The 2025 Shanghai Symposium on Particle Physics and Cosmology:Precision Higgs Factory Physics: Theory Meets Experiment

Report of Contributions

Contribution ID: **1**

Type: **not specified**

CEPC Overview

In this talk CEPC general status will be reported including CEPC accelerator EDR progress, CEPC detector reference design report, CEPC civil engineering design progress, CEPC industrial preparation, CEPC international collaboration and the preparation for the CEPC submission to China's 15th five year plan.

Primary author: GAO, Jie (Institute of High Energy Physics, Chinese Academy of Sciences (CN))

Presenter: GAO, Jie (Institute of High Energy Physics, Chinese Academy of Sciences (CN))

Contribution ID: **2**

Type: **not specified**

BSM Triple Higgs Couplings at Current and Future Colliders

We discuss the necessity and feasibility of BSM THC measurements at current and future colliders.

Primary author: HEINEMEYER, Sven (IFT/IFCA (CSIC))

Presenter: HEINEMEYER, Sven (IFT/IFCA (CSIC))

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

Recent highlights of ATLAS Higgs and di-Higgs physics

In this talk, I will introduce the recent highlights of ATLAS Higgs and di-Higgs physics results. These results are based on 140/fb of Run 2 data with $\sqrt{s}$ = 13 TeV, and some include the most up to date 165/fb of Run 3 data taken up to 2024 at $\sqrt{s}$ = 13.6 TeV.

Primary author: YANG, Hongtao (USTC)

Presenter: YANG, Hongtao (USTC)

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

Frontiers of Analytic Multi-loop Feynman Integrals

With the development on canonical differential equation, integral basis with uniformal transcendental weights, computational algebraic geometry method, the era of analytic computations of multi-loop multi-leg multi-scale Feynman integrals is coming. We analytically computed all 2loop 6point planar massless Feynman integrals. This is a mile stone of analytic feynman integral computation. The complete 3loop 5point integrals' analytic results are also coming soon.

Primary author: ZHANG, Yang (University of Science and Technology of China)

Presenter: ZHANG, Yang (University of Science and Technology of China)

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

SMEFT at future lepton colliders

I will give a brief overview on SMEFT global analyses at future lepton colliders and discuss some recent developments.

Primary author: GU, Jiayin (Fudan University)

Presenter: GU, Jiayin (Fudan University)

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

After g-2, what next for $U(1)_{L_\mu - L_\tau}$

In this talk I will discuss recent changes in the allowed parameter space for the $U(1)_{L_\mu - L_\tau}$ extension to the Standard Model. I will argue that despite the (g-2) anomaly disappearing, this model still holds a lot of potential, in particular as a portal to dark matter. This provides vital motivation for a future muon collider. Furthermore, I will present ongoing work with the TRIDENT collaboration, where we determine the future experimental sensitivity to such model.

Primary author: CHEEK, Andrew (TDLI, SJTU)

Presenter: CHEEK, Andrew (TDLI, SJTU)

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

Entanglement and Bell Nonlocality in τ+τ- at the LHC using Machine Learning for Neutrino Reconstruction

Experiments at the CERN Large Hadron Collider (LHC) have accumulated an unprecedented amount of data corresponding to a large variety of quantum states. Although searching for new particles beyond the Standard Model of particle physics remains a high priority for the LHC program, precision measurements of the physical processes predicted in the Standard Model continue to lead us to a deeper understanding of nature at high energies. We carry out detailed simulations for the process $pp \rightarrow \tau^+\tau^-$ to perform quantum tomography and to measure the quantum entanglement and the Bell nonlocality of the $\tau^+\tau^-$ two-qubit state, including both statistical and systematic uncertainties. By using advanced machine learning techniques for neutrino momentum reconstruction, we achieve precise measurements of the full spin density matrix, a critical advantage over previous studies limited by reconstruction challenges for missing momenta. Our analysis reveals a clear observation of Bell nonlocality with high statistical significance, surpassing 5σ, establishing $\tau^+\tau^-$ as an ideal system for quantum information studies in high-energy collisions. Given its experimental feasibility and the high expected sensitivity for Bell nonlocality, we propose that $\tau^+\tau^-$ should be regarded as the new benchmark system for quantum information studies at the LHC, complementing and extending the insights gained from the $t\bar{t}$ system.

