

T 83: Search for new particles IV

Time: Thursday 16:30–19:00

Location: L-2.017

T 83.1 Thu 16:30 L-2.017

Background estimate for a dijet resonance search with ATLAS at trigger level — ●FALK BARTELS — Kirchhoff-Institut für Physik, Heidelberg, Deutschland

Conventional LHC searches for dijet resonances are statistically limited in the sub-TeV range due to the reduced readout rate of lower p_T jet triggers. The ATLAS trigger-level analysis covers this part of the spectrum by recording a strongly reduced set of jet information processed by the High Level Trigger for all events passing the seeding Level-1 Trigger. This allows lowering the minimum measured dijet mass from ≈ 1 TeV to 450 GeV.

The total of 77 billion dijet events recorded in this way during Run-2 require a novel approach for determining the QCD background. A sliding window fit with an analytic function as performed to 2016 data can be used but reduces the sensitivity to wider resonances. An alternative background estimate based on truth-level theory predictions is presented.

T 83.2 Thu 16:45 L-2.017

Search for long-lived particles decaying in the CMS tracker detector — LISA BENATO, MELANIE EICH, GREGOR KASIECZKA, STUART NICHOLLS, ●KARLA PEÑA, PHILIPP RINCKE, and JÖRG SCHINDLER — Institut für Experimentalphysik, Universität Hamburg

Higgs-portal models propose the existence of a dark sector, neutral under all Standard Model (SM) gauge groups. Interaction between the dark sector and the SM is mediated solely by the Higgs boson, which mixes with its dark partner. As a consequence of this, the Higgs boson is predicted to decay also in the dark sector. Scenarios are considered where the Higgs boson decays into a pair of dark long-lived particles (LLPs), each of which travels a macroscopic distance before decaying back to a pair of SM particles—predominantly b quarks.

Decays occurring within the CMS tracking system result on displaced-vertex signatures, which can be observed with almost no background from the SM. However, as conventional tracking and vertex finding algorithms are optimized for prompt decays, these signatures are challenging to find and advanced reconstruction techniques are required. Studies of machine-learning methods for displaced-vertex reconstruction will be discussed and compared to a benchmark analysis, where information from displaced tracks is used to tag jets resulting from LLP decays. The status of a search for LLPs is presented, using data collected by the CMS detector in pp collisions at $\sqrt{s} = 13$ GeV.

T 83.3 Thu 17:00 L-2.017

Search for a Z' with couplings to top quarks and muons in CMS — ●BJÖRN TIEDEMANN, ALEXANDER FRÖHLICH, PAOLO GUNNELLINI, JOHANNES HALLER, ROMAN KOGLER, and ARNE REIMERS — Institut für Experimentalphysik, Universität Hamburg

A search for a heavy gauge boson Z' coupling exclusively to muons and top quarks in proton-proton collisions at $\sqrt{s} = 13$ TeV with the CMS experiment is presented. The search is performed assuming that the Z' is produced in association with a top quark pair and decays to two muons, resulting in $t\bar{t}\mu^+\mu^-$ finale state. Studies are presented to suppress background from standard model $t\bar{t}$ production. It is demonstrated how the sensitivity for this signal can be improved compared to inclusive searches in the dimuon mass spectrum.

T 83.4 Thu 17:15 L-2.017

Search for new particles in events with 4 top quarks at the ATLAS detector — ●ALICIA WONGEL for the ATLAS-Collaboration — DESY, Hamburg

A novel search for anomalous production of four-top-quark events is presented. It offers a unique way to probe top-philic resonances (Z') which can only be produced in association with top quarks ($t\bar{t}Z' \rightarrow t\bar{t}t\bar{t}$) and thus cannot be accessed in current searches. Full Run 2 data is used in this analysis. It focuses on one-lepton events, that ensure a high signal acceptance while suppressing multijet process events. Furthermore, the particular configuration where the resonance decays fully hadronically is investigated. A potential signal would manifest itself as a bump over the steeply falling mass spectrum of the two hadronically decaying top quarks ($m_{t\bar{t}}$). In this talk, an overview of the analysis strategy is given, including the background estimation techniques and measures taken to improve the mass resolution of the

reconstructed resonance.

T 83.5 Thu 17:30 L-2.017

A search for pair production of excited top quarks t^* — ●FINN LABE, PAOLO GUNNELLINI, JOHANNES HALLER, ANASTASIA KARAVDI-INA, and ROMAN KOGLER — Institut für Experimentalphysik, Universität Hamburg

A search for pair production of excited top quarks t^* in the decay channels $t^*t^* \rightarrow t\bar{t}g$ and $t^*t^* \rightarrow t\bar{t}\gamma$ is presented. The search is performed in the lepton + jets final state using data collected from proton-proton collisions at a center-of-mass energy of 13 TeV by the CMS experiment. Studies are shown using simulated signal events to examine the possibility of reconstructing the mass of the t^* . In addition, first results using data of the CMS detector will be shown. Events are classified by the presence of a reconstructed photon and the best signal hypothesis is chosen based on kinematic constraints from the top quark decays.

