Cosmo-Astro-Particle Symposium (CAP 2025) & The 19th TeV Workshop

Report of Contributions

https://indico.ihep.ac.cn/e/cap2025

Contribution ID: **3** Type: **not specified**

Probing triple Higgs production via 4□2□ decay channel at a 100 TeV hadron collider

Sunday, 14 December 2025 09:00 (20 minutes)

A comprehensive study of triple Higgs boson production in the 4□2□ decay final state is performed for the first time at a future 100 TeV hadron collider. The analysis incorporates modified Higgs self-couplings via trilinear Higgs self-coupling □3 and quartic Higgs self-coupling □4, enabling for a model-independent investigation of potential new physics effects. Higgs bosons are reconstructed using both resolved and boosted techniques. To optimize sensitivity across different kinematic regions, we introduce a novel event categorization strategy based on the triple Higgs invariant mass spectrum and the multiplicity of boosted Higgs bosons. In addition to a traditional cut-based analysis, a Boosted Decision Tree (BDT) approach is employed to exploit multivariate correlations among kinematic observables, leading to a significant improvement in sensitivity. Our result demonstrates that the 4□2□ channel provides a viable pathway for probing the Higgs quartic coupling, complementing the existing multi-Higgs production studies, and could reach 5 □ in significance for □3≤−1 and □4≥10 in the scanned range.

This work has been published on JHEP: https://doi.org/10.1007/JHEP08(2025)040

Primary author: 董, 振宇 (Peking University)

Co-author: SUN, Xiaohu (Peking University)

Presenter: 董, 振宇 (Peking University)

Session Classification: Contributed session

Contribution ID: **4** Type: **not specified**

Using the Moon to Detect Gravitational-Wave Background

Thursday, 11 December 2025 11:00 (30 minutes)

There is a recent growing interest in detecting gravitational waves (GWs) via lunar seismic measurements. It requires a precise understanding of the Moon's response to passing GWs but previous studies derived two seemingly different response functions—one using a field-theory approach and the other based on tidal forces—raising questions about their equivalence. Here, we analytically and numerically model the normal modes of the Moon excited by GWs. We demonstrate that the aforementioned functions are identical, with differences arising only from coordinate choices. Using the correct response function, we reassess the sensitivity of proposed lunar seismometers (e.g., China's Chang'e and Europe's Lunar GW Antenna), revealing flatter sensitivity curves between 10^{-3}–0.1 Hz than predicted by previous models. Equipped with the better understanding of the lunar response to GWs, we reevaluate the feasibility of constraining the stochastic GW background with lunar seismometer networks, deriving updated pattern and overlap reduction functions while relaxing idealized instrument assumptions.

Primary author: CHEN, Xian (Peking University)

Presenter: CHEN, Xian (Peking University)

Session Classification: Plenary session

Contribution ID: **5** Type: **not specified**

Combination of ATLAS and CMS searches for Higgs boson pair production at 13 TeV

Thursday, 11 December 2025 15:00 (20 minutes)

Ref. ATLAS-CONF-2025-012
This note presents a combination of searches for Higgs boson pair (HH) production performed by the ATLAS and CMS Collaborations using proton-proton collision data sets recorded at $\sqrt{s}$ = 13 TeV at the LHC Run 2, corresponding to integrated luminosities ranging between 126 and 140 fb^{-1}. The upper limit at the 95% confidence level on the total HH production cross section corresponds to 2.5 times the standard model (SM) prediction with an expected value of 1.7 (2.8) assuming the absence (presence) of the SM HH signal. The strength of the HH signal is measured to be $0.8^{+0.9}_{-0.7}$ relative to the SM prediction. The observed significance is found to be 1.1 standard deviations when 1.3 are expected for the SM HH signal. Constraints are set on the Higgs boson trilinear self-coupling and on the couplings of two Higgs bosons to two vector bosons, both normalized to the SM predictions and denoted as κ_λ and κ_{2V}, respectively. The observed individual constraints at the 95% confidence level are $-0.71 < \kappa_\lambda < 6.1$ and $0.73 < \kappa_{2V} < 1.3$, while the expected constraints assuming the presence of the SM HH signal are $-1.3 < \kappa_\lambda < 6.7$ and $0.66 < \kappa_{2V} < 1.4$.

