

Higgs 2022

Report of Contributions

Contribution ID: 8

Type: **not specified**

Higgs-Electroweak Portal to the Dark Sector - REMOTE

Thursday, November 10, 2022 5:20 PM (15 minutes)

Based on arXiv:2110.10691

Type of talk

Theory

Presenter: LI, Lingfeng (Brown U.)

Session Classification: Thursday Session B

Track Classification: Physics Topics: Beyond the Standard Model

Contribution ID: 14

Type: **not specified**

Higgs physics at the FCC-ee

Tuesday, November 8, 2022 12:10 PM (15 minutes)

The FCC-ee offers powerful opportunities to determine the Higgs boson parameters, exploiting over 106 $e^+e^- \rightarrow ZH$ events and almost 105 $WW \rightarrow H$ events at centre-of-mass energies around 240 and 365 GeV. This essay spotlights the important measurements of the ZH production cross section and of the Higgs boson mass. The measurement of the total ZH cross section is an essential input to the absolute determination of the HZZ coupling – a “standard candle” that can be used by all other measurements, including those made at hadron colliders – at the per-mil level. A combination of the measured cross sections at the two different centre-of-mass energies further provides the first evidence for the trilinear Higgs self-coupling, and possibly its first observation if the cross-section measurement can be made accurate enough. The determination of the Higgs boson mass with a precision significantly better than the Higgs boson width (4.1 MeV in the Standard Model) is a prerequisite to either constrain or measure the electron Yukawa coupling via direct $e^+e^- \rightarrow H$ production at $\sqrt{s}=125$ GeV. Approaching the statistical limit of 0.1% and $O(1)$ MeV on the ZH cross section and the Higgs boson mass, respectively, sets highly demanding requirements on accelerator operation (ZH threshold scan, centre-of-mass energy measurement), detector design (lepton momentum resolution, hadronic final state reconstruction performance), theoretical calculations, and analysis techniques (efficiency and purity optimization with modern tools, constrained kinematic fits, control of systematic uncertainties).

Type of talk

Future prospects

Presenter: Prof. DE FILIPPIS, Nicola (Politecnico/INFN Bari (IT))**Session Classification:** Tuesday Session B**Track Classification:** Physics Topics: Future Colliders

Contribution ID: 16

Type: **not specified**

Di-Higgs with missing transverse momentum at FCC-hh

Wednesday, November 9, 2022 2:55 PM (15 minutes)

The determination of the Higgs self-coupling from di-Higgs events with very high precision is one of the clearest benchmarks for the FCC-hh. Its potential has been well established already in several final states. In this talk studies into final states of the di-Higgs system which involve neutrinos are presented. The benefit of studying yet another di-Higgs final state is two-fold: First, any additional events included will add further precision to the measurement. Second, specifically neutrino channels will help to shed light on an experimental aspect for the FCC-hh which has not been well investigated yet: a robust reconstruction of the missing transverse momentum (ET-Miss) is crucial for such analyses. It is clear that ET-Miss reconstruction at the FCC-hh will be extremely challenging due to the high pile-up environment, with average interactions per bunch crossing of the order of 1000. In particular, $bbWW$, $bb\tau\tau$ and $bbZZ$ signals are analysed in the final state with 2 light charged leptons in addition to ET-Miss, using cut-based as well as multivariate techniques. Their expected sensitivity is extracted, and the impact of different scenarios for systematic uncertainties, such as the worsening of the ET-Miss resolution, is assessed.

Type of talk

Future prospects

Primary author: STAPF, Birgit (Deutsches Elektronen-Synchrotron (DE))

Co-authors: GALLO, Elisabetta (DESY); TACKMANN, Kerstin (Deutsches Elektronen-Synchrotron (DE)); LAUDAMUS, Kevin (Hamburg University (DE))

Presenter: STAPF, Birgit (Deutsches Elektronen-Synchrotron (DE))

Session Classification: Wednesday Session B

Track Classification: Physics Topics: Future Colliders

Contribution ID: 21

Type: **not specified**

Sensitivity to New Physics in final states with multiple gauge and Higgs bosons

Tuesday, November 8, 2022 10:40 AM (15 minutes)

We analyse the sensitivity to beyond-the-Standard-Model effects of hadron-collider processes involving the interaction of two electroweak (V) and two Higgs (H) bosons, $VVHH$, with V being either a W or a Z boson.

We examine current experimental results by the CMS collaboration in the context of a dimension-8 extension of the Standard Model in an effective-field-theory formalism. We show that constraints from vector-boson-fusion Higgs-pair production on operators that modify the Standard Model $VVHH$ interactions are already comparable with or more stringent than those quoted in the analysis of vector-boson-scattering final states. We study the modifications of such constraints when introducing unitarity bounds, and investigate the potential of new experimental final states, such as ZHH associated production. Finally, we show perspectives for the high-luminosity phase of the LHC.

Type of talk

Theory

Primary authors: CAPPATI, Alessandra (Centre National de la Recherche Scientifique (FR)); ZARO, Marco (Università degli Studi e INFN Milano (IT)); TORRIELLI, Paolo (Università e INFN Torino (IT)); COVARELLI, Roberto (Università/INFN Torino (IT))

Presenter: CAPPATI, Alessandra (Centre National de la Recherche Scientifique (FR))

Session Classification: Tuesday Session B

Track Classification: Physics Topics: Double Higgs

Contribution ID: 23

Type: **not specified**

Semi-dark Higgs decays: sweeping the Higgs neutrino floor

Thursday, November 10, 2022 5:40 PM (15 minutes)

We study exotic Higgs decays $h \rightarrow ZX$, with X an invisible beyond the Standard Model (SM) particle, resulting in a semi-dark final state. Such exotic Higgs decays may occur in theories of axion-like-particles (ALPs), dark photons or pseudoscalar mediators between the SM and dark matter. The SM process $h \rightarrow Z\nu\bar{\nu}$ represents an irreducible “neutrino floor” background to these new physics searches, providing also a target experimental sensitivity for them. We analyze $h \rightarrow Z + \text{invisible}$ searches at the LHC and a future ILC, showing that these exotic Higgs decays can yield sensitivity to unexplored regions of parameter space for ALPs and dark matter models.

Type of talk

Theory

Primary authors: AGUILAR-SAAVEDRA, Juan Antonio (University of Granada); CANO, Jose Manuel (IFT UAM/CSIC); CERDEÑO, David; NO, Jose Miguel (IFT-UAM/CSIC)

Presenter: CANO, Jose Manuel (IFT UAM/CSIC)

Session Classification: Thursday Session B

Track Classification: Physics Topics: Beyond the Standard Model

Contribution ID: 25

Type: **not specified**

High-energy resummation for Higgs boson plus jets production

Thursday, November 10, 2022 4:20 PM (15 minutes)

At high energies, fixed-order predictions for the production of a Higgs boson together with one or more jets suffer from large logarithms in invariant masses over transverse momenta. We resum these high-energy logarithms to all orders using the High Energy Jets (HEJ) framework, retaining the exact dependence on the top-quark mass. We compare our predictions to ATLAS and CMS measurements at 8 and 13 TeV.

Type of talk

Theory

Primary authors: MAIER, Andreas Martin (DESY); Dr PAPAEFSTATHIOU, Andreas (Kennesaw State University, GA, USA); HASSAN, Hitham (IPPP, University of Durham); SMILLIE, Jennifer (Higgs Centre for Theoretical Physics, Edin. U.); ANDERSEN, Jeppe Rosenkrantz (IPPP, University of Durham); PALTRINIERI, Jérémy (University of Edinburgh)

Presenter: MAIER, Andreas Martin (DESY)

Session Classification: Thursday Session A

Track Classification: Physics Topics: Precision measurements

Contribution ID: 26

Type: **not specified**

Constrain new physics scenarios with enhanced light quark Yukawa couplings in off-shell Higgs production

Wednesday, November 9, 2022 4:45 PM (15 minutes)

We consider the recent measurement of off-shell Higgs production by the CMS collaboration interpreted in terms of a width measurement of the Higgs boson and confront it with new physics in which the light quark Yukawa couplings are strongly enhanced. Even at the HL-LHC light quark Yukawa couplings of the first generation can only be constrained by factors of order a few hundred with respect to their Standard Model value. In what regards off-shell Higgs production, while enhanced light quark Yukawa couplings modify the Higgs width, a straightforward interpretation of the CMS measurement in terms of the width cannot be done as new production channels open up. Instead the dependence of the off-shell measurement on kinematic variables such as the invariant mass of the Z boson pair can be exploited to constrain new physics scenarios with enhanced light quark Yukawa couplings.

Type of talk

Theory

Primary authors: BALZANI, Elisa; GROEBER, Ramona (Università di Padova and INFN, Sezione di Padova); VITTI, Marco

Presenter: BALZANI, Elisa

Session Classification: Wednesday Session A

Track Classification: Physics Topics: Yukawa

Contribution ID: 27

Type: **not specified**

Higgs decay to charmonia and the charm-quark Yukawa coupling

Wednesday, November 9, 2022 2:20 PM (15 minutes)

With the discovery of the Higgs boson at the CERN Large Hadron Collider (LHC), the particle spectrum of the Standard Model (SM) is complete. The next target at the energy frontier will be to study the Higgs properties and to search for the next scale beyond the SM. Experimentally, the $H \rightarrow c\bar{c}$ channel would be extremely difficult to dig out because of both the weak Yukawa coupling and the daunting SM di-jet background. We propose to test the charm-quark Yukawa coupling at the LHC and future hadron colliders with the Higgs boson decay to J/ψ via the charm-quark fragmentation. Using the non-relativistic quantum chromodynamics (NRQCD), we study the Higgs decay channel $H \rightarrow c\bar{c} + J/\psi$ (or η_c), where both the color-singlet and color-octet contributions are considered. 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. Our result opens another door to improve determinations at the LHC of the Higgs Yukawa couplings: the final state from this decay mode is quite distinctive with $J/\psi \rightarrow e^+e^-$, $\mu^+\mu^-$ and the branching fraction is logarithmically enhanced by the charm-quark fragmentation mechanism.

Type of talk

Theory

Primary authors: TAN, Xiaoze (HIT); MA, Yang (University of Pittsburgh)**Co-authors:** LEIBOVICH, Adam (University of Pittsburgh); HAN, Tao**Presenter:** MA, Yang (University of Pittsburgh)**Session Classification:** Wednesday Session A**Track Classification:** Physics Topics: Yukawa

Contribution ID: 29

Type: **not specified**

Evidence of high-energy dynamics in Higgs-plus-jet distributions from LHC to FCC

Thursday, November 10, 2022 3:35 PM (15 minutes)

Recent analyses on high-energy inclusive Higgs-boson rates in proton collisions via the gluon fusion channel, matched with the state-of-the-art fixed-order N³LO accuracy, have shown that the impact of high-energy resummation corrections reaches 10% at the FCC nominal energies. This supports the statement that electroweak physics at 100 TeV is expected to receive relevant contributions from small- x physics. In this talk we will present novel predictions for transverse-momentum and rapidity distributions sensitive to the inclusive emission of a Higgs boson in association with a light-flavored jet in proton collisions, calculated within the NLL accuracy of the energy-logarithmic resummation. We will highlight how high-energy signals for this process are already present and visible at current LHC energies, and they become very important at FCC ones. We come out with the message that the improvement of fixed-order calculations on Higgs-sensitive QCD distributions is a core ingredient to reach the precision level of the description of observables relevant for the Higgs physics at the FCC.

