

# **New Frontiers in Lepton Flavor**

## **Report dei Contributi**

ID contributo: 1

Tipo: **non specificato**

## Lepton Flavor Violation at LHCb

*mercoledì 17 maggio 2023 11:20 (35 minuti)*

**Autore principale:** MOMBÄCHER, Titus (Technische Universitaet Dortmund (DE))

**Relatore:** MOMBÄCHER, Titus (Technische Universitaet Dortmund (DE))

**Classifica Sessioni:** Plenary

ID contributo: 2

Tipo: **non specificato**

## **Belle II status and prospects for studies of tau decays**

*mercoledì 17 maggio 2023 10:10 (35 minuti)*

**Autore principale:** ZANI, Laura (Istituto Nazionale di Fisica Nucleare)

**Relatore:** ZANI, Laura (Istituto Nazionale di Fisica Nucleare)

**Classifica Sessioni:** Plenary

ID contributo: 4

Tipo: **non specificato**

## Welcome and Introduction

*lunedì 15 maggio 2023 09:00 (15 minuti)*

**Classifica Sessioni:** Plenary

ID contributo: 5

Tipo: **non specificato**

## Theory - Charged Currents

*lunedì 15 maggio 2023 09:15 (35 minuti)*

**Relatore:** BORDONE, Marzia (CERN)

**Classifica Sessioni:** Plenary

ID contributo: 6

Tipo: **non specificato**

## LFU tests in $b \rightarrow c \ell \nu$ decays at LHCb

*lunedì 15 maggio 2023 09:50 (35 minuti)*

**Relatore:** MOHAMMED, Rizwaan (University of Oxford)

**Classifica Sessioni:** Plenary

ID contributo: 7

Tipo: **non specificato**

## **Belle II status and prospects for studies of charged currents**

*lunedì 15 maggio 2023 10:25 (35 minuti)*

**Relatore:** DEY, Sourav

**Classifica Sessioni:** Plenary

ID contributo: 8

Tipo: **non specificato**

## Physics Beyond the Standard Model with NA62

*lunedì 15 maggio 2023 12:05 (35 minuti)*

The NA62 experiment at CERN took data in 2016–2018 with the main goal of measuring the  $K^+ \rightarrow \pi^+ \nu \bar{\nu}$  decay. The NA62 dataset is also exploited to search for light feebly interacting particles produced in kaon decays. Searches for  $K^+ \rightarrow e^+ N$ ,  $K^+ \rightarrow \mu^+ N$  and  $K^+ \rightarrow \mu^+ \nu X$  decays, where  $N$  and  $X$  are massive invisible particles, are performed by NA62. The  $N$  particle is assumed to be a heavy neutral lepton, and the results are expressed as upper limits of  $O(10^{-8})$  of the neutrino mixing parameter  $|U_{\mu 4}|^2$ . The  $X$  particle is considered a scalar or vector hidden sector mediator decaying to an invisible final state. Upper limits of the decay branching fraction for  $X$  masses in the range 10–370 MeV/ $c^2$  are reported. An improved upper limit of  $1.0 \times 10^{-6}$  is established at 90% CL on the  $K^+ \rightarrow \mu^+ \nu \nu$  branching fraction. Dedicated trigger lines were employed to collect di-lepton final states, which allowed establishing stringent upper limits on the rates lepton flavor and lepton number violating kaon decays. Upper limits on the rates of several  $K^+$  decays violating lepton flavour and lepton number conservation, obtained by analysing this dataset, are presented.

