

The International Conference on Fundamental Physics from Quanta to Cosmos (ICFP 2026)

Report of Contributions

Contribution ID : 1

Type : **Oral**

The Generation and Detection of Chiral Gravitational Wave Backgrounds

Saturday, 24 October 2026 14:20 (20)

Chiral gravitational wave backgrounds are predicted in many well-motivated mechanisms. We investigate the detection of Chiral GWBs using a network of detectors under arbitrary configurations. We also propose a dipole pulsar timing array, which demonstrates sensitivity to Chiral gravitational wave backgrounds from the nanohertz to microhertz regime.

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

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

Session Classification : Gravitational Wave Physics (Room A)

Contribution ID : 2

Type : **Oral**

Violation and Restoration of Probability Positivity in Perturbative Quantum Field Theory

Saturday, 24 October 2026 14:00 (20)

We address the long-standing problem of negative decay and production rates in perturbative QCD

for exclusive processes by proposing amplitude-level NRQCD factorization as a systematic prescription.

Building on this, we present the first complete next-to-next-to-leading-order (NNLO) QCD correction to

the decay $J/\psi \rightarrow 3\gamma$. The resulting partial width,

$\Gamma(J/\psi \rightarrow 3\gamma) = 0.96_{-0.13}^{+4.32}$ eV, combines this NNLO contribution with

the known up to $\mathcal{O}(\alpha_s v^2)$ relativistic correction and shows markedly improved

agreement with the high-precision BESIII measurement. In the same way,

$\Gamma(\Upsilon \rightarrow 3\gamma) = 0.0086_{-0.0006}^{+0.0028}$ eV is obtained.

From a first-principles perspective, it is clear that for exclusive processes, taking the complete modulus squared of the full amplitude is precisely the proper definition of the probability distribution and guarantees its manifest positivity. This makes the amplitude-level prescription the natural and physically motivated scheme. For inclusive processes, however, one is forced to abandon the full modulus square due to the need to cancel infrared divergences at the level of the truncated squared amplitude.

Based on arXiv:2603.26199.

Primary author(s) : WANG, Jianxiong (Institute of High Energy Physics, Chinese Academy of Sciences)

Presenter(s) : GONG, Bin

Session Classification : Particle Phenomenology (Room B)

Contribution ID : 3

Type : **Oral**

Nonlinear gauge maps and the structure of Goldstone loops in canonical inflation

Saturday, 24 October 2026 16:10 (20)

Non-attractor inflation has drawn significant attention as a class of inflationary models due to its potential to generate primordial black holes (PBHs). However, calculating the one-loop corrections to curvature perturbations in these models has sparked considerable theoretical controversy. We find that symmetry serves as a crucial clue in such loop calculations, and the Ward identity is precisely the standard manifestation of symmetry in quantum field theory. In this presentation, we will demonstrate how to apply Ward identities to these loop calculations.

Primary author(s) : Dr FANG, ChengJun (ITP-CAS)**Presenter(s) :** Dr FANG, ChengJun (ITP-CAS)**Session Classification :** Gravity and Cosmology (Room C)

Contribution ID : 5

Type : **Oral**

Radiative corrections to neutron and inverse beta decay at low energies

Saturday, 24 October 2026 14:20 (20)

We compute electromagnetic radiative corrections in the inverse beta decay at reactor antineutrino energies within the heavy baryon chiral perturbation theory, provide the most accurate cross-section predictions for this process, present a complete error budget, and investigate impact on the energy reconstruction at JUNO. For the first time, we consistently include quantum electrodynamics, chromodynamics, and electroweak contributions and present the positron energy spectrum accounting for radiative corrections. Additionally, we include contributions from virtual pions and delta resonance to inverse beta decay and quantify the relation between the experimental value of the nucleon axial-vector charge and its evaluations within the lattice quantum chromodynamics.

Primary author(s) : Prof. TOMALAK, Sasha (ITP/CAS)**Presenter(s) :** Prof. TOMALAK, Sasha (ITP/CAS)**Session Classification :** Particle Phenomenology (Room B)

Contribution ID : 6

Type : **Oral**

Generalized Global Symmetry and Composite Electroweak Gauge Bosons

In this talk, I will talk about my recent work on generalized global symmetry and composite electroweak gauge boson. I will first review the basic facts about the generalized global symmetries. Then I talk about their role in the selection rules about the power-counting of the Wilson coefficients of certain Dim-6 operators in the composite electroweak gauge bosons scenario. The Phenomenological implications are also discussed.

Primary author(s) : LIU, Da (Shandong University)

Presenter(s) : LIU, Da (Shandong University)

Session Classification : Particle Phenomenology (Room B)

Contribution ID : 7

Type : **Oral**

The Quantum Magic of Standard Model Parameters

Saturday, 24 October 2026 15:30 (20)

The scattering of microscopic particles generically gives rise to highly structured quantum final states. A growing body of work has begun to explore whether the quantum-information characteristics of these states are merely emergent, or whether they encode deep principles of the underlying quantum field theory. Among these characteristics is magic, or non-stabilizerness, which measures the intrinsic nonclassical computational power of a quantum state. We present evidence that a fundamental parameter of the Standard Model—the weak mixing angle—may be selected by minimizing the magic of the final states arising from simple lepton scattering processes. These observations motivate a systematic exploration of particle scattering from the perspective of quantum information theory.

Primary author(s) : ☒, ☒ (IHEP)**Presenter(s) :** ☒, ☒ (IHEP)**Session Classification :** Particle Phenomenology (Room B)

Contribution ID : 12

Type : **Oral**

SN1987A constraints on the neutrino-dark-fermion interaction from resonant scattering with $C\nu B$

Sunday, 25 October 2026 15:30 (20)

Neutrino self-interactions mediated by a light scalar offer a compelling resolution to cosmological tensions and may naturally arise in neutrino mass generation mechanisms. When the scalar also couples to a light dark-sector fermion, supernova neutrinos can resonantly annihilate with the cosmic neutrino background ($C\nu B$) into invisible dark radiation, depleting the flux en route to Earth. We use this depletion to constrain the neutrino-scalar coupling from the SN1987A data. Within a Bayesian framework we analyze the data for two supernova neutrino emission models, a parameterized model and a 2D hydrodynamic simulation, and for two coupling types, a mass-independent one and a mass-proportional one. Our results show that new-physics limits from SN1987A cannot be quoted independently of the heavy-flavor emission, the flavor conversion, or the coupling structure. Finally, we forecast that a future high-statistics burst recorded by Hyper-Kamiokande would restore a meaningful upper bound even when flavor conversion is included.

