

Higgs Potential 2022

Report of Contributions

Contribution ID: 2

Type: **not specified**

利用对撞机上长寿命粒子信号检验电弱相变

Wednesday, 27 July 2022 14:30 (20 minutes)

We study the scenarios where a strong first order electroweak phase transition (FOEWPT) is triggered by a light singlet scalar, which has feeble interactions to the Higgs.

Since the singlet scalar is light and has weak couplings, it can decay at a macroscopic distance away from the collision point. Therefore, it can be regarded as a long-lived particles (LLP) in such scenarios. We perform the searches of the LLPs from the exotic Higgs decays, at the FASER, MAPP and CMS-Timing detectors of the 14 TeV HL-LHC, to probe the FOEWPT. In certain scenarios, we show that the LLP searches can help to reach the parameter space of the FOEWPT remarkably, where the searches for promptly exotic Higgs decays are not valid.

Primary author: LIU, Wei (Nanjing University of Science and Technology)

Presenter: LIU, Wei (Nanjing University of Science and Technology)

Session Classification: Direct BSM

Contribution ID: 3

Type: **not specified**

Search for Dark Higgs at ATLAS and potential to utilize the Xbb tagger

Wednesday, 27 July 2022 15:10 (20 minutes)

This talk will present the latest searches for Mono-H125 and Mono-Scalar productions with SM and BSM Higgs as a direct probe to BSM portal of new physics and especially Dark Matter. A potential of utilizing the boosted Xbb tagger will be also discussed.

Primary authors: LI, Changqiao (SJTU & TDLI); LIU, Qibin (TDLI & SJTU)

Co-author: LI, Shu (TDLI, SJTU)

Presenters: LI, Changqiao (SJTU & TDLI); LIU, Qibin (TDLI & SJTU)

Session Classification: Direct BSM

Contribution ID: 4

Type: **not specified**

Search for $H \rightarrow aa \rightarrow 4b$ exotic decays and VBF $HH \rightarrow 4b$ with CEPC and ATLAS

Tuesday, 26 July 2022 10:10 (20 minutes)

This talk will present the $HH \rightarrow 4b$ analysis result at ATLAS and also the exotic decays of 125 GeV SM Higgs to light scalar pairs in 4b final states with future circular colliders such as CEPC.

Primary author: 王震

Co-author: ZHU, Xuliang (TDLI, SJTU)

Presenter: 王震

Session Classification: DiHiggs & BSM

Contribution ID: 5

Type: **not specified**

ATLAS Higgs Combination

Monday, 25 July 2022 15:10 (20 minutes)

This talk will present the latest ATLAS Higgs combination result at the Higgs symposium to show the precision map after 10-year Higgs observation.

Primary author: LI, Changqiao (SJTU & TDLI)

Presenters: LI, Changqiao (SJTU & TDLI); 李, 昌樵 (Shanghai Jiao Tong University)

Session Classification: Higgs & indirect BSM

Contribution ID: 6

Type: **not specified**

The triplet Higgs leptogenesis

Wednesday, 27 July 2022 10:10 (20 minutes)

The triplet Higgs leptogenesis

Primary author: HAN, Chengcheng (中山大学)

Presenter: HAN, Chengcheng (中山大学)

Session Classification: Direct BSM

Contribution ID: 7

Type: **not specified**

Probing light quark Yukawa couplings through angularity distributions in Higgs boson decay

Monday, 25 July 2022 17:20 (20 minutes)

We propose to utilize angularity distributions in Higgs boson decay to probe light quark Yukawa couplings at e^+e^- colliders. Angularities τ_a are a class of 2-jet event shapes with variable and tunable sensitivity to the distribution of radiation in hadronic jets in the final state. Using soft-collinear effective theory (SCET), we present a prediction of angularity distributions from Higgs decaying to quark and gluon states at e^+e^- colliders to NNLL + $\mathcal{O}(\alpha_s)$ accuracy. Due to the different color structures in quark and gluon jets, the angularity distributions from $H \rightarrow q\bar{q}$ and $H \rightarrow gg$ show different behaviors and can be used to constrain the light quark Yukawa couplings. We show that the upper limit of light quark Yukawa couplings could be probed up to 15 ~ 22% level of the bottom quark Yukawa coupling in the Standard Model.

Primary author: Dr YAN, Bin (IHEP)

Presenter: Dr YAN, Bin (IHEP)

Session Classification: Higgs & indirect BSM

Contribution ID: 8

Type: **not specified**

A search for heavy Higgs bosons decaying into vector bosons in same-sign two-lepton final states in pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector

Wednesday, 27 July 2022 17:00 (20 minutes)

A search for heavy Higgs bosons decaying into a pair of vector bosons and produced in association with a vector boson is performed, using final states with two leptons of the same electric charge (electrons or muons), missing transverse momentum and jets. A data sample of proton-proton collisions at a centre-of-mass energy of 13 TeV recorded with the ATLAS detector at the Large Hadron Collider between 2015 and 2018 is used. The data correspond to a total integrated luminosity of 139 fb^{-1} . The observed data are in agreement with Standard Model background expectations. The results are interpreted using higher dimensional operators in an Effective Field Theory. The upper production cross-section limits at 95% confidence level are calculated as a function of the heavy Higgs boson mass and coupling strengths to vector bosons. Limits are set in the Higgs boson mass region 300 to 1500 GeV, and depend upon the assumed couplings. The highest heavy Higgs boson mass excluded with the coupling combinations explored is 900 GeV. Limits on coupling strength are also provided.

