NExT meeting at KCL

Report of Contributions

https://indico.cern.ch/e/1426632

Contribution ID: **1** Type: **not specified**

Harnessing SMEFT for new physics exploration and the role of electroweak perturbative corrections

Wednesday 26 June 2024 14:00 (30 minutes)

In the absence of direct evidence for new physics, Effective Field Theories (EFTs) serve as powerful tools for exploring potential new physics. As the Large Hadron Collider (LHC) continues to gather data, the importance of precision physics becomes increasingly clear. By focusing on the high-energy parameter space of correlated bosonic processes, we will demonstrate that certain blind directions in new physics can be disentangled during the High Luminosity Run of the LHC. Additionally, we will emphasise the crucial role of next-to-leading-order electroweak corrections in accurately determining the constraints on SMEFT parameters, using the W^+W^- production process as an example.

Presenters: BANERJEE, Shankha; BANERJEE, Shankha (Institute of Mathematical Sciences (IN))

Session Classification: Session 1

Contribution ID: **2** Type: **not specified**

Building Better Event Generators for the LHC

Wednesday 26 June 2024 14:30 (30 minutes)

The increasing precision of LHC measurements demands equally precise theoretical predictions. I will discuss one direction in which much fruitful progress has been made recently, namely the matching of NNLO calculations to parton shower programs. I will present results for colour-singlet production obtained using the GENEVA method for matching, and detail the path towards the simulation of coloured final states.

Presenter: LIM, Matthew (University of Sussex)

Session Classification: Session 1

Contribution ID: **3** Type: **not specified**

Searching for H→hh→bbττ in the 2HDM at the LHC

Wednesday 26 June 2024 15:00 (30 minutes)

In the framework of the two Higgs doublet Model (2HDM) type-1, we investigate the scope of the LHC in accessing the process H→hh→bbττ by performing a Monte Carlo (MC) analysis aimed at extracting this signal from the SM backgrounds, in the presence of a dedicated trigger choice and kinematical selection. We prove that some sensitivity to such a channel exists already at Run 3 of the LHC while the High-Luminosity LHC (HL-LHC) will be able to either confirm or disprove this theoretical scenario over sizable regions of its parameter space.

Presenter: SEMLALI, SOUAD (School of Physics and Astronomy, University of Southampton)

Session Classification: Session 1

Contribution ID: **4** Type: **not specified**

New physics in the third generation. A comprehensive SMEFT analysis and future prospects

Wednesday 26 June 2024 16:15 (30 minutes)

We present a comprehensive analysis of electroweak, flavor, and collider bounds on the complete set of dimension-six SMEFT operators in the U(2)5-symmetric limit. This operator basis provides a consistent framework to describe a wide class of new physics models and, in particular, the motivated class of models where the new degrees of freedom couple mostly to the third generation. By analyzing observables from all three sectors, and consistently including renormalization group evolution, we provide bounds on the effective scale of all 124 U(2)5-invariant operators. The relation between flavor-conserving and flavor-violating observables is analyzed taking into account the leading U(2)5 breaking in the Yukawa sector, which is responsible for heavy-light quark mixing. We show that under simple, motivated, and non-tuned hypotheses for the parametric size of the Wilson coefficients at the high scale, all present bounds are consistent with an effective scale as low as 1.5 TeV. We also show that a future circular ee collider program such as FCC-ee would push most of these bounds by an order of magnitude. This would rule out or provide clear evidence for a wide class of compelling new physics models that are fully compatible with present data.

Presenters: STEFANEK, Ben; STEFANEK, Ben

Session Classification: Session 2

Contribution ID: **5** Type: **not specified**

A 95 GeV Higgs Boson within a 2-Higgs Doublet Model

Wednesday 26 June 2024 16:45 (30 minutes)

This talk will focus on the explanation and implications of the excesses around 95 GeV in the di-photon and di-tau invariant mass distributions recently reported by the CMS collaboration at the LHC, together with the long-standing discrepancy observed at the Large Electron-Positron (LEP) collider in the b-bbar final state. The latest ATLAS results in the di-photon final state similarly reveal an excess of events within the same mass range, albeit with a bit lower significance, thereby corroborating the observations made by CMS. We have found that all three excesses can be explained simultaneously within the general 2HDM Type-III where the lightest CP-even Higgs boson serves as the source of the excesses, while satisfying up-to-date theoretical and experimental constraints. Characteristic features of the model parameter space explaining the data will also be pointed out making way for further exploration of the model in the near future. In particular, the 2HDM Type-III predicts a significant enhancement in the ttbar associated production of the SM-like 125 GeV Higgs boson. Such an effect can be tested soon at the High Luminosity LHC (HL-LHC).

Presenter: CHAKRABORTI, Manimala

Session Classification: Session 2

Contribution ID: **6** Type: **not specified**

Developing the Reconstruction of a Magnetised Gaseous Argon TPC for the DUNE Near Detector

Wednesday 26 June 2024 17:15 (30 minutes)

The Deep Underground Neutrino Experiment (DUNE) is a next-generation neutrino experiment that will consist of a near detector (ND) complex placed at Fermilab, several hundred meters downstream of the neutrino production point, and a larger far detector (FD) to be built in the Sanford Underground Research Facility (SURF), approximately 1300 km away. DUNE will record neutrino interactions from an accelerator- produced beam (the LBNF multi-megawatt wide-band neutrino beam planned for Fermilab) arriving at predictable times, but will also aim to detect rare events such as supernova neutrinos, potential nucleon decays and other beyond the Standard Model phenomena. The main role of the DUNE ND is constraining the systematic uncertainties in the neutrino oscillation measurements by characterising the energy spectrum and composition of the neutrino beam, as well as performing precision measurements of neutrino cross sections. The plan for DUNE is to be built using a staged approach with two main phases. While the Phase I ND complex is sufficient for early physics goals, a Phase II upgrade is planned in order to reach the designed sensitivity for the neutrino oscillation physics. The upgraded Phase II ND will feature ND-GAr, a magnetised high-pressure gaseous argon TPC surrounded by an electromagnetic calorimeter (ECal) and a muon tagger. The gaseous argon provides low detection thresholds, which would allow detailed measurements of nuclear effects at the interaction vertex using the same material as the FD. Additionally, the magnetic field and the ECal would enable efficient particle identification and momentum and charge reconstruction. GArSoft is the simulation and reconstruction software package developed for ND-GAr. The development of this software is crucial for the task of delivering a physics-driven detector design, as it allows us to understand the impact that design changes have on the physics. This talk will present an overview of the capabilities of ND-GAr and the ongoing efforts on the simulation and reconstruction software for the detector.

Presenter: MARTINEZ LOPEZ, Francisco (Queen Mary University of London (GB))

Session Classification: Session 2