

KEK-PH Lectures and Workshops 2020

Report of Contributions

Contribution ID: 1

Type: **not specified**

Renormalon problem in QCD and a direction to go beyond perturbation theory I

Wednesday, 1 July 2020 11:00 (1 hour)

In QCD, perturbation theory is an indispensable tool but is not an ultimate method in the sense that accuracies of perturbative predictions are limited. In particular, the so-called renormalon problem is known that perturbative expansions of observables give divergent series and cause inevitable uncertainties. This problem is becoming more serious from phenomenological aspects in recent years. I first give a review of the renormalon problem. The contents include causes of the divergence of perturbative series and its implications to nonperturbative physics. Subsequently, I discuss a possible direction to overcome the renormalon problem. For this purpose, one has to calculate perturbative contributions compatibly with the operator product expansion so that nonperturbative effects can eventually be included.

Presenter: Dr TAKAURA , Hiromasa (KEK)

Contribution ID: 2

Type: **not specified**

Physics at e+e-collider

Tuesday, 4 August 2020 10:00 (1 hour)

Part 1

General introduction: Why do we need new physics beyond the SM?

General introduction: processes in e+e- as a function of energy; run plan of the ILC

Higgs boson: SM predictions for the decay rates and properties – and, brief review of LHC measurements

Higgs boson: BSM effects on the Higgs couplings

Higgs boson: aspects of the experimental study in e+e-

Higgs boson: global fit of e+e- data in the context of SMEFT

Presenter: Prof. PESKIN, Michael (SLAC)

Session Classification: KEK-PH collider

Contribution ID: 3

Type: **not specified**

Lecture 2: Advanced topics of Hadron Collider Physics

Wednesday, 5 August 2020 11:30 (1 hour)

A bit of Statistics

Precision: Jets, Higher-order corrections, more kinematics, and machine learning

Long-Lived Particles

Future hadron colliders (physics)

I will introduce the basic concepts of hadron collider physics in the first part of the lecture and discuss a few advanced topics in the second part of the lecture. The goal is to let the audience get familiar with the key concepts/methodology of hadron collider physics, such as the parton distribution function and kinematical considerations. With these basic concepts, we can build a picture of the relevant processes at hadron colliders and have a deep appreciation of the endeavor of the discovery of the Higgs boson, and get prepared for quantitative assessment of physics potentials at hadron colliders. In the second half of the lecture, we will continue the discussion to precision physics, as well as some rudimentary understanding of statistics. If time permits, the basics of currently very active research topic of long-lived particles at colliders and satellite experiments will be introduced. Finally, I will sketch a longer-term picture of future collider program and physics.

Presenter: Prof. LIU, Zhen (Maryland)**Session Classification:** KEK-PH collider

Contribution ID: 4

Type: **not specified**

Physics at e+e-colliders

Tuesday, 4 August 2020 11:30 (1 hour)

Part 2.

e+e- -> 2 fermion reactions at e+e- colliders, s-channel resonance and compositeness searches

top quark: general theoretical orientation

top quark: threshold region

top quark: continuum region

top quark: possible BSM effects and tests of these

e+e- at high energy: e+e- -> t tbar h

e+e- at high energy e+e- -> hh + X

the long future of the ILC laboratory

Presenter: Prof. PESKIN , Michael

Session Classification: KEK-PH collider

Contribution ID: 5

Type: **not specified**

Lecture1: Basics of Hadron collider

Wednesday, 5 August 2020 10:00 (1 hour)

Lecture 1: Basics of Hadron Collider Physics

Intro to colliders

Parton distribution function

Kinematics

Discovery of the Higgs boson

I will introduce the basic concepts of hadron collider physics in the first part of the lecture and discuss a few advanced topics in the second part of the lecture. The goal is to let the audience get familiar with the key concepts/methodology of hadron collider physics, such as the parton distribution function and kinematical considerations. With these basic concepts, we can build a picture of the relevant processes at hadron colliders and have a deep appreciation of the endeavor of the discovery of the Higgs boson, and get prepared for quantitative assessment of physics potentials at hadron colliders. In the second half of the lecture, we will continue the discussion to precision physics, as well as some rudimentary understanding of statistics. If time permits, the basics of currently very active research topic of long-lived particles at colliders and satellite experiments will be introduced. Finally, I will sketch a longer-term picture of future collider program and physics.

