T 9: Higgs: Erweiterte Modelle

Zeit: Montag 16:00–18:30 Raum: S07

T 9.1 Mo 16:00 S07

An effective scanning method of the NMSSM parameter space — •Conny Beskidt[1], Wim de Boer[1], and Dmitri Kazakov[1,2] — [1]Karlsruhe Institute of Technology (IETP) — [2]JINR, ITEP, Moscow, Russia

The next-to minimal supersymmetric standard model (NMSSM) naturally provides a 125 GeV Higgs boson and a dark matter sector with electroweak scale neutralinos consistent with all experimental data, like relic density and non-observation of direct or indirect DM signals. However, more free parameters are introduced, which are strongly correlated especially if all radiative corrections from the GUT scale are considered. A simple parameter scan without knowing the correlation matrix is not efficient and missing out significant regions of the parameter space is at risk. We introduce a new technique to sample the NMSSM parameter space, which allows an efficient sampling with complete coverage. For this we reduce the 7D NMSSM parameter space to a 3D Higgs boson mass parameter space, which allows a detailed sampling of the Higgs mass space and therefore a complete study of the NMSSM Higgs sector including predictions of branching ratios and cross sections.

T 9.2 Mo 16:15 S07

Performance studies of advanced $X \to b\bar{b}$ tagging methods for searches of resonant di-Higgs boson production in the $b\bar{b}WW^*$ decay channel. — •Joshua Beirer, Kira Abeling, Jason Veatch, and Stan Lai — Georg-August-Universität Göttingen

The discovery of the Higgs boson in 2012 paved the way for the Higgs precision era at the LHC. With more data now available, it is increasingly important to search for extremely rare processes such as di-Higgs boson production, which would allow for a direct test of the Higgs mechanism. Furthermore, several beyond the Standard Model theories predict heavy resonances that can decay into two Higgs bosons and would enhance the di-Higgs boson production cross section. For resonant masses in the TeV mass range, the decay products are highly-boosted and appear very close to each other in the detector such that they cannot be resolved individually. Instead, hadronic decay products are collected in large R-jets such that the constituents can be studied using substructure information.

In order to exploit the large $H \to b\bar{b}$ branching ratio, sophisticated methods for boosted $b\bar{b}$ tagging are crucial. For this purpose, the Higgs boson is reconstructed as a large R-jet and associated small R-jets are used to identify the individual b-hadrons. In this talk, the performance of several new subjet tagging techniques in the $X \to HH \to b\bar{b}WW^*$ channel is presented, which are aimed to considerably improve the tagging in boosted topologies.

T 9.3 Mo 16:30 S07

Search for charged Higgs bosons of a Type I 2HDM in the final state with one lepton and four b jets — •David Brunner, Isabell Melzer-Pellmann, and Arathi Ramesh — DESY, Hamburg

The discovery of the Higgs boson at the LHC and various measurements of its coupling to SM particles confirms the predictions of the theoretical frame work of the Higgs mechanism. While in the SM the introduction of one complex scalar doublet is postulated, in more general theories two or more complex scalar doublets are introduced.

In the Two Higgs Doublet Model (2HDM) two complex scalar doublets are postulated, leading to two CP-even scalar Higgs bosons h and H, one CP-odd Higgs boson A and two charged Higgs bosons $H^{\pm}$. Four different types of the model can be studied depending on the coupling of the Higgs doublets to the SM fermions.

This search focuses on a Type I 2HDM model with an inverted scenario, where the H boson is defined as the SM Higgs boson. We investigate a scenario where the decay of the $H^{\pm}$ to the h boson and a $W^{\pm}$ boson is enhanced, while the h decays predominantly into b quarks and τ leptons. The production mode of the charged Higgs boson in association with one h is studied, where both h bosons each decay into two bjets and the $W^{\pm}$ decays leptonically.

The search uses proton-proton collision data recorded by the CMS experiment at the LHC in 2016-18 with a center of mass energy of $\sqrt{s} = 13$ TeV.