Primary author: XU, yue (Tsinghua University)

Co-author: Prof. CHEN, Xin (Tsinghua University)

Presenter: XU, yue (Tsinghua University)

Session Classification: Direct BSM

Contribution ID: 9

Type: **not specified**

New physics hints with 2HDM under the Higgs Boson Precision Measurements

Wednesday, 27 July 2022 16:40 (20 minutes)

We perform comparative studies for four types of the two Higgs Doublet Models (2HDMs) under the precision measurements of the Standard Model (SM) Higgs observables at the proposed Higgs factories. The exploration for the discovery potential is up to one-loop level. We find 5σ observability from the global fitting in a significant theory parameter space at future Higgs factories. We also examine the extent to which the different 2HDM theories may be distinguishable from one to the other at the 95% Confidence Level with four benchmark points as case studies. It confirms that the impacts of loop corrections are found to be significant in certain parameter regions.

Primary author: 苏, 伟 (university of Adelaide)

Co-authors: Dr LI, Shuailong (U of Arizona); Prof. SU, Shufang (University of Arizona); Prof. HAN, Tao (Univ. of Pittsburgh & TsingHua University); WU, Yongcheng (Carleton University)

Presenter: 苏, 伟 (university of Adelaide)

Session Classification: Direct BSM

Contribution ID: 10

Type: **not specified**

Higgs coupling combination measurement at ATLAS ten years after the discovery

The standard model of particle physics describes the known fundamental particles and forces that make up our universe, with the exception of gravity. One of the central features of the standard model is a field that permeates all of space and interacts with fundamental particles. The quantum excitation of this field, known as the Higgs field, manifests itself as the Higgs boson, the only fundamental particle with no spin. In 2012, a particle with properties consistent with the Higgs boson of the Standard Model was observed by the ATLAS and Compact Muon Solenoid (CMS) experiments at the Large Hadron Collider at CERN. Since then, more than 30 times as many Higgs bosons have been recorded by the ATLAS experiment, enabling much more precise measurements and new tests of the theory. Here, on the basis of this larger dataset, we combine an unprecedented number of production and decay processes of the Higgs boson to scrutinize its interactions with elementary particles. Interactions with gluons, photons, and W and Z bosons—the carriers of the strong, electromagnetic and weak forces—are studied in detail. Interactions with three third-generation matter particles (bottom (b) and top (t) quarks, and tauons (tau)) are well measured and indications of interactions with a second-generation particle (muons, mu) are emerging. These tests reveal that the Higgs boson discovered ten years ago is remarkably consistent with the predictions of the theory and provide stringent constraints on many models of new phenomena beyond the standard model.

Primary author: RAN, Kunlin (Beijing)

Presenter: RAN, Kunlin (Beijing)

Contribution ID: 11

Type: **not specified**

Search for Higgs boson pair production in $\tau\tau$ final state in pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector

Tuesday, 26 July 2022 09:30 (20 minutes)

This talk will show an overview of searches for non-resonant and resonant di-Higgs boson production in the $\tau\tau$ final state. The data set used corresponds to an integrated luminosity of 139 fb⁻¹ of proton–proton collisions at a center-of-mass energy of 13 TeV recorded by the ATLAS detector at the CERN Large Hadron Collider.

Primary author: 贾, 子航 (Nanjing University)

Presenter: 贾, 子航 (Nanjing University)

Session Classification: DiHiggs & BSM

Contribution ID: 12

Type: **not specified**

Measurements of the Higgs boson inclusive and differential fiducial cross-sections in the diphoton decay channel with $\sqrt{s} = 13$ TeV collisions at the ATLAS detector

Monday, 25 July 2022 10:05 (20 minutes)

A measurement of inclusive and differential fiducial cross-sections for the production of the Higgs boson decaying to two photons is performed using 139 fb^{-1} of proton–proton collision data recorded at $\sqrt{s} = 13$ TeV by the ATLAS experiment at the Large Hadron Collider. The inclusive cross-section times branching ratio, in a fiducial region closely matching the experimental selection, is measured to be $67 \pm 6 \text{ fb}$, which is in agreement with the state-of-the-art Standard Model prediction of $64 \pm 4 \text{ fb}$. In addition, the cross-section in four fiducial regions sensitive to various Higgs boson production modes and differential cross-sections as function of several observables are measured. All the measurements are found to be in agreement with the Standard Model predictions. The measured transverse momentum distribution of the Higgs boson is used as an indirect probe of the Yukawa coupling of the Higgs boson to the bottom and charm quarks. In addition, five differential cross-section measurements are used to constrain anomalous Higgs boson couplings to vector bosons in the Standard Model effective field theory framework.