Primary author(s) : GAO, Christina (Southern University of Science and Technology); LYU, Kun-Feng (University of Oklahoma); KE, Hu (Southern University of Science and Technology); ZOU, Rui (Southern University of Science and Technology)

Presenter(s) : ZOU, Rui (Southern University of Science and Technology)

Session Classification : Gravity and Cosmology (Room C)

Contribution ID : 13

Type : **Oral**

Probing gravitational waves with the orbital angular momentum of light

Sunday, 25 October 2026 14:40 (20)

We introduce an alternative approach to gravitational-wave (GW) detection in which GW information is encoded in the orbital angular momentum (OAM) states of photons. Starting from the propagation of vortex light in linearized gravity, we show that interaction with a GW induces transitions from an initial photon OAM state to neighboring OAM sidebands, providing a different optical observable of spacetime perturbations. Building on this interaction, we develop a GW detection framework in which the complex amplitudes of the induced OAM sidebands are measured using parametrized quantum state tomography. A V-shaped configuration provides sufficient independent degrees of freedom to resolve all seven wave parameters characterizing a GW. We further investigate the detectability of this approach by constructing a noise budget over the frequency range from 1 mHz to 100 Hz. The symmetry properties of the OAM states allow the GW signal to appear predominantly in the differential mode, while technical noise enters primarily through the common mode, enabling its suppression through balanced detection. Our analysis further shows that a compact, short-arm configuration can reduce mode-crosstalk noise without sacrificing the GW response. Together, these results establish a framework for probing GWs through the spatial-mode Hilbert space of light and motivate OAM-based sensing as a complementary approach to future GW detection.

Primary author(s) : Mr WU, Haorong (Wuhan University); Prof. FAN, Xilong (Wuhan University); Prof. CHEN, Lixiang (Xiamen University)

Presenter(s) : Mr WU, Haorong (Wuhan University)

Session Classification : Gravitational Wave Physics (Room A)

Contribution ID : 14

Type : Oral

A continuous wave window into neutron star structure

Sunday, 25 October 2026 15:30 (20)

Every rapidly spinning neutron star with slight asymmetry would broadcast a continuous hum of gravitational waves (GW). None of these signals has been detected yet, but the silence itself is measurable: searches now set upper limits on the GW amplitude of dozens of known pulsars, and for a growing subset those limits dig below the energy budget available from the stars' own spin-down. We ask what this kind of data, can say about the interior of a neutron star. The amplitude of the continuous signal depends on how much matter the star carries in its deformation and how that matter is distributed, its moment of inertia, which in turn is fixed by the unknown equation of state of dense matter. This opens a route to the neutron star mass-radius relation that is fully independent of the X-ray pulse-profile and binary-merger measurements that anchor current constraints. We build a hierarchical Bayesian pipeline that propagates simulated amplitude limits, treated consistently as non-detections, through stellar-structure calculations to the mass-radius plane, marginalizing over the unknown deformations of the pulsar population. Rather than claiming a new measurement, we chart the sensitivity frontier: how deep continuous-wave searches must go before they begin to weigh in on dense matter on their own.

Primary author(s) : HAZARIKA, Ayush (International Centre for Theoretical Physics Asia-Pacific (ICTP-AP), University of Chinese Academy of Sciences); MILLER, Andrew L. (ICTP-AP); PATRA, Naresh (CUHK, Shenzhen Campus); VAJPEYI, Avi (University of Auckland)

Presenter(s) : HAZARIKA, Ayush (International Centre for Theoretical Physics Asia-Pacific (ICTP-AP), University of Chinese Academy of Sciences)

Session Classification : Gravitational Wave Physics (Room A)

Contribution ID : 15

Type : **Oral**

Universal two-zero texture in SO(10): implications of JUNO and realization from non-invertible symmetries

Sunday, 25 October 2026 15:50 (20)

We apply the universal two-zero texture (UTZT) to all quark and lepton mass matrices in the SO(10) grand unified framework. With charged fermion masses fixed at their best-fit values, this texture contains only seven free parameters to account for nine flavor observables, rendering it highly predictive. Motivated by the recent JUNO indication in favor of the normal ordering of light neutrino masses, we perform an updated analysis of the UTZT in SO(10). The texture remains fully compatible with all current flavor data. The Dirac phase is predicted mainly in two regions, one of which matches very well with current data. A meV-scale $m\beta\beta$ is predicted, beyond the sensitivity bound of future neutrinoless double beta decay measurements. We further explore the origin of the UTZT from non-invertible symmetries, without introducing additional low-energy degrees of freedom. We show that the UTZT can be realized through non-invertible selection rules arising from the Z_3 gauging of Z_N , with a minimal realization corresponding to $N = 7$.

Primary author(s) : JIANG, Wen-Hao (HIAS, UCAS); Prof. ZHOU, Ye-Ling; Dr CHEN, Zi-Qiang

Presenter(s) : JIANG, Wen-Hao (HIAS, UCAS)

Session Classification : Particle Phenomenology (Room B)

Contribution ID : 17

Type : Oral

Investigation of a Diphoton Excess Near 152 GeV in Association with Dijets Using Run 3 Data at the LHC

Sunday, 25 October 2026 15:30 (20)

The multi-lepton anomalies observed at the LHC have motivated models with new scalar resonances, predicting a scalar at 150 ± 5 GeV. A narrow excess near $m_S = 152 \pm 1$ GeV was observed in Run 2 data in the $\gamma\gamma$, $Z\gamma$, and W^+W^- channels with a significance surpassing 5σ . In this work, we investigate a new excess in the ATLAS Run 3 data using diphoton production in association with two jets, focusing on event topologies similar to vector-boson fusion (VBF). The excess is studied using two simplified models, a singlet extension of the two-Higgs-doublet model (2HDM+S) and the Higgs Triplet Model (HTM). Following the recent ATLAS publication, a three-class neural network is used to separate VBF, gluon-gluon fusion, and non-resonant $\gamma\gamma + jj$ production. The published ATLAS analysis is recast by fitting the $m_{\gamma\gamma}$ spectrum near 152 GeV, giving a combined significance of 2.5σ using a part of the Run 3 dataset. The corresponding fiducial cross sections for HTM and 2HDM+S are 9.44 ± 4.74 fb and 7.41 ± 3.54 fb, respectively. The observed Run 3 excess is consistent and serves as further confirmation of the scalar candidate identified in Run 2, motivating further investigation with the full Run 3 dataset.