Primary authors: ZHOU, Baihong (TDLI, SJTU); LOW, Matthew (University of Pittsburgh); LIU, Qibin (SLAC National Accelerator Laboratory); HSU, Shih-Chieh (University of Washington); LI, Shu (TDLI, SJTU); HAN, Tao (University of Pittsburgh); WU, Tong Arthur (University of Pittsburgh); ZHANG, Yulei (University of Washington)

Presenter: ZHOU, Baihong (TDLI, SJTU)

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

Probing Neutral Triple Gauge Couplings via Zy production at Future Lepton Collider

Neutral triple gauge couplings (nTGCs) are absent in the Standard Model (SM) and at the dimension-6 level in the Standard Model Effective Field Theory (SMEFT), arising first from dimension-8 operators. As such, they provide a unique window for probing new physics beyond the SM. These dimension-8 operators can be mapped to nTGC form factors whose structure is consistent with the spontaneously-broken electroweak gauge symmetry of the SM. In this work, we study the probes of nTGCs in the reaction $e^+e^- \to Z\gamma$ at e^+e^- collider. A detector-level simulation and analysis of this reaction has been performed at the Circular Electron Positron Collider (CEPC) with collision energy $\sqrt{s}$ = 240 GeV and an integrated luminosity of 20 ab^{-1}. We present the sensitivity limits on probing the new physics scales of dimension-8 nTGC operators via measurements of the corresponding nTGC form factors.

Primary authors: LIU, Danning (Tsung-Dao Lee Institute, Shanghai Jiao Tong University); DUAN, Linjing (TDLI, SJTU); LI, Shu (TDLI, SJTU)

Presenter: DUAN, Linjing (TDLI, SJTU)

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

Welcome/Overview

Friday, 10 October 2025 09:00 (15 minutes)

Presenter: Prof. RAMSEY-MUSOLF, Michael

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

EW Precision

Friday, 10 October 2025 09:15 (45 minutes)

Presenter: Prof. VICINI, Alessandro (U Milan)

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

CEPC Overview

Friday, 10 October 2025 10:00 (45 minutes)

Presenter: GAO, Jie (Institute of High Energy Physics, Chinese Academy of Sciences (CN))

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

ZH Production NNLO

Friday, 10 October 2025 10:45 (45 minutes)

Presenter: SONG, Qian (Ghent U)

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

Precise Predictions for Semi-leptonic Heavy-to-light Decays

Friday, 10 October 2025 14:00 (45 minutes)

Presenter: CHEN, Long (Shandong University)

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

Frontiers of Multi-loop Analytic Feynman Integrals

Saturday, 11 October 2025 09:45 (45 minutes)

Presenter: ZHANG, Yang (University of Science and Technology of China)

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

BSM Off Z Pole

Friday, 10 October 2025 12:30 (45 minutes)

Presenter: QIAN, Zhuoni (Hangzhou Normal University)

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

Flavor Physics at the CEPC - A General Perspective

Saturday, 11 October 2025 10:30 (45 minutes)

Presenter: LIU, Tao (HKUST)

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

BSM e+e-

Friday, 10 October 2025 16:45 (45 minutes)

remote

Presenter: WEIGLEIN, Georg (DESY)

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

LNV at e+e-

Saturday, 11 October 2025 09:00 (45 minutes)

Presenter: ZHANG, Yongchao (Southeast University)

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

NNLO low energy

Friday, 10 October 2025 13:15 (45 minutes)

Presenter: DU, Yong (IMP CAS)

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

Precision Higgs CMS

Presenter: XIAO, Meng (Zhejiang university)

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

Di Higgs

Friday, 10 October 2025 16:00 (45 minutes)

Presenter: YANG, Hongtao (USTC)

