Scintillating fiber detectors for HypHI Phase 0 experiment *

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The first step of the HypHI project (Phase 0) has been performed in order to demonstrate the feasibility of precise hypernuclear spectroscopy with heavy ion induced reactions. In the experiment, light hypernuclei such as ${}^{3}_{\Lambda}$H, ${}^{4}_{\Lambda}$H and ${}^{5}_{\Lambda}$He are produced by induced reaction of ^{6}Li at 2 A GeV on a ^{12}C target, and the hypernuclei events are reconstructed by observing π^- decay channels by means of the invariant mass spectroscopy [1, 2]. In the Phase 0 experiment, three sets of two dimensional Scintillating fiber (SciFi) detectors ,TR0xy, TR1xy and TR2xy, are used to track charged particles behind the carbon target. They are also used to produce secondary vertex triggers to the data aquisition system [3]. Figure 1 shows the schematic layout

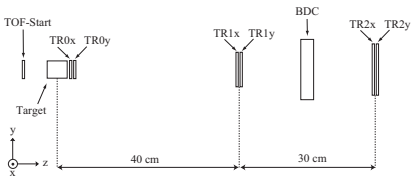

Figure 1: The schematic layout of the detector system in upstream of the spectrometer

of the experimental setup in front of the ALADiN magnet. TR0 is mounted right behind the graphite target, and TR1 and TR2 placed with distances of 40 cm and 70 cm, respectively, from the target. Each set consists of x and y plane for the horizontal and vertical tracking. In between TR1 and TR2, a drift chamber with six layers (BDC) was mounted to solve a stereo ambiguity in track finding process. Readout of scintillating photons is performed with H7260KS MOD (Hamamatsu) 32 channel multi-anode photomultiplier tube (PMT), which is an improved version of the commercial PMT H72690. It has grids in the glass window in front of the photo-cathode to separate each channel in order to reduce cross talks, and has booster cables in the last three dynode stages to stabilize the voltage under high beam intensity[4]. Analog signals from PMT are processed by a double-threshold discriminators (DTDs) from the MAMI KaoS collaboration to create LVDS logic signals. The timing information of leading- and trailing- edge of the LVDS logic signals were recorded by VUPROM2 which is a newly developed VME logic module with a FPGA running at 400 MHz. In addition, charge information of TR0 was stored by charge sensitive analog-to-digital converters (QDCs) to distinguish particles with different charges, Z = 1, 2 and 3, from their energy deposition in order to reduce background events [1].

A group of neighboring fired channels are clustered and hit position is calculated from the center of gravity of the hit cluster. The position resolution is defined as a width of the residual distribution, which is the distribution of distance between measured hit positions and track position extrapolated by the other detector. Figure 2 shows the residual hit position distribution at TR1 for the tracks extrapolated by TR0, TR2 and BDC for particles with Z = 1. Although further calibration has to be carried out, a position resolution of $\sim$ 0.47 mm in σ for particles with Z = 1 has been already achieved, which is close to the expected resolution[4]. For particles with Z = 2 and 3, position resolutions of 0.56 mm and 0.28 mm in σ have been achieved.

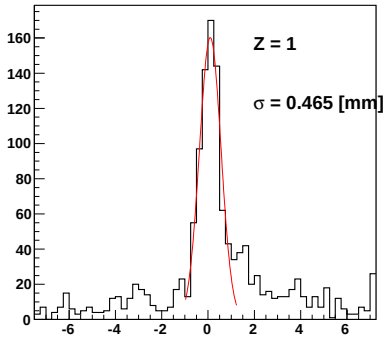

Figure 2: The residual distribution of the hit position at TR1 from the track extrapolated by TR0 and TR2 for particles with Z = 1.

References

[1] T.R. Saito *et al.*, Letter Of Intent of HypHI.

[2] T.R. Saito *et al.*, in these reports.

[3] S. Minami *et al.*, in these reports.

[4] D. Nakajima and B. Özel-Tashenov *et al.*, Nucl. Inst. Meth. A 608 (2009) 287-290

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