Primary author(s) : Dr SHARMA, Pramod (University of Witwatersrand); Mr CHAUHAN, Arnav (Institute of High Energy Physics); Dr MELLADO, Bruce (Institute of High Energy Physics); Dr DUTTA, Sukanta (SGTB Khalsa College, University of Delhi); Dr KUMAR, Mukesh (University of Witwatersrand); Dr MAZINI, Rachid (University of Witwatersrand)

Presenter(s) : Mr CHAUHAN, Arnav (Institute of High Energy Physics)

Session Classification : Particle Phenomenology (Room B)

Contribution ID : 20

Type : **Oral**

Entanglement Maximization and Symmetry Selection in Composite Higgs Models

Sunday, 25 October 2026 14:00 (20)

We propose a general mechanism for solving the strong CP problem with a heavy axion generated by confinement in a mirror sector. We present a simple realization of our mechanism in a mirror grand unified theory (GUT). The mirror GUT sector remains unbroken and dynamically generates a calculable heavy mass scale via confinement without fine tuning. Models in this class feature a heavy axion, whose potential is less sensitive to Planck-scale corrections, as well as a rich hidden sector from the confined mirror GUT. The solution to the strong CP problem remains unspoiled by the presence of additional phases in the GUT Yukawas, while still allowing the possibility of electric dipole moments within the reach of future experiments. Our proposal offers new directions in GUT model building, axion phenomenology, dark matter, and cosmology.

Primary author(s) : Prof. MA, Teng (ICTP-AP)**Presenter(s) :** ZHU, Mingdi**Session Classification :** Particle Phenomenology (Room B)

Contribution ID : 21

Type : **Oral**

How to bootstrap a Dark Photon

Saturday, 24 October 2026 15:50 (20)

Bootstrapping provides theoretical constraints of the parameter space allowed by the S-matrix properties: analyticity, unitarity, crossing symmetry. It has been applied to constrain different theories without making assumptions about their ultraviolet completions. However, its application in the forward limit of the scattering amplitudes is problematic when considering graviton exchange.

In this talk, I will review the different approaches for gravity bootstrap, in the particular case of a Dark Photon model. We will focus on the smearing method, which replaces the forward limit by a weighted integral over the transfer momentum. This approach has already been applied to the scattering of scalar particles mediated by graviton exchange. The pioneering contribution of this work is the implementation into scattering of vector particles, extending the existing forward-limit bootstrap of spin-1 particles.

From the phenomenological point of view, finding bounds for graviton mass and coupling in this setup would help probing models of gravitational particle production with vector particles as Dark Matter, as well as giving constraints for the quantum gravity swampland.

Primary author(s) : MA, Teng (ICTP-AP); Dr DONG, Ziyu (ICTP(Trieste)); DIAZ CARMONA, Álvaro (ICTP-AP); Mr ZHOU, Zizheng (ITP-CAS)

Presenter(s) : DIAZ CARMONA, Álvaro (ICTP-AP)

Session Classification : Gravity and Cosmology (Room C)

Contribution ID : 22

Type : **Oral**

Tracing out massive fields in cosmology

Saturday, 24 October 2026 15:50 (20)

Cosmological correlators are calculated through the in-in formalism in (quasi-)de Sitter background. Their effective description is best represented by a reduced density matrix. In this talk, I will first review the differences between the usual EFT used in scattering amplitude calculations and the Schwinger-Keldysh EFT for correlators. I will then discuss the reduced density matrix for a light field at finite time, obtained by tracing out a massive field in a quasi-single-field model with non-linear couplings. The trace generates branch-mixing terms which are generally present in the Schwinger-Keldysh formalism. Explicit calculations of the effective description and the bispectrum will be shown for a conformally coupled massive field. I will then discuss how a local effective field theory is obtained through a large mass expansion of the exact non-local effective description. Finally, I will study the symmetry and Schwinger-Keldysh constraints on the reduced density matrix.

Primary author(s) : SUN, Guanhao (Chongqing University)**Presenter(s) :** SUN, Guanhao (Chongqing University)**Session Classification :** Particle Phenomenology (Room B)

Contribution ID : 23

Type : **Oral**

Neutrino Magnetic Moments from Inverse Seesaw with Novel Horizontal Symmetry

Saturday, 24 October 2026 14:40 (20)

Mechanisms that generate large neutrino magnetic moments consistent with observed neutrino masses typically decouples the mechanism responsible for neutrino mass and the neutrino magnetic moment. In this letter, we propose a novel framework to explain neutrino mass while accommodating a large magnetic moment for the active neutrinos. The SM neutrinos get mass via the inverse seesaw mechanism. We introduce a novel horizontal-like softly broken $SU(2)_N$ symmetry in which SM particles are singlets. In the $SU(2)_N$ symmetric limit, one of the fermionic states participating in the inverse seesaw can possess a large magnetic moment while remaining massless. The $SU(2)_N$ symmetry is softly broken, and SM neutrinos obtain nonzero neutrino mass and large magnetic moment via sterile-active neutrino mixing. The active neutrinos can exhibit transition magnetic moments as large as $\mathcal{O}(10^{-11}\mu_B)$.

