOS 的初步系统设计和探测器模拟，以及初步的性能研究。

分会场五 / 330

面向高性能径迹探测器的高压 CMOS 芯片研发

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未来对撞机实验上通常需要大面积、高空间分辨率、良好时间分辨及抗辐照的带电径迹探测系统，如环形正负电子对撞机、LHCb 升级等。高压 CMOS 具有良好抗辐照性能、快速电荷收集，且可利用成熟的商用 CMOS 工艺。本报告将介绍探索先进的 55nm 高压 CMOS 工艺、用于粒子探测传感器的研发情况。基于 Low-Leakage 55nm 的 COFFEE1 芯片达到 8-9V 击穿电压，并观察到对激光信号响应。基于 High-Voltage 55nm 的 COFFEE2 芯片加入了像素内放大器和比较器电路，传感器达到 70V 击穿电压。其他测试正在进行。

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Calibrating Low-Energy Nuclear Recoils with Dual-Phase Argon TPC for Future Light Dark Matter Searches

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The dual-phase argon time projection chamber (DAr-TPC) has shown significant advantages in detecting Weakly Interacting Massive Particles (WIMPs) in low mass ranges (sub GeV/c² - 10 GeV/c²). However, due to the lack of energy calibration measurements for scintillation and ionization yields with nuclear recoil energy below 7.1 keV, the current analysis for constraining spin-independent dark matter interactions with nucleons is influenced by the accuracy of theoretical models and limited by searching sensitivity. To address this issue, we are preparing to build a small DAr-TPC to conduct a liquid argon calibration experiment of nuclear recoil response using a low-energy neutron beam. The goal is to obtain calibrated data for the 1.0 to 7.1 keV energy range of nuclear recoil. This poster will introduce the research background and the setup design of the calibration experiment, as well as showcase the progress of tests on the PMT arrays to be implemented in the apparatus, both at room temperature and in a liquid argon cryogenic environment.

分会场五 / 332

Overview of the software and performance studies of the LHCb Upgrade II Electromagnetic Calorimeter

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LHCb Upgrade II is a proposed detector upgrade for the fourth long-term shutdown of the LHC, which will operate at instantaneous luminosities up to $1.5 \times 10^{34} cm^{-2} s^{-1}$ and integral luminosities totaling about 300 fb^{-1}. The upgrade will fully collect and utilize the flavor physics opportunities offered by the HL-LHC and to explore a wide range of observable physics with unprecedented precision. The required substantial modifications of the current LHCb electromagnetic calorimeter (ECAL) due to high radiation doses in the central region and increased particle densities are referred to as PicoCal.

Currently, a number of scintillating sampling ECAL technologies are under investigation as part of an ongoing research and development effort. These technologies include the Spaghetti Calorimeter (SpaCal) utilizing garnet scintillating crystals with tungsten absorbers, SpaCal utilizing scintillating plastic fibers with tungsten or lead absorbers, and the Shashlik configuration featuring polystyrene tiles, lead absorbers, and fast wavelength-shifting fibers. Additionally, corresponding simulation and reconstruction software packages have been developed in conjunction with these studies. Timing capabilities with tens of picoseconds precision for neutral electromagnetic particles and increased granularity with denser absorber in the central region are needed for pile-up mitigation. A front-to-back longitudinal layered readout structure has also been introduced into the prototype with a view to improving the splitting performance of overlapping clusters. For both the SpaCal and Shashlik modules, we obtained a time resolution better than 20 ps at high energy. And the sampling term for energy resolution is about 10/sqrt(E) meets the requirement. Several typical ands benchmark analyses have been carried out, to demonstrate the performance of the PicoCal.

The talk will highlight the novel software developments for the PicoCal and the related important physics prospects.

分会场三 / 333

Spin hydrodynamics of Dirac fermions consistent with entropy principle

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In this study, the canonical formulation of the spin hydrodynamics of Dirac fermions is examined within a power counting scheme, where the spin variables are considered to be at the same order as the conventional hydrodynamic variables. An entropy-current analysis with a general spin potential reveals the importance of incorporating both the three components of spin density associated with spatial rotation symmetry and the other three components linked to boost symmetry to uphold the entropy principle. It is found that the boost variables have to be included in the stress-energy tensor, along with a totally antisymmetric spin tensor for Dirac fermions. The constitutive relations is chosen to be related to the phenomenological formulation of spin hydrodynamics by pseudogauge transformation. Upon linear-mode analysis, it is observed that the spin and hydrodynamic modes in this canonical formulation exhibit the same dispersion relations as the phenomenological formulation up to the relevant order.

分会场五 / 334

STCF 中主漂移室（MDCH）研制进展

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新一代正负电子对撞机——超级陶粲装置（STCF）的设计对撞亮度大于 $0.5\times10^{35}\mathrm{cm}^{-2}\ \mathrm{s}^{-1}$，预期事例率达到 400kHz，新装置上强辐照和高计数率的实验条件对外径迹探测器主漂移室（MDCH）提出了严峻挑战。研究人员对 MDCH 系统进行了详细设计和优化，包括整体机械及应力分析，超小单元的技术攻关，电极丝的高密度排布和固定方法研究，新定位子及穿丝工艺验证、丝张力控制及丝张力测量研究，电子学信号仿真，读出电子学架构及探测器时间与电荷测量方法研究，为未来 STCF 中 MDCH 工程机的研制提供了技术基础。

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Illuminating M87* inner 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.

