Two Days with Particle Physics Workshop

Wednesday 17 November 2021 - Thursday 18 November 2021

Book of Abstracts

Contents

2

Reminiscences of Steven Weinberg and his Impact in High Energy Physics

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3

The future of Collider Physics

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4

Quantum Chromodynamics at Hadron Colliders

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5

String Swampland Conjectures and Implications for Particle Phenomenology and de Sitter Cosmology

The string swampland conjectures are a list of criteria a low energy effective field theory (EFT) must satisfy to be UV completed in quantum gravity (QG). These conjectures are based on examples from string theory constructions. If an EFT does not respect these conditions it cannot be constructed from a string compactification. These criteria can be used in a bottom-up approach as a model selection principle or as constraints on an EFT parameter space. In this talk, we review some conjectures (including weak gravity conjecture, dS conjecture, trans-Planckian censorship conjecture, adS conjecture, distance conjecture, the Festina Lente bound) and study their implications for particle phenomenology and de Sitter cosmology.

6

CMS probes for beyond the standard model physics via Higgs boson

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This talk will mainly represent a review of the standard model Higgs boson and its role in searches for new physics at the large hadron collider. In the end, the latest beyond the standard model searches through Higgs interactions being performed at the CMS experiment collaboration will be addressed.

7

Probing bottom Yukawa couplings at future electron-proton colliders

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The proposed future $e^{-}p$ collider provides sufficient energies to produce the Standard Model Higgs Boson through $W^{\pm}$ and Z-boson fusion in charged and neutral current modes, respectively and to measure its properties. We take this opportunity to investigate the prospect of b-quark Yukawa coupling in the Standard Model Effective Field Theory framework and prob down the Wilson coefficients through the process of $e^{-}p \rightarrow \nu_{l}jH$ where the Higgs boson decays to a b-quark pair. The analysis is carried out considering two different center-of-mass energies of 1.3 and 3.46 TeV as the LHeC and FCC-eh benchmarks, including a realistic simulation of the detector response and the main sources of background processes. For backgrund rejection, a multivariate analysis using BDT training method, is performed and the expected limits at 95% CL are derived on the new physics couplings for each benchmark scenario.

8

Majorana Fermions in High Energy and Solid State Physics

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It is known that a Dirac-type matrix equation governs surface excitations in the superconductor-topological insulator system and Majorana zero-energy modes (MZM) arise as solutions of such an equation in the presence of vortices. Among other setups to realize MZMs, one can mention a p-wave superconductor with a non-relativistic kinetic term and a vortex order parameter. On the other hand, it is known that Majorana's original work was not restricted only to zero-energy modes, which are static solutions of the Majorana equation. His approach was quite general and he introduced a whole field, called Majorana Fermions. We review these concepts and their importance both in the high anergy physics and the solid state physics context.

9

Meeting opening

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10

The effects of non-helical component of hypermagnetic field on the evolution of the matter-antimatter asymmetry, vorticity, and hypermagnetic field

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The large-scale magnetic fields and the baryon asymmetry in the Universe are two important puzzles in particle physics and cosmology. In the symmetric phase of the early Universe before the electroweak phase transition (EWPT), these two seemingly unrelated problems are intertwined via the Abelian anomalous effect, $\nabla_\mu j^\mu \sim \vec{E}_Y.\vec{B}_Y$. Moreover, in imbalanced chiral plasma the magnetic and vorticity field lead to generation of electric current, which are known as the Chiral Magnetic Effect (CME) and Chiral Vortical Effect (CVE), respectively. In this talk we will show that the CVE and CME can lead to the generation and evolution of the hypermagnetic field and matter-antimatter asymmetries in the symmetric phase of the early Universe in the temperature range $100\ \text{GeV} \leq T \leq 10\ \text{TeV}$.

11

The generation of matter–antimatter asymmetries and hypermagnetic fields by the chiral vortical effect of transient fluctuations

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Generation of matter-antimatter asymmetry and large-scale magnetic fields in the Universe are two seemingly unrelated problems in particle physics and cosmology which are highly intertwined in the symmetric phase of the early Universe, due to the Abelian anomalous effects. The chiral vortical effect (CVE) is the generation of the electric current parallel to the vorticity field in the plasma. We show that due to the temperature-dependent chiral vortical effect, small overlapping transient fluctuations in the vorticity field in the plasma and temperature of matter degrees of freedom can lead to the generation of strong hypermagnetic fields and matter-antimatter asymmetries, all starting from zero initial values.