Primary author: Mr LU, Gangcheng (IHEP, CAS)

Presenter: Mr LU, Gangcheng (IHEP, CAS)

Session Classification: Higgs & indirect BSM

Contribution ID: 13

Type: **not specified**

H+HH combination @ ATLAS

Tuesday, 26 July 2022 16:20 (20 minutes)

Constraints on the Higgs boson self-coupling are set by combining the the double-Higgs boson analyses with the single-Higgs boson analyses . The data used by these analyses were recorded by the ATLAS detector at the LHC in proton-proton collisions at $s\sqrt{=13}$ TeV and corresponds to an integrated luminosity of 126-139 fb .

Primary author: HUANG, Yanping (高能所)

Co-author: Dr HE, Mingxu (IHEP)

Presenters: RAN, Kunlin (Beijing); RAN KUNLIN; HUANG, Yanping (高能所)

Session Classification: DiHiggs & BSM

Contribution ID: 14

Type: **not specified**

Searches for Higgs boson pair production in the $\tau\tau+\tau\nu$ final state with 139 fb⁻¹ of pp collision data with the ATLAS detector

Tuesday, 26 July 2022 09:50 (20 minutes)

The Higgs boson (H) was discovered at the Large Hadron Collider (LHC) in 2012, by the ATLAS and CMS collaborations. Many of its properties have been measured (mass, width, branching ratio), but the ultimate test of electroweak symmetry breaking is to reconstruct the Higgs potential, which can be determined from the Higgs boson trilinear self-coupling. This is uniquely accessible in the as-yet-unobserved Di-Higgs production, which is one of the primary physics goals for the High Luminosity LHC (HL-LHC). In this talk, I will present the results of searches for Higgs boson pair production in the $\tau\tau+\tau\nu$ final state at ATLAS. The searches use 139 fb⁻¹ of pp collision data with $\sqrt{s} = 13$ TeV recorded by the ATLAS experiment at the LHC between 2015 and 2018. The semi-leptonic and fully hadronic di-tau final states are considered. Upper limits are set on the non-resonant di-Higgs production cross-section assuming Standard Model kinematics and on the resonant di-Higgs production cross-section as a function of the resonance mass.

Primary author: 李, 致源 (Peking University)

Presenter: 李, 致源 (Peking University)

Session Classification: DiHiggs & BSM

Contribution ID: 15

Type: **not specified**

Search for Higgs pair production in association with a vector boson with the ATLAS detector

Tuesday, 26 July 2022 14:50 (20 minutes)

This talk will present a search for Higgs boson pair (hh) production in association with a vector boson (W or Z) using 139/fb of the proton-proton collision data at $\sqrt{s} = 13\text{TeV}$ recorded with the ATLAS detector. The search is performed in final states in which the vector boson decays leptonically ($W \rightarrow lv$, $Z \rightarrow ll$, $\nu\nu$ with $l = e, \mu$) and the Higgs bosons decay to a pair of b-quarks. It targets Vhh signals from both the Standard Model (SM) like non-resonant hh production and the resonant hh production predicted in some SM extensions. A 95% confidence-level upper limit of 183.5 (86.8) times the SM cross-section is observed (expected) for non-resonant Vhh production when assuming SM-like kinematics. Constraints on Higgs boson coupling modifiers are also set. For the resonant search, upper limits on the production cross-sections are derived for two specific models: one is the production of a vector boson along with a neutral heavy scalar resonance H that decays into hh, and the other is the production of a heavier neutral pseudoscalar resonance A that decays into a Z and H boson. Constraints in the parameter space of two-Higgs-doublet models are also derived.

Primary authors: MA, Lianliang (Shandong University); Mr LI, Tong (Shandong University); XU, Zhongyukun (Shandong University)

Presenter: Mr LI, Tong (Shandong University)

Session Classification: DiHiggs & BSM

Contribution ID: 16

Type: **not specified**

HH Combination in CMS

Tuesday, 26 July 2022 16:00 (20 minutes)

A combined measurement of the HH cross section and Higgs self-coupling was done by CMS at the beginning of 2022, in preparation for the 10th Anniversary of the Higgs discovery. This talk will present these exciting results.

Primary author: WANG, Jin (IHEP)

Presenter: WANG, Jin (IHEP)

Session Classification: DiHiggs & BSM

Contribution ID: 17

Type: **not specified**

Higgs Combination in CMS

Monday, 25 July 2022 15:30 (20 minutes)

This talk will present the latest combined measurement of Higgs cross sections and couplings with decay channels of single Higgs, as well as the constraints of Higgs self-coupling using single Higgs events.

Primary author: MONTI, fabio (高能所)

Presenter: MONTI, fabio (高能所)

Session Classification: Higgs & indirect BSM

Contribution ID: 18

Type: **not specified**

Search for non-resonant and resonant HH in the 4b final state with ATLAS

Tuesday, 26 July 2022 14:30 (20 minutes)

The discovery and properties measurements of the Higgs boson provide a deep understanding of the mechanism of electroweak symmetry breaking. However, the exact shape of the Brout, Englert and Higgs (BEH) potential remains unprobed. One of the parameters that determines its form is the Higgs boson's trilinear self-coupling that can be constrained via Higgs-boson pair (HH) production. This talk will present the most to date ATLAS results of the searches of non-resonant and resonant HH in the 4b final state and the corresponding measurements on the Higgs self-coupling.