Primary author: ZHOU, Baihong (Tsung-Dao Lee Institute, Shanghai Jiao Tong Univ. (CN))

Presenter: ZHOU, Baihong (Tsung-Dao Lee Institute, Shanghai Jiao Tong Univ. (CN))

Session Classification: Contributed session

Contribution ID: **6** Type: **not specified**

Search for Dark Higgs and Triple Higgs at ATLAS

Sunday, 14 December 2025 17:00 (30 minutes)

Ref. Phys. Rev. Lett. 134 (2025) 121801
A search is performed for dark matter particles produced in association with a resonantly produced pair of b-quarks with $30 < m_{bb} < 150$ GeV using 140 fb^{-1} of proton-proton collisions at a center-of-mass energy of 13 TeV recorded by the ATLAS detector at the LHC. This signature is expected in extensions of the Standard Model predicting the production of dark matter particles, in particular those containing a dark Higgs boson s that decays into $b\bar{b}$. The highly boosted s$\rightarrow b\bar{b}$ topology is reconstructed using jet reclustering and a new identification algorithm. This search places stringent constraints across regions of the dark Higgs model parameter space that satisfy the observed relic density, excluding dark Higgs bosons with masses between 30 and 150 GeV in benchmark scenarios with Z′ mediator masses up to 4.8 TeV at 95% confidence level. The result leads to the 1^{st} ever cosmological coherent dark Higgs search at LHC.

Ref. Phys. Rev. D 111 (2025) 032006
The 1^{st} ever search for the production of three Higgs bosons (□□□) at LHC has been performed in the $b\bar{b}b\bar{b}b\bar{b}$ final state is presented. The search uses 126 fb^{-1} of proton-proton collision data at √□ =13 TeV collected with the ATLAS detector at the Large Hadron Collider. The analysis targets both non-resonant and resonant production of □□□. The resonant interpretations primarily consider a cascade decay topology of □→□□→□□□ with masses of the new scalars □ and □ up to 1.5 and 1 TeV, respectively. In addition to scenarios where □ is off-shell, the nonresonant interpretation includes a search for Standard Model □□□ production, with limits on the trilinear and quartic Higgs self-coupling set. No evidence for □□□ production is observed. An upper limit of 59 fb is set, at the 95% confidence level, on the cross section for Standard Model □□□ production.

Primary author: LI, Shu (TDLI, SJTU)

Presenter: LI, Shu (TDLI, SJTU)

Session Classification: Plenary session

Contribution ID: **7** Type: **not specified**

Radio Search of Dark Matter

Saturday, 13 December 2025 11:30 (30 minutes)

Dark matter is the dominant matter in the Universe while its particle nature is still unknown. In this talk, I will introduce two major scenarios of dark matter: Axion dark matter and WIMP (Weakly Interactive Massive Particle) and show how radio telescopes can search and put constraints on their parameters. The first one is Axion, which is a compelling dark matter candidate of increasing scientific interests in recent years, and was originally postulated to solve the strong CP problem in particle physics. Axions can be converted into monochromatic radiation in the neutron star’s magnetosphere, constituting a unique window to probe its existence with a radio telescope. We used MeerKAT telescope to constrain the Axion DM decay rate from an isolated neutron stars. In addition, we used the recent Pulsar Polarization Array data to constrain the Ultra Light Dark Matter (ULDM) dark matter candidate. For WIMP, we used China FAST telescope to observe the synchrotron emission of WIMP dark matter decay in COMA Berenices dwarf galaxy and obtained strong constraints on WMIP decay channels. I will analyze these current results and give future prospects on using radio telescope to constrain dark matter.

Primary author: Prof. MA, Yin-Zhe (Stellenbosch University)

Presenter: Prof. MA, Yin-Zhe (Stellenbosch University)

Session Classification: Plenary session

Contribution ID: **8** Type: **not specified**

Structure Formation with Cosmic Strings

Thursday, 11 December 2025 17:00 (20 minutes)

Recent observations from the James Webb Space Telescope have revealed an unexpectedly high abundance of massive galaxies at very high redshifts, challenging the standard ΛCDM cosmological framework. Cosmic strings, which can act as nonlinear seeds in the early Universe, provide a promising explanation for this tension. In this talk, I will present our recent work on the impact of cosmic strings on early structure formation and how they may account for JWST high-redshift galaxies.

Primary author: JIAO, Hao (Institute for Basic Science)

Co-authors: Prof. BRANDENBERGER, Robert (McGill University); Prof. KANNAN, Rahul (York University); Ms KOEHLER, Sonja (Harvard University); Prof. REFREGIER, Alexandre (ETH Zurich)

Presenter: JIAO, Hao (Institute for Basic Science)

Session Classification: Contributed session

Contribution ID: **9** Type: **not specified**

Interact or Twist: Cosmological Correlators from Field Redefinitions Revisited

Sunday, 14 December 2025 10:50 (20 minutes)

In cosmology, correlation functions on a late-time boundary can arise from both field redefinitions and bulk interactions, which are usually believed to generate distinct results. In this letter, we propose a counterexample showcasing that correlators from local field redefinitions can be identical to the ones from bulk interactions. In particular, we consider a two-field model in de Sitter space, where the field space gets twisted by field redefinitions to yield a nontrivial reheating surface. We then exploit conformal symmetry to compute the three-point function, and show that the result takes the form of contact correlators with a total-energy singularity. Our finding suggests that in the effective field theory, a class of lower-dimensional operators, which were overlooked previously, may lead to nontrivial signals in cosmological correlators. As an illustration, we apply our result to cosmic inflation and derive a possibly leading signature of the Higgs in the primordial bispectrum.