Primary author(s) : AJAY, Kaladharan (ICTP-AP)**Presenter(s) :** AJAY, Kaladharan (ICTP-AP)**Session Classification :** Particle Phenomenology (Room B)

Contribution ID : 24

Type : **Oral**

Local Cosmography from Causal Set Pixies

Saturday, 24 October 2026 14:20 (20)

In causal set theory, spacetime is represented by a locally finite partially ordered set. The abundances of small combinatorial structures can be used to recover information about its continuum geometry. We study how chains and 2-pixies can be used to recover local cosmological quantities in four-dimensional, spatially flat FLRW spacetimes. For causal diamonds centered on a comoving observer, we calculate the symmetric abundances through fourth order in the proper duration and the difference between upward and downward 2-pixies through third order. Riemann normal expansions identify the geometric terms, and exact integration in conformal coordinates gives their coefficients. The symmetric counts determine combinations of the Hubble and deceleration parameters. The difference between upward and downward 2-pixies probes curvature evolution and gives access to the dimensionless third derivative of the scale factor, known as the cosmological jerk. We test the calculation with independent continuum integration and simulated causal sets, and study the inference using the full covariance of the counts. The tests separate geometric truncation error from sampling uncertainty and show the cost of including higher-order terms. The construction uses calibrated interval durations. Applying it within one causal set requires an intrinsic clock and a treatment of correlations between overlapping intervals.

Primary author(s) : LIU, He (Tsinghua University)**Presenter(s) :** LIU, He (Tsinghua University)**Session Classification :** Gravity and Cosmology (Room C)

Contribution ID : 25

Type : **Oral**

Probing Memory-Burdened Primordial Black Holes with Multi-Messenger Observations

Saturday, 24 October 2026 15:30 (20)

The memory burden (MB) effect can dramatically slow black hole evaporation once half of the initial mass is radiated, allowing very light primordial black holes (PBHs) to persist today as dark matter (DM). We probe this scenario across three complementary messengers.

Using LHAASO ultra-high-energy gamma-ray spectra of four Galactic sources, we constrain PBHs with masses 10^9 g. From 10 years of IceCube muon-track data and 14 dwarf spheroidal galaxies with D-factor uncertainties treated via a profile likelihood, we derive neutrino limits on the PBH abundance. The cosmic-ray signal from memory-burdened PBHs is also considered but yields weaker constraints.

In all channels no significant excess over background is found. The gamma-ray and neutrino probes provide independent and complementary limits on the MB scenario; the neutrino results improve substantially on previous work in the $k=1$ case, while the $k=2$ case and the cosmic-ray channel remain less constraining due to limited instrumental sensitivity in the relevant energy ranges. Our combined analysis thus significantly narrows the allowed parameter space for PBH dark matter under the MB effect.

Primary author(s) : TAN, Xiu-hui (Institute of Theoretical Physics, CAS)

Presenter(s) : TAN, Xiu-hui (Institute of Theoretical Physics, CAS)

Session Classification : Gravitational Wave Physics (Room A)

Contribution ID : 26

Type : **Oral**

Nash Equilibrium from Quantum-Field Entanglement

Sunday, 25 October 2026 14:20 (20)

Entanglement harvesting transfers quantum field correlations to localized probes, yet whether these correlations can alter stable strategic behavior has remained unclear. We formulate a quantum-input game in which two Unruh–DeWitt detectors harvest vacuum entanglement from a free massless scalar field in $(3 + 1)$ -dimensional Minkowski spacetime. A referee converts this state into payoffs using independent question qubits and phase-calibrated local Bell measurements. To leading perturbative order, the mean reward is proportional to the signed entanglement margin $\sqrt{\mathcal{H}^2 + \mathcal{Q}^2} - \mathcal{P}$, where $\mathcal{H}$ is the Hadamard correlation contribution, $\mathcal{Q}$ is the Pauli–Jordan causal contribution, and $\mathcal{P}$ is the local excitation noise. Away from payoff degeneracies, allowing each player to exit or to choose an early or late interaction yields $1 + 2n_+$ trembling-hand perfect equilibria, where n_+ counts the positive-reward timing equilibria. For one fixed protocol, five analytically certified settings realize the sequence $7 \rightarrow 3 \rightarrow 1 \rightarrow 7 \rightarrow 1$. They represent the spacelike region, the first commutator lobe, central carrier cancellation, the second lobe, and the post-wavefront Huygens regime. Thus, within this fixed quantum-input verification protocol, distinct field-correlation regimes generate different stable strategic structures.

Primary author(s) : Prof. XU, Hao (Yangzhou University)

Presenter(s) : Prof. XU, Hao (Yangzhou University)

Session Classification : Gravity and Cosmology (Room C)

Contribution ID : 27

Type : **Oral**

Solving the Strong CP Problem with Heavy Axions

Sunday, 25 October 2026 14:20 (20)

We propose a general framework that extends the Standard Model (SM) to the gauge group $SU(2k+3) \times Sp(2k)' \times U(1)'_Y \times Z_4$. The SM quarks are embedded in the fundamental multiplet of $SU(2k+3)$, $Sp(2k)'$ provides an extra technicolor (TC) sector, $U(1)'_Y$ helps reproduce the correct SM hypercharges, and, the discrete Z_4 forbids unwanted TC fermion mass terms. The strong CP problem is solved by two axions associated with the two non-Abelian groups. Both axions can be made heavy by the combined effects of small instantons and TC confinement. We scan the viable parameter space for different values of k and present the resulting axion spectrum. The predicted masses lie well above the conventional QCD-axion window and open a richer set of phenomenological signatures for experimental searches.

Primary author(s): JIANG, Xu-Hui (ICTP-AP); MA, Teng (ICTP-AP); DI RISI, Vigilante (ICTP-AP, University of Chinese Academy of Science); Ms LIN, Dan (ICTP-AP); Prof. CACCIAPAGLIA, Giacomo (LPTHE)

Presenter(s): JIANG, Xu-Hui (ICTP-AP)

Session Classification : Particle Phenomenology (Room B)

Contribution ID : 28

Type : **Oral**

Axion-magnetic resonance in the lab, the sun, and the galaxy

Saturday, 24 October 2026 16:10 (20)

Axion–photon conversion in magnetic fields provides a powerful probe of axions, but its sensitivity is often limited by the loss of coherence between axions and photons. Axion-magnetic resonance (AMR) overcomes this limitation through spatial or temporal variations of the magnetic field that compensate for their momentum mismatch. I will introduce this mechanism and discuss how it finds applications across different scales: specifically designed magnetic field profiles can extend the reach of laser-based laboratory axion searches [PRD 110 (2024) 1, 015018]; probe new QCD axion parameter space through solar helioscopes [JHEP 03 (2025) 071]; and lead to novel X-ray emission in galaxies (to appear in 2026).

