

## T 51: Suche nach Physik jenseits des Standardmodells III

Zeit: Mittwoch 16:30–19:05

Raum: Philo-HS4

**Gruppenbericht**

T 51.1 Mi 16:30 Philo-HS4

**Search for single production of vector-like quarks decaying into  $Wb$  in  $pp$  collisions at  $\sqrt{s} = 13$  TeV with the ATLAS detector** — ●ANJISHNU BANDYOPADHYAY<sup>1</sup>, IAN BROCK<sup>1</sup>, JANET DIETRICH<sup>2</sup>, HEIKO LACKER<sup>2</sup>, DUSTIN BIEDERMANN<sup>2</sup>, FERDINAND SCHENK<sup>2</sup>, DIDIER ALEXANDRE<sup>2</sup>, SERGIO GRANCAGNOLO<sup>2</sup>, TOBIAS KUPFER<sup>3</sup>, JOHANNES ERDMANN<sup>3</sup>, DANILO FERREIRA DE LIMA<sup>4</sup>, and DENNIS SPERLICH<sup>2</sup> — <sup>1</sup>University of Bonn — <sup>2</sup>Humboldt University, Berlin — <sup>3</sup>University of Dortmund — <sup>4</sup>University of Heidelberg

Vector-like quarks are coloured spin 1/2 fermions predicted by various Beyond the Standard Model (BSM) theories. A search for singly produced vector-like  $Q$  quarks, where  $Q$  can be either a  $T$  quark with charge  $+2/3$  or a  $Y$  quark with charge  $-4/3$ , performed with  $36.1 \text{ fb}^{-1}$  of proton-proton collision data taken at the LHC at a centre-of-mass energy of 13 TeV in 2015 and 2016 recorded by the ATLAS detector will be reported in this talk. This analysis targets  $Q \rightarrow Wb$  decays where the  $W$  boson decays leptonically. Here, events with one lepton and at least two jets are selected, requiring at least one  $b$ -tagged jet and at least one forward jet. The various methods and challenges encountered in this analysis will be shown in this talk. The results which are also interpreted as limits on the  $QWb$  coupling and the mixing with the Standard Model sector for a singlet  $T$  quark or a  $(Y, B)$  doublet will be presented in this talk.

T 51.2 Mi 16:50 Philo-HS4

**First search for single production of vector-like  $B$  quarks in the  $B \rightarrow bH$  decay channel with  $H \rightarrow \gamma\gamma$  with the ATLAS detector at  $\sqrt{s} = 13$  TeV** — ●BJÖRN WENDLAND<sup>1</sup>, FREDERIC SCHRÖDER<sup>2</sup>, ISABEL NITSCHÉ<sup>1</sup>, DIANE CINCA<sup>1</sup>, JOHANNES ERDMANN<sup>1</sup>, and KEVIN KRÖNINGER<sup>1</sup> — <sup>1</sup>TU Dortmund, Experimentelle Physik IV — <sup>2</sup>Bergische Universität Wuppertal

Vector-like quarks are the simplest extension of the Standard Model of particle physics (SM) with color charged fermions that is still allowed by data. The single production of vector-like  $B$  quarks, which is favored over the pair production at high masses, is considered in this analysis.

The decay of a singly produced  $B$  into a  $b$  quark and a Higgs boson with  $H \rightarrow \gamma\gamma$  is studied at the LHC for the first time using data taken with the ATLAS detector at a center-of-mass energy of 13 TeV. Although the  $H \rightarrow \gamma\gamma$  decay channel has a low branching ratio, this analysis benefits from the excellent mass resolution of the diphoton system.

The analysis strategy is based on the characteristic event topology with two photons with high transverse energy, one  $b$ -jet with high transverse momentum and one forward jet. The invariant mass of the  $B$  candidate is reconstructed from its decay products and used as discriminating variable against background. The main background contribution arises from non-resonant diphoton production with additional small contributions from SM Higgs boson production processes.

T 51.3 Mi 17:05 Philo-HS4

**Suche nach Paarproduktion von vektorartigen Quarks im Zerfallskanal  $T/B \rightarrow Zt/b$  bei  $\sqrt{s} = 13$  TeV am ATLAS-Experiment** — ●ELENA FREUNDLICH, JOHANNES ERDMANN und KEVIN KRÖNINGER — TU Dortmund, Lehrstuhl für Experimentelle Physik IV

Bei der Suche nach Physik jenseits des Standardmodells spielen Composite-Higgs-Modelle als Erweiterung des Standardmodells hin zu einer fundamentalen Theorie eine wichtige Rolle. Diese Modelle sagen vektorartige Quarks (VLQ) voraus, deren links- und rechtshändiger Anteil die gleichen Transformationseigenschaften unter der  $SU(2)$  besitzen.

