T 108: Methods in particle physics 6

Time: Friday 9:00–10:30 Location: Geb. 20.30: 2.066

T 108.1 Fri 9:00 Geb. 20.30: 2.066

The current status of the Mu2e experiment at Fermilab — •Stefan E. Müller, Anna Ferrari, Oliver Knodel, and Reuven Rachamin for the Mu2e-Collaboration — Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany

The Mu2e experiment, which is currently under construction at the Fermi National Accelerator Laboratory near Chicago, will search for the neutrinoless conversion of muons to electrons in the field of an aluminum nucleus. This process, which violates charged lepton flavor, is highly suppressed in the Standard Model and therefore undetectable. However, scenarios for physics beyond the Standard Model predict small but observable rates. The Mu2e experiment aims for a sensitivity four orders of magnitude better than previous experiments. This is achieved by a rigorous control of all backgrounds that could mimic the monoenergetic conversion electron signal.

In the presentation, the design and status of the Mu2e experiment and its detector subsystems will be presented.

T 108.2 Fri 9:15 Geb. 20.30: 2.066

The Camera Alignment System for the Mu3e Experiment — •Sophie Gagneur — Johannes Gutenberg-Universität Mainz

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. 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.

T 108.3 Fri 9:30 Geb. 20.30: 2.066

Status of the Mu3e Tile detector — •Elizaveta Nazarova, Konrad Briggl, Hans-Christian Schultz-Coulon, Jan Küpperbusch, Erik Steinkamp, and Anna Dunz for the Mu3e-Collaboration — Kirchhoff Institut für Physik, Universität Heidelberg, Heidelberg, Germany

The future Mu3e experiment at the Paul Scherrer Institute (PSI, Switzerland) will search for the decay $\mu^+ \to e^+e^+e^-$ down to a branching ratio sensitivity of 10^{-16}. Observation of such a lepton-flavour violating decay will test the Standard Model, where it is highly suppressed. The first phase of the experiment aims to reach the sensitivity of 2×10^{-15} using the availible at PSI muon beam with rates up to 1×10^8 Hz. In order to suppress possible background and perform the search with the proposed sensitivity, the experiment needs precise tracking and time measurements. The Mu3e tile detector is one the dedicated timing systems, providing precise detection of electrons with the time resolution below 100 ps. The detector consists of plastic scintillator tiles that are read out by silicon photomultipliers (SiPMs), while the analog signals of SiPMs are read by the MuTRiG ASICs.

This talk presents an overview of the current status of the Mu3e tile detector, including the development and production of individual components, as well as quality assurance measurements. The production of the full detector and its subsequent integration into the Mu3e experiment will be discussed.

T 108.4 Fri 9:45 Geb. 20.30: 2.066

Detector system and simulation of the 155 MeV Møller polarimeter at MESA — •Michail Kravchenko — Institute of Nuclear Physics, Johannes Gutenberg University Mainz — PRISMA+ Cluster of Excellence, Johannes Gutenberg University Mainz

The Mainz Energy-Recovering Superconducting Accelerator (MESA) is an electron accelerator that is currently under construction at Johannes Gutenberg University Mainz. One of the primary goals of MESA is to precisely measure the weak mixing angle $sin^2\theta_w$, an important parameter of the Standard Model, with a relative uncertainty of 0.14%. This measurement will be carried out by the P2 experiment by examining the parity-violating asymmetry in elastic electron-proton scattering at low momentum transfer Q^2. MESA will provide a 150 μA beam of alternatingly polarized 150 MeV electrons with very good beam stability. To fulfill the objectives of the P2 experiment, the beam polarization must be monitored online with a very low systematic error ($< 0.5\%$ relative). The 155 MeV Møller polarimeter using a polarized atomic hydrogen target, known as the Hydro-Møller polarimeter, as proposed by V. Luppov and E. Chudakov, offers the prospect of achieving these requirements. The updated design of the detector system for the Hydro-Møller polarimeter and the current results of the simulation with Geant4 are presented.

T 108.5 Fri 10:00 Geb. 20.30: 2.066

A novel approach to radon source production: ^{226}Ra implantation at ISOLDE facility at CERN — •giovanni volta, hardy simgen, and florian jörg — Max-Planck-Institut für Kernphysik, Heidelberg, Germany

Reliable radon sources are a key ingredient for calibrating and developing detectors for the radioactive noble gas ^{222}Rn. A novel approach to producing such sources is the implantation of ^{226}Ra into a carrier substrate at the ISOLDE facility at CERN. In light of the results of the first implantation tests of ^{226}Ra in a stainless steel sample, performed in 2017, in November 2023, a new implantation campaign has been performed. The aim was the implantation of at most 5 Bq of ^{226}Ra into different materials: Not only stainless steel but also other metals (copper, titanium, lead) as well as insulators (PTFE, acrylic, glass) and semiconductors (germanium and silicon). Eleven samples were implanted with the desired ^{226}Ra activity. The ISOLDE facility, operation, and preliminary characterization of these samples will be presented in this talk.

T 108.6 Fri 10:15 Geb. 20.30: 2.066

Measurement of Cross-sections of Intermediate Mass Nuclei with NA61/SHINE at CERN — •Neeraj Amin for the NA61/SHINE-Collaboration — Karlsruhe Insitute of Technology, Institute for Astroparticle Physics, Karlsruhe, Germany

The current understanding of cosmic-ray propagation in the Galaxy primarily depends on the secondary-to-primary flux ratios and the nuclear fragmentation cross-sections. Space-based detectors like AMS-02 and CALET have measured the fluxes with high precision ($< 5\%$). Yet, the large uncertainties on the fragmentation cross-section values considerably hamper the study. While the B/C and Li/C flux ratios are used to infer quantities like the ratio of diffusion coefficient to the size of the galactic halo D_0/L, this degeneracy can be broken by estimating the galactic halo size (L) by measuring the ^{10}Be/^{9}Be flux ratio. Therefore precise fragmentation cross-section measurements are crucial for modelling galactic cosmic-ray propagation. The fixed-target experimental facility NA61/SHINE at CERN can be utilized to remedy this situation. Pilot data on fragmentation was taken in 2018 to probe the feasibility of performing fragmentation studies at SPS energies using two fixed targets, polyethylene (C_2H_4) and graphite. In this contribution, we will present the production of beryllium (^{7}Be, ^{9}Be & ^{10}Be) and lithium isotopes (^{6}Li & ^{7}Li) in ^{12}C+p interactions at 13.5A GeV/c. Finally, we discuss the tailored framework for a specialized, high-statistics data initiative set for October 2024, focusing on investigating the fragmentation of primary nuclei from C to Si.