Primary author(s) : SUN, Chen (HIAS-UCAS)**Presenter(s) :** SUN, Chen (HIAS-UCAS)**Session Classification :** Particle Phenomenology (Room B)

Contribution ID : 29

Type : Oral

Quantum geometry effects in quantum field theory: Hamiltonian constraint generates gravity-matter entanglement in spherically symmetric loop quantum gravity

Sunday, 25 October 2026 14:40 (20)

In this work, we address a foundational challenge in quantum field theory on curved spacetime by developing a consistent framework in spherically symmetric loop quantum gravity. We introduce a methodology for defining meaningful superpositions of quantum geometry and matter states near the semiclassical apparent horizon. This is achieved by identifying a restricted subspace of the gravitational phase space, which ensures unitary equivalence among Fock representations of a scalar field across different quantum geometries. Within the resulting well-defined state space, we derive weak solutions to the quantum Hamiltonian constraint of general relativity near the semiclassical apparent horizon. Furthermore, we generalize the Hartle-Hawking vacuum state to this quantum geometric framework. The resulting state exhibits the inherent entanglement between geometry and matter, which arises from the quantum Hamiltonian constraint of general relativity. This work establishes a principled framework for studying geometry-matter entanglement and offers new insights into the quantum foundations of the black hole information paradox.

Primary author(s) : Prof. LONG, Gaoping (Jinan University)**Presenter(s) :** Prof. LONG, Gaoping (Jinan University)**Session Classification :** Gravity and Cosmology (Room C)

Contribution ID : 30

Type : **Oral**

Shadow of rotating black hole surrounded by dark matter

Saturday, 24 October 2026 15:30 (20)

Dark matter (DM), a fundamental cosmic component, motivates the study of its influence on black hole (BH) shadows, especially for spinning BHs confirmed by EHT observations. This work generalizes the Schwarzschild BH surrounded by DM to an axisymmetric Kerr BH using the Newman–Janis Algorithm (NJA), investigating the resulting event horizon and ergosphere structures. Employing null geodesics, we examine the effects of DM mass (ΔM) on BH shadow, including its radius, distortion, and the associated energy emission rate. Our analysis reveals that DM has a negligible effect below a critical mass, once this threshold is surpassed, all BH structures expand significantly. Furthermore, DM robustly contributes to the shadow maintaining a near circular shape, even for highly spinning BHs. This pronounced structural expansion under high DM mass may potentially exceed current observational constraints, suggesting that DM must either be absent in the immediate vicinity of the BH or its localized mass must remain below this critical value to be consistent with astrophysical observations.

Primary author(s) : FENG, Haiyuan (Shanxi Normal University)**Presenter(s) :** FENG, Haiyuan (Shanxi Normal University)**Session Classification :** Gravity and Cosmology (Room C)

Contribution ID : 31

Type : Oral

Multi-Band Constraints on Cosmic Strings: Unifying Harmonic and Burst Spectra

Sunday, 25 October 2026 14:20 (20)

Cosmic-string loops generate a broadband gravitational-wave background (GWB) that is typically modeled via two distinct formalisms: a discrete harmonic expansion, commonly used in pulsar-timing-array (PTA) studies, and a continuous burst superposition, employed in ground-based GWB searches. In this work, we formally unify the two formalisms, showing that they provide discrete and continuous representations of the same underlying radiation process and converge on the scale-invariant spectrum plateau. On the rising low-frequency branch, where the first few harmonics dominate, the discrete nature becomes important, causing the two formalisms to diverge. Within this unified framework, the spectral calculation is more consistent across frequency bands, enabling multi-band inference. Leveraging this physical insight, we perform joint Bayesian inference across four representative loop-distribution models using the NANOGrav, EPTA, and LIGO–Virgo–KAGRA (LVK) datasets. By jointly sampling the string tension $G\mu$ alongside the average cusp and kink numbers $\{N_c, N_k\}$, the loop-radiation uncertainties are accounted for. We find that employing the harmonic expansion strengthens the LVK bounds by 21% – 31% for three of these models. Additionally, the stringent LVK bounds preclude three of these models from explaining the observed PTA common signal. For the sole surviving model, our multi-band analysis improves the inferred limit on $G\mu$.

Primary author(s): ZHANG, Hansong (ICTP-AP); GUO, Huai-Ke; SAKELLARIADOU, Mairi; YANG, Fengwei; ZHAO, Yue

Presenter(s): ZHANG, Hansong (ICTP-AP)

Session Classification : Gravitational Wave Physics (Room A)

Contribution ID : 32

Type : **Oral**

Geodesic Focusing Conditions in $f(Q)$ Gravity

Sunday, 25 October 2026 14:00 (20)

In this talk, I will discuss the focusing of timelike geodesic congruences in $f(Q)$ gravity. I will first introduce geodesic deviation in symmetric teleparallel geometry and the modified Raychaudhuri equation obtained under a Weyl-type nonmetricity ansatz and an additional nonmetricity-acceleration condition. I will then present a focusing condition expressed in terms of the matter energy-momentum trace and an effective trace, and discuss the compatibility of the ansatz with homogeneous and isotropic connections. Finally, I will consider a shear-free flat FLRW background in the compatible coincident-gauge sector, where the modified Friedmann equations yield $T_{\text{eff}} = T$ for $f_Q > 0$. Under these assumptions, the focusing inequality is saturated and imposes no additional constraint on the matter content.

Primary author(s) : Prof. GENG, Chao-Qiang (HIAS-UCAS); Mr LIU, Chunhui (HIAS,UCAS); Dr QIU, Jianhui (HIAS,UCAS); Dr LUO, Ling-Wei (HIAS,UCAS)

Presenter(s) : Mr LIU, Chunhui (HIAS,UCAS)

Session Classification : Gravity and Cosmology (Room C)

Contribution ID : 33

Type : **Oral**

Addressing the CP-strong problem with two heavy axions

Sunday, 25 October 2026 14:40 (20)

We present a mechanism to solve the CP-strong problem with two heavy axions in a composite Higgs . An $Sp(8)$ technicolour group drives electroweak symmetry breaking by producing the Higgs as a pseudo-Nambu–Goldstone boson of the associated flavour symmetry breaking. The same sector generates the Standard Model Yukawa hierarchies through fundamental partial compositeness. At high energy, colour and technicolour are unified into $SU(11) \times Sp'(8)$, a UV completion engineered so that the two physical axion masses receive contributions both from $Sp'(8)$ small instantons and from the $Sp(8)$ confinement scale, naturally raising them well above the QCD axion mass. We analyse the pseudo-Nambu–Goldstone boson spectrum of the technicoloured sector, the resulting axion mass matrix, and the flavour structure of the Standard Model.