Es wird eine Analyse zur Suche nach Paarproduktion von VLQ bei  $\sqrt{s} = 13$  TeV am ATLAS-Experiment vorgestellt. Die betrachteten Zerfälle sind  $T \rightarrow Zt$  und  $B \rightarrow Zb$ , wobei die beiden VLQ  $T$  und  $B$  eine Ladung von  $+2/3e$  bzw.  $-1/3e$  tragen. Die betrachteten Ereignisse enthalten unter anderem ein hochenergetisches  $Z$ -Boson, das in ein Leptonenpaar  $\ell^+\ell^-$  zerfällt, mindestens zwei Jets mit großem Radiusparameter und mindestens zwei  $b$ -Jets. Die statistische Analyse wird unter Berücksichtigung systematischer Unsicherheiten durchgeführt und es werden untere Limits auf die Massen von  $T$  und  $B$

gesetzt.

T 51.4 Mi 17:20 Philo-HS4

**Search for excited bottom quarks decaying to  $tW$  with the CMS experiment** — JOHANNES HALLER, ROMAN KOGLER, and ●ALEXANDER FRÖHLICH — Universität Hamburg, Institut für Experimentalphysik

We present a search for singly produced excited bottom quarks ( $b^*$ ) decaying to  $tW$  in  $pp$ -collisions at  $\sqrt{s} = 13$  TeV. In this analysis, the muon + jets final state is studied. The  $W$  from the  $b^*$  is assumed to decay into a muon and a neutrino and hence its four-momentum is reconstructed from the muon and the missing transverse energy. The  $W$  from the top quark decays hadronically. The top quark is assumed to be highly boosted and is reconstructed in a single jet. For its identification the analysis makes use of a new top tagging algorithm, the Heavy Object Tagger with Variable R (HOTVR). The adaptive cone size of this algorithm allows for a stable reconstruction efficiency over a large range of  $b^*$  masses, which warrants a single analysis strategy for  $b^*$  masses of 700 GeV up to a few TeV. The distribution of the reconstructed  $b^*$  mass is used to search for deviations from the SM background prediction. Expected limits on the production cross-section are presented.

T 51.5 Mi 17:35 Philo-HS4

**Search for VBF produced diboson resonances in the all-jets final state at  $\sqrt{s} = 13$  TeV with the CMS experiment** — ●IRENE ZOI, ROBIN AGGLETON, and ANDREAS HINZMANN — Universität Hamburg

Many models of physics beyond the Standard Model (SM) predict the existence of heavy particles that decay to SM vector boson pairs. This talk presents a search for massive resonances produced through vector-boson-fusion (VBF) and decaying into a pair of vector bosons ( $WW$ ,  $WZ$  or  $ZZ$ ) where each boson decays to a quark anti-quark pair, extending the previously published searches optimized for production via gluon-fusion and quark anti-quark annihilation. The analysis is based on proton-proton collision data at  $\sqrt{s} = 13$  TeV collected by the CMS experiment at the CERN LHC during 2016 and corresponding to an integrated luminosity of  $35.9 \text{ fb}^{-1}$ . The signals studied in this analysis are narrow resonances with masses above 1.0 TeV, that decay to energetic vector bosons, considering various spin hypotheses. The particles emerging from each vector boson are very collimated and therefore merged into a single boosted jet. Jet substructure techniques are exploited to significantly reduce the SM background.

T 51.6 Mi 17:50 Philo-HS4

**Search for resonant  $WZ$  Production with the ATLAS detector at the LHC** — ●JOANY MANJARRES RAMOS, STEFANIE TODT, and CARSTEN BITTRICH — TU Dresden

Heavy resonances decaying into diboson pairs, are among the most common features to search for phenomena beyond the standard model (SM). The electroweak boson pair production, is a powerful test of the spontaneously broken gauge symmetry of the SM and can be also used to search for phenomena beyond the SM. There is a wide spectrum of theoretical models predicting these kinds of resonant signatures.

In this talk the details of the search for resonant  $WZ$  production by the ATLAS detector at the LHC in the fully leptonic final state will be presented. The results will be interpreted using a parameterization of Lagrangians which incorporate a heavy vector triplet (HVT), and the Georgi-Machacek model (GM) is also used as a benchmark for a singly-charged scalar resonance.

T 51.7 Mi 18:05 Philo-HS4

**Eine Suche nach exotischen Resonanzen im Zwei-Boson-Zerfallskanal mit vollhadronischem Endzustand mit dem CMS-Experiment** — MATTHIAS MOZER, THOMAS MÜLLER, VALÉRIE SCHEURER und ●DANIELA SCHÄFER — Institut für Experimentelle Teilchenphysik (ETP), Karlsruher Institut für Technologie (KIT)

