23rd Conference on Flavor Physics and CP Violation (FPCP 2025)

Monday 2 June 2025 - Friday 6 June 2025

Book of Abstracts

Contents

Opening talk . . . 1

Summary talk . . . 1

Review of Neutrino Physics . . . 1

Lattice Results . . . 1

Kaon theory . . . 1

QM Entanglement . . . 1

Rare kaon decays . . . 1

Experiment and prospects for EDMs . . . 2

Theory of penguins and radiative decays . . . 2

B spectroscopy . . . 2

Theory Overview . . . 2

Semileptonic and radiative decays . . . 2

Charm spectroscopy and exotics . . . 2

Theory Overview . . . 2

Axion searches . . . 2

Time-dependent CP violation in B decays . . . 3

Semileptonic B decays, determination of Vcb and Vub . . . 3

Direct CP violation in charm decays . . . 3

Dark sector physics – experimental searches . . . 3

Tau lepton decays . . . 3

Belle II upgrade . . . 3

Charned baryons . . . 4

CPV in K\to\mu\mu . . . 4

Tripartite entanglement in B decays . . . 4

Modelling Quark-Hadron Duality Violation in Inclusive $B \to X_c \ell \bar{\nu}$ . . . 4

Charged Lepton Flavour Violating Meson Decays in Seesaw Models . . . 5

Heavy Quark Theory . . . 5

Interface of Lattice and Continuum . . . 5

High-pT Theory . . . 5

Results and Prospects from Short-Baseline Reactors and Accelerators . . . 6

Neutrinoless double beta decay and neutrino masses . . . 6

Probing quantum decoherence using data from B meson decays . . . 6

Search for dark sector at BESIII . . . 6

Search for rare decays with charm data at BESIII . . . 7

g-2 theory updates . . . 7

Mass spectrum of ground state heavy-light mesons in relativistic independent quark model . . . 7

The Mu2e Experiment . . . 7

Heavy-flavour results from ATLAS experiment . . . 8

LFU and LUV in semileptonic B decays . . . 8

Electroweak penguin and radiative B decays . . . 8

LHCb upgrade . . . 9

Analysis of Lambda_b to Lambda(*) nu nu decays in light of recent Belle-II B+-> K+ nu nu data . . . 9

The role of nonperturbative dynamics in D-meson mixing . . . 9

Measurements of lepton-flavour universality in semileptonic B decay at Belle II . . . 9

Measurements of electroweak penguin and lepton-flavour violating B decays to final states with missing energy at Belle and Belle II . . . 10

Measurements of hadronic B decay rates at Belle and Belle II . . . 10

Rare and baryonic decays of charmed hadrons at Belle and Belle II . . . 10

Studies of hadron spectroscopy at Belle and Belle II . . . 11

Direct CP violation in B decays . . . 11

BSM physics probes at future neutrino facilities . . . 11

g-2 FNAL experiment . . . 11

PSI MEGII experiment 12

1

Opening talk

Corresponding Author: svjetlana.fajfer@ijs.si

2

Summary talk

Corresponding Author: libby@iitm.ac.in

Neutrino / **3**

Review of Neutrino Physics

B meson decays / **4**

Lattice Results

Kaon physics / **5**

Kaon theory

Corresponding Author: emmanuel.stamou@tu-dortmund.de

high-pT / **6**

QM Entanglement

Corresponding Author: juan.antonio.aguilar.saavedra@cern.ch

Kaon physics / **7**

Rare kaon decays

Corresponding Author: radoslav.marchevski@epfl.ch

CP violation, EDMs / **8**

Experiment and prospects for EDMs

Rare decays / **10**

Theory of penguins and radiative decays

Corresponding Author: waltmann@ucsc.edu

B spectroscopy / **11**

B spectroscopy

Corresponding Author: roman.miziuk@gmail.com

Charm / **12**

Theory Overview

Corresponding Author: apetrov@sc.edu

Charm / **13**

Semileptonic and radiative decays

Corresponding Author: weimin.song@cern.ch

Charm / **14**

Charm spectroscopy and exotics

Corresponding Author: remitche@indiana.edu

CP violation, EDMs / **15**

Theory Overview

Corresponding Author: aritz@uvic.ca

Dark sector / **16**

Axion searches

Corresponding Author: rplestid@caltech.edu

B meson decays / **17**

Time-dependent CP violation in B decays

Corresponding Author: tadeas.bilka@cern.ch

B meson decays / **18**

Semileptonic B decays, determination of Vcb and Vub

Corresponding Author: renu92garg@gmail.com

Charm / **19**

Direct CP violation in charm decays

Corresponding Author: yjin1@bnl.gov

Dark sector / **20**

Dark sector physics – experimental searches

Corresponding Author: roberta.volpe@pg.infn.it

Charged leptons / **21**

Tau lepton decays

Corresponding Author: fabian.becherer@desy.de

Future facilities / **22**

Belle II upgrade

Corresponding Author: cketter@hawaii.edu

Charm / 23

Charned baryons

Corresponding Author: gmezzadr@fe.infn.it

24

CPV in K\to\mu\mu

Author: Avital Dery[None]