Primary author(s) : DI RISI, Vigilante (ICTP-AP, University of Chinese Academy of Science)

Co-author(s) : Prof. CACCIAPAGLIA, Giacomo (LPTHE); MA, Teng (ICTP-AP); Dr JIANG, Xu-Hui (ICTP-AP); Mrs LIN, Dan (ICTP-AP)

Presenter(s) : DI RISI, Vigilante (ICTP-AP, University of Chinese Academy of Science)

Session Classification : Particle Phenomenology (Room B)

Contribution ID : 34

Type : **Oral**

Relational Scales and Hamiltonian Renormalization in Quantum Gravity

Saturday, 24 October 2026 14:40 (20)

How should one define a renormalization scale when spacetime geometry itself is quantum and dynamical? I will discuss a relational formulation of coarse graining in which physical resolution and mode ordering are defined by dynamical geometric observables, while RG flow remains distinct from physical clock evolution.

I will then present a Hamiltonian implementation using the non-perturbative functional renormalization group, where quantum fluctuations can modify the full momentum–velocity relation and the symplectic structure. Requiring consistent local evolution further constrains the effective Hamiltonian and provides a route from quantum-gravity dynamics to cosmological backgrounds, perturbations and observables.

Primary author(s) : LIU, Hongguang (Westlake University)

Presenter(s) : LIU, Hongguang (Westlake University)

Session Classification : Gravity and Cosmology (Room C)

Contribution ID : 35

Type : **Oral**

Searches and Latest Results for the Isotropic Gravitational-Wave Backgrounds with LIGO-Virgo-KAGRA detectors

Saturday, 24 October 2026 16:10 (20)

The gravitational-wave background (GWB) is a superposition of individually unresolved gravitational-wave (GW) signals arising from both astrophysical and cosmological sources accumulated throughout cosmic history. We refer to the GWB as “stochastic” as it can be characterized statistically as a mean zero stochastic field. For the isotropic GWB search considered here, the GWB is further assumed to be stationary, isotropic, and unpolarized. Detecting a stochastic GWB can provide information about astrophysical source populations and processes in the early Universe. In this talk, I will introduce the analysis methods, including the cross-correlation spectra, frequency estimator and parameter estimation, and present the latest results using LIGO–Virgo–KAGRA data through April 2025.

Primary author(s) : RAO, Ruhan (UCAS, ictp-ap)**Presenter(s) :** RAO, Ruhan (UCAS, ictp-ap)**Session Classification :** Gravitational Wave Physics (Room A)

Contribution ID : 36

Type : **Oral**

Probing Inflationary Origins of Primordial Black Holes with LIGO-Virgo-KAGRA O1-O4a data

Saturday, 24 October 2026 15:50 (20)

Large primordial curvature perturbations can produce primordial black holes (PBHs) and inevitably generate a scalar-induced stochastic gravitational-wave background upon horizon re-entry. In this talk, based on our recent work arXiv:2609.12867, we will present constraints from the combined LIGO–Virgo–KAGRA O1–O4a data on two representative inflationary mechanisms for producing such perturbations: ultra-slow-roll inflation and an inflationary phase transition. We find no evidence for either signal and derive 95% credible upper limits on the curvature-spectrum amplitude over the frequency range accessible to ground-based interferometers. Because PBH abundance depends exponentially on the perturbation amplitude, even a modest improvement in the amplitude constraint can translate into orders-of-magnitude stronger limits on PBH formation. The resulting bounds probe PBH abundances far below unity and can surpass conventional constraints. Importantly, the gravitational-wave signal preserves information about PBH formation even when the PBHs are too rare for direct searches or have already evaporated. These results demonstrate that stochastic gravitational-wave observations provide a powerful and complementary probe of small-scale inflationary physics, with future interferometers extending the reach to a broader range of inflationary epochs and PBH masses.

Primary author(s) : ☒, ☒ (XXXXXXXXXXXXXXXXXXXXXXXXXXXX)

Presenter(s) : ☒, ☒ (XXXXXXXXXXXXXXXXXXXXXXXXXXXX)

Session Classification : Gravitational Wave Physics (Room A)

Contribution ID : 37

Type : **Oral**

Silk damping in induced gravitational waves: a novel probe of new physics

Saturday, 24 October 2026 14:40 (20)

The early universe is a natural laboratory for high-energy physics, and gravitational waves, as direct probes of this epoch, inherently carry rich information related to high-energy physics. Silk damping, resulting from dissipation in the cosmic fluid, is a significant physical phenomenon in the early universe. In this talk, I will introduce our first study on Silk damping in induced gravitational waves. Silk damping notably suppresses the spectrum of induced gravitational waves on scales comparable to a diffusion scale at the decoupling of weakly-interacting particles. This characteristic suppression offers a novel and general observable for detecting the underlying particle interaction, especially for those mediated by heavy gauge bosons beyond the Standard Model. We anticipate that pulsar timing arrays are sensitive to gauge bosons with masses $\sim 10^3\text{--}10^4$ GeV, while space- and ground-based interferometers to those with masses $\sim 10^7\text{--}10^{12}$ GeV, leading to essential complements to traditional high-energy physics experiments.

Primary author(s) : Dr YAN-HENG, Yu (HIAs, UCAS)**Presenter(s) :** Dr YAN-HENG, Yu (HIAs, UCAS)**Session Classification :** Gravitational Wave Physics (Room A)

Contribution ID : 38

Type : **Oral**

Cosmological Stasis and Its Phenomenological Implications

Saturday, 24 October 2026 14:00 (20)

Cosmological stasis is a phenomenon in which multiple energy components with different equation-of-state parameters maintain constant abundances for an extended period despite the expansion of the universe. In this talk, I review how stasis arises and discuss the possible implications of this phenomenon in observations. These include the enhancement in the growth of matter density perturbations on small scales, and characteristic imprints in the stochastic gravitational-wave background.

