HK 44: Instrumentation VIII

Time: Thursday 16:15–18:00 Location: PHIL A 301

HK 44.1 Thu 16:15 PHIL A 301

Integrated Control Systems for the Silicon Tracking System of the CBM experiment — •David Gutierrez Menendez for the CBM-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany — Goethe-Universität Frankfurt, Frankfurt, Germany

The Silicon Tracking System (STS) is the central detector for charged-particle tracking in the Compressed Baryonic Matter (CBM) experiment at FAIR. Its performance relies not only on the precise operation of 1.8 million readout channels but also on robust Detector Control Systems (DCS) and Experiment Control Systems (ECS) to ensure safe, stable, and automated detector operation. The team previously carried out initial validation of control functionality in the mini-CBM setup. It exercised key components of the STS slow controls, readout supervision, and interlock logic under realistic beam conditions.

Building on these results, dedicated developments and extensive testing have been conducted in a large-scale lab setup to deploy a complete control infrastructure for the assembly and integration of the STS half-units, including monitoring, configuration, and finite-state-machine control for front-end electronics, power systems, and environmental sensors. This lab campaign also serves as a testbed for integrating DCS and ECS workflows ahead of installation at FAIR.

The current status of the STS control systems, together with recent progress and upcoming integration steps, will be presented.

HK 44.2 Thu 16:30 PHIL A 301

Systematic studies of the CBM MVD cooling system with CFD simulations — •Christopher Braun for the CBM-MVD-Collaboration — Goethe-Universität

The Micro Vertex Detector (MVD) is the first downstream detector of the Compressed Baryonic Matter Experiment (CBM) at the future Facility for Antiproton and Ion Research (FAIR). It consists of four planar stations, placed equidistantly at distances between 8 and 20 cm downstream of the target, and is equipped with dedicated CMOS Monolithic Active Pixel Sensors (MAPS). Its stations operate in a harsh radiation environment and within the moderate vacuum of the target chamber. Each detector plane will feature a material budget x/X_0 ranging between 0.3 and 0.5 %. These strict material budget constraints and vacuum operation call for a two-stage cooling system, based on passive, conductive inside, and an active, convective cooling outside of the acceptance.

This contribution will present the cooling concept of the CBM MVD, with focus on CFD simulations of the full system, which are compared with experimental results obtained with a prototype setup operating in vacuum, and a performance comparison of different coolants (Water, Glycol-Water, and Novec-649) for the detector's coolant temperature range between −10 °C and +15 °C.

HK 44.3 Thu 16:45 PHIL A 301

Precision Assembly for the P2 Inner Tracker — •Emre Eliboller for the P2-Collaboration — Institut fur Kernphysik, Johannes Gutenberg-Universitat, Johann-Joachim-Becher-Weg 45, Mainz, Germany

The P2 experiment at the new electron accelerator MESA in Mainz aims to measure the weak mixing angle in elastic electron-proton scattering at low momentum transfer Q^2 with unprecedented precision. Precise assembly of silicon tracker modules is essential for reliable track reconstruction and for controlling systematic uncertainties in the determination of the momentum transfer. The tracker system measures the scattering angle of outgoing low-energy electrons. To meet these requirements, an automated assembly workflow based on a four-axis robotic system (Gluebot) has been developed and validated.

The system was adapted to detector constraints with emphasis on alignment accuracy, repeatability, and operational stability. The detector design requires a sensor placement precision better than 50 μm. Targeted hardware modifications and software improvements were implemented in the Gluebot, enabling stable automated gluing and pick-and-place operations with μm-level positioning performance.

The feasibility of automated tracker-module assembly was demonstrated using representative components. Beyond its original scope, the system is used for additional detector projects, demonstrating its robustness. The talk will present the system design, achieved performance, and its role in ongoing tracker-module production.