Type of talk

Theory

Primary author: CELIBERTO, Francesco Giovanni (ECT*/FBK Trento & INFN-TIFPA)

Presenter: CELIBERTO, Francesco Giovanni (ECT*/FBK Trento & INFN-TIFPA)

Session Classification: Thursday Session B

Track Classification: Physics Topics: Precision measurements

Contribution ID: 30

Type: **not specified**

No channel left behind: revisiting Vh production at LHC, HL-LHC and FCC-hh

Tuesday, November 8, 2022 11:30 AM (15 minutes)

Diboson production processes provide good targets for precision measurements at present and future hadronic colliders. We consider Vh production, focusing on the $h \rightarrow b\bar{b}$ decay channel, whose sizeable cross section makes it easily accessible at the LHC. We perform an improved analysis combining the 0-, 1- and 2-lepton channels with a scale-invariant b -tagging algorithm that allows us to exploit events with either a boosted Higgs or resolved b -jets. This procedure offers a competitive sensitivity to 4 dimension-6 SMEFT operators, $\mathcal{O}_{\varphi q}^{(3)}$, $\mathcal{O}_{\varphi q}^{(1)}$, $\mathcal{O}_{\varphi u}$ and $\mathcal{O}_{\varphi d}$.

At FCC-hh, the $h \rightarrow b\bar{b}$ decay channel is competitive with the cleaner $h \rightarrow \gamma\gamma$ channel, provided systematic uncertainties can be kept under good control. In this context, we show that a rapidity binning can significantly reduce correlations, improving the sensitivity to $\mathcal{O}_{\varphi q}^{(1)}$ and $\mathcal{O}_{\varphi u}$.

Finally, we assess the impact of the Vh production channel on aTGC measurements, comparing with the determination at lepton colliders.

Based mostly on 2207.YYZZZ (to be published soon) and partially on 2011.13941 and 2004.06122.

Type of talk

Future prospects

Primary author: ROSSIA, Alejo Nahuel (University of Manchester)

Co-authors: GROJEAN, Christophe (DESY (Hamburg) and Humboldt University (Berlin)); BISHARA, Fady (DESY); PANICO, Giuliano (University of Florence and INFN Florence); ENGLERT, Philipp (DESY Hamburg)

Presenter: ROSSIA, Alejo Nahuel (University of Manchester)

Session Classification: Tuesday Session B

Track Classification: Physics Topics: Future Colliders

Contribution ID: 33

Type: **not specified**

On ttW production

Wednesday, November 9, 2022 3:40 PM (15 minutes)

One of the main backgrounds in the multi-lepton decay channels of ttH production is ttW production. There is a slight tension between the theoretical predictions for this processes and what is needed to describe the data. In this talk the main cause for this tension will be outlined, and a solution, based on an improved version of the FxFx merging technique, will be proposed. This talk is based on arXiv:2108.07826.

Type of talk

Theory

Primary author: FREDERIX, Rikkert (Lund University)

Presenter: FREDERIX, Rikkert (Lund University)

Session Classification: Wednesday Session A

Track Classification: Physics Topics: Yukawa

Contribution ID: 36

Type: **not specified**

Higgs studies with ILC

Tuesday, November 8, 2022 12:30 PM (15 minutes)

With technically mature design and well understood physics program, ILC is realistic option for realization of a Higgs factory. With a unique physics reach of a linear collider, ILC meaningfully complement projections for HL-LHC. Energy staged data collection, employment of beam polarization and capability to reach a TeV center-of-mass energy enable unique precision to probe BSM models above the discovery limit as well as to measure the Higgs self-coupling. These and other ILC studies in the Higgs sector will be discussed.

Type of talk

Future prospects

Primary author: MILUTINOVIC-DUMBELOVIC, Gordana (Vinca Institute of Nuclear Sciences, University of Belgrade)

Co-author: Prof. BOZOVIC JELISAVCIC, Ivanka (VINCA Institute of Nuclear Sciences, University of Belgrade (RS))

Presenter: MILUTINOVIC-DUMBELOVIC, Gordana (Vinca Institute of Nuclear Sciences, University of Belgrade)

Session Classification: Tuesday Session B

Track Classification: Physics Topics: Future Colliders

Contribution ID: 38

Type: **not specified**

Precision Higgs Phenomenology at N3LO and beyond

Thursday, November 10, 2022 4:40 PM (15 minutes)

Collider experiments will achieve percent level precision measurements of several processes key to answer some of the most pressing questions of contemporary particle physics. In this talk I will show that the capability to predict and describe such observables at next-to-next-to-next-to-leading order (N3LO) in QCD perturbation theory is crucial to fully exploit these experimental measurements.

I will describe how to compute differential distributions via slicing methods and illustrate the calculation of the N3LO TMD beam functions which were the missing ingredient for extending these techniques to N3LO.

Finally, I will present the recent calculation of the rapidity anomalous dimension (Collins-Soper kernel) to N4LO needed for the resummation of the Higgs transverse momentum spectrum at fourth logarithmic accuracy (N4LL).

Type of talk

Theory

Primary author: VITA, gherardo (SLAC)

Presenter: VITA, gherardo (SLAC)

Session Classification: Thursday Session A

Track Classification: Physics Topics: Precision measurements

Contribution ID: 40

Type: **not specified**

QCD and leading Yukawa corrections to $gg \rightarrow HH$

Thursday, November 10, 2022 6:00 PM (15 minutes)

In this talk, I will present a first look at the two-loop electroweak corrections to Higgs boson pair production in gluon-fusion, which might have a sizeable impact on the cross section. We have performed an analytic calculation of the two-loop diagrams contributing to $gg \rightarrow HH$ where a virtual Higgs boson is exchanged in the top quark loop. I will briefly describe our method used to solve massive two-loop box integrals and then discuss results for the form factors. We show that precise results can be obtained, even for $p_t \approx 100$ GeV and above.

Type of talk

Theory

Primary authors: ZHANG, Hantian (Karlsruhe Institute of Technology); DAVIES, Joshua; MISHIMA, Go; SCHÖNWALD, Kay; STEINHAUSER, Matthias (KIT)

Presenter: ZHANG, Hantian (Karlsruhe Institute of Technology)

Session Classification: Thursday Session A

Track Classification: Physics Topics: Double Higgs

Contribution ID: 42

Type: **not specified**

Higgs and scalar extensions of the SM

Thursday, November 10, 2022 11:00 AM (20 minutes)

Type of talk

Presenter: LEWIS, Ian (The University of Kansas)

Session Classification: Thursday Plenary Session

Contribution ID: 43

Type: **not specified**

An overview on low mass scalars at future lepton colliders

Thursday, November 10, 2022 2:55 PM (15 minutes)

Although many suggestions for BSM searches at future colliders exist, most of them concentrate on additional scalars that have masses higher than the current SM scalar mass. I will give a short overview on the current status of models and searches for scalars with masses below this. Based on <https://arxiv.org/abs/2205.09687>

Type of talk

Future prospects

Primary author: ROBENS, Tania Natalie (Rudjer Boskovic Institute (HR))

Presenter: ROBENS, Tania Natalie (Rudjer Boskovic Institute (HR))

Session Classification: Thursday Session B

Track Classification: Physics Topics: Beyond the Standard Model

Contribution ID: 45

Type: **not specified**

Two-loop QCD amplitudes for Higgs production with a bottom quark pair

Wednesday, November 9, 2022 3:20 PM (15 minutes)

I present the computation of the two-loop helicity amplitudes for Higgs boson production in association with a bottom quark pair. This work is of relevance to the precision studies of the bottom-quark Yukawa coupling, such as the analysis of new physics models which modify the strength of this coupling. I give an overview of the method and describe how we overcome the computational bottlenecks by using finite field reconstruction and the method of differential equations. The results are presented in terms of special functions suitable for numerical evaluation across the full physical phase space, making them useful for phenomenological applications.

This talk is based on arXiv:2107.14733

Type of talk

Theory

Primary authors: BADGER, Simon David (Universita e INFN Torino (IT)); HARTANTO, Heribertus Bayu (Cambridge University); KRYS, Jakub Marcin; ZOIA, Simone

Presenter: KRYS, Jakub Marcin

Session Classification: Wednesday Session A

Track Classification: Physics Topics: Precision measurements

Contribution ID: 47

Type: **not specified**

Higgs and supersymmetric extensions of the SM

Thursday, November 10, 2022 10:00 AM (20 minutes)

Type of talk

Presenter: RZEHAK, Heidi Angelika

Session Classification: Thursday Plenary Session

Contribution ID: 48

Type: **not specified**

HH: theory predictions in SM and EFT

Friday, November 11, 2022 11:00 AM (20 minutes)

Type of talk

Presenters: SCYBOZ, Ludovic Michel; SCYBOZ, Ludovic Michel (Max-Planck-Institut für Physik (DE)); SCYBOZ, Ludovic (University of Oxford); SCYBOZ, Ludovic

Session Classification: Friday Plenary Session

Contribution ID: 49

Type: **not specified**

The geometric SMEFT

Tuesday, November 8, 2022 5:15 PM (20 minutes)

Type of talk

Presenter: MARTIN, Adam Orion (University of Notre Dame (US))

Session Classification: Tuesday Plenary Session

Contribution ID: 50

Type: **not specified**

Higgs and BSM at Future colliders

Friday, November 11, 2022 11:30 AM (20 minutes)

Type of talk

Presenter: FRANCESCHINI, Roberto (Rome 3 U.)

Session Classification: Friday Plenary Session

Contribution ID: 51

Type: **not specified**

Higgs as portal to dark sectors

Thursday, November 10, 2022 11:30 AM (20 minutes)

Type of talk

Presenter: SALVIONI, Ennio (Universita e INFN, Padova (IT))

Session Classification: Thursday Plenary Session

Contribution ID: 52

Type: **not specified**

Higher-order predictions for Higgs processes

Monday, November 7, 2022 5:40 PM (20 minutes)

Type of talk

Presenter: HARLANDER, Robert Valentin (Rheinisch Westfaelische Tech. Hoch. (DE))

Session Classification: Monday Plenary session

Contribution ID: 53

Type: **not specified**

Improving parton showers for Higgs

Wednesday, November 9, 2022 9:30 AM (20 minutes)

Type of talk

Presenter: VAN BEEKVELD, Melissa Corona (Nikhef National institute for subatomic physics (NL))

Session Classification: Wednesday Plenary Session

Contribution ID: 54

Type: **not specified**

Interplay of Higgs and top quark physics

Wednesday, November 9, 2022 12:30 PM (20 minutes)

Type of talk

Presenter: VRYONIDOU, Eleni (University of Manchester (GB))

Session Classification: Wednesday Plenary Session

Contribution ID: 55

Type: **not specified**

Higgs and recent anomalies

Friday, November 11, 2022 12:00 PM (20 minutes)

Type of talk

Presenter: MARZOCCA, David (INFN Trieste)

Session Classification: Friday Plenary Session

Contribution ID: 56

Type: **not specified**

Higgs as a probe of electroweak baryogenesis

Thursday, November 10, 2022 12:00 PM (20 minutes)

Type of talk

Presenter: SENAHA, Eibun (Van Lang University)

Session Classification: Thursday Plenary Session

Contribution ID: 57

Type: **not specified**

Higgs and BSM at Future colliders (TBC)

Type of talk

Presenter: FRANCESCHINI, Roberto (Rome 3 U.)

