IBS-PNU Joint Workshop on Physics beyond the Standard Model

Report of Contributions

https://indico.cern.ch/e/852477

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

Probing charged Higgs bosons using Top quark polarisation

Wednesday 4 December 2019 16:00 (30 minutes)

We study the production and the decay of a heavy charged Higgs boson at the Large Hadron Collider (LHC) in gb fusion. The chiral structure of the $H^+\bar{t}b$ coupling can trigger a particular spin state of the top quark produced in the decay of a Charged Higgs boson and therefore, is sensitive to the underlying mechanism of the electroweak symmetry breaking (EWSB). Taking two benchmark models (2HDM type-I and 2HDM type-Y) as an example, we show that observables sensitive to the top quark polarisation – constructed of energies and angles of the top quark's decay products – can be used both as a discovery as well as a characterization tool. We discuss the resilience of these observables to the flavor scheme used in the calculations, and to the NLO QCD corrections.

Presenter: JUEID, Adil (Konkuk University)

Session Classification: Afternoon session II

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

Matter-antimatter asymmetry without loops

Wednesday 4 December 2019 16:30 (30 minutes)

We propose a new mechanism for generating matter-antimatter asymmetry via the interference of tree-level diagrams only. We first derive a general result that a nonzero CP-asymmetry can be generated via at least two sets of interfering tree-level diagrams involving either 2⟶2 or 1⟶N(with N≥3) processes. We illustrate this point in a simple TeV-scale extension of the Standard Model with an inert Higgs doublet and right-handed neutrinos, along with an electroweak-triplet scalar field. The imaginary part needed for the required CP-asymmetry comes from the trilinear coupling of the inert-doublet with the triplet scalar. Small Majorana neutrino masses are generated by both scotogenic and type-II seesaw mechanisms. The real part of the neutral component of the inert-doublet serves as a cold dark matter candidate. The evolutions of the dark matter relic density and the baryon asymmetry are intimately related in this scenario.

Presenter: DASGUPTA, Arnab (Seoul National University of Science and Technology)

Session Classification: Afternoon session II

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

Cosmological Relaxation from Dark Fermion Production

Wednesday 4 December 2019 17:00 (30 minutes)

We consider the cosmological relaxation solution to the electroweak hierarchy problem using the fermion production as a dominant friction force. In our approach, neither super-Planckian field excursions nor a large number of e-folds arise, and scanning over thermal Higgs mass squared is avoided. The produced fermions from the relaxion source through the derivative coupling are SM-singlets, what we call dark fermions, and they can serve as the keV scale warm dark matter candidates.

Presenter: MIN, Ui (KAIST)

Session Classification: Afternoon session II

Contribution ID: **7** Type: **not specified**

Probing sterile neutrino in meson decays with and without sequential neutrino decay

Wednesday 4 December 2019 17:30 (30 minutes)

We present the most systematic approach to discover a sterile neutrino N or constrain $|U_{\ell N}|^2$, the mixing between active neutrino ν_ℓ (with $\ell = \mu, \tau$) and the sterile neutrino N, from $B \to D\ell N$ decays. Our constraint on $|U_{\mu N}|^2$ achievable from Belle II data is comparable with that from the much larger data set of upgraded LHCb, even much better for mass of sterile neutrino $m_N < 2$˜GeV. We can also probe the Dirac and Majorana nature of N by observing the sequential decay of N, including suppression factors associated with observation of a displaced
vertex and helicity flip, for Majorana N.

