18th International Workshop on Top Quark Physics (TOP2025)

Report of Contributions

https://indico.cern.ch/e/1501204

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

Quantum-Enhanced Inference for Four-Top-Quark Signal Classification at the LHC Using Graph Neural Networks

Rare event classification in high-energy physics (HEP) plays a crucial role in probing physics beyond the Standard Model (BSM). Such processes serve as indirect searches for new physics by testing deviations from SM predictions in extreme kinematic regimes. The production of four top quarks in association with a (W^-) boson at ($\sqrt{s} = 13$) TeV is an exceptionally rare SM process with a next-to-leading-order (NLO) cross-section of $(6.6^{+2.4}_{-2.6} ab)$. In its fully hadronic decay mode, with intricate jet topology and overwhelming QCD background, demands advanced techniques for signal extraction, making it a prime candidate for new physics probes like anomalous top-quark interactions or EFT deviations . Identifying this process in the fully hadronic decay channel is particularly challenging due to overwhelming backgrounds from $t\bar{t}$, $t\bar{t}W$, $t\bar{t}Z$, and triple-top production processes. This study introduces **CrossQuantumPhysGNN (CQPGNN)**, a quantum-classical hybrid graph neural network (GNN) designed to tackle rare event classification. CQPGNN integrates GINEConv layers for particle-level features, a quantum circuit employing angle encoding and entanglement for global feature processing, and cross-attention fusion to combine local and quantum-enhanced global representations. Physics-informed losses enforce momentum conservation and jet multiplicity constraints derived from the event decay dynamics, making a faster physics informed convergence. Benchmarked against conventional methods, CQPGNN achieves a signal significance ($S/\sqrt{S+B}$) of $0.174 \pm 0.05\%$, recall of 0.957, and ROC-AUC of 0.961, surpassing BDTs ($0.148 \pm 0.04\%, 0.914, 0.908$) and Xgboost ($0.149 \pm 0.04\%, 0.924, 0.913$). The classification models are trained on parametrized Monte Carlo (MC) simulations of the CMS detector, with events normalized using cross-section-based reweighting to reflect their expected contributions in a dataset corresponding to $350 fb^{-1}$ of integrated luminosity. This ensures that significance calculations accurately reflect realistic collider conditions. The proposed method is benchmarked against conventional machine learning approaches, with results demonstrating improved classification significance. This quantum enhanced approach offers a novel framework for precision event selection at the LHC, leveraging high dimensional statistical learning and quantum-enhanced inference to tackle fundamental HEP challenges, aligning with cutting-edge ML developments.

Field

Pheno

Author: Mr ALI, Syed Haider (Department of Physics & Applied Mathematics, Pakistan Institute of Engineering and Applied Sciences (PIEAS), P. O. Nilore 45650, Islamabad)

Co-authors: Dr AHMAD, Ashfaq (Exp. High Energy Physics Department (EHEPD), National Centre for Physics (NCP), Shahdra Valley Road, 44000, Islamabad, Pakistan); Mr SAIEL, Muhammad (Department of Physics, Quaid-e-Azam university, Shahdra Valley Road, 45320, Islamabad, Pakistan.); Dr SHAUKAT, Nadeem (Center for Mathematical Sciences, Pakistan Institute of Engineering and Applied Sciences (PIEAS), P. O. Nilore 45650, Islamabad)

Presenter: Mr ALI, Syed Haider (Department of Physics & Applied Mathematics, Pakistan Institute

of Engineering and Applied Sciences (PIEAS), P. O. Nilore 45650, Islamabad)

Contribution ID: **2** Type: **Poster**

Top decay width at NNNLO in QCD

We present the first analytic results of next-to-next-to-next-to-leading-order (N3LO) QCD corrections to the top-quark decay width. We focus on the dominant leading color contribution, which includes light-quark loops. At next-to-next-to-leading order (NNLO), this dominant contribution accounts for 95% of the total correction. By utilizing the optical theorem, the N3LO corrections are related to the imaginary parts of the four-loop self-energy Feynman diagrams, which are calculated with differential equations. The results are expressed in terms of harmonic polylogarithms, enabling fast and accurate evaluation. The third-order QCD corrections decrease the leading-order decay width by 0.667%, and the scale uncertainty is reduced by half compared to the NNLO result. The most precise prediction for the top-quark width is now 1.321 GeV for mt= 172.69 GeV.