Primary authors: Dr WANG, Dong-Gang (Hong Kong University of Science and Technology); WANG, Xiangwei (Hong Kong University of Science and Technology); Mr YU, Wenqi (Hong Kong University of Science and Technology); WANG, Yi (H)

Presenter: WANG, Xiangwei (Hong Kong University of Science and Technology)

Session Classification: Contributed session

Contribution ID: **10** Type: **not specified**

Searching for long-lived axion-like particles via displaced vertices at the HL-LHC

Thursday, 11 December 2025 15:20 (20 minutes)

Axion-like particles (ALPs) are well-motivated extensions of the standard model (SM) that appear in various new physics scenarios. Searching for long-lived ALPs is a promising direction in collider experiments. This report discusses the potential of the HL-LHC to probe long-lived ALPs via their displaced vertex signatures within the photophobic ALP scenario.

Primary authors: 岳, 崇兴 (辽宁师范大学); 李, 欣洋 (辽宁师范大学)

Presenter: 李, 欣洋 (辽宁师范大学)

Session Classification: Contributed session

Contribution ID: **11** Type: **not specified**

Effective Theory for Light Portal Dark Matter Detection

Thursday, 11 December 2025 15:40 (20 minutes)

We develop a general framework for the computation of light-portal dark matter direct detection, incorporating a consistent treatment of finite momentum transfer. In this framework, dark matter interacts with Standard Model matter through a light mediator, which simultaneously serves as the force carrier for dark matter self-interaction, potentially with a distinct coupling strength. The corresponding effective theory relevant for detecting this class of dark matter is systematically constructed. Our analysis focuses on light (semi)relativistic dark matter, which may originate from cosmic-ray boosting and can be probed in high-threshold experiments such as large-volume neutrino detectors. In this context, the nucleon matrix elements of the effective operators at finite momentum transfer are required, made available through recent advances in lattice QCD and related nonperturbative methods. The relativistic Fermi gas model is used to convert the nucleon-level momentum transfer to the nuclear level, thereby incorporating nuclear effects pertinent to heavy-target experiments. To demonstrate the utility of the framework, we present ultraviolet-complete examples featuring spin-1 and spin-2 portal dark matter. For these models, we compute the differential cross sections with respect to momentum transfer, adopting parameter choices that address the so-called "core–cusp" problem in astrophysical observations via dark matter self-interactions.

Primary authors: CHEN, Qing (Anhui University of Science and Technology); ZHOU, Shuang-Yong (University of Science and Technology of China)

Presenter: CHEN, Qing (Anhui University of Science and Technology)

Session Classification: Contributed session

Contribution ID: **12** Type: **not specified**

Detecting gravitational waves with different systems

Thursday, 11 December 2025 14:30 (30 minutes)

Firstly, we briefly discuss how the hypothetical beyond-the-Standard-Model particle, the axion, can produce gravitational waves through several mechanisms. Then we present some of our recent proposals for detecting axions/gravitational waves, including cryogenic quantum transport technology, traditional spin systems, and specially engineered artificial magnetoelectric materials. We demonstrate that room-sized detectors have promising sensitivity to axions with masses from kHz to GHz, and that a similar device can also be used for high-frequency gravitational wave detection over the same frequency range.

Primary author: SUN, Sichun (Beijing Institute of Technology)

Presenter: SUN, Sichun (Beijing Institute of Technology)

Session Classification: Contributed session

Contribution ID: **13** Type: **not specified**

Ultimate Quantum Precision Limit at Colliders: Conditions and Case Studies

Saturday, 13 December 2025 09:00 (30 minutes)