Corresponding Author: avital.dery@cern.ch

I will discuss the possibility to extract short-distance parameters from the integrated CP asymmetry in $K \to \mu^+\mu^-$, the interplay between $A_{\rm CP}(K \to \mu^+\mu^-)$ and other observables, and the prospects for measurement within an LHCb-like setup as a case study.

25

Tripartite entanglement in B decays

Author: Juan Antonio Aguilar Saavedra[1]

[1] *Consejo Superior de Investigaciones Científicas (ES)*

Corresponding Author: juan.antonio.aguilar.saavedra@cern.ch

The tripartite entanglement between two spins and orbital angular momentum (OAM) has been previously discussed for Higgs decays into two vector bosons in 2403.13942. For B decays into two spin-one particles it is basically the same situation, though I never published it. I want to highlight the possibility of such measurements, using the data already published by experiments to calculate the value of entanglement markers. Thereby, experiments may be motivated to do it properly. Entanglement measurements involving OAM are quite rare, and never done yet in high-energy physics.

26

Modelling Quark-Hadron Duality Violation in Inclusive $B \to X_c \ell \bar{\nu}$

Authors: Ilija Sibin Milutin[None]; Keri Vos[1]; Rens Verkade[None]; Thomas Mannel[2]

[1] *Nikhef National institute for subatomic physics (NL)*

[2] *Siegen U*

Corresponding Authors: rverkade@nikhef.nl, ilija.milutin@gmail.com, keri.vos@cern.ch, mannel@hep.physik.uni-siegen.de

The Heavy Quark Expansion (HQE) is the main tool for calculating decay rates and kinematic moments of inclusive semi-leptonic B meson decays. The HQE manifests as an Operator Product Expansion (OPE) in terms of powers of the inverse heavy bottom quark mass ($1/m_b$). Using the HQE, the CKM matrix element V_{cb} has been extracted at percent-level precision from moments of inclusive $B \to X_c \ell \bar{\nu}$ decays. The calculations upon which the theoretical estimates rely are done in terms

of quarks and gluons, which are not accessible for experiments. Quark Hadron Duality (QHD) allows for a translation of theoretical predictions at the quark-level to experimental observables at the hadron-level. Due to the increased accuracy in HQE predictions up to $\mathcal{O}(1/m_b^5)$, violation of the QHD may start to become a relevant limit to the achievable precision. When QHD is violated, the OPE stops being a valid expansion. In my talk, I will show how we can derive a model for the Quark Hadron Duality Violation and how it can enter different kinematic moments of the $B \to X_c \ell \bar{\nu}$ decays and consequently affect the inclusive determination of V_{cb}.

28

Charged Lepton Flavour Violating Meson Decays in Seesaw Models

Authors: Jai More[1]; Kumar Rao[2]; PURUSHOTTAM SAHU[None]; Sankagiri Umasankar[3]; pravesh awasthi[None]

[1] *INDIAN INSTITUTE OF TECHNOLOGY BOMBAY*

[2] *Indian Institute of Technology, Bombay (IITB)*

[3] *Indian Institute of Technology Bombay (IIT Bombay)*

Corresponding Authors: apravesh2@gmail.com, more.physics@gmail.com, purushottams@iitbhilai.ac.in, uma@phy.iitb.ac.in, kumarrao2013@gmail.com

The occurrence of neutrino oscillations demands the existence of flavour violation in charged lepton sector. The relation between the branching ratios of different
charged lepton flavour violating (CLFV) decay modes depends on the details of the neutrino mass model. In this work, we consider the three types of simple seesaw mechanisms
of neutrino masses and study the correlation between the radiative CLFV decays and the meson CLFV decays. We find that the meson CLFV decay branching ratios are negligibly small in type-II seesaw mechanism whereas they are constrained to be at least three (two) orders of magnitude smaller than the radiative CLFV decay branching ratios in the case of type-I (type-III) seesaw mechanism. Thus the relationship between these two modes of CLFV decays helps in distinguishing between different types of seesaw mechanism. If, the branching ratios of CLFV decays of mesons are larger than those of radiative CLFV decays, it provides a strong hint that the neutrino mass generating mechanism is more complicated than simple seesaw.

