2026 CAU Beyond the Standard Model Focus Workshop

Report of Contributions

https://indico.cern.ch/e/caufocus26

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

Neutrino signals from dark matter spikes

Monday, 9 February 2026 09:30 (30 minutes)

We summarize the status of dark matter indirect searches using neutrinos as messengers, and we point out that dark matter spikes around supermassive black holes can enhance significantly the neutrino flux from nearby galaxies, possibly even at the reach of neutrino telescopes. In particular, we propose that the measured neutrino flux from NGC1068 could be attributed to dark matter annihilations, for parameters escaping detection from the Milky Way center, due to the strong stellar heating of the spike in the latter.

Presenter: IBARRA, Alejandro (Technical University of Munich)

Session Classification: S1

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

Boosted Dark Matter: Theory and Detection Prospects

Monday, 9 February 2026 10:00 (30 minutes)

Presenter: Dr TOMA, Takashi (Kanazawa University)

Session Classification: S1

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

Parity Violation in Spin-1 Dark Matter with EFT Descriptions

Monday, 9 February 2026 11:00 (30 minutes)

Presenter: Prof. YAMASHITA, Kimiko (Ibaraki University)

Session Classification: S2

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

Taming the dark photon production via a non-minimal coupling to gravity

Monday, 9 February 2026 11:30 (30 minutes)

I begin with a pedagogical introduction to cosmological particle production during and after inflation, reviewing the theoretical framework of inflaton dynamics, gravitational particle production, and numerical techniques. I discuss various production scenarios studied in different cosmological contexts, with emphasis on computational methods and challenges. I then present our recent work on massive vector dark matter with non-minimal couplings to gravity. Recent studies revealed "runaway" instability in such theories within the effective field theory (EFT) framework. We show this is an artifact of pushing the EFT beyond its validity regime. We construct explicit UV-complete models where non-minimal couplings arise from heavy scalars or Kaluza-Klein gravitons. These completions yield form-factors that automatically satisfy stringent constraints and eliminate all instabilities. We numerically reproduce the dark photon production and delineate the validity boundary, showing that the runaway instability appears only outside the EFT's regime of validity.

Presenter: YOON, Jong-Hyun

Session Classification: S2

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

Fermion reheating with a quartic inflaton potential

Monday, 9 February 2026 12:00 (30 minutes)

Presenter: MENKARA, Adriana

Session Classification: S2

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

Large and Hidden CP Violation in the Complex Two-Higgs-Doublet Model

We present a systematic study of large CP violation in the Complex Two-Higgs-Doublet Model with softly broken Z_2 symmetry, based on global scans of Type-I and Type-II realizations including theoretical consistency, collider data, and the stringent electron EDM constraint. We identify two qualitatively different CP-violating regimes: in Type-I, sizable gauge-sector CP violation is possible only in a near-degenerate Higgs scenario where the 125 GeV state is accompanied by a second neutral scalar, and the entire viable parameter space predicts a nonzero lower bound on the eEDM within reach of upcoming experiments; in contrast, Type-II suppresses gauge-sector CP violation but allows near-maximal CP mixing in the Yukawa sector of the heavy neutral Higgs bosons. We further uncover a phenomenon of hidden CP violation in the Higgs alignment limit, where heavy neutral scalars retain large intrinsic CP mixing despite vanishing gauge couplings, and show that this can be probed through cubic interactions involving the charged Higgs boson.

Presenter: SONG, Jeonghyeon

Session Classification: S3

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

Entanglement in Higgs Scattering and possible connection to symmetry

Monday, 9 February 2026 16:00 (30 minutes)

Presenter: Ms PADHAN, ROJALIN (Institute of Physics, Bhubaneswar)

Session Classification: S4

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

Deep learning approaches to top FCNC couplings to photons at the LHC

Monday, 9 February 2026 14:30 (30 minutes)

Presenter: Dr JUEID, Adil (Institute for Basic Science)

Session Classification: S3

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

Electric Dipole Moment of Electron induced by Electroweak Multiplet at Full Three-loop

Monday, 9 February 2026 15:15 (15 minutes)

