International Symposium on Cosmology and Particle Astrophysics: CosPA 2025

Report of Contributions

https://indico.ibs.re.kr/e/871

Contribution ID: **1** Type: **not specified**

Flavours of flavoured axion cosmology

Monday, 7 July 2025 17:00 (30 minutes)

The standard DFSZ axion model features stable domain walls, so requires a pre-inflationary axion. This means the density of axion dark matter depends on an unknowable initial misalignment angle and thus predictivity is compromised compared to the post-inflationary axion case. I present a systematic classification of flavour-dependent DFSZ Peccei-Quinn symmetry variants that have no domain wall problem and thus permit a post-inflationary axion. I then introduce the VISHnu model, which connects the Peccei-Quinn sector to neutrino mass generation via the type-1 seesaw model and hence also features thermal leptogenesis. Aspects of the inflationary dynamics of the model are then presented.

Presenter: VOLKAS, Raymond (U of Melbourne)

Session Classification: Plenary

Contribution ID: **2** Type: **not specified**

Oscillations and parity violation in gravitational wave background from extra tensor modes

Monday, 7 July 2025 17:30 (30 minutes)

Spectator fields which provide additional tensor degrees of freedom, on top of the standard metric tensor perturbations, can produce significant amounts of gravitational waves (GWs). Employing the effective field theory approach for spin-2 fields, we find a universal prediction that linear mixing between the metric and extra tensor modes inevitably induces oscillatory features in the GW spectrum. Moreover, parity-violating operators in the spin-2 sector can imprint chiral signatures on the resulting GW background. These results provide a model-independent characterization of the key signatures and observational implications of such scenarios which can be detected with future GW detectors.

Presenter: GORJI, Mohammad Ali (IBS CTPU-CGA)

Session Classification: Plenary

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

Searching for WIMPs in celestial bodies

Tuesday, 8 July 2025 09:30 (30 minutes)

The WIMP indirect detection signal is enhanced by the square of the WIMP density, and celestial bodies can catalyze WIMP annihilation by accumulating WIMPs with their gravitational potential. In particular, WIMP annihilation can induce a GeV neutrino signal from the Sun, the increase of the total luminosity of White Dwarfs in nearby Globular Clusters, or a sizeable radio emission from the Dark Matter cusp in the Black Hole of low−mass X−ray binaries. I will discuss how such signals can be complementary to direct detection to probe the WIMP thermal decoupling scenario and, in particular, how they allow to obtain bounds that do not depend on the WIMP velocity distribution.
Due to new telescope technologies in the next few years it will become possible to search for WIMPs using a growing list of stars and planets. To make this task easier I introduce WimPyCapture, a new module of the WimPyDD code (wimpydd.hepforge.org) that will soon be released for the calculation of the capture rate of WIMPS by generic celestial bodies in the single scatter or optically thin regime. The module will be fully integrated in WimPyDD and will allow to combine WIMP direct detection and capture in celestial bodies in virtually any scenario, including inelastic scattering, an arbitrary WIMP spin and a generic WIMP velocity distribution in the Galactic halo. WimPyCapture will include templates for the calculation of the WIMP capture rate in different celestial bodies such as the Earth, the Sun, Jupiter-like planets, main-sequence stars, brown and white dwarfs, allowing the user to extend the range of celestial targets in a straightforward way.

Presenter: SCOPEL, Stefano (Sogang U)

Session Classification: Plenary

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

PQ quality and scale hierarchy of extra dimensional axions

Tuesday, 8 July 2025 09:00 (30 minutes)

I discuss the PQ quality and scale hierarchy of extra dimensional axions in the context of 5-dimensional orbifold field theory on S^1/Z_2.

Presenter: CHOI, Kiwoon (IBS CTPU-PTC)

Session Classification: Plenary

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

A New Probe to DE & DM Interaction

Tuesday, 8 July 2025 10:00 (30 minutes)

The interaction between DM and DE has been proved successful in alleviating the coincidence problem and shown allowed by observations. The BINGO radio telescope is specifically designed to study the properties of DE and its interaction with DM during the late-time cosmic acceleration. We introduce the BINGO-ABDUS project, its current status, future development and its specific aim at providing new insights on the interaction between dark sectors.

Presenter: WANG, Bin (SJTU/Yangzhou)

Session Classification: Plenary

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

Flavorful Light Dark Matter Window From NA62 K -> π invisible

Friday, 11 July 2025 09:00 (30 minutes)

We explore the potential presence of new physics in the recent NA62 observation of the kaon decay K+ ⟶ π++Ɇ with missing energy Ɇ in the context of a dark-matter (DM) scenario that can explain the Belle II finding of enhanced rate of the b-meson decay B+ ⟶ K++Ɇ compared to the standard-model expectation, assuming that a light real scalar boson φ plays the role of DM. The DM particle is subject to significant restrictions from the observed relic abundance and from DM direct detection experiments incorporating the Migdal effect, indirect searches including that in cosmic microwave background data, and collider searches, except when its mass is between 110 MeV and 130 MeV.

Presenter: HE, Xiao-Gang (TDLI)

Session Classification: Plenary

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

Complications in Simple Dark Sectors

Friday, 11 July 2025 09:30 (30 minutes)

Dark sectors which may contain the dark matter required by observation have become increasingly well studied in recent years. One of the virtues of dark matter in a dark sector is the simplicity of such models, allowing for very general results. I'll discuss recent work on simple dark sectors that naturally give rise to slightly more complicated phenomenology, focusing on models of dark matter that can be probed with indirect detection. This talk will highlight areas where the community should focus on not-so-minimal models of dark matter.

Presenter: MCKEEN, David (TRIUMF)

Session Classification: Plenary

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

Phenomenological Consequences of Phase Transitions During Inflation

Friday, 11 July 2025 10:00 (30 minutes)

The large excursion of the inflaton field can significantly alter the properties of coupled spectator fields during inflation. This dynamic may trigger phase transitions in the spectator sector, leading to rich phenomenological implications. In this talk, I will discuss the observable signatures of such phase transitions, including gravitational waves, topological defects, and primordial non-Gaussianity.

Presenter: AN, Haipeng (Tsinghua U)

Session Classification: Plenary

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

Confronting IR divergences in de Sitter QFT

Friday, 11 July 2025 14:00 (30 minutes)

Scalar field theory on de Sitter space suffers from infrared (IR) divergences, highlighting the necessity of nonperturbative methods for IR resummation.
A well-known triad of statements encapsulates the IR issue:
(1) the massless Bunch–Davies vacuum breaks de Sitter invariance;
(2) the coincident limit of the two-point correlator exhibits secular growth; and
(3) stochastic inflation provides a nonperturbative resummation framework.
I will present an alternative perspective on each of these equivalent statements and discuss possible phenomenological implications.

Presenter: SYPSAS, Spyros (Centro de Ciencias Exactas, UBB)

Session Classification: Plenary

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

Inflation beyond slow-roll, non-Gaussianity, and primordial black holes

Friday, 11 July 2025 14:30 (30 minutes)

In single-field inflation, an ultra-slow-roll stage is needed to enhance the curvature perturbation ζ to generate primordial black holes (PBHs) on small scales, which is usually accompanied by large local non-Gaussianity. I will introduce the recent progress on the non-Gaussian curvature perturbation of a logarithmic form. It can naturally give rise to an exponential-tail or a double exponentially suppressed probability density function, which enhances or suppresses the PBH abundance significantly. I will also discuss the phenomenological implications of such non-Gaussianities on the scalar-induced gravitational waves.

Presenter: PI, Shi (ITP)

Session Classification: Plenary

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

Formation of primordial black holes from inflationary models

Friday, 11 July 2025 15:00 (30 minutes)

Primordial black holes (PBHs) are a kind of black holes which may form during the early stage of the universe. In this talk, I will discuss a class of inflationary models which seed the formation of PBHs.

Presenter: ZHANG, Ying-li (Tongji U)

Session Classification: Plenary

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

Cogenesis by Majoron

Tuesday, 8 July 2025 14:00 (30 minutes)

We propose a scenario for the cogenesis of baryon asymmetry and dark matter, realizing spontaneous leptogenesisby by Majoron in Type I seesaw model.
This mechanism requires significant kinetic motion, which we demonstrate can naturally arise from conventional misalignment under conditions of symmetry non-restoration

Presenter: CHUN, Eung Jin (KIAS)

Session Classification: Plenary

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

Decoding Stellar Core-Collapse and Compact-Object Formation with Neutrinos

Tuesday, 8 July 2025 15:30 (30 minutes)

Neutrinos emerge promptly from the cores of collapsing massive stars and are the most direct messengers of the microphysics that drives stellar core collapse. Owing to their small interaction cross-sections, they propagate with negligible attenuation, so their time- and energy-dependent flux records the full evolution from shock formation to the birth of a neutron star, or, if accretion continues, a black hole. Recent advances in detector sensitivity, background suppression, and light-curve modeling now permit quantitative analysis of this signal, turning the next Galactic burst into a laboratory for strong-gravity and dense-matter physics.

In this talk, I introduce a simulation-calibrated analytical model that reproduces both the prompt flash and the longer cooling tail of the neutrino light curve. Tests with synthetic data show that, even with a single water Cherenkov detector, one can extract key source parameters such as the remnant's mass, radius, and binding energy, and distinguish gradual neutron-star cooling from the abrupt cutoff that marks black-hole formation. The same framework converts the burst into an independent distance indicator and places meaningful limits on nuclear equations of state. These capabilities demonstrate that data-driven neutrino astronomy can now provide precise, model-constrained insights into gravitational collapse and the formation of compact objects.

Presenter: SUWA, Yudai (U of Tokyo)

Session Classification: Plenary

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

Topological Instanton for curved space particle creation and quantum reflections

Tuesday, 8 July 2025 15:00 (30 minutes)

Using the tanh potential as an example, we present a new class of real time instantons corresponding to general equivalence classes. The Euler-Lagrange equation solutions to saddle points are not unique for complex saddles: any contour in the equivalence classes maps to the same action due to Cauchy's theorem. This new tool resolves a number of existing puzzles, including curved space particle creation and reflection on a step potential.