分会场五 / 336

The Development and Commissioning of High Granular Scintillator-based Calorimeter of CEPC

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The Circular Electron Positron Collider (CEPC) is a proposed future high-energy lepton collider aimed at advancing our understanding of fundamental physics by exploring Higgs boson with unprecedented precision. A major challenge for the CEPC detectors is achieving a boson mass resolution (BMR) of 4%, which is required to separate the Higgs, Z, and W bosons in their hadronic decays. The baseline design of the CEPC detector was guided by the particle flow algorithm (PFA) concept to satisfy the BMR requirements. The BMR performance obtained by the PFA approach is primarily determined by the shower separation capability and energy resolution of calorimeters in detector system. Both electromagnetic and hadronic calorimeter with high granularity are crucial to meet requirements of separating decay channels by optimizing energy resolution for the desired BMR. Scintillator-based electromagnetic and hadronic calorimeter with analogue readout are potential calorimeter scheme candidates for the CEPC detector. In this presentation, a scintillator tungsten electromagnetic calorimeter (ScECAL) prototype and an analogue hadron calorimeter (AHCAL) prototype will be introduced, where the performance and validation of ScECAL and AHCAL based on Monte Carlo simulations and beam test data, including the energy response to high energy electrons in the range of 1-100 GeV/c are contained.

分会场三 / 337

Partonic effects on the charm azimuthal correlations in relativistic p + p collisions

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Measurements of heavy flavor quark correlations in heavy-ion collisions are crucial to understand the flavor dependence of quark energy loss mechanisms in hot and dense QCD matter. In addition to the heavy-ion collisions, experimental measurements of heavy flavor correlations in p+p collisions can provide insights into the contributions of perturbative and non-perturbative QCD processes to the correlation functions and further help in interpreting correlation measurements in heavy-ion collisions. In this study, we investigate charm quark and D-meson correlations using PYTHIA Event Generator and a multiphase transport model (AMPT). By introducing a transport model approach with partonic rescatterings connecting to the initial conditions provided by PYTHIA event generator, effects of the partonic collisions on the charm azimuthal correlations in relativistic p+p collisions are

investigated. It is found that the partonic collisions during the lifetime of the partons enhance the away-side correlation and suppress the near-side correlation, whereas hadronization and final state hadronic interactions bring tiny effect to the azimuthal correlations. These findings indicate that partonic effect plays an important role in the azimuthal correlations of heavy flavor particles in relativistic p+p collisions. Our study offers insights into the future experimental measurements of heavy quark correlation at RHIC and LHC energies.

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Event reconstruction of atmospheric neutrinos using Machine Learning-based method in JUNO

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The Jiangmen Underground Neutrino Observatory (JUNO), located in Southern China, is a multi-purpose neutrino experiment that consists of a 20-kton liquid scintillator detector. The primary goal of the experiment is to determine the neutrino mass ordering (NMO) and measure other neutrino oscillation parameters to sub-percent precision. Atmospheric neutrinos are sensitive to NMO via matter effects and can improve JUNO’ s total sensitivity in a joint analysis with reactor neutrinos; Good capability of reconstructing atmospheric neutrinos in JUNO is crucial for its physics goal.

In this talk, we present a novel multi-purpose reconstruction method for atmospheric neutrinos, by combining PMT waveform analysis and machine learning techniques. Multiple machine learning strategies, including usage of planer, spherical, and 3-dimensional models, as well as usage of neutron capture information are discussed. We show the performance of reconstructing atmospheric neutrino’ s directionality, energy and flavor-identification using Monte-Carlo simulations, and demonstrate that this method can achieve unprecedented reconstruction precision and fulfils the needs of JUNO.

分会场三 / 340

Polarized TMD FFs

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In this talk I will review our recent efforts to understand the polarized Transverse-Momentum-Dependent fragmentaion functions (TMD FFs) . Recent BELLE results on $\Lambda/\bar{\Lambda}$ polarization in e^+e^--annihilations stimulate a series of progress from several groups to understand the polarized TMD FF $D_{1T}^{\perp}$. Based on the fundamental isospin symmetry of QCD, we propose a new parametrization and apply it into e^+e^--annihilation, semi-inclusive DIS and also hadron/nucleus collisions. The isospin symmetry and further flavor structures of $D_{1T}^{\perp}$ is thoroughly investigated, and several predictions for observables in current and future facilities are presented. We further study the weak decay contributions to the parity-violating TMD FFs, which cause several non-negligible effects.

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南天大视场伽马射线望远镜（SWGO）项目

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伽马射线是探索宇宙极端天体物理的探针，是研究宇宙线的加速以及传播过程、探究宇宙线起源问题的重要信使。大面积地面粒子探测器阵列对甚高能及以上的伽马射线具有高灵敏度、大视场、高占空比等特点，能够高效观测伽马射线源。南天大视场伽马射线望远镜（SWGO）作为下一代伽马射线巡天实验项目，其建设地点拟选在南美洲。SWGO 将与北半球的 HAWC 和 LHAASO 等设施形成互补，从而实现对全天的观测。SWGO 高能量灵敏度、大视场等特点，将有助于对南天尤其是银心等高能天体区域的深入观测，从而推动对高能天体物理的研究。

分会场一 / 342

Search for T-odd mechanisms beyond the Standard Model with a transversely polarized electron target?

