T 63: Detector Systems II

Time: Wednesday 16:00–18:00 Location: Tm

T 63.1 Wed 16:00 Tm

Transverse momentum discriminating silicon modules for the Phase-II Upgrade of the CMS Outer Tracker — •Younes Otarid — Deutsches Elektronen-Sychrotron DESY, Hamburg, Germany

The Large Hadron Collider (LHC) will undergo a major High Luminosity upgrade with the goal of delivering a peak instantaneous luminosity of about $5 - 7.5 \times 10^{34} cm^{-2} s^{-1}$ by 2027. In order for the CMS experiment to cope with the higher radiation levels and data rates, the current CMS Silicon Outer Tracker will be replaced. The upgraded Outer Tracker will introduce a new module concept, made of two vertically stacked silicon sensors, which will exploit the strong magnetic field inside the CMS detector to select high transverse momentum particles locally and send the corresponding information to the triggering system.
This talk will focus on one of the two foreseen designs, the Pixel-Strip (PS) module, as well as the developments related to the module assembly and testing, covering the topics of momentum discriminating module design, DAQ system and automated assembly.

T 63.2 Wed 16:15 Tm

Development of a radiation monitoring system for satellite application — •Fabian Abo, Marius Hötting, Kevin Kröninger, and Jens Weingarten — Technische Universität Dortmund, Lehrstuhl für Experimentelle Physik IV

The use of commercial electronics components in satellites is increasing. Therefore, the understanding and investigation of radiation induced damages are inevitable. The *Lehrstuhl für Experimentelle Physik IV* at Technische Universität Dortmund is developing a radiation monitoring system based on Commercial-of-the-shelf (COTS) semiconductor components. The main principle is to detect and monitor the radiation induced damages. Nevertheless, the device is able to detect multiple particle types, store information about the accumulated dose and detect Single Event Effects (SEE) which could lead to a Bitflip as well as severe failure of electronical devices on board.
However, the radiation monitoring device has to operate within a defined bandwidth and a limited power usage to be useful as an additional payload.
In this talk we will present the results of temperature and radiation induced changes of different MOSFETS and diodes characteristics.

T 63.3 Wed 16:30 Tm

The intelligent PMTs for OSIRIS — Feng Gao[1], Achim Stahl[1], •Jochen Steinmann[1], Cornelius Vollbrecht[1,2], and Christian Wysotzki[1] — [1]RWTH Aachen University - Physics Institute III B, Aachen, Germany — [2]Forschungszentrum Jülich GmbH, Nuclear Physics Institute IKP-2, Jülich, Germany

The Online Scintillator Internal Radioactivity Investigation System (OSIRIS) allows an on the fly radiopurity measurement of the scintillator during filling of the JUNO detector. It consists of a 20 ton liquid scintillator target monitored by 76 intelligent photomultiplier tubes (iPMTs).

In the novel approach of the iPMT, all electronics required for the PMT operation are directly attached to its back. It includes an FPGA for control of the PMT and processing of the data. This reduces analog signal cable length to the absolute minimum and creates a very scalable system.

Each iPMT is connected via a single standard CAT5 Ethernet cable to the backend, where the cable is splitted into a synchronisation signal and the Ethernet part. The Ethernet wires are connected to a Power over Ethernet switch to supply the whole iPMT and integrate it into the DAQ and slow-control network.

This talk presents the concept of the iPMT and its realisation within OSIRIS.

T 63.4 Wed 16:45 Tm

Potting of the intelligent PMTs for OSIRIS — •feng gao, achim stahl, jochen steinmann, cornelius vollbrecht, and christian wysotzki for the JUNO-Collaboration — RWTH university, Aachen, Germany

For OSIRIS 76 intelligent PMTs (iPMTs) will be used inside pure water as light detectors. All readout electronics are mounted at the backside of the PMT. Compared with a traditional PMT readout, a pure digital signal will be sent from the iPMT to the back-end electronics, so that the PMT signal can be transmitted lossless.

The electronics soldered on the PMT are immersed within oil inside a cylindrical stainless steel shell. Heat, generated by the electronics, is transferred via oil and stainless steel to the cooled water pool. This way the electronics are kept at a stable temperature. In order to prevent the electronics from being exposed to pure water, potting is required.

The solution and process of the potting will be presented in this talk.

