Drift chambers for the HypHI project

E. Kim*[1,2], D. Nakajima[1,3], B. Özel-Tashenov[1,4], S. Bianchin[1], O. Borodina[1,5], V. Bozkurt[1,4], B. Göküzüm[1,4], S. Kim[1], Y. Ma[5,6], S. Minami[1], C. Rappold[1,7], and T.R. Saito[1,5]

[1]GSI, Darmstadt, Germany; [2]Seoul National University, Seoul, Korea; [3]Tokyo University, Tokyo, Japan; [4]Nigde University, Nigde, Turkey; [5]Mainz University, Mainz, Germany; [6]Tohoku University, Sendai, Japan; [7]Strasbourg University, Strasbourg, France

The HypHI project aims to perform the precise hypernuclear spectroscopy with stable heavy ion beams and rare isotope beams at GSI and FAIR in order to study hypernuclei at extreme isospin and measure hypernuclear magnetic moment directly [1]. As the first experiment of the HypHI project, the Phase 0 experiment was performed in August and October 2009 to demonstrate the feasibility of the experimental methods with ^{6}Li beams at 2 A GeV impinging on a ^{12}C target [2].

In the experiment, two drift chambers from KEK were installed for tracking charged particles. The small drift chamber was placed between scintillating fiber detectors (TR1 and TR2) [3], and the big drift chamber was placed behind the ALADiN magnet. The component plane, active area and drift length of the chambers are listed in Table 1.

Chamber	Active area [cm^2]	Plane	Drift length [mm]
Small	24(W)×14(H)	xx' (vertical)	2.5
		uu' (-15^o)	2.5
		vv' (15^o)	2.5
Big	120(W)×90(H)	XX' (horizontal)	4.5
		YY' (vertical)	4.5
		U (45^o)	9.0

Table 1: Specifications of drift chambers.

The gas mixture for both chambers was Ar (70 %) + CO_2 (30 %) at atmospheric pressure. In the small chamber, the high voltages were 1.53 kV for potential wires and 1.42 kV for cathode planes. In the big chamber, 2.20 kV (XY) and 2.43 kV (U) for potential wires and 1.48 kV (XY) and 1.59 kV (U) for shields were applied.

These chambers are designed to be operated up to 10^5 particles per second per wire. However, since these drift chambers were located on the beam axis and ^{6}Li beams with an intensity of 10^7 particles per second were used in the experiment, an insensitive area for the beam particles was implemented for both drift chambers with different techniques.

For the small chamber, the sense wires in the beam region (1.5 cm × 1.5 cm) were wrapped with teflon sheets (refer to Figure 1). Before the experiment, the insensitivity in that region was studied with ^{90}Sr β-source. It showed a total efficiency with all six planes of 2.2×10^{-4} and an efficiency per plane of 0.25 ± 0.04. In addition, another method by attaching mylar tapes on the cathode planes was applied to improve the insensitivity.

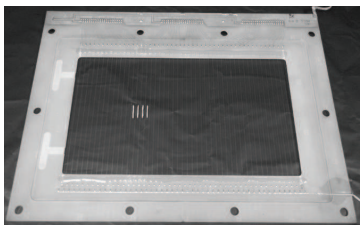

Figure 1: Taflon-wrapping to make the sense wire insensitive in the small chamber

For the big chamber, the beam region was made insensitive by connecting the sense wires and the potential wires to remove the electric field around the sense wires. With these techniques, both of the drift chambers have been operated with an beam intensity of up to 5×10^6 per second.

Logic signals from the discriminators of the drift chambers are to the newly developed universal logic modules VUPROM2 [4], and time information were recorded with a granularity of 2.5 ns.

References

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

[2] T.R. Saito *et al.*, Proposal of the HypHI Phase 0 experiment, submitted to G-PAC 33

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* e.kim@gsi.de