We investigate whether collider experiments can reach the quantum limit of precision, defined by the quantum Fisher information (QFI), using only classical observables such as particle momenta. As a case study, we focus on the $\tau^+\tau^-$ system and the decay channel $\tau \to \pi\nu$, which offers maximal spin-analyzing power and renders the decay a projective measurement.
We develop a general framework to determine when collider measurements can, in principle, saturate the QFI in an entangled biparticle system, and this framework extends naturally to other such systems. Within this framework, QFI saturation occurs if and only if the symmetric logarithmic derivative (SLD) commutes with a complete set of orthonormal separable projectors associated with collider-accessible measurements. This separability condition, reflecting the independence of decay amplitudes, is highly nontrivial. To meet this condition, a key requirement is that the spin density matrix be rank-deficient, allowing the SLD sufficient freedom. We show that the classical Fisher information asymptotically saturates the QFI for magnetic dipole moments and CP-violating Higgs interactions in selected phase-space regions, but not for electric dipole moments. These results bridge quantum metrology and collider physics, providing a systematic method to identify quantum-optimal sensitivity in collider experiments.

Primary author: LIU, Jia (Peking University)

Presenter: LIU, Jia (Peking University)

Session Classification: Plenary session

Contribution ID: **14** Type: **not specified**

Cosmological Gravitational Particle Production: Sterile Neutrinos as Dark Matter candidates

Thursday, 11 December 2025 17:20 (20 minutes)

In this work we consider cosmological gravitational production of Dirac sterile neutrinos as dark matter candidates during and after inflation. In the former, the Higgs field experiences large quantum fluctuations driving its average field value to the Hubble scale and above facilitating the sterile neutrino production. However, the production efficiency due to classical gravity still remains suppressed compared to the standard freeze-in mechanism. Quantum gravitational effects, on the other hand, are expected to break conformal invariance of the fermion sector by the Planck scale-suppressed operators irrespective of the mass. We find that such operators are very efficient in fermion production immediately after inflation, generating a significant background of stable or long-lived feebly interacting particles. This applies, in particular, to sterile neutrinos which can constitute cold non-thermal dark matter for a wide range of masses, including the keV scale.

Primary authors: DA SILVA, Duarte; KOUTROULIS, FOTIS (IHEP); Prof. LEBEDEV, Oleg (Helsinki University); Prof. POKORSKI, Stefan (Warsaw University)

Presenter: KOUTROULIS, FOTIS (IHEP)

Session Classification: Contributed session

Contribution ID: **15** Type: **not specified**

Scattering entanglement mediated by heavy particles

Thursday, 11 December 2025 18:00 (20 minutes)

The amount of information propagated by an intermediate heavy particle exhibits characteristic features in inelastic scatterings with n≥3 final particles. As the total energy increases, the entanglement entropy, between its decay products and other final particles, exhibits a universal sharp dip, suppressed by its small decay rate. This indicates an entanglement suppression from a low-energy effective theory to a channel dominated by an on-shell heavy particle. As demonstrations of these entanglement features, we study concrete models of 2⟶3 and 2⟶4 scatterings, which shed light on the entanglement structure beyond the area law derived for 2⟶2 scattering. In practice, these features may be probed by suitably marginalizing the phase-space distribution of final particles. References: JHEP 10 (2025) 003 [arXiv: 2507.03555].

Primary author: SOU, Chon Man (Tsinghua University)

Presenter: SOU, Chon Man (Tsinghua University)

Session Classification: Contributed session

Contribution ID: **16** Type: **not specified**

Dark Photon Oscillations in Waveguide

Saturday, 13 December 2025 17:00 (30 minutes)

Dark photons, which can kinetically mix with ordinary photons, represent the simplest extension to the standard model. Detecting their oscillations with visible photons could provide crucial insights into the nature of dark matter and fundamental interactions beyond the standard model. We propose a novel laboratory-based approach to detect dark photon oscillations using a laser in an Optical Time-domain Relectometry (OTDR) setup. The laser light propagating through the optical fiber undergoes oscillations with the dark photon, leading to measurable changes in the power flow. These oscillations can precisely measured, leveraging its high sensitivity and efficiency in detecting small variations in the optical signal. This approach could provide a new avenue for probing dark photon oscillations in the laboratory and greatly improve the current experimental sensitivity to dark photon in a wide mass range.

Primary author: 王, 雯宇 (北京工业大学)

Presenter: 王, 雯宇 (北京工业大学)

Session Classification: Plenary session

Contribution ID: **17** Type: **not specified**

Highlights of the HL-LHC physics projections by ATLAS and CMS

Friday, 12 December 2025 14:00 (30 minutes)

The ATLAS and CMS experiments are unique drivers of our fundamental understanding of nature at the energy frontier. In this contribution to the update of the European Strategy for Particle Physics, we update the physics reach of these experiments at the High-Luminosity LHC (HL-LHC) in a few key areas where they will dominate the state-of-the-art for decades to come.

