T 92: Higgs Boson: Extended Models 3

Time: Thursday 16:15–18:00 Location: T-H23

T 92.1 Thu 16:15 T-H23

Suche nach unsichtbaren Zerfällen des Higgs-Bosons in Ereignissen mit einem hadronisch zerfallenden Vektorboson mit dem ATLAS-Detektor — •Johannes Balz, Volker Büscher, Duc Bao Ta und Kira Köhler — 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 unsichtbaren Zerfällen des Higgs-Bosons jenseits des Standardmodells. Beim untersuchten Kanal wird das Higgs-Boson über die assoziierte Produktion mit einem Vektorboson erzeugt, wobei das beteiligte Vektorboson im weiteren Verlauf hadronisch zerfällt und das Higgs-Boson in für den Detektor unsichtbare Teilchen, zum Beispiel Dunkle Materie, zerfällt. Daher umfasst die Selektion Ereignisse mit hohem fehlendem Transversalimpuls und Jets, die kompatibel mit einem hadronisch zerfallenden Vektorboson sind. Dadurch kann der Hauptuntergrund $Z \to \nu\nu$ bereits stark unterdrückt werden. Die höchste Sensitivität liegt bei hohen Transversalimpulsen des Vektorbosons, das dann als ein großflächiger Jet rekonstruiert wird. Dessen Jetsubstrukturvariablen ermöglichen eine weitere Untergrundunterdrückung.

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

T 92.2 Thu 16:30 T-H23

Higgs Decay into Dark Matter in the CxSM at Next-to-Leading Order — •Felix Egle[1], Margarete Mühlleitner[1], Rui Santos[2,3], and João Viana[2] — [1]Institute for Theoretical Physics, Karlsruhe Institute of Technology, Wolfgang-Gaede-Str. 1, 76131 Karlsruhe, Germany — [2]Centro de Física Teórica e Computacional, Faculdade de Ciéncias, Universidade de Lisboa, Campo Grande, Edifício C8 1749-016 Lisboa, Portugal — [3]ISEL - Instituto Superior de Engenharia de Lisboa, Instituto Politécnico de Lisboa 1959-007 Lisboa, Portugal

The Complex Singlet extension of the Standard Model (CxSM) is one of the simplest models to extend the scalar sector of the Standard Model (SM) and is also able to provide a suitable Dark Matter (DM) candidate. A possibility to probe the DM candidate at the LHC is given by the decay of the 125 GeV SM-like Higgs boson into a pair of DM particles. In order to match the experimental accuracy, higher-order corrections to this process have to be considered. We will present the computation of the complete next-to-leading order electroweak corrections to this decay process. In particular, we will describe the renormalization procedure for the CxSM, compare different renormalization schemes, discuss theoretical and experimental constraints on the input parameters and compare the results with current exclusion bounds.

T 92.3 Thu 16:45 T-H23

Dark Matter Phase Transitions in 'CP in the Dark' — •Lisa Biermann, Margarete Mühlleitner, and Jonas Müller — Institute for Theoretical Physics, Karlsruhe Institute of Technology, 76128 Karlsruhe, Germany

We study the possibility of a strong first-order electroweak phase transition (SFOEWPT) in the extended scalar sector model 'CP in the Dark'. 'CP in the Dark' provides a Dark Matter (DM) candidate as well as explicit CP violation in the dark sector. A global minimization of the one-loop daisy-resummed effective potential at finite temperature is performed with the C++ code BSMPT. We find a broad viable parameter space for an SFOEWPT within the reach of XENON1T and future invisible decay searches. 'CP in the Dark' also offers SFOEWPT points that display spontaneous CP violation at finite temperature. Having not only an SFOEWPT that provides the necessary departure from thermal equilibrium, but also a source of additional non-standard CP violation, opens a promising gate towards enabling the creation of the BAU in an electroweak baryogenesis scenario.