Presenter: LEE, Donghun (Yonsei University)

Session Classification: Afternoon session II

Contribution ID: **8** Type: **not specified**

Dark Matter Heating vs. Rotochemical Heating in Old Neutron Stars

Thursday 5 December 2019 09:00 (1 hour)

Dark matter (DM) particles in the Universe accumulate in neutron stars (NSs) through their interactions with ordinary matter. It has been known that their annihilation inside the NS core causes late-time heating, with which the surface temperature becomes a constant value of 2000-3000 K for the NS age t > 10^6-10^7 years. This conclusion is, however, drawn based on the assumption that the beta equilibrium is maintained in NSs throughout their life, which turns out to be invalid for rotating pulsars. The slowdown in the pulsar rotation drives the NS matter out of beta equilibrium, and the resultant imbalance in chemical potentials induces late-time heating, dubbed as rotochemical heating. This effect can heat a NS up to 10^6 K for t > 10^6–10^7 years. In fact, recent observations found several old NSs whose surface temperature is much higher than the prediction of the standard cooling scenario and is consistent with the rotochemical heating. Motivated by these observations, we reevaluate the significance of the DM heating in NSs, including the effect of the rotochemical heating. We show that the signature of DM heating can still be detected in old ordinary pulsars, while it is concealed by the rotochemical heating for old millisecond pulsars. On the other hand, a discovery of a very cold NS can give a robust constraint on the DM heating, and thus on DM models.

Presenter: HAMAGUCHI, Koichi (University of Tokyo)

Session Classification: Morning session

Contribution ID: **9** Type: **not specified**

Dark Matter Targets with Exponentially Small Couplings

Thursday 5 December 2019 10:30 (1 hour)

Presenter: RUDERMAN, Joshua (New York University)

Session Classification: Morning session

Contribution ID: **10** Type: **not specified**

Four-form relaxation of Higgs mass and cosmological constant

Thursday 5 December 2019 11:30 (30 minutes)

We consider the cosmological relaxation of the Higgs mass and the cosmological constant due to the four-form fluxes in four dimensions. We introduce non-minimal four-form couplings for reheating the Universe after the last membrane nucleation and propose some simple examples with a pseudo-scalar or a complex singlet scalar field. We also discuss the implications of the non-minimal four-form coupling to gravity for flattening the inflaton potential in chaotic inflation models with a pseudo-scalar field.

Presenter: LEE, Hyun Min (Chung-Ang University and CERN)

Session Classification: Morning session

Contribution ID: **11** Type: **not specified**

Higgs inflation: updated

Thursday 5 December 2019 14:00 (30 minutes)

Higgs inflation is the best fitting model of cosmological inflation after the Planck data. I would like to discuss some recent discussions on fine-tuning, unitarity, violent preheating, and primordial black hole formation in Higgs inflation.

Presenter: PARK, Seong Chan (Yonsei University)

Session Classification: Afternoon session I

Contribution ID: **12** Type: **not specified**

Magnetogenesis from rotating scalar: à la scalar chiral magnetic effect

Thursday 5 December 2019 14:30 (30 minutes)

The chiral magnetic effect is a phenomenon that an electric current parallel to the magnetic fields is induced in the presence of the chiral asymmetry in the fermionic system. In this talk, I would like to point out that the electric current induced by the dynamics of a pseudo scalar field that anomalously couples to electromagnetic fields can be interpreted as a similar effect in the scalar system. Noting that the velocity of the pseudo scalar field, which is the phase of a complex scalar, represents that the system carries a global U(1) number asymmetry, we see that the induced current is proportional to the asymmetry and parallel to the magnetic field, which is the same to the chiral magnetic effect. The mechanism like the Affleck-Dine mechanism an asymmetry carried by the Affleck-Dine field can induce the electric current and give rise to the instability in the (electro)magnetic field if it is unbroken by the expectation value of the Affleck-Dine field. Cosmological consequences of this mechanism are investigated.

Presenter: SHIN, Chang Sub (IBS-CTPU)

Session Classification: Afternoon session I

Contribution ID: **13** Type: **not specified**

Neutrino self-interaction in the signals from blazar TXS 0506+056

Thursday 5 December 2019 15:00 (30 minutes)

Even though conventional leptonic or lepto-hadronic models of blazar successfully explain the observed electromagnetic component of the flaring signal from the Blazar TXS 0506+056 in a large range of energy window □□∈(10−1eV,102 GeV), the predicted neutrino flux is too small to be consistent with the IceCube observation at □□~300 TeV. We show that a sizable self-interaction of neutrinos with a light messenger resolves the discrepancy. Interestingly, the same physics can relieve the cosmological tension in □0 and □8.