Session Classification: Thursday Plenary Session

Contribution ID: 58

Type: **not specified**

Higgs couplings to fermions - REMOTE

Tuesday, November 8, 2022 3:45 PM (20 minutes)

Type of talk

Presenter: HAN, Tao

Session Classification: Tuesday Plenary Session

Contribution ID: 59

Type: **not specified**

(ATLAS+CMS) Properties of the Higgs boson (mass, width)

Monday, November 7, 2022 3:40 PM (20 minutes)

Type of talk

Presenter: VANLAER, Pascal (Universite Libre de Bruxelles (BE))

Session Classification: Monday Plenary session

Contribution ID: **60**

Type: **not specified**

(ATLAS+CMS) Studies of Higgs boson CP

Monday, November 7, 2022 5:10 PM (20 minutes)

Type of talk

Presenter: TAREK, Ahmed (Michigan State University (US))

Session Classification: Monday Plenary session

Contribution ID: **61**

Type: **not specified**

(ATLAS+CMS) Higgs cross section measurements

Monday, November 7, 2022 3:10 PM (20 minutes)

Type of talk

Presenter: DITTMER, Susan J (University of Illinois at Chicago (US))

Session Classification: Monday Plenary session

Contribution ID: 62

Type: **not specified**

(ATLAS+CMS) Measurements of Higgs couplings

Monday, November 7, 2022 4:40 PM (20 minutes)

Type of talk

Presenters: ROSATI, Stefano (Sapienza Universita e INFN, Roma I (IT)); ROSATI, Stefano (Istituto Nazionale di Fisica Nucleare Sezione di Roma 1)

Session Classification: Monday Plenary session

Contribution ID: **63**

Type: **not specified**

(ATLAS+CMS) EFT results from Higgs and beyond

Tuesday, November 8, 2022 4:45 PM (20 minutes)

Type of talk

Presenter: PIACQUADIO, Giacinto (State University of New York (US))

Session Classification: Tuesday Plenary Session

Contribution ID: 64

Type: **not specified**

(ATLAS+CMS) Rare channels ($\mu\mu$, $Z\gamma$, $H\gamma$, J/ψ)

Tuesday, November 8, 2022 3:15 PM (20 minutes)

Type of talk

Presenter: UMORET, Giulio (Universita e INFN Torino (IT))

Session Classification: Tuesday Plenary Session

Contribution ID: 65

Type: **not specified**

(ATLAS+CMS) Higgs coupling to b and c quarks

Tuesday, November 8, 2022 2:15 PM (20 minutes)

Type of talk

Presenter: CALANDRI, Alessandro (Eidgenoessische Technische Hochschule Zuerich (CH))

Session Classification: Tuesday Plenary Session

Contribution ID: **66**

Type: **not specified**

(ATLAS+CMS) Higgs boson production via ttH

Tuesday, November 8, 2022 2:45 PM (20 minutes)

Type of talk

Presenters: KATZY, Judith (DESY, HAMBURG); KATZY, Judith (Deutsches Elektronen-Synchrotron (DE))

Session Classification: Tuesday Plenary Session

Contribution ID: 67

Type: **not specified**

(ATLAS+CMS) Boosted jets and substructures for Higgs physics

Wednesday, November 9, 2022 9:00 AM (20 minutes)

Type of talk

Presenter: SMITH, Nick (Fermi National Accelerator Lab. (US))

Session Classification: Wednesday Plenary Session

Contribution ID: **68**

Type: **not specified**

(ATLAS+CMS) Higgs self-coupling

Wednesday, November 9, 2022 12:00 PM (20 minutes)

Type of talk

Presenter: Prof. DE FILIPPIS, Nicola (Politecnico/INFN Bari (IT))

Session Classification: Wednesday Plenary Session

Contribution ID: **69**

Type: **not specified**

(ATLAS+CMS) Search for resonances in HH/HV final states

Friday, November 11, 2022 9:30 AM (20 minutes)

Type of talk

Presenter: D'ONOFRIO, Adelina (Universita e INFN Roma Tre (IT))

Session Classification: Friday Plenary Session

Contribution ID: 71

Type: **not specified**

(ATLAS+CMS) Charged and neutral Higgs-like particles

Thursday, November 10, 2022 9:00 AM (20 minutes)

Type of talk

Presenter: KLIMEK, Pawel Jan (CERN)

Session Classification: Thursday Plenary Session

Contribution ID: 72

Type: **not specified**

(ATLAS+CMS) Progresses in signal and background modeling and recent measurements of background processes

Wednesday, November 9, 2022 10:00 AM (20 minutes)

Type of talk

Presenter: CUETO GOMEZ, Ana Rosario (CERN)

Session Classification: Wednesday Plenary Session

Contribution ID: 73

Type: **not specified**

(ATLAS+CMS+LHCb) Exotic and invisible decays of the observed Higgs boson - REMOTE

Thursday, November 10, 2022 9:30 AM (20 minutes)

Type of talk

Presenter: KHAZAIE, Elham (Isfahan University of Technology (IR))

Session Classification: Thursday Plenary Session

Contribution ID: 74

Type: **not specified**

(ATLAS+CMS+LHCb) Higgs in the light of Run 3, Run 4 and beyond

Friday, November 11, 2022 9:00 AM (20 minutes)

Type of talk

Presenter: MORANGE, Nicolas (Université Paris-Saclay (FR))

Session Classification: Friday Plenary Session

Contribution ID: 75

Type: **not specified**

Evolution of experimental techniques in Higgs analyses since discovery

Friday, November 11, 2022 1:40 PM (30 minutes)

Type of talk

Presenters: CERUTTI, Fabio (Lawrence Berkeley National Lab. (US)); CHERNYAVSKAYA, Nadya (CERN)

Session Classification: Friday Plenary Session

Contribution ID: 77

Type: **not specified**

Challenges in combinations of different Higgs measurements from different experiments

Friday, November 11, 2022 2:20 PM (30 minutes)

Type of talk

Presenters: MARINI, Andrea Carlo (CERN); DI NARDO, Roberto (Università e INFN Roma Tre (IT))

Session Classification: Friday Plenary Session

Contribution ID: 78

Type: **not specified**

The next decades in Higgs physics

Friday, November 11, 2022 3:40 PM (30 minutes)

Type of talk

Presenter: DAWSON, Sally

Session Classification: Friday Plenary Session

Contribution ID: 79

Type: **not specified**

Prospects on Higgs measurements at future colliders

Friday, November 11, 2022 3:00 PM (30 minutes)

Type of talk

Presenter: ROLOFF, Philipp (CERN)

Session Classification: Friday Plenary Session

Contribution ID: 82

Type: **not specified**

Constraining SMEFT four-quark operators via Higgs+jet production at NLO

Tuesday, November 8, 2022 9:00 AM (15 minutes)

Higgs data can provide better constraints on some top quark operators than top data. Since in Higgs observables various SMEFT operators enter, differential Higgs data might prove useful in global fits including those operators. In addition, such analysis could shed light on the chiral structure of the (eventual) heavy new physics beyond the Standard Model.

We calculate the dominant contributions of third generation four-quark operators to Higgs+jet production. They enter via loop corrections

to the (partonic) processes $gg \rightarrow gH$, $q\bar{q} \rightarrow gH$, $q(\bar{q})g \rightarrow q(\bar{q})H$, whose dominant Standard Model amplitude arises at one-loop level. Consequently, the inclusion of NLO ($\mathcal{O}(1/\Lambda^2)$) contributions to these processes requires a two-loop computation.

Our analysis consists in computing the matrix elements and, subsequently, the (hadronic) cross section via Monte Carlo integration. Finally we perform a fit to put bounds on the considered SMEFT coefficients.

Type of talk

Theory

Primary authors: GROEBER, Ramona (Università di Padova and INFN, Sezione di Padova); DI NOI, Stefano (Università di Padova and INFN, Sezione di Padova)

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

Session Classification: Tuesday Session B

Track Classification: Physics Topics: Effective Field Theory

Contribution ID: 83

Type: **not specified**

Gluon Jet Sphericity as a New Observable to Probe the CP Structure of Higgs-top Coupling - REMOTE

Wednesday, November 9, 2022 4:00 PM (15 minutes)

It is an important task in the SM to constrain the CP property of the Higgs boson, which still exhibits a large uncertainty. We propose a novel observable at the LHC to probe the CP structure of Higgs coupling to the top quark by employing the linear polarization of gluon jets. The linear polarization induces a preferred direction for the azimuthal energy distribution in the gluon jet, which corresponds directly to the CP phase of the Higgs-top coupling. By constructing an infrared safe transverse sphericity observable for the gluon jet, we show that this new approach has a significant power in constraining the CP property of Higgs boson, complementary to the methods that are currently used in the experimental analysis.

Type of talk

Theory

Primary author: YU, Zhite

Co-authors: YUAN, C.-P. (Michigan State University); MOHAN, Kirtimaan Ajaykant

Presenter: YU, Zhite

Session Classification: Wednesday Session A

Track Classification: Physics Topics: Yukawa

Contribution ID: **86**

Type: **not specified**

Higgs physics 10 years after the discovery

Monday, November 7, 2022 2:30 PM (30 minutes)

Type of talk

Presenters: ZANDERIGHI, Giulia (Max Planck Society (DE)); ZANDERIGHI, Giulia (CERN)

Session Classification: Monday Plenary session

Contribution ID: 87

Type: **not specified**

Gluon fusion into HH and ZH at NLO QCD

Thursday, November 10, 2022 5:20 PM (15 minutes)

We present the calculation of the virtual QCD corrections to $gg \rightarrow HH$ and $gg \rightarrow ZH$. The results are obtained combining an expansion in the small transverse momentum of the final particles with an expansion valid at high energies, and extending the range of validity of both expansions using Padé approximants. This approach can reproduce the available numerical results retaining the exact top quark mass dependence with an accuracy below the 1% level. In the case of ZH production, we use our results to obtain an analytical evaluation of the $gg \rightarrow ZH$ channel at NLO in QCD, including the effects of the change of the top quark mass renormalization scheme.

Type of talk

Theory

Primary authors: BELLAFRONTE, LUIGI (IGFAE); VITTI, Marco**Presenters:** BELLAFRONTE, LUIGI (IGFAE); VITTI, Marco**Session Classification:** Thursday Session A**Track Classification:** Physics Topics: Double Higgs

Contribution ID: 91

Type: **not specified**

YSF: Higgs pair production in SMEFT at full NLO QCD: an investigation of truncation effects

Wednesday, November 9, 2022 3:35 PM (12 minutes)

We present results for Higgs boson pair production in gluon fusion at NLO (2-loop) QCD including operators in the Standard Model Effective Field Theory (SMEFT) framework.