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

Boost the discover power: AI usage at CEPC Physics

Saturday, 11 October 2025 12:30 (45 minutes)

Presenter:　RUAN, Manqi (Institute of High Energy Physics, Beijing, China)

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

e+e- NNLO

Saturday, 11 October 2025 13:15 (45 minutes)

Presenter: CHEN, Xuan (Shandong University)

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

Quantum entanglement at Higgs factory

Saturday, 11 October 2025 14:30 (45 minutes)

Presenter: ZHANG, Hao (Theoretical Physics Division, Institute of High Energy Physics, Chinese Academy of Sciences)

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

Demystifying the Weak Mixing Angle

Saturday, 11 October 2025 15:15 (45 minutes)

Presenter: Prof. RAMSEY-MUSOLF, Michael

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

Exotic Higgs/Quantum Info

Sunday, 12 October 2025 09:00 (45 minutes)

Presenter: LIU, Jia (Peking University)

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

BSM/EW theory

Sunday, 12 October 2025 09:45 (45 minutes)

Presenter: GU, Jiayin (Fudan University)

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

LHC Higgs DM

Sunday, 12 October 2025 10:30 (45 minutes)

Presenter: WANG, Zirui (Fudan)

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

CEPC BSM

Presenter: ZHUANG, Xuai (IHEP)

Session Classification: Session 2

Contribution ID: **31**

Type: **not specified**

Honoring Yaquan Fang

Presenters: Prof. RAMSEY-MUSOLF, Michael; CHEN, Mingshui (IHEP)

Session Classification: Session 2

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

BSM Higgs

Sunday, 12 October 2025 15:30 (45 minutes)

Presenter: HEINEMEYER, Sven (IFT/IFCA (CSIC))

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

Panel

Sunday, 12 October 2025 16:15 (1 hour)

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

Close out

Sunday, 12 October 2025 17:15 (15 minutes)

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

Loop-level lepton flavor violation in the left-right symmetric model

The left-right symmetric model (LRSM) is a well-motived scenario to accommodate the tiny neutrino masses, e.g. via the type-I seesaw. The mixing of heavy neutrinos in the LRSM could induce lepton flavor violating (LFV) couplings of the $SU(2)_R$-breaking neutral scalar H_3, which arise at the 1-loop level via the heavy W_R boson and the heavy neutrinos. When H_3 is light, say at or below the GeV scale, such LFV signals can be searched for in the high-intensity experiments and the astrophysical observations. It turns out that the right-handed scale v_R is severely constrained, up to the 10^6 GeV scale, well above the direct high-energy collider limits.

Primary author: ZHANG, Yongchao (Southeast University)

Co-authors: Prof. WU, Pei-Wen;   Ms QIANG, Shufang

Presenter: ZHANG, Yongchao (Southeast University)

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

Quantum entanglement at Higgs factory

In this talk, we will discuss the prospects of testing quantum entanglement effects and Bell inequalities at future Higgs factories, as well as explore the potential of using these investigations to search for new physics beyond the Standard Model.

Primary author: Prof. ZHANG, Hao (Theoretical Physics Division, Institute of High Energy Physics, Chinese Academy of Sciences)

Presenter: Prof. ZHANG, Hao (Theoretical Physics Division, Institute of High Energy Physics, Chinese Academy of Sciences)

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

Precise Measurement of Higgs Hadronic Decay at CEPC

We conduct a detailed Monte Carlo study of the process $e^+e^- \to ZH$ at the CEPC. The analysis focuses on final states where the Z boson decays invisibly, while the Higgs boson decays hadronically through $H \to b\bar{b}$, $c\bar{c}$, gg and $s\bar{s}$. To distinguish among hadronic final states, we apply advanced jet-tagging methods based on ParticleNet, Particle Transformer, and the More-Interaction Particle Transformer, which make use of low-level particle information for more accurate classification. In addition, we develop a machine-learning-based event selection strategy to strengthen signal–background separation, leading to improved sensitivity in Higgs property measurements and stringent tests of Standard Model predictions at the CEPC.