Field

Pheno

Authors: Prof. LI, Hai Tao (Shandong University); Prof. WANG, Jian (Shandong University)

Presenter: Prof. WANG, Jian (Shandong University)

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

Keynote presentation

Monday 22 September 2025 10:15 (45 minutes)

Presenter: AGUILAR SAAVEDRA, Juan Antonio (Consejo Superior de Investigaciones Científicas (ES))

Session Classification: Introductions + keynote

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

Theory summary

Friday 26 September 2025 11:20 (45 minutes)

Presenter: ZANDERIGHI, Giulia (Max Planck Society (DE))

Session Classification: Summary and Last words

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

Experimental Summary

Friday 26 September 2025 12:05 (45 minutes)

Presenter: WAGNER, Wolfgang (Bergische Universitaet Wuppertal (DE))

Session Classification: Summary and Last words

Contribution ID: **16** Type: **Poster**

Top quark physics at FCC-ee and FCC-hh

The Future Circular Collider (FCC) programme provides unique opportunities for comprehensive and precise studies of top quark physics. At the FCC-ee, operating at and slightly above the top pair threshold, a precise measurement of the top quark mass with a statistical and systematic accuracy down to the MeV level can be achieved through a threshold scan. Furthermore, the FCC-ee run at 365 GeV allows precise determinations of top quark electroweak couplings, particularly the ttZ vertex with sub-percent precision, and enables stringent constraints on flavor-changing neutral currents (FCNC), such as the Vts coupling. At the FCC-hh, the unprecedented center-of-mass energy of 84 TeV enables precise differential measurements of top quark production processes at very high momentum transfer, such as top quark pairs and rare four-top final states. These high Q^2 measurements provide critical sensitivity to new physics effects at multi-TeV scales and will complement precision measurements from FCC-ee, thus offering a comprehensive exploration of the top quark sector.

Field

Pheno

Author: KLUTE, Markus (Karlsruhe Inst. of Technology (GER))

Presenter: KLUTE, Markus (Karlsruhe Inst. of Technology (GER))

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

Welcome message

Monday 22 September 2025 09:40 (10 minutes)

Session Classification: Introductions + keynote

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

Welcome message from the President of Hanyang University

Monday 22 September 2025 09:30 (10 minutes)

Field

Presenter: Prof. LEE, Ki-jeong (Hanyang University)

Session Classification: Introductions + keynote

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

Korea CMS TOP activity

Monday 22 September 2025 09:50 (15 minutes)

Field

Presenter: CHOI, Su Yong (Korea University (KR))

Session Classification: Introductions + keynote

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

Introductory information

Monday 22 September 2025 10:05 (10 minutes)

Field

Presenter: KIM, Tae Jeong (Hanyang University (KR))

Session Classification: Introductions + keynote

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

Physics objects in ATLAS

Monday 22 September 2025 11:30 (30 minutes)

Session Classification: Objects

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

Physics objects in CMS

Monday 22 September 2025 12:00 (30 minutes)

Session Classification: Objects

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

Advanced statistical methods (including unfolding) in ATLAS and CMS

Monday 22 September 2025 12:30 (30 minutes)

Session Classification: Objects

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

ttj production at NNLO in QCD

Monday 22 September 2025 14:30 (30 minutes)

Presenter: HARTANTO, Heribertus Bayu (Asia Pacific Center for Theoretical Physics (APCTP), Pohang, South Korea)

Session Classification: Cross-section Associate production

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

Inclusive top pair and single top cross sections in ATLAS and CMS [CMS]

Monday 22 September 2025 15:00 (30 minutes)

Session Classification: Cross-section Associate production

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

Differential top cross sections at ATLAS and CMS [ATLAS]

Monday 22 September 2025 15:30 (30 minutes)

Session Classification: Cross-section Associate production

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

Complete NLO corrections to tt in l + jet channel with full off-shell effects

Monday 22 September 2025 16:00 (30 minutes)

Field

Presenter: MANS, Leon (RWTH Aachen University)

Session Classification: Cross-section Associate production

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

Top quark pair production + vector boson in CMS [CMS]

Monday 22 September 2025 17:00 (30 minutes)

Session Classification: Associated production

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

Top quark pair production + vector boson in ATLAS [ATLAS]

Monday 22 September 2025 17:30 (30 minutes)

Session Classification: Associated production

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

ttbb at NLO precision in a variable flavor number scheme

Monday 22 September 2025 18:00 (30 minutes)

