T 74: Higgs: Erweiterte Modelle II / Suchen

Zeit: Donnerstag 16:30–19:00 Raum: Philo-HS2

T 74.1 Do 16:30 Philo-HS2

A search for pairs of Higgs bosons in the $b\bar{b}\tau^+\tau^-$ decay channel with the ATLAS detector — •Petar Bokan[1,2], Pedro Sales de Bruin[2], Jason Veatch[1], Arnaud Ferrari[2], and Stan Lai[1] — [1]II. Physikalisches Institut, Georg-August-Universität Göttingen — [2]Department of Physics and Astronomy, Uppsala University

After the discovery of the Higgs boson, a full measurement of the Higgs potential is needed to further probe the mechanism of electroweak symmetry breaking. Since the Higgs potential is related to the fact that the Higgs boson couples to itself, such a measurement can be performed by searching for pairs of Higgs bosons. However, the Standard Model (SM) predicted cross-section is very small due to destructive interference between the Higgs self-coupling and the Higgs-fermion Yukawa coupling production modes. On the other hand, a search for pairs of Higgs bosons potentially offers insight into physics beyond the Standard Model (BSM), since several BSM hypotheses predict heavy resonances that could decay to a pair of Higgs bosons.

A search for non-resonant and resonant Higgs boson pair production in the $b\bar{b}\tau^+\tau^-$ channel is presented for 36.1 fb^{-1} of $\sqrt{s} = 13$ TeV data taken by the ATLAS experiment at the Large Hadron Collider (LHC). The analysis considers the semi-leptonic and fully hadronic di-tau final states. The $b\bar{b}\tau^+\tau^-$ final state is one of the most sensitive channels and, in particular, it is the most sensitive channel to search for non-resonant Higgs boson pair production. A study on the High-Luminosity Large Hadron Collider (HL-LHC) prospects of the SM Higgs pair production in the $b\bar{b}\tau^+\tau^-$ channel is also presented in addition.

T 74.2 Do 16:45 Philo-HS2

Monte Carlo studies on the estimation of $ZZ \to \ell\ell\nu\nu$ background using $Z\gamma \to \ell\ell\gamma$ events — •Mangesh Sonawane[1], Beate Heinemann[2], Pieter Everaerts[2], Sarah Heim[2], and Jorge Sabater Iglesias[2] — [1]IISER Pune, Indien — [2]DESY Hamburg, Deutschland

In the search for Dark Matter (DM) at the LHC, SM particles are produced in association with DM particles, which are invisible as they don*t interact with the detector. Thus, events with large imbalance in transverse momentum are of interest. One such signature is $\ell\ell + E_T^{miss}$.

The dominant background contributing to the search for DM in the $\ell\ell + E_T^{miss}$channel is $ZZ \to \ell\ell\nu\nu$. Currently, this background is determined using Monte Carlo simulation, with an uncertainty of about 10%. The goal of this study is to establish a data driven method to estimate this background, and reduce the uncertainty. Using $Z\gamma \to \ell\ell\gamma$, a process with low backgrounds and a high BR$\times\sigma$, it is possible to estimate the $ZZ \to \ell\ell\nu\nu$ contribution. In regions where $p_T(\gamma) \gg M_Z$, the two processes are kinematically similar. They have the same production mechanisms, but differ due to the photon and Z boson couplings to the quarks being different, as well as the difference in mass (photons are massless, while Z bosons are massive). Introducing a transfer factor R as the ratio $\sigma(ZZ)/\sigma(Z\gamma)$ which is determined from simulation, the contribution of $ZZ \to \ell\ell\nu\nu$ to the background can be estimated from $Z\gamma \to \ell\ell\gamma$ data. The uncertainty on the prediction of R due to theoretical aspects is estimated in this work.

T 74.3 Do 17:00 Philo-HS2

Search for H→WW in MSSM Scenarios with the Emphasis on Minimizing Systematic Uncertainties using a Multi-Variate Strategy — David Brunner, Jordy Degens, •Peter Fackeldey, Olena Hlushchenko, Wolfgang Lohmann, Johannes Merz, Thomas Müller, Alexander Nehrkorn, Claudia Pistone, Dennis Roy, Hale Sert, Achim Stahl, and Dominik Wolfschläger — III. Physikalisches Institut B, RWTH Aachen University

A promising model beyond the Standard Model is the Minimal Supersymmetric Standard Model (MSSM), which is commonly parameterized in the Higgs sector by $\tan\beta$ and m_A. As in every 2HDM, five different Higgs bosons are predicted. Especially the decay of the heavy scalar Higgs boson into two W bosons is very sensitive to low values of $\tan\beta$ and m_A. Standard Model background processes are a challenge in this region. These backgrounds are modelled using data driven methods, whose performances heavily rely on the purity of their associated control regions. In the last few years Deep Learning showed remarkable progress and success in high energy physics. We present a classification strategy with deep neural networks, which increases the purity in control regions for SM background processes. This strategy minimizes systematic uncertainties and thus improves the limits in an unexplored region of the MSSM parameter space in the search for H→WW.

