CLFV2023: The 4th International Conference on Charged Lepton Flavor Violation

Report of Contributions

https://indico.desy.de/e/37920

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

Introduction & Welcome

Tuesday, 20 June 2023 09:00 (15 minutes)

Presenter: SCHOENING, Andre (Phys. Inst. Heidelberg)

Session Classification: Session 1

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

Local Welcome

Tuesday, 20 June 2023 09:15 (15 minutes)

Presenter: UWER, Ulrich (Physikalisches Institut Heidelberg)

Session Classification: Session 1

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

Theory Overview

Tuesday, 20 June 2023 09:30 (1 hour)

Presenter: DAVIDSON, Sacha (University Montpellier 2, LUPM)

Session Classification: Session 1

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

Sensitivity of mu->e processes to tau flavor change

Tuesday, 20 June 2023 11:00 (30 minutes)

Presenter: ARDU, Marco (Montpellier)

Session Classification: Session 2

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

Light new physics at CLFV experiments

Tuesday, 20 June 2023 11:30 (30 minutes)

Presenter: REDIGOLO, Diego (INFN Florence)

Session Classification: Session 2

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

Mu3e

Tuesday, 20 June 2023 13:30 (40 minutes)

Presenter: WAUTERS, Frederik (Johannes Gutenberg University Mainz)

Session Classification: Session 3

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

MEG-II

Tuesday, 20 June 2023 14:10 (40 minutes)

Presenter: GALLI, Luca (INFN Pisa)

Session Classification: Session 3

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

Mu2e

Tuesday, 20 June 2023 15:20 (40 minutes)

Presenter: EDMONDS, Andrew (Boston University)

Session Classification: Session 4

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

COMET

Tuesday, 20 June 2023 16:00 (40 minutes)

Presenter: TANG, Jian (Sun Yat-sen University)

Session Classification: Session 4

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

What can be measured in elastic muon-to-electron conversion?

Tuesday, 20 June 2023 16:40 (30 minutes)

Presenter: HAXTON, Wick (Berkeley)

Session Classification: Session 4

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

Searches for CLFV at ATLAS and CMS

Wednesday, 21 June 2023 09:00 (30 minutes)

Presenter: PEZZULLO, Giani (Yale University)

Session Classification: Session 5

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

Lepton Universality and CLFV at BELLE II

Wednesday, 21 June 2023 09:30 (30 minutes)

Presenter: TENCHINI, Francesco (BELLE (BELLE II Experiment))

Session Classification: Session 5

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

Lepton Universality and CLFV at LHCb

Wednesday, 21 June 2023 10:00 (30 minutes)

Presenter: FRAU, Giulia (Physics Institute, Heidelberg)

Session Classification: Session 5

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

Lepton Universality and CLFV at BES-III and STCF

Wednesday, 21 June 2023 11:00 (30 minutes)

Presenter: XIANG, Teng (Peking University)

Session Classification: Session 6

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

LFV/CLFV at e+e- Colliders

Wednesday, 21 June 2023 11:30 (30 minutes)

Presenter: LUSIANI, Alberto (Scuola Normale Superiore and INFN, sezione di Pisa)

Session Classification: Session 6

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

PIONEER

Wednesday, 21 June 2023 13:30 (30 minutes)

Presenter: VELGHE, Bob (TRIUMF)

Session Classification: Session 7

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

NA62

Wednesday, 21 June 2023 14:00 (30 minutes)

Presenter: SWALLOW, Joel (CERN)

Session Classification: Session 7

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

Status of g-2 HVP Calculation

Wednesday, 21 June 2023 14:30 (30 minutes)

Presenter: LEHNER, Christoph (Uni Regensburg)

Session Classification: Session 7

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

MUonE

Wednesday, 21 June 2023 15:30 (30 minutes)

Presenter: HAHN, Kristian (Northwestern University)

Session Classification: Session 8

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

FNAL g-2

Wednesday, 21 June 2023 16:00 (30 minutes)

Presenter: REIMANN, René (Johannes Gutenberg University, Mainz)

Session Classification: Session 8

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

JPARC g-2

Wednesday, 21 June 2023 16:30 (30 minutes)

