Serial Check of Micron Silicon Strip Detectors

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Part of the ANKE Silicon Tracking Telescopes (STT) are 69, 300 and 500μm thick double-sided structured silicon-strip detectors from Micron Semiconductor (UK). Each detector provides 128 on one and 151 segments on the other side. To guarantee a precise energy measurement by each segment, a semi-automatic method to check the performance has been developed.
The first five 300μm detectors were received in Spring 2005. Their performance check has been realized in laboratory. In vacuum an α-source (^{241}Am) was placed at a distance of 5 cm from the approximate center of the p-side of every detector. Energy spectra of every segment and 2D-plots of energy distributions between adjacent segments were analyzed. Different irregularities of segment responses were found and classified.

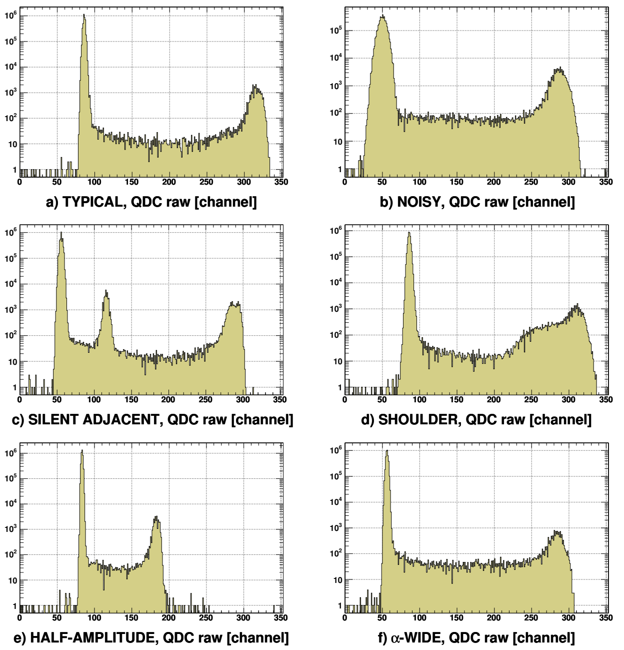

Fig. 1: a) Typical energy spectrum; b-f) Energy spectra of peculiar segments.

A regular energy spectrum (Fig.**??**.a) contains beside some small background two peaks of gaussian shape: one from the pedestal and the other from the α-particle energy deposit. Five kind of deviations from this regular spectrum have been found:

- **Noisy Segments** (Fig.**??**.b). Both peaks are 2-3 times wider than usual together with an about 5 times increased background.

- **Silent Segments** with no α-peak. Neighbours of silent segment have apparently a kind of short-cut with it, because they have always an additional peak of signals with an amplitude approximately 4 times smaller then the α-peak.

- **Shoulder Segments** have a non-typical shape of the α-peak with an additional significant tail to the left side. The background around the peak is increased by about a factor 10.

- **Half-Amplitude Segments** have peaks of regular shape and intensity, but the amplitude is approximately two times smaller then usual.

- **α-Wide Segments** have a normal pedestal peak, but the α-peak is wider and of less intensity together with an increased background.

Any of the described irregularities leads to a non-precise energy measurement for the affected segment. It was found that all these peculiar effects appear along the whole segment. A two-dimensional plot like Fig.**??** gives an impression on the performance of each detector. It shows the number of detected α-particles in dependence on the segment numbers on both detector sides. An entry is generated whenever the deposited α-energy is close as one σ to the peak-position. All regular segments have equal α counting rates after geometrical acceptance corrections.

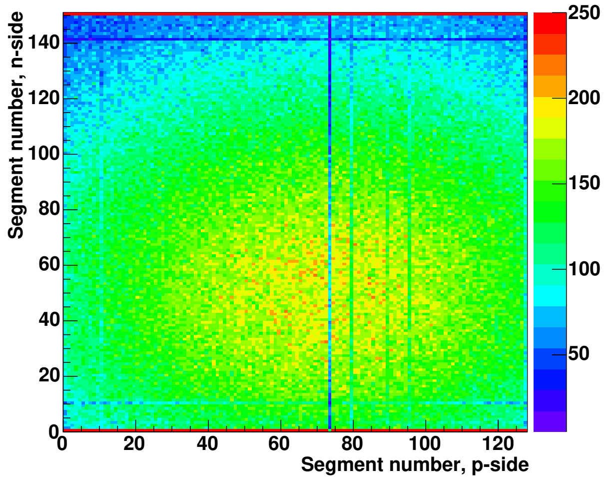

Fig. 2: α-particle distribution over a detector.

97 % of all detector segments are faultless. Nevertheless none of the detectors fullfills the given specification of 99 % fully working segments. The losses are typically of about 6 % per detector for a 2-d reconstruction and therefore about 12 % in a track reconstruction with two involved detector.
The obtained results together with the voltage-current characteristics have been delivered to Micron Semiconductor. They are the basis for an on-going discussion to improve the production technology for the next sample of detectors for the ANKE Silicon Tracking Telescopes.

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