Presenter: KATZY, Judith (Deutsches Elektronen-Synchrotron (DE))

Session Classification: Associated production

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

Single top associated production in ATLAS and CMS [CMS]

Monday 22 September 2025 18:30 (30 minutes)

Session Classification: Associated production

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

Quantum observables with top quarks at future lepton colliders

Friday 26 September 2025 09:30 (30 minutes)

Presenter: HORODECKI, Pawel (Gdansk University of Technology)

Session Classification: Perspectives

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

The Future Circular Collider: Feasibility Study for a New Research Infrastructure

Friday 26 September 2025 10:00 (40 minutes)

Presenter: DEFRANCHIS, Matteo (CERN)

Session Classification: Perspectives

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

Top2026 announcement

Friday 26 September 2025 12:50 (10 minutes)

Session Classification: Summary and Last words

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

Closing remarks, proceedings instructions

Friday 26 September 2025 13:00 (10 minutes)

Session Classification: Summary and Last words

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

State-of-the-art cross sections for ttH: NNLO predictions matched with NNLL resummation and EW corrections

Tuesday 23 September 2025 09:30 (30 minutes)

Presenter: KULESZA, Anna (University of Muenster)

Session Classification: top+Higgs

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

Recent results on top associated Higgs production at ATLAS and CMS [CMS]

Tuesday 23 September 2025 10:00 (30 minutes)

Session Classification: top+Higgs

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

How to Unfold Top Decays

Tuesday 23 September 2025 11:00 (30 minutes)

Presenter: PALACIOS SCHWEITZER, Sofia (ITP, University Heidelberg)

Session Classification: Top quark mass

Contribution ID: **39** Type: **not specified**

Recent results on top mass from ATLAS and CMS [ATLAS]

Tuesday 23 September 2025 11:30 (30 minutes)

Session Classification: Top quark mass

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

Top-quark mass extraction from energy correlators

Tuesday 23 September 2025 12:00 (30 minutes)

Presenter: MOULT, Ian (Yale University)

Session Classification: Top quark mass

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

Electroweak corrections in the SMEFT at high energies

Tuesday 23 September 2025 14:00 (30 minutes)

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

Session Classification: EFT

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

EFT results in the top quark sector in CMS [CMS]

Tuesday 23 September 2025 14:30 (30 minutes)

Session Classification: EFT

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

EFT results in the top quark sector in ATLAS [ATLAS]

Tuesday 23 September 2025 15:00 (30 minutes)

Session Classification: EFT

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

"Global"EFT combinations in ATLAS and CMS [ATLAS]

Tuesday 23 September 2025 15:30 (30 minutes)

Session Classification: EFT

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

Searching for resonances in four top-quark production

Tuesday 23 September 2025 16:30 (30 minutes)

Field

Presenter: LI, Hao-lin (Zhongshan University)

Session Classification: Searches

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

Searches for new physics in final states involving top quarks in ATLAS and CMS [CMS]

Tuesday 23 September 2025 17:00 (30 minutes)

Session Classification: Searches

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

Probes of flavor symmetry and violation with top quarks in ATLAS and CMS [CMS]

Tuesday 23 September 2025 17:30 (30 minutes)

Session Classification: Searches

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

Collider-Flavour Complementarity from the bottom to the top

Tuesday 23 September 2025 18:00 (30 minutes)

Presenter: TETLALMATZI-XOLOCOTZI, Gilberto (Siegen University)

Session Classification: Searches

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

Complete NLO prediction for triple top-quark production

Wednesday 24 September 2025 11:30 (30 minutes)

Presenter: EL FAHAM, Hesham (The University of Manchester)

Session Classification: Rare process

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

Rare top processes in ATLAS and CMS [ATLAS]

Wednesday 24 September 2025 12:00 (30 minutes)

Session Classification: Rare process

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

Toponium physics - Overview

Thursday 25 September 2025 09:30 (30 minutes)

Presenter: HAGIWARA, Kaoru (KEK)

Session Classification: Theory mini-workshop

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

Third-order correction to top-quark pair production near threshold II. Potential contributions

Thursday 25 September 2025 10:00 (30 minutes)

Field

Presenter: KIYO, Yuichiro (Tohoku University)

Session Classification: Theory mini-workshop

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

Updated predictions for toponium production at the LHC

Thursday 25 September 2025 10:30 (30 minutes)

Field

Presenter: LIMATOLA, Giovanni

Session Classification: Theory mini-workshop

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

Simulating toponium formation signals at the LHC

Thursday 25 September 2025 11:30 (30 minutes)

Presenter: FUKS, Benjamin

Session Classification: Theory mini-workshop

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

Can a pseudoscalar with a mass of 365 GeV in two-Higgs-doublet models explain the CMS ttbar excess?

