

The 21st Workshop of the LHC Higgs Working Group

Report of Contributions

Contribution ID: 1

Type: **not specified**

Thursday Plenary 1

Contribution ID: 2

Type: **not specified**

Introduction

Wednesday 4 December 2024 14:00 (10 minutes)

Presenters: CALANDRI, Alessandro (ETH Zuerich); KARLBERG, Alexander (CERN); MISTLBERGER, Bernhard (SLAC); ARNOLD, Hannah (Stony Brook)

Session Classification: Plenary (WG1)

Contribution ID: 3

Type: **not specified**

ggF status report (17'+5')

Wednesday 4 December 2024 14:10 (22 minutes)

Session Classification: Plenary (WG1)

Contribution ID: 4

Type: **not specified**

VBF status report (17+5')

Wednesday 4 December 2024 14:32 (22 minutes)

Presenter: CHEN, Jiayi (Simon Fraser University)

Session Classification: Plenary (WG1)

Contribution ID: 5

Type: **not specified**

VH status report (15'+7')

Wednesday 4 December 2024 14:54 (22 minutes)

Presenter: LIM, Matthew (University of Sussex)

Session Classification: Plenary (WG1)

Contribution ID: 6

Type: **not specified**

ttH/tH status report

Session Classification: Plenary (WG3)

Contribution ID: 7

Type: **not specified**

Off-shell status report

Session Classification: Plenary (WG3)

Contribution ID: 8

Type: **not specified**

BR status report

Session Classification: Plenary (WG3)

Contribution ID: 9

Type: **not specified**

ttH/tH status report (17'+5')

Thursday 5 December 2024 14:00 (22 minutes)

Presenter: KATZY, Judith (DESY)

Session Classification: Plenary (WG1) + Future colliders

Contribution ID: **10**

Type: **not specified**

Off-shell status report (17'+5')

Thursday 5 December 2024 14:22 (22 minutes)

Session Classification: Plenary (WG1) + Future colliders

Contribution ID: 11

Type: **not specified**

BR status report (10'+5')

Thursday 5 December 2024 14:44 (15 minutes)

Presenter: SPIRA, Michael (Paul Scherrer Institute)

Session Classification: Plenary (WG1) + Future colliders

Contribution ID: 12

Type: **not specified**

Overview of HH searches at ATLAS

Friday 6 December 2024 11:00 (15 minutes)

Presenter: RUIZ MARTINEZ, Arantxa (IFIC Valencia)

Session Classification: Plenary (WG4)

Contribution ID: 13

Type: **not specified**

Overview of HH searches at CMS

Friday 6 December 2024 11:15 (15 minutes)

Presenter: LANGE, Torben (National Institute of Chemical Physics and Biophysics, Tallinn)

Session Classification: Plenary (WG4)

Contribution ID: 14

Type: **not specified**

VBF HH with Powheg

Friday 6 December 2024 11:30 (20 minutes)

Presenter: REINHARDT, Simon (University of Tuebingen)

Session Classification: Plenary (WG4)

Contribution ID: 15

Type: **not specified**

NLO EW corrections on ggHH cross section [remote]

Friday 6 December 2024 11:50 (20 minutes)

Presenter: YU, Huai-Min (Peking University)

Session Classification: Plenary (WG4)

Contribution ID: 16

Type: **not specified**

Resonant HH production: interference effects and higher-order corrections

Friday 6 December 2024 12:10 (20 minutes)

Presenter: RADCHENKO SERDULA, Kateryna (DESY)

Session Classification: Plenary (WG4)

Contribution ID: 17

Type: **not specified**

Higgs physics at future colliders (20'+10')

Thursday 5 December 2024 15:00 (30 minutes)

Presenter: MCCULLOUGH, Matthew Philip (CERN)

Session Classification: Plenary (WG1) + Future colliders

Contribution ID: **18**

Type: **not specified**

Updates from PDF global fits

Friday 6 December 2024 09:00 (30 minutes)

Presenter: HUSTON, Joey (Michigan State University)

Session Classification: Cross-topic plenary

Contribution ID: 19

Type: **not specified**

2HDM and 6dim operators to achieve strong-first-order electroweak phase transition

Friday 6 December 2024 09:30 (20 minutes)

Presenter: BIERMANN, Lisa (Paul Scherrer Institute)

Session Classification: Cross-topic plenary

Contribution ID: 20

Type: **not specified**

MSSM working group summary

Wednesday 4 December 2024 16:00 (18 minutes)

Presenter: BAGNASCHI, Emanuele Angelo (INFN Frascati)

