T 5: Higgs Searches

Time: Monday 16:30–18:00 Location: HSZ/0101

T 5.1 Mon 16:30 HSZ/0101

An interference search for heavy Higgs bosons decaying to a top-antitop-quark pair with the ATLAS detector — •Nicola de Biase, Katharina Behr, and Eleanor Jones — Deutsches Elektronen-Synchrotron

New pseudoscalar (A) and scalar (H) states coupling strongly with $t\bar{t}$ states are predicted by many models with an extended Higgs sector, such as two-Higgs Doublet Models (2HDMs), which add a second Higgs doublet to the SM. In 2HDMs with fermion coupling structure of type II, these states decay predominantly to $t\bar{t}$, provided that they are massive enough (m>500 GeV) and that the ratio between the vacuum-expectation-values of the two Higgs doublets ($\tan\beta$) is small ($\tan\beta \lesssim 3$). To date, this parameter region is only little constrained by direct searches, as any search in the $t\bar{t}$ final state is complicated by the interference between the signal process (gluon-gluon initiated A/H production) and the dominant and irreducible background, which is the Standard Model production of $t\bar{t}$ pairs. This interference produces a characteristic peak-dip structure in the $t\bar{t}$ mass spectrum. In this talk, a search for pseudoscalar and scalar states decaying to a pair of top-quarks will be presented, using the full Run-II ATLAS dataset. Special attention will be given to the conceptual and technical challenges regarding the treatment of interference effects in the statistical analysis of the data.

T 5.2 Mon 16:45 HSZ/0101

Search for charged Higgs bosons in $H^+ \to W^+h$ decays with the ATLAS detector — Dominik Duda, •Simon Grewe, Sandra Kortner, and Hubert Kroha — Max Planck Institut für Physik

Many theories beyond the Standard Model predict the existence of charged Higgs bosons. The main production mode of these new particles depends on their mass. For large masses ($m(H^+) > m(t) + m(b)$), the dominant mode of production is in association with a top quark and a bottom quark (tbH^+). In the alignment limit of the Two-Higgs-Doublet Model (2HDM), heavy charged Higgs bosons with $m(H^+) > m(t) + m(b)$ decay almost exclusively via $H^+ \to tb$. In other models such as the Georgi-Machacek model, however, significant branching ratios for $H^+ \to W^+h$ are possible. This decay has so far not been studied by ATLAS or CMS.
A search for $H^+ \to W^+h$ decays in association with a top and bottom quark is presented, based on the full Run-2 dataset of the ATLAS experiment. The analysis targets final states with resolved $h \to b\bar{b}$ decays containing five or more jets, one charged lepton and missing transverse momentum. The reconstruction of the charged Higgs boson decay, as well as the definition of the signal and control regions is based on boosted decision trees (BDTs). Limits on $\sigma(pp \to tbH^+) \times BR(H^+ \to W^+h)$ are obtained by a maximum likelihood fit of the reconstructed H^+ mass spectrum.
This talk presents an overview of the analysis with special emphasis on the signal reconstruction and the development of the signal and control regions.

T 5.3 Mon 17:00 HSZ/0101

Search for inelastic Dark Matter with a Dark Higgs at Belle II — •Patrick Ecker, Giacomo De Pietro, Jonas Eppelt, Torben Ferber, and Pablo Goldenzweig — Institute of Experimental Particle Physics (ETP), Karlsruhe Institute of Technology (KIT)

Belle II has a unique reach for a broad class of models that postulate the existence of Dark Matter particles in the MeV-GeV mass range. One highly motivated scenario is a model which involves inelastic Dark Matter, consisting of two Dark Matter states with a mass splitting between them and the presence of a Dark Higgs boson. This model has a signature of up to two displaced vertices, one from the resonant decay of the Dark Higgs and another non-resonant one emerging from the decay of the involved Dark Matter particles. This talk will present a way to search for such signatures, which is not only challenging due to the presence of displaced vertices but also because of the seven-dimensional parameter space of the model.

T 5.4 Mon 17:15 HSZ/0101

Search for non-resonant light axion-like particles with heavy vector bosons in the final state. — •Anna Albrecht[1], Steffen Albrecht[1], Andreas Hinzmann[2], and Ankita Mehta[1] — [1]Institut für Experimentalphysik, Universität Hamburg — [2]DESY, Hamburg, previously Universität Hamburg

Many extensions of the Standard Model (SM) propose axion-like particles (ALPs) that could solve the strong CP problem and are proposed as dark matter candidates. A non-resonant search for light off-shell ALPs as mediators between gluons and heavy bosons (ZZ, ZH) is presented. Only the hadronic decays of two vector bosons are considered. For the high invariant mass of the diboson system, the differential cross section via ALPs as mediator decreases slower than the SM production. To extract the signal a three dimensional maximum likelihood fit of the jet masses and the invariant mass of the diboson system is performed. The analysis is performed using pp collision data collected by the CMS experiment at $\sqrt{s} = 13\,\text{TeV}$ in the years 2016 - 2018.

T 5.5 Mon 17:30 HSZ/0101

Low Temperature MMC-based Muon Veto for IAXO — •Daniel Unger, Christian Enss, Andreas Fleischmann, Daniel Hengstler, Ashish Jadhav, and Loredana Gastaldo — Kirchhoff Institute for Physics, Heidelberg University, Im Neuenheimer Feld 227, 69120 Heidelberg, Germany.

An array of Metallic Magnetic Calorimeter (MMC) operated at a few mK in a dilution refrigerator is considered as a possible focal plane detector for the IAXO helioscope. For such an experiment, the background rate must be smaller than $10^{-6}\,\text{keV}^{-1}\text{cm}^{-2}\text{s}^{-1}$. However, we expect the rate of events related to cosmic muons to be two orders of magnitude larger. A traditional muon veto composed by scintillating panels would have to cover the full cryostat, a volume of about $3\,\text{m}^3$. A cryogenic muon veto surrounding the $150\,\text{cm}^3$ volume of the detector module could veto muon related events more efficiently. We present the development of a large-area MMC-based muon veto. Muons will be detected through their energy deposition while traversing a silicon wafer with thickness of 0.4 mm and an area of $30\,\text{cm}^2$. We discuss the design and the fabrication challenges of the muon veto in addition to the prototype setup for testing purposes. We aim to characterize the performance of the large silicon detector and at the same time study the spectrum of muon related events detected by the MMC array as well as of the residual background due to natural radioactivity. Finally, we evaluate the suitability of MMC arrays for low background measurements.

T 5.6 Mon 17:45 HSZ/0101

Recent Updates on the ALPS II Experiment — •Gulden Othman for the ALPS-Collaboration — Institut für Experimental Physik, Universität Hamburg, Luruper Chaussee 149, 22761 Hamburg

The Any Light Particle Search II (ALPS II) experiment searches for axions and axion-like particles (ALPs) in an important parameter space that is relevant in understanding anomalous astrophysical phenomena, including stellar evolution. ALPS II takes advantage of the axion coupling to photons using a Light-Shining-through-a-Wall technique. Photons created using a strong laser may convert into ALPs in the presence of a strong magnetic field, traverse a light-tight barrier, reconvert into photons in another strong magnetic field, and be subsequently detected. By using two mode-matched optical resonators before and after the barrier, ALPS II aims to surpass the sensitivity of previous experiments by three orders of magnitude. In this talk, we will discuss the exciting recent progress and current status of ALPS II as we continue with our science program at DESY.