T 92.4 Thu 17:00 T-H23

Combination of Higgs boson measurements using Simplified Template Cross Sections with interpretations in the κ-framework at the ATLAS experiment — •Joshua Clercx — Universität Hamburg/DESY, Hamburg, Germany

In the past, the standard model (SM) has been very successful in explaining and predicting a wide range of phenomena, but currently there are clear indications that not everything is described by the SM. Experimental measurements of certain high energy physics parameters could show deviations from the theoretical predictions, which would indicate the existence of physics beyond the standard model (BSM). Depending on where these deviations are found, it also gives some insight into which BSM physics theories are interesting to further investigate. Measurements in the Higgs sector are especially interesting, as there are many opportunities to detect BSM effects here. The most precise measurements in the Higgs sector are obtained by combining measurements of cross sections of different Higgs boson production processes and decay channels. This is typically done in the Simplified Template Cross Sections (STXS) framework: measurements of cross sections of mutually exclusive regions of phase space, defined per production process, are combined. The measurements can be interpreted in the κ-framework as a test of the SM coupling values of the Higgs boson to other SM particles. What will be presented are results from the most recent combination from the autumn of 2021, which is based on analyses of 13 TeV data with an integrated luminosity of up to 139 fb^{-1}.

T 92.5 Thu 17:15 T-H23

Z_2 Non-Restoration and Composite Higgs: Singlet-Assisted Baryogenesis w/o Topological Defects — Andrei Angelescu, Florian Goertz, and •Aika Tada — Max-Planck-Institut für Kernphysik, Heidelberg

Simple scalar extensions of the Standard Model with a spontaneously broken Z_2 symmetry allow for a strongly first order electroweak phase transition, as sought in order to realize electroweak baryogenesis. To circumvent the emergence of phenomenologically problematic domain walls often encountered in this context, in 2112.12087 (A. Angelescu, F. Goertz, AT), a scalar singlet framework featuring a thermal history which does not restore Z_2 in the early universe is proposed. This can be realized in a low energy effective theory with D>4 operators. A possible UV completion is provided by a $SO(6)/SO(5)$ Composite Higgs model with fermions in a symmetric $20'$ of $SO(6)$, where the potential and the Yukawa terms are obtained by spurion analysis and a CP violating term arises. Matching the two models and exploring them numerically shows that this scenario can fulfil all Sakharov criteria needed for electroweak baryogenesis.

T 92.6 Thu 17:30 T-H23

Constraining possible $\mathcal{CP}$-admixtures in modified Higgs sectors — •Marco Menen, Henning Bahl, Philip Bechtle, Elina Fuchs, Sven Heinemeyer, Judith Katzy, Krisztian Peters, Matthias Saimpert, and Georg Weiglein — Physikalisch-Technische Bundesanstalt Braunschweig

The question why an excess of matter over antimatter was produced shortly after the Big Bang is one of the greatest unsolved problems of modern physics. The Standard Model of particle physics cannot explain the amount of $\mathcal{CP}$ violation needed for the observed baryon asymmetry of the universe. Additional $\mathcal{CP}$ violation may be found in the Higgs sector where a mixed $\mathcal{CP}$ state of the 125 GeV Higgs boson is not ruled out experimentally by current search limits.

In this talk, the Higgs Characterization model is presented. It is parameterized by factors c_i and $\tilde{c}_i$ which modify the scalar and pseudoscalar part of Higgs couplings to other SM particles, respectively. The program HiggsSignals (HS) is used to calculate the resulting Higgs signal rates and compare them to available Run 1 and Run 2 data from the Large Hadron Collider (LHC) at CERN.

The signal rate measurements in HS are complemented by a dedicated $\mathcal{CP}$ analysis in the $H \to \tau\tau$ decay from CMS. Furthermore, constraints from the current best limit on the electron electric dipole moment are examined to complement the constraints from the LHC. The amount of baryogenesis reachable within the allowed parameter space regions is computed in the vev insertion approximation with optimal parameters.

T 92.7 Thu 17:45 T-H23

Studies of di-Higgs production at the FCC-hh in the bbZZ(ll$\nu\nu$) final state — •Kevin Laudamus — DESY, Hamburg, Germany

The FCC-hh is a proposed circular hadron collider at an energy of 100 TeV. The total integrated luminosity is expected to be around 30 ab^{-1}. With such a large dataset, 400 times more double-Higgs events are expected than with the full HL-LHC dataset, allowing to measure the Higgs self-coupling with high precision. As a consequence, also rarer final states, which are not within reach of the (HL)-LHC, have good prospects at the FCC-hh. One such final state is the bbZZ(ll$\nu\nu$) channel, which is studied in this work. A multivariate analysis of bbll$\nu\nu$ events is implemented and upper limits on the di-Higgs production cross-section are derived in order to assess the potential of this channel. Moreover, it is investigated in how far specific kinematic regions, such as at high Higgs transverse momentum, can be exploited. In these studies, particular attention needs to be paid to the reconstruction of the missing transverse momentum, which will be extremely challenging at the FCC-hh due to the very high pile-up environment.