Presenter: Dr LIU, Zhen (Maryland)**Session Classification:** KEK-PH collider

Contribution ID: 6

Type: **not specified**

Renormalon problem in QCD and a direction to go beyond perturbation theory II

Tuesday, 7 July 2020 11:00 (1 hour)

In QCD, perturbation theory is an indispensable tool but is not an ultimate method in the sense that accuracies of perturbative predictions are limited. In particular, the so-called renormalon problem is known that perturbative expansions of observables give divergent series and cause inevitable uncertainties. This problem is becoming more serious from phenomenological aspects in recent years. I first give a review of the renormalon problem. The contents include causes of the divergence of perturbative series and its implications to nonperturbative physics. Subsequently, I discuss a possible direction to overcome the renormalon problem. For this purpose, one has to calculate perturbative contributions compatibly with the operator product expansion so that nonperturbative effects can eventually be included.

Presenter: Dr TAKAURA , Hiromasa (KEK)

Contribution ID: 7

Type: **not specified**

Resummation of perturbative series and Resurgence in quantum field theory I

Wednesday, 8 July 2020 11:00 (1 hour)

Perturbative series in Quantum Field Theory (QFT) is typically divergent. While there is a standard way to resum divergent series called Borel resummation, it is expected that naive Borel resummation does not work in many QFTs including QCD. Resurgence is often used to cure this kind of situation both in physics and mathematics. In my lecture, I will begin with general expectation on perturbative series in QFT and introduce resurgence with some simple examples. Then I will explain recent attempts to apply resurgence to QFT. Although it is natural to ask whether one can apply resurgence to some realistic theories such as QCD, I do not have a clear answer to the question at this moment because we do not have sufficient data yet. Instead I will discuss what should be done or known to answer the question.

Presenter: Prof. HONDA, Masazumi (YITP)

Contribution ID: 8

Type: **not specified**

Resummation of perturbative series and Resurgence in quantum field theory II

Wednesday, 15 July 2020 11:00 (1 hour)

Perturbative series in Quantum Field Theory (QFT) is typically divergent. While there is a standard way to resum divergent series called Borel resummation, it is expected that naive Borel resummation does not work in many QFTs including QCD. Resurgence is often used to cure this kind of situation both in physics and mathematics. In my lecture, I will begin with general expectation on perturbative series in QFT and introduce resurgence with some simple examples. Then I will explain recent attempts to apply resurgence to QFT. Although it is natural to ask whether one can apply resurgence to some realistic theories such as QCD, I do not have a clear answer to the question at this moment because we do not have sufficient data yet. Instead I will discuss what should be done or known to answer the question.

Presenter: Prof. HONDA, Masazumi (YITP)

Contribution ID: 9

Type: **not specified**

Heavy quark pair productions at ILC

Tuesday, 4 August 2020 13:30 (30 minutes)

We expect the ILC with polarized beams will shed light on the chiral structures of the electroweak couplings to all fermions. In the experimental viewpoint, the key of such measurements is to discriminate between fermion and anti-fermion in pair production events. In this talk, I will report recent developments and what we have achieved so far based on the studies within the ILD collaboration, especially for t-, b-, and c-quark pair productions.

Presenter: Dr YONAMINE, Ryo (Tohoku)

Session Classification: KEK-PH collider

Contribution ID: 10

Type: **not specified**

Dark matter detection at future lepton colliders

Tuesday, 4 August 2020 14:00 (20 minutes)

Future lepton colliders are now intensively discussed around the world, and we have so far four proposals of the colliders; one from Asia (ILC and CEPC) and the other from Europe (FCC-ee and CLIC). The main goal of the colliders at the first stage ($s^{1/2} = 240\text{-}250$ GeV) is to precisely measure known Higgs couplings to tackle the problem of the electroweak symmetry breaking. On the other hand, it is also interesting to discuss whether other new physics signals, in particular dark matter's, can be detected or not. In this talk, I would like to talk about how important roles future lepton colliders can play to detect dark matter.

