A Λ Trigger for the FOPI Detector System ◊

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Recently, the search for deeply bound nuclear states with antikaons has attracted large interest. In Ref. [1], the authors claim that the p+p reaction might be a promising tool to produce (K^-pp) nuclear bound states. Such an experiment will be performed using the FOPI detector [2] to detect the final state particles.

The final state of the $pp \to (K^-pp)K^+ \to \Lambda p K^+$ reaction involves Λ hyperons which can be detected using their decay into p + π^- (64% branching ratio). Thus, the FOPI detector will be extended by a Λ trigger system, in order to enrich events containing Λ candidates.

Such a Λ trigger (SIΛVIO – SIlicon Λ Vertexing and Identification Online) built from (double sided) silicon strip detectors is currently under construction. The concept foresees at least two detector layers downstream of the target with distances such that the bulk part of the produced Λs should decay in between the two layers. Fig. 1 illustrates the configuration to be used: the first layer is an annular single sided silicon divided into sectors (left panel), and layer 2 is an arrangement out of eight double sided silicons with rectangular area and strips on both sides. Layer 1 is placed approx. 3 cm behind the target, and layer 2 has a distance of 10 cm from layer 1. The polar angular coverage of the setup from ranges from ≈10° to ≈33°.

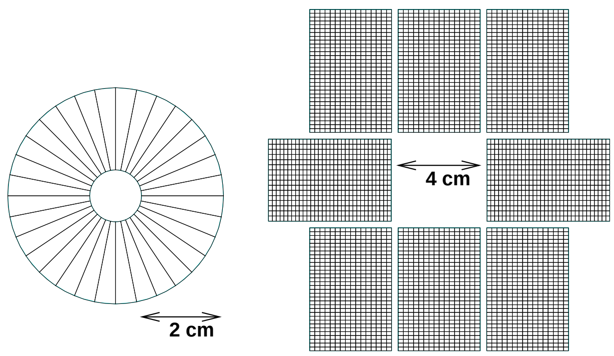

Fig. 1: Cut through the two silicon layers. Left: layer 1, right: layer 2. The hole in the middle is left for the beam.

The two layers as shown in Fig. 1 are incorporated into the FOPI simulations environment based on GEANT3.21. The simulations aim to study the acceptance and efficiency of the trigger including all relevant physics processes and finally the reconstruction of the physical signal using the information of all subdetectors. To test the performance of the trigger, the yield of accepted events coming from the signal reaction compared to background events using a transport model (UrQMD) has been evaluated under different trigger conditions. The easiest and probably most practical condition, requesting at least one hit in the first layer and at least one hit more in the second layer, accepts 26% of the signal events and rejects about 96% of the background. Applying other trigger conditions, the background rejection can be improved but on the cost of the accepted signal. Production of δ electrons and small angle scattering are included in the simulation.

A test of the trigger concept has been carried out at GSI in October 2007. A π^-, ($p\pi^+$) beam of 1.17 GeV/c momentum has been focused directly on two consecutive double sided detectors with 40·40 mm^2 area, 1 mm pitch on each side and a thickness of 1 mm. The aim of this measurement was to test the online trigger capability for MIPS and the integration of the trigger into the FOPI DAQ. The readout of the silicon detectors was done using the Mesytec analog electronics which provide a relatively fast information on the number of channels that fire above a given threshold. Such signals are employed to compare the hit multiplicity of two consecutive silicon layers and realize a Λ trigger. During the test experiment, data have been stored for multiplicity triggers equal to 1 or to 2. For a given trigger, the number of MIPS per event are processed offline and divided by the number of triggered events. In Fig. 2 the outcome is plotted as a function of the run number. For an ideal trigger the purity should be 1 or 2 for the multiplicity triggers 1 or 2, respectively. The experimental result is close to this value and the purity of the trigger is estimated to be 94-98%.

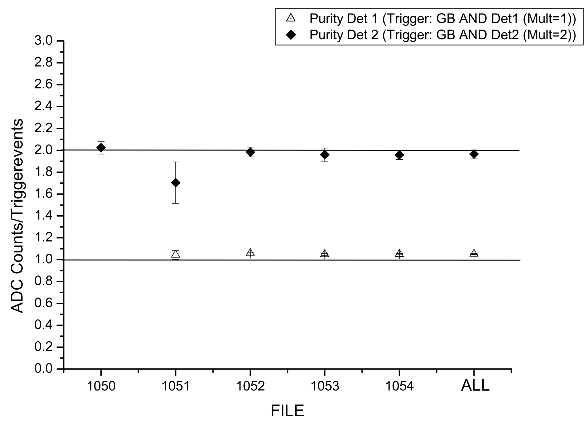

Fig. 2: Trigger purity for two different trigger multiplicities as a function of the run number.

References

[1] Yamazaki and Akaishi, Phys.Rev. **C 76** (2007) 045201
[2] http://www.gsi.de/documents/DOC-2007-Mar-168-1.pdf

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