Presenter: JHO, Yongsoo (Yonsei University)

Session Classification: Afternoon session I

Contribution ID: **14** Type: **not specified**

Towards the ultimate axion dark matter sensitivity in the 1-20 GHz frequency range

Thursday 5 December 2019 16:00 (30 minutes)

The IBS-CAPP has currently accomplished all its technical challenges towards achieving the ultimate sensitivity in axion dark matter: DFSZ level even for 10% axion dark matter content in the local halo. Early next year we are expecting to receive a low temperature superconducting (LTS), 12T magnet LTS-12T/320mm, based on Nb3Sn cable, from Oxford Instruments, which will enable us to cover the 1-8 GHz axion frequency range. For the rest of the frequency range of 8-20 GHz we need to finish the high temperature superconducting (HTS) 25T magnet being developed at BNL. I will present the current status and the rising competition from around the world for the various frequency ranges.

Presenter: SEMERTZIDIS, Yannis (IBS-CAPP and KAIST)

Session Classification: Afternoon session II

Contribution ID: **15** Type: **not specified**

TBA

Presenter: KIM, Yoonbai (Sungkyunkwan University)

Session Classification: Afternoon session II

Contribution ID: **16** Type: **not specified**

Inert Doublet Model with U(1) symmetry

Friday 6 December 2019 15:00 (30 minutes)

Presenter: SONG, Jeonghyeon (Konkuk University)

Session Classification: Afternoon session I

Contribution ID: **17** Type: **not specified**

Recent (non-Rx) highlights from Belle

Thursday 5 December 2019 17:00 (30 minutes)

In this talk, we present recent highlights of physics results from Belle, other than R(D(*)), *R_K(*). We also show a recent status of the Belle II experiment.

Presenter: KWON, Yongjoon (Yonsei University)

Session Classification: Afternoon session II

Contribution ID: **18** Type: **not specified**

Recent developments in partial compositeness

Friday 6 December 2019 09:00 (1 hour)

I review attempts at constructing models of partial compositeness from strongly coupled gauge theories. A few minimality assumptions allow one to isolate a small number of prototypical models that can be studied on the lattice and probed at colliders. I review recent results in these two areas, such as the spectrum from the lattice and two possible exotic signatures at colliders, namely light and weakly coupled additional ALPs and additional decays of top partners.

Presenter: FERRETTI, Gabriele (Chalmers University)

Session Classification: Morning session

Contribution ID: **19** Type: **not specified**

The Lattice Study of SU(2) with Many Fermions

Friday 6 December 2019 10:30 (1 hour)

Depending on the number of Fermions a gauge theory can have a behavior ranging from asymptotic freedom to asymptotic safety. I show the behavior of SU(2) gauge theory with 4,6,8,24, and 48 fermions measured from lattice field theory simulations. We observe limits for the lower and upper edge of the conformal window and measure anomalous dimensions for mass and coupling. We also try to understand the behavior with very high number of fermions, possibly leading to second conformal window.

Presenter: LEINO, Viljami (Technical University of Munich)

Session Classification: Morning session

Contribution ID: **20** Type: **not specified**

Common exotic decays of vector-like top partners: Motivation, challenges, and opportunities for collider searches

Friday 6 December 2019 11:30 (30 minutes)

Presenter: FLACKE, Thomas (IBS-CTPU)

Session Classification: Morning session

Contribution ID: **21** Type: **not specified**

A Natural Composite GUT

Friday 6 December 2019 14:00 (30 minutes)

Presenter: LEE, Seung Joon (Korea University)

Session Classification: Afternoon session I

Contribution ID: **22** Type: **not specified**

Lattice NRQCD study of heavy quark and anti-quark annihilations in QGP and heavy dark matter annihilations in early universe