Session Classification: Plenary (WG3)

Contribution ID: 21

Type: **not specified**

bbH: subgroup report and NNLO+PS generators in the massless and massive schemes

Wednesday 4 December 2024 16:18 (18 minutes)

We provide an update on the status of Higgs production in association with a bottom-quark pair, highlighting recent developments by the bbH subgroup. We discuss the differences between the two flavour schemes and their state-of-the-art predictions, including cross-section interpolations for 13.6 TeV. Additionally, we report on novel event generators developed in the massless and massive scheme at NNLO QCD accuracy matched to parton showers. We show that NNLO corrections in the 4FS solve the long-standing issue of discrepancies between 4FS and 5FS predictions. Future directions can involve developing consistent combinations of 4FS and 5FS NNLO+PS predictions and extending these calculations to lighter quark flavours.

Presenter: BIELLO, Christian (Max-Planck Institute for Physics)

Session Classification: Plenary (WG3)

Contribution ID: 22

Type: **not specified**

NMSSM subgroup report

Wednesday 4 December 2024 16:36 (18 minutes)

Presenter: MUEHLEITNER, Milada Margarete (KIT)

Session Classification: Plenary (WG3)

Contribution ID: 23

Type: **not specified**

Exotic decays subgroup: Axion-like particle connections to the Higgs and top

Wednesday 4 December 2024 16:54 (18 minutes)

Presenter: BIEKOETTER, Anke (JGU Mainz)

Session Classification: Plenary (WG3)

Contribution ID: 24

Type: **not specified**

Extended scalar sector subgroup report

Wednesday 4 December 2024 17:12 (18 minutes)

Presenter: JAFFEL, Khawla (University of Science and Technology of China)

Session Classification: Plenary (WG3)

Contribution ID: 25

Type: **not specified**

Measurements of Higgs couplings to bosons at ATLAS and CMS

Thursday 5 December 2024 16:00 (22 minutes)

Presenter: DAVIS, Jeffrey (Johns Hopkins)

Session Classification: Plenary (WG2)

Contribution ID: 26

Type: **not specified**

Measurements of Higgs couplings to fermions and interpretations of Higgs XS measurements at ATLAS and CMS

Thursday 5 December 2024 16:22 (22 minutes)

Presenter: JOVICEVIC, Jelena (Institute of Physics, University of Belgrade)

Session Classification: Plenary (WG2)

Contribution ID: 27

Type: **not specified**

BSM & SMEFT Interpretation of Higgs measurements at LHC and HL-LHC

Thursday 5 December 2024 16:44 (22 minutes)

Presenter: MIMASU, Ken (University of Southampton)

Session Classification: Plenary (WG2)

Contribution ID: 28

Type: **not specified**

Non-linear CP violation

Thursday 5 December 2024 17:06 (22 minutes)

Presenter: BHARDWAJ, Akanksha (Oklahoma State University)

Session Classification: Plenary (WG2)

Contribution ID: 29

Type: **not specified**

Introduction

Thursday 5 December 2024 09:00 (10 minutes)

Session Classification: WG4 parallel session

Contribution ID: **30**

Type: **not specified**

STXS Overview

Friday 6 December 2024 09:50 (20 minutes)

Presenter: BONANOMI, Matteo (University of Hamburg)

Session Classification: Cross-topic plenary

Contribution ID: 31

Type: **not specified**

Higgs+charm ATLAS (10'+10')

Thursday 5 December 2024 09:20 (20 minutes)

Presenter: REYNOLDS, Elliot (University of Kansas)

Session Classification: WG1 parallel session

Contribution ID: 32

Type: **not specified**

Higgs+charm CMS (10'+10')

Thursday 5 December 2024 09:40 (20 minutes)

Presenter: BEVILACQUA, Tiziano (University of Zuerich)

Session Classification: WG1 parallel session

Contribution ID: 33

Type: **not specified**

ttHbb highlights/summary of the WG1 - ttH/tH workshop (10'+10')

Thursday 5 December 2024 10:00 (20 minutes)

WG1 ttH/tH workshop: <https://indico.cern.ch/event/1440845/>

Presenter: SCHROEDER, Matthias (University of Hamburg)

Session Classification: WG1 parallel session

Contribution ID: 34

Type: **not specified**

Updated ttHbb results ATLAS (10'+10')

Thursday 5 December 2024 10:20 (20 minutes)

Presenter: FROCH, Alexander (Université de Genève)

Session Classification: WG1 parallel session

Contribution ID: 35

Type: **not specified**

VHcc ATLAS+CMS focusing on modelling uncertainties (20'+10')