Presenter: PEN, Ue-Li (Academia Sinica)

Session Classification: Plenary

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

Universe with a large lepton asymmetry

Tuesday, 8 July 2025 14:30 (30 minutes)

The recent determination of the primordial abundance of He4 suggests that our universe has a large lepton asymmetry. We consider the Q-ball scenario that produces the large lepton asymmetry without generating a large baryon asymmetry. We also discuss the enhancement of gravitational waves and resonant production of sterile neutrinos in the scenario.

Presenter: KAWASAKI, Masahiro (ICRR/U of Tokyo)

Session Classification: Plenary

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

Unexplored gravitational wave backgrounds on intergalactic scales

Wednesday, 9 July 2025 09:00 (30 minutes)

Stochastic gravitational wave backgrounds have become a hot topic in cosmology. However, very few studies have been done on gravitational waves on intergalactic scales. I discuss possible sources on these scales which could even be parity violating, and present a method to probe such gravitational waves.

Presenter: SASAKI, Misao (APCTP/IPMU)

Session Classification: Plenary

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

Cosmological Implications of Unification: Topological Structures and Gravitational Waves

Wednesday, 9 July 2025 09:30 (30 minutes)

The grand unified theory (GUT) provides a rationale for the arbitrariness of the Standard Model (SM) and explains many enigmas of nature at the outset of a single gauge group. The GUTs predict the proton decay, and the spontaneous symmetry breaking (SSB) of the higher symmetry group may lead to the formation of topological defects, which are indispensable in the context of cosmological observations. Topological defects such as magnetic monopoles, cosmic strings, and their composite structures arise naturally in various GUTs through symmetry-breaking phase transitions in the early Universe. I will discuss the formation of string and its various composite structures in SO(10) GUTs. We will discuss the realizations of 'metastable' strings (MSS), 'quasistable' strings (QSS), and 'walls bounded by strings' (WBS) in SO(10) GUTs. We will explore the stochastic gravitational wave background emitted from such networks of composite structures. The gravitational waves emitted from MSS, QSS and WBS with superheavy (GUT scale) strings can explain the recent exciting evidence of the stochastic gravitational waves in the NANOGrav and other pulsar timing array data.

Presenter: MAJI, Rinku (IBS CTPU-CGA)

Session Classification: Plenary

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

Real-time analysis of vacuum decay in curved spacetime

Wednesday, 9 July 2025 10:00 (30 minutes)

The phase transition of a false vacuum due to a first-order phase transition has been studied by analysis using Euclidean time conventionally. Such analysis has also been performed for curved spacetimes, and a certain thermodynamic interpretation has been given to phase transitions in de Sitter spacetimes and spacetimes containing black holes. In this talk, I will distinguish myself from such studies by presenting an analysis using Lorentz time, and will discuss how the same problem can be interpreted.

Presenter: YOKOYAMA, Jun'ichi (IPMU)

Session Classification: Plenary

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

Early Dark Energy Models and Cosmological Tensions

Wednesday, 9 July 2025 14:00 (30 minutes)

Observational data, such as the Hubble constant (H0) and cosmic birefringence, challenge the ΛCDM model. The Hubble tension indicates differing expansion rates between CMB measurements and direct observations of supernovae/Cepheid variables. Cosmic birefringence causes rotation in the CMB polarization plane. We briefly review on the Early Dark Energy Models (EDE) and explain known results that the Ultralight Axion-like model with n=3 alleviates Hubble tension but does not fit CMB EB mode observations satisfactorily. We reanalyse and emphasize our notice that the CMB EB angular power spectrum's shape is sensitive to cosmological parameters, which leads to the conclusion that the axion-like EDE model with n=3 aligns well with both cosmic birefringence and Hubble tension.

Presenter: LEE, Bum-Hoon

Session Classification: Plenary

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

Sommerfeld effect and unitarity

Wednesday, 9 July 2025 14:30 (30 minutes)

The annihilation cross section of dark matter has an important role in dark matter phenomenology. If dark matter couples to a light force mediator, the exchange of the mediator non-perturbatively distorts the wave function of the dark matter from the plane wave. This effect significantly modifies the annihilation cross section .This effect is called as the Sommerfeld effect. In this talk, I will talk about how the annihilation cross section with Sommerfeld effect is calculated from Schroedinger equation. Our method is consistent with the partial wave unitarity bound and it can be applied to s-wave and higher-ell waves.

Presenter: SATO, Ryosuke (Osaka U)

Session Classification: Plenary

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

(ZOOM) Electroweak phase transition and cosmological magnetic field from a symmetry perspective

Wednesday, 9 July 2025 15:00 (30 minutes)

On the one hand, it is known that the electroweak symmetry breaking (EWSB) in the Standard Model (SM) is a crossover. On the other hand, in the last decade, the notion of the symmetry has been greatly generalized by recognizing that the symmetry is equivalent to the presence of the topological operators. This enables us to discover new symmetries in the SM. After reviewing how these new symmetries are consistent with quantum gravity, we argue the status of the EWSB taking into account the generalized symmetry. The cosmological magnetic fields can be viewed as the consequence of the spontaneously broken magnetic symmetry. We also present a computation of the mixing angle during the EWSB in a gauge-invariant way.

Presenter: HAMADA, Yuta (KEK)

Session Classification: Plenary

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

The SABRE South Experiment at the Stawell Underground Physics Laboratory

Wednesday, 9 July 2025 15:30 (30 minutes)

SABRE is an international collaboration that will operate similar particle detectors in the Northern (SABRE North) and Southern Hemispheres (SABRE South). This innovative approach aims to distinguish potential dark matter signals from seasonal backgrounds: a pioneering strategy only feasible with a Southern Hemisphere experiment. SABRE South is located at the Stawell Underground Physics Laboratory (SUPL), in regional Victoria, Australia.
SUPL is a newly constructed facility situated 1024 metres underground (~2900 metres water equivalent) within the Stawell Gold Mine. Its construction was completed in late 2023 and is the first of its kind in the Southern Hemisphere.
SABRE South employs ultra-high purity NaI(Tl) crystals immersed in a linear alkyl benzene (LAB)-based liquid scintillator veto, surrounded by passive steel and polyethylene shielding, and topped with a plastic scintillator muon veto.
Significant progress has been made in the procurement, testing, and preparation of equipment for the installation of SABRE South. The assembly of the experiment at SUPL will take place throughout 2025. The SABRE South muon detector and data acquisition systems are already operational and actively collecting data at SUPL, and full commissioning of SABRE South is planned for the first quarter of 2026.
This presentation will provide an update on the overall progress of the SABRE South construction, its anticipated performance, and its potential physics reach.

Presenter: URQUIJO, Phillip (U of Melbourne)

Session Classification: Plenary

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

More fields are different: Stochastic view of multi-field inflationary scenario

Thursday, 10 July 2025 09:00 (30 minutes)

High-energy physics often motivates multi-field inflationary scenarios where stochastic effects play a crucial role. Peculiar to multi-field models, the noise-induced centrifugal force results in a longer duration of inflation depending on the number of fields, even when the stochastic noises themselves are small. We show that, in such small-noise regimes, the number of fields generically discriminates whether inflation successfully terminates or lasts forever. Our results indicate that inflation with an extremely large number of fields may fail to realise our observable Universe.

Presenter: TAKAHASHI, Tomo (Saga U)

Session Classification: Plenary

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

Resolving the neutrino mass and DESI BAO tensions with neutrino chemical potential

Thursday, 10 July 2025 09:30 (30 minutes)

The standard Planck ΛCDM model is well known to encounter several tensions when confronted with various cosmological data, including the neutrino mass and the DESI BAO tensions. The former tension refers to the neutrino mass constraint from CMB fitting being substantially below the lower bound from neutrino oscillation experiments. In the latter, the BAO scales measured by DESI disagree significantly with the Planck ΛCDM prediction at redshifts below 1. To resolve these tensions, we examine a simple and natural extension of the standard ΛCDM model, which allows relic neutrinos to have finite chemical potentials. We confront this ΛCDMξ model, ΛCDM with neutrino mass Mν and degeneracy ξ3 as additional parameters, with various cosmological datasets. Fitting the ΛCDMξ model to the CMB temperature data, we find 3σ evidence for nonzero neutrino mass (Mν = 0.57 + 0.17 − 0.13 eV) and degeneracy (ξ3 = 1.13 + 0.41 − 0.19), and the O(1) neutrino degeneracy parameter is compatible with galaxy pairwise velocity and Big Bang Nucleosynthesis (BBN) data. Furthermore, the recent DESI BAO data strongly prefer the ΛCDMξ model to the Planck ΛCDM model.

Presenter: CHU, Ming-Chung (CUHK)

Session Classification: Plenary

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

Metric-Affine Theories of Gravity: From theory to new possible effects

Thursday, 10 July 2025 10:00 (30 minutes)

General Relativity is based on Riemannian geometry, where gravity is solely represented by the metric degrees of freedom. This framework can be generalized by introducing torsion and non-metricity into the underlying geometry. In this talk, I will describe how to construct such theories and how these geometrical quantities might lead to new effects on astrophysical and cosmological scales. I will show that the gauge approach to gravity can be formulated without known ghost instabilities by including cubic interactions, and I will present novel effects that this theory might exhibit.

Presenter: BAHAMONDE, Sebastian (IPMU)

Session Classification: Plenary

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

Are we entering a new era of modern cosmology?

