T 51: BSM physics (theory)

Time: Wednesday 16:00–18:30 Location: Ta

T 51.1 Wed 16:00 Ta

Testing the 2HDMS — •Steven Paasch[1], Cheng Li[1], Gudrid Moortgat-Pick[1,2], Sven Heinemeyer[3], and Florian Lika[2] — [1]Deutsches Elektronen-Synchroton — [2]Universität Hamburg — [3]Instituto de Física Teórica (UAM/CSIC), Universidad Autónoma de Madrid Cantoblanco

The 2HDMS is based on the CP-conserving 2HDM extended by a complex singlet field. We impose an additional Z3 symmetry on the potential. This leads to a Higgs-sector similar to the Next-to-Minimal Supersymmetric SM (NMSSM), while having fewer symmetry conditions compared to supersymmetric models. We introduce the theoretical background of this model and set it up for phenomenological studies. For this we study theoretical constraints including tree-level perturbative unitarity, boundedness from below conditions and vacuum stability constraints. Furthermore we look at experimental constraints from direct searches for BSM Higgs bosons at colliders. This defines the basis for our study on the 96 GeV excesses at CMS and LEP.

T 51.2 Wed 16:15 Ta

Standard Model Extensions from Asymptotic Safety with Higgs and Flavor Portals — Gudrun Hiller[1], Clara Hormigos-Feliu[2], Daniel Litim[3], and •Tom Steudtner[1,3] — [1]Fakultät Physik, TU Dortmund, Otto-Hahn-Str.4, D-44221 Dortmund, Germany — [2]INFN, Sezione di Roma P.le A. Moro, 2, I-00185 Roma, Italy — [3]Department of Physics and Astronomy, University of Sussex, Brighton, BN19QH, United Kingdom

I present a study of several SM extensions which are free of Landau poles and instabilities until the Planck scale, stabilise the Higgs sector, and allow to accommodate discrepancies of lepton anomalous magnetic moments.

Our models feature a singlet matrix scalar field, three generations of vectorlike leptons, and direct links to the Higgs and flavor sectors via new Yukawa and portal couplings.

I will highlight properties the renormalisation group evolution, important phenomenological implications and some aspects of collider searches.

T 51.3 Wed 16:30 Ta

Top and Beauty synergies in SMEFT-fits at present and future colliders — Stefan Bissmann, •Cornelius Grunwald, Gudrun Hiller, and Kevin Kröninger — TU Dortmund, Fakultät Physik, Deutschland

The Standard Model Effective Field Theory (SMEFT) has become an established framework for searching physics beyond the Standard Model. Combining observables from top-quark and B physics has recently been shown to be a promising approach for improving constraints within SMEFT. In this talk, we present studies on the combination of measurements from top-quark and B physics in fits of SMEFT Wilson coefficients. We combine observables from top-quark pair production and decay processes with $Z \to b\bar{b}$ and $b \to s$ transitions. We point out how the individual datasets allow to probe different sets of Wilson coefficients and how a combined fit to current top-quark and B data improves the constraints. We also demonstrate the influence of future measurements on the results of our fits by considering future projections for measurements from HL-LHC, Belle II and CLIC.

T 51.4 Wed 16:45 Ta

Towards constraining triple gluon operators through tops — •Prasham Jain[1], Debjyoti Bardhan[2], Diptimoy Ghosh[3], and Arun Thalapillil[4] — [1]Albert-Ludwigs-Universität Freiburg, Physikalisches Institut, Hermann-Herder-Straße 3, D-79104 Freiburg, Germany — [2]Department of Physics, Ben-Gurion University of the Negev, Beer Sheva 8410501, Israel — [3]Indian Institute of Science Education and Research, Homi Bhabha road, Pashan, Pune 411008, India — [4]Indian Institute of Science Education and Research, Homi Bhabha road, Pashan, Pune 411008, India

Effective field theory techniques provide important tools to probe for physics beyond the Standard Model in a relatively model-independent way. In this talk, the CP-even dimension-6 purely gluonic operator is revisited to investigate the possible constraints on it by studying its effect on top-pair production at the LHC, in particular the high p_T and $m_{t\bar{t}}$ tails of the distribution. Cut-based analysis reveals that the scale of New Physics when this operator alone contributes to the production process is greater than 3.6 TeV at 95% C.L., which is a much stronger bound compared to the bound of 850 GeV obtained from Run-I data using the same channel. This is reinforced by an analysis using Machine Learning techniques. This study complements similar studies that have focussed on other collider channels to study this operator.

T 51.5 Wed 17:00 Ta

Vector-boson scattering - concrete model realization versus EFT — •Jannis Lang, Stefan Liebler, Heiko Schäfer-Siebert, and Dieter Zeppenfeld — Institute for Theoretical Physics, Karlsruhe Institute of Technology (KIT), 76128 Karlsruhe, Germany

We consider a concrete UV complete model with additional fermions and scalars being multiplets under $SU(2)_L$ in the $SU(2)_L$ limit of the Standard Model. We derive its impact on vector-boson scattering, both in the full model as well as in terms of an effective field theory (EFT). The validity of the plain EFT and unitarized versions in comparison to the full model is examined, and the impact for experimental analyses bounding EFT operators is pointed out.