T 63.5 Wed 17:00 Tm

Performance of the intelligent PMTs for OSIRIS — •Christian Wysotzki[1], Feng Gao[1], Achim Stahl[1], Jochen Steinmann[1], and Cornelius Vollbrecht[1,2] — [1]RWTH Aachen University - Physics Institute III B, Aachen, Germany — [2]Institut für Kernphysik, Forschungszentrum Jülich, Jülich 52428, Germany

OSIRIS (Online Scintillator Internal Radioactivity Investigation System) is a standalone 20-ton liquid scintillator detector. As a subsystem of the JUNO experiment, it provides surveillance of the liquid scintillator quality with respect to the radiopurity.

OSIRIS uses 76 20-inch PMTs as detector units and harnesses a novel approach of readout. The analog signal digitization is located on the backend of the PMT. Additionally, each PMT has signal processing resources consisting of an FPGA plus processor combination. This allows the implementation of high-speed algorithms directly on the back of the PMT, denoted as “intelligence”.

Performance results of a prototype system will be presented in this talk.

T 63.6 Wed 17:15 Tm

Radiopurity treatment of the intelligent PMTs for OSIRIS — •Cornelius Vollbrecht[1,2], Feng Gao[2], Livia Ludhova[1,2], Achim Stahl[2], Jochen Steinmann[2], and Christian Wysotzki[2] — [1]Forschungszentrum Jülich - Institute for Nuclear Physics, IKP-2, Jülich, Germany — [2]RWTH Aachen University - Physics Institute III B, Aachen, Germany

The Jiangmen Underground Neutrino Observatory (JUNO), currently under construction in Southern China, is expected to yield new insights regarding the mass hierarchy of neutrinos. In order to reach the design sensitivity for detecting reactor and solar neutrinos, a radiopure liquid scintillator is required.

The Online Scintillator Internal Radioactivity Investigation System (OSIRIS) allows an on-line quality evaluation of the scintillator during filling of the JUNO detector. It features a 20 ton liquid scintillator target monitored by 76 intelligent photomultiplier tubes (iPMTs).

Because contamination with radioactive isotopes might prevent OSIRIS to reach its target sensitivity, the detector has to be cleaned prior to installation. For removing potential production residues from the iPMTs, a cleaning procedure has been developed. In this talk, the construction of the facility using ultra pure water at RWTH Aachen University will be presented.

T 63.7 Wed 17:30 Tm

A novel neutron imaging detector based on neutron sensitive MCP on Timepix3 Readout — •Saime Gürbüz[1], Jochen Kaminski[1], Markus Gruber[1], Markus Köhli[1,2], Michael Lupberger[1], and Klaus Desch[1] — [1]Physikalisches Institut, Universität Bonn — [2]Physikalisches Institut, Universität Heidelberg

Neutron imaging is a method to research materials non-invasively. In the University of Bonn, we are developing a state-of-art neutron imaging detector with a high spatial resolution.

As a neutron converter, we use a B(10) and Gd enriched Microchannel plate detector (MCP). The MCP has been studied with cold and thermal neutrons for neutron imaging and it already showed very promising results in means of neutron detection efficiency and spatial resolution. Our aim is to design a novel detector which will combine the efficiency of the MCP with a good time and spatial resolution readout system.

The detector readout is achieved by 4 Timepix3 AISCs. The

Timepix3 is an upgraded version of Timepix with additional features of package based readout and better timing resolution of upto 1.5 ns. With the help of the new readout technique, it has less counting losses. It can simultaneously record arrival time and time over threshold. A Timepix3 can achieve good timing resolution and spatial resolution at the same time.

In this talk, we will present the concept and the current status of the first prototype of the neutron sensitive MCP on a Timepix3 readout.

T 63.8 Wed 17:45 Tm

Production of low-background poly(ethylene naphthalate) as a self-vetoing structural material for LEGEND-200 — •Felix Fischer for the PEN-Collaboration — Max-Planck-Institut für Physik, 80805 Munich, Germany

Poly(ethylene naphthalate), PEN, is a widely used industrial polyester which intrinsically scintillates in the blue wavelength region. Measurements have established a high intrinsic radio purity. This has sparked interest in the material for use in low-background experiments. The entire process from commercially available PEN pellets to an optically active support-structure for the next generation $0\nu\beta\beta$-search experiment LEGEND-200 is presented. In addition, new measurements on radiopurity are presented as well as first characterisation studies important for the performance in a low-background experiment.