

LHC TOP WG meeting

Report of Contributions

Contribution ID: 1

Type: **not specified**

Measurements of inclusive and differential cross-sections of $t\bar{t}+\gamma$ production in pp collisions at $\sqrt{s}=13$ TeV with the ATLAS detector

Wednesday 24 April 2024 14:00 (20 minutes)

Based on <https://arxiv.org/abs/2403.09452>.

The absolute and normalised differential cross-sections are measured for several variables characterising the photon, lepton and jet kinematics as well as the angular separation between those objects. The observables are found to be in good agreement with the Monte Carlo predictions. The photon transverse momentum differential distribution is used to set limits on effective field theory parameters related to the electroweak dipole moments of the top quark. The combined limits using the photon and the Z boson transverse momentum measured in $t\bar{t}$ production in associations with a Z boson are also set.

Presenters: HAHN, Jan (Universitaet Siegen); HAHN, Jan Joachim (Universitaet Siegen (DE))

Session Classification: Joint session of the LHC EFT and Top Working Groups

Contribution ID: 2

Type: **not specified**

Search for charged-lepton-flavour violating $\mu\tau q$ interactions in top-quark production and decay in pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector at the LHC

Wednesday 24 April 2024 14:30 (20 minutes)

Based on <https://arxiv.org/abs/2403.06742>.

The analysis targets events containing two muons with the same electric charge, a hadronically decaying τ -lepton and at least one jet, with exactly one b-tagged jet, produced by a $\mu\tau q$ interaction. Agreement with the Standard Model expectation within 1.6σ is observed, and limits are set at the 95% CL on the charged-lepton-flavour violation branching ratio of $B(t \rightarrow \mu\tau q) < 8.7 \times 10^{-7}$. An Effective Field Theory interpretation is performed yielding 95% CL limits on Wilson coefficients, dependent on the flavour of the associated light quark and the Lorentz structure of the coupling.

Presenter: KEMPSTER, Jacob Julian (University of Sussex (GB))

Session Classification: Joint session of the LHC EFT and Top Working Groups

Contribution ID: 3

Type: **not specified**

Search for baryon number violation in top quark production and decay using proton-proton collisions at $\sqrt{s} = 13$ TeV

Wednesday 24 April 2024 15:00 (20 minutes)

Reference: <https://arxiv.org/abs/2402.18461> (TOP-22-003)

A search is presented for baryon number violating interactions in top quark production and decay. Upper limits are placed on the strength of baryon number violating couplings. For the first time the production of single top quarks via baryon number violating interactions is studied. This allows the search to set the most stringent constraints to date on the branching fraction of the top quark decay to a lepton, an up-type quark (u or c), and a down-type quark (d, s, or b). The results improve the previous bounds by three to six orders of magnitude based on the fermion flavor combination of the baryon number violating interactions.

Presenter: GOLDOUZIAN, Reza (University of Notre Dame (US))

Session Classification: Joint session of the LHC EFT and Top Working Groups

Contribution ID: 4

Type: **not specified**

Combination of ATLAS and CMS measurements sensitive to EFT effects

Session Classification: Joint session of the LHC EFT and Top Working Groups

Contribution ID: 5

Type: **not specified**

Collider sensitivity to SMEFT heavy-quark operators at one-loop in top-quark processes

*Wednesday 24 April 2024 16:00 (20 minutes)*Based on <https://arxiv.org/abs/2402.06528>

We study the effects of four-heavy-quark operators in the production of top quarks in the framework of the Standard Model Effective Field Theory (SMEFT) at the LHC. In particular, we compute for the first time the total contribution of the four-top-quark operator which enters only at the one-loop level in the top-quark pair production process. Analytical results at one-loop are presented for the gluon- and quark-initiated sub-processes, which allowed a first complete validation of the SMEFT@NLO in Madgraph5_aMC@NLO. The 95% CL bounds on four-heavy-quark operators from the available top-quark pair and four-top-quark production data are provided, which are complementary to other bounds found in the literature. We focus on the comparison of the sensitivities of the top-quark pair and the four-top-quark production processes, where in the latter case the four-top-quark operator contributes at tree-level. We conclude that the sensitivities of the two processes to four-heavy-quark operators are comparable. The projected sensitivities of both processes at HL-LHC are also presented.