Thursday, 10 July 2025 14:00 (30 minutes)

Recently, a 3~4σ preference for dynamical dark energy has been reported by the Dark Energy Spectroscopic Instrument (DESI) collaboration, which has inspired hot debates on new physics or systematics. In this letter, we reveal that this preference is significantly biased by an external low-redshift supernova (low-z SN) sample, which was combined with the Dark Energy Survey SN program (DES-SN) in their Year-Five data release (DESY5). Using the intercept in the SN magnitude-distance relation as a diagnostic for systematics, we find not only large dispersions but also a large discrepancy in the low-zSN sample when compared to the high-z DES-SN sample within the single DESY5 compilation. Correcting for this low-zsystematics with or without including the cosmic microwave background data can largely reduce the preference for dynamical DE to be less than 2σ. Therefore, the DESI preference for dynamical DE is biased by some unknown systematics in the low-z SN sample.

Presenter: CAI, Rong-Gen (ITP/Ningbo)

Session Classification: Plenary

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

Is a stable anisotropic inflation viable?

Thursday, 10 July 2025 14:30 (30 minutes)

Recently, the cosmological principle, an underlying assumption of modern cosmology, has been questioned extensively due to the emergence of observational anomalies associated with not only an early phase but also a late-time phase of our observable universe. Consequently, a stable anisotropic inflation seems to be a reasonable mechanism for connecting an early anisotropic inflationary phase to a late-time cosmic acceleration phase of the universe. More interestingly, it will be shown in this talk that such anisotropic inflation could be cosmologically viable in the light of Planck 2018 data, provided a suitable setup of fields

Presenter: DO, Tuan Quoc (Phenikaa U)

Session Classification: Plenary

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

Reconstructing Dark Energy

Thursday, 10 July 2025 15:00 (30 minutes)

Reconstructing the expansion history of the universe and the properties of dark energy have been among the main goals of physical cosmology. I will discuss reconstructing dark energy in light of the most recent cosmological observations, including DESI-2025 BAO observations, various supernova compilations, and Planck CMB data. I will also discuss some theoretical implications of the parametric and non-parametric reconstructions.

Presenter: SHAFIELOO, Arman (KASI)

Session Classification: Plenary

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

(ZOOM) Disentangling Modified Gravity and Massive Neutrinos with Intrinsic Shape Alignments of Massive Halos

Thursday, 10 July 2025 15:30 (30 minutes)

Presenter: LEE, Jounghun (SNU)

Session Classification: Plenary

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

Strong First-Order Electroweak Phase Transition in the Type-I two-Higgs doublet model via multi-step transitions

Tuesday, 8 July 2025 11:10 (20 minutes)

We investigate strong first-order electroweak phase transitions in the Type-I two-Higgs-doublet model's inverted Higgs scenario (where the 125 Giga-electron Volt Higgs boson is the heavier CP-even scalar), motivated by its potential for electroweak baryogenesis. A comprehensive parameter scan, incorporating current theoretical and experimental constraints (including flavor, Higgs, and electroweak data), identifies physically viable regions. We analyze the characteristics of single and multi-step strong phase transitions using computational tools like BSMPT. Crucially, the known correlation between the vacuum uplifting measure and phase transition strength found in single-step transitions vanishes for multi-step pathways in this scenario. We characterize distinct phenomenological features (such as Higgs masses and mixing parameters) of points enabling strong transitions, noting their dependence on the specific transition history. Associated gravitational waves, predominantly sourced by sound waves, are evaluated for detection by future interferometers like LISA.

Presenter: SONG, Jeonghyeon (Konkuk U)

Session Classification: Parallel 1

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

WIMP and FIMP Dark Matter in Singlet-Triplet Fermionic Model

Tuesday, 8 July 2025 11:30 (20 minutes)

We present an extension of the SM involving three triplet fermions, one triplet scalar and one singlet fermion, which can explain both neutrino masses and dark matter. One triplet of fermions and the singlet are odd under a symmetry, thus the model features two possible dark matter candidates. The two remaining even triplet fermions can reproduce the neutrino masses and oscillation parameters consistent with observations. We consider the case where the singlet has feeble couplings while the triplet is weakly interacting and investigate the different possibilities for reproducing the observed dark matter relic density. This includes production of the triplet WIMP from freeze-out and from decay of the singlet, as well as freeze-in production of the singlet from decay of particles that belong to the thermal bath or are thermally decoupled. While freeze-in production is usually dominated by decay processes, we also show cases where the annihilation of bath particles gives a substantial contribution to the final relic density. This occurs when the new scalars are below the TeV scale, thus in the reach of the LHC. The next-to-lightest odd particle can be long-lived and can alter the successful BBN predictions for the abundance of light elements, these constraints are relevant in both the scenarios where the singlet or the triplet are the long-lived particle. In the case where the triplet is the DM, the model is subject to constraints from ongoing direct, indirect and collider experiments. When the singlet is the DM, the triplet, which is the next-to-lightest odd particle, can be long-lived and can be probed at the proposed MATHUSLA detector.

Presenter: ROY, Abhishek (CQUeST)

Session Classification: Parallel 1

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

Oscillon decay accelerated by coupling external scalar field

Tuesday, 8 July 2025 11:50 (20 minutes)

Oscillons are long-lived, spherically symmetric solitons that can arise in real scalar field theories with potentials shallower than quadratic. They are considered to form via parametric resonance during the preheating stage after inflation and serve as localized storagies of the inflaton field's energy. Due to their extended lifetimes, oscillons may play a significant role in the early universe, particularly during the reheating phase. However, estimating their lifespan is complicated by the interactions of the inflaton field with other fields, which is natural in realistic reheating scenarios. In this study, we investigate how a coupled external real scalar field affects the decay and lifespan of an individual oscillon. By numerically computing the instability bands of the external field with the inhomogeneous oscillon profile as background, we show that the resonance behavior depends intricately on the shape of the oscillon profile. Different instability mechanisms can dominate in different ranges of the coupling strength. Especially, as the oscillon loses energy, the exponential growth of the external field may cease before the oscillon reaches its critical energy for collapse. Furthermore, our simulations indicate that though energy can be efficiently extracted from the oscillon through coupling to the external field, this does not necessarily lead to its destruction even under strong coupling or large amplitudes of the external field. These results suggest that oscillons can remain long-lived across a wide range of coupling strengths, with potential implications for their role in cosmological evolution.

Presenter: LI, Siyao (IBS CTPU-CGA)

Session Classification: Parallel 1

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

Second leptogenesis for large baryon-lepton asymmetry discrepancy

Tuesday, 8 July 2025 12:10 (20 minutes)

We study a novel leptogenesis scenario with the temperature-dependent mass of heavy Majorana neutrino by the wave dark matter to explain the matter-antimatter asymmetry of the Universe. The leptogenesis happens twice in this scenario: the first leptogenesis occurs above the electroweak scale, while the second leptogenesis occurs below it. The sphaleron process converts the lepton asymmetry to the baryon asymmetry during the first leptogenesis, but not for the second leptogenesis due to the sphaleron decoupling at the electroweak scale. This mechanism potentially explains the significant discrepancy between baryon and lepton asymmetries, which is recently reported by EMPRESS. This talk is based on JHEP 03 (2024) 003 and PRD 111, 055026 (2025).

Presenter: KIM, Yechan (KAIST)

Session Classification: Parallel 1

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

Cooling the Shock: New Supernova Constraints on Dark Photons

Tuesday, 8 July 2025 11:10 (20 minutes)

During the accretion phase of a core-collapse supernova (SN), dark-photon (DP) cooling can be largest in the gain layer below the stalled shock wave. In this way, it could counteract the usual shock rejuvenation by neutrino energy deposition and thus prevent the explosion. This peculiar energy-loss profile derives from the resonant nature of DP production. The largest cooling and thus strongest constraints obtain for DP masses of 0.1–0.4 MeV, a range corresponding to the photon plasma mass in the gain region. Electron-capture supernovae, once observationally unambiguously identified, could provide strong bounds even down to nearly 0.01 MeV. For a coupling strength so small that neutrino-driven explosions are expected to survive, the DP cooling of the core is too small to modify the neutrino signal, i.e., our new argument supersedes the traditional SN1987A cooling bound.

Presenter: YUN, Seokhoon (IBS CTPU-PTC)

Session Classification: Parallel 2

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

The Neutron Capture Process Low-Mass Dark Matter Experiments

Tuesday, 8 July 2025 11:30 (20 minutes)

Many low-mass dark matter experiments focus on highly segmented detectors with low particle detection thresholds. For these situations in particular, the neutron capture process is important to consider for direct low-energy calibrations and a possible background source. I will summarize the effect of this process on dark matter searches, specifically focusing on the SuperCDMS collaboration and collaborations with similar detector setups.

Presenter: VILLANO, Anthony (U of Colorado, Denver)

Session Classification: Parallel 2

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

Probing Terrestrial Relic Neutrino Charge with Mach-Zehnder Interferometer

Tuesday, 8 July 2025 11:50 (20 minutes)

We propose a novel mechanism to detect terrestrial cosmic neutrino background's (CNB) limit of electric charge by employing Mach-Zehnder interferometer with asymmetrical arm placement – one at the Earth's surface and the other is placed underground. Assuming that relic neutrinos possess a small but nonzero charge, their coherent forward scattering with photons induces measurable phase shift in a laser beam. From the terrestrial CNB overdensity resulting from weak interaction induced by neutrino-antineutrino asymmetry near the surface of the earth, we formulate the quantum interaction Hamiltonian and analyze the induced phase shift under realistic interferometric constraints. The projected sensitivity reaches of our setup are evaluated under three operation regimes: the standard quantum limit (SQL), the Heisenberg limit, and the super-Heisenberg limit. For neutrino masses mν = 0.05 eV, our scheme can probe fractional electric charges εν as small as 9.3×10−11, 1.6×10−16, and 2.9×10−22, respectively. The proposed interferometric strategy surpasses existing laboratory bounds and even astrophysical constraints when operating in the Heisenberg or super-Heisenberg mode.