Presenter: Prof. MATSUMOTO, Shigeki (Kavli IPMU)

Session Classification: KEK-PH collider

Contribution ID: 12

Type: **not specified**

SUSY models for the muon g-2 anomaly, and their implications

Tuesday, 4 August 2020 14:40 (20 minutes)

The muon g-2 anomaly is an important guide towards new physics beyond the Standard Model as it indicates new particles lighter than $O(100)$ GeV. Supersymmetric standard model is an attractive candidate explaining the anomaly since it also solves other important puzzles: the hierarchy problem, charge quantization and dark matter nature. In this talk, I would like to show that, by considering existent constraints, the viable scenario is almost fixed, which can be tested at the high luminosity LHC.

Presenter: Dr YOKOZAKI, Norimi (KEK)

Session Classification: KEK-PH collider

Contribution ID: 13

Type: **not specified**

Early kinetic decoupling of dark matter and the Higgs invisible decay in collider experiments

Tuesday, 4 August 2020 14:20 (20 minutes)

We revisit the Higgs-to-invisible decay ratio in Higgs-portal dark matter models. The Higgs-to-invisible decay searches are powerful probes of the models with increasing sensitivity in upcoming colliders. Close to the mass threshold of a Higgs decay into a pair of DM particles, the coupling value is expected to be very small in order to be compatible with the observed value of the thermal relic abundance. This small coupling perfectly fits with the current status of Higgs-to-invisible constraints and direct detection experiments, such as the XENON1T experiment. At the same time, the small coupling implies a lower DM scattering rate with particles in the early Universe plasma. The suppression of the scattering rate makes the kinetic decoupling happens earlier. Thus, the standard assumption in many relic abundance computations, namely the local thermal equilibrium, is not justified during the freeze-out process. We reanalyze Higgs-portal DM models, such as the Scalar-Singlet and a fermion DM model, taking the new effect of early kinetic decoupling in the relic abundance computation into account. Our results show that a larger value of the DM coupling to the Higgs is allowed. Therefore, current and future Higgs-to-invisible decay searches can generically probe more of the parameter space than previously expected.

Presenter: Dr ABE , Tomohiro (KMI, Nagoya)

Session Classification: KEK-PH collider

Contribution ID: 14

Type: **not specified**

Anomaly Mediation at Future Hadron Colliders

Tuesday, 4 August 2020 15:20 (20 minutes)

We discuss prospects of studying models with anomaly mediated supersymmetry breaking at future hadron colliders with centre-of-mass energy of 100 TeV. In such a class of models, charged Wino becomes long-lived with its decay length of ~ 6 cm, and the charged Wino tracks may be identified in particular by the inner pixel detector; the charged Wino tracks can be used not only for the discrimination of standard model backgrounds but also for the event reconstructions. We show that precise determinations of the Bino, Wino, and gluino masses are possible at the FCC. For such measurements, information about the charged Wino tracks, including the one about the velocity of the charged Wino using the time of the hit at the pixel detector, is crucial. With the measurements of the gaugino masses in the pure gravity mediation model, we have an access to more fundamental parameters like the gravitino mass. We also show that the lifetime of charged Wino may be measured by using the information about the distribution of the flight lengths of charged Winos. We propose a procedure for the lifetime determination and show how the accuracy changes as we vary the mass spectrum of superparticle. We also discuss the effects of the detector layouts on the lifetime determination.

Presenter: Dr CHIGUSA , So (KEK)

Session Classification: KEK-PH collider

Contribution ID: 15

Type: **not specified**

Higgs self-coupling as a probe of sphaleron properties

Tuesday, 4 August 2020 15:40 (20 minutes)

Sphaleron is a non-perturbative solution of electroweak gauge theories, which is crucially important for various scenarios of baryogenesis. In many of new physics models, the deviation in the sphaleron energy from the standard-model prediction is proportional to that in the triple Higgs boson coupling with opposite signs. This interesting relation would be useful to determine the sphaleron property by measuring the Higgs self-coupling at future collider experiments.