Presenter: Mr VÁSQUEZ TOCORA, Andrés Felipe (IFT - Universidade Estadual Paulista - Julio de Mesquita Filho)

Session Classification: Joint session of the LHC EFT and Top Working Groups

Contribution ID: 6

Type: **not specified**

Renormalisation group running effects in $p p \rightarrow$ $t\bar{t} h$ in the Standard Model Effective Field Theory

Wednesday 24 April 2024 16:30 (20 minutes)

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

Session Classification: Joint session of the LHC EFT and Top Working Groups

Contribution ID: 7

Type: **not specified**

Indirect constraints on top quark operators from a global SMEFT analysis

Wednesday 24 April 2024 17:00 (20 minutes)

Presenter: STANZIONE, Alfredo

Session Classification: Joint session of the LHC EFT and Top Working Groups

Contribution ID: 8

Type: **not specified**

Joint drink in salle de pas perdu

Wednesday 24 April 2024 18:00 (2 hours)

Contribution ID: 9

Type: **not specified**

Introduction

Thursday 25 April 2024 09:00 (20 minutes)

Presenters: Prof. MALTONI, Fabio (Universite Catholique de Louvain (UCL) (BE) and Università di Bologna); PALENCIA CORTEZON, Jose Enrique (Universidad de Oviedo (ES)); ALDAYA MARTIN, Maria (DESY); WAGNER, Wolfgang (Bergische Universitaet Wuppertal (DE))

Session Classification: LHC top WG Open Meeting

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

Combination of measurements of the top quark mass from data collected by the ATLAS and CMS experiments at $\sqrt{s} = 7$ and 8 TeV

*Thursday 25 April 2024 09:30 (20 minutes)*Reference: <https://arxiv.org/abs/2402.08713>

A combination of fifteen top quark mass measurements performed by the ATLAS and CMS experiments at the LHC is presented. The data sets used correspond to an integrated luminosity of up to 5 and 20–1 of proton-proton collisions at center-of-mass energies of 7 and 8 TeV, respectively.

Presenters: OWEN, Mark Andrew (University of Glasgow (GB)); MULDER, Martijn (CERN); DEFRANCHIS, Matteo (CERN)

Session Classification: LHC top WG Open Meeting

Contribution ID: 11

Type: **not specified**

Top-quark pole mass extraction at NNLO accuracy, from total, single- and double-differential cross sections for $t\bar{t}+X$ production at the LHC

*Thursday 25 April 2024 10:00 (20 minutes)*Reference: <https://arxiv.org/abs/2311.05509>

We extract the top-quark mass value in the on-shell renormalization scheme from the comparison of theoretical predictions for $pp \rightarrow t\bar{t}+X$ at next-to-next-to-leading order (NNLO) QCD accuracy with experimental data collected by the ATLAS and CMS collaborations for absolute total, normalized single-differential and double-differential cross-sections during Run 1, Run 2 and the ongoing Run 3 at the Large Hadron Collider (LHC). For the theory computations of heavy-quark pair-production we use the MATRIX framework, interfaced to PineAPPL for the generation of grids of theory predictions, which can be efficiently used a-posteriori during the fit, performed within xFitter. We take several state-of-the-art parton distribution functions (PDFs) as input for the fit and evaluate their associated uncertainties, as well as the uncertainties arising from renormalization and factorization scale variation. Fit uncertainties related to the datasets are also part of the extracted uncertainty of the top-quark mass and turn out to be of similar size as the combined scale and PDF uncertainty.

Presenters: ZENAIEV, Oleksandr; ZENAIEV, Oleksandr (Hamburg University)**Session Classification:** LHC top WG Open Meeting

Contribution ID: 12

Type: **not specified**

ATLAS-CMS comparison: Search for flavour-changing neutral-current couplings between the top quark and Higgs boson in multi-lepton final states

Thursday 25 April 2024 11:30 (20 minutes)

A search for flavour-changing neutral-current interactions involving the top quark, the Higgs boson and an up-type quark ($q = u, c$) with the ATLAS detector at the Large Hadron Collider is presented. The analysis considers leptonic decays of the top quark along with Higgs-boson decays into two W bosons, two Z bosons or a $\tau^+\tau^-$ pair. It focuses on final states containing either two leptons (electrons or muons) of the same charge or three leptons, of which exactly two have an identical charge. The considered processes are $t\bar{t}$ production with one top quark decaying via $t \rightarrow Hq$ and $pp \rightarrow Ht$ production. The proton-proton collision data set analysed amounts to 140 fb^{-1} at $\sqrt{s} = 13 \text{ TeV}$.

Presenter: GEYIK, Marvin Emin (Bergische Universitaet Wuppertal (DE))

Session Classification: LHC top WG Open Meeting

Contribution ID: 13

Type: **not specified**

ATLAS-Highlight-1: Precise test of lepton flavour universality in W-boson decays into muons and electrons in pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector

Thursday 25 April 2024 12:00 (20 minutes)

Reference: <https://arxiv.org/abs/2403.02133>

The ratio of branching ratios of the W boson to muons and electrons, $R_{\mu/eW} = B(W \rightarrow \mu\nu)/B(W \rightarrow e\nu)$, has been measured using 140 fb⁻¹ of pp collision data at $\sqrt{s}=13$ TeV collected with the ATLAS detector at the LHC, probing the universality of lepton couplings.

