Characterization of double sided silicon micro-strip sensors with a pulsed infra-red laser system for the CBM experiment*

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The Silicon Tracking System (STS) of the Compressed Baryonic Matter (CBM) experiment at FAIR is composed of 1292 double-sided silicon micro-strip sensors. For the development and the quality assurance of produced sensors a laser test system has been built up. The main aim of the sensor scans with the pulsed infra-red laser system is to determine the charge sharing between strips and to measure the uniformity of the sensor response over the whole active area. The prototype sensors CBM02 tested so far with the laser system have 256 strips with a pitch of 50 μm on each side [1]. They are read out by the self-triggering n-XYTER prototype read-out electronics.

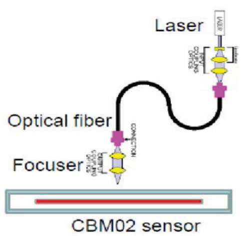

Figure 1: Schematic representation of the laser setup.

The laser system is intended to measure the sensor response in an automatized procedure at several thousand positions across the sensor with focused infra-red laser light ($\sigma_{spotsize} \approx 15$ μm). The duration (~5 ns) and power (few mW) of the laser pulses are selected such that the absorption of the laser light in the 300 μm thick silicon sensors produces about 24k electrons, which is similar to the charge created by minimum ionizing particles (MIP) there.

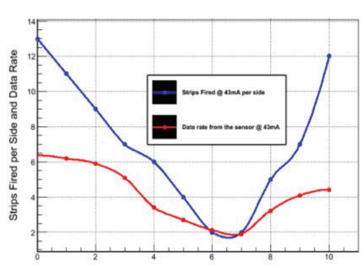

Figure 2: Dependence of number of fired strips on the distance to focuser from the sensor surface.

The wavelength of the laser was chosen to be 1060 nm because the absorption depth of infra-red light with this wavelength is of the order of the thickness of the silicon sensors [2]. Figure 1 shows the measurement setup in a schematic view. The laser light is transmitted through a 6 μm (inner diameter) thick optical fibre to a two-lens focusing system, which focuses the light to a spot size of about 15 μm diameter; working distance is about 10 mm. Figure 2 shows the dependence of the number of fired strips as a function of the distance of the laser to the sensor surface. The best focusing was obtained at position 7 w.r.t the reference level.

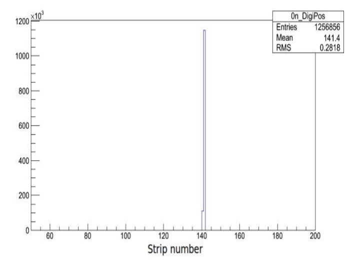

Figure 3: Distribution of hits per strips on n-side.

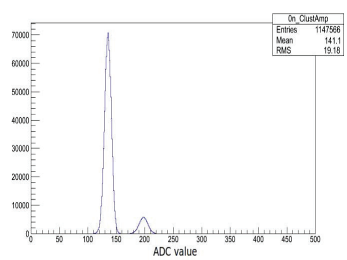

Figure 4: ADC amplitude distribution (n-side).

We have illuminated a prototype sensor with a focused pulsed laser and could achieve a spot size of a little more than one strip [See Figure 3]. The preliminary results demonstrate that we are successful in inducing charge similar to 1 MIP (24k electrons). Figure 4 shows that the number of single-strip clusters is about an order of magnitude higher than that of two-strip clusters. The next step of our work will be to investigate the charge sharing function between the strips.

References

[1] J.M. Heuser *et al.*, CBM Progress Report 2011, Darmstadt. 2012 p.17

[2] P.O'Connor *et al.*, Proc. of SPIE Vol. 6276 62761W-1, p.2

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