T 9.4 Mo 16:45 S07

Combination of di-Higgs searches using 13 TeV data collected by the ATLAS detector — •Florian Beisiegel, Alessandra Betti, Jochen Dingfelder, Tatjana Lenz, Alexander Melzer, and Norbert Wermes — University of Bonn

The discovery of the Higgs boson in 2012 was a great success of modern particle physics since it served as a proof of the Higgs mechanism introduced in 1964. One focus of the current particle physics experiments at the LHC is the measurement of the Higgs properties, such as its coupling strengths to fundamental particles. In addition to the coupling of the Higgs boson to fermions and gauge bosons, the Higgs mechanism also predicts a Higgs self-coupling. The triple-Higgs self-coupling can be measured in the di-Higgs production channel (non-resonant production).

Di-Higgs analyses also facilitate the search for new heavy particles that decay to two Higgs bosons (resonant production).

By combining di-Higgs searches with different final states the upper limits on the di-Higgs production cross section can be further improved. This talk presents a combination of six different di-Higgs final states ($HH \to 4b$, $bb\tau\tau$, $bb\gamma\gamma$, $bbWW$, $WW\gamma\gamma$, $4W$) using 36.1 fb^{-1} of data collected at $\sqrt{s} = 13$ TeV with the ATLAS detector. In addition to results on the resonant and non-resonant production modes, constraints on the Higgs self-coupling and interpretations in different BSM models will be shown.

T 9.5 Mo 17:00 S07

Double Higgs boson production and Higgs self-coupling at CLIC — Philipp Roloff[1], •Ulrike Schnoor[1], Rosa Simoniello[1,2], and Boruo Xu[3] — [1]CERN, Geneva, Switzerland — [2]Johannes-Gutenberg-Universität Mainz, Germany — [3]University of Cambridge, UK

The trilinear Higgs self-coupling has a central role in the understanding of electroweak symmetry breaking as it determines the shape of the Higgs potential. Its investigation is a crucial component of physics at future colliders. CLIC, the Compact Linear Collider, is a high-energy electron-positron accelerator being studied as an option for the post-LHC era. Its high-energy stages at $\sqrt{s} = 1.5$ and 3 TeV give direct access to Higgs boson pair production, from which the Higgs self-coupling can be extracted. This talk covers the full-simulation analysis of the expected sensitivity of the high-energy stages of CLIC to double Higgs production. The cross-section measurement of double Higgsstrahlung and differential observables in W-fusion Higgs-pair production are combined to give the expected sensitivity of CLIC to the trilinear Higgs self-coupling.

T 9.6 Mo 17:15 S07

Search for additional Higgs bosons decaying into W+W- with CMS using full Run 2 data — Jordy Degens, Günter Flügge, Olena Hlushchenko, Wolfgang Lohmann, Thomas Müller, •Dennis Roy, Hale Sert, Achim Stahl, and Alexander Zotz — III. Physikalisches Institut B, RWTH Aachen University

After the successful Run 2 data-taking period of the LHC, analyses on the full Run 2 data have been started. With an integrated luminosity of 137 fb^{-1} as measured by CMS, it can be hoped to find new particles, such as those expected from the minimal supersymmetric extension of the standard model (MSSM).
The high mass $H \to WW$ analysis aims to search for resonances at higher masses, which may originate from a heavier Higgs boson, as well as to provide limits on 2HDM and MSSM scenarios. This is achieved by studying the di-leptonic channel, in which each W boson decays into either an electron or a muon. The status and future plans of this analysis on the full Run 2 dataset are presented in this talk.

T 9.7 Mo 17:30 S07

Suche nach unsichtbaren Zerfällen des Higgs-Bosons mit dem ATLAS-Detektor — •Johannes Balz, Katharina Bierwagen, Volker Büscher, Andreas Reiss und Christian Schmitt — Institut für Physik, Johannes Gutenberg-Universität Mainz

Eines der gegenwärtig größten Ziele für das ATLAS Experiment ist neben der präzisen Vermessung des Standardmodells (SM) die Suche nach Physik jenseits des SM.