Presenter: OTERO, Vincent Gene (National Taiwan Normal U)

Session Classification: Parallel 2

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

Some studies on dark matter self-interaction

Tuesday, 8 July 2025 12:10 (20 minutes)

In this talk I will briefly introduce some previous researches I have gone through on the topic of self-interacting dark matter (SIDM). For particle aspect, I will review the inclusion of SIDM, the enhancement of potential DM accumulating in the core of stellar objects and its potential observations. For astrophysical aspect, I will introduce the properties of exotic stellar objects constituted by SIDM, and their gravitational signals. Finally, we show the Bondi accretion around a spherical symmetric compact objects (could be a black hole or a dark star) if it is surrounded by SIDM.

Presenter: CHEN, Chian-Shu (Tamkang U)

Session Classification: Parallel 2

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

Microscopic Theory for DM from Topological Gravity

Tuesday, 8 July 2025 16:40 (20 minutes)

From topological supergravity, we have found that the action for gravitino contains a coupling between the gravitino and a scalar field. By analogy with the Yukawa coupling, we integrate out the gravitino to obtain an effective action for this scalar field, which may furnish a potential microscopic theory for scalar dark matter.

Presenter: DENG, Jianqiao (CUHK)

Session Classification: Parallel 1

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

Impact of light sterile neutrinos on cosmic structure formation

Sterile neutrinos with masses on the eV scale are promising candidates to account for the origin of neutrino mass and the reactor neutrino anomalies. The mixing between sterile and active neutrinos in the early universe could result in a large abundance of relic sterile neutrinos, which depends on not only their physical mass $m_{\rm phy}$ but also their degree of thermalization, characterized by the extra effective number of relativistic degrees of freedom $\Delta N_{\rm eff}$. Using neutrino-involved N-body simulations, we investigate the effects of sterile neutrinos on the matter power spectrum, halo pairwise velocity, and halo mass and velocity functions. We find that the presence of sterile neutrinos suppress the matter power spectrum and halo mass and velocity functions, but enhance the halo pairwise velocity. We also provide fitting formulae to quantify these effects.

Presenter: HU, Rui (CUHK)

Session Classification: Parallel 1

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

Void spin distribution as a powerful probe of σ8

Tuesday, 8 July 2025 17:40 (20 minutes)

We present a numerical proof of the concept that the void spin distributions can provide a tight constraint on the amplitude of matter density fluctuation on the scaleof 8 h inverse Mpc (σ8) without being severely deteriorated by the degeneracies of σ8 with cold dark matter density parameter multiplied by the dimensionless Hubble parameter square (Ωcdmh^2), total neutrino mass (Mν) and dark energy equation of state (w). Applying the Void-Finder algorithm to a total of 15 AbacusSummit N-body simulations of 15 different cosmological models , we identify the giant voids and measure the magnitudes of rescaled specific angular momenta of point-like void halos as their spins. The 15 cosmologies include the Planck ΛCDM and 14 non-Planck models, each of which differs among one another only in one of {σ8, Ωcdmh^2, Mν, w}. We determine the probability density distribution of void spins for each model and for the first time find it to be well approximated by the generalized Gamma distribution with two characteristic parameters, k and θ. It turns out that the best-fit values of k and θ exhibit very sensitive dependence only on σ8, being almost insensitive to Ωcdmh^2, Mν and w. This exclusive σ8-dependence of the void spin distributions is confirmed to be robust against the variation of the mass and number cuts of void halos. We also test an observational feasibility of estimating the void spins from real data on the galaxy redshifts.

Presenter: KANG, Geonwoo (SNU)

Session Classification: Parallel 1

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

Evading the Current Direct Detection Bound through Metastable Particle-Assisted Freeze-Out

Tuesday, 8 July 2025 17:00 (20 minutes)

In this work, we have explored the conversion-driven freeze-out scenario, where the next-to-lightest stable particle (NLSP) sets the dark matter (DM) abundance through
the process "NLSP SM $\leftrightarrow$ DM SM". Although DM is produced via
freeze-out mechanism, its interaction strength with the visible sector can
range from weak-scale to feeble-scale couplings. This leads to a vast,
largely unexplored parameter space that remains beyond the reach of current
direct, indirect, and collider searches with possibility of detection
in near future.
We have studied this mechanism in the context of an alternative $U(1)_{B-L}$ model, where four chiral fermions are required to cancel gauge anomalies, in contrast to the usual case with three right-handed neutrinos. The observed relic abundance,
as measured by Planck, is successfully reproduced within this framework. The viable parameter space can be probed by future direct detection experiments,
while remaining inaccessible to indirect searches in near future.
Our results show that the DM relic density is highly sensitive to both the NLSP's interaction strength with the visible sector and the mass difference between the NLSP and DM but not on the DM interaction strength with the visible sector.
When the NLSP decays to DM via a two-body process involving an extra gauge boson,
the decay can be long-lived, outside the CMS or ATLAS detector at LHC.
In contrast, if the NLSP decays via a CP-odd Higgs, it decays promptly inside the detector.
We have investigated the prospects for detecting such long-lived NLSP signatures
at the proposed MATHUSLA detector, with similar conclusions applying to the ongoing FASER experiment. Finally, we find that choosing arbitrarily small values for the
gauge coupling and the BSM fermionic mixing angle can violate successful BBN predictions.

Presenter: KHAN, Sarif (CAU)

Session Classification: Parallel 1

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

Dark gauge-mediated supersymmetry breaking

Tuesday, 8 July 2025 17:20 (20 minutes)

We investigate dark gauge-mediated supersymmetry breaking with an unbroken U(1) gauge symmetry and a massless dark photon. Messengers charged under both Standard Model and dark gauge groups generate new soft SUSY-breaking terms via gauge kinetic mixing. Large mixing significantly alters superpartner spectra compared to standard GMSB, reduces the μ parameter, and predicts a relatively light Higgsino detectable at the LHC. Simple messenger scenarios yield a very light bino-dark photino state observable in exotic Higgs decays at future colliders. The cosmological and phenomenological effects of stable, fractionally charged messenger states are also explored.

Presenter: LEE, Jiheon (KAIST)

Session Classification: Parallel 1

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

Nailing down the theoretical uncertainties of $\bar{D}$ spectrum produced from dark matter

Tuesday, 8 July 2025 16:40 (20 minutes)

The detection of cosmic antideuterons at kinetic energies below a few GeV/n could provide a smoking gun signature for dark matter (DM). However, the theoretical uncertainties arising from the choice of coalescence models were so far one of the main limiting factors for precise predictions of the $\overline{\mathrm{D}}$ flux. In this talk, we present a novel calculation of the $\overline{\mathrm{D}}$ source spectra, based on the Wigner formalism, for which the Argonne wave function has been used. A remarkable feature of this formalism is that it excellently agree with the ALEPH measurement of $\overline{\mathrm{D}}$ although it does not contain any free parameters. The analysis is based on state-of-art tools for Monte Carlo event generation including full spin correlations, off-shell effects, and all the electroweak and Higgs triple and quartic interactions in the showering process. The theoretical uncertainties due to the choice of the coalescence model is of order of a few percent for $\overline{\mathrm{D}}$ kinetic energies relevant to DM searches with GAPS and AMS, and for DM masses above a few tens of GeV. We provide the tabulated source spectra for all the relevant DM annihilation/decay channels and DM masses between 5 GeV and 100 TeV, on this GitHub repository: https://github.com/ajueid/CosmiXs.git.
Based on:
https://arxiv.org/abs/2411.04815
https://arxiv.org/abs/2312.01153

Presenter: JUEID, Adil (IBS CTPU-PTC)

Session Classification: Parallel 2

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

Dynamical friction for circular orbits in self-interacting ultralight dark matter and Fornax globular clusters

Tuesday, 8 July 2025 17:00 (20 minutes)

We investigate the impact of repulsive self-interaction in ultralight dark matter (ULDM) on dynamical friction in circular orbits in ULDM halos and its implications for the Fornax dwarf spheroidal (dSph) galaxy's globular clusters. Using the Gross-Pitaevskii-Poisson equations, we derive the dynamical friction force considering soliton density profiles for both non-interacting and strongly self-interacting ULDM. Our results show that self-interactions reduce the dynamical friction effect further than both the non-interacting ULDM and standard cold dark matter models. Furthermore, we derive the low Mach number approximation to simplify the analysis in the subsonic motion, where the tangential component of dynamical friction dominates. Applying these findings to the Fornax dSph, we calculate the infall timescales of globular clusters, demonstrating that strong self-interaction can address the timing problem more effectively. We constrain the parameter space for ULDM particle mass and self-coupling constant, which are consistent with other constraints from astronomical and cosmological observations.

Presenter: KOO, Hyeonmo (U of Seoul)

Session Classification: Parallel 2

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

Can white dwarfs be powered by self-annihilating dark matter?

Tuesday, 8 July 2025 17:20 (20 minutes)

White dwarfs (WDs) are compact remnants of stars, supported by electron degeneracy pressure, and their structures are generally considered to be well understood. However, there are notable discrepancies between the observed mass-radius (MR) relationship of WDs and the predicted values. We explore the possibility that WDs could serve as a portal to dark matter (DM) physics by investigating the effects of admixing self-annihilating dark matter (SADM) into WDs. Our findings suggest that some of the observed peculiar WDs can be explained even if SADM constitutes less than 1% of the WD's total mass, with a self-annihilation cross-section $\langle \sigma v \rangle$ that is much smaller than the thermal relic cross-section.

Presenter: CHU, Cheuk Nam (CUHK)

Session Classification: Parallel 2

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

Holographic Correlators of Boundary/Crosscap CFTs in Two Dimensions

Thursday, 10 July 2025 12:10 (20 minutes)

This work explores holographic correlators within the frameworks of two-dimensional Boundary Conformal Field Theory (BCFT) and Crosscap Conformal Field Theory (XCFT). Utilizing the AdS/CFT correspondence, we compute stress tensor correlators in BCFT, considering both tensionless and tensionful end-of-the-world (EOW) brane scenarios. We derive recurrence relations for two-point and three-point correlators and examine the impact of non-zero brane tension on correlators. Extending these results, we investigate the holographic duals of XCFTs, presenting explicit scalar and stress tensor correlator computations on projective geometries such as RP2. Additionally, we analyze stress tensor correlators at a finite cutoff, uncovering deformations to one-point and two-point functions induced by the cutoff. Our findings provide novel insights into the holographic structures of BCFT and XCFT while laying the groundwork for future research into higher-dimensional extensions.