Presenter: Prof. KANEMURA, Shinya (Osaka)

Session Classification: KEK-PH collider

Contribution ID: 16

Type: **not specified**

Probing $\mu\tau$ flavor-violating solutions for the muon $g-2$ anomaly at colliders

Tuesday, 4 August 2020 16:00 (20 minutes)

The discrepancy between the measured value and the Standard Model prediction of the muon anomalous magnetic moment is one of the most important issues in the particle physics. It is known that introducing a mediator boson X with the $\mu\tau$ lepton flavor violating (LFV) couplings is one good solution to explain the discrepancy, due to the τ mass enhancement in the one-loop correction. We study the signal of this model, i.e. the same-sign leptons, at the LHC and at the Belle II, assuming the flavor-diagonal couplings are suppressed. We show that the Belle II experiment is highly sensitive to the scenario in the mediator mass range of $\mathcal{O}(1-10)$ -GeV, using the $e+e-$ to $\mu\tau\mu\tau$ process induced by the X .

Presenter: Dr TAKEUCHI, Michihisa (KMI, Nagoya)

Session Classification: KEK-PH collider

Contribution ID: 17

Type: **not specified**

Tagging boosted weak gauge bosons with deep learning

Wednesday, 5 August 2020 13:30 (20 minutes)

We demonstrate that the classification of boosted, hadronically-decaying weak gauge bosons can be significantly improved over traditional cut-based and BDT-based methods by using deep learning and the jet charge variable. We construct binary taggers for W^+ vs. W^- and Z vs. W discrimination, as well as an overall ternary classifier for $W^+/W^-/Z$ discrimination. We construct both ordinary and new composite CNNs. The method enhances the physics potential in SM measurements and searches for new physics that is sensitive to the electric charge of weak gauge bosons.

Presenter: Prof. CHIANG, Cheng-Wei (National Taiwan University)

Session Classification: KEK-PH collider

Contribution ID: **18**

Type: **not specified**

Minkowski Functionals for Jet Tagging

Wednesday, 5 August 2020 13:50 (20 minutes)

Presenter: Dr LIM, Sung Hak

Session Classification: KEK-PH collider

Contribution ID: 19

Type: **not specified**

Learning Physics at Future e-e+ Colliders with Machine

Wednesday, 5 August 2020 14:10 (20 minutes)

Information deformation and loss in jet clustering are one of the major limitations for precisely measuring hadronic events at future e-e+ colliders. Because of their dominance in data, the measurements of such events are crucial for advancing the precision frontier of Higgs and electroweak physics in the next decades. In a recent arXiv paper (<https://arxiv.org/pdf/2004.15013.pdf>), the speaker and his collaborators showed that this difficulty can be well-addressed by synergizing the event-level information into the data analysis, with the techniques of deep neural network. In relation to that, they introduced a CMB-like observable scheme, where the event-level kinematics is encoded as the Fox-Wolfram (FW) moments at leading order and multi-spectra at higher orders. Then they developed the classifiers in two ways to achieve this goal: jet-level with the FW moments and brute-force event-level. As an application, these classifiers were applied to measuring Higgs decay width at e-e+ colliders, with the data of $5ab^{-1}@240GeV$. The precision obtained is significantly better than the baseline ones presented in documents. In this talk, the speaker will give an overview on these aspects and discuss their potential impacts for future collider-physics study.

Presenter: Prof. LIU, Tao (The Hong Kong University of Science and Technology)

Session Classification: KEK-PH collider

Contribution ID: 20

Type: **not specified**

Flavor Physics at Future Z-Factories: $b \rightarrow s\tau\tau$ Measurements and Beyond

Wednesday, 5 August 2020 14:30 (20 minutes)

$b \rightarrow s\tau^+\tau^-$ measurements are highly motivated for addressing lepton-flavor-universality(LFU)-violating puzzles such as $R_{K^{(*)}}$ anomalies. The anomalies of $R_{D^{(*)}}$ and $R_{J/\psi}$ further strengthen their necessity and significance, given that the LFU-violating hints from both involve the third-generation leptons directly. Z factories of future e^-e^+ colliders stand at a great position to conduct such measurements, because of their relatively high production rates and reconstruction efficiency for B mesons at Z pole. To fully explore this issue, we pursue a sensitivity study for four $b \rightarrow s\tau^+\tau^-$ benchmark channels, namely, $B^0 \rightarrow K^{*0}\tau^+\tau^-$, $B_s \rightarrow \phi\tau^+\tau^-$, $B^+ \rightarrow K^+\tau^+\tau^-$ and $B_s \rightarrow \tau^+\tau^-$, at the future Z factories. A scheme of B-meson reconstruction mainly based on detector tracking system is developed for this purpose. The simulations indicate that at Tera-Z the branching ratios of the first three channels can be measured with a precision of $\mathcal{O}(10^{-7})$ and that of $B_s \rightarrow \tau^+\tau^-$ with a precision of $\mathcal{O}(10^{-5})$. The interpretation of these results in effective field theory is presented.