B meson decays / **29**

Heavy Quark Theory

Corresponding Author: mannel@hep.physik.uni-siegen.de

Extra session / **30**

Interface of Lattice and Continuum

Corresponding Author: martin.gorbahn@liverpool.ac.uk

High pT / **32**

High-pT Theory

Corresponding Author: haisch@mpp.mpg.de

Neutrino / **33**

Results and Prospects from Short-Baseline Reactors and Accelerators

Neutrino / **34**

Neutrinoless double beta decay and neutrino masses

Corresponding Author: pettus@indiana.edu

35

Probing quantum decoherence using data from B meson decays

Authors: Ashutosh K. Alok[None]; Jitendra Kumar[1]; Neetu Raj Singh Chundawat[2]; Saurabh Rai[None]; Uma Sankar Sankagiri[3]

[1] *IIT Jodhpur*

[2] *Indian Institute of Technology Jodhpur*

[3] *IIT Bombay*

Corresponding Authors: uma@phy.iitb.ac.in, chundawat.1@iitj.ac.in, akalok@iitj.ac.in, saurabhrai@iitj.ac.in, jkumar@iitj.ac.in

The time evolution of neutral B mesons plays a fundamental role in determining key parameters of flavor physics. While their behavior is typically analyzed under the assumption of perfect quantum coherence, interactions with the surrounding environment can induce $decoherence$. Such environmental effects on neutral meson systems can be effectively described within the framework of open quantum systems. Decoherence can obscure the precise extraction of crucial parameters, such as the oscillation frequency Δm and the CP-violating parameter $\sin 2\beta$.

Using the available experimental data, we present the first combined analysis of mixing asymmetry and CP-asymmetry measurements for B_d mesons, demonstrating that decoherence parameter λ_d is nonzero with a significance of approximately 6 σ. Furthermore, we establish the first experimental constraints on the decoherence parameter λ_s for B_s mesons, confirming its nonzero value at a significance level of 3 σ.

36

Search for dark sector at BESIII

Author: Fabrizio Bianchi[None]

Corresponding Author: fabrizio.bianchi@to.infn.it

The BESIII experiment is a symmetric e^+e^- collider operating at c.m. energy from 2.0 to 4.95 GeV. With the world's largest threshold production data set of J/Ψ (10 billion), $\Psi(3686)$ (2.6 billion), and $20fb^{-1}$ of D meson pairs from $\Psi(3770)$ decay, we are able to search for various dark sectors produced in e^+e^- annihilation and meson decay processes. In this talk, we report the search for K^0_s invisible decay and $\Sigma \to p + invisible$, search for Axion-like particle with J/Ψ data, search for Z' invisible decay via $J/\Psi \to \mu^+\mu^- X$ and search for massless dark photon through the charm FCNC process $D^0 \to$ ' and D^0'.

37

Search for rare decays with charm data at BESIII

Author: Fabrizio Bianchi[None]

Corresponding Author: fabrizio.bianchi@to.infn.it

The BESIII experiment has collected 2.6 billion of $\Psi(3686)$ events, 10 billion of J/Ψ events, 20 fb^-1 of D meson pairs at 3.773 GeV, and 7.33 fb^-1 $D_sD_s^*$ events from 4.128 to 4.226 GeV. The huge data samples allow us to search for rare processes in charm hadron decays. In this talk, we report the search for FCNC decay in $D_s^+ \to h(h')e^+e^-$, lepton number violation process $D_s^+ \to h^-h^0e^+e^+$ and $\phi \to \pi^+\pi^+e^-e^-$, and lepton flavor violation process $J/\Psi \to e\mu$ and $J/\Psi \to e\tau$. The search for J/Ψ weak decays containing D meson, $J/\Psi \to D^0\mu^+\mu^-$ and $J/\Psi \to D^0$ will also be presented.