Presenter: HE, Song (Ningbo U)

Session Classification: Parallel 2

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

The holographic TT¯bar deformation of the entanglement entropy in (A)dS/CFT

Tuesday, 8 July 2025 18:00 (20 minutes)

In recent years, the holographic duality between $T\bar{T}$-deformed conformal field theory (CFT) and Anti-de Sitter (AdS) spacetime with finite radial cutoff has received significant attention. The study of $T\bar{T}$ deformation within the framework of de Sitter (dS)/CFT duality has also progressed. In this talk, we generalize the replica method in both AdS and dS holography to derive a general expression for the entanglement entropy of arbitrary single spatial intervals within the $T\bar{T}$-deformed framework. Especially, in dS/dS holography and half-dS holography, we find that the dual field theory exhibits non-locality by analyzing the strong subadditivity and boosted strong subadditivity of entanglement entropy.

Presenter: CHANG, Jing-Cheng (Lanzhou U)

Session Classification: Parallel 2

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

A Match Made in Heaven: Linking Observables in Inflationary Cosmology

Wednesday, 9 July 2025 11:10 (20 minutes)

Cosmological correlation functions are fundamental observables in early universe cosmology and offer a remarkable window into the fundamental laws that governed the Universe's earliest moments. In this talk, the speaker will derive a correlator-to-correlator factorisation formula under mild assumptions, establishing a profound relationship between different observables in the context of primordial cosmology. As a concrete example, he will show that, in the minimal model of inflation that violates parity through a gravitational Chern-Simons term, the resulting parity-odd curvature trispectrum is a simple "double copy"of curvature–graviton mixed bispectra. This provides the first explicit example of a cosmological cutting rule that can be directly tested by future observations.

Presenter: ZHU, Yuhang (IBS CTPU-CGA)

Session Classification: Parallel 1

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

Open system EFT for gauge fields and gravity

Wednesday, 9 July 2025 11:30 (20 minutes)

I will discuss how to construct an open systems EFT for gauge fields and gravity based on recent developments in Schwinger-Keldysh EFTs. I will then apply the EFT to two representative examples: Maxwell theory and inflation.

Presenter: CHRISTODOULIDIS, Perseas (Ewha Womans U)

Session Classification: Parallel 1

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

Regularized pole inflation and Einstein-Cartan gravity

Wednesday, 9 July 2025 11:50 (20 minutes)

The latest observation from ACT on the scalar spectral index n_s on the cosmic microwave background (CMB) favors a larger value than previous results. To account for this, we propose a class of inflation models, dubbed regularized pole inflation, with a regularized second order pole in the kinetic term of the inflaton which can increase n_s and fit the new data. The regularized pole inflation also exhibits attractor behavior as long as the regulator is small. Such kind of kinetic structure can be naturally realized in the Einstein-Cartan framework.

Presenter: HE, Minxi (IBS CTPU-PTC)

Session Classification: Parallel 1

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

Bimodal distributions in the stochastic-δN formalism with the inflaton and the curvaton

Wednesday, 9 July 2025 12:10 (20 minutes)

The stochastic formalism is an effective theory of long-wavelength modes that incorporates probabilistic noise from short-wavelength modes as they exit the horizon. This is expected to have non-perturbative properties, particularly useful in the context of primordial black hole (PBH) formation. Indeed, PBHs are formed from large perturbations exceeding a threshold when they reenter the horizon.

In this presentation, I will review the stochastic delta-N formalism allowing us to calculate curvature perturbations and demonstrate the application of this formalism to the case with the presence of a curvaton. I will demonstrate bimodal distributions of curvature perturbations, whose peaks correspond to each reheating scenario of the curvaton since the stochastic delta-N formalism is supposed to behave non-perturbative and distributions have certain width. Finally, the possibilities of PBH formation in this scenario will be mentioned.

Presenter: KURODA, Tomotaka (IBS CTPU-CGA)

Session Classification: Parallel 1

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

Peaks sphericity of non-Gaussian random fields

Wednesday, 9 July 2025 11:50 (20 minutes)

We formulate the statistics of peaks of non-Gaussian random fields and implement it to study the sphericity of peaks. For non-Gaussianity of the local type, we present a general formalism valid regardless of how large the deviation from Gaussian statistics is. For general types of non-Gaussianity, we provide a framework that applies to any system with a given power spectrum and the corresponding bispectrum in the regime in which contributions from higher-order correlators can be neglected. We present an explicit expression for the most probable values of the sphericity parameters, including the effect of non-Gaussianity on the profile. We show that the effects of small perturbative non-Gaussianity on the sphericity parameters are negligible, as they are even smaller than the subleading Gaussian corrections. In contrast, we find that large non-Gaussianity can significantly distort the peak configurations, making them much less spherical.

Presenter: UWABO-NIIBO, Michiru (IBS CTPU-CGA)

Session Classification: Parallel 2

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

Primordial Black Hole Reformation in the Early Universe

Wednesday, 9 July 2025 11:30 (20 minutes)

Light primordial black holes (PBHs) can be formed in a variety of scenarios from inflationary scenarios to first order phase transitions. Extremely light PBHs with masses M<10^8 g evaporate before the era of BBN, leaving behind little trace of their existence except for gravitational waves. We show that if these PBHs are produced in high enough abundances to initiate an early matter-dominated era, then the growth of PBH perturbations during this phase is enough to trigger a secondary collapse into larger PBHs. These heavier reformed PBHs have extended lifetimes and can produce observable signals in the present, such as high energy gamma rays along with a coincident gravitational wave background.

Presenter: LU, Philip (KIAS)

Session Classification: Parallel 2

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

Memory Burden Effects and New Mass Ranges of Primordial Black Hole Dark Matter

Wednesday, 9 July 2025 11:10 (20 minutes)

I report the latest results of our group for the new mass ranges of primordial black hole to be dark matter if we seriously consider the memory burden effect.

Presenter: KOHRI, Kazunori (NAOJ)

Session Classification: Parallel 2

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

Schwinger pair production in global (anti-)de Sitter spacetimes

Wednesday, 9 July 2025 12:10 (20 minutes)

We study the spontaneous emission of spin-1/2 fermions in a uniform electric field in the global coordinates of two-dimensional (anti-)de Sitter space. The production of fermion pairs is enhanced in de Sitter (dS) space. However, it is reduced in anti-de Sitter (AdS) in which weak electric fields below the BF bound prohibits pair production. We discover a reciprocal relation between the mean number of fermions in dS space and AdS space provided that the spacetime curvature is analytically continued.

Presenter: CHEN, Chiang-Mei (NCU)

Session Classification: Parallel 2

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

empty

empty

Session Classification: Parallel 2

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

Signatures of Primordial Gravitational Waves on the Large-Scale Structure of the Universe

Wednesday, 9 July 2025 17:00 (20 minutes)

Primordial gravitational waves (GWs), beyond their direct detection prospects, can induce second-order scalar perturbations. These tensor-induced scalar modes evolve similarly to standard matter perturbations and leave distinct imprints on the large-scale structure (LSS). In this talk, I will present a detailed study of these effects, including analytical results for the evolution of induced density contrasts across radiation- and matter-dominated eras, and the role of GWs energy density fluctuations as a source. I will also discuss how the resulting non-Gaussianity reflects the nature of the primordial GWs spectrum, ranging from scale-invariant to sharply peaked models. These findings suggest novel observational avenues to probe primordial GWs using galaxy surveys and LSS data, opening a complementary window to the early Universe beyond traditional GWs detectors.

Presenter: BARI, Pritha (IBS CTPU-CGA)

Session Classification: Parallel 2

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

Primordial Gravitational Waves from Phase Transitions During Reheating

Wednesday, 9 July 2025 17:20 (20 minutes)

We study primordial gravitational waves (GWs) generated from first-order phase transitions (PTs) during cosmic reheating. Using a minimal particle physics model, and a general parametrization of the inflaton energy density and the evolution of the Standard Model temperature, we explore the conditions under which PTs occur and determine the corresponding PT parameters (the PT temperature, duration and strength), which depend on the evolution of the background during reheating. We find that, in certain cosmological scenarios, PTs can be delayed and prolonged compared to the standard post-inflationary evolution. Incorporating these PT parameters, we compute the resulting GW spectrum generated from the various processes occurring during a first-order PT: bubble collisions, sound waves, and magneto-hydrodynamic turbulence. We find that, in comparison to the standard cosmological history, the GW amplitude and peak frequency can be modified by several orders of magnitude due to the additional enhancement or suppression arising from the cosmological evolution during reheating. In particular, the GW spectra could be within the reach of next-generation GW and CMB observatories.
(based on arXiv: 2506.02116)

Presenter: BANIK, Amitayus (CBNU)

Session Classification: Parallel 2

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

Can Horndeski Genesis be Nonpathological?

We present a minimal setup within the framework of Horndeski gravity that can describe a non-pathological Genesis scenario. Our setup allows for a fully stable transition to the kination epoch, during which General Relativity (GR) is restored. This Genesis scenario circumvents the no-go theorem at the cost of encountering the risk of strong coupling in the past. Interestingly, our scenario admits two different regimes for the background solution for Hubble parameter at the Genesis stage: power-law behavior and manifestly non-power-law behavior. We explicitly show that, in both regimes, our model remains within unitarity bounds. In most cases, the tensor spectrum is blue-tilted. Then, we adopt a mechanism with a spectator field that allows for a red-tilted scalar power spectrum. We also suggest a deformation of the model that enables us to achieve sufficiently small values for the r ratio. Finally, we discuss the geodesic (in)completeness of the current model.