Presenter: Dr LI, Lingfeng (HKUST)

Session Classification: KEK-PH collider

Contribution ID: 21

Type: **not specified**

Search for lepton-flavor violating processes at LHC

Wednesday, 5 August 2020 15:10 (30 minutes)

Presenter: Prof. TSUNO, Soji (KEK)

Session Classification: KEK-PH collider

Contribution ID: 22

Type: **not specified**

Cornering Higgsino at the LHC

Wednesday, 5 August 2020 15:40 (20 minutes)

A Higgsino-like particle is an attractive candidate for the WIMP dark matter. Thanks to the electroweak interaction, the production cross section of the Higgsino at the LHC is rather high. However, the huge Standard Model background prevents the Higgsino discovery, and the present LHC sensitivity can be even worse than the LEP result in some parameter region. In this talk, I discuss a new search strategy to explore such a parameter region by utilizing exotic tracks from the charged Higgsino: soft displaced track and disappearing track.

Presenter: Dr SHIRAI, Satoshi (Kavli IPMU, Tokyo)

Session Classification: KEK-PH collider

Contribution ID: 23

Type: **not specified**

Probing long-lived particles at Higgs factories

Wednesday, 5 August 2020 16:00 (20 minutes)

We study displaced vertex signatures of long-lived particles (LLPs) from exotic Higgs decays in the context of a Higgs-portal model and a neutral-naturalness model at the circular electron positron collider (CEPC) and future circular collider e^+e^- (FCC-ee). Such two models feature two representative mass ranges for LLPs, which show very different behavior in their decay signatures. The Higgs-portal model contains a very light sub-GeV scalar boson stemming from a singlet scalar field appended to the Standard Model. Such a light scalar LLP decays into a pair of muons or pions, giving rise to a distinctive signature of collimated muon-jet or pion-jet, thanks to the sub-GeV mass. On the other hand, the neutral-naturalness model, e.g., folded supersymmetry, predicts the lightest mirror glueball of mass $O(10)$ GeV, giving rise to long decays with a large transverse impact parameter because of the relatively large mass. Utilizing such distinct characteristics to remove the background, we estimate the sensitivities of searches for light scalar bosons and mirror glueballs at the CEPC and FCC-ee. We find either complementary or stronger coverage compared to the previous results in the similar contexts.

Presenter: Dr WANG, Zeren Simon (APCTP)

Session Classification: KEK-PH collider

Contribution ID: 24

Type: **not specified**

Searches for new light particles at ILC main beam dump

Wednesday, 5 August 2020 16:20 (20 minutes)

The International Linear Collider (ILC) is the highest-priority next collider as a Higgs factory. In the linear collider, almost all accelerated particles that do not interact strongly at the collision point are not recycled and are all thrown into beam dumps, which is very different from the case of circular colliders. Therefore, a beam dump experiment in the linear collider can be performed in parallel with the main experiment, which has a great advantage in terms of statistics. In this study, we estimate the detection sensitivity to new light particles that interacts not only to primary electron beams but also to secondary photons, electrons, positrons, and muons in the ILC beam dump. This study demonstrates that the ILC beam dump experiment has an enhanced sensitivity to axion-like particles and leptophilic dark sectors by an order of magnitude compared with previous experiments and other future beam dump experiments.

Presenter: Dr SAKAKI, Yasuhito (KEK)

Session Classification: KEK-PH collider

Contribution ID: 26

Type: **not specified**

Particle-physics constraints from stars

Wednesday, 21 October 2020 16:00 (2 hours)

Stars can be powerful laboratories to constrain the properties of low-mass particles such as neutrinos, axions, dark photons, low-mass dark-matter candidates, and others. This lecture will mainly focus on the back-reaction on stellar properties caused by the emission of new particles, so we will explain some of the basics of stellar evolution theory. We will also review some old and new limits that are of particular interest at the particle-physics “intensity frontier”.