Presenter: Dr OGAWA, Shinji (Kyushu University)

Session Classification: Session 8

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

Lepton colliders, CLFV and New Physics

Thursday, 22 June 2023 09:00 (30 minutes)

Presenter: DEV, Bhupal (Washington University in St. Louis)

Session Classification: Session 9

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

Muonium-Antimuonium Conversion (Theory)

Thursday, 22 June 2023 09:30 (30 minutes)

Presenter: UESAKA, Yuichi (Kyushu Sangyo University)

Session Classification: Session 9

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

Experimental Prospects for Fundamental Physics with Muonium

Thursday, 22 June 2023 10:00 (30 minutes)

Presenter: ZHAO, Shihan (Sun Yat-sen University)

Session Classification: Session 9

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

Muon-Ion Collider

Thursday, 22 June 2023 11:00 (30 minutes)

Presenter: ZUO, Xunwu (Karlsruhe (KIT))

Session Classification: Session 10

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

Experimental Limiting Factors in the Search for mu-> e gamma

Thursday, 22 June 2023 11:30 (30 minutes)

Presenter: RENGA, Francesco (INFN Roma)

Session Classification: Session 10

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

Mu2e-II

Thursday, 22 June 2023 12:00 (30 minutes)

Presenter: MÜLLER, Stefan (Dresden-Rossendorf (HZDR))

Session Classification: Session 10

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

Synergies with Muon Collider

Thursday, 22 June 2023 13:30 (30 minutes)

Presenter: FOL, Elena (CERN)

Session Classification: Session 11

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

HiMB

Thursday, 22 June 2023 14:00 (30 minutes)

Presenter: PAPA, Angela (INFN/PSI)

Session Classification: Session 11

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

Future Accelerator Upgrades and Muons at FNAL

Thursday, 22 June 2023 14:30 (30 minutes)

Presenter: LYNCH, Kevin (Fermi National Accelerator Laboratory)

Session Classification: Session 11

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

Conclusions

Thursday, 22 June 2023 16:00 (40 minutes)

Presenter: ECHENARD, Bertrand (Caltech)

Session Classification: Session 12

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

Adjourn

Thursday, 22 June 2023 16:40 (20 minutes)

Session Classification: Session 12

Contribution ID: **33** Type: **not specified**

High-precision muon decay predictions for cLFV experiments

The search for charged Lepton Flavour Violation (cLFV) in muon decay is a sensitive probe to test the Standard Model at the intensity frontier. The MEG II and Mu3e experiments at the Paul Scherrer Institut (PSI) are respectively designed to detect $\mu \to e\gamma$ and $\mu \to eee$ with an unprecedented accuracy. In addition, both experiments are sensitive to cLFV decays of a muon into an invisible axion-like particle X, which is assumed to escape undetected. A viable channel is the two-body decay $\mu \to eX$, whose signature is a monochromatic signal close to kinematic endpoint of the $\mu \to e\nu\bar{\nu}$ background. Another possible process for MEG II is the radiative decay $\mu \to eX\gamma$. The hunt for such elusive signals requires extremely accurate theoretical predictions for simulation and data analysis.

In this poster, a new state-of-the-art computation of $\mu \to eX(\gamma)$ and $\mu \to e\nu\bar{\nu}(\gamma\gamma)$ is presented. Both decays have been implemented in McMule, a novel Monte Carlo framework for the evaluation of higher-order radiative corrections for low-energy processes with leptons. In addition to taking into account all polarisation and mass effects, the signal $\mu \to eX(\gamma)$ includes next-to-leading order corrections, while the background $\mu \to e\nu\bar{\nu}(\gamma\gamma)$ includes next-to-next-to-leading order corrections and logarithmically enhanced terms at even higher orders. The impact of the results on the sensitivity of MEG II and Mu3e on the branching ratio of $\mu \to eX$ is also discussed.