**Relatore:** TINTI, Gemma Maria (Istituto Nazionale di Fisica Nucleare)**Classifica Sessioni:** Plenary



ID contributo: 9

Tipo: **non specificato**

## Rare Decays at ATLAS and CMS

*lunedì 15 maggio 2023 12:40 (35 minuti)*

**Relatore:** VENDITTI, Rosamaria (Istituto Nazionale di Fisica Nucleare)

**Classifica Sessioni:** Plenary

ID contributo: **10**

Tipo: **non specificato**

## **Theory - Neutral Currents**

*lunedì 15 maggio 2023 11:30 (35 minuti)*

**Relatore:** GUADAGNOLI, Diego (CNRS)

**Classifica Sessioni:** Plenary

ID contributo: 11

Tipo: **non specificato**

## Measurement of $b \rightarrow s l+l-$ decays at LHCb

*lunedì 15 maggio 2023 14:45 (35 minuti)*

**Relatore:** QUAGLIANI, Renato (École polytechnique Fédérale de Lausanne)

**Classifica Sessioni:** Plenary

ID contributo: 12

Tipo: **non specificato**

## **Belle II status and prospects for studies of neutral currents**

*lunedì 15 maggio 2023 15:20 (35 minuti)*

**Relatore:** BERTACCHI, Valerio (Aix Marseille Univ, CNRS/IN2P3, CPPM, Marseille, France)

**Classifica Sessioni:** Plenary

ID contributo: 13

Tipo: **non specificato**

## Phenomenology of LFV/LFU in Leptons

*martedì 16 maggio 2023 09:00 (35 minuti)*

**Relatore:** CALIBBI, Lorenzo (Nankai University)

**Classifica Sessioni:** Plenary

ID contributo: 14

Tipo: **non specificato**

## Physics at MEG II

*martedì 16 maggio 2023 09:35 (35 minuti)*

**Autore principale:** CHIAPPINI, Marco (Istituto Nazionale di Fisica Nucleare)

**Relatore:** CHIAPPINI, Marco (Istituto Nazionale di Fisica Nucleare)

**Classifica Sessioni:** Plenary

ID contributo: 15

Tipo: **non specificato**

## Physics at Mu2E

*martedì 16 maggio 2023 10:10 (25 minuti)*

**Autore principale:** MURAT, Pavel (Fermilab)

**Relatore:** MURAT, Pavel (Fermilab)

**Classifica Sessioni:** Plenary

ID contributo: 16

Tipo: **non specificato**

## **g-2: Theory Introduction**

*martedì 16 maggio 2023 14:10 (35 minuti)*

**Autore principale:** STOFFER, Peter (University of Zurich and PSI)

**Relatore:** STOFFER, Peter (University of Zurich and PSI)

**Classifica Sessioni:** Plenary



ID contributo: 17

Tipo: **non specificato**

## **Muon g-2 / MUonE**

*martedì 16 maggio 2023 14:45 (35 minuti)*

**Autore principale:** PRICE, Josep (University of Liverpool)

**Relatore:** PRICE, Josep (University of Liverpool)

**Classifica Sessioni:** Plenary

ID contributo: **19**

Tipo: **non specificato**

## Physics at Mu3E

*martedì 16 maggio 2023 11:30 (35 minuti)*

**Autore principale:** MARTIN PEREZ, Cristina (LLR, Ecole Polytechnique, IN2P3-CNRS)

**Relatore:** MARTIN PEREZ, Cristina (LLR, Ecole Polytechnique, IN2P3-CNRS)

**Classifica Sessioni:** Plenary

ID contributo: **20**

Tipo: **non specificato**

## Theory - High pT Searches

*mercoledì 17 maggio 2023 09:00 (35 minuti)*

**Relatore:** SMOLKOVIC, Aleks (University of Bern)

**Classifica Sessioni:** Plenary

ID contributo: 21

Tipo: **non specificato**

## High Pt Searches at ATLAS and CMS

*mercoledì 17 maggio 2023 09:35 (35 minuti)*

**Autore principale:** BEVAN, Adrian (Queen Mary)

**Relatore:** BEVAN, Adrian (Queen Mary)

**Classifica Sessioni:** Plenary

ID contributo: 23

Tipo: **non specificato**

## **Future Prospects - What Next?**

*mercoledì 17 maggio 2023 11:55 (35 minuti)*

**Autore principale:** ISIDORI, Gino

**Relatore:** ISIDORI, Gino

**Classifica Sessioni:** Plenary

ID contributo: 24

Tipo: **non specificato**

## Discussion and Closing Remarks

*mercoledì 17 maggio 2023 12:30 (45 minuti)*

**Classifica Sessioni:** Plenary

ID contributo: 26

Tipo: **non specificato**

## Search for Charged Lepton Flavor Violation in $J/\psi$ decays at BESIII

*lunedì 15 maggio 2023 17:25 (15 minuti)*

The observation of any CLFV process would be a clear signal of new physics beyond the Standard Model. Various decay modes, including lepton ( $\mu$ ,  $\tau$ ) decays, pseudoscalar meson ( $K$ ,  $\pi$ ) decays, vector meson ( $\phi$ ,  $J/\psi$ ,  $\Upsilon$ ) decays, and Higgs decays, have been explored to detect the violation. This presentation focuses on the search for CLFV at the BESIII experiment, the results of the search for  $J/\psi \rightarrow e\tau/e\mu$  using the 10 billion  $J/\psi$  events collected by the BESIII experiment are presented. The upper limits at the 90% confidence level are  $B(J/\psi \rightarrow e\tau) < 7.5 \times 10^{-8}$  and  $B(J/\psi \rightarrow e\mu) < 4.5 \times 10^{-9}$ , respectively. Improving the previously published limits by two orders of magnitudes, the results are the most stringent CLFV searches in heavy quarkonium systems.