Charged leptons / **38**

g-2 theory updates

Corresponding Author: mattia.bruno@cern.ch

39

Mass spectrum of ground state heavy-light mesons in relativistic independent quark model

Author: Lopamudra Nayak[1]

[1] *NISER Bhubaneswar*

Corresponding Author: lopalmn95@gmail.com

The confining strength or model parameters and constituent quark masses are determined after fitting the ground state masses with experimental data of respective mesons. We analyzed these from the hyperfine splitting of heavy-light and heavy flavored ground state mesons in the framework of relativistic independent quark (RIQ) model with one gluon exchange and centre of mass correction. For the s-wave mesons with spin parity $J^P = 0^-$ and 1^-, the masses obtained are in accordance with the experimental physical masses. The results will serve as good complementary tools in further study of dynamics of the meson and will behave as a foundation for the higher excited and exotic states of hadron.

40

The Mu2e Experiment

Author: Sophie Middleton[1]

[1] *Caltech*

Corresponding Author: smidd@caltech.edu

The Mu2e experiment, based at Fermilab, will search for the coherent, neutrino-less conversion of a negative muon into an electron in the field of an aluminum nucleus, an example of Charged Lepton Flavor Violation (CLFV). Observation of CLFV at Mu2e would be an unambiguous signal of physics beyond the Standard Model (BSM). Mu2e aims to improve upon the previous upper limit by four orders of magnitude and reach an unprecedented single event sensitivity of 3×10^{-17} on the conversion rate. Mu2e is sensitive to a wide range of BSM models and will indirectly probe effective mass scales up to 10^4 TeV/c^2. To achieve its design goal, Mu2e will utilize an integrated system of solenoids to create an intense muon beam. The background will be kept at a sub-event level through careful detector design choices. The experiment is approaching a very important and exciting stage in its life cycle. Construction is almost complete. Commissioning is beginning and physics data-taking is scheduled for 2027. This talk will explore the theoretical motivations, design, and current status of the Mu2e experiment.

41

Heavy-flavour results from ATLAS experiment

Author: ATLAS Speaker[None]

Co-author: Evelin Meoni [1]

[1] *Universita della Calabria e INFN (IT)*

Corresponding Author: evelin.meoni@cern.ch

This talk will overview the recent results on heavy-flavour hadron production and decays and spectroscopy of heavy-flavour exotic states obtained with Run-2 data. It will cover the most precise measurement of the B^0 meson lifetime, measurement of charmed meson production cross-section, studies of resonant structures in di-charmonium spectrum.

B meson decays / **42**

LFU and LUV in semileptonic B decays

Corresponding Author: manuel.franco.sevilla@cern.ch

Rare decays / **43**

Electroweak penguin and radiative B decays

Corresponding Author: eluned.anne.smith@cern.ch

Future facilities / **44**

LHCb upgrade

Corresponding Author: zehua.xu@cern.ch

45

Analysis of Lambda_b to Lambda(*) nu nu decays in light of recent Belle-II B+-> K+ nu nu data

Authors: Dargi Shameer[1]; Diganta Das[1]; Ria sain[None]

[1] *International Institute of Information Technology, Hyderabad*

Corresponding Authors: diganta.das@iiit.ac.in, ria.sain.2013@gmail.com

The Belle-II experiment has recently reported the first measurement of $B^+ \to K^+ \nu\bar{\nu}$ decay which exceeds the Standard Model prediction by approximately 2.7σ. The deviation may indicate the presence of new physics beyond the Standard Model in the $b \to s\nu\nu$ sector. Under this assumption, we study the hadronic $\Lambda_b \to \Lambda(\to p\pi)$and $\Lambda_b \to \Lambda^*(\to NK)\nu\nu$ decays within both the Standard Model and beyond. We work in a low-energy effective field theory framework with additional light right-handed neutrinos. We calculate the differential branching ratios of these decay modes and explore the implications of the Belle-II results through various observables.

46

The role of nonperturbative dynamics in D-meson mixing

Author: Blaženka Melić[1]

[1] *Rudjer Boskovic Institute*

Corresponding Author: blazenka.melic@irb.hr

The theoretical predictions for the $D - \bar{D}$ mixing parameters fall significantly short of experimental measurements, with discrepancies spanning several orders of magnitude. This divergence is largely attributed to the Glashow–Iliopoulos–Maiani (GIM) mechanism, which suppresses leading-order contributions. However, higher-order corrections and nonperturbative effects have the potential to mitigate this suppression, particularly through flavor SU(3) symmetry breaking. In this work, we explore the long-distance contributions arising from nonlocal QCD condensates, incorporating for the first time the impact of mixed condensates within multiple models. Our results demonstrate an improvement in the predicted values of $D - \bar{D}$ mixing parameters by an order of magnitude, providing insights into the role of nonperturbative QCD dynamics. While the theoretical estimates remain below experimental values, this study represents a crucial step toward bridging the gap between theory and observation, highlighting the importance of nonlocal QCD effects in understanding $D - \bar{D}$ mixing.