Main reference: arXiv:2211.01040

Primary author: GURGONE, Andrea (University & INFN Pavia)

Presenter: GURGONE, Andrea (University & INFN Pavia)

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

A Comparative Study of Z′ mediated Charged Lepton Flavor Violation at future lepton colliders

Charged lepton flavor violation (CLFV) represents a transition between charged leptons of different generations that violates lepton flavor conservation, which is a clear signature of possible new physics beyond the standard model. By exploiting a typical example model of extra Z′ gauge boson, we perform a detailed comparative study on CLFV searches at several future lepton colliders, including a 240 GeV electron-positron collider and a TeV scale muon collider. Based on detailed signal and background Monte-Carlo studies with fast detector simulations, we derive the potentials in searching for Z′ mediated CLFV couplings with $e\mu$, $e\tau$ and $\mu\tau$ of different future colliders. The results are compared with the current and prospect limits set by either low-energy experiments or the high-energy LHC experiments. The sensitivity of the τ related CLFV coupling strength at future lepton colliders will be significantly improved in comparison to the current best constraints and the prospect constraints for the $\mu\tau$ channel.

Primary author: LI, Jingshu (Sun Yat-sen University)

Presenter: LI, Jingshu (Sun Yat-sen University)

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

Advanced Muon Facility at FNAL

Thursday, 22 June 2023 15:00 (30 minutes)

Presenter: HITLIN, David (Caltech)

Session Classification: Session 11

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

LEPTON FLAVOR VIOLATION SEARCHES IN B DECAYS AT LHCb

According to the Standard Model (SM), the lepton flavour is conserved in electroweak transitions, meaning that the different flavors of leptons do not mix or transform into each other. Observation of Lepton-Flavour Violating (LFV) processes would be a clear signal of physics beyond the Standard Model. This poster discusses recent results on charged LFV searches with b-hadron decays at the LHCb experiment.

Primary author: FULGHESU, Tommaso (LPNHE - Centre National de la Recherche Scientifique (FR))

Presenter: FULGHESU, Tommaso (LPNHE - Centre National de la Recherche Scientifique (FR))

Contribution ID: **39** Type: **not specified**

The Camera Alignment System for the Mu3e Experiment

The Mu3e experiment under construction at the Paul Scherrer Institute, Switzerland, aims to search for the lepton flavour violating decay of a muon into one electron and two positrons with an ultimate sensitivity of one in 10^{16} muon decays. The Mu3e detector consists of High-Voltage Monolithic Active Pixel Sensors (HV-MAPS) for an accurate track and vertex reconstruction complemented with scintillating tiles and fibres for precise timing measurements. The individual subdetector systems are placed in the 1m diameter bore of a 1T superconducting magnet.
In order to achieve the high sensitivity goal, special attention must be paid to the exact alignment of the detector elements. Misalignment may occur not only due to the construction or integration of the different detector parts but may also be caused by environmental influences during the operation of the experiment. To reduce the effects of misalignment and to achieve the best possible momentum resolution, a track-based alignment program is used. With the help of this tool, however, certain deformations of the detector that produce the same track quality, the so-called weak modes, cannot be resolved.
To compensate for this, an optical system based on 18 camera modules is also being developed. In combination with high contrast optical fiducials, the cameras determine their positions among each other and to the different detector elements. At the moment several combinations of camera settings and different fiducials are being tested in order to achieve a sufficient precision to fulfil the experimental objectives.

Primary author: GAGNEUR, Sophie (Johannes Gutenberg-Universität Mainz)

Presenter: GAGNEUR, Sophie (Johannes Gutenberg-Universität Mainz)

Contribution ID: **40** Type: **not specified**

Leptonic CPV phases: impact for Higgs & Z decays and CP-asymmetries

Heavy neutral leptons are well motivated SM extensions and their presence induces modifications in the lepton mixing matrix, including new Dirac and Majorana CP violating phases.
In this presentation we discuss the role of the heavy neutral fermions and the new CP violating phases in Higgs and Z-boson lepton flavour violating decays.
We further study the associated decay CP asymmetries. Among the many interesting phenomenological implications it is worth noticing that the $Z \to \mu\tau$ decay rates are within reach of FCC-ee, with associated CP asymmetries that can potentially reach up to 20% –30%.