**Autori principali:** LI, Jingshu; Prof. YOU, Zhengyun (Sun Yat-sen University)

**Relatore:** LI, Jingshu

**Classifica Sessioni:** Young Researchers Talks

ID contributo: 28

Tipo: non specificato

## Looking for an axion in a haystack of muons

*martedì 16 maggio 2023 16:25 (15 minuti)*

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

In this contribution, I will present a new state-of-the-art computation of  $\mu \rightarrow eX$  and  $\mu \rightarrow e\nu\bar{\nu}$ . 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  $\mu \rightarrow eX$  includes next-to-leading order corrections, while the background  $\mu \rightarrow e\nu\bar{\nu}$  includes next-to-next-to-leading order corrections and logarithmically enhanced terms at even higher orders. I will also discuss the impact of the results on the sensitivity of MEG II and Mu3e on the branching ratio of  $\mu \rightarrow eX$ .

Main reference: arXiv:2211.01040

**Autore principale:** GURGONE, Andrea (University & INFN Pavia)

**Relatore:** GURGONE, Andrea (University & INFN Pavia)

**Classifica Sessioni:** Young Researchers Talks



ID contributo: 29

Tipo: non specificato

## Digital holographic interferometry method for tracking detector modules displacement

*martedì 16 maggio 2023 17:40 (15 minuti)*

In high energy particle physics scattering experiments, the precision of the reconstructed particle tracks can be fundamental. For this reason, a method for detecting the displacement of tracking detector modules is developed. The modules are silicon planes mounted on a frame and used in the MUonE project, which aims at a precision measurement of the scattering angle of elastic muon-electron scattering. From the scattering angle, the hadronic contribution to the anomalous magnetic moment of the muon is extracted. To achieve the desired accuracy, the position of the tracking detector planes must be continuously monitored. The allowable relative displacements must be less than 10  $\mu\text{m}$ . To meet the specifications and to monitor as large an area of the detector as possible, a digital holographic interferometer was developed. It is based on a novel lens-less design in off-axis holographic geometry. Light from a fiber-coupled laser source is split by a fiber beam splitter, with one output used to illuminate the detector plane and the other for the reference beam. The two beams produce an interference pattern on a CMOS image sensor. To obtain relative displacement information, successive images are superimposed on an initial reference image and reconstructed by solving the Rayleigh-Sommerfeld diffraction integral taking into account the spherical wavefronts of the beams. The interference fringes that appear in the reconstructed holographic image provide a measure of the relative displacement of the detector plane compared to the initial position. The performance of the reconstruction method used was verified with the proposed setup at a real tracking station.

**Autori principali:** ARENA, Aldo (Istituto Nazionale di Fisica Nucleare); CANTATORE, Giovanni (Istituto Nazionale di Fisica Nucleare); KARUZA, Marin (Istituto Nazionale di Fisica Nucleare)

**Relatore:** ARENA, Aldo (Istituto Nazionale di Fisica Nucleare)

**Classifica Sessioni:** Young Researchers Talks

ID contributo: 30

Tipo: non specificato

## Beam Tests of an Entrance Detector for the Muon EDM Experiment

*martedì 16 maggio 2023 16:40 (15 minuti)*

In the Muon EDM experiment in preparation at the Paul Scherrer Institute (PSI), an entrance detector is needed to trigger the storage mechanism if a muon with the right phase space is injected. A first detector prototype consists of a very thin (100  $\mu\text{m}$ ) plastic scintillator to trigger the arrival of a muon, and a long rectangular channel to ensure that the muon follows the desired trajectory for storage. Both the rectangular channel, which consists of four tiles of plastic scintillators, and the thin scintillator are coupled to silicon photomultipliers. We present results of a dedicated beam-time at PSI in December 2022 to study this detector. By equipping the detector with auxiliary scintillators, we measured the efficiency of the thin scintillator and its timing properties with 28 MeV/c muons. Additionally, optical crosstalk in the rectangular channel was studied for two different channel configurations and the possible paths on which muons traverse the detector were identified.

