

## T 66: Searches/BSM IV (BSM with Tops, LQs)

Time: Thursday 16:15–18:00

Location: ZHG010

T 66.1 Thu 16:15 ZHG010

**Search for new physics in all-hadronic  $t\bar{t}\bar{t}$  using ML with the CMS experiment** — ●SHAHZAD SANJRANI<sup>1,2</sup>, FREYA BLEKMAN<sup>1,3</sup>, and JOEL GOLDSTEIN<sup>2</sup> — <sup>1</sup>Deutsches ElektronenSynchrotron DESY, Hamburg, Germany — <sup>2</sup>University of Bristol, Bristol, United Kingdom — <sup>3</sup>University of Hamburg, Hamburg, Germany

There is current interest in searching for beyond the standard model particles produced in association with a top quark pair,  $t\bar{t}+X$  ( $X \rightarrow t\bar{t}$ ). This project focuses on a top-philic  $Z^*$  resonance model that may significantly enhance the  $t\bar{t}\bar{t}$  cross section. The all-hadronic channel is explored in the resolved regime using a novel machine learning algorithm, SPA-Net, which performs permutation-invariant jet-parton assignment to reconstruct events. This talk presents initial limits using this network to discriminate signal against large QCD multijet- and  $t\bar{t}$ -dominated backgrounds. Studies shown use Monte Carlo simulations of proton-proton collision data gathered by the CMS detector at the LHC.

T 66.2 Thu 16:30 ZHG010

**Search for 3 top BSM resonances in boosted all hadronic final state with the CMS experiment** — ●LUCIA XIMENA COLL SARAVIA<sup>1</sup>, FREYA BLEKMAN<sup>1,2</sup>, ANDREAS HINZMANN<sup>1</sup>, KUAN-YU LIN<sup>1</sup>, and MATTHIAS KOMM<sup>1</sup> — <sup>1</sup>DESY, Hamburg, Germany — <sup>2</sup>University of Hamburg, Hamburg, Germany

The production of three top quarks (3-top) has been identified as a promising signal for probing new physics beyond the Standard Model (BSM). Various BSM models propose a hypothetical  $Z'$  boson that preferentially couples to top quarks, which could manifest as an enhanced 3-top signal, a scenario yet unexplored by the CMS experiment. Recent analyses by ATLAS and CMS indicate that the observed four and three top cross section fits are consistent with predictions of a three top production cross section exceeding that of the Standard Model (SM). This study explores two channels in the fully hadronic final state:  $tZ'$  and  $tWZ'$ . Studies of three boosted top quark jets for  $Z'$  masses in the TeV range and the search sensitivity of Run 2 and Run 3 will be reported.

T 66.3 Thu 16:45 ZHG010

**Search for Leptoquark pair production in  $b\bar{t}b\bar{t}$  final states with the ATLAS experiment** — ●JOHANNES KLAS, TATJANA LENZ, and JOCHEN DINGFELDER — Physikalisches Institut, Universität Bonn, Nussallee 12, 53115 Bonn

Leptoquarks are hypothetical particles that carry lepton and baryon quantum numbers and can thus decay into a quark and a lepton, which is forbidden in the Standard Model (SM). They are predicted in various theories beyond the SM, like theories of quark-lepton unification or Grand Unified Theories. Leptoquarks may offer an explanation of some of the open questions in the SM like the anomalous magnetic moment of the muon or the anomalies observed in the decay of B-Mesons into D-Mesons. The search for pair production of leptoquarks in the  $b\bar{t}b\bar{t}$  final state using Run 2 ATLAS  $pp$  collision data will be presented in this talk. New methods to reconstruct leptoquark events are explored and the limits on the cross section are compared to the previous ATLAS Run 2 results.

