Low-pressure MWDC system for ESPRI experiment

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Elastic scattering of protons with RI beams (ESPRI) has been used to study the ground-state properties of unstable nuclei[1]. In order to achieve good energy resolution in the experiment, position and angular resolutions of 100 μm and 0.1 mrad are required at a position of the solid hydrogen target. The typical energy and intensity of the beam are 200-300 MeV/nucleon and 10^{5-6} particles per second (pps), respectively. This report describes a multi wire drift chamber (MWDC) system newly constructed for this purpose.

Figure 1 shows a schematic layout of the system, and Table 1 shows the specification of the MWDC. Two MWDCs are installed inside a vacuum chamber at a distance of 1 m. Through the SHV connectors, negative potentials are applied to the cathode planes and the potential wires against the anode wires. Signals from the anode wires are converted into LVDS signals by the ASDs (GND, GNA-210), and fed to multihit TDCs.

The chamber including the MWDCs, with volume of about 25 L, is filled with 100% quench gas (CH_4, C_2H_6, i-C_4H_{10}) at low pressures to reduce multiple scattering of the beam. Figure 2 shows a schematic diagram of the gas handler system. The pressure of the gas is controlled with a pressure controller (MKS, 640B), and measured with two vacuum gauges (INFICON, CDG025D-X3). The flow rate is adjusted with a metering valve (Swagelok, SS-4MG / SS-4L).

Basic characteristics of the system were evaluated with a ^{132}Xe beam at HIMAC. Figure 3 shows the detection efficiency as a function of the bias voltage when i-C_4H_{10} (99.5%) was used at 6666 Pa. Definition of symbols in Fig. 3 is the same as in Ref. 3. The flow rate was about 100 cc/min at 1 atm to maintain the purity of more than 99%. The efficiency reached 100% without any electric discharge. In addition, position resolution for each plane was about 60 μm (rms).

In summary, we constructed a low-pressure MWDC system. By using the ^{132}Xe beam and the i-C_4H_{10} gas, basic characteristics were evaluated for the beam intensities of 10^{3-4} pps. We will further study these quantities for the beam intensities of 10^{5-6} pps.

Table 1. Specification of each MWDC. The design was based on the MWDC for SAMURAI[2].

Configuration	X-X'-Y-Y'-X-X'-Y-Y'
Effective area	77.5 mm(X) × 77.5 mm(Y)
Drift length	2.5 mm (Anode-Potential)
Gap	$4.8^{+0.0}_{-0.1}$ mm (Cathode-Cathode)
Anode wire	W-Re / Au (Diameter: 16 μm)
Potential wire	Al / Au (Diameter: 80 μm)
Cathode foil	Kapton / Al (Thickness: 7.5 μm)
Window foil	Aramid (Thickness: 4 μm)

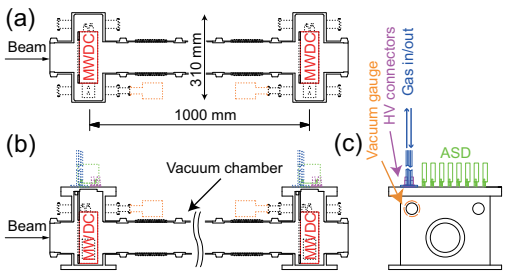

Fig. 1. Schematic layout of the MWDC system: (a) vertical sectional, (b) cross sectional, (c) front views.

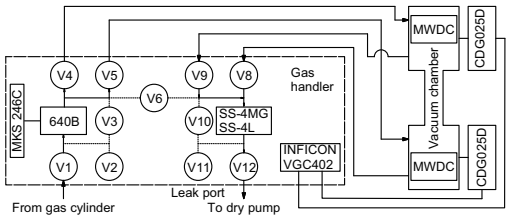

Fig. 2. Schematic diagram of the gas handler system.

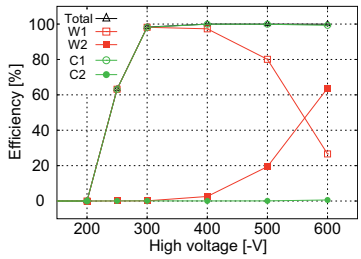

Fig. 3. Detection efficiency for the 200 MeV/nucleon Xe beam. The beam intensity was 6×10^3 particles per pulse (pulse width 1 s). The threshold voltages of the ASDs were -20 mV. Definition of the symbols is the same as in Ref. 3.

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References

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