**Autore principale:** STAEGER, David (Paul Scherrer Institute)

**Coautore:** PAPA, Angela (Paul Scherrer Institut); VITALI, Bastiano (Istituto Nazionale di Fisica Nucleare)

**Relatore:** STAEGER, David (Paul Scherrer Institute)

**Classifica Sessioni:** Young Researchers Talks

ID contributo: 31

Tipo: non specificato

## Searches for lepton-flavour-violating decays of the Higgs boson into e tau and mu tau in $\sqrt{s}=13$ TeV pp collisions with the ATLAS detector

*lunedì 15 maggio 2023 16:55 (15 minuti)*

This talk presents the results of a direct search for lepton-flavour-violating decays of the Higgs boson into e tau and mu tau final states with the ATLAS detector at the LHC with Run 2 data. Both leptonically and hadronically decaying tau leptons are included and two different background estimation techniques are employed: a MC-template method, based on data-corrected simulation samples, and a data-driven method, based on exploiting the symmetry between electrons and muons in the Standard Model backgrounds. Observed (Expected) upper limits are set on the branching ratios at 95% confidence level,  $B(H \rightarrow e \tau) < 0.20\%$  (0.12%) and  $B(H \rightarrow \mu \tau) < 0.18\%$  (0.09%), and a best-fit branching ratio difference,  $B(H \rightarrow \mu \tau) - B(H \rightarrow e \tau)$ , of  $0.25 \pm 0.10$  is found in the channel where the tau-lepton decays to leptons, compatible with a value of zero within 2.5 sigma.

**Autore principale:** GOMEZ DELEGIDO, Antonio Jesus (Univ. of Valencia and CSIC (ES))

**Relatore:** GOMEZ DELEGIDO, Antonio Jesus (Univ. of Valencia and CSIC (ES))

**Classifica Sessioni:** Young Researchers Talks

ID contributo: 32

Tipo: non specificato

## Searches of lepton-flavour-violating decays of the Higgs boson with the ATLAS detector at the HL-LHC

*lunedì 15 maggio 2023 17:10 (15 minuti)*

This talk presents a study of the prospects of searches for lepton-flavour-violating decays of the Higgs boson into  $e\tau$  and  $\mu\tau$  final states with 3000 fb<sup>-1</sup> of proton-proton collisions at  $\sqrt{s} = 14$  TeV using the ATLAS detector at the HL-LHC. The expected HL-LHC results are estimated by extrapolating the recently published ATLAS search in the Run 2 dataset to the HL-LHC conditions, accounting for, among others, the increase in the integrated luminosity and the potential reduction of uncertainties associated with particle reconstruction with the upgraded ATLAS detector. The signatures  $H \rightarrow e\tau$  and  $H \rightarrow \mu\tau$  are treated as independent signals, and two independent approaches of the background estimation are employed and compared.

**Autore principale:** BHALLA, Naman Kumar

**Relatore:** BHALLA, Naman Kumar

**Classifica Sessioni:** Young Researchers Talks

ID contributo: 33

Tipo: non specificato

## Search for supersymmetric sleptons and charginos with the ATLAS detector

*lunedì 15 maggio 2023 16:40 (15 minuti)*

A new search for the electroweak production of supersymmetric particles decaying into two leptons with missing transverse momentum is presented. Two simplified models are considered: direct pair production of sleptons decaying into the lightest neutralinos through leptons of the Standard Model (SM) and direct pair production of the lightest charginos decaying into the lightest neutralinos through W bosons of the SM. The analysis targets phase space regions where the difference in mass between the slepton or the lightest chargino and the lightest neutralino is close to or below the mass of the W boson. Such regions with compressed mass spectra have not been covered by any searches conducted so far due to the low cross section of the supersymmetric signal. Therefore, improved analysis strategies are crucial to separate the supersymmetric signal from the SM backgrounds. A search for an excess of same-flavour lepton pairs in opposite-sign lepton events is made in the direct slepton pair production analysis while a machine learning approach using boosted decision trees is exploited in the chargino pair production analysis and considering both the same-flavour and different-flavour channels. No significant excesses over the expected background are observed using proton-proton collisions data collected by the ATLAS experiment at  $\sqrt{s}=13$  TeV and exclusion limits at 95% confidence level are set for each considered model. Exclusion limits are also set for selectrons and smuons separately and portions of the region excluded by the search of smuons pair production are expected to be compatible with the  $g-2$  anomaly for small  $\tan\beta$  values.