Presenter: Prof. RAFFELT, Georg (Munich, Max Planck Inst.)

Session Classification: KEK-PH + KEK-Cosmo DM

Contribution ID: 29

Type: **not specified**

Direct search of dark matter

Tuesday, 13 October 2020 10:00 (2 hours)

Direct search of dark matter is expanding its search phase space. This lecture will cover the concepts, current status, and prospects of the dark matter direct searches including related topics.

Presenter: Prof. MIUCHI, Kentaro (Kobe University)

Session Classification: KEK-PH + KEK-Cosmo DM

Contribution ID: 31

Type: **not specified**

XENON1T excess in local Z_2 DM models with light dark sector

Tuesday, 13 October 2020 13:00 (20 minutes)

Presenter: KIM, Jongkuk (KIAS)

Session Classification: KEK-PH + KEK-Cosmo DM

Contribution ID: 32

Type: **not specified**

A model of electroweakly interacting non-abelian vector dark matter

Tuesday, 13 October 2020 13:20 (20 minutes)

Presenter: MATSUSHITA, Kohei (Nagoya University)

Session Classification: KEK-PH + KEK-Cosmo DM

Contribution ID: 33

Type: **not specified**

Pseudo-Nambu-Goldstone dark matter from gauged $U(1)_{B-L}$ symmetry

Tuesday, 13 October 2020 13:40 (20 minutes)

Presenter: ABE, Yoshihiko (Kyoto University)

Session Classification: KEK-PH + KEK-Cosmo DM

Contribution ID: 34

Type: **not specified**

Unification for Darkly Charged Dark Matter

Tuesday, 13 October 2020 14:00 (20 minutes)

Presenter: YAMADA, Masaki (Tohoku University)

Session Classification: KEK-PH + KEK-Cosmo DM

Contribution ID: 35

Type: **not specified**

Indirect Search for Secluded Dark Matter with Neutrinos

Tuesday, 13 October 2020 14:50 (20 minutes)

Presenter: ASAI, Kento (University of Tokyo)

Session Classification: KEK-PH + KEK-Cosmo DM

Contribution ID: 36

Type: **not specified**

Dependence of accessible dark matter annihilation cross-sections on the density profiles of dwarf spheroidal galaxies with the CTA

Tuesday, 13 October 2020 15:10 (20 minutes)

Presenter: HIROSHIMA, Nagisa (University of Toyama)

Session Classification: KEK-PH + KEK-Cosmo DM

Contribution ID: 37

Type: **not specified**

Non-spherical dark halo structures and J-factor mapping for the Galactic dwarf spheroidals

Tuesday, 13 October 2020 15:30 (20 minutes)

Presenter: HAYASHI, Kohei (Tohoku University)

Session Classification: KEK-PH + KEK-Cosmo DM

Contribution ID: **38**

Type: **not specified**

Primordial Black Hole Dark Matter

Tuesday, 13 October 2020 15:50 (20 minutes)

Presenter: KOHRI, Kazunori (KEK)

Session Classification: KEK-PH + KEK-Cosmo DM

Contribution ID: 39

Type: **not specified**

Novel approaches to ultra-low-mass dark matter detection

Tuesday, 13 October 2020 16:40 (20 minutes)

Presenter: STADNIK, Yevgeny (Kavli IPMU)

Session Classification: KEK-PH + KEK-Cosmo DM

Contribution ID: 40

Type: **not specified**

Stability of Axion Dark Matter-Photon Conversion

Tuesday, 13 October 2020 17:00 (20 minutes)

Presenter: MASAKI, Emi (Kobe University)

Session Classification: KEK-PH + KEK-Cosmo DM

Contribution ID: 41

Type: **not specified**

Axion Supernova-scope

Tuesday, 13 October 2020 17:20 (20 minutes)

Presenter: NAGATA, Natsumi (University of Tokyo)

Session Classification: KEK-PH + KEK-Cosmo DM

Contribution ID: 42

Type: **not specified**

Gravitational waves from phase transitions at the electroweak scale

Wednesday, 4 November 2020 16:00 (1 hour)

In extensions of the Standard Model of particle physics, this could have been a first order phase transition, at about 10 picoseconds after the Big Bang. I will discuss the dynamics of the transition, the characteristic spectrum of gravitational radiation, and the prospects for observing the radiation at the future space-based gravitational wave detector LISA.