47

Measurements of lepton-flavour universality in semileptonic B decay at Belle II

Author: Steven Robertson[1]

[1] *IPP / University of Alberta*

Corresponding Author: steven.robertson@ualberta.ca

The first run of the Belle II experiment collected a 365 fb^{-1} sample of $e^+e^- \to B\bar{B}$ collisions at a centre-of-mass energy corresponding to the $\Upsilon(4S)$ resonance. These data, with low particle multiplicity, constrained initial state kinematics and excellent lepton identification, are an ideal environment to study lepton-flavour universality in semileptonic decays of the B meson.
We present results on the ratios of semitauonic decay rates compared to those to light leptons in both exclusive and inclusive B decay. These include new measurements of the ratios for exclusive $B \to D^{(*)}\ell\nu$ decays $R(D^{(*)})$ in events tagged by a semileptonic B decay.

48

Measurements of electroweak penguin and lepton-flavour violating B decays to final states with missing energy at Belle and Belle II

Author: Steven Robertson[1]

[1] *IPP / University of Alberta*

Corresponding Author: steven.robertson@ualberta.ca

The Belle and Belle II experiments have collected a 1.2 ab^{-1} sample of $e^+e^- \to B\bar{B}$ collisions at a centre-of-mass energy corresponding to the $\Upsilon(4S)$ resonance. These data, with low particle multiplicity and constrained initial state kinematics, are an ideal environment to search for rare electroweak penguin B decays and lepton-flavour-violating B decays to final states with missing energy from neutrinos.
Results from $b \to s\nu\bar{\nu}$ processes and their interpretation are presented. In addition, we present searches for the processes $B \to K^{(*)}\tau^+\tau^-$. Finally, we present our search for the lepton-flavour violating decay $B^0 \to K^{*0}\tau^{\pm}\ell^{\mp}$, where ℓ is an electron or muon, is described.

49

Measurements of hadronic B decay rates at Belle and Belle II

Author: Steven Robertson[1]

[1] *IPP / University of Alberta*

Corresponding Author: steven.robertson@ualberta.ca

The Belle and Belle II experiments have collected a 1.2 ab^{-1} sample of $e^+e^- \to B\bar{B}$ collisions at a centre-of-mass energy corresponding to the $\Upsilon(4S)$. The study of hadronic B decays in these data allow the precise measurement of absolute branching fractions and angular distributions of the decay products. These measurements provide tests of QCD and allow the generation of more realistic simulation samples. We present measurements of the decays $\bar{B}^0 \to D^+\pi^-\pi^0$ and B decays to baryons.

50

Rare and baryonic decays of charmed hadrons at Belle and Belle II

Author: Steven Robertson[1]

[1] *IPP / University of Alberta*

Corresponding Author: steven.robertson@ualberta.ca

The Belle and Belle II experiments have collected a $1.6\ \mathrm{ab}^{-1}$ sample of e^+e^- collision data at centre-of-mass energies near the $\Upsilon(nS)$ resonances. These samples contain a large number of $e^+e^- \to c\bar{c}$ events that produce charmed mesons and baryons. We present searches for rare flavour-changing neutral current processes and measure several radiative decays of the $D_{(s)}$ meson. Further, we study several decays of the Ξ_c baryon to determine branching fractions and decay asymmetries.

51

Studies of hadron spectroscopy at Belle and Belle II

Author: Steven Robertson[1]

[1] *IPP / University of Alberta*

Corresponding Author: steven.robertson@ualberta.ca

The Belle and Belle II experiments have collected a $1.6\ \mathrm{ab}^{-1}$ sample of e^+e^- collision data at centre-of-mass energies near the $\Upsilon(nS)$ resonances. These data include a 19.2 fb^{-1} sample of data collected at centre-of-mass energies near the $\Upsilon(10753)$ resonance. We present several scan results including $e^+e- \to \Upsilon(nS)\eta$. In addition, we present a measurement of the B^0 and B^+ meson mass difference.

B meson decays / **53**

Direct CP violation in B decays

Corresponding Author: marina.artuso@cern.ch

Neutrino / **54**

BSM physics probes at future neutrino facilities

Corresponding Author: shoemaker@vt.edu

Charged leptons / **55**

g-2 FNAL experiment

Corresponding Author: lkg5@cornell.edu

Charged leptons / **56**

PSI MEGII experiment

Corresponding Author: mori@icepp.s.u-tokyo.ac.jp