Thursday 5 December 2024 10:40 (30 minutes)

Presenter: FENG, Zhuoran (Nikhef)

Session Classification: WG1 parallel session

Contribution ID: 36

Type: **not specified**

VHbb ATLAS+CMS focusing on modelling uncertainties (20'+10')

Thursday 5 December 2024 11:10 (30 minutes)

Presenter: REISSEL, Christina (MIT)

Session Classification: WG1 parallel session

Contribution ID: 37

Type: **not specified**

PDF uncertainties on predictions for Higgs production in gluon-gluon fusion (15'+5')

Thursday 5 December 2024 11:40 (20 minutes)

Lightning talk

Presenter: GARZELLI, Maria Vittoria (University of Hamburg)

Session Classification: WG1 parallel session

Contribution ID: **38**

Type: **not specified**

Triple Higgs searches in ATLAS

Thursday 5 December 2024 09:10 (20 minutes)

Session Classification: WG4 parallel session

Contribution ID: 39

Type: **not specified**

Overview of triple Higgs theory

Thursday 5 December 2024 09:50 (30 minutes)

Presenter: ROBENS, Tania Natalie (Rudjer Boskovic Institute)

Session Classification: WG4 parallel session

Contribution ID: 40

Type: **not specified**

Triple Higgs searches in CMS [tbc]

Thursday 5 December 2024 09:30 (20 minutes)

Session Classification: WG4 parallel session

Contribution ID: 41

Type: **not specified**

Multi-Higgs Production and the Electroweak Phase Transition

Thursday 5 December 2024 10:20 (20 minutes)

Exploring the Higgs sector via multi-Higgs production searches is a main goal for run-3 and high-lumi LHC. Can these searches inform us about the electroweak phase transition and matter-antimatter asymmetry? We address this question in the context of the TRSM (Two-Real-Singlet Model), which has known benchmark points enhancing multi-Higgs production. We update the triple-Higgs production benchmark points to include refined perturbativity bounds and explore the type of electroweak phase transition that occurs in the early universe; whether continuous or the first-order discontinuous phase transition desired for matter-antimatter asymmetry. After presenting our work, I outline lessons on correlating the type of electroweak phase transition and the enhancement of di-Higgs or triple Higgs production, highlighting the importance of the theory's vacuum expectation value of today and the symmetries of the model.

Presenter: KARKOUT, Osama (Nikhef)

Session Classification: WG4 parallel session

Contribution ID: 42

Type: **not specified**

Effect of anomalous HHH and ZZHH couplings on the decay width of $H \rightarrow 4l$ [remote]

Thursday 5 December 2024 10:40 (20 minutes)

Despite the discovery of the Higgs boson, the Higgs sector of the standard model is still not fully established. In particular, the self-couplings of the Higgs boson and its couplings with gauge bosons are still to be fully determined. We consider electroweak corrections to the processes $H \rightarrow \nu e \nu \tilde{\nu} \nu m \nu \tilde{\nu}$ and $H \rightarrow e^+ e^- \mu^+ \mu^-$. The corrections depend on the HHH coupling. We investigate this dependence in the kappa-framework without violating gauge invariance. We find that the width depends on coupling significantly.

Presenter: DAS, Biswajit (The Institute of Mathematical Sciences, Chennai)

Session Classification: WG4 parallel session

Contribution ID: 43

Type: **not specified**

Double Higgs production in vector boson fusion at NLO QCD with anomalous couplings

Thursday 5 December 2024 11:00 (20 minutes)

We present a calculation of the NLO QCD corrections to Higgs boson pair production in vector boson fusion, combined with the leading operators parametrising anomalous interactions in non-linear Effective Field Theory (HEFT). Based on our Monte Carlo implementation using GoSam+Whizard, we investigate the effects of anomalous Higgs couplings on various observables.

Presenter: BRAUN, Jens (KIT)

Session Classification: WG4 parallel session

Contribution ID: 44

Type: **not specified**

Workshop opening

Wednesday 4 December 2024 09:00 (30 minutes)

Session Classification: Opening and joint LHC EFT / LHC Higgs plenary

Contribution ID: 45

Type: **not specified**

Higgs Mass Predictions in the CP-Violating High-Scale NMSSM

Thursday 5 December 2024 09:54 (18 minutes)

In a supersymmetric theory, large mass hierarchies can lead to large uncertainties in fixed-order calculations of the SM-like Higgs mass. A reliable prediction is then obtained by performing the calculation in an effective field theory (EFT) framework, involving the matching to the full supersymmetric theory at the high scale to include contributions from the heavy particles, and a subsequent renormalization-group running down to the low scale. In my talk, I report on the prediction of the SM-like Higgs mass within the CP-violating Next-to-Minimal Supersymmetric extension of the SM (NMSSM) in a scenario where all non-SM particles feature TeV-scale masses. The matching conditions are calculated at full one-loop order using two approaches. These are the matching of the quartic Higgs couplings as well as of the SM-like Higgs pole masses of the low- and high-scale theory. A comparison between the two methods allows for an estimate of the size of terms suppressed by the heavy mass scale that are neglected in a pure EFT calculation as given by the quartic-coupling matching. The calculation is implemented in a new version of the public program package NMSSMCALC.