Primary author: Prof. ZHOU（周）, Chen（辰）(Peking University（北京大学）)

Presenter: Prof. ZHOU（周）, Chen（辰）(Peking University（北京大学）)

Session Classification: Contributed session

Contribution ID: **18** Type: **not specified**

Complete long-lived particle of 2HDM

Thursday, 11 December 2025 16:30 (30 minutes)

In this work we study the prospect of detecting light CP-even and CP-odd scalars. 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. We then analyze the complete long-lived particle of 2HDM, and reaches of light scalars in the large $\tan\beta$ region of the Type-I 2HDM

Primary author: Prof. SU, Wei (Sun Yat-Sen University)

Presenter: Prof. SU, Wei (Sun Yat-Sen University)

Session Classification: Contributed session

Contribution ID: **19** Type: **not specified**

Probing light dark matter in direct detection and neutrino experiments

Saturday, 13 December 2025 09:30 (30 minutes)

Detecting light dark matter is a frontier challenge requiring a blend of conventional and cutting-edge approaches. Direct detection with low-threshold nuclear or electron recoil detectors, quantum-enhanced sensors, and searches for annihilation or production signatures offer promising avenues. Combining these methods and refining background discrimination will be crucial to uncovering the nature of light dark matter, potentially revealing a key piece of the universe's mysterious composition. I will talk about our recent works on these topics.

Primary author: WU, Lei (南京师范大学)

Presenter: WU, Lei (南京师范大学)

Session Classification: Plenary session

Contribution ID: **20** Type: **not specified**

Probing lepton flavor violating dark matter scenarios via astrophysical photons and positrons

Friday, 12 December 2025 15:00 (20 minutes)

In this Letter we explore, for the first time, the constraints on lepton flavor violating (LFV) dark matter (DM) scenarios via the astrophysical photons and positrons, including both the annihilation and decay modes, $\mathtt{DM}(+\mathtt{DM}) \to e^{\pm}\mu^{\mp}, e^{\pm}\tau^{\mp}, \mu^{\pm}\tau^{\mp}$. Given the presence of LFV interactions in various DM models and the challenge of probing such interactions at terrestrial facilities, such as DM direct detection and collider experiments, indirect detection offers a unique approach to investigating them. We utilize the currently available photon datasets from the XMM-Newton, INTEGRAL, and Fermi-LAT telescopes, along with the positron datasets from the AMS-02 satellite, to establish stringent bounds on the relevant annihilation cross sections or decay widths. In particular, we include contributions to the photon spectrum from final state radiation, radiative decays, and inverse Compton scattering. We find that the INTEGRAL (AMS-02) provides the most stringent bound on the annihilation cross sections and decay widths for DM mass below (above) approximately 20 GeV, which are comparable to those of their lepton flavor conserving counterparts.

Primary author: 梁, 锦汉 (Nanjing University)

Presenter: 梁, 锦汉 (Nanjing University)

Session Classification: Contributed session

Contribution ID: **21** Type: **not specified**

Little Red Dots from Small-Scale Primordial Black Hole Clustering

Sunday, 14 December 2025 09:40 (20 minutes)

The James Webb Space Telescope (JWST) observations have identified a class of compact galaxies at high redshifts (\(4 \lesssim z \lesssim 11\)), dubbed “little red dots” (LRDs). The supermassive black holes (SMBHs) of $10^{5-8}\,\mathrm{M}_{\odot}$ in LRDs favor a heavy-seed origin.
We propose a mechanism for their formation: Clusters of primordial black holes, formed through long-short mode coupling on small scales in the early Universe, undergo sequential mergers over extended timescales. This mechanism can evade cosmic microwave background distortions and result in heavy-seed SMBHs via runaway mergers. We employ Monte Carlo simulations to solve the Smoluchowski coagulation equation and determine the runaway merging timescale. The resulting stochastic gravitational wave background offers a distinct signature of this process, and the forming SMBHs can be highly spinning at their formation due to the spin residual of the cluster from tidal fields. This mechanism may explain the rapidly spinning SMBHs in LRDs under the assumption of obscured active galactic nuclei.

Primary authors: 张, 柏锐 (清华大学); Prof. 安, 海鹏 (清华大学); Dr 冯, 维祥 (清华大学)

Presenter: 张, 柏锐 (清华大学)

Session Classification: Contributed session

Contribution ID: **22** Type: **not specified**

Probe Neutrino & Dark Matter with Cosmic Gravitational Focusing

Saturday, 13 December 2025 16:00 (30 minutes)

When a cosmic fluid, such as relic neutrinos or a minor light dark matter (DM) component, passes by the cold DM halo, it would be focused by the gravitational attraction. Then the fluid density is enhanced on the downwind side. Such cosmic gravitational focusing (CGF) effect can be used to probe the neutrino masses and the fraction of the minor light DM. With galaxy cross correlation that can be observed with the DESI galaxy survey, CGF can provide much better sensitivity than the existing observations.