Presenter: PETROV, Pavel (IBS CTPU-CGA)

Session Classification: Parallel 2

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

Gravitational-wave Extraction using Independent Component Analysis

Wednesday, 9 July 2025 16:40 (20 minutes)

Independent component analysis (ICA) is a method to extract a set of time-series data using "statistical independency" of each component. We applied ICA to extract gravitational wave (GW) signals directly from the detector data. Our idea is to extract a coherent signal that is included in multiple detectors and find it by shifting the data set around its arrival time. In this article, we report several tests using injected signals, and show that this method works for inspiral-wave events with a signal-to-noise ratio of > 15. We then applied the method to actual LIGO-Virgo-KAGRA O1-O3 events, and showed that the identification of the arrival time can be estimated more precisely than previously reported. This approach does not require templates of waveform, therefore it is attractive for testing theories of gravity, and for finding unknown GW.

Presenter: SHINKAI, Hisaaki (Osaka Institute of Technology)

Session Classification: Parallel 1

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

Detection of Gravitational Waves using Electromagnetic Waves beyond Geometrical Optics

Wednesday, 9 July 2025 17:00 (20 minutes)

Modern gravitational wave (GW) detectors primarily utilize electromagnetic waves (EMWs) in the geometric optics regime. Geometric optics is applicable when the wavelength of the EMWs is much shorter than the characteristic scale of spacetime curvature or variations in the medium. In this work, we explore the potential of using EMWs beyond the geometric optics regime for GW detection. To this end, we directly solve the perturbed Maxwell equations. Obtaining solutions requires appropriate boundary conditions. We propose suitable boundary conditions, formulated in terms of gauge-invariant quantities, to ensure experimental controllability. Decomposing a general electromagnetic (EM) field into phase and amplitude components is not straightforward. Therefore, we propose using the stress-energy tensor of the EM field as an observable physical quantity for perturbed EMWs. We derive the stress-energy tensor for the perturbed EM field from first principles and investigate its properties. Based on this, we present several scenarios in which such methods may be applied to GW detection.

Presenter: PARK, Chan (Henan Academy of Science)

Session Classification: Parallel 1

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

Binary strange quark star merger in fully general-relativistic simulation

Wednesday, 9 July 2025 17:20 (20 minutes)

Numerical simulations of strange quark stars (QSs) are challenging due to the strong density discontinuity at the stellar surface. This issue becomes even more problematic in merger scenarios, as any ejected strange matter droplets also exhibit discontinuous density surfaces. In this work, we perform general-relativistic simulations of binary QS merger and observe the formation of spiral arms in the post-merger phase, with densities comparable to the central densities of the stars. Such behavior has not been observed in previous QS merger simulations that employ a smooth density tail to handle the density discontinuity at the star surface. We also extract the emitted gravitational wave signals and compare with those from binary neutron star mergers.

Presenter: LUK, Ho Ching (CUHK)

Session Classification: Parallel 1

Contribution ID: **63** Type: **not specified**

Novel Polarization Modes of Gravitational Waves

Wednesday, 9 July 2025 17:40 (20 minutes)

In this talk, we present the discovery of two previously unrecognized gravitational wave polarization modes—namely, shear modes. We explore the polarization structure of gravitational waves in torsionless spacetimes with non-metricity, which constitute one of the most widely studied classes of non-Riemannian geometries. Since gravitational wave polarization modes are characterized by the relative motion of test particles, we begin by deriving the general form of the relative motion equations. Our analysis reveals that non-metricity can induce entirely new shear polarization modes when test particles carry hypermomentum, thereby extending the conventional classification of six standard polarization modes. After establishing this result from the perspective of particle dynamics, we proceed to examine the problem from the viewpoint of the field equations. We illustrate that certain modified gravity theories admit shear-mode gravitational waves as solutions to their field equations. In particular, we show that in general second-order symmetric teleparallel gravity theories, shear modes propagating at the speed of light necessarily emerge when test particles possess hypermomentum.

Presenter: DONG, Yu-Qi (Lanzhou U)

Session Classification: Parallel 1

Contribution ID: **64** Type: **not specified**

Black holes in nonlinear electrodynamics

Thursday, 10 July 2025 11:10 (20 minutes)

Black holes in the Einstein-Maxwell theory are Reissner-Nordstrom (RN) and Kerr-Newman (KN) black holes. In this talk black holes are studied in the nonlinear electrodynamics (NED) of Plebanski class of the Maxwell scalar and pseudo scalar. These NED black holes exhibit many interesting features and modify the photon propagation.

Presenter: KIM, Sang Pyo (Kunsan Nat'l U)

Session Classification: Parallel 1

Contribution ID: **65** Type: **not specified**

New results in bumblebee gravity

Thursday, 10 July 2025 11:30 (20 minutes)

Bumblebee gravity is currently a popular topic, and models are ubiquitus in the literature. In this talk, I will first review the current state of the art; then, I will describe a surprising connection between the bumblebee field and dark energy, as well as results from perturbation theory which rules out a large class of models.

Presenter: NILSSON, Nils Albin (IBS CTPU-CGA)

Session Classification: Parallel 1

Contribution ID: **66** Type: **not specified**

O(D,D) string cosmology from double field theory

Thursday, 10 July 2025 11:50 (20 minutes)

The low-energy limit of string theory contains additional gravitational degrees of freedom that are not present in general relativity. Together with the metric, these fields are naturally embedded in the O(D,D)-symmetric framework of double field theory (DFT). First I will explain how the O(D,D) symmetry uniquely prescribes the interactions between the extended gravitational sector and other matter, leading to novel features beyond conventional string cosmology. Then I will show how the generalized conservation laws modify the conditions for conservation of curvature perturbations. Finally, I will present some examples of analytic solutions, including candidate models for bouncing cosmologies.

Presenter: ANGUS, Stephen (Sogang U)

Session Classification: Parallel 1

Contribution ID: **67** Type: **not specified**

Black holes in string-inspired Euler-Heisenberg theory

Thursday, 10 July 2025 12:10 (20 minutes)

We consider higher-order derivative gauge-field corrections that arise in the fundamental context of dimensional reduction of string theory and Lovelock-inspired gravities and obtain an exact and asymptotically flat black-hole solution, in the presence of nontrivial dilaton configurations. Specifically, by considering the gravitational theory of Euler-Heisenberg nonlinear electrodynamics coupled to a dilaton field with specific coupling functions, we perform an extensive analysis of the characteristics of the black hole, including its geodesics for massive particles, the energy conditions, scalar quasi-normal modes, thermodynamical and stability analysis. The inclusion of a dilaton scalar potential in the action can also give rise to asymptotically (anti-)de Sitter spacetimes and an effective cosmological constant.

Presenter: NAKAS, Theodoros (IBS CTPU-CGA)

Session Classification: Parallel 1

Contribution ID: **68** Type: **not specified**

Quantum Gravity Meets DESI: Dynamical Dark Energy in Light of Swampland Trans-Planckian Censorship Conjecture

Thursday, 10 July 2025 11:10 (20 minutes)

As an implication from Quantum Gravity, the swamplandish Trans-Planckian Censorship Conjecture (TCC) prohibits eternal cosmological acceleration, a prediction that aligns naturally with the quintom-B behavior from the latest DESI DR2 data. Primarily, we implement TCC bounds within the framework of dynamical dark energy, especially in the w0waCDM parametrization and f(T), f(Q) modified gravities, demonstrating that TCC is very powerful to constrain or exclude them. Our findings imply that viable dynamical dark energy scenarios must asymptotically transit to deceleration, shedding light on new physics consistent with both cosmological observations and fundamental Quantum Gravity principles.

Presenter: WANG, Junkai (Tsinghua U)

Session Classification: Parallel 2

Contribution ID: **69** Type: **not specified**

Tightening dynamical dark energy constraints with galaxy alignments

Thursday, 10 July 2025 11:30 (20 minutes)

Recent 2σ–4σ deviations from the cosmological constant Λ suggest that dark energy (DE) may be dynamical, based on baryon acoustic oscillations and full-shape galaxy clustering analyses. This calls for even tighter DE constraints to narrow down its true nature. In this talk, I present how galaxy intrinsic alignments (IA) can enhance the full-shape galaxy clustering–based DE constraints, using Fisher forecasts on various extensions of dynamical DE models, including scenarios with curvature, massive neutrinos, and modified gravity. Incorporating IA improves the DE figure of merit by 42%–57% and tightens the primordial power spectrum amplitude constraints by 17%–19%. Our findings highlight IA's potential as a valuable cosmological probe complementary to galaxy clustering.

Presenter: SHIM, Junsup (Academia Sinica)

Session Classification: Parallel 2

Contribution ID: **70** Type: **not specified**

Can blue-tilted primordial power spectrum save the small scale crisis in MW? –From the perspective of Zoom-In simulation for MW host size dark matter halo

Thursday, 10 July 2025 11:50 (20 minutes)

Recent observations from the James Webb Space Telescope revealed a surprisingly large number of galaxies at high redshift, challenging the standard Lambda Cold Dark Matter cosmology with a power-law primordial power spectrum. Previous studies alleviated this tension with a blue tilted primordial power spectrum ($P(k) \propto k^{m_s}$ with $m_s > 1$ at small scales $> 1\ \mathrm{Mpc}^{-1}$). In this study, we examine whether the blue tilted model can boost dark matter substructures especially at low redshift, thereby addressing other potential challenges to the standard cosmology. First, substructures in the standard cosmological model may not be sufficient to explain the anomalous flux ratio problem observed in strong gravitational lensing. Second, the number of observed nearby satellite galaxies could be higher than the theoretical predictions of the standard cosmology, after completeness correction and tidal stripping by baryonic disks. To study the impact of a blue tilted primordial power spectrum on substructures, we perform high-resolution cosmological zoom-in dark matter-only simulations of Milky Way host size halos, evolving to redshift $z = 0$. At $z = 0$, we find that the blue-tilted subhalo mass functions can be enhanced by more than a factor of two for subhalo masses M_{sub}
$lesssim 10^{10}$
$msun$, whereas the subhalo V_{max} functions can be enhanced by a factor of four for maximum circular velocities V_{max}
$lesssim 30\ \mathrm{km/s}$. The blue-tilted scaled cumulative substructure fraction can be an order of magnitude higher at ∼10\% of the virial radius. The blue-tilted subhalos also have higher central densities, since the blue-tilted subhalos reach the same V_{max} at a smaller distance R_{max} from the center. We have also verified these findings with higher-resolution simulations. This work is based on the preprint https://arxiv.org/abs/2412.16072.