Contributions from subsets of higher order terms in $\frac{1}{\Lambda^2}$, such as squared dimension-6 operators at cross section level and double operator insertions at amplitude level, are used as a proxy for the study of truncation effects of the SMEFT expansion. The different truncation options are contrasted to the non-linear Higgs Effective Field Theory (HEFT) framework for selected phenomenological examples.

Type of talk

Theory

Primary author: LANG, Jannis

Co-authors: HEINRICH, Gudrun (KIT); SCYBOZ, Ludovic

Presenter: LANG, Jannis

Session Classification: Wednesday Session B

Track Classification: Physics Topics: Effective Field Theory

Contribution ID: 92

Type: **not specified**

Probing extended Higgs models with the non-decoupling effect by future collider and cosmological experiments

Thursday, November 10, 2022 3:15 PM (15 minutes)

We discuss theoretical and experimental constraints on extended Higgs models with large quantum corrections. Such large quantum effects play an important role to realize the strongly first-order electroweak phase transition. We use a new Higgs EFT describing the strongly first-order phase transition in order to discuss model independent results. We show that the parameter region satisfying the sphaleron decoupling condition can be searched by future collider experiments, gravitational wave observations and primordial black hole observations. This talk is based on the following reference and work:

[1] S. Kanemura, R. Nagai and M. Tanaka, JHEP 06 (2022) 027 [arXiv: 2202.12774].

[2] K. Hashino, S. Kanemura, T. Takahashi and M. Tanaka, Work in progress.

Type of talk

Theory

Primary author: TANAKA, Masanori

Co-authors: HASHINO, Katsuya (Tokyo University of Science); Prof. KANEMURA, Shinya (Osaka University); Prof. TAKAHASHI, Tomo (Saga University)

Presenter: TANAKA, Masanori

Session Classification: Thursday Session B

Track Classification: Physics Topics: Beyond the Standard Model

Contribution ID: 94

Type: **not specified**

Bayesian vs Frequentist approach in SMEFT global analyses

Tuesday, November 8, 2022 9:20 AM (15 minutes)

We present an updated global SMEFT analysis in the Higgs and Electroweak sectors with the SFitter framework.

The main result we present is the comparison of the results obtained with a frequentist and with a bayesian approach. The implementation of Bayesian inference in the SFitter framework is one of the main novelties of this work, and it is motivated by its greater scalability to large-dimensional fits and faster numerical convergence, compared to the frequentist likelihood treatment.

Further, we include new measurements for the Full Run II data published in recent years by the LHC experiments. We will stress the importance of a careful uncertainty treatment in this context, particularly of flat theory uncertainties. We will also discuss the impact of high invariant mass measurements on kinematically enhanced operators.

Finally, we enlarge the set of constrained operators to include corrections to the muon Yukawa coupling and to the top chromomagnetic dipole moment.

Type of talk

Theory

Primary authors: GEOFFRAY, Emma (Heidelberg University); BRIVIO, Ilaria (University of Zurich); LUCHMANN, Michel (Universität Heidelberg); ELMER, Nina Marie; BRUGGISSER, Sebastian (University Heidelberg); PLEHN, Tilman

Presenter: ELMER, Nina Marie

Session Classification: Tuesday Session B

Track Classification: Physics Topics: Effective Field Theory

Contribution ID: 95

Type: **not specified**

The bottom quark mass from Higgs measurements

Tuesday, November 8, 2022 12:10 PM (15 minutes)

The measurement of the $H \rightarrow b\bar{b}$ decay rate by ATLAS and CMS offers an opportunity to test the scale evolution or “running” of the bottom quark mass. With an excellent mass sensitivity, reduced dependence on α_s and a clearly identifiable scale, the Higgs decay process is the ideal laboratory to extract a high-scale quark mass. The mass at the scale given by the Higgs boson mass, $m_b(m_H)$ is determined to be 2.6 ± 0.3 GeV. Combining this new measurement with the determination of $m_b(m_b)$ from low-energy data and $m_b(m_Z)$ from LEP and SLD measurements at the Z-pole, we revisit the scale evolution of the bottom quark mass, finding an unambiguous confirmation of this SM prediction. The result from PRL128 (2021) is updated with the latest results by ATLAS and CMS and projections of the future precision at the HL-LHC and a future Higgs/top/EW factory are presented.

Type of talk

Experimental measurements

Primary author: SPIRA, Michael (Paul Scherrer Institute (CH))**Presenter:** SPIRA, Michael (Paul Scherrer Institute (CH))**Session Classification:** Tuesday Session A**Track Classification:** Physics Topics: Yukawa

Contribution ID: 96

Type: **not specified**

Measuring the Higgs Trilinear Self-Coupling at the FCC-ee

The determination of the Higgs self-couplings are of primary importance in particle physics and cosmology. They characterise the Higgs potential and thus the electroweak symmetry breaking mechanism. Moreover, the structure of the potential could shed some light on the naturalness problem and the self-couplings control the properties of the electroweak phase transition, determining its possible relevance for baryogenesis. Sizeable deviations in the Higgs self-couplings are expected in several Beyond the Standard Model scenarios, including Higgs portal models or theories with Higgs compositeness. All of these considerations motivate the effort spent investigating the achievable precision on the Higgs self-interactions at future collider experiments. Here we will report on our investigation of the measurement of the Standard Model Higgs trilinear self-coupling parameter at the FCC-ee using single Higgs production channels, via its production cross section. We have introduced several Higgs boson production channels at $\sqrt{s} = 240, 365$ GeV, used improved Monte Carlo samples including initial and final state radiation and a new orthogonal categorization of events. The Higgs boson mass was constrained to be within 5.6 MeV around the nominal value of 125 GeV at 68% CL using inclusive leptonic Higgsstrahlung channels at both energies. We used inclusive Higgsstrahlung (leptonic and hadronic) and exclusive vector boson fusion channels in a combined analysis to extract the sensitivity on the respective cross sections as well as on the trilinear self-coupling. We show that the signal strength modifiers used to estimate the precision on the Higgsstrahlung and vector boson fusion production cross sections could be measured with sub-percent and percent precision at the FCC-ee under the assumption that the decay of the Higgs boson follows the Standard Model expectation. In a similar manner, we extracted the Higgs boson trilinear self-coupling κ_λ using one-loop corrections to the leading order Feynman diagrams of Higgsstrahlung and vector boson fusion. Results are obtained assuming all couplings except for κ_λ are set to the Standard Model values.

Type of talk

Future prospects

Primary authors: HÄRRINGER, Nico; SALERNO, Roberto (CNRS/IN2P3 - LLR, École polytechnique); LEMMON, Roy Crawford (STFC Daresbury Laboratory (GB)); SASIKUMAR, Swathi (Max-Planck-Institute for Physics)

Presenter: LEMMON, Roy Crawford (STFC Daresbury Laboratory (GB))

Session Classification: Wednesday Session B

Track Classification: Physics Topics: Future Colliders

Contribution ID: 98

Type: **not specified**

Reasons for HEFT: why we may need more than SMEFT

Tuesday, November 8, 2022 10:20 AM (15 minutes)

The electroweak symmetry-breaking sector is one of the most promising and uncharted parts of the Standard Model; but it seems likely that new electroweak physics may be out of reach of the present accelerator effort

and the hope is to observe small deviations from the SM. Given that, Effective Field Theory becomes the logic method to use, and SMEFT has become the standard. However, the most general theory with the known particle content is HEFT, and whether SMEFT suffices should be investigated in future experimental efforts. Building on investigations by other groups that established geometric criteria to distinguish SMEFT from HEFT (useful for theorists examining specific beyond-SM completions), we seek more phenomenological understanding and present an analogous discussion aimed at a broader audience. We discuss various aspects of (multi-) Higgs boson production from longitudinal electroweak gauge bosons

$W_L W_L \rightarrow n \times h$ in the TeV region as the necessary information to characterise the Flare function, $\mathcal{F}(h)$, which determines whether SMEFT or HEFT is needed. We also present tree-level amplitudes including contact and exchange channels, as well as a short discussion on accessing \mathcal{F} from the statistical limit of many bosons. We discuss the status of the coefficients of the series expansion of $\mathcal{F}(h)$, its validity, whether its complex-h extension can be used to predict or not a tell-tale zero, and how they relate to the dimension-6 and -8 SMEFT

operators in the electroweak sector. We derive a set of new correlations among BSM corrections to the HEFT coefficients that help decide, from experimental data, whether we have a viable SMEFT. This analysis can be

useful for machines beyond the LHC that could address the challenging final state with several Higgs boson.

Type of talk

Theory

Primary authors: SALAS-BERNÁRDEZ, Alexandre (Universidad Complutense de Madrid); LLANES-ESTRADA, Felipe J.; SANZ-CILLERO, Juan José (Universidad Complutense de Madrid & IPARCOS); Dr GOMEZ AMBROSIO, Raquel (Milano Bicocca)

Presenter: SANZ-CILLERO, Juan José (Universidad Complutense de Madrid & IPARCOS)

Session Classification: Tuesday Session B

Track Classification: Physics Topics: Effective Field Theory

Contribution ID: **101**Type: **not specified**

Search for a sub-GeV Higgs portal scalar decaying to dileptons in MicroBooNE

Thursday, November 10, 2022 5:00 PM (15 minutes)

The MicroBooNE detector is a 60 m³ active volume liquid argon time projection chamber located at Fermilab approximately 100 m from a high intensity stopped kaon source. We use this setup to search for a light, long-lived scalar boson that mixes with the Higgs boson and could be produced in rare kaon decays. We present results of our search for different dilepton signatures of these scalar boson decays, and set world-leading direct limits on the Higgs–scalar mixing angle for scalar boson masses below 275 MeV.

Type of talk

Experimental measurements

Primary author: GUZOWSKI, Pawel (The University of Manchester)

Presenter: GUZOWSKI, Pawel (The University of Manchester)

Session Classification: Thursday Session B

Track Classification: Physics Topics: Beyond the Standard Model

Contribution ID: 103

Type: **not specified**

CMS ECAL techniques, calibration and performance towards run 3

Tuesday, November 8, 2022 12:30 PM (15 minutes)

Many physics analyses using the CMS detector at the LHC require accurate, high resolution electron and photon energy measurements. Excellent energy resolution is crucial for studies of Higgs boson decays with electromagnetic particles in the final state, as well as searches for very high mass resonances decaying to energetic photons or electrons. The CMS electromagnetic calorimeter (ECAL) is a fundamental component of these analyses, and its energy resolution is crucial for the Higgs boson mass measurement in the $H \rightarrow ZZ \rightarrow 4l$ and $H \rightarrow gg$ channels.

The energy response of the calorimeter has been precisely calibrated exploiting the full Run 2 (2015-18) dataset, and has been used for the legacy reprocessing of these data. A dedicated calibration of each detector channel has been performed. This talk will summarize the improved ECAL performance that has been achieved, and will describe how this impacts on the sensitivity of the Higgs mass measurement in the $H \rightarrow ZZ \rightarrow 4l$ and $H \rightarrow gg$ channels. The calibration plans currently being developed to achieve and maintain the optimum ECAL performance during LHC Run 3 (2022-25) will also be discussed. A new system has been developed to automatically execute the calibration workflows on a daily basis during data taking in Run 3. This new development aims to reduce the time needed to provide the best possible performance for physics analyses by one order of magnitude. The general structure of the system will be presented, along with results from the first year of operation in 2022.