Thursday 25 September 2025 12:00 (30 minutes)

Presenter: Prof. SONG, Jeonghyeon (Konkuk University)

Session Classification: Theory mini-workshop

Contribution ID: **56** Type: **not specified**

Impact of Interference Effects on Higgs-boson Searches in the Di-top Final State at the LHC

Thursday 25 September 2025 12:30 (30 minutes)

Presenter: KUMAR, Romal

Session Classification: Theory mini-workshop

Contribution ID: **57** Type: **not specified**

Precise predictions for the top-quark decay

Thursday 25 September 2025 14:30 (30 minutes)

Field

Presenter: Dr CHEN, Long (Shandong University)

Session Classification: Properties

Contribution ID: **58** Type: **not specified**

Measurement of spin correlation and entanglement in ATLAS and CMS [ATLAS]

Thursday 25 September 2025 15:00 (30 minutes)

Session Classification: Properties

Contribution ID: **59** Type: **not specified**

Measurements other top properties (asymmetries etc) in ATLAS and CMS [CMS]

Thursday 25 September 2025 15:30 (30 minutes)

Session Classification: Properties

Contribution ID: **60** Type: **not specified**

Latest results on ttbar production threshold [CMS]

Thursday 25 September 2025 16:30 (30 minutes)

Session Classification: ttbar threshold and and Joker talks

Contribution ID: **61** Type: **not specified**

Latest results on ttbar production threshold [ATLAS]

Thursday 25 September 2025 17:00 (30 minutes)

Session Classification: ttbar threshold and and Joker talks

Contribution ID: **62** Type: **not specified**

Joker talk 1

Thursday 25 September 2025 17:30 (30 minutes)

Session Classification: ttbar threshold and and Joker talks

Contribution ID: **63** Type: **not specified**

Joker talk 2

Thursday 25 September 2025 18:00 (30 minutes)

Session Classification: ttbar threshold and and Joker talks

Contribution ID: **64** Type: **not specified**

Public lecture [English]

Presenter: TENCHINI, Roberto (Universita & INFN Pisa (IT))

Session Classification: Public lecture

Contribution ID: **65** Type: **not specified**

Public lecture

Presenter: Prof. PARK, Seong Chan (Yonsei University)

Session Classification: Public lecture

Contribution ID: **66** Type: **Poster**

Reconstructing Toponium using Recursive Jigsaw Reconstruction

Recent results from the CMS experiment at the Large Hadron Collider indicate the presence of a top-quark pair bound state near the $t\bar{t}$ threshold region. We present a way to reconstruct a toponium state at the ttbar threshold region formed at the Large Hadron Collider using Recursive Jigsaw Reconstruction. We have considered the Non-Relativistic QCD based toponium model implemented in MadGraph5_aMC@NLO. The final states, consisting of two b-jets, two oppositely charged leptons and missing energy that arises from two neutrinos, are used. The goal of the Recursive Jigsaw Reconstruction is to make use of rules that can help resolve combinatorics ambiguity in preparing the decay tree for a given physics event. Additionally, missing energy coming from two neutrinos needs to be resolved so as to reconstruct the event. We apply four different strategies within the RestFrames package and compare the results of reconstruction resulting from each of the methods. Owing to the method, one can also access kinematic variables in rest frames belonging to the intermediate particle states thereby providing additional means to discriminate the SM ttbar background from the toponium. Our preliminary results indicate that this method may be useful to gain additional insights into physics phenomenology at the ttbar threshold region.

Field

Pheno

Authors: DESAI, Aman (University of Adelaide (AU)); Prof. JACKSON, Paul (University of Adelaide)

Presenter: DESAI, Aman (University of Adelaide (AU))

Contribution ID: **67** Type: **not specified**

Search for H->cc and measurement of H->bb via ttH production

A search for the standard model Higgs boson decaying to a cc pair, produced in association with a tt pair (ttH) is presented. The search is performed with the full Run 2 dataset, corresponding to an integrated luminosity of 138/fb. Advanced machine learning techniques are employed for jet flavor identification and event classification. The H->bb decay is measured simultaneously. The measurement provides the best individual limits on H->cc to date, and achieves a 4.4 std. dev. significance for the existence of ttH(H->bb). The measurement relies heavily on the background estimation of tt+heavy flavor jets, and should be an interesting highlight for the TOP2025 conference.