Presenter: WU, Jianhao (CUHK)

Session Classification: Parallel 2

Contribution ID: **71** Type: **not specified**

How a local structure impacts our understanding on fundamental physics

Tuesday, 8 July 2025 17:40 (20 minutes)

In current concordance cosmological model, Lambda-CDM model, we are facing serious cosmic tensions, such as Hubble tension, S_8 tension, dipole tension, etc. These problems challenge the basic assumption of cosmology, cosmological principle. In this talk, I will show how a local structure, a Gpc-scale void, impacts our understanding on Hubble tension, S_8 tension, and dipole tension, and a misinterpretation on cosmic tensions could mislead our understanding on fundamental physics. Meanwhile, if such a Gpc-scale void exists, the cosmological principle would be strongly broken. Then, we will combine recent DESI BAO result to reconstruct the density profile of this local structure to show its potential existence.

Presenter: DING, Qianhang (IBS CTPU-CGA)

Session Classification: Parallel 2

Contribution ID: **72** Type: **not specified**

De Sitter cosmological correlators via wormholes

Thursday, 10 July 2025 16:40 (20 minutes)

De sitter space may have its version of information problem. This may manifest as non-trivial behavior of correlation functions with spatial separation. We study one of wormhole contributions to the two-point function in the 2-dimensional JT gravity. We speculate on the nature of problem and resolution via wormholes.

Presenter: JUNG, Sunghoon (SNU)

Session Classification: Parallel 1

Contribution ID: **73** Type: **not specified**

Crunch from AdS bubble collapse in unbounded potentials

Thursday, 10 July 2025 17:00 (20 minutes)

I am going to talk about a scalar field theory with a Minkowski false vacuum and an unbounded (or very deep) true vacuum. We will see compelling evidence that an AdS bubble of vanishing total energy, embedded in asymptotically flat spacetime, generically undergoes a spherical collapse which leads to a space-like curvature singularity after the formation of trapped surfaces and apparent horizons. The crunch singularity, which is hidden behind an apparent horizon, occurs before the true vacuum is reached, and the existence of a lower bound of the scalar field potential is not a necessary condition for its formation.

Presenter: LOZANOV, Kaloian (APCTP)

Session Classification: Parallel 1

Contribution ID: **74** Type: **not specified**

Bound on Lyapunov exponent in Charged and Rotating AdS Black Hole

Thursday, 10 July 2025 17:20 (20 minutes)

We investigate the bound on chaos for a charged probe particle in charged, rotating, AdS black hole backgrounds, particularly in the Kerr–Newman–AdS and Kerr–Sen–AdS spacetimes. By analyzing the particle's radial dynamics near the local extremum of the effective potential, we compute the Lyapunov exponent and examine potential violations of the bound on chaos proposed by Maldacena, Shenker, and Stanford.

Presenter: LEE, Hocheol (Dongguk U)

Session Classification: Parallel 1

Contribution ID: **75** Type: **not specified**

Entropy created when colliding particles fall into a black hole

Thursday, 10 July 2025 17:40 (20 minutes)

If two particles collide in the vicinity of a black hole horizon, their center of mass energy is practically unlimited, so another black hole with a large mass and thus entropy can be created. The resulting black hole
can then merge with the original one. If the black hole is created very close to the horizon, its energy will be highly redshifted for ansymptotic observer. However, its entropy is not redshifted. We demonstrated that
the newly created entropy can be higher than the Bekenstein-Hawking entropy of the final black hole, though we neglect that a certain amount of energy can escape to infinity, carrying away part of the entropy
produced in the process. This is a counterexample to the statement that the black hole thermal entropy counts all the states inside the black hole. Unlike similar examples, this colliding process does not involve exotic matter, alternative theories of gravity, nor artificial ad hoc gluing of two different spacetimes.

Presenter: DAI, De-Chang (Nat'l Dong Hwa U, Taiwan)

Session Classification: Parallel 1

Contribution ID: **76** Type: **not specified**

Boulware Vacuum vs. Regularity: Vacuum State on the Horizonless Regular Spacetime

Thursday, 10 July 2025 18:00 (20 minutes)

When quantum fields live in curved spacetime, their behavior is highly sensitive to the choice of vacuum, which reflects the global structure of the background spacetime. Furthermore, their renormalized stress-energy tensor (RSET) requires the introduction of a local higher-order curvature effect, which induces the trace anomaly. These facts highlight that both the global and local properties of spacetime critically influence the quantum fields and their RSET.

In this work, we examine the vacuum state and its corresponding renormalized stress-energy tensor (RSET) in static horizonless regular spacetime in both two and four dimensions. Using the local field formulation of the anomaly-induced effective action, we show that the regularities of the spacetime and the RSET dictate the appropriate vacuum state. Furthermore, through a case study under the horizonless Bardeen-type spacetime, we demonstrate that the preferred vacuum state is not the Boulware vacuum in the black hole spacetime case, but a nontrivial one with a different RSET profile.

Presenter: NUMAJIRI, Kota (YITP, Kyoto U)

Session Classification: Parallel 1

Contribution ID: **77** Type: **not specified**

Synaptic Field Theory

Thursday, 10 July 2025 16:40 (20 minutes)

Theoretical understanding of deep learning remains elusive despite its empirical success. In this study, we propose a novel "synaptic field theory"that describes the training dynamics of synaptic weights and biases in the continuum limit. Unlike previous approaches, our framework treats synaptic weights and biases as fields and interprets their indices as spatial coordinates, with the training data acting as external sources. This perspective offers new insights into the fundamental mechanisms of deep learning and suggests a pathway for leveraging well-established field-theoretic techniques to study neural network training.

Presenter: YI, Jaeok (KAIST)

Session Classification: Parallel 2

Contribution ID: **78** Type: **not specified**

How Anisotropic can the Universe be: Constraining Axially Symmetric Bianchi Type I Model with Self-Consistent Recombination History and Observables

Thursday, 10 July 2025 17:20 (20 minutes)

Recent cosmological measurements suggest the possibility of an anisotropic universe. As a result, the Bianchi Type I model, being the simplest anisotropic extension to the standard Friedmann-Lemaître-Robertson-Walker metric has been extensively studied. In this work, we show how the recombination history should be modified in an anisotropic universe and derive observables by considering the null geodesic. We then constrain the axially symmetric Bianchi Type I model by performing Markov Chain Monte Carlo with the acoustic scales in Cosmic Microwave Background (CMB) and Baryon Acoustic Oscillation data, together with local measurements of H(z) and Pantheon Supernova data. Our results reveal that the anisotropic model is not worth a bare mention compared to the ΛCDM model, and we obtain a tight constraint on the anisotropy that generally agrees with previous studies under a maximum temperature anisotropy fraction of 2×10−5. To allow for a non-kinematic CMB dipole, we also present constraints based on a relaxed maximum temperature anisotropy comparable to that of the CMB dipole. We stress that there is a significant difference between the geodesic-based observables and the naive isotropic analogies when there is a noticeable anisotropy. However, the changes in recombination history are insignificant even under the relaxed anisotropy limit.

Presenter: NG, Boris Hoi-Lun (CUHK)

Session Classification: Parallel 2

Contribution ID: **79** Type: **not specified**

Constraining the Type 3 interacting dark-energy model using matter pairwise velocity

Thursday, 10 July 2025 17:00 (20 minutes)

Dark sector interactions can be explored via the so-called Type 3 model where dark matter and dark energy exchange momentum, so as to minimize deviations from the ΛCDM background expansion history, which agrees well with various observations. Using N-body simulations, we analyze the imprint of Type 3 model parameters, the momentum exchange coupling constant β and the slope of scalar field potential λ, on large-scale structure (LSS) observables, particularly the matter pairwise velocity statistics. We find that β and λ induce opposing effects on the mean matter peculiar pairwise velocity and velocity dispersion. Our results highlight the potential of velocity statistics as a probe of dark sector interactions and underscore the importance of disentangling β and λ in cosmological analyses.

Presenter: LUO, Kin Ho (CUHK)

Session Classification: Parallel 2

Contribution ID: **80** Type: **not specified**

Modified Gravity After GW170817: A window via Scalar-Photon Couplings?

Thursday, 10 July 2025 17:40 (20 minutes)

The near luminality and non-decay of Gravitational Waves (GWs) has ruled out all quartic and quintic Beyond Horndeski theories with a minimally coupled photon. In this talk, I show that — with specific couplings between the scalar and the photon — one can ensure luminal GWs and their suppressed decay in at least one viable Beyond Horndeski theory. I also discuss extensions of these scalar-photon couplings to general DHOST (Based on 2405.02281, 2412.13460)

Presenter: VALENCIA-VILLEGAS, Mauricio (Lomonosov Moscow State U)

Session Classification: Parallel 2

Contribution ID: **81** Type: **not specified**

Non-linearities in black hole perturbation theory

Friday, 11 July 2025 11:10 (20 minutes)

In this talk, I will discuss recent progress in understanding non-linear tidal responses and gravitational-wave tails in black hole perturbation theory. In the first part, I will present new findings demonstrating that GR black holes possess an infinite number of vanishing non-linear tidal Love numbers. These results are derived systematically using a worldline effective field theory framework, revealing deeper symmetry structures that constrain black hole tidal responses beyond the linear regime. In the second part, I will discuss the generation of gravitational-wave tails arising from non-linear perturbations during the ringdown phase. Remarkably, they decay more slowly than the well-known linear Price tails, indicating that at late times, non-linear effects dominate the gravitational-wave signal. Implications for gravitational-wave observations and theoretical modeling of black hole mergers will be highlighted.