Primary author: 张, 瑞 (U)**Presenter:** 张, 瑞 (U)**Session Classification:** DiHiggs & BSM

Contribution ID: 19

Type: **not specified**

Measurement of the Higgs boson differential fiducial cross sections in the four-lepton decay channel in pp collisions at $\sqrt{s} = 13$ TeV

Monday, 25 July 2022 09:45 (20 minutes)

The talk would cover the properties of the Higgs boson measured in the $H \rightarrow ZZ \rightarrow 4\ell$ ($\ell = e, \mu$) decay channel. For this, a data sample of proton-proton collisions at a center-of-mass energy of 13 TeV is used, corresponding to an integrated luminosity of 137 fb^{-1} recorded by the CMS detector at the LHC. In the measurements, the fiducial cross section is reported with respect to several observables sensitive to the production and decay of the Higgs boson, where the results are compared with theory predictions.

Primary authors: Mrs GUO, Qianying (BUAA); Dr JAVAID, Tahir (BUAA)

Presenter: Dr JAVAID, Tahir (BUAA)

Session Classification: Higgs & indirect BSM

Contribution ID: 20

Type: **not specified**

Investigating Higgs self-interaction through di-Higgs plus jet production

Tuesday, 26 July 2022 11:20 (20 minutes)

The Higgs self coupling measurement is quite essential for determining the shape of the Higgs potential and nature of the Higgs boson. We propose the di-Higgs plus jet final states at hadron colliders to increase the discovery sensitivity of the Higgs self coupling at the low invariant mass region. Our simulation indicates that the allowed region of the Higgs self coupling would be further narrowed from $[-1.5, 6.7]$ from the most recent ATLAS report down to $[0.5, 1.7]$. Furthermore, we find negative Higgs self couplings would be disfavored beyond 2σ confidence level at a future 100 TeV collider with the help of this signal.

Primary author: Mr CHAI, kangyu (Theoretical Physics Division, Institute of High Energy Physics, Chinese Academy of Sciences, Beijing 100049, China)

Presenter: Mr CHAI, kangyu (Theoretical Physics Division, Institute of High Energy Physics, Chinese Academy of Sciences, Beijing 100049, China)

Session Classification: DiHiggs & BSM

Contribution ID: 21

Type: **not specified**

Constraining the Higgs-charm coupling at CMS

Monday, 25 July 2022 16:40 (20 minutes)

The Higgs boson couplings to fermions and vector bosons have been well established since its discovery. Measuring the Higgs interaction with the charm quark is one of the next milestones on LHC, yet it is a challenging task due to the small branching ratio of $H \rightarrow c\bar{c}$ and the difficulty in charm tagging. This talk presents the latest search for a Higgs boson decaying to a $c\bar{c}$ pair using the VH modes with the full Run 2 CMS dataset. Novel deep learning methods are applied to the analysis, including identification of the charm or double-charm jet and reconstruction of the jet mass. These novel techniques substantially improve the sensitivity of the search for $H \rightarrow c\bar{c}$ signal, leading to the most strength limit on Higgs-charm Yukawa coupling to date. It also marks the first observation of $Z \rightarrow c\bar{c}$ process at a hadron collider. Besides, the talk sheds light on future perspectives of Higgs-charm coupling measurements in the era of HL-LHC.

Primary author: LI, Congqiao (Peking University)

Presenter: LI, Congqiao (Peking University)

Session Classification: Higgs & indirect BSM

Contribution ID: 22

Type: **not specified**

CP properties measurement of the Higgs boson interaction with τ leptons with the ATLAS detector

The talk will present a measurement of the charge conjugation and parity (CP) properties in the Higgs boson interaction with τ leptons. The study is based on a measurement of CP -sensitive angular observables defined by the visible decay products of tau lepton decays, performed using a data sample corresponding to 139 fb of proton–proton collisions recorded at a center-of-mass energy of $\sqrt{s}=13$ TeV with the ATLAS detector at the Large Hadron Collider. The talk will outline the main part of the analysis, from the reconstruction of the CP -sensitive variables to the event selection and background estimation. The results are extracted from a profile likelihood fit using both signal sensitive regions as well as control regions for the main background processes. The results are compatible with the Standard Model predictions and the analysis is also able to exclude a pure CP -odd hypothesis at the level of 3.4 standard deviations.

Primary author: DE MARIA, Antonio (Nanjing University)

Presenter: DE MARIA, Antonio (Nanjing University)

Contribution ID: 23

Type: **not specified**

Search for scalar leptoquarks in the $b\tau$ final state with the ATLAS detector

Wednesday, 27 July 2022 17:20 (20 minutes)

This talk will present a search for scalar leptoquarks in $b\tau$ final state using a data sample corresponding to 139 fb^{-1} of proton–proton collisions recorded at a center-of-mass energy of $\sqrt{s} = 13 \text{ TeV}$ with the ATLAS detector at the Large Hadron Collider. The signal benchmark model considered is a scalar leptoquark with an electric charge of $4/3e$ and quantum numbers $3_B + L = -2$, which decays exclusively into a b -quark and a tau-lepton. The talk will outline the main part of the analysis, from the event selection to the background estimation and the result extraction through a fit performed on the signal regions.