HK 44.4 Thu 17:00 PHIL A 301

Investigations of gas flow through nozzles to optimise the deflection of filament target beams — •Eva-Maria Hausch, Jost Froning, Simon Obszerninks, and Alfons Khoukaz — Institut für Kernphysik, Universität Münster, 48149 Münster, Germany

To deflect a cryogenic hydrogen target beam, a recently developed method called cryobending is used, whereby gaseous helium is directed towards the filament target beam through deflection nozzles. Experiments have indicated that this allows the target beam to be deflected in a targeted manner to overcome a distance of more than 4 metres. Two types of deflection nozzles have been tested so far. In addition to experimental approaches such as interferometry, gas flow simulations are intended to determine the most effective type and size of nozzle, i.e. with which nozzle the least amount of helium gas can be used for the largest possible deflection to minimise the impact on the vacuum. In this talk, the first approaches to determining the optimal operating parameters regarding cryobending will be discussed.
Funding was received from GSI F&E (MSKHOU2527), BMBF (05P21PMFP1) and NRW Netzwerke (NW21-024-E).

HK 44.5 Thu 17:15 PHIL A 301

Design of the liquid hydrogen target for the P2 parity violating experiment at MESA — Sebastian Baunack[1], Maarten Bonnekamp[2,4], Boris Gläser[1], Shruti Gudla[1], Rahima Krini[1], Frank Maas[1,2,3], •Jayanta Naik[1], Moran Neher[1], Tobias Rimke[1], Paul Schöner[2], Siddharth Thakker[1], and Malte Wilfert[1] for the P2-Collaboration — [1]Institut für Kernphysik, Johannes Gutenberg-Universität Mainz — [2]Helmholtz-Institut Mainz, Johannes Gutenberg-Universität Mainz — [3]PRISMA Cluster of Excellence, Johannes Gutenberg-Universität Mainz — [4]IRFU, CEA, Université Paris-Saclay, Gif-sur-Yvette, France

The P2 experiment aims to precisely measure the weak mixing angle $\sin^2\theta_W$ through parity-violating electron-proton scattering at low momentum transfer. This is projected to achieve a relative precision of 0.16% for $\sin^2\theta_W$. To achieve this precision, there is a need for a target design that will have small false asymmetry due to aluminum windows and the conical diverter. The liquid hydrogen target is 60 cm long, along with a potential helium cell positioned upstream of the primary hydrogen cell.

In this talk, the design of the target cell is explained, which includes the simulation results for the aluminum upstream and downstream windows, helium cell, and the conical flow diverter.

HK 44.6 Thu 17:30 PHIL A 301

Long-distance filament target beams — •Jost Froning, Eva-Maria Hausch, Simon Obszerninks, and Alfons Khoukaz — Institut für Kernphysik, Universität Münster, 48149 Münster, Germany

When using cryogenic filament target beams in accelerator experiments in nuclear and particle physics, it may be necessary to overcome greater distances between the beam production nozzle and the interaction point. To demonstrate the suitability of such a filament target beam, a new setup with a distance of more than 4 m between the nozzle and the beam dump was recently commissioned in Münster. This talk shows how a continuous frozen hydrogen filament target beam with a diameter of 10 μm can be deflected and guided to the interaction point using a newly developed technique called cryobending, which uses helium gas to steer the target beam.
Funding was received from GSI F&E (MSKHOU2527), BMBF (05P21PMFP1) and NRW Netzwerke (NW21-024-E).

HK 44.7 Thu 17:45 PHIL A 301

Electromagnetic Characterization and Performance Analysis of Button Beam Position Monitors - cSTART — •Anjana Madhusoodhanan Nair PK[1,2], Arnulf Quadt[1], Christoph Quitmann[2], Dima El Khechen[3], Jakob Krämer[2], and Nigel John Smale[3] — [1]II. Physikalisches Institut Georg-August-Universität Göttingen — [2]RI Research Instruments GmbH, Bergisch Gladbach — [3]Karlsruhe Institute of Technology

Button-type Beam Position Monitors (BPMs) are a key element of the beam diagnostics system for the cSTART (compact STorage ring

for Accelerator Research and Technology) project, where precise beam position measurements are essential for stable operation. This study presents the electromagnetic characterization and performance evaluation of the cSTART button BPM design through a combination of numerical simulations and experimental validation, including *CST Particle Studio* simulations of signal formation, button capacitance, frequency response, and wakefield effects, as well as Time Domain Reflectometry measurements and beam-based tests at the FLUTE facility with controlled beam offsets. The results demonstrate the accuracy, limitations, and suitability of the BPM system for cSTART operation and contribute to the optimization of beam diagnostics in compact storage ring accelerators.