Field

CMS

Author: PALENCIA CORTEZON, Jose Enrique (Universidad de Oviedo (ES))

Presenter: PALENCIA CORTEZON, Jose Enrique (Universidad de Oviedo (ES))

Contribution ID: **68** Type: **not specified**

BSM interpretation of four top quark production in CMS

A reinterpretation of four top quark (tttt) production is presented using the full Run 2 dataset recorded by the CMS experiment, corresponding to an integrated luminosity of 138/fb. The analysis targets BSM scenarios using the existing tttt production measurement, including constraints on effective field theory (EFT) operators, top-philic heavy resonances, and the top-Yukawa coupling. The results provide competitive limits on several new physics models and demonstrate the sensitivity of multi-top final states to a wide range of BSM effects.

Field

CMS

Author: PALENCIA CORTEZON, Jose Enrique (Universidad de Oviedo (ES))

Presenter: PALENCIA CORTEZON, Jose Enrique (Universidad de Oviedo (ES))

Contribution ID: **69** Type: **not specified**

EFT measurement in ttbar process

Effective Field Theory (EFT) provides a universal framework for probing beyond the Standard Model physics at LHC scales. Recent advances in analysis techniques and increased dataset complexity have significantly enhanced the sensitivity of EFT studies. We present the latest results on EFT obtained using ttbar production by the CMS collaboration, probing interactions between the top quark and the SM Higgs and vector bosons.

Field

CMS

Author: PALENCIA CORTEZON, Jose Enrique (Universidad de Oviedo (ES))

Presenter: PALENCIA CORTEZON, Jose Enrique (Universidad de Oviedo (ES))

Contribution ID: **70** Type: **not specified**

Top-quark pair production and decay: toward NNLO+PS accuracy

In this presentation, we will discuss recent advancements in NNLO+PS predictions for top-quark pair production and decay within the MiNNLO framework. MiNNLO provides a robust method for incorporating next-to-next-to-leading order (NNLO) QCD corrections directly into fully differential predictions, offering unprecedented accuracy. This approach enables a consistent treatment of both production and decay processes, ensuring realistic event simulation compatible with experimental analyses. I will highlight the theoretical developments, key challenges, and the impact of these improvements on phenomenological studies, with a focus on their relevance to the increasing precision demands of LHC experiments.

Field

Pheno

Author: SIGNORILE , Chiara

Co-authors: BIELLO, Christian; ZANDERIGHI, Giulia; WIESEMANN, Marius

Presenter: SIGNORILE , Chiara

Contribution ID: **71** Type: **not specified**

Towards a NNLO+PS generator for ttH production in POWHEG

The current MiNNLOPS technology enables next-to-next-to-leading order (NNLO) QCD predictions matched to parton showers (NNLO+PS) for heavy-quark pair production in arbitrary kinematics (QQF), within the POWHEG framework. Among QQF processes, Higgs production in association with a heavy-quark pair is particularly relevant for LHC phenomenology. In the case of ttH production, the main bottleneck is the absence of the exact two-loop (double-virtual) contribution. Compared to bbH production, the presence of the large top-quark mass requires a combination of different approximations across distinct kinematic regimes. We present a validation of soft and high-energy approximations at the NLO+PS level and provide first differential results at NNLO+PS, with the estimated double-virtual corrections. Once the exact two-loop amplitude becomes available, the reweighting capabilities of the POWHEG framework will offer a valid path to achieving full NNLO+PS accuracy, without the need for new grid evaluations or event generation.

Field

Pheno

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

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

Contribution ID: **75** Type: **not specified**

Rare and exclusive few-body decays of the top quark

We will report on an extensive survey of rare and exclusive few-body decays of the top quark, defined as those with branching fractions BR$\gtrsim 10^{-5}$ and two or three final-state particles [1]. Such rare decays probe physics beyond the Standard Model (BSM), constitute a background for exotic decays into new BSM particles, and provide precise information on quantum chromodynamics factorization with small nonperturbative corrections. We tabulate the theoretical BR values for almost 40 rare decay channels of the heaviest elementary particle, indicating the current experimental limits in their observation. Among those, we have computed for the first time semiexclusive top-quark decays into a quark plus a meson, while updating predictions for a few other rare partial widths. The feasibility of measuring each of these unobserved decays is estimated for p-p collisions at the high-luminosity Large Hadron Collider (HL-LHC), and for e+e- and p-p collisions at the future circular collider (FCC).