T 74.4 Do 17:15 Philo-HS2

Search for Neutral MSSM Higgs Bosons in the H/A→ $\tau\tau$ channel at ATLAS — •Emily Thompson, William Davey, and Jochen Dingfelder — Physikalisches Institut Universität Bonn

The Minimal Supersymmetric Standard Model (MSSM) is an extension of the Standard Model (SM) that is able to address problems of the SM such as the hierarchy problem, gauge coupling unification and the existence of dark matter. Its Higgs Sector consists of two charged, $H^{\pm}$, and three neutral Higgs bosons, h, H, A. The couplings of H and A to down-type fermions are enhanced over a large region of parameter space, resulting in increased branching fractions to τ leptons and b-quarks. This has motivated a variety of searches of MSSM Higgs bosons decaying into $\tau\tau$ final states.

In this talk, a search for neutral MSSM Higgs Bosons decaying into a τ lepton pair is presented in the channel where one τ decays leptonically and the other τ decays hadronically. The selection is split into a b-tagged and a b-veto region to optimize the sensitivity for different production processes. Currently, the H→ $\tau\tau$ analysis is being developed for use with the full Run 2 dataset of proton-proton collision data collected with the ATLAS detector at a centre-of-mass energy of $\sqrt{s}$ = 13 TeV. The recent progress of this development is presented, with a focus on signal region optimization.

T 74.5 Do 17:30 Philo-HS2

Identifizierung geboosteter $h \to b\bar{b}$-Zerfälle mit dem ATLAS-Detektor — •Stefan Maschek, Andreas Hönle, Felix Müller, Hubert Kroha und Sandra Kortner — Max-Planck-Institut für Physik

Mit seiner Masse von 125 GeV zerfällt das Higgsboson h vorwiegend in bottom-Antibottom-Quarkpaare, welche aufgrund von Hadronisierung und Fragmentierung im Detektor als Jet gemessen werden können. Stark geboostete Higgsbosonen, wie sie in Zerfällen hypothetisch neuer, massiver Teilchen auftreten können, haben die Eigenschaft, dass die Jets der beiden bottom-Quarks fast kollinear gerichtet sind und nicht voneinander getrennt werden können. Um eine solche geboostete Topologie dennoch identifizieren zu können, werden Jets mit großen Radien definiert, welche die Zerfallsprodukte beider b-Quarks umfassen. Diese großen Jets unterscheiden sich durch hohe invariante Massen von einfachen Quark- und Gluonjets. Darüber hinaus werden b-Quarktagging und verschiedene Variablen, die die Jetsubstruktur charkterisieren, zur Diskriminierung der Signalereignisse gegenüber dem Untergrund verwendet. In diesem Vortrag werden die jüngsten Entwicklungen bei der $h \to b\bar{b}$-Identifizierung und deren Anwendung bei der Suche nach neuen, schweren Teilchen vorgestellt, die in ein Higgsboson und ein W-oder Z-Boson zerfallen.

T 74.6 Do 17:45 Philo-HS2

Search for a heavy charged Higgs boson in Run-2 — •Francesco Peri, Heiko Lacker, and Janet Dietrich — Humboldt University of Berlin

Charged Higgs bosons ($H^{\pm}$) are predicted by many Beyond-the-Standard Model (BSM) scenarios, like the MSSM (Minimal Supersymmetric Standard Model). The production mechanisms and decays of such particles strongly depend on their mass. This presentation focuses on heavy charged Higgs bosons, with a mass larger than the top-quark mass. In this case, the dominant production mode is in association with a top quark, while the decay is into a top-bottom pair. The latest developments from the ATLAS collaboration are hereby discussed, presenting the results obtained during Run-2 and including prospectives for the future.

T 74.7 Do 18:00 Philo-HS2

Search for new Physics in Boosted $hh \to bb\tau\tau$ Decays at ATLAS. — •David Kirchmeier, Arno Straessner, and Wolfgang Mader — IKTP, TU Dresden, Germany

The resonant and non-resonant production of two Higgs bosons play an important role, in the investigation of the Higgs self-coupling and

in searches for physics beyond the Standard Model.

Due to the relatively high Higgs mass and its narrow width, decays into two Higgs bosons are ideal e.g. in searches for heavy Higgs bosons like they are predicted by supersymmetric theories or heavy Kaluza-Klein Gravitons. Furthermore the $hh \to bb\tau\tau$ decay channel is promising as the Higgs decay into bb has the highest branching ratio, while the decay into $\tau\tau$ final states has still a moderately high branching ratio and allows good separation against QCD background.