Presenter: WONG, Sam (CUHK)

Session Classification: Parallel 1

Contribution ID: **82** Type: **not specified**

A Photon Cloud Induced from an Axion Cloud

Friday, 11 July 2025 12:10 (20 minutes)

It is known that the coupling between axions and photons can lead to a superradiant growth and cause electromagnetic (EM) bursts when the coupling constant multiplied with the amplitude of the axion clould is larger than a critical value. In the first-order of the coupling constant, we studied how the existence of an axion cloud influences the distribution of EMs around a Kerr black hole, and found that even for very small couplings, as long as there is a background EM field satisfying the field equation in Kerr background, there would exist an oscillating photon EM cloud with the same frequency as the axion cloud. The evolution of the photon EM cloud with time and azimuthal angle is obtained analytically while the distribution on the cross section is solved numerically. Intriguingly, the induced EMs have very different symmetries in contrast with the background EMs, which may provides as a feature for the existence of both an axion cloud and the axion-photon coupling. Also, for near horizon region, we compare the induced EMs (photons as fields) with the photon region (photons as particles) and find some coincides. Essentially, the induced photon cloud is sourced by the axion cloud via the coupling, not related to superradiance effects.

Presenter: TANG, Zi-Yu (IBS CTPU-CGA)

Session Classification: Parallel 1

Contribution ID: **83** Type: **not specified**

Photon rings of stationary hairy black holes

Friday, 11 July 2025 11:50 (20 minutes)

The black hole image consists of the black hole shadow, photon ring and accretion construction, whose shape and size reflect the strong field properties of the central black hole. In this talk, I will present the images of both spherically and axially symmetric Horndiski black holes, which exhibit novel features, differentiating those of the Schwarzschild black hole in general relativity.

Presenter: KUANG, Xiao-Mei (Yangzhou U)

Session Classification: Parallel 1

Contribution ID: **84** Type: **not specified**

Quasinormal modes of an accelerating black hole in the near-Nariai limit

Friday, 11 July 2025 11:30 (20 minutes)

We investigated the quasinormal modes of massless scalar perturbation on a near-extreme accelerating black hole. The accelerating black hole spacetime is described by the Plebański-Demiański metric, which can be characterized by seven physical parameters. We showed that the conformally invariant Klein-Gordon equation can be separated through transformations that remove the conformal factor in the metric. Furthermore, we found that for a near-Nariai black hole, where its event horizon and cosmo-acceleration horizon are located extremely close, the effective potential of the radial perturbation equation is reduced to the Pöschl-Teller potential. This allows us to analytically obtain an exact solution, indicating that the decay rate of the quasinormal mode depends solely on the surface gravity of the black hole for each quantized mode.

Presenter: HAN, Hyewon (Dongguk U)

Session Classification: Parallel 1

Contribution ID: **85** Type: **not specified**

Gravitational wave lensing as a probe of small-scale structures in our universe

Friday, 11 July 2025 11:10 (20 minutes)

Gravitational waves emitted from binary black hole mergers exhibit highly distinctive characteristics. When these waves undergo gravitational lensing, the resulting distortions in amplitude and phase can be identified. This phenomenon can thus be leveraged to probe small-scale dark matter structures that may have originated in the early universe. In this talk, I will discuss recent advances in this field, including measurements of the small-scale matter power spectrum through lensing.

Presenter: CHOI, Han Gil (IBS CTPU-CGA)

Session Classification: Parallel 2

Contribution ID: **86** Type: **not specified**

Investigating ultra-high-density equations of state through gravitational waves from binary neutron stars mergers

Friday, 11 July 2025 11:30 (20 minutes)

I will present our results on how to possibly discriminate equations of state with a quark-hadron crossover with respect to equations of state with purely hadronic matter or with a first-order quark-hadron transition through gravitational waves emitted in binary neutron star mergers.

Presenter: BAIOTTI, Luca (U of Osaka)

Session Classification: Parallel 2

Contribution ID: **87** Type: **not specified**

Gravitational waveforms from periodic orbits around a quantum-corrected black hole

Friday, 11 July 2025 11:50 (20 minutes)

In this work, we focus on periodic orbits of a small celestial object around a supermassive quantum-corrected black hole in loop quantum gravity and compute the corresponding gravitational waveforms. We view the small celestial object as a massive test particle and obtain its four-velocity and effective potential. We explore the effects of quantum corrections on marginally bound orbits, innermost stable circular orbits, and other periodic orbits. Using the numerical kludge scheme, we further explore the gravitational waveforms of the small celestial object along different periodic orbits. The waveforms exhibit distinct zoom and whirl phases in a complete orbital period, closely tied to the quantum parameter $\hat{\alpha}$. We also perform a spectral analysis of the gravitational waves from these periodic orbits and assess their detectability. With the steady progress of space-based gravitational wave detection programs, our findings will contribute to utilizing extreme mass-ratio inspirals to test and understand the properties of quantum-corrected black holes.

Presenter: YANG, Sen (Lanzhou U)

Session Classification: Parallel 2

Contribution ID: **88** Type: **not specified**

Superradiant Bosons Driving Supermassive Black Hole Mergers

Friday, 11 July 2025 12:10 (20 minutes)

Ultralight bosons (ULBs) can form macroscopic superradiant clouds around spinning black holes. We show that for scalar ULB masses $\mu \sim 10^{-22} - 10^{-21}$ eV boson cloud dynamical friction drives supermassive black hole (SMBH) final-parsec evolution in
$lesssim$1~Gyr and suppresses the nanohertz gravitational wave background with turnover. Considering century-monitored OJ287 system, we place novel bounds restricting ULB mass range $\mu \simeq (8.5 - 22) \times 10^{-22}$~eV independent of any dark matter assumptions and show ULB drag can also efficiently reconcile any future confirmations of the debated orbital decay excess. Forthcoming pulsar timing array data and precise SMBH orbital timings will decisively test this scenario.

Presenter: ZHU, Huiyu (IBS CTPU-CGA)

Session Classification: Parallel 2

Contribution ID: **89** Type: **not specified**

Magnetar Formation via Accretion Induced Collpase of White Dwarfs

Thursday, 10 July 2025 18:00 (20 minutes)

Magnetars, which are neutron stars with a surface magnetic field strength of order 10^14 G, are the most magnetic objects in the universe. However, their formation channels are not yet fully understood. We present the first two-dimensional axisymmetric MHD simulations of accretion-induced collapse (AIC) of rotating white dwarfs (WDs). Unlike previous studies of AIC that imposed an ad hoc magnetic field configuration on an initially non-magnetized hydrostatic WD, our initial conditions are self-consistently constructed by solving the MHD equilibrium equations that contain a mixed toroidal and poloidal component. Our findings show that with initial surface magnetic field strength constrained by isolated WD observations, the protoneutron star can reach a field strength consistent with magnetar observations. Our results suggest that the AIC of a magnetized white dwarf could be a possible channel for forming a magnetar.

Presenter: SIU HEI, Cheung (CUHK)

Session Classification: Parallel 2

Contribution ID: **90** Type: **not specified**

Can Horndeski Genesis be Nonpathological?

Wednesday, 9 July 2025 17:40 (20 minutes)

We present a minimal setup within the framework of Horndeski gravity that can describe a non-pathological Genesis scenario. Our setup allows for a fully stable transition to the kination epoch, during which General Relativity (GR) is restored. This Genesis scenario circumvents the no-go theorem at the cost of encountering the risk of strong coupling in the past. Interestingly, our scenario admits two different regimes for the background solution for Hubble parameter at the Genesis stage: power-law behavior and manifestly non-power-law behavior. We explicitly show that, in both regimes, our model remains within unitarity bounds. In most cases, the tensor spectrum is blue-tilted. Then, we adopt a mechanism with a spectator field that allows for a red-tilted scalar power spectrum. We also suggest a deformation of the model that enables us to achieve sufficiently small values for the r ratio. Finally, we discuss the geodesic (in)completeness of the current model.

Presenter: PETROV, Pavel (IBS CTPU-CGA)

Session Classification: Parallel 2

Contribution ID: **91** Type: **not specified**

Cosmological stimulated emission

Wednesday, 9 July 2025 16:40 (20 minutes)

We study the analogy between graviton emission and absorption in a thermal radiation environment and the laser mechanism, in which photons of the same momentum and polarization are amplified. Using interaction-picture perturbation theory, we analyze the time evolution of the graviton number operator and its expectation value in a squeezed vacuum state, which characterizes the inflationary graviton state. First, we examine this effect in a thermal bath in a Minkowski background and find that emission or absorption occurs depending on the initial squeezing parameters. As a thought experiment, we consider LIGO/Virgo-like detectors immersed in a radiation environment at temperatures of O(0.1) GeV. In this scenario, graviton numbers at frequencies of O(100) Hz could be enhanced, suggesting a possible mechanism for amplifying gravitational wave signals. While this setup is beyond current experimental capabilities, it highlights potential advancements in gravitational wave detection. The significant effect observed in a flat background implies a backreaction of the thermal bath on spacetime. Thus, understanding this effect in an expanding universe is essential. During the radiation-dominated era of the early universe, gravitons within the horizon at reheating undergo stimulated absorption. We find a secular logarithmic growth for the superhorizon mode, leading to the breakdown of perturbative analysis, which requires further investigation in future.

Presenter: OTA, Atsuhisa (Chongqing U)

Session Classification: Parallel 2

Contribution ID: **92** Type: **not specified**

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Tuesday, 8 July 2025 18:00 (20 minutes)

Session Classification: Parallel 1