Nearly all physics analyses at CMS rely on the precise reconstruction of particles from their signatures observed in the experiment's calorimeters. This involves both energy reconstruction, including the recovery of energy lost in gaps and cracks within the detector volumes, and particle identification. These tasks have traditionally been performed by classical algorithms and BDT regressions, both of which rely on human-engineered high-level quantities.

Bypassing human "feature engineering", and instead training deep learning algorithms on low-level signals, has the potential to recover lost information and improve the overall reconstruction performance. We have developed novel algorithms for particle reconstruction in the CMS calorimeters based on graph neural networks (GNNs) which allow us to represent the energy deposits recorded in the calorimeter directly in our models. We have also developed end-to-end mass regression techniques using convolutional neural networks (CNNs), that allow us to reconstruct merged photons from highly Lorentz-boosted decays, such as $H \rightarrow aa \rightarrow 4g$, using low-level detector information.

In this work we will show the performance of our machine learning architectures in energy clustering, energy estimation and mass regression in the CMS Electromagnetic Calorimeter (ECAL). We will demonstrate the impact of these techniques in terms of improved energy resolution, significantly improved mass resolution for merged photon decays, and better resilience to effects such as detector gaps, early showering upstream of the calorimeter, and pileup, with respect to the previous state-of-the-art approaches.

Type of talk

Experimental measurements

Presenter: JAIN, Shilpi (Science and Technology Facilities Council STFC (GB))

Session Classification: Tuesday Session A

Track Classification: Physics Topics: Precision measurements

Contribution ID: 105

Type: **not specified**

Higgs boson measurements in the VBF production mode at CMS

Tuesday, November 8, 2022 10:20 AM (15 minutes)

The VBF production mode has the 2nd largest production cross section for Higgs bosons in the SM at the LHC, and provides a way to study the Higgs boson's interactions with vector bosons. In this talk, recent measurements of the VBF Higgs boson production mode at CMS will be discussed. All measurements make use of data collected during Run 2 of the LHC.

Type of talk

Experimental measurements

Presenter: MUKHERJEE, Soumya (Tata Inst. of Fundamental Research (IN))

Session Classification: Tuesday Session A

Track Classification: Physics Topics: Precision measurements

Contribution ID: 106

Type: **not specified**

Constraints on anomalous Higgs boson couplings and EFT with the CMS experiment

Tuesday, November 8, 2022 9:40 AM (15 minutes)

We present the most recent searches for CP and anomalous couplings (AC) in Higgs boson production and decay. Couplings of the Higgs boson to both vector bosons and fermions will be discussed in various production channels and final states. The results have been performed with data from the full CMS Run 2 dataset, corresponding to an integrated luminosity of 138 fb^{-1} at a center-of-mass energy of 13 TeV. They significantly improve upon previous constraints. Results in the context of effective field theories (EFT) will also be presented.

Type of talk

Experimental measurements

Presenter: URDA, Lourdes (CIEMAT (Madrid))

Session Classification: Tuesday Session B

Track Classification: Physics Topics: Effective Field Theory

Contribution ID: 107

Type: **not specified**

Higgs mass measurement and its prospects in the four-lepton final state at CMS - REMOTE

Tuesday, November 8, 2022 9:20 AM (15 minutes)

The latest measurement of the Higgs mass in the 4l final state at CMS will be presented. The prospects with the HL-LHC on the Higgs mass sensitivity will also be shown.

Type of talk

Experimental measurements

Presenter: ZHANG, Chenguang (Chinese Academy of Sciences (CN))

Session Classification: Tuesday Session A

Track Classification: Physics Topics: Precision measurements

Contribution ID: **108**Type: **not specified**

Higgs boson differential cross section measurement in the 4ℓ final state

Tuesday, November 8, 2022 10:00 AM (15 minutes)

The most recent fiducial differential cross section measurements performed in the $H \rightarrow ZZ \rightarrow 4\ell$ ($\ell = e, \mu$) decay channel are presented. The results have been obtained using data collected by the CMS experiment, corresponding to an integrated luminosity of 138 fb^{-1} at a centre of mass energy of 13 TeV. The fiducial cross section is measured with respect to several observables sensitive to the production and decay of the Higgs boson, where the observed results are compared with different theory predictions. A summary of possible interpretations of the obtained results is also presented.

Type of talk

Experimental measurements

Presenter: TARABINI, Alessandro (LLR, École polytechnique (FR))

Session Classification: Tuesday Session A

Track Classification: Physics Topics: Precision measurements

Contribution ID: 109

Type: **not specified**

Summary of the CMS Higgs and di-Higgs searches in bb final state including boosted topologies

Tuesday, November 8, 2022 11:50 AM (15 minutes)

This talk will present the latest CMS results on the measurement of Higgs boson production with $H \rightarrow bb$ decays. It will consider the Higgs boson production via gluon fusion in the boosted topology (ggF Hbb), via vector boson fusion (VBF Hbb), in association with a vector boson (VH Hbb), and with a top quark pair (ttHbb). In addition, the talk will discuss the latest results of the search for the non-resonant HH production in the $4b$ final state with full Run 2 LHC data.

Type of talk

Experimental measurements

Presenter: HAUBRICH, Nicholas Joseph (Princeton University (US))

Session Classification: Tuesday Session A

Track Classification: Physics Topics: Yukawa

Contribution ID: 110

Type: **not specified**

Single H combinations from CMS

Tuesday, November 8, 2022 11:30 AM (15 minutes)

Recent years have seen an unprecedented development of techniques devoted to identifying jets from the hadronization of heavy flavor quarks. This was made possible by the extensive usage of modern machine learning techniques. In particular, the identification of heavy resonance final states involving a pair of bottom or charm quarks largely benefited from these developments. In addition, boosted topologies have also been explored in the di-tau final state. For this case dedicated tau reconstruction techniques were developed to resolve tau leptons stemming from the decay of a highly boosted Higgs boson. This talk presents a compendium of the most recent CMS analyses searching for Higgs bosons decaying into bottom or charm quark-antiquark pairs, or pairs of tau leptons, in the boosted regime by exploiting the main production modes: gluon-fusion (ggH), associated production (VH), and vector boson fusion (VBF). The techniques employed for flavor tagging will in particular be discussed. The analyses have been carried out exploiting the full Run-2 dataset collected by the CMS experiment at $\sqrt{s}=13$ TeV.

Type of talk

Experimental measurements

Presenter: LENZI, Piergiulio (Universita e INFN, Firenze (IT))**Session Classification:** Tuesday Session A**Track Classification:** Physics Topics: Precision measurements

Contribution ID: 111

Type: **not specified**

CMS searches for the Higgs boson decay into charm quark-antiquark pair

Wednesday, November 9, 2022 2:40 PM (15 minutes)

The most recent direct searches for the $H \rightarrow c\bar{c}$ process by the CMS Collaboration will be presented. The results are obtained using the full Run 2 LHC data collected in proton-proton collisions at a center of mass energy of 13 TeV, targeting the associated production of the Higgs boson with a Vector boson (W or Z boson) and, for the first time, the gluon fusion production mechanism. To fully exploit the Higgs decay topology in the different regimes of the Higgs boson transverse momentum, two strategies have been adopted for the Higgs candidate reconstruction; Either as two well-separated and individually resolved small-radius jets or as a single large-radius jet, which is more relevant for Higgs bosons with higher momentum. The analyses build on novel machine learning-based algorithms for charm quark(s) identification, and jet and mass regression. The analyses are validated by observing the VZ, $Z \rightarrow c\bar{c}$, and the Drell-Yan, $Z \rightarrow c\bar{c}$ processes for the first time at a hadron collider experiment. The results represent the world's most stringent constraints on Higgs-charm Yukawa coupling.

Type of talk

Experimental measurements

Presenter: STAMENKOVIC, Marko (Brown University (US))

Session Classification: Wednesday Session A

Track Classification: Physics Topics: Yukawa

Contribution ID: 112

Type: **not specified**

YSF: Search for a pair of pseudoscalars in decays of the Higgs boson in CMS

Thursday, November 10, 2022 2:00 PM (12 minutes)

Several Beyond Standard Model theories motivate an extended Higgs sector. Searches for additional Higgs bosons, based on these predictions, constitute an intensive subject of study within CMS. The two Higgs doublet models (2HDM) are by now heavily constrained. But models, where the two Higgs doublets are extended by one additional Higgs singlet complex field (2HDM+S), remain consistent with SM measurements as well as constraints from searches for additional Higgs bosons and supersymmetry with a considerable phase-space still unconstrained. The Higgs sector of the 2HDM+S models features seven physical states: three CP-even, two CP-odd, and two charged bosons. The current constraints from H(125) couplings measurements allow a non-negligible branching fraction for H(125) decays into non-SM particles, thus making the lightest pseudoscalar boson of the 2HDM+1S models, a_1 , potentially accessible in the $H(125) \rightarrow a_1 a_1$ decay, with a sufficiently high rate to be detected at the LHC. This talk will present an overview of the searches performed in CMS on exotic decays of the Higgs boson to a pair of pseudoscalars during the Run 2 data-taking period. It will cover the wide spectrum of probed decay channels which span an extensive range of masses of the pseudoscalar boson from very boosted to non-boosted topologies.

Type of talk

Experimental measurements

Presenter: PRAMOD, Lakshmi (Deutsches Elektronen-Synchrotron (DE))

Session Classification: Thursday Session B

Track Classification: Physics Topics: Beyond the Standard Model

Contribution ID: 113

Type: **not specified**

Measurement of the Higgs boson inclusive and differential fiducial production cross sections in the diphoton decay channel

Thursday, November 10, 2022 2:35 PM (15 minutes)

Measurements of the inclusive and differential fiducial cross sections of Higgs boson decaying to a pair of photons are presented. The analysis is performed using proton-proton collisions data recorded with the CMS detector at the LHC at a centre-of-mass energy of 13 TeV and corresponding to an integrated luminosity of 138 fb⁻¹. The measurements performed in fiducial regions target different production modes and are performed as function of several observables describing the diphoton system, the number of additional jets present in the events, and event-level observables. Two double differential measurements are also performed.

Type of talk

Experimental measurements

Presenter: MAZUMDAR, Kajari (Tata Inst. of Fundamental Research (IN))

Session Classification: Thursday Session A

Track Classification: Physics Topics: Precision measurements

Contribution ID: 114

Type: **not specified**

CMS di-Higgs searches in final states with two photons

Wednesday, November 9, 2022 5:10 PM (15 minutes)

This talk will present the latest CMS results on the search of non-resonant and resonant di-Higgs production, with one of the Higgs boson decaying to a pair of photons. The search for resonant di-Higgs production covers both the final state with two 125 GeV Higgs bosons as well as the final state with a 125 GeV Higgs boson and a different new scalar. The diphoton decay channel has excellent mass resolution and relatively low background and is hence the most sensitive or amongst the most sensitive final states for these searches.