Primary author: GE, Shao-Feng (SJTU)

Presenter: GE, Shao-Feng (SJTU)

Session Classification: Plenary session

Contribution ID: **23** Type: **not specified**

GW from inflaton decay and photon bremsstrahlung

Thursday, 11 December 2025 17:40 (20 minutes)

Effective field theory (EFT) concept provides a necessary tool for obtaining general predictions of low energy theory valid below its unitarity breaking scale (cutoff scale). Early Universe inflation and subsequent reheating could be a unique setup for testing potentially observable effects coming from the derivative expansion of the corresponding EFT around the flat space vacuum. In this work, we consider an EFT describing perturbative reheating dominated by the decay of inflaton to photons caused by the dimension-5 operator $\phi F_{\mu\nu}F^{\mu\nu}$. We compute the graviton production during reheating and high frequency gravitational wave signal due to the bremsstrahlung effect in the presence of $R_{\mu\nu\lambda\rho}F^{\mu\nu}F^{\lambda\rho}$ operator. It may lead to the dominant contribution at high momenta if the EFT cutoff is lower than the Planck mass. Assuming the general consequences of the unitarity and causality constraints, which imply that all EFT operators should be present, and be suppressed by the scales following from the dimension analysis, we obtain the observational constraints (CMB bound for the dark radiation) on mass of the inflaton and UV cutoff of gravity. We found that for the typical parameters of large field inflation models the gravitational cutoff scale cannot be lower than 10^{15} GeV.

Primary authors: TOKAREVA, Anna (HIAS); Mr CHENG, Jiaxin (HIAS, UCAs)

Presenter: Mr CHENG, Jiaxin (HIAS, UCAs)

Session Classification: Contributed session

Contribution ID: **24** Type: **not specified**

Gravitational waves and primordial black holes produced by dark meta stable vacuum decay

Sunday, 14 December 2025 10:00 (20 minutes)

Inspired by string theory and cosmological constant problem, it is plausible that the Universe's vacuum structure is characterized by a landscape of metastable vacua. If the dark vacuum is metastable, bubbles of lower-energy phases can nucleate at an approximately constant rate. Because the Hubble expansion rate is monotonically non-increasing with cosmic time, such nucleation can eventually lead to percolation and completion of a dark-sector phase transition. In this work, we investigate the phenomenological consequences of this transition, focusing on the resulting stochastic gravitational-wave background and the potential formation of primordial black holes.

Primary authors: LI, Tingyu (Tsinghua); Prof. AN, haipeng (Tsinghua); CHEN, yang (Tsinghua)

Presenter: LI, Tingyu (Tsinghua)

Session Classification: Contributed session

Contribution ID: **25** Type: **not specified**

Chiral gravitational wave background from axion-like fields

Friday, 12 December 2025 14:30 (30 minutes)

Axions and axion-like particles can be probed through gravitational waves indirectly, often referred to as "audible axions". The usual concept of audible axion relies on the coupling between the axions and the gauge fields. Here we consider an axion-like mechanism with coupling to the Nieh–Yan term. This interaction leads to the direct and efficient production of gravitational waves during the radiation-dominated era, originating from the tachyonic instability of the gravitational perturbations with the Nieh–Yan term. We calculate the energy spectral density of the chiral gravitational wave background and the comoving energy density of axion-like fields. Based on the numerical results, we explore the parameter space of axion masses and decay constants for detectable gravitational wave signals, either in pulsar timing arrays or space-based gravitational wave detections.

Primary author: Dr ZHANG, Yun-Long (NAOC (National Astronomical Observatories, CAS))

Presenter: Dr ZHANG, Yun-Long (NAOC (National Astronomical Observatories, CAS))

Session Classification: Contributed session

Contribution ID: **26** Type: **not specified**

Probing Heavy Dark Matter in Red Giants

Friday, 12 December 2025 17:00 (30 minutes)

Red giants (RGs) efficiently capture dark matter (DM) through elastic scattering with stellar nuclei. Once accumulated in the helium core, the DM population can become self-gravitating and collapse, injecting energy through scattering and (when relevant) delayed annihilation. This localized heating can trigger a premature helium flash, reducing the luminosity at the tip of the RG branch. By requiring consistency with observed RG luminosities, we derive constraints on heavy DM, finding sensitivity to masses around 10^{11}GeV and spin-independent cross sections near 10^{-37}cm, comparable to leading direct-detection limits.

