T 97: Future colliders

Time: Thursday 16:00–18:00 Location: Geb. 30.34: LTI

T 97.1 Thu 16:00 Geb. 30.34: LTI

Heavy-quark precision measurements at FCC-ee — Kevin Kröninger[1], Romain Madar[2], Stéphane Monteil[2], and •Lars Röhrig[1,2] — [1]TU Dortmund University, Department of Physics, Dortmund — [2]Université Clermont-Auvergne, Laboratoire de Physique de Clermont, Clermont-Ferrand

The FCC-ee, proposed as the successor to the Large Hadron Collider, aims at electron-positron collisions in order to achieve unprecedented precision in the electroweak sectors, producing in particular about $\mathcal{O}(10^{12})$ $Z \to q\bar{q}$ events. This makes it possible to measure electroweak observables related to the $Z \to b\bar{b}$ coupling with a very high accurary. However, the accuracy of these measurements is expected to be limited by systematic uncertainties, primarily originating from events related to light-quark physics.

To enhance overall measurement precision, we introduce an ultra-pure b-flavour tagger. This tagger relies on exclusive b-hadron reconstruction to effectively eliminate background contributions. We evaluate its performance and discuss the remaining systematic uncertainties in the measurement of $R_b = \frac{\Gamma(Z\to b\bar{b})}{\Gamma(Z\to q\bar{q})}$ and the b-quark forward-backward asymmetry A^b_{FB}.

These results are put in context alongside top-quark measurements at FCC-ee, allowing us to establish stringent constraints on dimension-6 operators within the SMEFT framework.

T 97.2 Thu 16:15 Geb. 30.34: LTI

Unique physics probes at FCC-ee for both Standard Model and beyond — Simon Keilbach, Jan Kieseler, Markus Klute, Matteo Presilla, and •Xunwu Zuo — KIT, Karlsruhe, Germany

The Future Circular Collider (FCC) is a post-LHC project aiming to provide unprecedented insights into both Standard Model physics and beyond. The first stage of FCC features electron-positron collisions (FCC-ee) at center-of-mass energies ranging from 91 GeV for Z boson production to around 365 GeV for top-quark pair production. The FCC-ee, benefiting from low experimental backgrounds, precisely determined collision energy, and outstanding luminosity, offers various novel ways to probe physics, which are unfavorable in current experiments. This talk selects a few recent physics studies that are unique to the FCC-ee dataset and discusses the preliminary results as well as physics outlooks.

T 97.3 Thu 16:30 Geb. 30.34: LTI

Discrimination of models with additional Z-bosons at muon colliders — •Kateryna Korshynska[1], Maximilian Löschner[1], Mariia Marinichenko[1], Krzysztof Mekala[2], and Jürgen Reuter[1] — [1]Deutsches Elektronen-Synchrotron DESY, Notkestr. 85, 22607 Hamburg, Germany — [2]Faculty of Physics, University of Warsaw, Pasteura 5, 02-093 Warszawa, Poland

We study the discovery reach and discrimination power of future muon colliders for a variety of Z'-models, such as the Left-Right Symmetric Model or the Sequential Standard Model. The study is carried out by combining a set of observables for leptonic and hadronic channels, together with the respective estimated systematic and statistical uncertainties. We discuss the influence of polarized initial or final state partons on the discrimination power of the models in terms of the expected resolution of axial and vector couplings. We will show that even for unpolarized partons, there is a noteworthy potential for distinguishing Z'-models and a high discovery reach in terms of the Z'-mass range.

T 97.4 Thu 16:45 Geb. 30.34: LTI

Towards a No-Lose Theorem for New Physics at Future Colliders — Philip Bechtle, Klaus Desch, Christian Grefe, and •Murillo Vellasco — Rheinische Friedrich-Wilhelms-Universität Bonn, Germany

For over half a century, the Standard Model of particle physics (SM) has stood as the current best description of matter and its interactions, despite recent experimental results, such as the muon $g-2$ and the B-anomalies, providing hints at an underlying, more fundamental theory. Whereas the proposal of the Large Hadron Collider was supported by the "No-Lose Theorem", which guaranteed the discovery of either the Higgs or some other New Physics (NP) process, no such analogous result can be stated at the moment for potential future collider experiments. This is due to the UV-complete nature of the Standard Model including the Higgs Boson.

In this talk, I will outline the steps towards a potential new "No-Lose Theorem" for future colliders, based on a parametrization of recent experimental deviations using the reasonably model-independent framework of the Standard Model Effective Field Theory (SMEFT). Under the assumption that these deviations are true NP effects, they can be parametrized using SMEFT in order to study their measurability in future experiments, since SMEFT operators can directly affect kinematic distributions and precision observables. The results of these studies could eventually point to a set of optimal future experiments, which, under these assumptions, are guaranteed to lead to fundamental discoveries.