Primary author(s) : Prof. HUANG, Fei (Anhui University of Science and Technology)

Co-author(s) : Prof. DIENES, Keith (University of Arizona); Prof. TAIT, tim (University of California, Irvine); Prof. THOMAS, Brooks (Lafayette College); Dr HEURTIER, Lucien (King's College London); Prof. SINHA, Kuver (University of Oklahoma); Dr XU, Tao (Hong Kong University of Science and Technology); Dr HAJKARIM, Fazlollah (University of Oklahoma)

Presenter(s) : Prof. HUANG, Fei (Anhui University of Science and Technology)

Session Classification : Gravity and Cosmology (Room C)

Contribution ID : 39

Type : Oral

Methods for Detecting Gravitational Waves from mini-Extreme-Mass-Ratio Inspirals: A Spectral-Leakage-Aware Framework

Sunday, 25 October 2026 15:50 (20)

Mini-extreme-mass-ratio inspirals (mini-EMRIs), in which a subsolar-mass compact object orbits a much heavier compact object, are long-duration gravitational-wave sources of interest to ground-based detectors. Their signals can remain in band for hours to years, making fully coherent matched-filter searches computationally expensive. Semicoherent time-frequency searches reduce this cost by dividing the data into short Fourier segments and combining segment-level powers or related statistics. Conventional implementations, however, often require the signal to remain approximately monochromatic within each segment, thereby limiting the coherent duration when the signal frequency evolves appreciably.

We extend the Σ Track framework beyond the quasi-monochromatic regime in two steps. First, we derive a linear-chirp model for the spectral leakage produced within a short-time Fourier segment. Second, we construct the ΣR statistic, a weighted sum of power ratios over a finite multi-pixel track, to recover signal power distributed among neighboring frequency bins. The resulting sensitivity model further motivates a frequency-layered search in which the coherent duration is optimized separately in different frequency intervals.

For a fiducial $(1.5, 10^{-5}) M_{\odot}$ mini-EMRI and under the assumptions of our analytic comparison, the optimized ΣR configuration yields an effective detection volume about an order of magnitude larger than that of the Hough-like reference statistic considered here.

More broadly, the proposed framework provides a systematic way to incorporate spectral leakage into semicoherent time-frequency statistics and to optimize the coherence time across the signal band, thereby extending power-track searches to long-duration signals with appreciable frequency evolution.

Primary author(s) : WANG, Zixuan (ICTP-AP)

Presenter(s) : WANG, Zixuan (ICTP-AP)

Session Classification : Gravitational Wave Physics (Room A)

Contribution ID : 40

Type : **Oral**

Evo-MCTS: Gravitational-Wave Algorithm Search and Lessons for AI-Assisted Physics

Sunday, 25 October 2026 14:00 (20)

This talk presents Evo-MCTS (arXiv:2508.03661), a framework combining large language models, Monte Carlo tree search, and evolutionary optimization for automated algorithm discovery, using gravitational-wave signal searches as a case study. Through analyses of search trajectories and subsequent audits, we examine how benchmark design influences optimization and how independent validation and physical consistency checks can distinguish improvements in evaluation metrics from genuine scientific advances. Building on these findings, we explore the potential of large language models in theoretical physics, including the search for exact black-hole solutions through symbolic computation and formal verification in Lean, and discuss broader opportunities and challenges for AI-assisted scientific research.

Primary author(s) : WANG, He (ICTP-AP, UCAS)**Presenter(s) :** WANG, He (ICTP-AP, UCAS)**Session Classification :** Gravitational Wave Physics (Room A)

Contribution ID : 41

Type : **Oral**

Induced Gravitational Waves: From Gauge Issue to Primordial Black Hole Dark Matter

Monday, 26 October 2026 15:15 (25)

Scalar-induced gravitational waves provide a unique probe of enhanced primordial fluctuations and primordial black holes (PBHs). I will first address the longstanding gauge issue in the definition of induced gravitational waves, presenting a gauge-invariant calculation of the observable second-order gravitational-wave strain. I will then discuss the induced gravitational-wave signal associated with PBH dark matter in space-based detectors. We find that Taiji can probe the entire remaining asteroid-mass window in which PBHs may constitute dark matter, with a signal-to-noise ratio up to 10^{3-4} .

Primary author(s) : Prof. PI, Shi**Presenter(s) :** Prof. PI, Shi**Session Classification :** Plenary Sessions

Contribution ID : 42

Type : **Oral**

Parameter degeneracy and information loss in inverse flavor mapping for high-energy astrophysical neutrinos

Sunday, 25 October 2026 16:10 (20)

Given a high-energy astrophysical neutrino flux, its source flavor ratios $\eta = \{\eta_e, \eta_\mu, \eta_\tau\}$ are correlated with the ones $f = \{f_e, f_\mu, f_\tau\}$ measured at a neutrino telescope via $f = P\eta$, where the elements of P consist of four lepton flavor mixing parameters. But realistic inverse flavor mapping $\eta = P^{-1}f$ encounters unavoidable parameter degeneracy and information loss, especially in or near the $\det P = 0$ limit allowed by current neutrino oscillation data. In this work we explore the parameter correlation condition for $\det P = 0$ including the μ - τ reflection symmetry case, formulate the corresponding constraints on f_e and f_μ versus η_e and η_μ , and illustrate to what extent the source flavor distribution can be mapped by using the recent IceCube all-sky neutrino flux data ranging from 5 TeV to 10 PeV under the assumption that the relevant sources have a common flavor composition.