In particular the regime of very high mass resonances above 1 TeV is experimentally challenging. The high boost of the b- and τ-pair systems lead to signatures with close-by pairs of b-jets and tau decays in the ATLAS detector and requires dedicated experimental techniques to tag those topologies. This talk presents a search for new physics in the highly boosted $bb\tau\tau$ final state while also going into some of the latest developments in the identification of boosted hadronic τ pair decays in ATLAS.

T 74.8 Do 18:15 Philo-HS2

Suche nach Dunkler Materie im Mono-Higgs-Kanal mit dem ATLAS-Detektor bei einer Schwerpunktenergie von 13 TeV — •Rainer Röhrig, Sandra Kortner, Hubert Kroha und Patrick Rieck — Max-Planck-Institut für Physik, München

Dunkle Materie dominiert die Materie im Universum und ist einer der wichtigsten Hinweise auf Physik jenseits des Standardmodells. Die Teilchennatur der Dunklen Materie ist bisher unbekannt, jedoch wird vermutet, dass sie aus sogenannten WIMPs bestehen könnte. Solche Teilchen könnten am LHC erzeugt und im ATLAS-Detektor in Ereignissen mit hohen fehlenden Transversalimpuls beobachtet werden. Die Paarproduktion von Teilchen der Dunklen Materie zusammen mit dem entdeckten Higgs-Boson, der sogennante Mono-Higgs-Kanal, liefert eine neue Signatur für Dunkle Materie. Am vielversprechendsten ist dabei die Suche im Endzustand mit Higgs-Bosonzerfällen in $b\bar{b}$-Paare. Die Higgs-Bosonen werden hier mit hohen Impulsen erzeugt, was zu einer starken Kollimation der beiden b-Quarks im Endzustand führt, die daher als ein gemeinsamer Hadron-Jet mit großem Radiusparameter rekonstruiert werden. Die Rekonstruktion der Jets aus Teilchenspuren bei variablem Radiusparameter wurde untersucht. Diese Substruktur der Jets liefert zusätzliche Kriterien zur Unterdrückung des Untergrunds und reduziert die durch die b-Jetidentifizierung bedingten systematischen Unsicherheiten. Für die Suche nach Mono-Higgs-Ereignissen wurde die Sensitivität für verschiedene Signalmodelle untersucht und die Daten der Jahre 2015-2017 analysiert.

T 74.9 Do 18:30 Philo-HS2

Search for a light CP-odd Higgs boson decaying into a pair of taus — •Paul Moder, Dirk Duschinger, Wolfgang Mader, and Arno Straessner — IKTP Dresden, Deutschland

In 2012 the Standard Model was confirmed with the discovery of the Higgs boson and since then its predictions have often been proven to be correct when compared to experiments. However there are still some phenomena it can not explain, for example the anomalous magnetic moment of the muon, which shows significant deviations in the experiment. These deviations could be explained in the context of a 2 Higgs Doublet Model (2HDM). This model predicts a second Higgs doublet which leads to four additional Higgs bosons, one of them CP-odd. This model contains several free parameters. Of particular interest are the mass of the CP-odd Higgs boson and the couplings to charged leptons and up type quarks.

In this talk, an analysis for the search for a light CP-odd Higgs boson is presented. In the analysis the Higgs boson is produced via gluon fusion because of its strong coupling to top quarks. The mass range for the CP-odd Higgs boson lies between 60GeV and 120GeV with decays into a pair of tau leptons, where both tau leptons decay leptonically, one into an electron, one into a muon.

T 74.10 Do 18:45 Philo-HS2

Search for heavy Vh resonances with the ATLAS detector in the final state with boosted $h \to b\bar{b}$ decays — •Andreas Hönle, Sandra Kortner, Hubert Kroha, Stefan Maschek, and Felix Müller — Max-Planck-Institut für Physik, München, Deutschland

Many extensions of the Standard Model (SM) predict the existence of heavy resonances that decay into boson pairs. A process with promising search prospects is the decay of a heavy particle into a SM vector boson V ($\equiv W, Z$) and the SM Higgs boson h with a subsequent leptonic V decay and a Higgs boson decay into a pair of b quarks.

The searches now move towards higher masses, since the lighter heavy resonance candidates have been widely excluded with present data. Therefore, the topologies with boosted decay products become increasingly important. The b quark from such boosted Higgs boson decays are often nearly collinear, such that the two corresponding b jets oftentimes merge into a single large-radius jet.

In this talk, the optimized techniques for the reconstruction of boosted $h \to b\bar{b}$ decays are introduced, and their use in the search for heavy Vh resonances will be explained.