Primary authors: ZHU, Chunxiang; YANG, Haijun (Shanghai Jiao Tong University (CN)); WANG, Kun (University of Shanghai for Science and Technology); ZHU, Yifan; WANG, xinzhu (上海交通大学)

Presenter: ZHU, Yifan

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

Precise Predictions for Semi-leptonic Heavy-to-light Decays

We present the first complete $\mathcal{O}(\alpha_s^2)$ and $\mathcal{O}(\alpha_s^3)$ perturbative QCD corrections to all Heavy-to-light structure functions underlying the triple-differential semi-leptonic decay rates of heavy quarks. In particular, we presented the so-far most accurate theoretical predictions for the Top and Bottom quark semi-leptonic decay widths, including the currently known electroweak corrections, the error of which meets the request by current and future lepton colliders. Other than the cutting-edge precision results, theoretically novel observations and fresh insights are made regarding heavy-quark masses and decays.

Primary authors: Dr CHEN, Long (Shandong University); Dr CHEN, Xiang (Peking University); Dr GUAN, Xin (Peking University); Prof. MA, Yan-Qing (Peking University)

Co-authors: Dr NIGGETIEDT, Marco (Max-Planck-Institut f\"ur Physik); Dr LI, Zhe (Shandong University)

Presenter: Dr CHEN, Long (Shandong University)

Contribution ID: **39**

Type: **not specified**

NNLO mixed QCD-EW corrections to W-pair production at electron-positron colliders

The discrepancy between the CDF measurement and the Standard Model theoretical prediction for the W-boson mass underscores the importance of conducting high-precision studies on the W boson, which is one of the predominant objectives of proposed future e+e− colliders. We investigate in detail the production of W-boson pairs at e+e− colliders, and compute the next-to-next-to-leading order mixed QCD-EW corrections to both the integrated cross section and various kinematic distributions. By employing the method of canonical differential equations, we analytically calculate the two-loop master integrals for the mixed QCD-EW virtual corrections. After rationalization of square roots, we express these master integrals in terms of Goncharov polylogarithms. However, six of the master integrals at weight 4 involve square roots that cannot be rationalized. They are ultimately expressed in terms of elliptic multiple polylogarithms. Upon applying our analytic expressions of these master integrals to the phenomenological analysis of W-pair production, we observe that the $O(\alpha\alpha s)$ corrections are significantly impactful in the $\alpha(0)$ scheme, which can reach up to 1%.

Primary author: LI, Zhe

Presenter: LI, Zhe

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

EW Vacuum Decay Induced by Domain Walls in the N2HDM

The Next-to-Two-Higgs-Doublet model (N2HDM) has a rich vacuum structure where multiple electroweak (EW) breaking minima, as well as CP and electric-charge breaking minima, can coexist. These minima can be deeper than the electroweak vacuum $v_{ew} \approx 246$ GeV of our universe, making our vacuum metastable. In such a case, one needs to calculate the tunneling rate from the EW vacuum to the deeper minimum. If the decay rate is larger than the universe's age, our vacuum is deemed long-lived, and the parameter point is in principle allowed. If the decay rate is smaller than the universe's age, then our vacuum is unstable and the parameter point is ruled out. However, domain walls (DW) in the N2HDM can substantially alter this picture. We show in this work that inside the DW, the barrier between our electroweak minimum and the deeper minimum can disappear, leading the scalar fields to classically roll over to the deeper minimum that nucleates inside the DW and then expands outside of it everywhere in the universe. We show that such behavior can happen to parameter points where the lifetime of our vacuum is several orders of magnitude larger than the age of the universe, making these parameter points with very long-lived EW minimum ruled out.