T 51.6 Wed 17:15 Ta

Dark Matter and nature of Electroweak Phase Transition in the Inert Doublet Model — •Sven Fabian[1], Florian Goertz[1], and Yun Jiang[2] — [1]Max-Planck-Institut für Kernphysik, Heidelberg, Germany — [2]TianQin Research Center for Gravitational Physics & School of Physics and Astronomy, Zhuhai, P.R. China

In this talk, we will provide a comprehensive analysis of the prospect to realize Dark Matter (DM) and to enhance the Electroweak Phase Transition (EWPhT) in the Inert Doublet Model. Taking the latest constraints from collider physics and direct-detection experiments into account, we will investigate the possibility of a strong first-order EWPhT via one or two steps in combination with a significant amount of the measured DM abundance both in the low-mass and in the high-mass regime, exploring also new regions of parameter space. We will find that the low-mass regime leads to a parameter space providing a significant DM abundance as well as to a strong first-order EWPhT either via one or two steps. On the contrary, the high-mass regime either gives rise to a significant amount of DM or to a strong first-order EWPhT, the latter being necessary for explaining the present baryon-antibaryon asymmetry.

T 51.7 Wed 17:30 Ta

Direct Detection of Dark Matter: Precision Predictions in a Simplified Model Framework — •Christoph Borschensky, Gabriele Coniglio, Barbara Jäger, Josef Jochum, and Vincent Schipperges — Eberhard Karls Universität Tübingen, Auf der Morgenstelle 14, 72076 Tübingen

In my talk, I will present a calculation of the next-to-leading order QCD corrections for the scattering of dark matter particles off nucleons in the framework of simplified models with s- and t-channel mediators. These results are matched to the Wilson coefficients and operators of an effective field theory that is generally used for the presentation of experimental results on spin-independent and spin-dependent direct detection rates.

Detailed phenomenological studies illustrate the complementary reach of collider searches for dark matter and the direct detection experiments CRESST and XENON. In the case of cancellation effects in the tree-level contributions, one-loop corrections can have a particularly large impact on exclusion limits in the case of combined $s + t$-channel models.

T 51.8 Wed 17:45 Ta

Absolute neutrino mass as the missing link to the dark sector — •Sybrand Zeinstra[1], Thede de Boer[1], Michael Klasen[1], and Caroline Rodenbeck[2] — [1]Institut für Theoretische Physik, WWU Münster — [2]Institut für Kernphysik, WWU Münster

With the KATRIN experiment, the determination of the absolute neutrino mass scale down to cosmologically favored values has come into reach. We show that this measurement provides the missing link between the Standard Model and the dark sector in scotogenic models, where the suppression of the neutrino masses is economically explained

by their only indirect coupling to the Higgs field. We determine the linear relation between the electron neutrino mass and the scalar coupling λ_5 associated with the dark neutral scalar mass splitting to be $\lambda_5 = 3.1 \times 10^{-9} m_{\nu_e}/\text{eV}$. This relation then induces correlations among the DM and new scalar masses and their Yukawa couplings. Together, KATRIN and future lepton flavor violation experiments can then probe the fermion DM parameter space, irrespective of the neutrino mass hierarchy and CP phase.

T 51.9 Wed 18:00 Ta

Probing radiative seesaw models with neutrinos from the sun at IceCube — •Thede de Boer[1], Sybrand Zeinstra[1], Raffaela Busse[2], Michael Klasen[1], and Alexander Kappes[2] — [1]Institut für Theoretische Physik, WWU Münster — [2]Institut für Kernphysik, WWU Münster

Dark matter scattering off of nuclei in the sun and subsequent DM self-annihilations can lead to an enhanced neutrino flux which is in principle detectable at IceCube. We study possible event rates considering a radiative seesaw model containing scalar triplet and singlet-doublet fermion dark matter candidates. In the case of scalar dark matter, the absence of a spin dependent scattering on nuclei results in a low capture rate in the Sun, which is reflected in an event rate of less than one event per year. For singlet-doublet fermion dark matter there exists a spin dependent scattering process next to the spin independent one, allowing for higher event rates. Due to a correlation between both processes, the stringent limits on the spin dependent cross section set by XENON1T exclude most points detectable at IceCube.

T 51.10 Wed 18:15 Ta

Gravitational waves from collapsing domain walls in a 2HDM + complex singlet — •Luis Hellmich — DESY, Hamburg, Germany

I investigate the possibility of domain wall formation in a 2HDM + complex singlet with a discrete $\mathbb{Z}_2$- and an additional $\mathbb{Z}_3$-symmetry. Spontaneous breaking of the discrete symmetries at the elctroweak phase transition leads to the formation of domain walls, which may collapse sufficiently fast, if there exists a bias term in the potential to break the symmetries explicitly. The gravitational waves (GW) produced by these collapsing domain walls are analyzed, taking into account a combination of constraining collider and cosmological data. The resulting GW spectra are compared to limits of current and future GW detectors.