Presenter: BORSCHEFSKY, Christoph (KIT)

Session Classification: WG3 parallel session

Contribution ID: 46

Type: **not specified**

Recent developments in NMSSMCALC

Thursday 5 December 2024 10:12 (18 minutes)

Supersymmetry is among the most promising BSM frameworks solving many of the SM's theoretical and experimental shortcomings as well as providing a rich phenomenology across all sectors of the theory. The Next-to-Minimal-Supersymmetric-Standard-Model (NMSSM) is a natural successor of minimal supersymmetry providing a richer phenomenology in many regards such as e.g. more sources of CP-violating, scalar states lighter than the SM-like Higgs boson or additional dark matter candidates, to name a few. In order to scrutinize the NMSSM parameter space, precise predictions for a variety of observables within given scenarios are required. The program NMSSMCALC is addressing this demand by implementing precision calculations within the Higgs- and electroweak sector which are continuously improved and extended to match the experimental accuracy. Therefore, NMSSMCALC allows to confront a given benchmark-scenario with experimental observations and check its validity with high confidence.

In this talk we will present recent developments in NMSSMCALC that extend its portfolio by precision predictions for low-energy observables such as the W-boson mass, the muon anomalous magnetic moment or electric dipole moments. Furthermore, we report on improvements for precision predictions in the Higgs sector. Predictions for both, the Higgs boson masses and effective trilinear Higgs couplings have been recently improved at the two-loop level. We discuss the impact of loop-corrected couplings and masses on Higgs-to-Higgs decays, as computed by NMSSMCALC and demonstrate their potential to reduce the theoretical uncertainty of the Higgs boson pair production cross-section.

Presenter: GABELMANN, Martin (DESY)

Session Classification: WG3 parallel session

Contribution ID: 47

Type: **not specified**

Higgs to dark showers

Thursday 5 December 2024 11:44 (18 minutes)

Presenter: SITTI, Emre (ETH Zuerich)

Session Classification: WG3 parallel session

Contribution ID: 48

Type: **not specified**

MSSM Higgs boson production via gluon fusion

Thursday 5 December 2024 10:50 (18 minutes)

Presenter: SPIRA, Michael (Paul Scherrer Institute)

Session Classification: WG3 parallel session

Contribution ID: 49

Type: **not specified**

yt-induced Hbb as a background for HH searches (10' + 10')

Thursday 5 December 2024 09:00 (20 minutes)

Presenter: ZARO, Marco (Università degli Studi and INFN Milano)

Session Classification: WG1 parallel session

Contribution ID: 50

Type: **not specified**

Finite Width and Interference

Friday 6 December 2024 10:10 (20 minutes)

Session Classification: Cross-topic plenary

Contribution ID: 51

Type: **not specified**

Rare and exotic Higgs decays in ATLAS

Thursday 5 December 2024 09:18 (18 minutes)

Presenter: BOYE, Diallo (Brookhaven National Laboratory)

Session Classification: WG3 parallel session

Contribution ID: 52

Type: **not specified**

Exotic Higgs decays in CMS

Thursday 5 December 2024 09:00 (18 minutes)

Presenter: PRAMOD, Lakshmi (DESY)

Session Classification: WG3 parallel session

Contribution ID: 53

Type: **not specified**

Rare and Exclusive Higgs boson decays

Friday 6 December 2024 14:00 (10 minutes)

Presenters: D'ENTERRIA, David (CERN); LE, Van Dung (Ho Chi Minh City University)

Session Classification: Lightning session for LHCHWG Report 5

Contribution ID: 54

Type: **not specified**

Exotic decays of Higgs bosons to ALPS (ATLAS and CMS) (20'+5')

Thursday 5 December 2024 09:00 (25 minutes)

Presenter: TRISCHUK, Dominique (Brandeis University)

Session Classification: WG2 parallel session

Contribution ID: 55

Type: **not specified**

A log story short: running contributions to radiative Higgs decays in SMEFT (20'+5')