Type of talk

Experimental measurements

Presenter: Mr WANG, Chu (Chinese Academy of Sciences (CN))

Session Classification: Wednesday Session B

Track Classification: Physics Topics: Double Higgs

Contribution ID: 115

Type: **not specified**

Searches for Higgs boson pair production in final states with two bottom quarks and two tau leptons and in multilepton final states at CMS

Wednesday, November 9, 2022 4:30 PM (15 minutes)

The latest results on non-resonant Higgs boson pairs (HH) production in the bbtatau final state (where one Higgs boson decays into a pair of bottom quarks and the other decays into a pair of tau leptons) as well as in the multilepton final state will be presented. Both the gluon fusion and vector boson fusion production mechanisms are investigated. The bbtatau final state gives a good trade-off between a sizeable branching fraction (7.3%) and the purity of the tautau selection. This purity makes the bbtatau channel one of the most sensitive among those studied. These results considerably improve the latest ones published in 2016, profiting both from increased luminosity and novel analysis techniques that enhance the sensitivity of the search, i.e. extensive use of machine learning techniques for both event selection and signal extraction. The multilepton analysis selects 2-4 leptons and targets final states with 4 W bosons, 2 W bosons and 2 tau leptons, or 4 tau leptons.

Type of talk

Experimental measurements

Presenter: LEON HOLGADO, Jaime (CIEMAT - Centro de Investigaciones Energéticas Medioambientales y Tec. (ES))

Session Classification: Wednesday Session B

Track Classification: Physics Topics: Double Higgs

Contribution ID: 117

Type: **not specified**

Searches for additional heavy Higgs bosons

Thursday, November 10, 2022 2:15 PM (15 minutes)

Extensions of the Standard Model Higgs sector with a second Higgs doublet allow for the existence of charged Higgs bosons as well as heavy pseudoscalar Higgs bosons. The heavy pseudoscalars can decay into a Z boson and a lighter scalar Higgs boson, which could be either the established 125 GeV state, or a new heavier sibling. Charged Higgs bosons are probed in various final states, including decays to a W boson and another lighter scalar. This presentation discusses recent results from the CMS experiment based on the Run 2 dataset.

Type of talk

Experimental measurements

Presenter: LEYVA PERNIA, Daina (Deutsches Elektronen-Synchrotron (DE))**Session Classification:** Thursday Session B**Track Classification:** Physics Topics: Beyond the Standard Model

Contribution ID: 118

Type: **not specified**

Searches for Higgs to invisible at CMS

Wednesday, November 9, 2022 5:25 PM (15 minutes)

Although the Higgs boson decay to four neutrinos predicted by the SM is inaccessibly small at the LHC, the Higgs boson branching fraction to invisible detector signatures can be significantly enhanced under various BSM scenarios. Searches for Higgs to invisible probe in particular Higgs portal models where the Higgs boson couples directly to dark matter, and the resulting constraints from the LHC explore a complementary dark matter candidate mass region lower than is accessible by the direct detection experiments. A summary of the latest searches for Higgs boson decays to invisible signatures is presented, using the full Run-2 dataset collected by the CMS experiment.

Type of talk

Experimental measurements

Presenter: WHITE, Robert Stephen (University of Bristol (GB))**Session Classification:** Wednesday Session A**Track Classification:** Physics Topics: Beyond the Standard Model

Contribution ID: 119

Type: **not specified**

Searches for light neutral bosons of an extended Higgs sector via decays of the SM-like Higgs boson

Thursday, November 10, 2022 4:40 PM (15 minutes)

Extensions of the Higgs sector beyond the standard model, in particular models with two Higgs doublets and possibly additional singlets, predict the existence of additional particles in the Higgs sector. These additional particles include a neutral Higgs boson with a large allowed mass region. When the mass of the neutral Higgs boson is less than half the Higgs boson mass, an important search channel is via decays of the SM-like Higgs boson that include these additional neutral bosons. These decays leave a rich variety of possible experimental signatures, with the dominant decay mode depending on the neutral Higgs boson mass range. This talk summarizes the latest search results for light neutral Higgs bosons via SM-like Higgs boson decays, using the full LHC Run-2 dataset collected by the CMS experiment.

Type of talk

Experimental measurements

Presenter: SAWANT, Siddhesh (Baylor University (US))

Session Classification: Thursday Session B

Track Classification: Physics Topics: Beyond the Standard Model

Contribution ID: 120

Type: **not specified**

Recent STXS measurements from CMS

Thursday, November 10, 2022 3:35 PM (15 minutes)

With the large data set collected during Run 2 of the LHC, it is possible to go beyond inclusive Higgs boson cross section measurements. One way in which this is done is through the simplified template cross sections (STXS), which make use of several variables to divide up the phase space of the different Higgs boson production modes. The binning is designed to be particularly sensitive to possible BSM effects. This talk will discuss the latest STXS measurements from the CMS experiment, for example in the $H \rightarrow \tau\tau$ and $H \rightarrow WW$ decay channels. The analysis techniques used to optimise the sensitivity to the different STXS bins will also be described.

Type of talk

Experimental measurements

Presenter: NIGAMOVA, Aliya (University of Hamburg (DE))

Session Classification: Thursday Session A

Track Classification: Physics Topics: Precision measurements

Contribution ID: 121

Type: **not specified**

HH combinations from CMS

Wednesday, November 9, 2022 5:30 PM (15 minutes)

At the LHC, a large range of different Higgs boson production modes and decay channels are studied. To obtain a full overview of the couplings between the Higgs boson and other particles, the data from these individual measurements of production and decay channels are combined. This is also the case for searches for HH production, where even more different final state combinations are possible, and where the best sensitivity is also reached by combining data from all these different channels. This talk focusses on the most recent combined measurements of single Higgs boson production and decay modes, as well as combined measurements of double Higgs boson production, with the CMS experiment. Constraints on the couplings between the Higgs boson and other SM particles, and on the Higgs boson self-interaction, will be presented.

Type of talk

Experimental measurements

Presenter: WANG, Jin (Chinese Academy of Sciences (CN))**Session Classification:** Wednesday Session B**Track Classification:** Physics Topics: Double Higgs

Contribution ID: 122

Type: **not specified**

ZH production in gluon fusion at NLO QCD

Thursday, November 10, 2022 5:00 PM (15 minutes)

We present NLO QCD corrections to ZH production in gluon fusion, including the effects of the top-quark mass. Our results are obtained by combining virtual corrections evaluated numerically using sector decomposition with virtual corrections obtained in an high-energy expansion.

We discuss the uncertainties related to the top-quark mass renormalization scheme and we present phenomenological results.

Type of talk

Theory

Primary author: KERNER, Matthias (Karlsruhe Institute of Technology)**Presenter:** KERNER, Matthias (Karlsruhe Institute of Technology)**Session Classification:** Thursday Session A**Track Classification:** Physics Topics: Precision measurements

Contribution ID: 124

Type: **not specified**

YSF: Search for a dark photon in resonant mono-photon signatures from Higgs boson decays

Thursday, November 10, 2022 6:00 PM (12 minutes)

The search for dark photon (γ_d) in resonant mono-photon signatures from the Higgs boson decay $H \rightarrow \gamma \gamma_d$ in the ZH production mode with $Z \rightarrow \ell\ell$ has been performed using 139 fb⁻¹ of proton-proton collision data recorded with the ATLAS detector at a centre-of-mass energy $\sqrt{s} = 13$ TeV at the Large Hadron Collider during the 2015-2018 Run 2. A global fit to the Boosted Decision Tree (BDT) score, including all background processes, has been performed to estimate the excess of events that could be interpreted as a possible signature of $H \rightarrow \gamma \gamma_d$ in the final state. Dominant backgrounds, consisting in fake E_{miss} and $e \rightarrow \gamma$, have been estimated using data-driven techniques: an ABCD method has been implemented for fake E_{miss} while $e \rightarrow \gamma$ fake-rates have been estimated via $Z \rightarrow ee$ boson decay and applied in dedicated probe- e CRs. Results covering a γ_d mass range from massless up to 40 GeV are provided in terms of limits on the branching ratio of such a decay mode of the Higgs boson.

Type of talk

Experimental measurements

Presenter: PIAZZA, Federica (Università degli Studi e INFN Milano (IT))**Session Classification:** Thursday Session B**Track Classification:** Physics Topics: Beyond the Standard Model

Contribution ID: 125

Type: **not specified**

Exotic decays of the Higgs bosons

Wednesday, November 9, 2022 5:05 PM (15 minutes)

Precision studies of the properties of the Higgs bosons may provide a unique window for the discovery of new physics at the LHC. New phenomena can in particular be revealed in the search for lepton-flavor-violating or exotic decays of the Higgs bosons, as well as in their possible couplings to hidden-sector states that do not interact under Standard Model gauge transformations. This talk presents recent searches by the ATLAS experiment for decays of the Higgs bosons to new particles, using collision data at $\sqrt{s} = 13$ TeV collected during the LHC Run 2.

Type of talk

Experimental measurements

Presenter: SEBASTIANI, Cristiano (University of Liverpool (GB))

Session Classification: Wednesday Session A

Track Classification: Physics Topics: Beyond the Standard Model

Contribution ID: 126

Type: **not specified**

Searches for resonances decaying to pairs of Higgs boson in ATLAS

Wednesday, November 9, 2022 4:50 PM (15 minutes)

Several physics scenarios beyond the Standard Model predict the existence of new particles that can subsequently decay into a pair of Higgs bosons. This talk summarises ATLAS searches for resonant HH production with LHC Run 2 data. Several final states are considered, arising from various combinations of Higgs boson decays.

Type of talk

Experimental measurements

Presenter: BALUNAS, William (University of Cambridge (GB))

Session Classification: Wednesday Session B

Track Classification: Physics Topics: Double Higgs

Contribution ID: 128

Type: **not specified**

Searches for additional Higgs bosons in ATLAS

Thursday, November 10, 2022 2:35 PM (15 minutes)

The discovery of the Higgs boson with the mass of about 125 GeV completed the particle content predicted by the Standard Model. Even though this model is well established and consistent with many measurements, it is not capable to solely explain some observations. Many extensions of the Standard Model addressing such shortcomings introduce additional neutral Higgs-like bosons. The current status of searches for such new neutral Higgs bosons based on the full LHC Run 2 dataset of the ATLAS experiment at 13 TeV are presented.

Type of talk

Experimental measurements

Presenter: LI, Ke (University of Washington (US))**Session Classification:** Thursday Session B**Track Classification:** Physics Topics: Beyond the Standard Model

Contribution ID: 129

Type: **not specified**

Prospects for single- and di-Higgs measurements at the HL-LHC with the ATLAS and CMS experiments

Wednesday, November 9, 2022 3:15 PM (15 minutes)

The large dataset of about 3 ab^{-1} that will be collected at the High Luminosity LHC (HL-LHC) will be used to measure Higgs boson processes in detail. Studies based on current analyses have been carried out to understand the expected precision and limitations of these measurements. The large dataset will also allow for better sensitivity to di-Higgs processes and the Higgs boson self coupling. This talk will present the prospects for Higgs and di-Higgs results with the ATLAS detector at the HL-LHC.

