Commissioning of the New Λ Trigger for the FOPI Spectrometer ◇

M. Berger, L. Fabbietti, O. Hartmann, and R. Münzer

Recently, the search for deeply bound nuclear states with antikaons has attracted large interest. It was recently found [1] that the p+p reaction might be well suited for the production of (K^-pp) nuclear bound states. We have proposed to perform an exclusive measurement using the FOPI detector [2] exploiting the reaction p+p at 3.5GeV and to build for this purpose a dedicated trigger device.
The final state of the $pp \rightarrow (K^-pp)K^+ \rightarrow \Lambda p K^+$ reaction involves Λ hyperons which can be detected using their decay into p + π^- (64% branching ratio). Thus, the FOPI detector has been extended by a Λ trigger system, in order to enrich events containing Λ candidates.
The scheme of the Λ trigger (SIΛVIO – SIlicon Λ Vertexing and Identification Online) is shown in figure 1. It consists of two detector layers downstream of the target with distances such that the bulk part (about 60%) of the produced Λs decay in between the two layers.

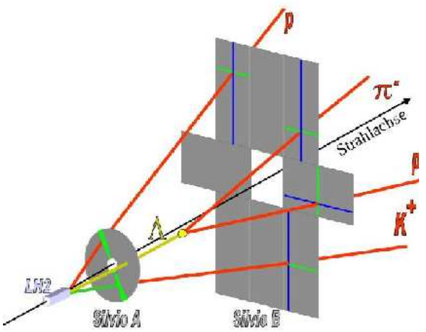

Fig. 1: Schematic view of the trigger concept.

The first layer (SIΛVIO A) is a single-sided, 1mm thick annular detector segmented in 32 slices, while the second layer (SIΛVIO B) consists of a patch-work of 8 rectangular double-sided, 1 mm thick, $40x60mm^2$ with 1 mm pitch for each side. The event selection is performed requiring online that the hit multiplicity on the second silicon layer is higher (1 or 2 hits more) than the hit multiplicity on the first layer. This operation is taken care by the Mesytec analog electronics that reads out the annular and the n side of the 8 rectangular detectors. The Mesytec shaper provide a trigger signal according to the hit multiplicity on each detector and can be set such to realize the above mentioned trigger condition. The p-side of the rectangular detectors has been read out with an APV-25 chip which allows a compact readout of all the channels. The assembled detector system is shown in figure 2, where the boards on which SIΛVIO A and B are hosted and the APV-25 cards are visible.

Fig. 2: Assembled SIΛVIO system.

A test has been carried out at GSI to test the performance of the trigger system. A proton beam at 3GeV with an intensity of 10^5 particles/sec has been focused on a plastic target and the full FOPI spectrometer, together with the Λ-trigger, has recorded data under different trigger condition. The main trigger (LVL1) has been set requiring at least one charge particle to cross the FOPI-RPC and the FOPI-PLAWA, the time of flight detectors situated at mid- and forward rapidity in the laboratory reference system respectively. The Λ trigger has been set such to accept events with one or more particle hits on SIΛVIO A in coincidence with two ore more hits on SIΛVIO B.

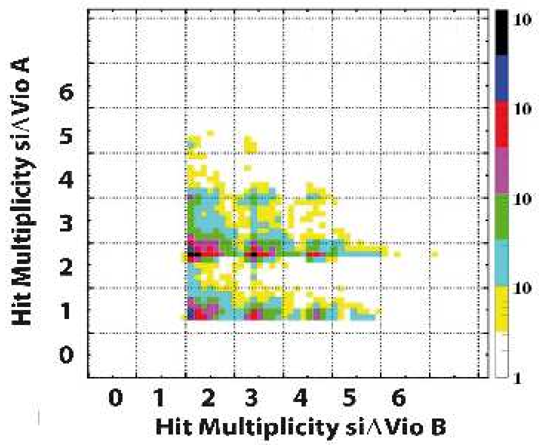

Fig. 3: Offline particle multiplicity of SiΛVio A versus the particle multiplicity on SiΛVio B.

Figure 3 shows the particle multiplicity obtained via an offline calibration for events which fullfil the Λ trigger condition. One can see how clean the required multiplicity condition is selected by the trigger. In overall a reduction of a factor 14 respect to the LVL1 trigger has been obtained applying the Λ trigger condition.

References

[1] Yamazaki *et al.*, arXiv:0810.5182v1 nucl-ex.
[2] http://www.gsi.de/documents/DOC-2007-Mar-168-1.pdf

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