Presenter: Prof. HINDMARSH, Mark (Sussex)

Session Classification: KEK-PH + KEK-Cosmo GW

Contribution ID: 43

Type: **not specified**

Gravitational waves from first-order phase transitions: Towards a better prediction

Wednesday, 4 November 2020 17:00 (1 hour)

In the upcoming decades, gravitational waves (GWs) will be an important tool in probing the early Universe and in testing high energy physics. In this lecture I will review GW production in cosmological first-order phase transitions, putting more emphasis on analytic understanding of the process. The structure of the lecture will be:

- Basics of GW production in the early Universe
- GW production in first-order phase transitions: conditions for producing large amount GWs & particle models satisfying these conditions
- Three GW sources in first-order phase transitions: bubble collisions, sound waves, turbulence
- Towards better prediction of the signal: analytic vs. numerical
- Recent hot topic(s)

Presenter: Dr JINNO, Ryusuke (DESY)

Session Classification: KEK-PH + KEK-Cosmo GW

Contribution ID: 44

Type: **not specified**

NANOGrav and primordial black holes

Wednesday, 4 November 2020 13:00 (30 minutes)

Presenter: TERADA, Takahiro (IBS)

Session Classification: KEK-PH + KEK-Cosmo GW

Contribution ID: 45

Type: **not specified**

Testing stochastic gravitational wave signals by PBH microlensing

Wednesday, 4 November 2020 13:40 (30 minutes)

Presenter: SUGIYAMA, Sunao (Kavli IPMU, Tokyo)

Session Classification: KEK-PH + KEK-Cosmo GW

Contribution ID: 46

Type: **not specified**

NANOGrav and first-order phase transition in the early Universe

Wednesday, 4 November 2020 14:20 (30 minutes)

Presenter: YAMADA, Masaki (Tohoku)

Session Classification: KEK-PH + KEK-Cosmo GW

Contribution ID: 47

Type: **not specified**

Future measurements of stochastic gravitational wave background through pulsar timing by SKA

Wednesday, 4 November 2020 15:00 (30 minutes)

Presenter: TAKAHASHI, Keitaro (Kumamoto)

Session Classification: KEK-PH + KEK-Cosmo GW

Contribution ID: 48

Type: **not specified**

An on-shell view of four-dimensional blackholes

Tuesday, 1 December 2020 10:00 (2 hours)

In this lecture, I will introduce massive spinor helicity formalism developed in 1709.04891, and explore the electromagnetic/gravitational interactions of high spin particles. We will define, kinematically, minimal coupling for particles of arbitrary spin. While there are no known elementary particles beyond spin-2, we will demonstrate that these minimal coupling the multiple spin-moments of rotating black holes. This particle like description of black hole dynamics is a reflection of the no hair theorem.

Presenter: Prof. HUANG, Yu-Tin (NTU)

Session Classification: KEK-PH Amplitude

Contribution ID: 49

Type: **not specified**

Introduction to the amplituhedron

Wednesday, 2 December 2020 10:00 (2 hours)

Recent years have revealed a variety of mathematical and physical structures underlying scattering amplitudes, with redefinitions of scattering amplitudes where the usual principles of locality and unitarity are derivative from geometry. The amplituhedron is one of the examples, a purely geometric object which gives scattering amplitudes of planar $N=4$ SYM. All tree-level amplitudes and all-loop integrands correspond to the differential forms with logarithmic singularities on the boundaries of the amplituhedron. In this lecture, I will give a review of scattering amplitudes in planar $N=4$ SYM first. After this, I will explain the definition of the amplituhedron and see how to obtain scattering amplitudes from this geometric object.

Presenter: Dr KOJIMA, Ryota (NTU)

Session Classification: KEK-PH Amplitude

Contribution ID: 51

Type: **not specified**

BSM Physics with Light Particles

Thursday, 4 February 2021 17:00 (1h 30m)

I will discuss the motivations for physics beyond the Standard Model below the Fermi scale, resulting in the existence of feebly interacting long-lived particles. The experimental prospects to search for these particles will be outlined.