Friday 6 December 2019 14:30 (30 minutes)

Presenter: KIM, Seyong (Sejong University)

Session Classification: Afternoon session I

Contribution ID: **23** Type: **not specified**

Strong first order phase transition in composite Higgs models

Thursday 5 December 2019 16:30 (30 minutes)

We study the strong first order electroweak phase transition (SFOEWPT) with the SO(6)/SO(5) composite Higgs model, whose scalar sector contains one Higgs doublet and one real singlet. Six benchmark models are built with fermion embeddings in 1, 6, and 15 of SO(6). We show that SFOEWPT cannot be triggered under the minimal Higgs potential hypothesis, which assumes the scalar potential is dominated by the form factors from the lightest composite resonances. To get a SFOEWPT, the contributions from local operators induced by physics above the cutoff scale are needed. We take the 6 + 6 model as an example to investigate the gravitational waves prediction and the related collider phenomenology.

Presenter: XIE, Ke-Pan (Seoul National University)

Session Classification: Afternoon session II

Contribution ID: **24** Type: **not specified**

Higgs precision with Deep Learning

Friday 6 December 2019 16:00 (30 minutes)

Presenter: PARK, Myeonghun (Seoultech)

Session Classification: Afternoon session II

Contribution ID: **25** Type: **not specified**

4D asymptotically safe quantum field theories (Skype)

Friday 6 December 2019 17:00 (30 minutes)

Presenter: SANNINO, Francesco (CP3, University of Southern Denmark)

Session Classification: Afternoon session II

Contribution ID: **26** Type: **not specified**

Neutrino Oscillations in Dark Matter

Friday 6 December 2019 16:30 (30 minutes)

Presenter: CHOI, Ki-Young (Sungkyunkwan University)

Session Classification: Afternoon session II

Contribution ID: **27** Type: **not specified**

Searching for New Physics Signals from Timing Spectra at Neutrino Experiment

Friday 6 December 2019 17:30 (30 minutes)

We propose a novel strategy to search for new physics signals in timing spectra, envisioning the situation in which new particles come from the decay of a heavier mother particle with a finite particle width. For example, the timing distribution of events induced by the dark matter particle scattering at the detector may populate in a relatively narrow range, forming a "resonance-like" shape. Due to this structural feature, the signal may be isolated from the backgrounds, in particular when the backgrounds are uniformly distributed in energy and time. We analyze the existing data for the CsI detector of the COHERENT experiment with a timing cut and an energy cut, and find an excess in the timing distribution which can be explained by dark matter. Our new approach can be generally utilized for searching for new physics such as light dark matter or non-standard neutrino interaction in coherent neutrino scattering experiments including CCM, COHERENT, and JSNSˆ2.

Presenter: PARK, Jong-Chul (Chungnam National University)

Session Classification: Afternoon session II

Contribution ID: **28** Type: **not specified**

Why the quark mass is so small: the chiral symmetry and Heun's equation

Saturday 7 December 2019 09:00 (30 minutes)

We show that a holographic abelian Higgs model leads us to the Heun's equation, which is the same one derived for the bag model studied by Lichtenberg. The correspondence between two models resembles the AdS/CFT dictionary. The spectrum follows linear confinement for zero quark mass, while it is highly non-linear for finite quark mass. It can be traced back to the difference in the singularity class of equation of motion made by the quark mass. It suggests that the origin of the chiral symmetry is tied to the dynamics of color confinement.

Presenter: SIN, Sang-Jin (Hanyang University)

Session Classification: Morning session

Contribution ID: **29** Type: **not specified**

Higher Curvature Gravity and its implication

Saturday 7 December 2019 09:30 (30 minutes)

Einstein gravity may be coming from the leading linear term of the curvature in the low energy effective action. As the simplest extension of the Einstein gravity with the higher curvature term, we study the model with the Gauss-Bonnet term, which is the simplest term allowing the equation of motion to be at the 2nd order. The model wi analyze is the dilaton Einstein Gauss-Bonnet theory. We study the properties of this model, especially the black holes, and the cosmological implications in the early universe.