Type of talk

Future prospects

Presenter: VERNIERI, Caterina (SLAC National Accelerator Laboratory (US))

Session Classification: Wednesday Session B

Track Classification: Physics Topics: Future Colliders

Contribution ID: 130

Type: **not specified**

Probing the nature of electroweak symmetry breaking with Higgs boson pairs in ATLAS

Wednesday, November 9, 2022 5:50 PM (15 minutes)

In the Standard Model, the ground state of the Higgs field is not found at zero but instead corresponds to one of the degenerate solutions minimising the Higgs potential. In turn, this spontaneous electroweak symmetry breaking provides a mechanism for the mass generation of nearly all fundamental particles. The Standard Model makes a definite prediction for the Higgs boson self-coupling and thereby the shape of the Higgs potential. Experimentally, both can be probed through the production of Higgs boson pairs (HH), a rare process that presently receives a lot of attention at the LHC. In this talk, the latest HH searches by the ATLAS experiment are reported, with emphasis on the results obtained with the full LHC Run 2 dataset at 13 TeV. Non-resonant HH search results are interpreted both in terms of sensitivity to the Standard Model and as limits on the Higgs boson self-coupling. The Higgs boson self-coupling can be also constrained by exploiting higher-order electroweak corrections to single Higgs boson production. A combined measurement of both results yields the overall highest precision, and reduces model dependence by allowing for the simultaneous determination of the single Higgs boson couplings. Results for this combined measurement are also presented.

Type of talk

Experimental measurements

Presenter: VEATCH, Jason Robert (California State University (US))

Session Classification: Wednesday Session B

Track Classification: Physics Topics: Double Higgs

Contribution ID: 131

Type: **not specified**

Combined measurements of Higgs boson coupling and cross section with the ATLAS detector

Tuesday, November 8, 2022 9:40 AM (15 minutes)

With the full Run 2 pp collision dataset collected at 13 TeV, very detailed measurements of Higgs boson coupling and kinematical properties can be performed, exploiting a variety of final states and production modes, probing different regions of the phase space with increasing precision. Coupling, fiducial and differential measurements can then be combined to exploit the specific strength of each channel, thus providing the most stringent global measurement of the Higgs properties. This talk presents the latest combination of Higgs boson coupling measurements by the ATLAS experiment, discussing results in term of production modes, branching fractions and Simplified Template Cross Sections, as well as their interpretations in the framework of kappa modifiers to the strength of the various coupling and decay properties; and the latest combination of the Higgs boson fiducial and differential cross sections in various Higgs boson decays, as well as their combination and interpretations in term of constrain of beyond-the-Standard-Model phenomena.

Type of talk

Experimental measurements

Presenter: MUSKINJA, Miha (Lawrence Berkeley National Lab. (US))

Session Classification: Tuesday Session A

Track Classification: Physics Topics: Precision measurements

Contribution ID: 132

Type: **not specified**

Measurements and interpretations of Simplified Template Cross Sections, differential and fiducial cross sections in Higgs boson decays to two photons with the ATLAS detector - REMOTE

Thursday, November 10, 2022 2:55 PM (15 minutes)

Higgs boson decays to two photons can be selected with high efficiency, and the very good invariant mass resolution allows a robust subtraction of the continuous backgrounds, making this channel an excellent tool both for precision measurements and searches for new phenomena involving the Higgs boson. This talk presents measurements of Simplified Template Cross Sections, differential and fiducial cross sections, as measured in the diphoton decay channel by the ATLAS experiment using the full Run 2 dataset of pp collision data collected at 13 TeV at the LHC, as well as generic searches for BSM phenomena where the Higgs boson is produced in association with other objects and decays in photon pairs. Measurements are further interpreted in the context of an Effective Field Theory.

Type of talk

Experimental measurements

Presenters: SCHWARZ, Thomas Andrew (Fermi National Accelerator Lab. (US)); SCHWARZ, Thomas Andrew (University of Michigan (US))

Session Classification: Thursday Session A

Track Classification: Physics Topics: Precision measurements

Contribution ID: 133

Type: **not specified**

Measurements and interpretations of Simplified Template Cross Sections and differential and fiducial cross sections in Higgs boson decays to two W bosons with the ATLAS detector

Thursday, November 10, 2022 3:15 PM (15 minutes)

The Higgs boson decays to two W bosons has the largest bosonic branching fraction and can be used to perform some of the most precise measurements of the Higgs boson production cross sections. This talk will present Higgs boson cross section measurements by the ATLAS experiment in the $H \rightarrow WW^*$ decay channel using pp collision data collected at 13 TeV, including those for different Higgs boson production processes in the Simplified Template Cross Section framework, and fiducial and differential cross-sections.

Type of talk

Experimental measurements

Presenter: CARNESALE, Maria (Sapienza Universita e INFN, Roma I (IT))

Session Classification: Thursday Session A

Track Classification: Physics Topics: Precision measurements

Contribution ID: 135

Type: **not specified**

Measurement of Higgs boson mass and width using bosonic decay channels with the ATLAS detector

Tuesday, November 8, 2022 9:00 AM (15 minutes)

The mass of the Higgs boson can be measured in the Higgs to four leptons and Higgs to two photons decay channels, where the excellent mass resolution can be used to reconstruct the Higgs boson invariant mass. The same decays can be used to measure the Higgs boson natural width, either by exploiting the offshell Higgs contribution to the four leptons and two leptons plus two neutrinos production at high mass, or the interference of the Higgs to diphotons decay with the diphotons continuous production. This talk presents the most recent measurements of Higgs boson mass and width by the ATLAS experiment exploiting the Higgs boson decays into two photons or four leptons, using the full Run 2 dataset of pp collisions collected at 13 TeV at the LHC. This talk also reviews recent improvements of the muon reconstruction, identification and momentum calibration in ATLAS, crucial to the measurement of the Higgs boson mass in the four-lepton channel. New analysis techniques are exploited, including multivariate analyses for rejecting background hadrons from prompt muons from the hard interactions, as well as in-situ corrections significantly reducing biases in muon momenta induced by residual detector displacements

Type of talk

Experimental measurements

Presenter: ARTONI, Giacomo (Sapienza Universita e INFN, Roma I (IT))**Session Classification:** Tuesday Session A**Track Classification:** Physics Topics: Precision measurements

Contribution ID: 136

Type: **not specified**

Measurement of CP properties of the Higgs boson coupling to weak bosons using diphoton and four lepton decays at the ATLAS experiment

Thursday, November 10, 2022 2:15 PM (15 minutes)

The CP properties of the Higgs boson couplings to weak bosons can be probed in production by exploiting the Vector Boson Fusion process, or by studying the properties of the Higgs decay to two Z bosons. This talk presents the measurement of the CP properties to weak bosons by the ATLAS experiment using Higgs to two photon decays in VBF production, or Higgs to four leptons decays, and the full Run 2 dataset of pp collisions collected at 13 TeV at the LHC. The results are provided in the framework of Effective Field Theories.

Type of talk

Experimental measurements

Presenter: COELHO LOPES DE SA, Rafael (University of Massachusetts (US))

Session Classification: Thursday Session A

Track Classification: Physics Topics: Effective Field Theory

Contribution ID: 137

Type: **not specified**

YSF: Search for Lepton-Flavour-Violating Decays of the Higgs Boson

Wednesday, November 9, 2022 6:05 PM (12 minutes)

This talk presents the results of a direct search for lepton-flavour-violating decays of the Higgs boson to $e\tau$ and $\mu\tau$ final states with the ATLAS detector at the LHC. Both leptonically and hadronically decaying tau leptons are included and two different background estimation techniques are employed: A direct estimation of the background using MC, and a data-driven approach exploiting the electron-muon symmetry of the Standard Model. Both methods use data-derived estimations of misidentified background contributions, and MVA techniques to separate signal events from background.

Type of talk

Experimental measurements

Presenter: AMOS, Kieran Robert (Univ. of Valencia and CSIC (ES))

Session Classification: Wednesday Session A

Track Classification: Physics Topics: Beyond the Standard Model

Contribution ID: 140

Type: **not specified**

Measurements of Higgs boson properties in decays to two tau leptons with the ATLAS detector

Tuesday, November 8, 2022 11:10 AM (15 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.

Type of talk

Experimental measurements

Presenter: ORDEK, Serhat (Uppsala University (SE))

Session Classification: Tuesday Session A

Track Classification: Physics Topics: Yukawa

Contribution ID: 144

Type: **not specified**

Measurements and interpretations of the Higgs boson properties in its couplings to top, bottom and charm quarks with the ATLAS detector

Wednesday, November 9, 2022 3:00 PM (15 minutes)

Testing the Yukawa couplings of the Higgs boson to fermions is essential to understand the origin of their masses, and studies are made by exploring the properties of the Higgs boson decays to quark pairs. The talk presents various measurements of the Higgs boson decays to two bottom quarks and searches for Higgs boson decays to two charm quarks by the ATLAS experiment using the full Run 2 dataset of pp collisions collected at 13 TeV at the LHC, as well as their combination and interpretation.

Type of talk

Experimental measurements

Presenter: KE, Yan (Stony Brook University (US))

Session Classification: Wednesday Session A

Track Classification: Physics Topics: Yukawa

Contribution ID: 146

Type: **not specified**

Searches for invisible Higgs boson decays at the ATLAS experiment

Wednesday, November 9, 2022 5:45 PM (15 minutes)

In the Standard Model, the branching ratio for Higgs boson decays to invisible final states is very small, but it can be significantly enhanced in extensions of the Standard Model. This talk presents searches for Higgs boson decays to invisible final states by the ATLAS experiment using the full Run 2 dataset of pp collisions collected at 13 TeV at the LHC, as well as their combination and interpretation.

Type of talk

Experimental measurements

Presenter: WANG, Song-Ming (Academia Sinica (TW))

Session Classification: Wednesday Session A

Track Classification: Physics Topics: Beyond the Standard Model

Contribution ID: 147

Type: **not specified**

Combined Effective Field Theory interpretation of ATLAS Higgs and Standard Model measurements

Tuesday, November 8, 2022 10:00 AM (15 minutes)

In the absence of direct observations of new physics beyond the Standard Model, interpretations of results using Effective Field Theories can be a powerful tool to place near-model-independent constraints on new physics scenarios, or better observe deviations from the Standard Model and have it interpreted in terms of specific new interactions. This talk presents Effective Field Theory interpretations of individual and combined results from the ATLAS experiment, including the combined measurements of the Higgs boson coupling properties.

Type of talk

Experimental measurements

Presenter: KORTMAN, Bryan (Nikhef National institute for subatomic physics (NL))

Session Classification: Tuesday Session B

Track Classification: Physics Topics: Effective Field Theory

Contribution ID: 148

Type: **not specified**

Search for rare decays of the Standard Model Higgs boson with the ATLAS detector

Thursday, November 10, 2022 3:55 PM (15 minutes)

The Standard Model predicts several rare Higgs boson decay channels, among which are decays to a Z boson and a photon, H to Zgamma, and to a low-mass lepton pair and a photon H to lgamma, and a pair of muon. The observation of Zgamma decays could open the possibility of studying the CP and coupling properties of the Higgs boson in a complementary way to other analyses. In addition, the search for Higgs decays into a vector quarkonium state and a photon provides access to charm- and bottom-quark couplings alternative to the direct H->bb/cc search. Several results for decays based on pp collision data collected at 13 TeV will be presented.