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Within the Standard Model, transverse single spin asymmetries in electron elastic scatterings arise only from multi-photon exchanges. Experiments at MIT-Bates, MAMI, JLab, where transversely polarized electron beams scatter off both hydrogen and nuclei targets, show surprising discrepancies from theoretical calculations based on unitary and optical theorem. 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.

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 (pe⃗) scattering instead of electron-proton (e⃗ 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 Q2) 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 e⃗ 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 pe⃗ scattering could be an attractive approach to search for new physics.

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CUPID-China 实验进展与计划

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无中微子双贝塔衰变实验探索中微子是否为马约拉纳费米子，对于轻子数守恒和中微子质量来源等重要物理目标有着独特的意义，因此成为现代粒子物理研究最重要的研究课题之一。CUORE 是当前最灵敏的无中微子双贝塔衰变实验之一，CUPID 实验在 CUORE 的基础上，采用^{100}Mo 为探测目标，并同时读取光信号和热信号，从而大大降低来自于表面α 和环境γ 的本底。CUPID-China 合作组正在积极进行探测器的各项研发工作，并开展国际合作，希望能利用锦屏地下实验室世界领先的低本底条件，进行无中微子双贝塔衰变实验。本报告介绍合作组目前的研发进展以及未来的计划。

分会场三 / 344

Softening of the Hypertriton Transverse Momentum Spectrum in Heavy-Ion Collisions

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Understanding the properties of hypernuclei helps to constrain the interaction between hyperon and nucleon, which is known to play an essential role in determining the properties of neutron stars. Experimental measurements have suggested that the hypertriton ($^3_\Lambda$H), the lightest hypernucleus, exhibits a halo structure with a deuteron core encircled by a Λ hyperon at a distance of about 10 fm. This large $\Lambda - d$ distance in $^3_\Lambda$H wave function is found to cause a suppressed $^3_\Lambda$H yield and a softening of its transverse momentum (p_T) spectrum in relativistic heavy-ion collisions. Within the coalescence model based on nucleons and Λ hyperons from a microscopic hybrid hydro model with a hadronic afterburner for nuclear cluster production in Pb-Pb collisions at $\sqrt{s_{NN}}$= 5.02 TeV, we show how this softening of the hypertriton p_T spectrum appears and leads to a significantly smaller mean p_T for $^3_\Lambda$H than for helium-3 (^{3}He). The latter is opposite to the predictions from the blast-wave model which assumes that $^3_\Lambda$H and ^{3}He are thermally produced at the kinetic freeze-out of heavy ion collisions. The discovered quantum mechanical softening of the (anti-)hypertriton spectrum can be experimentally tested in relativistic heavy-ion collisions at different collision energies and centralities and used to obtain valuable insights to the mechanisms for light (hyper-)nuclei production in these collisions.

分会场一 / 347

Searching for heavy neutral lepton and seesaw mechanisms at muon colliders

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The future muon collider with high energy and high luminosity can be an ideal place to search for new physics. It can play as an emitter of electroweak gauge bosons and thus leads to substantial

vector boson scattering (VBS) processes. In this series of works, we focus on heavy neutral lepton (HNL), Type-II and Type-III seesaw mechanisms, attempting to reveal the origin of neutrino masses through them at muon collider.

For searching HNL, we investigate the production of it and lepton number violation (LNV) signature through VBS at high-energy muon colliders. They provide clean and robust LNV signatures to tell the nature of Majorana HNLs and thus have more advantageous benefits than direct $\mu\mu$ annihilation. We analyze the potential of searching for Majorana HNL and obtain the exclusion limits on mixing $V_{\ell N}$.

In Type-II and Type-III seesaw mechanisms, through the pair production of charged Higgs (Type-II seesaw) and heavy fermions (Type-III seesaw), we investigate searching potential for the heavy particles at future high-energy muon collider.

The publication：
- Heavy neutral lepton: 2306.17368
- Type-II seesaw: 2301.07274
- Type-III seesaw: 2205.04214

分会场三 / 348

The E-M field in small collision system p+A with a transversely polarized proton

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With experimental data of DIS involving transversely polarized proton, we have calculated the 3-D charge density inside a polarized proton, which is found to have a significant non-spherical symmetry. Then we have calculated the properties of E-M field generated by a single transversely polarized proton. Based on them, the E-M field generated in small collision system p+A which involving a transversely polarized proton are studied. We find that the orientation of this E-M field has a significant dependence on the direction of transverse polarization of the proton, and the correlation function ($\Delta\gamma$) has also significant dependence on the angle between the reaction plane and the direction of polarization. This finding provides a new direction for probing the chiral magnetic effect (CME).

分会场一 / 349

Testing Electroweak Phase Transition and Dark Matter Phenomenology at the LHC

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The Standard Model extended with a complex or real singlet scalar can admit a strong first order electroweak phase transition as needed for electroweak baryogenesis. The real singlet component

that mixes with the Standard Model Higgs boson leads to the possibility of di-Higgs and di-boson final states in pp collisions. The complex component can provide a dark matter (DM) candidate that leads to the possibility of a $b^{-}b$+MET final state, which is a brand new search channel at the LHC. Focusing on these channels, I will discuss the prospective reach at the LHC for a heavy singlet-like scalar in regions of (c)xSM parameter space compatible with a SFOEWPT (and DM phenomenology).