Presenter: Prof. SHAPOSHNIKOV, Mikhail (EPFL)

Session Classification: KEK-PH Long-lived particles

Contribution ID: 52

Type: **not specified**

Fixed target experiments using electron and positron beams

Wednesday, 10 February 2021 10:00 (2 hours)

Now that new heavy particles have not been found at the LHC, focusing on light and weakly interacting new particles is one direction to go. Fixed target experiments using accelerators play a part in this. I will explain the basics of the phenomena in fixed target experiments, and how to calculate the number of signal on a target induced by $e^+ e^-$ beams. Trends in some fixed-target experiments will be introduced. I will discuss a few ideas for fixed target experiments at the ILC, and hope

that this talk will encourage people to think about the possibility of experiments other than the collider experiment at the ILC site.

Presenter: SAKAKI, Yasuhito (KEK)

Session Classification: KEK-PH Long-lived particles

Contribution ID: 55

Type: **not specified**

Filling the gap between inclusive and exclusive processes

Wednesday, 24 March 2021 16:30 (1h 30m)

Computation of QCD processes is always hard. The use of lattice QCD is limited to low-lying hadronic (often single-particle) states, so that only exclusive processes can be computed. Perturbation theory, plus operator product expansion, is used for high-energy processes for which the final states are not specified, or summed over all possible states, i.e. inclusive processes. There are annoying cases, where two analyses are mutually contradictory, as seen in the $|V_{cb}|$ and $|V_{ub}|$ determinations. They suggest that there remain some unknown systematic effects in either or both analyses. In this talk I argue that one can construct a theoretical method that can treat both cases in principle, by extending the lattice QCD approach.

Presenter: Prof. HASHIMOTO, Shoji (KEK)

Session Classification: KEK-PH Flavor

Contribution ID: 56

Type: **not specified**

Exclusive $b \rightarrow s \mu \mu$ Processes as Precision Probes of the Standard Model

Tuesday, 30 March 2021 17:00 (1h 30m)

I will provide a review of the theoretical basis of predictions for exclusive $b \rightarrow s \mu \mu$ processes within the Standard Model and beyond. I will then discuss how present phenomenological studies of these decays are carried out, what improvements are forthcoming, and how the results should be interpreted.

Presenter: Dr VAN DYK, Danny (TUM)

Session Classification: KEK-PH Flavor

Contribution ID: 57

Type: **not specified**

Heavy QCD Axion in $b \rightarrow s$ transition

Wednesday, 24 March 2021 13:00 (20 minutes)

Presenter: TOBIOKA, Kohsaku (Florida State University)

Session Classification: KEK-PH Flavor

Contribution ID: 58

Type: **not specified**

Revisiting electroweak radiative corrections to $b \rightarrow sll$ in SMEFT

Wednesday, 24 March 2021 13:20 (20 minutes)

Presenter: UEDA, Daiki (University of Tokyo)

Session Classification: KEK-PH Flavor

Contribution ID: 59

Type: **not specified**

Imprint of SUSY in radiative B meson decays

Wednesday, 24 March 2021 13:40 (20 minutes)

Presenter: HIDAKA, Keisho (Tokyo Gakugei University)

Session Classification: KEK-PH Flavor

Contribution ID: **60**

Type: **not specified**

Lepton flavor violations from soft SUSY breaking terms in modular flavor models

Wednesday, 24 March 2021 14:00 (20 minutes)

Presenter: SHIMOMURA, Takashi (Miyazaki University)

Session Classification: KEK-PH Flavor

Contribution ID: 61

Type: **not specified**

Probing $\mu e \gamma \gamma$ contact interactions with $\mu \rightarrow e$ conversion

Wednesday, 24 March 2021 14:50 (20 minutes)

Presenter: YAMANAKA, Masato (Osaka City University)

Session Classification: KEK-PH Flavor

Contribution ID: 62

Type: **not specified**

Time evolution of Lepton family Number carried by Majorana Neutrinos

Wednesday, 24 March 2021 15:10 (20 minutes)

Presenter: MOROZUMI, Takuya (Hiroshima University)

Session Classification: KEK-PH Flavor

Contribution ID: 63

Type: **not specified**

Quark-hadron duality for charm mixing in the 't Hooft model

Wednesday, 24 March 2021 15:30 (20 minutes)

Presenter: UMEEDA, Hiroyuki (Academia Sinica))

Session Classification: KEK-PH Flavor