No significant excess above the Standard Model prediction is observed in the explored leptoquark mass range (0.4–2.5 TeV), and 95% confidence-level upper limits are set on the production cross-section times branching fraction of leptoquarks decaying to $b\tau$. Based on the analysis results leptoquark masses below 1.26 TeV, 1.30 TeV and 1.41 TeV are excluded for a scalar leptoquark Yukawa coupling to b -quark and tau-lepton of 1.0, 1.7 and 2.5, respectively.

Primary author: DE MARIA, Antonio (Nanjing University)

Presenter: DE MARIA, Antonio (Nanjing University)

Session Classification: Direct BSM

Contribution ID: 24

Type: **not specified**

Dihedral Angle Observable for Measuring CP Property of Top-Higgs Interaction

Monday, 25 July 2022 14:30 (20 minutes)

We propose a new dihedral angle observable to measure the CP property of the interaction of top quark and Higgs boson in the $t\bar{t}H$ production at the 14 TeV LHC. We consider two decay modes of the Higgs boson, $H \rightarrow b\bar{b}$ and $H \rightarrow \gamma\gamma$, and show that the dihedral angle distribution is able to distinguish the CP-even and the CP-odd hypothesis at 95% confidence level with an integrated luminosity of $\sim 180 \text{ fb}^{-1}$.

Primary author: Dr ZHANG, Rui (IHEP)

Presenter: Dr ZHANG, Rui (IHEP)

Session Classification: Higgs & indirect BSM

Contribution ID: 25

Type: **not specified**

Measuring CP properties of Higgs boson interactions with τ leptons with the ATLAS detector

Monday, 25 July 2022 14:50 (20 minutes)

This talk will present a measurement of the charge conjugation and parity (CP) properties in the Higgs boson interaction with τ leptons. The Yukawa interaction is generalized with a single mixing angle parameter ϕ_τ to describe CP -odd interactions between the Higgs boson and τ leptons. The study is based on a measurement of CP -sensitive angular observables defined by the visible decay products of τ lepton decays, performed using a data sample corresponding to 139 fb^{-1} of proton–proton collisions recorded at a center-of-mass energy of $\sqrt{s} = 13 \text{ TeV}$ with the ATLAS detector at the Large Hadron Collider.

Without assuming Standard Model hypothesis for the $H \rightarrow \tau\tau$ signal strength, the mixing angle ϕ_τ is measured to be $9 \pm 16^\circ$, with an expected value of $0 \pm 28^\circ$ at the 68% confidence level.

The pure CP -odd hypothesis is disfavoured at 3.4 standard deviations.

The results are compatible with the predictions for the Higgs boson in the Standard Model as well as CP -violating scenarios.

Primary authors: DE MARIA, Antonio (Nanjing University); LI, Huanguo (Nanjing University); ZHANG, Lei (Nanjing University)

Presenter: LI, Huanguo (Nanjing University)

Session Classification: Higgs & indirect BSM

Contribution ID: 26

Type: **not specified**

Higgs boson decay to charmonia via c -quark fragmentation

Monday, 25 July 2022 17:00 (20 minutes)

We calculate the decay branching fractions of the Higgs boson to J/ψ and η_c via the charm-quark fragmentation mechanism for the color-singlet and color-octet states in the framework of non-relativistic QCD.

The decay rates are governed by the charm-quark Yukawa coupling, unlike the decay $H \rightarrow J/\psi + \gamma$, which is dominated by the γ^*-J/ψ mixing.

We find that the decay branching fractions can be about 2×10^{-5} for $H \rightarrow c\bar{c} + J/\psi$, and 6×10^{-5} for $H \rightarrow c\bar{c} + \eta_c$. We comment on the perspective of searching for the Higgs boson to J/ψ transition at the High-Luminosity LHC for testing the charm-quark Yukawa coupling.

Primary author: Prof. HAN, Tao (University of Pittsburgh)

Co-authors: Prof. LEIBOVICH, Adam K. (University of Pittsburgh); Dr TAN, Xiaoze (Harbin Institute of Technology); Dr MA, Yang (University of Pittsburgh)

Presenter: Dr TAN, Xiaoze (Harbin Institute of Technology)

Session Classification: Higgs & indirect BSM

Contribution ID: 27

Type: **not specified**

Primordial black holes from an electroweak phase transition

Wednesday, 27 July 2022 09:50 (20 minutes)

We propose a mechanism that forms primordial black holes (PBHs) via a first-order electroweak phase transition (FOEWPT). The FOEWPT is realized by extending the Standard Model with a real singlet scalar, while the PBH formation is achieved by the collapse of non-topological solitons called Fermi-balls. Such solitons form via trapping fermions in the false vacuum during the FOEWPT, and they eventually collapse into PBHs due to the internal Yukawa attractive force. We demonstrate that a scenario with PBH dark matter candidate can exist, and the typical experimental signals include FOEWPT gravitational waves and the multi-lepton/jet or displaced vertex final states at the LHC.