There has been remarkable progress in recent years in the electric dipole moment (EDM) measurements of electron using paramagnetic atom or molecule. In a previous study, we calculated the contribution to the electron EDM induced by the CP-violating Yukawa interaction of electroweak multiplets at the three-loop level in effective field theory. We found that this contribution might reach the sensitivity of future EDM experiments. However, this calculation involves an uncertainty relating to threshold corrections that cannot be evaluated in the effective field theory. In this study, we calculate the electron EDM induced by electroweak multiplets at full three-loop. As a result, we found that the threshold correction contributes at the same order as the result of the effective field theory and that the full result is larger than the previous study. This talk is based on JHEP02(2025)082 and a content being written in a paper.

Presenter: OGAWA, Kiyoto (Nagoya.Univ)

Session Classification: S3

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

SUSY and non-SUSY analysis of truly confining gauge theories

Monday, 9 February 2026 16:30 (15 minutes)

We classify 4D N=1 truly confining supersymmetric gauge theories, in which no center charges can be screened. This property guarantees that Wilson loops in the fundamental representation exhibit an area law. We systematically identify all such theories for simple Lie groups and determine the allowed matter content. In each theory, we find condensing magnetic operators, which are expected to explain confinement via the dual Meissner effect. We also analyze the non-SUSY versions of truly confining gauge theories and identify stable vacua that indicate confinement via the dual Meissner effect.

Presenter: SAITO, Shota (Kavli IPMU)

Session Classification: S4

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

Spontaneous Leptogenesis in Type I Seesaw

Tuesday, 10 February 2026 09:30 (30 minutes)

Presenter: CHUN, Eung Jin (Korea Institute for Advanced Study)

Session Classification: S5

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

Quantum enhanced sensing for ultralight dark matters

Tuesday, 10 February 2026 10:00 (30 minutes)

Presenter: XU, Bin

Session Classification: S5

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

Identifying high energy sources of CP violation and PQ breaking with electric dipole moments

Tuesday, 10 February 2026 11:00 (30 minutes)

Presenter: Dr IM, Sang Hui (IBS CTPU)

Session Classification: S6

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

Rare meson decays with dark matter emission

Tuesday, 10 February 2026 11:30 (30 minutes)

Presenter: OKAWA, Shohei (APCTP)

Session Classification: S6

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

Belle II excess and dark matter

Wednesday, 11 February 2026 14:30 (30 minutes)

The Belle II Collaboration recently announced the first observation of the □ → □ + □ □ decay process. This decay channel provides a particularly clean signal and allows for high theoretical precision. However, their measurement shows a 2.7□ deviation from the Standard Model prediction. To address this excess, we study a scalar dark matter model. Assuming a dark □ (1)□=□(1)□□–□□ symmetry, this symmetry is spontaneously broken to a local discrete symmetry, which guarantees the stability of dark matter. Within this framework, we can simultaneously explain the recent excess in B r (□⟶□+ □□) reported by the Belle II Collaboration and the observed relic abundance of dark matter.

Presenter: Dr KIM, Jongkuk (Chung-Ang University)

Session Classification: S11

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

Dark pion scattering and vector resonance in Sp(4) gauge theory

Tuesday, 10 February 2026 12:00 (30 minutes)

Presenter: LEE, Jong-Wan (Institute for Basic Science (IBS))

Session Classification: S6

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

Self-resonant dark matter with Z_4 gauged symmetry

Tuesday, 10 February 2026 15:30 (15 minutes)

Presenter: RADICCE JUSTINO, Lucca

Session Classification: S7

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

Stable dark matter from Pauli blocking in the degenerate fermion background with Quantum Field Theory

Tuesday, 10 February 2026 15:45 (15 minutes)

We study a mechanism to make dark matter stable based on the Pauli blocking in the fermion background. In the background where fermions occupy the states, the decay of dark matter to those final states is not allowed, as a result, DM becomes stable. We derive the evolution equations of the distribution function in the quantum field theory and compare it with the Boltzmann equation. We apply this mechanism to a realistic model of neutrino and dark matter.