Presenter: LEE, Bum-Hoon (Sogang University)

Session Classification: Morning session

Contribution ID: **30** Type: **not specified**

Black holes in holographic quantum gravity

Saturday 7 December 2019 10:30 (30 minutes)

Presenter: KIM, Seok (Seoul National University)

Session Classification: Morning session

Contribution ID: **31** Type: **not specified**

Complete Prepotential of 5d Superconformal Field Theories

Saturday 7 December 2019 11:00 (30 minutes)

Presenter: LEE, Kimyeong (KIAS)

Session Classification: Morning session

Contribution ID: **32** Type: **not specified**

Perturbative methods in holography vs. Supersymmetric Localization

Saturday 7 December 2019 11:30 (30 minutes)

We study supergravity BPS equations which correspond to mass- deformation of some representative AdS/CFT examples. The field theory of interest are N=4, D=4 super Yang-Mills, the ABJM model in D=3, and the Brandhuber-Oz fixed point in D=5. For these gauge theories the free energy with mass terms for matter multiplets is calculable in large-N limit using supersymmetric localization technique. We suggest a perturbative method to solve the supergravity equations. For the dual of mass-deformed ABJM model we reproduce the known exact solutions. For the mass-deformed Brandhuber-Oz theory our method gives the holographic free energy in analytic form. For N=1* deformations of N=4 super Yang-Mills, we calculated exactly some expansion coefficients, which were only known numerically before our work.

Presenter: KIM, Nakwoo (Kyung Hee University)

Session Classification: Morning session

Contribution ID: **36** Type: **not specified**

Dark Axion Portal

Wednesday 4 December 2019 14:00 (30 minutes)

Presenter: LEE, Hye-Sung (KAIST)

Session Classification: Afternoon session I

Contribution ID: **37** Type: **not specified**

Searching for Dark Photons at the LHeC and FCC-he

Wednesday 4 December 2019 14:30 (30 minutes)

Extensions of the Standard Model (SM) gauge group with a new $U(1)_X$ predict an additional gauge boson. Through kinetic mixing with the SM photons featured by a coupling ϵ, the ensuing so-called dark photons γ', which acquire mass as a result of the breaking of the gauge group $U(1)_X$, can interact with the SM field content. These massive dark photons can therefore decay to pairs of leptons, hadrons, or quarks, depending on their mass $m_{\gamma'}$. In this work, we discuss searches for dark photons in the mass range around and below one GeV at the LHeC and FCC-he colliders. The signal is given by the displaced decays of the long-lived dark photon into two charged fermions. We discuss the impact of conceivable irreducible (SM and machine-related) backgrounds and different signal efficiencies. Our estimates show that the LHeC and FCC-he can test a domain that is complementary to other present and planned experiments.

Presenter: WANG, Zeren Simon (APCTP)

Session Classification: Afternoon session I

Contribution ID: **38** Type: **not specified**

Axion-photon-dark photon oscillation and its implication for 21 cm observation

Wednesday 4 December 2019 15:00 (30 minutes)

We examine the resonant conversion of axion-like particle (ALP) or dark photon to the electromagnetic photon in the early Universe, which takes place due to the ALP-photon-dark photon oscillations in background dark photon gauge fields. It is noted that the corresponding conversion probability can have an unusual spectral feature which allows strong conversion at low frequency domain, but has negligible conversion at high frequencies above certain critical frequency which is determined by the ALP coupling to dark photon and the strength of background dark photon gauge field. We apply this scheme to heat up the 21 cm photons without affecting the Cosmic Microwave Background, which can explain the tentative absorption signal of 21 cm photons detected recently by the EDGES experiment.

Presenter: YUN, Seokhoon (KIAS)

Session Classification: Afternoon session I