**Relatore:** BALLABENE, Eric (Istituto Nazionale di Fisica Nucleare)

**Classifica Sessioni:** Young Researchers Talks

ID contributo: 34

Tipo: **non specificato**

## **Invisible NP in Flavor**

*martedì 16 maggio 2023 12:05 (35 minuti)*

**Autore principale:** REDIGOLO, Diego (LPTHE-CNRS)

**Relatore:** REDIGOLO, Diego (LPTHE-CNRS)

**Classifica Sessioni:** Plenary

ID contributo: 35

Tipo: **non specificato**

## The injection channel of the muEDM experiment

*martedì 16 maggio 2023 16:55 (15 minuti)*

At the Paul Scherrer Institute (PSI), we are setting up an experiment to search for the electric dipole moment of the muon (muEDM) using the frozen-spin technique. The discovery of a muEDM would indicate violation of charge conjugation parity symmetry and lepton flavor universality, beyond the Standard Model. The experiment aims to achieve a sensitivity of  $\sigma(d_\mu) \leq 6 \times 10^{-23} e \cdot cm$ .

The focus of this study is the off-axis injection of muons into a  $3T$  storage solenoid. Muons need to be transported from the exit of the beamline, low-field region, into the strong magnetic field of the solenoid. For this purpose, a magnetically shielded channel is constructed. In the direct vicinity of the injection helix inside the solenoid bore, we will use superconducting (SC) shield to avoid any hysteresis effect, while farther away in the fringe field we will use an iron tube. We will produce two prototypes of SC injection tubes: the first will use a commercial high temperature SC tape wrapped around a  $15mm$  inner diameter copper tube, while the second will utilize several Nb-Ti/Nb/Cu sheets obtained from CERN, wrapped and mechanically clamped around another  $15mm$  inner diameter copper tube. To evaluate the effectiveness of the SC shields, we will measure their shielding factors and calculate the muon injection efficiency from the beamline into the solenoid.

**Autore principale:** DOINAKI, Anastasia (Paul Scherrer Institute (PSI))

**Coautore:** SCHMIDT-WELLENBURG, Philipp (Paul Scherrer Institute)

**Relatore:** DOINAKI, Anastasia (Paul Scherrer Institute (PSI))

**Classifica Sessioni:** Young Researchers Talks

ID contributo: 36

Tipo: **non specificato**

## The positron reconstruction at the Muon $g-2$ Experiment

*martedì 16 maggio 2023 18:25 (15 minuti)*

In April 2021, the E989 Muon  $g-2$  collaboration at Fermilab published a measurement of the muon anomaly ( $a_\mu$ ) based on the Run-1 dataset with 0.46 ppm precision. The measured value confirmed the previous BNL experiment and increased the discrepancy with the Theory Initiative (2020) theoretical value to  $4.2\sigma$ . A new publication with a precision improved by factor 2 is expected for this Summer. The experimental technique requires a precise determination of the muon anomalous precession frequency based on the calorimeter data. This talk will discuss the reconstruction of the decay positrons observed by the calorimeters, the state of the art gain calibration system, and the analysis techniques employed to achieve a lower than 50 parts per billion systematic uncertainty on the precession measurement.

**Autore principale:** GIROTTI, Paolo (Pi)**Relatore:** GIROTTI, Paolo (Pi)**Classifica Sessioni:** Young Researchers Talks



ID contributo: 37

Tipo: **non specificato**

## Search for a muon Electric Dipole Moment Using the Frozen Spin Technique

*martedì 16 maggio 2023 15:20 (35 minuti)*

Despite the many successes of the Standard Model of Particle Physics, there are still several physical observations that it cannot explain, such as matter-antimatter asymmetry, non-zero neutrino masses, and the existence of dark matter. To address these limitations, extensions to the Standard Model are necessary, and a search for electric dipole moments of leptons is a valuable test. The measurement of the electric dipole moment of the muon is of particular interest, given recent experimental results indicating lepton-flavor universality violation and new results on the muon magnetic anomaly from Fermilab. A non-zero electric dipole moment of the muon would indicate Charge-Parity symmetry violation beyond the Standard Model. A dedicated experimental search for the muon electric dipole moment (EDM) has been proposed at Paul Scherrer Institute (PSI) using the frozen spin technique. In this technique, the anomalous spin precession of the muons in a storage ring is suppressed by applying an electric field in the radial direction. The muon EDM experiment will take place in two phases: the first phase will demonstrate the frozen spin technique using a precursor experiment with 28 MeV muons from the  $\pi E1$  beamline at PSI, while the second phase will make use of 125 MeV muons from the  $\mu E1$  beamline, which could search for muon EDM up to a sensitivity of  $6 \times 10^{-23}$  e.cm after a year of data taking. In this talk, we will describe the precursor experiment at PSI and provide an update on the current status of the experiment.