In diesem Vortrag geht es um die Suche nach direkten, unsichtbaren

Zerfällen des Higgs-Bosons, die nur mit Modellen jenseits des Standardmodells beschrieben werden können. Bei ATLAS wurde dies bisher nur in den Higgs-Produktionskanälen Vektor-Bosonen-Fusion und Assoziierte Produktion untersucht. In dem am LHC dominanten Produktionskanal Gluon-Fusion werden unsichtbare Higgs-Boson-Zerfälle nur sichtbar, wenn im Anfangszustand zusätzliche Abstrahlungen stattfinden. Diese unterscheiden sich von den Abstrahlungen im dominanten Untergrundprozess $Z \to \nu\nu$ durch unterschiedliche Quark- und Gluonjetanteile. Dadurch ist eine Untergrundunterdrückung mithilfe von Quark-Gluon-Tagging möglich.

Im Vortrag wird der aktuelle Stand der Analyse bei einer Schwerpunktsenergie von $\sqrt{s}$=13 TeV vorgestellt.

T 9.8 Mo 17:45 S07

Possible NMSSM deviations from the SM-like signal strengths of the 125 GeV Higgs boson — •Conny Beskidt[1], Wim de Boer[1], and Dmitri Kazakov[1,2] — [1]Karlsruhe Institute of Technology (IETP) — [2]JINR, ITEP, Moscow, Russia

In the next-to minimal supersymmetric standard model (NMSSM) seven Higgs bosons are predicted: 3 scalar, 2 pseudo-scalar and 2 charged Higgs bosons. In the decoupling limit where the heavier Higgs bosons are well above the Z-boson mass limit and the mixing of the Higgs singlet and doublets is small, the NMSSM prefers SM-like couplings for one of the light Higgs bosons. The signal strengths are defined as the ratio of the production cross sections times branching ratios divided by the SM predictions. We investigate the regions of parameter space where the signal strength of the observed 125 GeV Higgs boson can deviate from one and if deviations would be observed, the correlation between the deviations for signal strengths to vector bosons and fermions.

T 9.9 Mo 18:00 S07

Search for CP-violation in gluon fusion production of the Higgs boson in $H \to \tau_{lep}\tau_{had}$ decay at $\sqrt{s} = 13$ TeV with the ATLAS detector — •Daariimaa Battulga, Kathrin Becker, and Markus Schumacher — Physikalisches Institut, Universität Freiburg

CP-violation is one of the necessary Sakharov conditions to explain the observed asymmetry between matter and anti-matter in the universe. The magnitude of the observed CP-violation in the neutral meson sector, as described by the CKM matrix in the Standard Model, is insufficient to explain the observed asymmetry. Hence it is important to search for new sources of CP-violation e.g., in the Higgs boson sector. A test of CP-invariance of Higgs boson production in gluon fusion in association with two jets is performed exploiting the decay $H \to \tau_{lep}\tau_{had}$ based on proton-proton collision data corresponding to 140 fb^{-1} collected by the ATLAS experiment. The presentation will discuss the analysis strategy using CP-odd optimal observables and in particular the event selection to isolate the signal from background contributions.

T 9.10 Mo 18:15 S07

Search for neutral Higgs Bosons Production in Final States with b-quarks in the semi-leptonic channel — •Antonio Vagnerini — DESY Hamburg

The LHC discovery of a Standard-Model-like Higgs particle in 2012 could be a portal to an extended Higgs sector predicted by several models, such as the Minimal-Supersymmetric Extension of the SM (MSSM) and the more general Two-Higgs-Doublet Model (2HDM). The additional Higgs states predicted by such extended models can have enhanced coupling to b-quarks in several scenarios, such as the 2HDM Type-II and -IV. This analysis is the search for neutral Higgs bosons decaying into a b-quark pair and produced in association with at least one additional b-quark. In the final state, we require a muon, stemming from b-hadron decays, to lie within any of the two b-jets emitted in the Higgs decay. This type of selection allows us to probe Higgs bosons with low masses. Detailed studies of the analysis strategy and its sensitivity are presented together with parameters of extended models for several mass hypotheses.