Primary author: YUN, Seokhoon (IBS-CTPU-PTC)

Presenter: YUN, Seokhoon (IBS-CTPU-PTC)

Session Classification: Plenary session

Contribution ID: **27** Type: **not specified**

EFTs for Cosmological Correlators

Sunday, 14 December 2025 11:10 (20 minutes)

Effective field theories (EFTs) provide a powerful framework to parametrise unknown aspects of possible ultraviolet (UV) physics. However, compared to traditional EFTs for scattering amplitudes in flat space, there are at least three distinct sources of subtlety in EFTs for cosmological correlators in de Sitter space, which include (1) the expansion of the spacetime background itself, (2) the breakdown of unitarity and the necessary inclusion of dissipation effect and stochastic noise, and (3) the enhanced role of infrared (IR) divergences and the need to resum secular growth. In this talk, I will explain how to construct the appropriate (open) EFTs for general cosmological correlators. In particular, I will consider equal-time correlation functions of massless inflaton with exchanges of massive spectator fields via both IR-finite and IR-divergent couplings. With the knowledge of analytic computations in the UV theories, we can determine the (dominant) EFT operators in the IR theories and the corresponding Wilson coefficients by the standard matching process.

Primary author: 秦, 哲涵 (清华大学)

Presenter: 秦, 哲涵 (清华大学)

Session Classification: Contributed session

Contribution ID: **28** Type: **not specified**

Searching for new physics at colliders

Thursday, 11 December 2025 09:30 (30 minutes)

Presenter: CAO, Qing-Hong (Peking University)

Session Classification: Plenary session

Contribution ID: **29** Type: **not specified**

New physics searching results from the ATLAS collaboration

Friday, 12 December 2025 09:00 (30 minutes)

Presenter: OKAWA (大川), Hideki (英希) (中国科学院高能物理研究所)

Session Classification: Plenary session

Contribution ID: **30** Type: **not specified**

Recent new physics searching results from the LHCb collaboration

Friday, 12 December 2025 10:00 (30 minutes)

Presenter: SUN, Liang

Session Classification: Plenary session

Contribution ID: **31** Type: **not specified**

Latest progress and physics goals of CEPC

Friday, 12 December 2025 11:30 (30 minutes)

Presenter: DA COSTA, Joao Guimaraes

Session Classification: Plenary session

Contribution ID: **32** Type: **not specified**

Progress and physics goals of the STCF

Friday, 12 December 2025 11:00 (30 minutes)

Presenter: PENG, Haiping

Session Classification: Plenary session

Contribution ID: **33** Type: **not specified**

Recent progress in dynamical dark energy and gravitational-wave observations

Saturday, 13 December 2025 14:30 (30 minutes)

Presenter: ZHANG, Xinming

Session Classification: Plenary session

Contribution ID: **34** Type: **not specified**

TBD

Presenter: YANG, Huan

Session Classification: Plenary session

Contribution ID: **35** Type: **not specified**

New physics searching results from the CMS collaboration

Friday, 12 December 2025 09:30 (30 minutes)

Presenter: WANG, Zirui

Session Classification: Plenary session

Contribution ID: **36** Type: **not specified**

Lattice QCD in Searching for New Physics

Friday, 12 December 2025 12:00 (30 minutes)

Presenter: JI, Xiangdong

Session Classification: Plenary session

Contribution ID: **37** Type: **not specified**

Origin of Mass and Scattering Amplitudes: from Higgs to Kaluza-Klein and Chern-Simons

Saturday, 13 December 2025 14:00 (30 minutes)

Presenter: HE, Hongjian

Session Classification: Plenary session

Contribution ID: **38** Type: **not specified**

Kilohertz Gravitational Wave Astronomy

Thursday, 11 December 2025 11:30 (30 minutes)

Presenter: YANG, Huan

Session Classification: Plenary session

Contribution ID: **39** Type: **not specified**

Formation of the Little Red Dots from the core-collapse of self-interacting dark-matter halos

Friday, 12 December 2025 16:30 (30 minutes)

Presenter: JIANG, Fangzhou

Session Classification: Plenary session

Contribution ID: **40** Type: **not specified**

Probing the Pulsar Explanation of the Galactic-Center GeV Excess Using Continuous Gravitational-Wave Searches

Saturday, 13 December 2025 10:00 (30 minutes)

Presenter: ZHAO, Yue

Session Classification: Plenary session

Contribution ID: **41** Type: **not specified**

No cosmological constraints on dark photon dark matter from resonant conversion

Saturday, 13 December 2025 11:00 (30 minutes)