墙报展及评选 / 350

用于 TES 探测器的单通道 DC-SQUID 读出电子学

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直流超导量子干涉仪（DC-SQUID）作为一种低噪声前放，利用磁通锁定的原理线性放大信号，广泛应用于超导边沿探测器（TES）信号的低温读出。为了分析信号，低温放大的信号需要在室温端进一步放大。本工作中，介绍了可以用于 TES 信号读出的多级串联 SQUID 阵列（SSA）设计，基于 TES 读出需求我们设计了一套适用于 SSA 的低噪声室温读出电子学。室温电子学除了进一步放大读出 SSA 的低温信号，还为 SSA 提供磁通反馈回路实现磁通锁定，以及 SQUID 工作需要的偏置电流、磁通输入信号。我们在 4K 脉管制冷机中，基于研制的室温电子学提供偏置电流、输入和反馈磁通，实现了磁通锁定放大。我们测试了 SSA 在不同偏置电流下的超导特性以及磁通响应。得到 SQUID 临界电流 IC、SQUID 磁通互感系数 M，符合器件设计预期。最后对磁通锁定后系统的噪声成分进行了分析，为下一步系统优化给出了参考。

墙报展及评选 / 352

低温晶体量热器中 NTD-Ge 热传感器的制备和特性研究

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中子嬗变掺杂锗 NTD-Ge 是通过中子辐照及相应的嬗变掺杂过程产生具有十分均匀掺杂分布的锗半导体，在极低温度下其电阻对温度变化十分灵敏，且具有信号读出相对简单、大动态范围等独特优势，广泛应用于低温晶体量热器的热传感器。我们在中国先进研究堆对一批 10N 纯度的高纯锗进行了热中子辐照，经过放射性冷却之后，对 NTD-Ge 的热中子辐照剂量、中子辐照缺陷以及载流子浓度等关键特性进行了测量研究。探索制定了 NTD-Ge 热传感器的电极制备流程，涉及表面抛光、离子注入、真空镀膜等多种微纳加工工艺，并解决了 NTD-Ge 金属电极粘附性差的问题。利用搭建的 NTD-Ge 极低温测试系统，对制备的 NTD-Ge 热传感器的极低温电阻-温度性能进行了测量，得到最低 ~20 mK 低温下 NTD-Ge 的 R-T 特性符合理论预期的优良结果。

分会场三 / 353

Extended Nambu–Jona-Lasinio model for quark and nuclear matters

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In this work, we extend the two-flavor Nambu–Jona-Lasinio model to one capable of exploring quark and nuclear matter consistently. With an extra term standing for quark-nucleon interactions, nucleons could automatically emerge as color-singlet three-quark entities by following a process similar to mesons. Besides the quark part in mean field approximation, both mesons and nucleons could contribute to the thermodynamic potential thus possibly give rise to quarkyonic matter beyond mean field. In the study, two kinds of "confining" couplings are adopted for the new interaction term and two different quark masses are considered for comparison. It turns out that only confined nuclear matter or deconfined quark matter is possible for all the cases at zero temperature, thus quarkyonic matter is not favored at all. Even more strictly, only the case with stronger confinement effect and a smaller quark mass admits a physical first-order phase transition from nuclear matter to quark matter around twice saturation density.

分会场五 / 354

正负电子对撞及中微子物理中时间投影室技术应用研究进展

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时间投影室（Time Projection Chamber）技术，是利用粒子径迹产生电离电子的漂移时间和漂移方向的投影位置确定径迹三维重建的探测器技术，探测中除可以读出电离信号外，还可读取粒子的漂移时间，从而精确确定粒子径迹。近年来，时间投影室技术发展很快，已应用于大型高能物理实验，作为正负电子对撞机的大体积中心探测器及多径迹精密测量方面备受重视。也发展了用于粒子天体物理领域内中微子研究的时间投影室等。

自 2010 年，中国科学院高能物理研究所加入（Lepton Collider Time Projection Chamber，LCTPC）国际合作组以来，积极踊跃的开展该技术各种应用研究。比如面对下一代环形高能正负电子对撞机物理研究，时间投影室已作为下一代环形正负电子对撞机技术设计报告（Technical Design Report，TDR）的基准主径迹探测器，该技术具有低物质量、高占空比、三维高精度长径迹重建和良好粒子鉴别能力，为满足在高亮度运行时具备高空间分辨率和出色的粒子鉴别（PID）能力，本课题组完成了大量模拟优化研究、实验研究解决各种关键技术问题，已完成正离子流控制 (IBF×Gain≤1) 、紫外激光径迹 (100m) 和粒子鉴别 PID (3.6%) 技术应用研究。利用 Cluster Counting 分析技术可有效提升粒子鉴别能力。比如台山中微子实验物理要求：200keV - 1MeV 中微子探测，输入反应堆中微子能谱能量分辨率好于10%。反应堆裂变产生的中微子穿过 TPC 探测器，会与气体中自由电子发生弹性散射产生离径迹，通过探测电子电离能量及气体中散射方向重建中微子能谱，深入研究中微子性质；课题组已成功研制出一套充入高气压 10atm 的 CF_4 工作气体时间投影室原型机。本报告将给出高能物理研究所在正负电子对撞及中微子物理中，时间投影室技术应用研究的最新进展。

分会场五 / 355

下一代环形正负对撞机中像素型读出时间投影室技术研究进展

Authors: Yue Chang[1]; Huirong Qi[2]