Viele Erweiterungen des Standardmodells sagen die Existenz neuer Teilchen mit Massen im TeV-Bereich voraus, die zum Beispiel über ihren resonanten Zerfall in zwei Vektor-Bosonen nachgewiesen werden könnten. Die hier präsentierte Suche benutzt bei einer Schwerpunktsenergie von 13 TeV mit dem CMS-Detektor aufgenommene Da-

ten, um im vollhadronischen Endzustand nach exotischen Zwei-Boson-Resonanzen zu suchen. Aufgrund der großen Masse der gesuchten Resonanzen sind ihre Zerfallsprodukte stark geboostet. Ein solches geboostetes Vektor-Boson kann nicht mehr über zwei einzelne Jets rekonstruiert werden, sondern seine Zerfallsprodukte werden stattdessen in einen einzigen "fetten" Jet geclustert. Um zwischen solchen Jets, die von stark geboosteten Vektor-Bosonen stammen, und Untergrund-Jets zu unterscheiden, werden Methoden basierend auf der Substruktur der Jets verwendet (*V-tagging*). Eine weitere Herausforderung ist die Modellierung des von QCD-Multijet Ereignissen dominierten Untergrundes. Hierfür wird eine neue Strategie verwendet, die auf einem multidimensionalen Fit im Zwei-Jet-Massenspektrum  $m_{jj}$  und den zwei Jet-Massen  $m_{\text{jet}1}$  und  $m_{\text{jet}2}$  beruht.

T 51.8 Mi 18:20 Philo-HS4

**b tagging bei der Suche nach Dibosonresonanzen mit dem CMS Experiment** — MATTHIAS MOZER, THOMAS MÜLLER, DANIELA SCHÄFER und VALERIE SCHEURER — Institut für Experimentelle Teilchenphysik (ETP), Karlsruher Institut für Technologie (KIT)

Bei der Suche nach Dibosonresonanzen im vollhadronischen Kanal kann die Sensitivität verbessert werden, indem speziell für Z-Bosonen nach dem Zerfall in zwei b-Quarks gesucht wird. Zur Selektion dieser Zerfälle wird der „double-b tagger“ verwendet, ein Werkzeug, das speziell für die Suche nach geboosteten Zerfällen des Higgs Bosons in zwei b-Quarks entwickelt wurde.

Im Vortrag wird die Verwendbarkeit des „double-b taggers“ für Z-Bosonen sowie die Verbesserung der Ausschlussgrenzen mithilfe der Methode gezeigt.

T 51.9 Mi 18:35 Philo-HS4

**Search for a heavy resonance  $Z'$  decaying into  $T't$  in lepton+jets final states at  $\sqrt{s} = 13$  TeV with the CMS experiment** — ANNA BENECKE, JOHANNES HALLER, ANDREAS HINZMANN, and ROMAN KOGLER — Universität Hamburg

Many models of physics beyond the Standard Model predict vector-like quarks ( $T'$ ) and a new heavy gauge boson ( $Z'$ ). While decays of the  $Z'$  and  $T'$  into Standard Model particles have been studied already, no dedicated searches for the decay  $Z' \rightarrow tT'$  with  $T' \rightarrow Ht$  have

been performed so far. This talk presents the results of a search for a heavy spin-1 resonance  $Z'$  decaying into  $T't$  at  $\sqrt{s} = 13$  TeV based on data collected by the CMS experiment in 2016 corresponding to an integrated luminosity of  $36 \text{ fb}^{-1}$ . Two decay modes of the  $T'$  quark to third generation Standard Model quarks are considered:  $T' \rightarrow Ht$  and  $T' \rightarrow Zt$ . Jet substructure techniques are used to identify the boosted hadronic decays of H or Z bosons and significantly reduce the SM backgrounds. A  $\chi^2$  method is used for the reconstruction of the  $Z'$  mass. Its distribution is used to identify possible deviations of the data from the SM background prediction. Finally, model independent exclusion limits on the production cross section are derived as well as two interpretations in the context of a heavy gauge boson  $Z'$  and a heavy gluon  $G^*$  are presented.

T 51.10 Mi 18:50 Philo-HS4

**A search for high-mass resonances decay to  $\tau\nu$  in pp-collisions at  $\sqrt{s} = 13$  TeV with the ATLAS detector** — CHRISTOS VERGIS, WILL DAVEY, and JOCHEN DINGFELDER — Physikalisches Institut, Universität Bonn, Germany

Many models beyond the Standard Model predict the existence of new heavy charged ( $W'$ ) gauge bosons. In case of leptonic  $W'$  decays, the signature is a high- $p_T$  lepton and large missing energy from the emitted neutrino. Although searches for  $W' \rightarrow e/\mu$  are more sensitive than  $W' \rightarrow \tau\nu$  for universal coupling to leptons, decays to tau lepton are well suited for models in which the  $W'$  couples preferentially to third-generation fermions.

The search for heavy resonances decaying to a tau lepton and a neutrino is performed in events where the tau lepton decays hadronically, using  $36.1 \text{ fb}^{-1}$  of pp-collision data at  $\sqrt{s} = 13$  TeV recorded by the ATLAS detector at the LHC. This is the first search for  $W'$  bosons in this decay channel from ATLAS. No significant excess of events over the Standard Model expectation was found and 95% CL upper limits are set on the visible  $\tau\nu$  production cross section,  $\sigma(pp \rightarrow \tau\nu + X) \cdot B \cdot A \cdot \epsilon$ .  $W'$  bosons with masses below 3.74 TeV (SSM) and 2.1-3.76 TeV (non-universal models) are excluded, significantly improving the limits set by other searches for new gauge bosons with non-universal couplings.

In this talk, an overview of the  $W' \rightarrow \tau\nu$  analysis and the current results will be given.