T 83.6 Thu 17:45 L-2.017

Search for displaced decays of massive particles in multijet events with the ATLAS detector — ●EMILY THOMPSON for the ATLAS-Collaboration — DESY, Hamburg, Germany

Massive, long lived particles (LLPs) are predicted to exist in several theories beyond the Standard Model. For example, models with small couplings, such as R-parity-violating supersymmetry, and models allowing for decays via highly virtual intermediate states, such as Split supersymmetry, can result in LLPs. With lifetimes ranging from picoseconds to nanoseconds, these LLPs could decay to several electrically charged particles in the inner tracking volume of the ATLAS detector, resulting in a displaced secondary vertex that can be reconstructed.

This presentation concerns a search for high-mass displaced vertices reconstructed in the ATLAS inner detector in multijet events with 136 fb^{-1} of data collected at $\sqrt{s} = 13$ TeV. There are no Standard Model particles that give rise to high-mass displaced vertices. Therefore, the backgrounds stem from various instrumental effects and their expected yields are estimated from data. In this talk, a novel method to estimate all sources of background inclusively is discussed.

T 83.7 Thu 18:00 L-2.017

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

A search is presented for singly produced excited bottom quarks (b^*) decaying to a top quark and a W boson in pp collisions at $\sqrt{s} = 13$ TeV using the full Run2 dataset corresponding to 137 fb^{-1} recorded with the CMS detector. The search is performed in the lepton + jets final state, where the top quark decays hadronically, and the W boson decays into a lepton and a neutrino.

The reconstruction and identification of the top quark is done with the Heavy Object Tagger with Variable R (HOTVR). Its stable performance over a large range in transverse momentum allows for a high signal sensitivity over a wide range of b^* masses. Data driven methods are used to estimate standard model background contributions from misidentified objects.

T 83.8 Thu 18:15 L-2.017

A data-driven estimate of the ZZ background in the search for high mass Higgs bosons — ●FANG-YING TSAI for the ATLAS-Collaboration — DESY

An additional Higgs boson is predicted by many models such as the two-Higgs-doublet model (2HDM). This talk will mainly focus on a data-driven method used to estimate the dominant ZZ background in the search for $X \rightarrow ZZ \rightarrow \ell^+ \ell^- + \text{MET}$. Currently, the ZZ $\rightarrow \ell^+ \ell^- + \nu\nu$ background is estimated from simulated MC samples and it contributes the largest systematic uncertainties to the analysis. The idea of the $Z\gamma$ methodology is to make use of the similarity of the ZZ and $Z\gamma$ processes, especially in the regions where the mass difference between the Z and the photon does not matter. The ZZ/ $Z\gamma$ cross-section ratio is calculated in bins of the $\nu\nu$ pt and γ pt and applied to the $Z\gamma$ events in data, together with a correction of the photon reconstruction effi-

ciency to mimic the production of the ZZ background. The presented studies use the full ATLAS Run 2 data sample (2015-2018) in proton-proton collisions at $\sqrt{s} = 13$ TeV centre-of-mass energy, corresponding to 139 fb^{-1} .

T 83.9 Thu 18:30 L-2.017

Search for high-mass resonances decaying to $\tau\nu$ in pp-collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector — ●CHRISTOS VERGIS and JOCHEN CHRISTIAN DINGFELDER for the ATLAS-Collaboration — Physikalisches Institut, Bonn, Germany

Many models beyond the Standard Model predict the existence of new heavy charged gauge bosons (W'). In case of leptonic W' decays, the signature in the detector is a high- p_T lepton and large missing energy from the undetected neutrino. Although searches for $W' \rightarrow (e/\mu)\nu$ 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 the third-generation of fermions.

This talk will cover the search for heavy resonances decaying to a tau and a neutrino, in events where the tau lepton decays hadronically, using data collected during the 2015-2018 pp-collisions at $\sqrt{s} = 13$ TeV by the ATLAS detector at the LHC. Recent updates to the background estimation and analysis strategy will be discussed. Preliminary expected exclusion limits to the W' masses in the Sequential Standard Model

(as benchmark model) and models with preferential couplings to the third generation of fermions will be shown. Following the increase in luminosity as well as upgrades in the tau reconstruction algorithms and analysis strategy, the reach of the search is significantly improved compared to the first ATLAS results.

T 83.10 Thu 18:45 L-2.017

Search for heavy resonances decaying to VH in the $H \rightarrow WW \rightarrow 4q$ channel — PAOLO GUNNELINI, JOHANNES HALLER, ROMAN KOGLER, and ●ANDREA MALARA — Institut für Experimentalphysik, Universität Hamburg

A search for new heavy particles decaying to a Higgs and a Z boson is presented. The analysis is performed on the dataset recorded by the CMS experiment in proton-proton collisions at a centre-of-mass energy of 13 TeV in the year 2016, which corresponds to an integrated luminosity of 35.9 fb^{-1} .

The final state resulting from the $H \rightarrow WW \rightarrow 4q$ and $Z \rightarrow \ell\ell$ is analysed. In order to maximise the sensitivity to a potential signal in highly-energetic processes with collimated final-state objects, deep neural network techniques as well as multiple jet algorithms are used to identify jets characterised by a 4-prong structure. Expected upper exclusion limits on the production cross section of the new resonance are derived.