Type of talk

Experimental measurements

Presenter: WHITE, Aaron (Harvard University (US))

Session Classification: Thursday Session B

Track Classification: Physics Topics: Beyond the Standard Model

Contribution ID: 151

Type: **not specified**

Flavour tagging with the ATLAS and CMS detectors at the HL-LHC

Tuesday, November 8, 2022 11:50 AM (15 minutes)

The High-Luminosity LHC (HL-LHC) era will herald significant increases in both the instantaneous luminosity and the number of interactions per bunch crossing. To cope with these significantly more complex conditions, detector upgrades are planned to maintain and surpass the current physics performance. The replacement of the current Inner Detector with a new all-silicon Inner Tracker (ITk) is one of the key upgrades planned for the ATLAS detector. The ITk upgrade provides excellent tracking performance, which will enhance other reconstruction algorithms dependent upon tracking, and ultimately the physics reach of the experiment. In particular, the identification of jets originating from heavy flavour hadrons, known as flavour tagging, is heavily reliant upon tracking and is ideally placed to benefit from the detector upgrade. The performance of recent state-of-the-art flavour tagging algorithms [1,2] applied to the upgraded ATLAS detector was previously presented, which achieved significant performance enhancements to the benefit of several physics analyses. However, new algorithmic developments could further benefit from the HL-LHC detector upgrades to provide additional enhancements in the performance. This talk will survey recent algorithmic developments in the ATLAS flavour tagging community, including algorithms based on deep sets and graph neural networks, and compare their performance with the previous algorithms in the context of HL-LHC upgrades such as the ITk.

Type of talk

Future prospects

Presenter: KAKATI, Nilotpal (Weizmann Institute of Science (IL))

Session Classification: Tuesday Session B

Track Classification: Physics Topics: Future Colliders

Contribution ID: 155

Type: **not specified**

YSF: Fisher Information and simulation-based inference in searches for CP-violating EFT components in the HWW interaction via leptonic WH production

Thursday, November 10, 2022 2:00 PM (12 minutes)

The Higgs sector is a possible avenue for searches of BSM sources of CP violation, with $V(V=W,Z)H$ production offering a way to separately probe the HWW and HZZ interactions, not possible in channels such as weak boson fusion. In this work, we search for CP-violating (CP-odd) EFT components in the HWW interaction via leptonic WH production - $W(-\rightarrow l \nu)H$. This is a channel which allows high trigger efficiencies, good final state object resolution and good signal-to-background discrimination. Phenomenological studies in this channel have proposed angular variables sensitive to these components, that require the full reconstruction of the W boson 4-vector and rely on the reconstruction of the longitudinal momentum of the neutrino. The latter is not only experimentally difficult (resulting in loss of resolution and efficiency) but, in addition, it is only possible up to a 2-fold ambiguity. The main goal of this work is to explore the simulation-based inference method SALLY (Score Approximates Likelihood Locally) to reconstruct a statistically optimal observable using the full kinematic information available in the event, bypassing the need for full neutrino reconstruction. The Fisher Information formalism is used to benchmark the sensitivity of different kinematic observables, angular observables and the SALLY method to this component, both inclusively as well as differentially, allowing us to define an optimal binning for the different observables. The expected 95% CL exclusion limits with both the Fisher Information formalism - mainly sensitive to the linear, CP-violating SM-EFT interference term - and the asymptotic likelihood ratio formalism are obtained and compared, allowing us to handle the effect of the quadratic EFT term (CP-even by nature) on the sensitivity of the different observables.

Type of talk

Theory

Primary author: BARRUÉ, Ricardo (LIP - Laboratorio de Instrumentacao e Fisica Experimental de Partículas)

Co-authors: CONDE MUINO, Patricia (LIP - Laboratorio de Instrumentação e Física Experimental de Partículas (PT)); SANTOS, Rui (ISEL and CFTC-UL); DAO, Valerio (CERN)

Presenter: BARRUÉ, Ricardo (LIP - Laboratorio de Instrumentacao e Fisica Experimental de Partículas)

Session Classification: Thursday Session A

Track Classification: Physics Topics: Effective Field Theory

Contribution ID: 156

Type: **not specified**

Higgs physics at a muon collider

Wednesday, November 9, 2022 2:35 PM (15 minutes)

The muon collider is the ideal machine for reaching multi-TeV centre-of-mass energy and high luminosity lepton collisions, thanks to the low beamstrahlung and synchrotron radiation loss compared to $e^+ e^-$ colliders.

In such conditions, the number of produced Higgs bosons will allow to measure its couplings to fermions and bosons with an unprecedented precision.

However, in order to evaluate its physics reaches, the detector performance must be determined, since they may be strongly affected by very high fluxes of particles coming from muons decaying in circulating beams. In this contribution latest results on jet reconstruction and jet flavour identification performance, evaluated via full simulation of the muon collider detector, are presented. Most recent results on the precision on the measurement of the Higgs production cross sections are shown. The signal and the physics background samples are fully simulated and reconstructed at 3 TeV center of mass energy, evaluating the effects of the beam-induced background on the detector performance.

Type of talk

Future prospects

Presenter: GIAMBASTIANI, Luca (Universita e INFN, Padova (IT))

Session Classification: Wednesday Session B

Track Classification: Physics Topics: Future Colliders

Contribution ID: 158

Type: **not specified**

YSF: A Phenomenological study of Higgs jets in a High energy muon collider - REMOTE

Wednesday, November 9, 2022 2:20 PM (12 minutes)

A muon collider provides an interesting opportunity to test various aspects of Higgs physics and potential BSM models. For a muon collider, Vector-boson fusion provides the dominant channel for the production of Higgs bosons. We calculate the lowest and higher order Higgs jet distribution as a function of jet invariant mass for the super-renormalizable splitting $h \rightarrow hh$ and compare it to the background QCD jet distribution calculated from the NLL resummed cross section for e^+e^- annihilation. The qualitative difference between the two distributions shows up distinctly at collider center of mass energies greater than 10 TeV as the peak of the QCD jets is pushed off to higher invariant jet masses, making it easier to observe the super-renormalizable and ultra-collinear $h \rightarrow hh$ jet distribution. This can also prove to be an important channel to test potential BSM models.

Type of talk

Theory

Primary authors: STERMAN, George (Stony Brook University); DESAI, Jay (Stony Brook University)

Presenter: DESAI, Jay (Stony Brook University)

Session Classification: Wednesday Session B

Track Classification: Physics Topics: Future Colliders

Contribution ID: 160

Type: **not specified**

Top-Yukawa-induced Corrections to Higgs Pair Production

Thursday, November 10, 2022 5:40 PM (15 minutes)

Higgs-boson pair production at hadron colliders is dominantly mediated by the loop-induced gluon-fusion process $gg \rightarrow HH$ that is generated by heavy top loops within the Standard Model with a minor per-cent level contamination of bottom-loop contributions. The QCD corrections turn out to be large for this process. In this talk, we discuss the top-Yukawa-induced part of the electroweak corrections to this process and their relation to an effective trilinear Higgs coupling with integrated out top-quark contributions.

Type of talk

Theory

Primary authors: SCHLENK, Johannes; SPIRA, Michael (Paul Scherrer Institute (CH)); MUEHLLEITNER, Milada (Unknown)

Presenter: SPIRA, Michael (Paul Scherrer Institute (CH))

Session Classification: Thursday Session A

Track Classification: Physics Topics: Double Higgs

Contribution ID: 161

Type: **not specified**

Portrait of Enrico Fermi as a young scientist (his thesis in Pisa and early articles)

Tuesday, November 8, 2022 5:45 PM (35 minutes)

In the years 1922-1926 Enrico Fermi, then in his early twenties, was scientifically active in Pisa, Gottingen, Leiden and Florence. Apart from his experimental thesis on X rays, most of his research activity was purely theoretical, and covered a wide spectrum of issues, from general relativity (Fermi coordinates, electromagnetic mass) to statistical mechanics (Fermi statistics), from atomic physics to collision theory (method of virtual photons) and to the newborn wave mechanics. We briefly review the main results he obtained in that period, stressing their originality and permanent relevance.

Type of talk

Presenter: Prof. ROSSI, Paolo (Università di Pisa - Dipartimento di Fisica "E. Fermi")

Session Classification: Tuesday Plenary Session

Contribution ID: 166

Type: **not specified**

Higgs searches at LHCb

Wednesday, November 9, 2022 11:30 AM (20 minutes)

LHCb is a spectrometer that covers the forward region of proton-proton collisions, in the pseudo-rapidity range from 2 to 5. Thanks to the relatively background-free events in the high mass region, the precise reconstruction, and the trigger system with low energy thresholds, LHCb is the ideal place to search for (exotic) Higgs decays in a complementary space with respect to ATLAS and CMS. In this talk, the latest searches on BSM Higgs decays performed at LHCb will be presented, and the prospects for future LHC data-taking periods will be given. Moreover the possibility of observing the Standard Model $H \rightarrow b\bar{b}$ and $H \rightarrow c\bar{c}$ decays at LHCb in the future LHCb upgrades will be discussed.

Type of talk

Presenter: VAZQUEZ SIERRA, Carlos (CERN)

Session Classification: Wednesday Plenary Session

Contribution ID: 167

Type: **not specified**

ATLAS Highlight - Measurement of Higgs boson off-shell production and total width using the $H \rightarrow ZZ \rightarrow 4l$ and $2l2\nu$ channels

Wednesday, November 9, 2022 11:00 AM (20 minutes)

Type of talk

Presenter: VEEN, Michiel Jan (University of Massachusetts (US))

Session Classification: Wednesday Plenary Session

Contribution ID: **168**

Type: **not specified**

CMS Highlight: Latest results in the H->ZZ->4l channel

Friday, November 11, 2022 10:00 AM (20 minutes)

Type of talk

Presenter: CAPPATI, Alessandra (Centre National de la Recherche Scientifique (FR))

Session Classification: Friday Plenary Session

Contribution ID: **169**Type: **not specified**

Welcome & Opening

Monday, November 7, 2022 2:00 PM (30 minutes)

Presenters: FRANCAVILLA, Paolo (Universita & INFN Pisa (IT)); DE CURTIS, Stefania (Universita e INFN, Firenze (IT)); ELISA MARCUCCI, LAURA; GRASSI, Marco (Universita & INFN Pisa (IT)); ROLANDI, Gigi (Universita & INFN Pisa (IT)); MAGNANI, Pierpaolo (Comune di Pisa)

Session Classification: Monday Plenary session

Contribution ID: 170

Type: **not specified**

Closing

Friday, November 11, 2022 4:20 PM (10 minutes)

Type of talk

Presenter: PIACQUADIO, Giacinto (State University of New York (US))

Session Classification: Friday Plenary Session

Contribution ID: 171

Type: **not specified**

Round Table - Higgs@10

Wednesday, November 9, 2022 6:45 PM (1h 30m)

Contribution ID: 172

Type: **not specified**

Higgs 2023 Conference

Friday, November 11, 2022 4:35 PM (5 minutes)

Presenter: WANG, Jin (Chinese Academy of Sciences (CN))

Session Classification: Friday Plenary Session