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近年来，高能物理领域对味物理和 Higgs 物理探测需求不断提高，下一代环形高能正负电子对撞机加速器对撞亮度设计也不断提升。中国的 CEPC 和欧洲 FCC-ee 均作为高亮度 Higgs 粒子和 Z 粒子工厂，在 Z 峰值的对撞亮度已达到$10^{36}cm^{-2}s^{-1}$。时间投影室在正负电子对撞机实验的概念设计报告（CDR）、技术设计报告（TDR）中均作为基准主径迹探测。相对于传统大尺寸 Pad 型读出采用毫米级设计（如：$1\,mm \times 6\,mm$），新发展的像素型时间投影室技术（Pixel TPC）是目前国际合作组 ECFA 和 LCTPC 重要技术研发方向和研究热点。为满足在高亮度运行时具备高空间分辨率和出色的粒子鉴别（PID）能力，同时考虑 TPC 端盖读出通道数和总功耗等技术参数，需要完成深入的模拟和大量的实验研究。

在中国科学院高能物理研究所，本课题组针对该研究热点，并解决这些关键技术问题。首先通过模拟和实验研究，主要解决以下两个问题：一是像素型读出技术的粒子分辨能力及 Cluster Counting 数据分析验证，二是保证物理目标前提下，优化设计像素单元读出尺寸。基于 Garfield++ 和 Geant4 搭建的 CEPC Pixel TPC 模拟软件框架。该框架分为数字化和数据重建两个部分，数字化部分对主要的电离、漂移、扩散和读出放大等过程进行了参数化；数据重建部分包括事例查找、径迹重建，并利用簇团计数实现探测器性能的优化。通过探测效率的模拟研究分析了簇团计数的优势，结果显示出高颗粒度读出具有明显优势。同时本课题组与 DRD1、LCTPC 国际合作组合作，基于已研制的 TEPix 芯片设计 TPC 读出模块，将在德国 DESY 开展像素读出的束流实验研究。本报告将给出详细的研究现状和最新研究进展。

分会场一 / 356

Search for a heavy resonance decaying into a top quark and a W boson in the lepton+jets final state at √s = 13 TeV

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A search for a heavy resonance decaying into a top quark and a W boson in proton-proton collisions at √s = 13 TeV is presented. The data was recorded by CMS detector and correspond to an integrated luminosity of up to 138 fb−1. The analysis is performed in the lepton+jets final state, where the top quark is reconstructed from an electron or muon, missing transverse momentum and a jet identified as originat- ing from a bottom quark. The W boson from the resonance decay is reconstructed as a single large-radius jet, identified by its characteristic substructure. The results are interpreted in the context of an excited bottom quark b∗ model. No statistically significant excess over the expected background is found, and b∗ quarks with left- handed, right-handed, and vector-like chiralities are excluded at 95% confidence level for masses below 2.4, 2.8, and 3.1 TeV, respectively.

分会场五 / 357

大型高能物理实验中的高速光纤数据传输系统

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大型高能物理实验中前端探测器与后端系统之间需要一套稳定、高速、双向、抗辐照的数据传输系统，以解决前端至后端的高带宽数据发送需求，以及后端至前端的触发、时钟和控制等信息的传输需求。结合抗辐照、功耗、带宽、体积和成本等方面的综合考量，往往使用光通信系统来实现这一目标，这一解决方案在欧洲核子中心 CERN 的 LHC 实验中得到了实际应用验证。在这一套双向光纤数据传输系统中，涉及到光模块定制、抗辐照高速激光器驱动芯片、TIA 跨导放大芯片、双向数据接口芯片等模块与芯片研发，在具体设计层面还涉及到高精度锁相环、时钟恢复、高速并串/串并转换、数据编解码等一些底层芯片设计。本次报告将对这一双向光通信系统的整体架构、重要芯片的功能模型以及其中部分芯片的核心设计技术进行简要介绍。

分会场五 / 358

HFRS-TPC 前端读出电子学原型机研制进展

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即将于 2025 年建成的强流重离子加速器（High Intensity heavy-ion AcceleratorFacility, HIAF）上包含了一条放射性次级束分离线（HIAF FRagment Separator，HFRS）。HFRS 具备普通传输线和实验线（即分离器）的双重功能，是束流能量和强度都更高的新一代放射性束流装置。该束线在多个位置上选择了一对相互倒置的 Twins-TPC 探测器实现粒子鉴别和束流监测。Twins-TPC 作为整个束线各探测器中通道数最多、数据量最大的分系统，对读出电子学提出了高集成度、高计数率和大动态范围的要求，基于此需求，本文开展了 HFRS-TPC 前端读出电子学原型机系统的研制，针对高集成度、大动态范围的需求开展了技术攻关。
HFRS-TPC 前端读出电子学原型机系统由 ASIC 板、前端板、数据汇总板和时钟扇出板构成，可以实现 256 路探测器信号的读出和处理。其中 ASIC 板基于近物所自研的一款 ASIC 芯片 FEAM 研制，实现探测器信号的放大、整形等处理；前端板基于两片高集成度 ADC 和 FPGA，单板实现 64 路模拟信号的 AD 转换及在线处理，处理后的数据通过光纤接口传输至数据汇总板；数据汇总板单板可以实现 8 路光纤数据汇总，汇总后数据通过 PCIe 3.0 接口直接上传至服务器；时钟扇出板提供多路同步时钟，各前端板基于同步时钟工作。
在实验室对原型机系统进行测试，采用信号源模拟探测器输出。测试表明，在 10fC-1PC 输入动态范围内，系统积分非线性好于 1%，在输入大于 100fC 后，系统时间分辨（sigma）好于 1ns。原型机与 Twins-TPC 探测器原型机对接，使用激光进行测试，电子学系统工作正常。下一步，将针对高计数率需求继续开展技术攻关，满足 HFRS-TPC 单通道 100kHz 的计数率要求。