Primary author: Dr XIE, Ke-Pan (University of Nebraska-Lincoln)

Co-author: Prof. HUANG, Peisi (University of Nebraska-Lincoln)

Presenter: Dr XIE, Ke-Pan (University of Nebraska-Lincoln)

Session Classification: Direct BSM

Contribution ID: 28

Type: **not specified**

Electroweak phase transition in the 2HDM: Collider and Gravitational Wave

Wednesday, 27 July 2022 11:20 (20 minutes)

The knowledge of the Higgs potential is crucial for understanding the origin of mass and the thermal history of our Universe. We show how collider measurements and observations of stochastic gravitational wave signals can complement each other to explore the multiform scalar potential in 2HDM. Accounting for theoretical and current experimental constraints, we analyze the key ingredients in the shape of the Higgs potential triggering the transmutation in phase transition, focusing on the barrier formation and the upliftment of the true vacuum. The strong phase transition regime is favored for lower scalar masses, rendering strong extra motivation for collider searches. We contrast the dominant collider signals at the HL-LHC with observable gravitational wave signal at LISA. We obtain that the HL-LHC will be able to cover a vast range of the strong phase transition parameter space, with scalar decays to heavy fermions being the most promising smoking gun signatures.

Primary authors: KALADHARAN, Ajay (Oklahoma State University); Dr GONVALVES, Dorival (Oklahoma State University); 吴, 永成 (N)

Presenter: 吴, 永成 (N)

Session Classification: Direct BSM

Contribution ID: 29

Type: **not specified**

Search for the Higgs boson pair production in $bb\mu\mu$ Final State at hadron colliders

Tuesday, 26 July 2022 11:40 (20 minutes)

A search for Higgs boson pair production via gluon-gluon and vector boson fusion processes in $bb\mu\mu$ final state at hadron colliders is presented. The search uses Monte Carlo sample simulated from proton-proton collisions with an integrated luminosity of 300 fb^{-1} . An upper limit at 95% confidence level is set on the product of the Higgs boson pair production cross section and branching fraction into $bb\mu\mu$. The expected upper limit is 138 times the SM prediction. The expected 95% CL constraints on κ_λ and κ_{2V} , derived from limits on the HH production cross section, are found to be $-25.9 < \kappa_\lambda < 31.3$ and $-6.4 < \kappa_{2V} < 8.6$, respectively.

Primary authors: GUO, Botao (Peking University); Prof. SUN, Xiaohu (Peking University)

Presenter: GUO, Botao (Peking University)

Session Classification: DiHiggs & BSM

Contribution ID: 30

Type: **not specified**

Searches for FCNC interactions of the top quark with the ATLAS experiment

Wednesday, 27 July 2022 14:50 (20 minutes)

The large integrated luminosity collected by the ATLAS detector at the highest proton-proton collision energy provided by LHC allows to probe the presence of new physics that could enhance the rate of rare processes in the SM. The LHC can therefore gain considerable sensitivity for Flavour Changing Neutral Current (FCNC) interactions of the top quark. In the SM, FCNC involving the top-quark decay to another up-type quark and a neutral boson are so small that any measurable branching ratio for such a decay is an indication of new physics. The ATLAS experiment has performed searches for FCNC couplings of the top quark with a photon, gluon, Z boson or Higgs boson. In this contribution, the most recent results are presented, which include the complete data set of 139/fb at 13 TeV collected at the LHC during run 2 (2015-2018). The large data set, together with improvements in the analysis, yields a strong improvement of the expected sensitivity compared to previous experiments and partial analyses of the LHC data.

Primary author: XIA, mingming (Tsinghua University)

Presenter: XIA, mingming (Tsinghua University)

Session Classification: Direct BSM

Contribution ID: 31

Type: **not specified**

Domain wall network from first-order phase transitions and gravitational waves

In this work, we studied the dynamics of the domain walls formed during the first-order phase transition by lattice simulation, as well as the gravitational waves. The numerical results indicate that the domain walls created during the first-order phase transition evolve into cosmic domain wall network in the case of without the biased term, while the domain walls decay directly and do not form cosmic domain wall network when the biased term is taken into account. We find that the gravitational waves generated by the dynamical evolution of the domain wall are in the same frequency band as those generated by the first-order phase transition, and the gravitational waves generated by the domain wall are dominant.

Primary authors: Mr WEI, dongdong (SYSU); Prof. JIANG, yun (SYSU)

Presenter: Mr WEI, dongdong (SYSU)

Contribution ID: 32

Type: **not specified**

Probing Higgs CP properties at the CEPC

Monday, 25 July 2022 12:25 (20 minutes)

In the Circular Electron Positron Collider (CEPC), a measurement of the Higgs CP mixing through $e^+e^- \rightarrow ZH \rightarrow l^+l^- (\mu^+\mu^-/e^+e^-)H (\rightarrow b\bar{b}/c\bar{c}/gg)$ process is presented, with 5.6 ab^{-1} e^+e^- collision data at the center-of-mass energy of 240 GeV. In this study, the CP -violating parameter $\hat{\alpha}_{AZ}$ is constrained between the region of -6.69×10^{-2} and 6.32×10^{-2} and $\hat{\alpha}_{ZZ}$ between -1.67×10^{-2} and 1.65×10^{-2} at 95% confidence level. This study demonstrates the great potential of probing Higgs CP properties at the CEPC.

Primary author: SHA, Qiyu

Co-authors: Dr LI GANG(EPD.IHEP), Gang (高能所); Prof. GU, Jiayin (Fudan University); Prof. FANG YAQUAN, Yaquan (高能所)

Presenter: SHA, Qiyu

Session Classification: Higgs & indirect BSM

Contribution ID: 33

Type: **not specified**

Dynamics of electroweak phase transitions in the singlet-extend model.