**Autore principale:** CHAKRABORTY, Ritwika (PSI)

**Relatore:** CHAKRABORTY, Ritwika (PSI)

**Classifica Sessioni:** Plenary

ID contributo: 38

Tipo: non specificato

## Background studies and normalization of signal events in the Mu2e experiment

*martedì 16 maggio 2023 18:10 (15 minuti)*

The Mu2e experiment is currently being constructed at Fermilab to search for the neutrino-less conversion of negative muons into electrons in the field of an aluminum nucleus. The experiment aims at a sensitivity of four orders of magnitude higher than previous related experiments, which implies highly demanding accuracy requirements both in the design and during the operation. To achieve such a goal, two important tasks should be accomplished. First, it is essential to estimate precisely the particle yields and all the backgrounds that could mimic the monoenergetic conversion electron signal. Second, it is necessary to normalize the signal events accurately. The normalization of the signal events is planned to be done using a detector system made of an HPGe detector and a Lanthanum Bromide detector, which will measure the rate of muons stopped on the aluminum target by looking at the emitted characteristic X- and  $\gamma$ -rays of energies up to 1809 keV. Therefore, it is essential to evaluate the detector system's performance before the start of the actual experiment. In this study, the first task was addressed by an extensive campaign of Monte Carlo simulations to investigate the relevant parameters and their impact on the experiment's sensitivity. The second task was handled by taking advantage of the Helmholtz-Zentrum Dresden-Rossendorf pulsed Bremsstrahlung photon beam at the ELBE facility. The detector system was tested at the ELBE facility under timing and background conditions similar to the ones expected at the Mu2e experiment. The study presents and discusses the simulation results and the detector system testing campaign.

**Autore principale:** RACHAMIN, Reuven (Helmholtz-Zentrum Dresden-Rossendorf (HZDR))

**Relatore:** RACHAMIN, Reuven (Helmholtz-Zentrum Dresden-Rossendorf (HZDR))

**Classifica Sessioni:** Young Researchers Talks

ID contributo: 39

Tipo: non specificato

## The Strong2020 and RadioMonteCarlow activities

*lunedì 15 maggio 2023 17:55 (15 minuti)*

During the last 15 years the “Radiative Corrections and Monte Carlo Generators for Low Energies” Working Group (Radio MontecarLow WG, see [www.lnf.infn.it/wg/sighad/](http://www.lnf.infn.it/wg/sighad/)) has been providing valuable support to the development of radiative corrections and Monte Carlo generators for low energy  $e^+e^-$  data and tau-lepton decays.

Its operation started in 2006 and proceeded until the last few years. During this period, the Radio MontecarLow WG held 20 meetings in which theorists and experimentalists, experts working in the field of  $e^+e^-$  physics and partly also from the tau community, produced the report “Quest for precision in hadronic cross sections at low energy: Monte Carlo tools vs. experimental data” [Eur. Phys. J. C 66, 585-686 (2010) (<https://arxiv.org/abs/0912.0749>)], cited more than 300 times.

While the working group has been operating for more than 15 years without a formal basis for funding, parts of the program have recently been included as a Joint Research Initiative in the group application of the European hadron physics community, STRONG2020, to the European Union, with a more specific goal of creating an annotated database for low-energy hadronic cross sections in  $e^+e^-$  collisions. The database will contain information about the reliability of the data sets, their systematic errors, and the treatment of Radiative Corrections. In this talk, we will report on both these initiatives. These efforts have been revived by the first measurement of the muon anomalous magnetic moment at Fermilab in 2021, which, when combined with the previous Brookhaven experiment, differs by  $4.2\sigma$  from the White Paper Standard Model prediction [Phys. Rep. 887, 1 (2020)] and by  $1.5\sigma$  from the Lattice based calculation [Nature 593 (2021) 51]; and also by the recent measurement of the  $e^+e^- \rightarrow \pi^+\pi^-$  cross section measurement with the CMD-3 detector [arXiv:2302.08834v1 [hep-ex] (2023)], which evaluates the hadronic contribution to the muon anomalous magnetic moment that is significantly larger than the value obtained from previous measurements and hence it is in less tension with the experimental measurement of  $a_\mu$ .