分会场一 / 359

Precision measurement of Zgamma+jets differential cross-section using full run2 data in ATLAS

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Precision measurements have played a key role in the development of particle physics. This presentation will report the latest measurement of differential cross-section of Drell-Yan $Z\gamma$ process using data collected by the ATLAS detector in run2, in particular concerning the jet activities. $Z\gamma$ production is a major background for many new physics process and $Z\gamma$ itself can also be used for indirect search for new physics such as EFT studies. The jets produced in association to $Z\gamma$ would also provide us a great chance to test several key QCD calculations. In this talk we'll present the data analysis method as well as discussing the results comparing to theoretical predictions.

分会场一 / 360

Matching Higgs triplets to HEFT: non-decoupling and polar coordinates

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We consider real Higgs triplet extension to Standard Model and match it to a non-linear effective field theory, the Higgs Effective Field Theory(HEFT). For the decoupling and non-decoupling regimes different power counting methods are adopted, the effective Lagrangians at leading order are derived. Their effects in physical observables are plotted. Later we present the parametrization of the Higgs doublet in polar coordinates, and get effective Lagrangian at next-to-leading order. New parametrization method allow us to derive all orders as it overcomes the kinematic mixing between Nambu-Goldstone bosons and new heavy particles. We also use it to the complex Higgs triplet in Type-II seesaw model.

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Formation and growth of solitons in nonminimally gravitating dark matter

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The presence of solitons is a generic prediction in ultralight dark matter models. We investigate their formation and growth, along with the surrounding miniclusters, through 3+1-dimensional simulations. For the first time, we include fully dynamical nonminimal couplings of dark matter to gravity, which modify the mass-radius relation of solitons. Our results show that solitons can form dynamically via gravitational condensation. We also demonstrate that solitons can become unstable and collapse when their densities reach critical values, irrespective of whether the nonminimal couplings are attractive or repulsive. This instability could impact the distribution and phenomenology of solitons in the present-day universe.

墙报展及评选 / 362

Production of Proton and Light Nuclei in Au+Au Collisions by RHIC-STAR in the High Baryon Density Region

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Light nuclei are loosely bound objects with a few MeV binding energies. The systematic measurement of light nuclei production in heavy-ion collisions across a wide energy range is a valuable tool to probe the QCD phase structure and gain insight into the underlying production mechanism. In 2018, RHIC started the second phase of the beam energy scan program (BES-II). The STAR Fixed Target (FXT) program was proposed to achieve lower center-of-mass energies and higher baryon density regions. Up to now, the STAR experiment has recorded high statistics data at $\sqrt{s_{\rm NN}}$ = 3 - 13.7 GeV in Au+Au collisions.

In this poster, we will present the proton and light nuclei production in Au+Au collisions at $\sqrt{s_{\rm NN}}$ = 3 GeV (FXT) recorded by the STAR experiment. The analysis will include results from center to peripheral collisions, and span from mid-rapidity to target rapidity. The transverse momentum (p_T) spectra, coalescence parameters (B_A), particle ratios, and compound yield ratios will be shown and compared with other experiment groups for a wide range of energies.

墙报展及评选 / 363

Vortical structure and the effects on directed flow in non-central relativistic heavy-ion collisions from a multiphase transport model

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With the extreme temperatures and energy densities generated by ultra-relativistic heavy-ion collisions, a new state of matter—Quark-Gluon-Plasma (QGP), with surprising fluid properties will be cr sions can generate a large initial angular momentum, resulting in strong vorticity of $\omega \approx (9 \pm 1) \times 10^{21} s^{-1}$ in the fluid, estimated from the global Λ hyperon polarization measurements in Au+Au collisions. This vortical structure may change the azimuthal distribution of the particle produced in the QGP.

We study the global and local vortical structure during the parton expansion phase and the directed flow (v_1) of final charm and light flavor hadrons in Au+Au collisions based on a multiphase transport model (AMPT) framework. We find that inharmonious expansion dominates the parton dynamics, and the integral vorticity depends on the rapidity and momentum of the parton. We also initially input a global vortical pattern caused by the instant electromagnetic field into the partonic interaction phase. This initial global vortex will dissipate quickly during the parton expansion phase. But the dv_1/dy as a function of rapidity for final pion, kaon, protron and D-meson is changed compared to the default AMPT. The differences in the dv_1/dy between positive and negative charged particles are also studied and the values are comparable to the measurements at RHIC energy. These findings are expected to guide us to better understand and constrain the fireball's vorticity with the v_1 measurements in ultra-relativistic heavy-iron collisions.

分会场一 / 365

CP violation in boosted top quark decay

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We propose a novel observable in boosted top quark decay, which can be used to measure the anomalous Wtb interaction. The observable is an angular correlation between the $t \to bW$ decay plane and the $W \to f\bar{f}'$ decay plane, which is related to the polarization of W. We show that a forward-backward asymmetry of the angular distribution is sensitive to complex phases in the Wtb anomalous couplings for both leptonic and hadronic decay modes of top quark. In this work, we analyze the prospects of probing the CP violation in the $t\bar{t}$ system at future lepton colliders.