Wednesday, 27 July 2022 09:30 (20 minutes)

It has been demonstrated that first-order phase transitions (PTs) are achievable in a large number of BSM models. However, the successful nucleation of PT vacuum bubbles is often overlooked. Using the singlet model as an example, we will present the possible patterns of PTs achieved and build the connection to the vacuum structure at zero temperature. In this talk we focus on the one-step PTs and discuss the PT dynamics from nucleation and percolation. We find that bubble nucleation may be unsuccessful even though first-order PTs happened, and low temperature PTs favors relatively slow PTs. Finally, we comment on the limitations of studying the physics of PTs using the mean-field approach.

Primary authors: Mr CHEN, Haibin (Sun Yat-sen University); Prof. JIANG, Yun (Sun Yat-sen University)

Presenter: Mr CHEN, Haibin (Sun Yat-sen University)

Session Classification: Direct BSM

Contribution ID: 34

Type: **not specified**

Domain wall networks from first-order phase transitions and produced gravitational waves

Wednesday, 27 July 2022 12:00 (20 minutes)

In the first-order phase transitions (PTs) bubble collision is an important source of gravitational waves (GW). Following this process, the domain walls can be formed when degenerate true vacua occur as a result of the breaking of a discrete symmetry. Using lattice simulations, we study the dynamical evolution of domain walls and compute the produced power spectrum of GWs. It turns out that the network of the domain wall is formed after the completion of PTs and the lifetime of the wall network largely depends on whether or not the degenerate vacua are lifted. We conclude that domain wall networks continue to produce GWs in the aftermath of PTs, leading to dramatically changing the spectral shape and enhancing the magnitude by about one order at lower wave numbers.

Primary authors: Mr WEI, dongdong (SYSU); Prof. JIANG, yun (SYSU)

Presenter: Mr WEI, dongdong (SYSU)

Session Classification: Direct BSM

Contribution ID: 35

Type: **not specified**

Introduction

Monday, 25 July 2022 09:10 (5 minutes)

Presenter: Prof. SUN, Xiaohu (Peking University)

Session Classification: Opening

Contribution ID: 36

Type: **not specified**

Welcome from PKU

Monday, 25 July 2022 09:00 (10 minutes)

Presenter: Prof. MAO, Yajun (Peking University)

Session Classification: Opening

Contribution ID: 37

Type: **not specified**

Gravitational wave searches of the type-II seesaw model

Wednesday, 27 July 2022 11:40 (20 minutes)

In this talk, we will firstly briefly review the type-II seesaw model that is responsible for non-vanishing neutrino masses and the baryon asymmetry of the Universe. Then after discussing its collider signatures, we will explain how to investigate this model using gravitational wave searches at future gravitational wave observatories such as BBO and DECIGO. Time permitting, the complementarity between collider and gravitational wave searches for this model will also be discussed.

This talk is based on: <https://arxiv.org/abs/2203.01561>

Primary author: DU, Yong (ITP CAS)

Co-authors: Dr BIAN, Ligong (ITP/KITPC); ZHOU, Ruiyu (CQUPT)

Presenter: DU, Yong (ITP CAS)

Session Classification: Direct BSM

Contribution ID: **38**

Type: **not specified**

Highlights in CEPC

Monday, 25 July 2022 11:55 (30 minutes)

Invited plenary talk

Presenter: Prof. FANG YAQUAN, Yaquan (高能所)

Session Classification: Higgs & indirect BSM

Contribution ID: 39

Type: **not specified**

Higgs couplings at future colliders

Monday, 25 July 2022 11:25 (30 minutes)

Invited plenary talk

Presenter: LIU, Zhen (FNAL)

Session Classification: Higgs & indirect BSM

Contribution ID: 40

Type: **not specified**

Higgs precision prediction

Monday, 25 July 2022 14:00 (30 minutes)

Invited plenary talk

Presenters: Prof. YANG, Lilin (Zhejiang University); YANG, Lilin (Zhejiang University)

Session Classification: Higgs & indirect BSM

Contribution ID: 41

Type: **not specified**

Higgs precision measurements at CMS and ATLAS

Monday, 25 July 2022 09:15 (30 minutes)

Invited plenary talk

Presenter: SARICA, Ulascan (U)

Session Classification: Higgs & indirect BSM

Contribution ID: 42

Type: **not specified**

Higgs rare decay at CMS and ATLAS

Monday, 25 July 2022 16:10 (30 minutes)

Invited plenary talk

Presenter: ZHOU, Chen (Peking University)

Session Classification: Higgs & indirect BSM

Contribution ID: 43

Type: **not specified**

CP Phases in 2HDM and Effective Potential: A Geometrical View

Wednesday, 27 July 2022 16:20 (20 minutes)

Using a geometric description of 2HDM, we classify CP invariants into three independent sectors such as scalar potential, Yukawa interaction and CKM matrix. Thermal effective potential of 2HDM is calculated in a basis invariant way. It is shown that the CP violation in Yukawa interactions can contribute to effective potential at one loop level but the CP phase in the CKM matrix cannot leak to effective potential at all orders. In the 2HDM with a softly broken Z_2 symmetry, the leading thermal correction tends to restore the CP symmetry at high temperature.