Presenter: JOH, Junghoon (SungKyunKwan University)

Session Classification: S7

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

Aspects of Sommerfeld Enhancement in the light of Halo gamma-ray excess

Tuesday, 10 February 2026 16:30 (30 minutes)

Presenter: JHO, Yongsoo

Session Classification: S8

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

Neutrino masses and mixed dark matter from doublet and singlet scalars

Tuesday, 10 February 2026 17:00 (30 minutes)

We consider the extension of the SM with an inert scalar doublet, three right-handed neutrinos, and singlet scalar fields, ϕ and S. In this model, neutrino masses are zero in the limit of the unbroken Z4 discrete symmetry. We show that when the singlet scalar field ϕ gets a VEV, the Z4 symmetry is broken to Z2, and neutrino masses are generated at one-loops due to the mixings between the neutral components of the inert scalar doublet and the singlet scalar field S. There is a dark matter candidate from the lightest neutral scalar field, which is a mixture of the inert scalar doublet and the singlet scalar field S, in general. The Z4 breaking mass terms are constrained by electroweak precision data and direct detection (DD) bounds for dark matter, favoring small mixings or almost degenerate masses for the DM scalars. As a result, we discuss the implications of the results for small neutrino masses and DD-safe dark matter. Finally, we discuss on the possible collider signatures in our model.

Presenter: KIM, Seongsik (Chung-Ang University)

Session Classification: S8

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

From Scattering Amplitudes to Black Holes

Wednesday, 11 February 2026 09:30 (30 minutes)

Presenter: AOKI, Katsuki (YITP, Kyoto University)

Session Classification: S9

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

Black holes as a probe of BSM particles

Wednesday, 11 February 2026 10:00 (30 minutes)

Astrophysical probes are powerful tools to search for Beyond the Standard Model (BSM) particles, complementary to terrestrial detectors. As commonly exist throughout the Universe, black holes (BH) are intriguing astrophysical objects due to their strong gravity that can help to study BSM particles. In this talk, I will show that BSM particles can interact and form structures around BHs, here called environment. Depending on the masses of BSM particles, the density profiles of dense environments show different features which can be probed by various observations, such as gravitational waves. Particularly in a binary system of a BH and a companion, if such BSM environments exist, the evolution of the binary will deviate from the predictions of general relativity, which can lead to observable signals and be detected.

Presenter: Dr HE, Minxi

Session Classification: S9

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

Modular Cosmology: Implications for Inflation

Wednesday, 11 February 2026 11:00 (30 minutes)

Modular symmetry arises in various extensions of the Standard Model and plays an important role in particle phenomenology, particularly as a framework for flavor symmetries. In this talk, I will explore the cosmological implications of modular symmetry, with a special focus on inflationary physics. I will discuss how specific couplings between moduli and the Standard Model sector can influence inflationary dynamics and leave characteristic imprints on inflationary observables.

Presenter: AOKI, Shuntaro

Session Classification: S10

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

Constraining Inflation via FIMP dark matter using the β-function with collider implications

Wednesday, 11 February 2026 11:30 (30 minutes)

Presenter: KHAN, Sarif (Goettingen University)

Session Classification: S10

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

Peccei Quinn genesis

Wednesday, 11 February 2026 12:00 (15 minutes)

Presenter: SONG, Junho

Session Classification: S10

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

Higgs pole inflation in the light of ACT data

Wednesday, 11 February 2026 12:15 (15 minutes)

Presenter: HAN, Jeonghak

Session Classification: S10

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

The Seesaw Route to Neutrino Asymmetry and Baryogenesis in light of EMPRESS observation

Wednesday, 11 February 2026 15:00 (30 minutes)

We present a type-I seesaw scenario within the supersymmetric $U(1)_{B-L}$ extension of the Standard Model that simultaneously explains the large electron–neutrino asymmetry suggested by EMPRESS and the observed tiny baryon asymmetry. Both asymmetries originate from the decay of the $B-L$ Higgs condensate dominating the early Universe. It's early rare decays into heavy right-handed neutrinos generate baryon asymmetry via resonant leptogenesis, while later decays produce a large lepton asymmetry. The correct magnitudes are obtained for normal neutrino mass hierarchy. The model also predicts a gravitational-wave background from cosmic strings, potentially observable by ultimate DECIGO.

