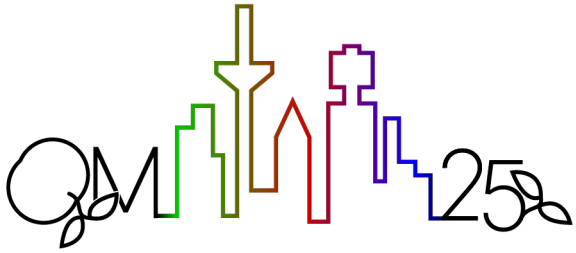

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From Concept to Implementation: The Silicon Tracking System of the CBM Experiment

The CBM experiment at the future FAIR facility is a multipurpose forward spectrometer designed to operate at high interaction rates of up to 10 MHz, implementing a triggerless, free-streaming readout system. CBM aims to study the properties of strongly interacting matter at high baryon net density, where phenomena such as a first-order phase transition from hadronic to partonic matter and a chiral phase transition are anticipated.
As the primary tracking detector of the CBM experiment, the Silicon Tracking System (STS) is engineered to efficiently reconstruct trajectories of charged particles, achieving a momentum resolution better than 2% within a 1 Tm magnetic field, and to be capable of identifying complex decay topologies. The STS consists of 876 modules arranged in eight tracking stations, keeping a low material budget of less than 10% X_0. The core component of STS is the detector module, which integrates double-sided, double-metal silicon microstrip sensors connected via low-mass microcables to custom-developed readout ASICs mounted on two front-end electronics boards.
Currently, the STS project is focused on the series production of modules and ladders for the final detector. This phase involves precise assembly and rigorous quality control procedures at every fabrication step. Comprehensive functional and thermal stress testing is conducted on fully assembled modules to ensure their reliability before integration onto carbon-fiber ladders. Simultaneously, the operational capabilities of the STS modules are assessed in various application scenarios, including high-intensity nucleus-nucleus collisions at GSI facilities and the E16 experiment at J-PARC, which serve as platforms for performance evaluation.
This report offers an overview of the CBM STS module and ladder production process, presents results from functional testing, and shares insights gained from operational deployments across different experimental setups.

Category

Experiment

Collaboration (if applicable)

CBM Collaboration

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