T 66.4 Thu 17:00 ZHG010

**Search for resonant Leptoquark production using Run 2  $pp$  collision data of the ATLAS experiment** — ●CHRISTOPHER ENGEL, ADRIAN ALVAREZ, and STEFAN TAPPROGGE — Institute for Physics, Johannes Gutenberg University, Mainz, Germany

A Leptoquark is a hypothetical particle that couples to both leptons and quarks and carries both lepton and quark quantum numbers. Leptoquarks are predicted by many extensions of the Standard Model,

including Grand Unified Theories, and might explain similarities between the lepton and the quark generations. One way of searching for such a particle would be to look for the production of a single Leptoquark in proton-proton collisions caused by the interaction of a lepton and a quark coming from the inner structure of protons.

This talk focuses on this resonant production of a single Leptoquark decaying into an electron and a b-quark, which results in an electron+b-jet signal in the detector. This resonant structure in the invariant mass distribution of the electron and b-jet system could be identified on top of a smoothly falling background. One of the main goals of this contribution is the presentation of the background processes, the required cut optimization and the expected exclusion limits based on the Run 2 ATLAS data with  $140 \text{ fb}^{-1}$ .

T 66.5 Thu 17:15 ZHG010

**Search for dark matter production in association with a single top quark at the CMS experiment** — ●MORITZ MOLCH<sup>1</sup>, DOUG BERRY<sup>2</sup>, ULRICH HUSEMANN<sup>1</sup>, MICHAEL WASSMER<sup>1</sup>, and SEBASTIAN WIELAND<sup>1</sup> — <sup>1</sup>Institute of Experimental Particle Physics (ETP), Karlsruhe Institute of Technology (KIT) — <sup>2</sup>Fermi National Accelerator Laboratory (FNAL), Batavia, IL

This talk presents results of a search for the production of dark matter (DM) candidates in association with a single top quark in proton-proton collisions at a center-of-mass energy of  $\sqrt{s} = 13 \text{ TeV}$  with the CMS experiment, with a data set corresponding to an integrated luminosity of  $138 \text{ fb}^{-1}$ .

Since DM candidates are expected to interact only very weakly, they are not directly detectable with the CMS detector. Therefore the final state consists of a single top quark and missing transverse momentum.

The presented analysis targets the final state in which the top quark decays hadronically. A key feature of this analysis is the use of large-radius jets in combination with multivariate techniques to separate jets which originate from a top quark decay from purely QCD-initiated jets. The major backgrounds are estimated in the maximum likelihood fit for signal extraction using data from multiple control regions. Finally, the results are interpreted in the context of a simplified model introducing a flavor-changing neutral current at tree-level by a spin-1 mediator and spin-1/2 DM candidates.

T 66.6 Thu 17:30 ZHG010

**Exploring boosted top quark decays using Run 3 data collected by the CMS experiment** — ●JOHANNA MATTHIENEN<sup>1</sup>, JOHANNES HALLER<sup>1</sup>, ROMAN KOGLER<sup>2</sup>, and DANIEL SAVOIU<sup>1</sup> — <sup>1</sup>Institut für Experimentalphysik, Universität Hamburg — <sup>2</sup>DESY, Hamburg

Highly energetic top quarks produced in proton-proton collisions at the LHC can result in decay products that are highly collimated, appearing as a single large-radius jet in the CMS detector. These jets exhibit a distinctive internal substructure, enabling discrimination between top quark jets and those arising from other QCD processes. However, discrepancies between distributions in recorded data and simulations require corrections to the simulations. The boosted topology offers a unique opportunity to probe for new heavy particles decaying into top-antitop quark pairs. This presentation provides first insights from the ongoing LHC Run 3, focusing on the top-antitop quark mass spectrum as a potential window to new physics phenomena.

T 66.7 Thu 17:45 ZHG010

**Search for Leptoquarks in the multilepton channel with ATLAS Run-2 data** — ●ONDREJ MATOUSEK and ANDRE SOPCZAK — Czech Technical University in Prague

The latest results in the search for leptoquarks in the multilepton channel are presented using ATLAS Run-2 data.