Primary author: PINSARD, Emanuelle (Clermont)

Presenter: PINSARD, Emanuelle (Clermont)

Contribution ID: **41** Type: **not specified**

The Mu3e pixel detector

The Mu3e experiment searches for the lepton flavor violating decay $^{+}\to e^{+}e^{-}e^{+}$ with an ultimate aimed sensitivity of 1 event in 10^{16} decays.
For this goal a very high momentum resolution is required.
This goal can only be achieved by reducing the material budget per tracking layer to $X/X_0 \approx 0.1\,\%$ and by using gaseous helium as coolant, a novelty for particle detectors.
The pixel detector is based on High-Voltage Monolithic Active Pixel Sensors (HV-MAPS) which are thinned down to a thickness of $50\,\mu$m.

This poster offers an overview of the Mu3e pixel detector, encompassing the vertex detector, the outer tracking layers, and the gaseous helium cooling system.
Additionally, it outlines the upcoming production of the pixel detector, including the quality control measures for the chips and modules.

Primary author: RUDZKI, Thomas Theodor (Physikalisches Institut Heidelberg)

Presenter: RUDZKI, Thomas Theodor (Physikalisches Institut Heidelberg)

Contribution ID: **42** Type: **not specified**

The (Z,A) dependence of muon-to-electron conversion

Should muon-to-electron conversion in the field of a nucleus be found in the current generation of experiments, the measurement of the atomic number dependence of the process will become an important experimental goal. We present a new treatment of the (Z,A) dependence of muon-to-electron conversion. Our approach differs from earlier work in that it combines nuclear charge distribution determinations from both electron scattering and muonic atoms, takes into account the effect of permanent quadrupole deformations, and employs a Hartree-Bogoliubov model for the neutron distributions. The results are compared with earlier calculations.

Primary authors: HITLIN, David (Caltech); BORREL, Leo (California Institute of Technology)

Co-author: Dr MIDDLETON, Sophie (California Institute of Technology)

Presenter: HITLIN, David (Caltech)

Contribution ID: **43** Type: **not specified**

A data-driven method for antiproton background measurement in Mu2e

The Mu2e experiment will search for the CLFV process of neutrinoless, coherent conversion of muon to electron in the field of an Al nucleus. The experimental signature is a monochromatic conversion electron (CE) with energy $E_{CE} = 104.97$ MeV. CE-like e^-s could also come from processes like Decay in Orbit of muons stopped in the Stopping Target (ST), cosmic muons interacting or decaying within the detector or antiprotons ($\overline{p}$) produced by the proton beam at the Production Target and annihilating in the ST. The background expected from $\overline{p}$s is very low but highly uncertain. It cannot be efficiently suppressed by the time window cut used to reduce the prompt background because the $\overline{p}$s are significantly slower than the other beam particles. We are developing a data-driven approach to constrain the $\overline{p}$ background. We plan to exploit another final state of $p\overline{p}$ annihilation in the ST, with a much larger Branching Ratio to constrain the background by comparison. $p\overline{p}$ annihilation can give multi-track final state with momentum of $\sim$ 100 MeV/c for each track at a much higher rate than signal like e^-. The idea is to identify and reconstruct these multi-track events and estimate the $\overline{p}$ background by comparison. The Mu2e detector and the default event reconstruction procedure are designed for efficient single track event reconstruction. The topology of a multi track event is very different from a CE event. We are creating new, holistic algorithms to reconstruct single as well as multi-track events. The poster will present the status and discuss the prospects of this novel proto analysis of the antiproton background in Mu2e.

Primary author: CHITHIRASREEMADAM, Namitha (University of Pisa)

Co-authors: Dr MARIA RICCI, Alessandro (University of Pisa); PEZZULLO, Giani (Yale University); Ms NIGRELLI, Giulia (University of Pisa); Mr KITAGAWA, Hussain (University of Pisa); STORTINI, Matthew (Yale University); Dr MURAT, Pavel (Fermilab); DONATI, Simone (University of Pisa)

Presenter: CHITHIRASREEMADAM, Namitha (University of Pisa)