T 97.5 Thu 17:00 Geb. 30.34: LTI

Multiple boson production at high-energy muon colliders to probe the Higgs-muon coupling — Eugenia Celada[1,2], Tao Han[3], Wolfgang Kilian[4], •Nils Kreher[4], Yang Ma[5], Fabio Maltoni[1,5,6], Davide Pagani[5], Jürgen Reuter[7], Tobias Striegl[4], and Keping Xie[3,8] — [1]Università di Bologna, Bologna, Italy — [2]University of Manchester, Manchester , United Kingdom — [3]University of Pittsburgh, Pittsburgh, USA — [4]University of Siegen, Siegen, Germany — [5]INFN, Sezione di Bologna, Bologna, Italy — [6]Université catholique de Louvain, Louvain-la-Neuve, Belgium — [7]Deutsches Elektronen-Synchrotron DESY, Hamburg, Germany — [8]Michigan State University, East Lansing, USA

I will present a phenomenological study of the sensitivity of the muon-Yukawa sector at a high-energy muon collider. While this sector is described by a single parameter in the Standard Model, effects of new physics that are not aligned with the Yukawa interactions of the Standard Model can introduce a more sophisticated parameter dependence that can be understood in the framework of either SMEFT or HEFT. Exploiting the coincident small value of the muon-Yukawa coupling and its subtle role in the high-energy production of multiple bosons (vector and Higgs bosons), I will discuss the possibility of constraining the muon-Higgs couplings through a combined analysis of the production cross sections of multiple bosons at both 3-TeV and 10-TeV muon collider levels. Furthermore, I will discuss the implications of an extended Higgs sector on the same processes in both frameworks.

T 97.6 Thu 17:15 Geb. 30.34: LTI

Physics Performance and Detector Requirements at an Asymmetric Higgs Factory — •Antoine Laudrain, Ties Behnke, Mikael Berggren, Karsten Büsser, Frank Gaede, Christophe Grojean, Benno List, Jenny List, Jürgen Reuter, and Christian Schwanenberger — DESY, Notkestraße 85, 22607 Hamburg

The Hybrid Asymmetric Linear Higgs Factory (HALHF) proposes a shorter and cheaper alternative for a future Higgs factory. The design includes a 500 GeV electron beam accelerated by an electron-driven plasma wake-field, and a conventionally-accelerated 31 GeV positron beam. Assuming plasma acceleration R&D challenges are solved in a timely manner, the asymmetry of the collisions brings additional issues regarding the detector and the physics analyses, from forward boosted topologies and beam backgrounds. This contribution will detail the impact of beam parameters on beam-induced backgrounds, and provide a first look at what modification to e.g. the ILD can improve the physics performance at such a facility. The studies are benchmarked against some flagship Higgs Factory analyses for comparison.

T 97.7 Thu 17:30 Geb. 30.34: LTI

Trilinear Higgs Couplings in N2HDM and 2HDMS Type 2 at e+e- Colliders — •Daniel Schieber[1], Gudrid Moortgat-Pick[1], Sven Heinemeyer[2], and Cheng Li[3] — [1]Universität Hamburg — [2]Cantabria Inst. of Phys. — [3]SYSU, ShenZhen

The Next to two Higgs Doublet Model (N2HDM) and Two Higgs Doublet Model plus complex Singlet (2HDMS) are promising model candidates, for physics beyond the Standard Model (SM). Both can embed the 95 GeV excesses at LEP, CMS and ATLAS. We consider the N2HDM as a limiting case of the 2HDMS when the $\mathcal{CP}$-odd singlet decouples from SM particles. Close to this limit, the models differ mainly by the additional trilinear terms in the 2HDMS, which arise due to its $\mathbb{Z}_3$ symmetry. This difference may lead to phenomenological effects in the di-Higgs production at collider experiments. We study the di-Higgs production at e^+e^- colliders, such as the ILC_{500}, and identify the parameter regions where we expect these differences to exceed the experimental uncertainties.

T 97.8 Thu 17:45 Geb. 30.34: LTI

Probe of top-quark electroweak couplings at the FCC-ee — •Simon Keilbach, Jan Kieseler, Markus Klute, Matteo Presilla, and Xunwu Zuo — KIT, Karlsruhe, Germany

The Future Circular Collider (FCC) is a post-LHC project aiming to provide unprecedented insights on both Standard Model physics and beyond, featuring electron-positron collisions (FCC-ee) as the first stage of the program. The FCC-ee operation includes a dataset with a collision energy of around 365 GeV, containing roughly 2 million instances of top-quark pair production. With such a clean collection of top quarks, we expect to enter a new era of top precision measurements, among which the top electroweak coupling parameters, especially the ttZ and ttgamma couplings, are of crucial importance. Traditional proposals for such measurements rely on beam polarization to disentangle the ttZ and ttgamma contributions. This talk reports a recent study at FCC-ee on the possibility of ttZ and ttgamma measurements with unpolarized incoming beams.