**Autore principale:** Sig. COTROZZI, Lorenzo (Istituto Nazionale di Fisica Nucleare)

**Relatore:** Sig. COTROZZI, Lorenzo (Istituto Nazionale di Fisica Nucleare)

**Classifica Sessioni:** Young Researchers Talks

ID contributo: 40

Tipo: non specificato

## Systematic effects in the search for the muon EDM using the frozen-spin method

*martedì 16 maggio 2023 17:25 (15 minuti)*

At the Paul Scherrer Institute we are developing a high precision instrument to measure the electric dipole moment (EDM) of the muon. The salient feature of the experiment is the use of the frozen-spin method to suppress the anomalous precession of the muon spin, allowing for a sensitivity that cannot be achieved with conventional g-2 muon storage rings. With this technique, the expected statistical sensitivity for the EDM after one year of data taking is  $6 \times 10^{-23} e \cdot \text{cm}$  with the  $p = 125$  MeV/c muon beam available at PSI.

Reaching this goal necessitates a comprehensive analysis on spurious effects that mimic the EDM signal. This work discusses a quantitative approach to study systematic effects for the frozen-spin method when searching for the muon EDM. Equations for the motion of the muon spin in the electromagnetic fields of the experimental system are analytically derived and validated by simulation. The kinematics of decay positrons in the context of the experiment will also be shown.

**Autore principale:** DUTSOV, Chavdar (Paul Scherrer Institute)

**Relatore:** DUTSOV, Chavdar (Paul Scherrer Institute)

**Classifica Sessioni:** Young Researchers Talks

ID contributo: 41

Tipo: non specificato

# The Dispersive Matrix perspective on Lepton Flavour Universality observables

*lunedì 15 maggio 2023 17:40 (15 minuti)*

The ratios  $R(D^{(*)})$  are defined as the  $\tau/\mu$  ratio of the branching fractions of semileptonic  $B \rightarrow D^{(*)}$  decays. They are a powerful test of Lepton Flavour Universality (LFU) and are determined by the hadronic Form Factors (FFs) describing the  $B \rightarrow D^{(*)}$  decays. Through the novel Dispersive Matrix (DM) approach, we describe these FFs without assumptions on their functional dependence on the momentum transfer. The DM method is based on the non-perturbative determination of the dispersive bounds due to unitarity and analyticity, and allows to determine in a model-independent way the FFs in the full kinematical range, starting from existing Lattice QCD data which are available only at large momentum transfer. Using the unitarity bands of the FFs, which are then independent of the experimental determinations of the differential decay widths, we compute new fully-theoretical expectations of the LFU ratios. Our results read  $R(D) = 0.296(8)$  and  $R(D^*) = 0.275(8)$ , each of which is compatible with the corresponding world average of the measurements at the  $2.0\sigma$  and  $0.6\sigma$  level, respectively. We will also discuss the application of the DM method to semileptonic  $B_s \rightarrow D_s^{(*)}$  decays and present new results for the LFU ratios  $R(D_s^{(*)})$ , which offer a complementary way to test LFU in  $b \rightarrow c$  quark transitions.

**Autori principali:** MARTINELLI, Guido (Istituto Nazionale di Fisica Nucleare); NAVIGLIO, Manuel (Istituto Nazionale di Fisica Nucleare); SIMULA, Silvano (Istituto Nazionale di Fisica Nucleare); VITTORIO, Ludovico (LAPTh, Annecy)