Presenter: HUANG, Junwu

Session Classification: Plenary session

Contribution ID: **42** Type: **not specified**

Recent results from lhaaso

Saturday, 13 December 2025 12:00 (30 minutes)

Presenter: BI, Xiao-Jun

Session Classification: Plenary session

Contribution ID: **43** Type: **not specified**

Gravothermal Collapse in Dark Matter Halos: Physics, Predictions, and Evidence

Saturday, 13 December 2025 15:00 (30 minutes)

Presenter: YU, Haibo

Session Classification: Plenary session

Contribution ID: **44** Type: **not specified**

Status and progress of dark matter direct detection experiments

Friday, 12 December 2025 17:30 (30 minutes)

Presenter: LIN, Qing

Session Classification: Plenary session

Contribution ID: **45** Type: **not specified**

TBD

Presenter: YUN, Seokhoon

Session Classification: Plenary session

Contribution ID: **46** Type: **not specified**

Numerical simulation of symmetry breaking

Saturday, 13 December 2025 16:30 (30 minutes)

Presenter: BIAN, Ligong

Session Classification: Plenary session

Contribution ID: **47** Type: **not specified**

TBD

Presenter: BALLESTEROS, Guillermo

Session Classification: Plenary session

Contribution ID: **48** Type: **not specified**

Tunneling rate at finite temperature

Sunday, 14 December 2025 14:00 (30 minutes)

Presenter: YAMAGUCHI, Masahide

Session Classification: Plenary session

Contribution ID: **49** Type: **not specified**

Inflationary QCD phase diagram

Sunday, 14 December 2025 14:30 (30 minutes)

Presenter: NOUMI, Toshifumi

Session Classification: Plenary session

Contribution ID: **50** Type: **not specified**

Hayden Lee, A Hidden Pattern in Cosmological Correlators

Sunday, 14 December 2025 15:00 (30 minutes)

Presenter: LEE, Hayden

Session Classification: Plenary session

Contribution ID: **51** Type: **not specified**

Flowing one-point correlator in QCD

Sunday, 14 December 2025 16:00 (30 minutes)

Presenter: SUN, Minho

Session Classification: Plenary session

Contribution ID: **52** Type: **not specified**

Search Results for Physics Beyond the Standard Model with LIGO-Virgo-KAGRA's O1-O4a Runs

Sunday, 14 December 2025 16:30 (30 minutes)

Presenter: GUO, Huaike

Session Classification: Plenary session

Contribution ID: **53** Type: **not specified**

Symbolic Reduction of Multi-loop Feynman Integrals via Generating Functions

Sunday, 14 December 2025 17:30 (30 minutes)

Presenter: FENG, Bo

Session Classification: Plenary session

Contribution ID: **54** Type: **not specified**

(New) physics around the supermassive black hole

Thursday, 11 December 2025 10:00 (30 minutes)

Presenter: SHU, Jing

Session Classification: Plenary session

Contribution ID: **55** Type: **not specified**

Probing MeV dark matter through solar reflection

Friday, 12 December 2025 15:20 (20 minutes)

Presenter: NIE, Haoming

Session Classification: Contributed session

Contribution ID: **56** Type: **not specified**

TBD

Sunday, 14 December 2025 09:20 (20 minutes)

Presenter: AOKI, Shuntaro

Session Classification: Contributed session

Contribution ID: **57** Type: **not specified**

Massive inflationary amplitudes: differential equations and complete solutions for general trees

Sunday, 14 December 2025 11:30 (20 minutes)

Presenter: LIU, Haoyuan

Session Classification: Contributed session

Contribution ID: **58** Type: **not specified**

Massive Inflationary Amplitudes: New Representations and Degenerate Limits

Sunday, 14 December 2025 11:50 (20 minutes)

Presenter: ZANG, Jiaju

Session Classification: Contributed session

Contribution ID: **59** Type: **not specified**

Recent results from ATLAS experiment: Higgs to dimuon and toponium

Thursday, 11 December 2025 14:00 (30 minutes)

Presenter: LI, Haifeng

Session Classification: Contributed session

Contribution ID: **60** Type: **not specified**

Opening

Thursday, 11 December 2025 09:15 (15 minutes)

Presenter: AN, Haipeng

Session Classification: Plenary session

Contribution ID: **61** Type: **not specified**

Unifying Particle Physics and Cosmology in Type IIA String Theory

Friday, 12 December 2025 15:40 (20 minutes)

Presenter: LIU, Yang

Session Classification: Contributed session

Contribution ID: **62** Type: **not specified**

Dark matter implications from XENONnT and LZ data

Thursday, 11 December 2025 18:20 (20 minutes)

Presenter: XU, Changlong

Session Classification: Contributed session