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The First LHAASO Catalog of Gamma-ray Sources

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The results of the first catalog of very-high energy and ultra-high energy gamma-ray sources detected by LHAASO will be presented in this talk. The catalog was compiled using 508 days of data collected by the Water Cherenkov Detector Array (WCDA) from March 2021 to September 2022 and 933 days of data recorded by the Kilometer Squared Array (KM2A) from January 2020 to September 2022. This catalog represents the main result from the most sensitive large coverage gamma-ray survey of the sky above 1 TeV, covering declination from -20° to 80°. In total, the catalog contains 90 sources with an extended size smaller than 2° and a significance of detection at $> 5\sigma$. Based on our source association criteria, 32 new TeV sources are proposed in this study. Among the 90 sources, 43 sources are detected with ultra-high energy ($E > 100$ TeV) emission at $> 4\sigma$ significance level.

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JUNO reactor IBD selection with machine learning method

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Jiangmen Underground Neutrino Observatory (JUNO) is a multi-purpose neutrino experiment located in southern China. The primary goal of JUNO is to determine the neutrino mass ordering and measure several neutrino oscillation parameters to sub-percent precision by measuring the oscillated reactor antineutrino spectrum at 52.5 km from eight nuclear reactors. Selection of the reactor IBD signal with high efficiency and accuracy is key to measuring the oscillated reactor antineutrino spectrum. I will present a box-cut method to separate the IBD signal from background. Besides, the results of separating IBD signals and accidentals by machine learning method will also be discussed.

墙报展及评选 / 368

Lumical Detector Design and Reconstruction Algorithm

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Lumical 是 CEPC 的亮度探测器 Y 用于探测朝前区小角度散射的正负电子 Y 在这个 poster 中我们将会介绍我们对 Lumical 探测器的几何设计方案 Y 以及通过 bhabha 事例的产生子模拟矫正的重建算法设计同时 Y 对称的正负 z 轴探测器也可以进一步提高重建算法精度我们希望通过这样的设计 Y 使得 Lumical 的精度能够达到 0.01% 以上通过设计一款这样的高精度 Lumical 探测器 Y 希望能够有助于确定对撞机的综合光度准确的光度数据对于研究电弱过程测试标准模型和探索潜在的新物理至关重要 Y 使 Lumical 成为 CEPC 中电弱点精确物理研究的重要组成部分。

Lumical is a luminosity detector of CEPC Y used to detect positive and negative electrons scattered at small angles in the forward region. In this poster, we will introduce our geometric design scheme for Lumical detectors, as well as the reconstruction algorithm design based on simulating the generation of bhabha events as the correction. Meanwhile, symmetrical positive and negative z-axis detectors can further improve the accuracy of reconstruction algorithms. We hope that through this design, Lumical's accuracy can reach over 0.01%. By designing such a high-precision Lumical detector, it is hoped that it can help determine the comprehensive luminosity of the collider. Accurate luminosity data are critical for studying electroweak processes, testing the Standard Model, and exploring potential new physics, making Lumical an indispensable component for precise physics study of electrical weak points in CEPC.

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讨论（1）

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讨论（2）

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《高能物理领域计算资源和建设》

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高能物理战略研讨会 / 372

Opening

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《高能物理国际态势（国际高能加速器、探测器研发布局、技术前沿动态及规划)》

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高能物理战略研讨会 / 374

《科学院高能物理规划研究报告》

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高能物理战略研讨会 / 375

《基于加速器高亮度前沿战略（STCF 项目进展报告)》

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高能物理战略研讨会 / 376

《基于加速器高能量前沿战略（CEPC 项目进展报告)》

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分会场三 / 377

ALICE 实验进展

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ALICE 实验进展

分会场三 / 378

Phase diagram –theory

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Phase diagram –theory

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手征磁效应研究进展

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手征磁效应研究进展

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超周边重离子碰撞物理实验研究进展

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超周边重离子碰撞物理实验研究进展

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小系统新进展——集体流之后

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小系统新进展——集体流之后

分会场三 / 382

相对论重离子碰撞中精细核结构的重要性

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相对论重离子碰撞中精细核结构的重要性

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Nucleon spin structures and opportunities at EicC

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Nucleon spin structures and opportunities at EicC

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相对论重离子碰撞中矢量介子自旋排列的实验测量进展

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相对论重离子碰撞中矢量介子自旋排列的实验测量进展

分会场三 / 385

Lattice QCD study of heavy quark diffusion

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Lattice QCD study of heavy quark diffusion

晨光杯报告与评审 / 386

Observation of the Anomalous Shape of X(1840) in J/ψ → γ3(π + π −)Indicating a Second Resonance Near pp⁻ Threshold（报告人：陈通）

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Precision Measurement of Reactor Antineutrino Oscillation atKilometer-Scale Baselines by Daya Bay（报告人：陈志源）

晨光杯报告与评审 / 388

Microscopic Encoding of Macroscopic Universality: Scaling Properties ofDirac Eigenspectra near QCD Chiral Phase Transition（报告人：黄玮平）

晨光杯报告与评审 / 389

A tera–electron volt afterglow from a narrow jet inan extremely bright gamma-ray burst（报告人：黄勇）

