Development of a gas target system for high energy resolution measurement at 0°

H. Matsubara[1], A. Tamii[1], T. Adachi[1], M. Dozono[2], H. Fujita[3], K. Fujita[1], Y. Fujita[4], N. Fujita[5], K. Hatanaka[1], D. Ishikawa[1], M. Itoh[6], M. Kato[1], T. Kawabata[7], S. Kuroita[2], K. Nakanishi[7], A. Nonaka[5], H. Okamura[1], H. Sakaguchi[5], S. Sakaguchi[7], Y. Sakemi[6], Y. Sasamoto[7], Y. Shimbara[8], Y. Shimizu[7], K. Suda[1], Y. Tameshige[1], R. Yamada[8], Y. Yamada[2], M. Yosoi[1], and J. Zenihiro[9]

[1] *Research Center for Nuclear Physics (RCNP), Osaka University, Ibaraki, Osaka 567-0047, Japan*
[2] *Department of Physics, Kyusyu University, Higashi, Fukuoka 812-8581, Japan*
[3] *School of Physics, University of the Witwatersrand, Johannesburg 2050, South Africa*
[4] *Department of Physics, Osaka University, Toyonaka, Osaka 560-0043, Japan*
[5] *Department of Applied Physics, Miyazaki University, Miyazaki 889-2192, Japan*
[6] *Cyclotron and Radioisotope Center (CYRIC), Tohoku University, Sendai, Miyagi 980-8578 Japan*
[7] *Center for Nuclear Study, University of Tokyo, Wako, Saitama 351-0198, Japan*
[8] *Department of Physics, Niigata University, Niigata, Niigata 950-2181, Japan*
[9] *Department of Physics, Kyoto University, Sakyo, Kyoto 606-8502, Japan*

A gas target system for high energy resolution measurement with using a dispersed beam at 0° was developed. The system was designed to achieve an energy resolution of 30 keV in FWHM in (p,p') experiments at 0° via a 295 MeV proton beam. A specification of the target system was modified from Ref. [1], and then a target apparatus was newly produced. An energy resolution goes worse in a measurement at finite angles because a matching condition of the Grand Raiden spectrometer can not satisfy.

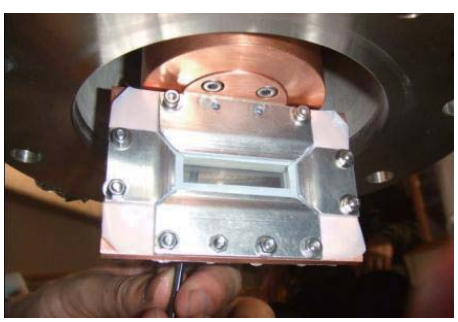
A target cell has a wide window to pass a dispersed beam which results in being horizontally broadened at the target position. A size of the window was 44×14 mm^2 in the dispersive direction and its perpendicular one, respectively (Fig. 1 (A)). An aramid film with a thickness of 6 μm was used as a window material of the cell. It was found to be able to bear a pressure of up to 3 atm. A typical pressure of a target gas filled in the cell was 1 atm. Liquid nitrogen can be used to cool a gas in order to increase its target thickness.

A temperature and a pressure of a target gas were measured to deduce a target thickness. A temperature sensor of a Pt-100 and a pressure transmitter were used. The data were recorded and monitored on a Linux PC through a GPIB connection. A cell length is also an important parameter to deduce its target thickness, however, it is hard to measure it directly because a baloon like property of an aramid film increases a total length of the cell when a gas is filled up to at 1 atm. A CO_2 gas was used to deduce a precise length of the cell via a cross section of ^{12}C which was well known. Here, note that an aramid film also contains an element of carbon.

Because a dry pump is used in a gas handling system, a target gas can be filled into the cell without any oil contaminations. Even if a pressure of a source gas is less than 1 atm, the pump can compress it up to at 1 atm at the least, and 4 atm at the most when there is much source gas. When a connection from the cell to the pump is reversed, a gas used in the cell can be collected and stored in a bottle through the pump. Such a recycling gas system can be useful in case that one uses an expensive gas, *e.g.* ^{36}Ar.

Figure 1 (B) shows a typical spectrum of the cell windows, aramid, with an empty target gas at 0°. We note that there are two types of aramid, one is made by Tore and its compositional formula is $C_{49}O_7N_7Cl_6H_3$, and the other is by Asahi-kase and $C_{14}O_2N_2H_3$. A thin film, we used, includes chlorine. Typcal results with filling a target gas, ^{20}Ne and ^{36}Ar, are shown in Ref. [2].

(A)



(B)

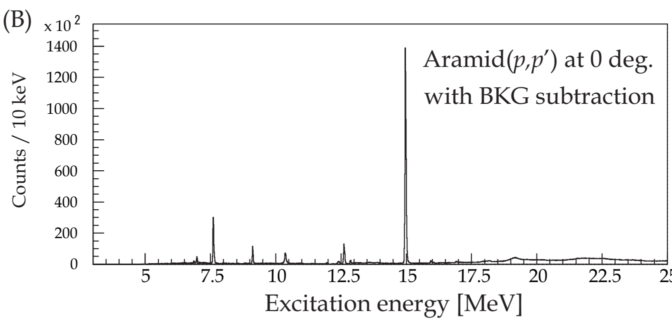


Figure 1: (A) : A photograph of the gas cell newly developed is shown. It has a wide window to pass a dispersed beam. (B) : A typical spectrum of the cell with an empty gas at 0° with background subtraction is shown. Signals due to aramid films ($C_{49}O_7N_7Cl_6H_3$) are seen.

References

[1] T. Kawabata *et al.*, Nucl. Instr. Meth. A 459 (2001) 171.

[2] H. Matsubara *et al.*, in this Annual Report.