Thursday 5 December 2024 09:25 (25 minutes)

Presenter: GUEDES, Guilherme (DESY)

Session Classification: WG2 parallel session

Contribution ID: 56

Type: **not specified**

Interference Effects in $gg \rightarrow H \rightarrow Z\gamma$ Beyond Leading Order (20'+5') [remote]

Thursday 5 December 2024 09:50 (25 minutes)

Presenter: BUCCIONI, Federico (Technical University of Munich)

Session Classification: WG2 parallel session

Contribution ID: 57

Type: **not specified**

CP-sensitive observables in STXS ttH cross sections (20'+5')

Thursday 5 December 2024 10:35 (25 minutes)

Presenter: CARNELLI, Alberto (IRFU Saclay - CNRS)

Session Classification: WG2 parallel session

Contribution ID: **58**

Type: **not specified**

NMSSM MasterCode, Benchmarks for NMSSM

Friday 6 December 2024 14:10 (10 minutes)

Presenter: EGLE, Felix (DESY)

Session Classification: Lightning session for LHCHWG Report 5

Contribution ID: 59

Type: **not specified**

Probing CPV with DPhijj in H->WW (ATLAS) (20'+5')

Thursday 5 December 2024 11:00 (25 minutes)

Presenter: CLARRY, Cameron (University of Toronto)

Session Classification: WG2 parallel session

Contribution ID: **60**

Type: **not specified**

Offshell coupling measurements (CMS) (20'+5')

Thursday 5 December 2024 11:25 (25 minutes)

Presenter: GRITSAN, Andrei (Johns Hopkins)

Session Classification: WG2 parallel session

Contribution ID: **61**

Type: **not specified**

Updates on charged Higgs cross sections

Thursday 5 December 2024 11:08 (18 minutes)

Presenter: BAGNASCHI, Emanuele Angelo (INFN Frascati)

Session Classification: WG3 parallel session

Contribution ID: **62**

Type: **not specified**

Extended scalars and dark matter

Thursday 5 December 2024 11:26 (18 minutes)

Presenter: SANTOS, Rui (ISEL and CFTC-UL)

Session Classification: WG3 parallel session

Contribution ID: 63

Type: **not specified**

LLPs from Exotic Higgs decays using faraway sub-detectors

Thursday 5 December 2024 09:36 (18 minutes)

Presenter: GRIESER, Nathan (University of Cincinnati)

Session Classification: WG3 parallel session

Contribution ID: 64

Type: **not specified**

EFT/Higgs Experimental Summary (20'+10')

Wednesday 4 December 2024 09:30 (30 minutes)

Presenter: PARK, Tae Hyoun (Max-Planck Institute for Physics)

Session Classification: Opening and joint LHC EFT / LHC Higgs plenary

Contribution ID: 65

Type: **not specified**

EFT Meets Cosmology (20'+10')

Wednesday 4 December 2024 10:00 (30 minutes)

Presenter: LÖFGREN, Johan (Uppsala)

Session Classification: Opening and joint LHC EFT / LHC Higgs plenary

Contribution ID: **66**

Type: **not specified**

STXS Predictions (12'+3')

Wednesday 4 December 2024 11:00 (15 minutes)

Presenter: MIMASU, Ken (University of Southampton)

Session Classification: Joint LHC EFT / LHC Higgs plenary

Contribution ID: 67

Type: **not specified**

STXS Interpretation of VH(bb) (15'+5')

Wednesday 4 December 2024 11:15 (20 minutes)

Presenter: CALANDRI, Alessandro (ETH Zuerich)

Session Classification: Joint LHC EFT / LHC Higgs plenary

Contribution ID: **68**

Type: **not specified**

Running Effects in Higgs SMEFT (15'+5')

Wednesday 4 December 2024 11:35 (20 minutes)

Presenter: DI NOI, Stefano (Università and INFN, Padova)

Session Classification: Joint LHC EFT / LHC Higgs plenary

Contribution ID: **69**

Type: **not specified**

SMEFiT (15'+5')

Wednesday 4 December 2024 11:55 (20 minutes)

Presenter: MANTANI, Luca (IFIC Valencia)

Session Classification: Joint LHC EFT / LHC Higgs plenary

Contribution ID: 70

Type: **not specified**

SMEFT/Higgs Experimental Outlook (20'+10')

Wednesday 4 December 2024 12:15 (30 minutes)

Presenter: BOLDRINI, Giacomo (LLR Palaiseau - CNRS)

Session Classification: Joint LHC EFT / LHC Higgs plenary