**Relatore:** VITTORIO, Ludovico (LAPTh, Annecy)

**Classifica Sessioni:** Young Researchers Talks

ID contributo: 42

Tipo: non specificato

## Implementation of the frozen-spin technique for the search for a muon electric dipole moment

*martedì 16 maggio 2023 17:10 (15 minuti)*

In a dedicated experiment at the Paul Scherrer Institute (PSI) [A. Adelman *et al.*, arXiv:2102.08838 (2021)], the muEDM Collaboration seeks to implement, for the first time, the frozen-spin technique [F.J.M. Farley *et al.*, Phys. Rev. Lett., **93**, 052001 (2004)] in order to advance the search for the muon electric dipole moment (EDM) with an improved sensitivity  $\mathcal{O}(10^3)$  below the current direct limit  $d_\mu < 1.8 \times 10^{-19} \text{ ecm}$  (95% C.L.) [G.W. Bennett *et al.*, Phys. Rev. D, **80**, 052008 (2009)]. Muons from a high flux continuous beamline at PSI will be injected helically into a 3 T superconducting solenoid. To achieve a stable orbit at its centre, such that the frozen spin conditions may be realised, a sub-microsecond trapping scheme must be implemented. A pulsed radial magnetic field will transfer the longitudinal momentum into an almost purely transverse orbit. The field will be generated by two circular coils supplied with synchronised and counter-propagating current pulses. The pulse should be 50 – 100 ns wide with peak amplitude 60 – 100 A and critically it must occur with no more than 100 ns delay after a muon entrance trigger. Furthermore, any residual currents following the primary pulse must be suppressed to avoid systematic effects arising from oscillatory precession of the muon spin. The eddy currents induced in conductive elements of the system will contribute to the system inductance, thus altering the system resonance, and also cause damping of the magnetic field at the position of the muon orbit. A first prototype of the muEDM experiment has recently been developed to perform tests which provide essential input for the development of a pulsed current supply and inform design optimisation towards a first demonstration of the frozen-spin technique with muons at PSI.

**Autore principale:** HUME, Timothy (PSI - Paul Scherrer Institut)

**Coautore:** SCHMIDT-WELLENBURG, Philipp (Paul Scherrer Institute)

**Relatore:** HUME, Timothy (PSI - Paul Scherrer Institut)

**Classifica Sessioni:** Young Researchers Talks

ID contributo: 43

Tipo: **non specificato**

## A search for a muon to electron conversion in COMET

*martedì 16 maggio 2023 10:35 (25 minuti)*

A COMET experiment aims to search for the muon to electron conversion with aluminium nuclei with four orders of magnitude improved upper limit sensitivity than the current one at J-PARC, JAPAN. The experiment recently completed the new proton beamline and performed the muon transportation using a curved solenoid called phase-alpha. In this presentation, we will present the preliminary result from phase-alpha, the preparation status for the intermediate sensitivity experiment, COMET phase-I, and the ultimate target of COMET phase-II.

**Autore principale:** FUJII, Yuki**Relatore:** FUJII, Yuki**Classifica Sessioni:** Plenary

ID contributo: 45

Tipo: **non specificato**

## Measuring tau g-2 using ATLAS Pb+Pb collisions

*lunedì 15 maggio 2023 16:25 (15 minuti)*

Relativistic heavy-ion beams at the LHC are accompanied by a large flux of equivalent photons, leading to photon-induced processes. Measurements of photon-induced production of tau lepton pairs can be used to constrain the tau lepton's anomalous magnetic dipole moment ( $g-2$ ). This talk presents a recent ATLAS measurement using muonic decays of tau leptons in association with electrons and tracks which provides one of the most stringent limits available to date.

**Autore principale:** STANEK, Weronika (DESY)

**Relatore:** STANEK, Weronika (DESY)

**Classifica Sessioni:** Young Researchers Talks



ID contributo: 46

Tipo: **non specificato**

## An ultra-light helium cooled pixel detector for the Mu3e experiment

*martedì 16 maggio 2023 17:55 (15 minuti)*

The Mu3e experiment searches for the lepton flavour violating decay  $\mu^+ \rightarrow e^+ e^- e^+$  with an ultimate aimed sensitivity of 1 event in  $10^{16}$  decays.

To achieve this goal, the experiment must minimize the material budget per tracking layer to  $X/X_0 \approx 0.1\%$  and use gaseous helium as coolant.

The pixel detector uses High-Voltage Monolithic Active Pixel Sensors (HV-MAPS) which are thinned down to  $50 \mu\text{m}$ .

Both helium cooling and HV-MAPS are a novelty for particle detectors.

In this talk, I present my work on successfully cooling a pixel tracker using gaseous helium.

The thermal studies focus on the two inner tracking layers, the Mu3e vertex detector, and the first operation of a functional thin pixel detector cooled with gaseous helium.

The approach, which circulates gaseous helium under ambient pressure conditions with gas temperature around  $0^\circ\text{C}$  using a miniature turbo compressor with a mass flow of  $2 \text{ g/s}$  allows the vertex detector to operate below  $70^\circ\text{C}$  at heat densities of up to  $400 \text{ mW/cm}^2$ .

Finally, performance data of the final HV-MAPS used by Mu3e, the MuPix11, is presented.

These results demonstrate the feasibility of using HV-MAPS combined with gaseous helium as coolant for an ultra-thin pixel detector exploring new frontiers in lepton flavor.

**Autore principale:** RUDZKI, Thomas Theodor

**Relatore:** RUDZKI, Thomas Theodor

**Classifica Sessioni:** Young Researchers Talks