Re-measurement of the ^{4}He(^{8}He, ^{8}Be) reaction

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In our previous study, the candidate resonance of the $4n$ system (tetra-neutron) was found using the ^{4}He(^{8}He, ^{8}Be)$4n$ reaction with a 186-MeV/nucleon ^{8}He beam.[1)] A new measurement improved in terms of data statistics and energy accuracy was performed to confirm the existence of tetra-neutron resonance.[2)]

To obtain the mass of tetra-neutrons by the missing mass method, it is necessary to determine the energy and scattering angle of the recoiling particle ^{8}Be. Because ^{8}Be is unbound, it decays into two alpha particles immediately. In this experiment, the pair of alpha particles was simultaneously detected at the final focal plane S2 of the SHARAQ spectrometer to reconstruct the invariant mass of ^{8}Be.

At S2, two cathode readout drift chambers (CRDCs) were installed. One CRDC has two segments for the horizontal direction, and it can provide the beam position in the horizontal and vertical directions. The horizontal and vertical positions are given by the induced charge distribution over the cathode pads and by the drift time of the anode wires, respectively. The horizontal position can be determined by fitting the charge distribution with the SECHS function.

$$f(x) = \frac{p_0}{\cosh^2\left(\frac{x-p_1}{p_2}\pi\right)} \tag{1}$$

To apply for two-particle tracking, the summation of Eq. (1) was used.

$$f(x) = \frac{p_0}{\cosh^2\left(\frac{x-p_1}{p_2}\pi\right)} + \frac{p_0 p_3}{\cosh^2\left(\frac{x-p_4}{p_5}\pi\right)} \tag{2}$$

Figure 1 shows an example of the fitting results. The data are well reproduced by the fitting function in red. The charge can be obtained by integrating each SECHS function in Eq. (2).

As the next analysis step, we consider the reliable identification of two tracks by a ^{8}Be particle. Some events contain the overwrapped tracks on the same direction. Figure 2 shows typical patterns of two-particle tracking. Proper identification of the ^{8}Be events will be confirmed by combining the tracking and charge-deposit data.

Data analysis is in progress toward the final result.

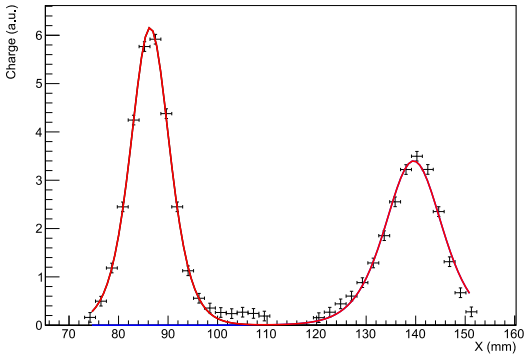

Fig. 1. Example of the charge distribution measured by CRDC. The fitting function is shown by the red line.

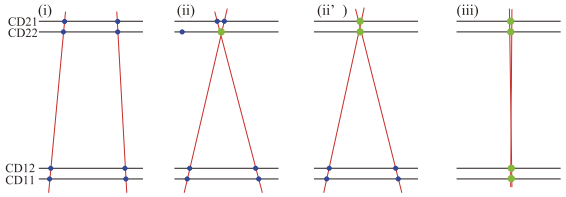

Fig. 2. Two-particle tracking patterns. The filled circles indicate the hit points of alpha particles in the pair of CRDCs. The green circles represent the crossing of two tracks. (i) Two tracks are completely divided. (ii) and (ii') Two tracks cross at one or two segments. (iii) Two tracks are completely overwrapped.

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