Presenter: HAWKINGS, Richard (CERN)

Session Classification: LHC top WG Open Meeting

Contribution ID: 14

Type: **not specified**

Dark matter as the trigger of flavor changing neutral current decays of the top quark

Thursday 25 April 2024 12:30 (20 minutes)

Reference: <https://arxiv.org/abs/2402.08652>

In this talk, I will discuss a possible connection between dark matter (DM) and one-loop induced top quark FCNC decays. In a simplified t-channel DM model that extends the SM with one colored scalar mediator and one right-handed fermion both odd under an ad-hoc Z_2 symmetry, I will show that moderate to large rates of the top quark FCNC decays are possible while respecting the existing constraints. Then I will discuss the phenomenological implications at hadron colliders (HL-LHC and FCC-hh) of four phenomenologically viable scenarios.

Presenter: Dr JUEID, Adil (Institute for Basic Science)

Session Classification: LHC top WG Open Meeting

Contribution ID: 15

Type: **not specified**

A blueprint for understanding the Monte-Carlo top quark mass parameter

*Thursday 25 April 2024 10:30 (20 minutes)*Reference: <https://arxiv.org/abs/2404.09856>

To control the scheme of the Monte-Carlo (MC) top quark mass parameter several ingredients are mandatory, concerning the knowledge of the IR dynamics of the top mass sensitive observable, the MC parton shower and the MC hadronization evolution. I discuss these ingredients and their interplay for the simple case of 2-jettiness for boosted top production in electron-positron annihilation, where these ingredients are now all known for the Herwig MC. Apart from having an at least NLL precise parton shower, which Herwig can provide for event-shapes, a crucial novel development is a QCD factorization compatible hadronization model, which I describe in some detail. The outcome is that for 2-jettiness the Herwig top mass parameter now represents a well defined and shower cut dependent renormalization scheme that can be quantified and controlled at NLO prediction. The approach I discuss represents a blueprint for controlling the scheme of the MC top mass parameter that may eventually be also applied to direct-type top quark mass measurements.

Presenters: HOANG, Andre; HOANG, Andre (Austrian Academy of Sciences (AT))**Session Classification:** LHC top WG Open Meeting

Contribution ID: 16

Type: **not specified**

Theory predictions for tZj production

Thursday 25 April 2024 14:30 (20 minutes)

Presenter: PAGANI, Davide (Universita e INFN, Bologna (IT))

Session Classification: LHC top WG Open Meeting

Contribution ID: 17

Type: **not specified**

CMS-Highlight-1: Measurement of inclusive and differential cross sections for single top quark production in association with a W boson in proton-proton collisions at 13.6 TeV

Thursday 25 April 2024 15:00 (20 minutes)

Reference: CMS-PAS-TOP-23-008 (<https://cds.cern.ch/record/2893766>)

Presenter: SOTO RODRIGUEZ, Alejandro (Universidad de Oviedo (ES))

Session Classification: LHC top WG Open Meeting

Contribution ID: 18

Type: **not specified**

CMS-Highlight-2: Inclusive and differential measurement of top quark cross sections in association with a Z boson

Thursday 25 April 2024 15:30 (20 minutes)

Reference: CMS-PAS-TOP-23-004 (<https://cds.cern.ch/record/2893862>)

Presenter: COLOMBINA, Federica (Deutsches Elektronen-Synchrotron (DE))

Session Classification: LHC top WG Open Meeting

Contribution ID: **19**

Type: **not specified**

ATLAS highlight

Session Classification: LHC top WG Open Meeting

Contribution ID: 20

Type: **not specified**

CMS-Highlight-3: Measurement of the inclusive $t\bar{t}$ cross section in final states with one lepton and additional jets and combination with the final states with two leptons at 5.02 TeV with 2017 data

Thursday 25 April 2024 17:00 (20 minutes)

Reference: CMS-PAS-TOP-23-005 (<https://cds.cern.ch/record/2895219>)

Presenter: DEL RIEGO BADAS, Javier (Universidad de Oviedo (ES))

Session Classification: LHC top WG Open Meeting

Contribution ID: 21

Type: **not specified**

The rise and fall of light stops in the LHC top quark sample

Thursday 25 April 2024 17:30 (20 minutes)

Reference: <https://arxiv.org/abs/2312.09794>

We discuss the possibility that light new physics in the top quark sample at the LHC can be found by investigating with greater care well known kinematic distributions, such as the invariant mass $m_{b\ell}$ of the b-jet and the charged lepton in fully leptonic $t\bar{t}$ events. We demonstrate that new physics can be probed in the rising part of the already measured $m_{b\ell}$ distribution. To this end we analyze a concrete supersymmetric scenario with light right-handed stop quark, chargino and neutralino.