晨光杯报告与评审 / 390

Higgs 衰变到正反粲夸克对的寻找与喷注神经网络的研究（报告人：李聪乔））

晨光杯报告与评审 / 391

利用大型强子对撞机 ATLAS 上的四轻子末态事例寻找暗光子以及矢量玻色子 ZZ 的散射过程（报告人：刘明依）

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Determining Feynman Integrals with Only Input from Linear Algebra（报告人：刘志峰）

晨光杯报告与评审 / 393

Coupled-Channel Analysis of the χ c1(3872) Line Shape with BESIII Data（报告人：马俊力）

晨光杯报告与评审 / 394

Lattice QCD Calculation of Electroweak Box Contributions to Superallowed Nuclearand Neutron Beta Decays（报告人：马鹏翔）

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Single Transverse Spin Asymmetry as a New Probe ofStandard-Model-Effective-Field-Theory Dipole Operators（报告人：文新锴）

晨光杯报告与评审 / 396

3D Structure of Jet-Induced Diffusion Wake in an Expanding Quark-Gluon Plasma（报告人：杨忠）

晨光杯报告与评审 / 397

A multi-cubic-kilometre neutrino telescopein the western Pacific Ocean（报告人：叶子平）

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Beam Energy Dependence of Triton Production andYield Ratio (Nt × Np/N2d) in Au + Au Collisions at RHIC（报告人：张定伟）

晨光杯报告与评审 / 399

Precise Measurements of Decay Parameters and CP Asymmetry with Entangled Λ-Λ⁻ Pairs（报告人：张剑宇）

晨光杯报告与评审 / 400

Determination of Spin-Parity Quantum Numbers of X（2370）as 0− + from J/ψ → γK0sK0sη’（报告人：张鹏）

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Flash Talk

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Observation of the BOAT GRB from LHAASO

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分会场四 / 403

Locating a Super PeVatron at Cygnus Region

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LHAASO-KM2A 精确测量 0.3 到 30PeV 的宇宙线全粒子能谱和平均对数质量

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阿尔法磁谱仪（AMS）宇宙线原子核能谱最新测量结果

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分会场四 / 406

Problem of cosmic ray origin and precise measurements

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AMS 实验测量宇宙线粒子流强随时间变化最新结果

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Review of θ_{13} measurements and latest results from Daya Bay

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反应堆中微子能谱：大亚湾实验最新结果与 JUNO-TAO 实验

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江门中微子实验探测器技术研发及现状

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Neutrino Oscillation Physics in JUNO

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Neutrino Oscillation Analysis with Combined Data from Super-Kamiokande and T2K

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伽马射线暴等暂现源观测及其研究 @GXU 地基天文观测平台

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Search for WIMP DM in PandaX-4T experiment

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CDEX 实验研究进展及展望

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Latest results of the DArk Matter Particle Explorer

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AMS 实验正负电子、反质子流强谱最新测量结果与暗物质的间接寻找

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DESI Y1: Cosmological Constraints from the Measurements of Baryon Acoustic Oscillations

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Illuminating M87* inner shadow with dark matter annihilation

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Angular correlation and deformed Hellings-Downs curve by spin-2 ultralight dark matter

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Constraints on the properties of dark matter by astronomical observations

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A proposed PKU-Muon experiment for muon tomography and dark matter search

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The GAPS Experiment for Indirect Dark Matter Searches with Low-energy Cosmic-Ray Antinuclei

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Search for Coherent Elastic Scattering of Solar B8 Neutrinos in the XENONnT

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Searching for Solar Boron-8 Neutrinos via Coherent Elastic Neutrino-Nucleus Scattering with PandaX-4T Experiment

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CICENNS: 300-kg CsI(Na) Detector for Coherent Elastic Neutrino-Nucleus Scattering (CEvNS)

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RELICS: 基于液氙双相时间投影室的反应堆中微子相干弹性散射测量

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RECODE：高纯锗反应堆中微子相干散射实验

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大型超高能伽马源立体跟踪装置（LACT）项目进展

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AMS 同位素测量最新结果

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AMS 实验测量宇宙线氘同位素的最新结果

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Measurement of Iron Spectrum in Cosmic Rays with DAMPE

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Measurements of the boron-to-carbon and boron-to-oxygen flux ratios in cosmic rays with DAMPE

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Observation of the MGRO J1908+06 Region with LHAASO

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A real-time monitor on extragalatic tranisents with the LHAASO-WCDA

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Revisiting primordial neutrino asymmetries, spectral distortions and cosmological constraints with full neutrino transport

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Angular correlation and deformed Hellings-Downs curve by spin-2 ultralight dark matter

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A ROOT based detector geometry and event visualization system for JUNO-TAO

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JUNO 实验上的探测器 ID 和几何管理系统

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GeV neutrino interaction study

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CICENNS: 300-kg CsI(Na) Detector for Coherent Elastic Neutrino-Nucleus Scattering (CEvNS)

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锦屏百吨中微子探测器本底屏蔽设计

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Investigating Dark Matter in Antiproton Cosmic Rays and Searching for Antimatter in Cosmic Rays with DAMPE

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Properties of Forbush decreases of electrons and positrons revealed by the Dark Matter Particle Explorer

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基于全数据集的大亚湾反应堆中微子实验中缪子事例率的季节变化

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利用 AMS02 宇宙线周期性能谱对太阳调制模型进行研究

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Carbon, Oxygen and CNO combined spectra measurement with DAMPE

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