In-beam test of a prototype CBM Silicon Tracking System at COSY*

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In January 2012, a prototype setup of the Silicon Tracking System (STS) for the CBM Experiment has been tested in a 2.4 GeV/c proton beam at the COSY synchrotron of Research Center Jülich, Germany. The experiment aimed at a full-sytem test of prototype detector stations, data acquisition system, detector controls and online monitoring. Hit and cluster finding algorithms were applied to evaluate the performance of neutron-irradiated prototype sensors. A simple track reconstruction algorithm was applied to the data acquired to determine the position resolution of the system.

Experimemtal set-up

The experiment in the JESSICA cave is shown in Fig. 1. It comprised three silicon detector stations and two scintillating fiber hodoscopes for beam monitoring. A further CBM prototype detector for the muon detection system was installed downstream of the silicon stations. All detectors were read out with self-triggering front-end electronics based on the n-XYTER1.0 ASIC that delivered time-stamped digitized analog data to the acquisition system. The two outer silicon stations, operated already in the 2010 beam test [1], included *CBM02* prototype sensors and were used as reference detectors. In the middle station, that could be rotated around the vertical axis to allow for different beam incidence angles, *CBM04* prototype sensors were under test irradiated with neutrons up to the maximum fluence 10^{14} n_{eq}/cm^2 expected in the CBM experiment. The sensors have been described in [2].

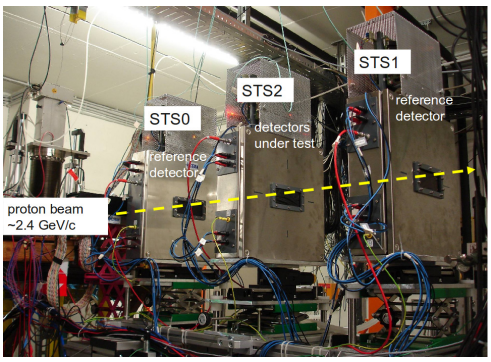
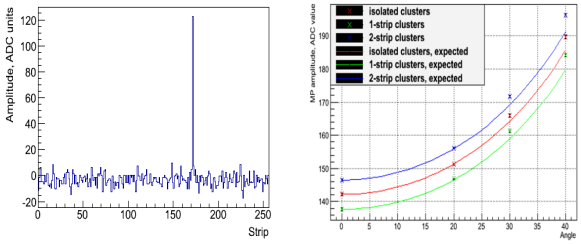


Figure 1: Beam test set-up of the prototype STS.

Results

The amplitude distributions of particle hits in the sensors demonstrated clear separation of the signal from the noise. An example of a strip hit pattern is shown in Fig. 2 (a). With increasing beam incidence angle, the charge spread over clusters of adjacent strips grows as expected, which is shown in Fig. 2 (b). After geometrical alignment of the system a simple track algorithm was applied to selected events with single particle hits, as depicted in Fig. 3. The spatial resolution obtained in both transverse coordinates was of the order of 35 μm for the reference stations, about a factor two worse that expected from the 58 μm strip pitch alone. The resolution of the irradiated sensors was slightly worse. It has to be further investigated how the increased currents with irradiated sensors and thus imposed higher thresholds, and other factors, impact on those results.



(a) (b)

Figure 2: (a) Example of a single strip fired by a passing proton in a test sensor with 256 strips. (b) Cluster charge as a function of the beam incidence angle.

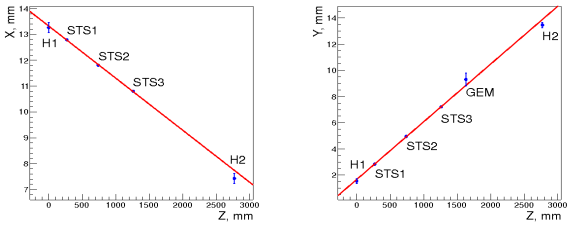


Figure 3: A reconstructed track shown in two projections.

References

[1] GSI Scientific Report 2010 26

[2] GSI Scientific Reports 2009 10 and 2011 34

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