Primary author: SASSI, Mohamed Younes (University of Hamburg)

Co-author: Prof. MOORTGAT-PICK, Gudrid (University of Hamburg)

Presenter: SASSI, Mohamed Younes (University of Hamburg)

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

Precision Higgs CMS

Friday, 10 October 2025 15:15 (45 minutes)

Presenter:　XIAO, Meng (Zhejiang university)

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

CEPC BSM

Sunday, 12 October 2025 12:30 (45 minutes)

Presenter: ZHUANG, Xuai (IHEP)

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

Honoring Yaquan Fang

Sunday, 12 October 2025 13:15 (30 minutes)

Presenters: Prof. RAMSEY-MUSOLF, Michael;   CHEN, Mingshui (IHEP)

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

Interplay between baryon preservation criterion in electroweak baryogenesis and future collider experiments

Abstract

Primary author:　WU, Yanda

Presenter:　WU, Yanda

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

Electroweak baryogenesis from charged current anomalies in B meson decays

We demonstrate for the first time that new physics explaining the long standing charged B meson anomalies, $R(D^{(*)})$, can be the source of CP violation that explains the observed baryon asymmetry of the universe (BAU). We consider the general two Higgs doublet model with complex Yukawa couplings and compute the BAU in the semiclassical formalism, using a novel analytic approximation for the latter. After imposing constraints from both flavor observables and the electron electric dipole moment (eEDM), we find that a significant BAU can still be generated for a variety of benchmark points in the parameter space, assuming the occurrence of a sufficiently strong first order electroweak phase transition. These scenarios, which explain both the $R(D^{(*)})$ flavor anomalies and the BAU, can be probed with future eEDM experiments and Higgs factories measurements.

Primary author: Dr SIERRA FONSECA, CRISTIAN FELIPE (Nanjing Normal University)

Co-authors: Prof. RAMSEY-MUSOLF, Michael; ATHRON, Peter (Nanjing Normal University); WU, Yongcheng (Nanjing Normal University)

Presenter: Dr SIERRA FONSECA, CRISTIAN FELIPE (Nanjing Normal University)

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

TBD

Presenter: LIU, Tao (HKUST)

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

After g-2, what next for U (1)Lμ−Lτ

Saturday, 11 October 2025 16:30 (20 minutes)

Presenter: CHEEK, Andrew (TDLI, SJTU)

Session Classification: Session 1

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

Probing Neutral Triple Gauge Couplings via Z(ℓℓ/⊠⊠)⊠ production at Future Lepton Collider

Saturday, 11 October 2025 16:50 (20 minutes)

Presenter: DUAN, Linjing (TDLI, SJTU)

Session Classification: Session 1

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

NNLO mixed QCD-EW corrections to W-pair production at electron-positron colliders

Saturday, 11 October 2025 17:10 (20 minutes)

Presenter: LI, Zhe (Shandong University)

Session Classification: Session 1

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

Entanglement and Bell Nonlocality in τ+τ- at the LHC using Machine Learning for Neutrino Reconstruction

Saturday, 11 October 2025 17:50 (20 minutes)

Presenter: ZHOU, Baihong (TDLI, SJTU)

Session Classification: Session 1

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

Precise Measurement of Higgs Hadronic Decay at CEPC

Saturday, 11 October 2025 18:10 (20 minutes)

Presenter: ZHU, Yifan (TDLI&SPA, SJTU)

Session Classification: Session 1

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

Electroweak baryogenesis from charged current anomalies in B meson decays

Saturday, 11 October 2025 17:30 (20 minutes)

Presenter: SIERRA FONSECA, CRISTIAN FELIPE (Nanjing Normal University)

Session Classification: Session 1

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

Verifying the Resonance Schemes of Unstable Particles at Lepton Colliders

Sunday, 12 October 2025 13:45 (35 minutes)

Presenter: Prof. GE, Shao-Feng (TDLI-SJTU)

Session Classification: Session 2

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

Interplay between baryon preservation criterion in electroweak baryogenesis and future collider experiments

Sunday, 12 October 2025 14:20 (20 minutes)

Presenter: WU, Yanda

Session Classification: Session 2

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

EW Vacuum Decay Induced by Domain Walls in the N2HDM

Sunday, 12 October 2025 14:40 (20 minutes)

Presenter: SASSI, Mohamed Younes (University of Hamburg)

Session Classification: Session 2