Presenter: FRANCESCHINI, Roberto (Rome 3 U.)

Session Classification: LHC top WG Open Meeting

Contribution ID: 22

Type: **not specified**

3t vs 4t calculation at C-NLO

Friday 26 April 2024 09:30 (20 minutes)

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

Session Classification: LHC top WG Open Meeting

Contribution ID: 23

Type: **not specified**

Plans for 4-top-quark LHCTopWG combination

Friday 26 April 2024 10:00 (20 minutes)

Presenters: RAVINA, Baptiste (Georg August Universitaet Goettingen (DE)); SKOVPEN, Kirill (Ghent University (BE))

Session Classification: LHC top WG Open Meeting

Contribution ID: 24

Type: **not specified**

Four top final states with NLO accuracy in perturbative QCD: 4 lepton channel

*Friday 26 April 2024 10:30 (20 minutes)*Reference: <https://arxiv.org/abs/2401.10678>

Triggered by the observation of four top-quark production at the LHC by the ATLAS and CMS collaboration we report on the calculation of the next-to-leading order QCD corrections to the Standard Model process $pp \rightarrow t\bar{t}t\bar{t}$ in the 4ℓ top-quark decay channel. We take into account higher-order QCD effects in both the production and decays of the four top quarks. The latter effects are treated in the narrow width approximation, which preserves top-quark spin correlations throughout the calculation. We present results for two selected renormalisation and factorisation scale settings and three different PDF sets.

Presenters: WOREK, Malgorzata Maria (Rheinisch Westfaelische Tech. Hoch. (DE)); DIMITRAKOPOULOS, Nikolaos

Session Classification: LHC top WG Open Meeting

Contribution ID: 25

Type: **not specified**

Top-Quark Decay at Next-to-Next-to-Next-to-Leading Order in QCD

*Thursday 25 April 2024 16:00 (20 minutes)*Reference: <https://arxiv.org/abs/2309.01937>

We present the first complete high-precision QCD corrections to the inclusive decay width Γ_t , the W-helicity fractions $f_{\{L,R,0\}}$ and semi-inclusive distributions for the top-quark decay process $t \rightarrow b + W + X_{\text{QCD}}$ at NNNLO in the strong coupling constant α_s .

Presenter: CHEN, Xiang (Peking University)**Session Classification:** LHC top WG Open Meeting

Contribution ID: 26

Type: **not specified**

Quantum Top Entanglement in SMEFT

Wednesday 24 April 2024 17:30 (20 minutes)

Presenters: SEVERI, Claudio (University of Manchester); SEVERI, Claudio (Universita e INFN, Bologna (IT))

Session Classification: Joint session of the LHC EFT and Top Working Groups

Contribution ID: 27

Type: **not specified**

Probing entanglement in top quark production with the CMS detector

Friday 26 April 2024 11:30 (20 minutes)

Reference: CMS-PAS-TOP-23-001 (<https://cds.cern.ch/record/2893854>)

Entanglement is an intrinsic property of quantum mechanics and its measurement probes the current understanding of the underlying quantum nature of elementary particles at a fundamental level. A measurement of the extent of entanglement in top quark-antiquark events produced in proton-proton collisions at a center-of-mass energy of 13 TeV is performed on the data recorded by the CMS experiment at the CERN LHC in 2016, corresponding to an integrated luminosity of 35.9 fb⁻¹.

Presenters: JUNG, Andreas Werner (Purdue University (US)); NEGRO, Giulia (Purdue University (US))

Session Classification: LHC top WG Open Meeting

Contribution ID: 28

Type: **not specified**

Comparison of the ATLAS and CMS measurements of entanglement in top-quark-antiquark pair production

Friday 26 April 2024 12:00 (20 minutes)

Presenter: AFIK, Yoav (University of Chicago (US))

Session Classification: LHC top WG Open Meeting

Contribution ID: 29

Type: **not specified**

Threshold and bound state effects in $t\bar{t}$

Friday 26 April 2024 12:30 (20 minutes)

Presenters: SEVERI, Claudio (Universita e INFN, Bologna (IT)); SEVERI, Claudio (University of Manchester)

Session Classification: LHC top WG Open Meeting