Primary author(s) : CHEN, Zi-Qiang (HIAS-UCAS); Prof. XING, Zhi-zhong (IHEP); ZHOU, Ye-Ling (HIAS-UCAS)

Presenter(s) : CHEN, Zi-Qiang (HIAS-UCAS)

Session Classification : Particle Phenomenology (Room B)

Contribution ID : 43

Type : **Oral**

The recent status and future plan for CDEX and CJPL

Saturday, 24 October 2026 09:00 (25)

Presenter(s) : QIAN YUE

Session Classification : Plenary Sessions

Contribution ID : 44

Type : **Oral**

Highlights from LHAASO and implications on cosmic ray physics and new physics

Saturday, 24 October 2026 09:25 (25)

Presenter(s) : XIAOJUN BI

Session Classification : Plenary Sessions

Contribution ID : 45

Type : **Oral**

A Model of GeV-Scale Dark Matter Stabilized by Baryon Number Conservation

Saturday, 24 October 2026 09:50 (25)

Presenter(s) : ALEJANDRO IBARRA

Session Classification : Plenary Sessions

Contribution ID : 46

Type : **Oral**

Phases of Particle Dark Matter

Saturday, 24 October 2026 10:15 (25)

Presenter(s) : JOSHUA T. RUDERMAN

Session Classification : Plenary Sessions

Contribution ID : 47

Type : **Oral**

Leptogenesis Determined by Low Energy Parameters

Saturday, 24 October 2026 11:00 (25)

Presenter(s) : XIAO-GANG HE

Session Classification : Plenary Sessions

Contribution ID : 48

Type : **Oral**

Spontaneous leptogenesis driven by majoron

Saturday, 24 October 2026 11:25 (25)

Presenter(s) : EUNG JIN CHUN

Session Classification : Plenary Sessions

Contribution ID : 49

Type : **Oral**

B-L Supersymmetric Extension of the Standard Model (BLSSM)

Saturday, 24 October 2026 11:50 (25)

Presenter(s) : SHAABAN KHALIL

Session Classification : Plenary Sessions

Contribution ID : 50

Type : **Oral**

Spin orbit coupling and global polarization in heavy ion collisions

Sunday, 25 October 2026 09:00 (25)

Presenter(s) : ZUO-TANG LIANG

Session Classification : Plenary Sessions

Contribution ID : 51

Type : **Oral**

The Taiji project

Sunday, 25 October 2026 09:25 (25)

Presenter(s) : ZIREN LUO

Session Classification : Plenary Sessions

Contribution ID : 52

Type : **Oral**

The TianQin project

Sunday, 25 October 2026 09:50 (25)

Presenter(s) : JIANWEI MEI

Session Classification : Plenary Sessions

Contribution ID : 53

Type : **Oral**

Quantum corrections to the inflationary power spectrum

Sunday, 25 October 2026 10:15 (25)

Presenter(s) : JUN'ICHI YOKOYAMA

Session Classification : Plenary Sessions

Contribution ID : 54

Type : **Oral**

Real Picture of Microscopic Process

Sunday, 25 October 2026 11:00 (25)

Presenter(s) : TI-PEI LI

Session Classification : Plenary Sessions

Contribution ID : 55

Type : **Oral**

Explicit Lorentz invariant QED pair production rates from superstrings

Sunday, 25 October 2026 11:25 (25)

Presenter(s) : JIAN-XIN LU

Session Classification : Plenary Sessions

Contribution ID : 56

Type : **Oral**

Recent results from the JUNO experiment

Sunday, 25 October 2026 11:50 (25)

Presenter(s) : ZEYUAN YU

Session Classification : Plenary Sessions

Contribution ID : 57

Type : **Oral**

Lifetimes of singly and doubly heavy baryons

Monday, 26 October 2026 09:00 (25)

Presenter(s) : HAI-YANG CHENG

Session Classification : Plenary Sessions

Contribution ID : 58

Type : **Oral**

Progress and Status of Next-Generation Collider Projects in China: STCF, CEPC, and Beyond

Monday, 26 October 2026 09:25 (25)

Presenter(s) : YANGHENG ZHENG

Session Classification : Plenary Sessions

Contribution ID : 59

Type : **Oral**

Paradigm-changing studies of spin entangled hyperons and antihyperons at BESIII

Monday, 26 October 2026 09:50 (25)

Presenter(s) : HAI-BO LI

Session Classification : Plenary Sessions

Contribution ID : **60**

Type : **Oral**

DESI dark energy survey

Monday, 26 October 2026 10:45 (25)

Presenter(s) : GONGBO ZHAO

Session Classification : Plenary Sessions

Contribution ID : 61

Type : **Oral**

Minimal inelastic DM model for the LZ event and galactic center gamma-ray excess

Monday, 26 October 2026 11:10 (25)

Presenter(s) : PYUNGWON KO

Session Classification : Plenary Sessions

Contribution ID : 62

Type : **Oral**

Exploring the Gravitational-Wave Universe: Science Cases for Taiji

Monday, 26 October 2026 11:35 (30)

Presenter(s) : YOUJUN LU

Session Classification : Plenary Sessions

Contribution ID : 63

Type : **Oral**

Cosmological and High Energy Physics implications from gravitational-wave background searches in LIGO-Virgo-KAGRA's O1-O4a runs

Monday, 26 October 2026 12:05 (25)

Presenter(s) : MAIRI SAKELLARIADOU

Session Classification : Plenary Sessions

Contribution ID : 64

Type : **Oral**

Unifying Fast Radio Bursts with Supernova Remnant Evolution

Monday, 26 October 2026 14:00 (25)

Presenter(s) : DI LI

Session Classification : Plenary Sessions

Contribution ID : 65

Type : **Oral**

Gravitational Waves with High Frequency and Higher Curvature Gravity

Monday, 26 October 2026 14:25 (25)

Presenter(s) : BUM-HOON LEE

Session Classification : Plenary Sessions

Contribution ID : 66

Type : **Oral**

Measuring Parity Asymmetry in Gravitational-Wave Backgrounds

Monday, 26 October 2026 14:50 (25)

Presenter(s) : NAOKI SETO

Session Classification : Plenary Sessions

Contribution ID : **67**

Type : **Oral**

The LISA mission

Monday, 26 October 2026 15:40 (25)

Presenter(s) : STEFANO VITALE

Session Classification : Plenary Sessions

Contribution ID : **68**

Type : **Oral**

Little Red Dots: The Wandering Black Holes

Saturday, 24 October 2026 14:00 (20)

Presenter(s) : Prof. WANG, Yu (ICTP)

Session Classification : Gravitational Wave Physics (Room A)

Contribution ID : **69**

Type : **Oral**

Astrophysical Graviton Squeezing Can Be Hidden in the Far Field

Sunday, 25 October 2026 15:50 (20)

Presenter(s) : ZHOU, Zi-Zheng

Session Classification : Gravity and Cosmology (Room C)