[1] David d'Enterria, Van Dung Le, "Rare and exclusive few-body decays of the Higgs, Z, W bosons, and the top quark", J.Phys.G 52 (2025) 5, 053001; arXiv:2312.11211 [hep-ph]

Field

Pheno

Authors: D'ENTERRIA, David (CERN); LE, Van Dung (Vietnam National University (VN))

Presenter: LE, Van Dung (Vietnam National University (VN))

Contribution ID: **76** Type: **Poster**

The interference effect of ⊠ and new physics near ⊠ threashold at LHC

Many Beyond the Standard Model (BSM) theories predict new scalar bosons ⊠ that couple to top quarks. Such scalars contribute to $gg \to t\bar{t}$ production via $gg \to \phi^* \to t\bar{t}$, leading to significant interference with the Standard Model $gg \to t\bar{t}$ amplitude. Near the $t\bar{t}$ threshold, top quark pairs form bound states, requiring careful theoretical treatment of the production dynamics. In this work, we study the interference between BSM scalar and SM $t\bar{t}$ production while explicitly incorporating bound state effects through matrix element reweighting techniques. This approach allows us to properly account for the modified kinematics and enhanced sensitivity to new physics signatures in the near-threshold region.

Field

Pheno

Author: KIM, JINHEUNG

Presenter: KIM, JINHEUNG

Contribution ID: **77** Type: **Poster**

One-loop Amplitudes for $t\bar{t}j$ and $t\bar{t}\gamma$ Productions at the LHC

We present analytic expressions for the one-loop QCD helicity amplitudes contributing to top-quark pair production in association with a photon or a jet at the Large Hadron Collider (LHC), evaluated through $O(\epsilon^2)$ in the dimensional regularisation parameter, ϵ. These amplitudes are required to construct the two-loop hard functions that enter the NNLO QCD computation. The helicity amplitudes are expressed as linear combinations of algebraically independent components of the ϵ-expanded master integrals, with the corresponding rational coefficients written in terms of momentum-twistor variables. We derive differential equations for the pentagon functions, which enable efficient numerical evaluation via generalised power series expansion method.

Field

Pheno

Authors: BRANCACCIO, Colomba; CANKO, Dhimiter (NSCR "Demokritos"); HARTANTO, Heribertus Bayu (Asia Pacific Center for Theoretical Physics (APCTP), Pohang, South Korea); Dr BERA, Souvik (Asia Pacific Center for Theoretical Physics)

Presenter: Dr BERA, Souvik (Asia Pacific Center for Theoretical Physics)

Contribution ID: **78** Type: **Poster**

Two-loop QCD corrections for radiative top decay process

I will present the calculation of two-loop QCD amplitudes for the radiative top decay process t->Wbg, with the W-boson decay to a lepton-neutrino pair included. This amplitude is required in the computation of top quark pair production in association with a jet at NNLO QCD accuracy where the top decays are included in the narrow width approximation. Analytic form of the two-loop helicity amplitudes are derived in terms of master integrals. These master integrals are evaluated numerically using generalised series expansion method to solve the associated differential equations.

Field

Pheno

Authors: BRANCACCIO, Colomba; HARTANTO, Heribertus Bayu (Asia Pacific Center for Theoretical Physics (APCTP), Pohang, South Korea); KRAUS, Manfred (UNAM)

Presenter: BRANCACCIO, Colomba

Contribution ID: **79** Type: **Poster**

Two-loop Integrals for leading colour ttW production

We present the calculation of two-loop Feynman integrals contributing to NNLO QCD corrections to the production of a top-quark pair in association with a W boson at hadron colliders, in the leading colour approximation. This process constitutes a key signature at the Large Hadron Collider, and the precise prediction of its cross-section is imperative for comparisons with experimental data. In our study, we employ the method of differential equations, facilitated by using finite field methods to reconstruct the differential equation matrices. The presence of the top quark in the virtual propagators, in addition to the mass of the external W boson, gives rise to complex algebraic and analytic structures, such as nested square roots and three elliptic curves.

Field

Pheno

Author: CANKO, Dhimiter (Università di Bologna)

Presenter: CANKO, Dhimiter (Università di Bologna)