Performance of a first prototype module for the CBM Silicon Tracking System*

T. Balog[1,2], *I. Sorokin*[3,4], *and J. M. Heuser*[1]

[1]GSI, Darmstadt, Germany; [2]Comenius University, Bratislava, Slovakia; [3]Goethe University Frankfurt a.M., Germany; [4]KINR, Kiev, Ukraine

The building block of the CBM Silicon Tracking System is a detector module, a functional unit of one or several daisy-chained double-sided silicon microstrip sensors, read-out cables and front-end electronics. Ten modules will be located on a detector ladder. Several ladders build up a STS tracking station [1].

A first prototype module comprises CBM01 double-sided sensor with 1024 channels on both sides. On every side 1/8 of the channels are read out via low-mass cables connected to two front-end boards each hosting one n-XYTER chip.

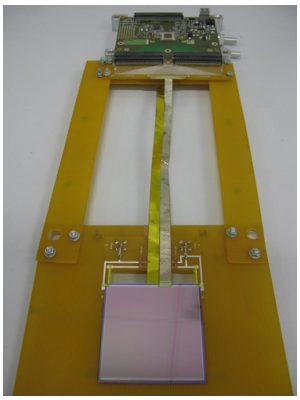

Figure 1: Photo of the prototype module.

Measurements

The noise performance of the system was determined using external triggers where baselines of the read-out electronics were triggered. Main noise source in the strip silicon detectors with cables is interstrip capacitance which was determined for all three prototypres (Table 1). In the analysis the gaussian fits of the baseline distributions were calculated and their standard deviations (σ) taken as a measure of the noise in the channels. According to the n-XYTER ADC calibration the noise is then expressed in equivalent noise charge (ENC) - amount of charge seen by the read-out electronics (Figure 2) [2].

Afterwards the charge collection efficiency for all three demonstrators was measured using a ^{241}Am source with Silicon detector. It's 59.5 keV gamma line corresponds to 114 ADC units. As seen in Figure 3 signal amplitude depends on the length of the cable connected to sensor. Within the measured prototypes the charge collection efficiency was above 85%.

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Length of read-out cable [cm]	Interstrip capacitance [pF]
10 cm	16.5 pF
20 cm	22.1 pF
30 cm	26.8 pF

Table 1: Measured interstrip capacitances of prototypes.

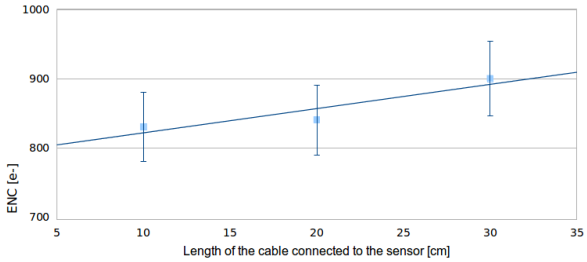

Figure 2: Noise performance of the prototype modules as a function of read-out cable length.

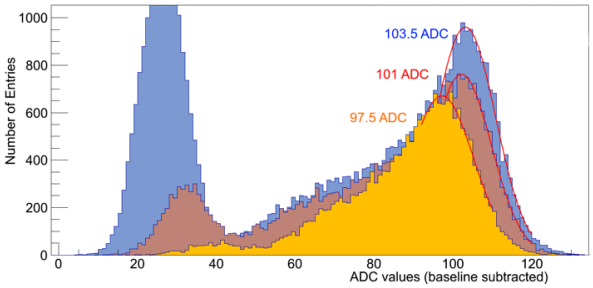

Figure 3: ^{241}Am spectra from the prototype modules.

Conclusion

For efficient track recontruction with the STS the noise of the read-out module is required to be below 4 ke$^-$. The measurements with the prototype module achieved a noise level well below 3 ke$^-$ (measure of 3σ).

According to the measured noise and the charge collection efficiency the expected signal-to-noise ratio for minimum ionizing particle in the prototype modules is above 20.

References

[1] GSI Scientific Report 2011, p.22

[2] I. Sorokin et al.: Transconductance calibration of n-XYTER 1.0, This report