HK 59: Instrumentation XV

Time: Thursday 14:00–15:30 Location: HK-H4

Group Report HK 59.1 Thu 14:00 HK-H4

The Silicon Tracking System of the CBM Experiment — •Osnan Maragoto Rodriguez for the CBM-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

The Silicon Tracking System (STS) is the central detector for charged-particle identification and momentum determination in the future CBM experiment. It is designed for tracking up to 1000 charged particles per event in nucleus-nucleus collisions at interaction rates up to 10 MHz. Its futures are a low material budget~2% of radiation length, a single-point resolution of ~30 μm inside 1 Tm magnetic field leading to a momentum resolution better than 2%. The experimental conditions pose demanding requirements in terms of channel density and read-out bandwidth: more than 1.6 million channels will be read out with self-triggering electronics. An online event analysis concept will be applied to provide real-time event building and selection. The test and characterization of detector modules, operated in high-intensity heavy-ion beam from the GSI-SIS18 accelerator, as well as the mechanical design and the cooling concepts are, currently, some of the most important goals of the project. This contribution will bring an overview of the STS detector with emphasis on the current status of the detector modules, their performance with beam-target interactions as part of the FAIR Phase 0 activities, the readout chain and system integration aspects aiming towards the pre-series production phase

HK 59.2 Thu 14:30 HK-H4

Quality control and position mapping of the silicon microstrip sensors for the CBM-STS detector — •Olga Bertini for the CBM-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

The central detector of the CBM experiment at FAIR, the Silicon Tracking System (STS), is designed to reconstruct up to thousand charged particle tracks produced at SIS100 in heavy-ion interactions at rates of up to 10 MHz.

The eight tracking stations of the STS, operating in the aperture of a super conducting dipole magnet with 1 T field, will cover the polar angles between 2.5° and 25°. The stations with a total sensor area of 4.2 m^2 will comprise about 900 detector modules consisting of double-sided silicon microstrip sensors, ultra-thin readout cables and front-end electronics that are mounted onto lightweight carbon fiber support strictures. More than 1000 double-sided sensor were produced and delivered to GSI, where their quality was controlled optically and electrically.

A summary of the tests carried out and the quality achieved will be given. The mapping of the sensors to the positions in the detector matching the quality grades and required radiation tolerance will be shown.

HK 59.3 Thu 14:45 HK-H4

The $\overline{\text{P}}$ANDA Cluster-Jet Target at COSY - recent Results and Developments — •Philipp Brand, Daniel Bonaventura, Hanna Eick, Benjamin Hetz, Christian Mannweiler, Sophia Vestrick, and Alfons Khoukaz for the PANDA-Collaboration — Institut für Kernphysik, Westfälische Wilhelms-Universität Münster, 48149 Münster, Germany

The $\overline{\text{P}}$ANDA cluster-jet target will be the Day-1 target for the $\overline{\text{P}}$ANDA experiment within the High Energy Storage Ring (HESR) at FAIR. With this device a target thickness of more than 10^{15} atoms/cm^2 is achieved at the interaction point more than 2 m below the nozzle.

To study the influence of such a target on the properties of an accelerator beam, it is installed at the COoler SYnchrotron (COSY) in Jülich. Here, also a barrier bucket cavity and the stochastic cooling are installed, which will be used later at FAIR in the HESR. Therefore, the studies performed within beam times at COSY will give important input for the PANDA experiment. Within this talk results from recent beam times as well as new developments on the target system are presented.

This project has received funding from BMBF (05P19PMFP1 and 05P21PMFP1), GSI FuE (MSKHOU1720 and MSKHOU2023) and the EU's Horizon 2020 programme (824093).

HK 59.4 Thu 15:00 HK-H4

A prototype for hydrogen-based droplet targets for nuclear and particle physics experiments — •Christian Mannweiler, Daniel Bonaventura, and Alfons Khoukaz — Westfälische Wilhelms Universität, Münster, Germany

Internal target experiments play an important role in in particle physics research. For example, the PANDA experiment at the future HESR accelerator at FAIR will use both a hydrogen cluster-jet target and a hydrogen pellet target.

Another target technology which is closely related to the pellet target is the droplet target. The operating principle of a hydrogen droplet target is to squeeze cryogenically cooled, fluid hydrogen through a small nozzle of, e.g. 10 microns. A piezo actor induces vibrations on the nozzle, causing the hydrogen beam passing through the nozzle to break up. Depending on the nozzle diameter and the piezo frequency, a droplet beam with a diameter of around 20 microns is created. Currently, there are several challenges concerning this technology, chiefly the issue of nozzle clogging, which occurs routinely and hinders the stable long-term operation of such targets.

To combat this issue and improve the overall performance of droplet targets, a new prototype droplet target was recently constructed and commissioned at the WWU Münster. It will be used to tackle the aforementioned nozzle clogging issue as well as other challenges.

In our contribution we will present the new target prototype and its capabilities as well as first results. This project has received funding from the EU Horizon 2020 programme (824093).

HK 59.5 Thu 15:15 HK-H4

The cryogenic stopping cell for the Super-FRS at FAIR: status and outlook — •Daler Amanbayev[1], Samuel Ayet San Andres[1], Timo Dickel[1,2], Hans Geissel[1,2], Wolfgang Plass[1,2], Christoph Scheidenberger[1,2], the Super-FRS Experiment Collaboration[2], and the FRS Ion Catcher Collaboration[2] — [1]II. Physikalisches Institut, Justus-Liebig-Universität Gießen, Gießen, Germany — [2]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

The beams of exotic nuclei for the high-precision experiments planned at the Low-Energy Branch (LEB) of the Super-FRS at FAIR are produced at relativistic energies of up to 1.5 GeV/u, and have to be slowed down and thermalized down to a few eV. A gas-filled cryogenic stopping cell (CSC) is a key device in this process.

In order to achieve its challenging design performance parameters of areal densities of up to 40 mg/cm^2 for stopping efficiencies of almost unity, fast ion extraction down to times of 10 ms and a rate capability of 10^7 ions per second, a novel two-stage orthogonal extraction concept has been developed. Detailed simulations of the CSC are verified and projected from the performance of the prototype CSC, which is being successfully used in online experiments as a part of the FRS Ion Catcher at GSI.

In this talk, the major components and processes of the CSC will be highlighted, such as fine-pitched radio-frequency carpet design, simulations of ion trajectories traversed by gas jets, a cryogen-free cooling system and an ultra-clean buffer gas recovery system.