T 19: Detector Systems, Electronics

Time: Monday 16:30–17:45 Location: POT/0106

T 19.1 Mon 16:30 POT/0106

Development of a high temperature superconducting magnet for applications in space. — •Christian von Byern[1], Laurenz Klein[1], Daniel Louis[1], Tim Mulder[1,2], Irfan Özen[1], Stefan Schael[1], Thorsten Siedenburg[1], and Michael Wlochal[1] — [1]Physics Institute 1B, RWTH Aachen University — [2]CERN

While AMS-02 is currently operated on board of the International Space Station, the next generation of cosmic particle detector is already planned. AMS-100 will be operated at Lagrange Point 2 and will feature a geometric acceptance of 100m*sr. With this large acceptance and improved momentum resolution a measurement of cosmic rays up to the PeV scale will be possible and an improvement of factor 1000 regarding the sensitivity of anti-matter measurements is expected.

The magnetic field of the spectrometer will be generated by a High Temperature Superconducting (HTS) solenoid. This coil will include several layers of individual HTS tapes. The coil is operated at 55K, and it will produce a field of 0.5T at 10kA current. To reduce the material budget in terms of mass and interaction length the HTS tapes will be stabilized using few millimetres of aluminium. As an intermediate step a small demonstrator coil is in preparation. In this R&D phase multiple samples, including straight cable samples, meteoroid impacts samples as well as coil samples with a few windings are prepared and teste. In this talk measurement results of the different samples will be presented and discussed.

T 19.2 Mon 16:45 POT/0106

Development of a quench detection system based on optical fibres for the AMS-100 high temperature superconducting solenoid. — •Clemens Dittmar[1], Markus Gastens[2], Caroline Girmen[3], Stefan Schael[1], Thorsten Siedenburg[1], and Michael Wlochal[1] — [1]Physics Institute I B, RWTH Aachen, Germany — [2]Institute of Structural Mechanics and Lightweight Design SLA, RWTH Aachen, Germany — [3]Fraunhofer Institute for Production Technology IPT, Aachen, Germany

The magnetic spectrometer AMS-100, which includes a high temperature superconducting coil, is being designed to measure cosmic rays and detect cosmic antimatter in space. This extreme environment requires a suitable sensing solution to monitor critical changes in the solenoid structure, for example the beginning of a quench in the superconducting coil. Rayleigh scattering-based distributed optical fibre sensors (DOFS) fulfil the high requirements for these extreme conditions, as they are small and lightweight, can be used under cryogenic temperatures, are immune to electromagnetic interference and have sub-millimetre spatial resolution over long distances. The established application of using this system only allows a coupled measurement of mechanical and thermal signals, based on knowledge of the thermomechanical behaviour of the structure being measured. A precise calibration of the temperature and strain response of the optical fibre in the range of 77K to 350K was achieved and a measurement principle was developed to decouple the mechanical and thermal signals.

T 19.3 Mon 17:00 POT/0106

Development of a High-Current, Low-Voltage Remote Power Supply for the P2 Tracking Detector — •Lars Steffen Weinstock for the P2-Collaboration — PRISMA+ Cluster of Excellence and Institute of Nuclear Physics, Johannes Gutenberg University Mainz

The P2 experiment is planned for the Mainz Energy recovering Superconducting Accelerator (MESA), which is currently under construction. The goal of P2 is to determine the electroweak mixing angle with an unprecedented precision at low energy scales with by measuring the parity violating asymmetry in proton-electron scattering at low momentum transfer. A key parameter for the analysis, the electron momentum transfer during scattering, is measured by the P2 tracker, which is placed inside the 0.6 T solenoid spectrometer. The tracker utilises over 4000 High-Voltage Monolithic Active Pixel Sensors (HV-MAPS) each drawing about 500 mA at a supply voltage of 2 V. Due to the high amount of radiation as well as thermal and noise constraints, the power conversion was shifted from the front-end to the counting room at a distance of 30 meters to the detector using a remote-sense technique.

This talk gives an overview of the P2 experiment and the powering scheme of its tracking detector, as well as the current state of development of the remote power supply using a combination of physics (COMSOL) and electronics simulation (SPICE) to estimate the performance and stability of the supplied power.

T 19.4 Mon 17:15 POT/0106

DC-DC Converter Development for the Mu3e Experiment — •Sophie Gagneur for the Mu3e-Collaboration — Institut für Kernphysik , JGU 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 combined with scintillating tiles and fibres for precise timing measurements. The entire detector and front-end electronics are located in the 1m diameter bore of a 1T superconducting magnet. A compact power distribution system based on custom DC-DC converters provide the detector ASICs and readout FPGAs with supply voltages of 1.1V to 3.3V with currents up to 30A per channel. 126 converters are placed as close as possible to the detector and provide 9kW of power in total. The talk presents the development process of the Mu3e DCDC converters and the results of recent prototype tests.

T 19.5 Mon 17:30 POT/0106

FPC prototype tests and results for the ATLAS High Granularity Timing Detector Demonstrator — •Maria Soledad Robles Manzano[1], Andrea Brogna[2], Jan Ehrecke[1], Atila Kurt[2], Lucia Masetti[1], Jigar Patel[1], Binh Pham[2], Fabian Piermaier[2], Steffen Schoenfelder[2], Quirin Weitzel[2], and Patricia Theobald[2] — [1]Institut für Physik, Johannes Gutenberg-Universität Mainz — [2]PRISMA Detektorlabor, Johannes Gutenberg-Universität Mainz

The ATLAS detector requires upgrades to face the challenges of the new High Luminosity LHC, in particular the increase of pile-up interactions. The High-Granularity Timing Detector (HGTD) will be built in order to mitigate the effects of pile-up in the ATLAS forward region, providing time information with a resolution of about 30 ps per track. The active area consists of 2-double-sided disks per end-cap. The HGTD basic unit, so-called module, is made up of two 2x2 cm^2 Low Gain Avalanche Detectors bump-bonded to two ASICs and glued to a flexible PCB. The modules are connected to the Peripheral Electronics Boards, surrounding the active area, via a Flexible Printed Circuit (Flex tail) that serves as interconnection for power, communication signals and HV bias. A prototype of different lengths of the flex tail for a small scale, but full chain HGTD demonstrator has been produced and tested. The tests results of both electrical and mechanical performance of the prototype are presented.