Presenter: DATTA, Arghyajit

Session Classification: S11

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

Testing neutrino mass origins with supernova neutrinos

Tuesday, 10 February 2026 15:00 (30 minutes)

Presenter: KONG, Chui-Fan

Session Classification: S7

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

Periodic dynamics induced by wave dark matter: From neutrino to superconductor

Wednesday, 11 February 2026 15:30 (15 minutes)

The oscillating wave dark matter can act as a periodic driver, producing distinct modulation signatures not only in particle physics (e.g., neutrinos), but also in solid-state physics (e.g., superconductors). This talk is based on our recent papers PRD 108, 095028 (2023); JHEP 07 (2025) 269; arXiv: 2509.22892.

Presenter: KIM, Yechan (KAIST)

Session Classification: S11

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

Spin Correlation and Quantum Observables at Colliders

Wednesday, 11 February 2026 16:15 (30 minutes)

Presenter: KANG, Dong Woo (KIAS)

Session Classification: S12

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

Quantum Correlations at the LHC

Wednesday, 11 February 2026 16:45 (30 minutes)

Presenter: NAVARRO, Alberto (Seoultech)

Session Classification: S12

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

Gravitational Wave Messages from Dark Sectors and Grand Unification

Thursday, 12 February 2026 09:30 (30 minutes)

Presenter: KERSTEN, Joern (University of Bergen)

Session Classification: S13

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

A new mechanism of gravitational wave production

Thursday, 12 February 2026 10:00 (30 minutes)

First-order phase transitions in the early Universe are a well-motivated source of gravitational waves (GWs). In this talk, I will discuss a previously overlooked GW production mechanism: gravitational transition radiation, arising from graviton emission by particles whose mass changes as they pass through expanding bubble walls. The resulting spectrum features a distinctive shape with a peak frequency redshifting to f_peak ~ T0 ~ 10 GHz, where T0 is the current temperature of the Universe. This mechanism is generic and is expected to operate similarly for domain walls and other relativistic interfaces.

Presenter: AI, Wenyuan

Session Classification: S13

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

Electroweak phase transition and bubble wall dynamics

Thursday, 12 February 2026 11:00 (30 minutes)

Presenter: BRANCHINA, Carlo (Università della Calabria)

Session Classification: S14

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

Magnetic Helicity, Higgs Winding, and Chiral Asymmetry

Thursday, 12 February 2026 11:30 (30 minutes)

Presenter: MUKAIDA, Kyohei (DESY)

Session Classification: S14

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

Chasing the two-Higgs-doublet model via electroweak corrections at e+ e− colliders

Monday, 9 February 2026 15:00 (15 minutes)

We present a comprehensive study of Higgs boson production associated with a neutrino pair at e+e− colliders ($e^+e^- \to h\nu\bar{\nu}$) at the next-to-leading-order accuracy in both the Standard Model and the two-Higgs-doublet model. We show that new physics effects from the extended Higgs sector can be probed through electroweak corrections, which lead to several percent deviations from the Standard Model predictions in total cross sections and differential distributions, even in the alignment limit. This highlights the potential of precision studies at future e+e− colliders for searching new physics.

Presenter: BANNO, Tatsuya

Session Classification: S3

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

Understanding Galactic Dark Matter with Generative Models and Physics-Informed Neural Networks

Thursday, 12 February 2026 12:00 (30 minutes)

Mapping the Milky Way's dark matter requires moving beyond traditional, rigid dynamical models. In this talk, generative models—specifically Normalizing Flows—are used to learn the stellar phase space distribution directly from Gaia data. This approach enables a flexible, model-independent reconstruction of the Galactic gravitational potential and local dark matter density. These data-driven techniques provide a promising avenue to handle complex observational biases and what they reveal about the dark sector's influence on our Galaxy.

Presenter: LIM, Sung Hak (Rutgers University)

Session Classification: S14

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

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

Monday, 9 February 2026 16:45 (15 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.
This paper is published in JCAP 01 (2026) 020 [arXiv:2504.19219]

Presenter: KOO, Hyeonmo

Session Classification: S4