Primary authors: Prof. CAO, Qing-Hong (Peking University); 许, 昌龙 (school of physics Peking University); 程, 程 (北京大学物理学院)

Presenter: 程, 程 (北京大学物理学院)

Session Classification: Direct BSM

Contribution ID: 44

Type: **not specified**

Review of g-2 recent progresses

Wednesday, 27 July 2022 14:00 (30 minutes)

Invited plenary talk

Presenter: Prof. LI, Liang (Shanghai Jiao Tong University)

Session Classification: Direct BSM

Contribution ID: 45

Type: **not specified**

W mass excess and new Higgs beyond SM

Presenter: Prof. HE, Xiao-Gang (SJTU/NCTS)

Contribution ID: 46

Type: **not specified**

BSM Higgs searches at the LHC

Wednesday, 27 July 2022 15:50 (30 minutes)

Invited plenary talk

Presenter: QIAN, Jianming (University of Michigan)

Session Classification: Direct BSM

Contribution ID: 47

Type: **not specified**

W boson mass: EW Fits and New Physics

Wednesday, 27 July 2022 10:50 (30 minutes)

Invited plenary talk

Presenter: Dr WU, Lei (Nanjing Normal University)

Session Classification: Direct BSM

Contribution ID: 48

Type: **not specified**

Higgs Precision Physics at Current and Future Colliders

Tuesday, 26 July 2022 09:00 (30 minutes)

Invited plenary talk

Presenter: Prof. SU, Shufang (University of Arizona)

Session Classification: DiHiggs & BSM

Contribution ID: 49

Type: **not specified**

Phase transition and GW

Tuesday, 26 July 2022 10:50 (30 minutes)

Invited plenary talk

Presenter: HUANG, Fa Peng (Sun Yat-Sen (Zhongshan) University)

Session Classification: DiHiggs & BSM

Contribution ID: 50

Type: **not specified**

The Multi-lepton anomalies at the LHC and implications

Tuesday, 26 July 2022 14:00 (30 minutes)

Invited plenary talk

Presenter: MELLADO, Bruce (University of the Witwatersrand)

Session Classification: DiHiggs & BSM

Contribution ID: 51

Type: **not specified**

Di-Higgs analyses from ATLAS and CMS

Tuesday, 26 July 2022 15:30 (30 minutes)

Invited plenary talk

Presenter: Dr LENEY, Katharine (Southern Methodist University)

Session Classification: DiHiggs & BSM

Contribution ID: 52

Type: **not specified**

Helicity amplitudes without gauge cancellation for electroweak processes

Monday, 25 July 2022 10:25 (20 minutes)

Multiple EW vector boson amplitudes are known to have bad energy behavior for individual Feynman diagrams, which causes many problems for numerical and theoretical analysis. Based on Goldstone equivalence theorem (GET), we introduce a new representation of Feynman rules that makes GET manifest, while reproduces the exact results of the amplitudes. The new helicity has no subtle gauge cancellation, every diagram has a specific physical interpretation. We implement this new Feynman rules into numerical codes of HELAS (Helicity Amplitude Subroutines) and study several processes with the new HELAS.

Primary author: Dr CHEN (谌), Junmou (俊谋) (Jinan University (Guangdong))

Presenter: Dr CHEN (谌), Junmou (俊谋) (Jinan University (Guangdong))

Session Classification: Higgs & indirect BSM

Contribution ID: 53

Type: **not specified**

Geometric and Topological Higgs Mechanisms: Mass Generations and Massive Scattering Amplitudes

Wednesday, 27 July 2022 09:00 (30 minutes)

Invited plenary talk

Presenter: Prof. HE, Hong-Jian (Shanghai Jiao Tong University)

Session Classification: Direct BSM

Contribution ID: 54

Type: **not specified**

Resolving Degenerate 125 GeV Higgs Bosons

Monday, 25 July 2022 10:45 (20 minutes)

The CP property of the 125 GeV Higgs boson remains a mystery nowadays, which implies the possibility of new physics. We consider a scenario that degenerated 125 GeV CP-even and CP-odd Higgs bosons in a CP conserving Lagrangian will contribute to nontrivial CP measurement. We use 2HDM as an example to show that DiHiggs production in future hadron and electron-positron colliders are potentially resolving such cases.

Primary authors: Prof. CAO, Qing-Hong (Peking University); Dr LIU, Yandong (Beijing Normal University); 文, 新锴 (PKU); ZHANG, 昊 (Institute of High Energy Physics, Chinese Academy of Sciences); 许, 昌龙 (school of physics Peking University); 程, 匡 (北京大学物理学院)

Presenter: 许, 昌龙 (school of physics Peking University)

Session Classification: Higgs & indirect BSM

Contribution ID: 55

Type: **not specified**

The Higgs boson: The past, present, and future

Wednesday, 27 July 2022 20:00 (2 hours)

Presenter: Prof. HAN, Tao (Univ. of Pittsburgh & TsingHua University)

Session Classification: Public talk at the 10th anniversary of the Higgs boson discovery

Contribution ID: 56

Type: **not specified**

HiggsPotential2022 summary

Wednesday, 27 July 2022 17:40 (20 minutes)

Presenter: Prof. SUN, Xiaohu (Peking University)

Session Classification: Closing