Contribution ID: **44** Type: **not specified**

A study to suppress a sneaking cosmic muon background in the COMET experiment

The COMET experiment aims to search for muon-to-electron conversion with an unprecendetedly high sensitivity. One of the severest backgrounds in the Phase-I experiment is originated from cosmic muons. In particular, part of the rear side of a detector solenoid magnet is difficult to be covered by veto counters. Cosmic muons sneak into the solenoid from the loophole, scattered and leaving a track in a cylindrical drift chamber. Among them, a positive muon track with reverse direction may mimic a signal electron with 105 MeV/c. In order to suppress the sneaking cosmic positive muon background, we developed a method to discriminate the track direction by using track fitting quality based on the GENFIT framework. We demonstrated that the positive muon background can be reduced by an order of magnitude. In this presentation, we will report the idea, demonstration, preliminary results, and prospects of further improvement.

Primary author: MORITSU, Manabu (Kyushu University)

Presenter: MORITSU, Manabu (Kyushu University)

Contribution ID: **45** Type: **not specified**

Developing Novel Track Reconstruction Algorithms for the Mu2e Experiment

The Mu2e experiment plans to search for neutrinoless muon to electron conversion in the field of a nucleus. Such a process violates lepton flavor conservation. To perform this search, a muon beam is focused on an aluminum target, the muons are stopped in the field of the aluminum nucleus, and electrons emitted from subsequent muon decays in orbit are measured. The endpoint energy for this process is 104.97 MeV; an excess of measured electrons at this energy signifies neutrinoless muon to electron conversion has occurred. Currently under construction at the Fermilab Muon Campus, Mu2e will stop 10^{18} muons on target in 3 years of running, with the goal of reaching a single event sensitivity of 3×10^{-17} on the branching ratio. In order to reach such a sensitivity, one must write software that efficiently reconstructs the tracks of conversion electrons that pass through the Mu2e tracker. This has been achieved by breaking the reconstruction process down into four successive steps: hit reconstruction, time clustering, helix finding, and a final track fitting. One shortcoming of the current code is that the time clustering and helix finding stages make various assumptions that make them highly tuned to conversion electrons at the endpoint energy. This limits the collaboration's ability to constrain some backgrounds, and search for a larger range of physics. The work presented here details an ongoing project to develop novel time clustering and helix finding algorithms that increase the acceptance of other physics processes.

Primary author: STORTINI, Matthew (Yale University)

Co-authors: Mr PEZZULLO, Giani (Yale University); Mr MURAT, Pavel (FNAL); DEMERS, Sarah (Yale University)

Presenter: STORTINI, Matthew (Yale University)

Contribution ID: **46** Type: **not specified**

A silicon pixel detector prototype for μSR

Muon spin rotation (μSR) is a powerful technique for studying the magnetic and superconducting properties of materials by utilizing positive muons as highly sensitive local magnetic probes. Traditional μSR experiments use scintillators as detectors, which limit sensitivity to subtle magnetic dynamics due to pile-up issues.
Employing silicon pixel sensors with superior spatial and temporal resolution enables precise tracking of muon stopping positions and clear identification of decay positrons through vertex reconstruction. This integration not only allows for much higher muon beam rates but also facilitates smaller sample sizes, longer data gate lengths, and broader depth penetration, thereby opening up new possibilities for exploring novel research directions and subtle effects in magnetic and superconducting systems.

High-Voltage Monolithic Active Pixel Sensors (HV-MAPS), originally designed with an extremely low material budget for low-energy electron tracking in the Mu3e experiment, are well-suited for μSR measurements. To showcase the potential of this technology, a prototype telescope equipped with four layers, each comprising 2x2 MuPix11 sensors, is currently under development, aiming to demonstrate the practical application of silicon pixel sensors in μSR experiments.

Primary author: MANDOK, Lukas (Physikalisches Institut Universität Heidelberg)

Co-author: RUDZKI, Thomas Theodor (Physikalisches Institut Heidelberg)

Presenter: MANDOK, Lukas (Physikalisches Institut Universität Heidelberg)

Contribution ID: **47** Type: **not specified**

MuPix11 - The Mu3e Pixel Track Chip

Presenter: IMMIG, David Maximilian (Physikalisches Institut Universität Heidelberg)

Contribution ID: **48** Type: **not specified**

Route to Conference Dinner

Wednesday, 21 June 2023 18:00 (1 hour)