Development of New Dispersive Beam Transportation for WN-course at RCNP

H. Fujita [a], Y. Fujita [a], K. Harada [a], Y. Shimbara [a],
K. Hatanaka [b], K. Katori [c], T. Noro [b],

[a] *Department of Phisics, Osaka University, Toyonaka, Osaka 560-0043, Japan*
[b] *Research Center for Nuclear Physics (RCNP), Ibaraki, Osaka 567-0047, Japan*
[c] *Institute for Chemical and Physical Research (RIKEN), Wako, Saitama 351-0106, Japan*

By applying the dispersion matching technique for the beam transportation to a spectrometer, the deterioration of momentum resolution caused by the momentum spread of the incoming beam can be compensated [1], [2], [3]. An ion optical design usually used for the dispersive beam transportation to the spectrometer Grand Raiden through the beam line WN-course is difficult to realize since it has no object point in the beam line. Therefore, ion optical calculation was done for a new beam transportation which has an object point. The beam line is divided into two sections at this object point and the beam line can be tuned for each sections separately. In this report, this new dispersive beam transportation is presented.

The first section is to the beam viewer BV-EXT and the second section is from BV-EXT to the target and the beam from the RCNP ring cyclotron is focused at object point BV-EXT. Trajectories of the beam in the second section is shown in Fig 1. In this section, dispersion $(x \mid \delta)$ of 37m is generated and the magnification $(x \mid x)$ is -1.8. This beam transportation was tested in a (^{3}He,t) experiment at zero degrees. Incident energy of the beam was 150MeV/u.

After searching the strengths of quadrupole magnets to realize dispersion matching, an energy resolution less than 110keV was realized. In addition, by cutting the emittance of the beam using a pair of slits at the beam viewer BV5a, an energy resolution less than 90keV was realized. The spectrum obtained in the ^{27}Al(^{3}He,t) reaction is shown in Fig 2.

Under the condition of dispersion matching, horizontal position of the beam at the target corresponds to the different momentum of the beam. Using steering magnet just before the target and a narrow ^{27}Al strip target with a width of 2mm, momentum of the beam passing through the target can be selected. By steering the beam, it was found that the resolution observed at the focal plane of the spectrometer changes by a factor of two, suggesting that the focussing condition of the beam is different at different position on the target. It is suspected that the focal plane of the beam line is tilted, namely second order terms are large.

By changing the beam condition of transportation in the first section of the beam line, the size of beam spot at object point can change. By tuning the size of beam spot, it was found that energy resolution at the focal plane changes rather largely. It is considered that the large magnification $(x \mid x)$ of this beam transportation is related with the phenomena.

References

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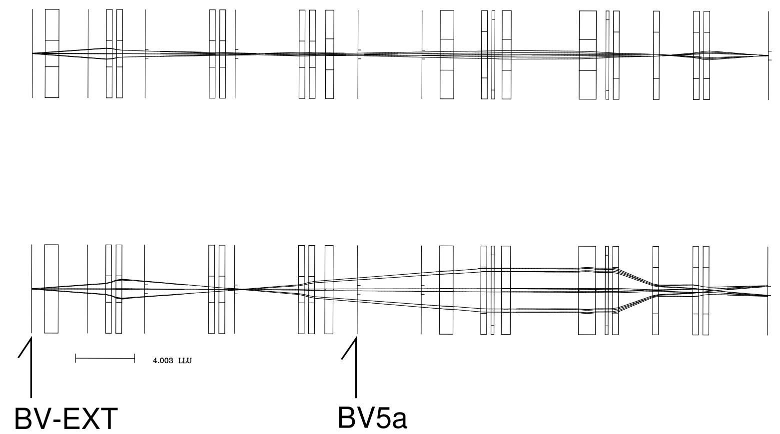

Figure 1: Schematic trajectories of dispersive beam transportation. The horizontal trajectory is shown on left side and the vertical trajectory on right side. The ion optical calculation is performed by using a code GIOS. The trajectories show how the beam behaves when the dispersion of 37m and the angular dispersion of 20rad are realized at the target point.

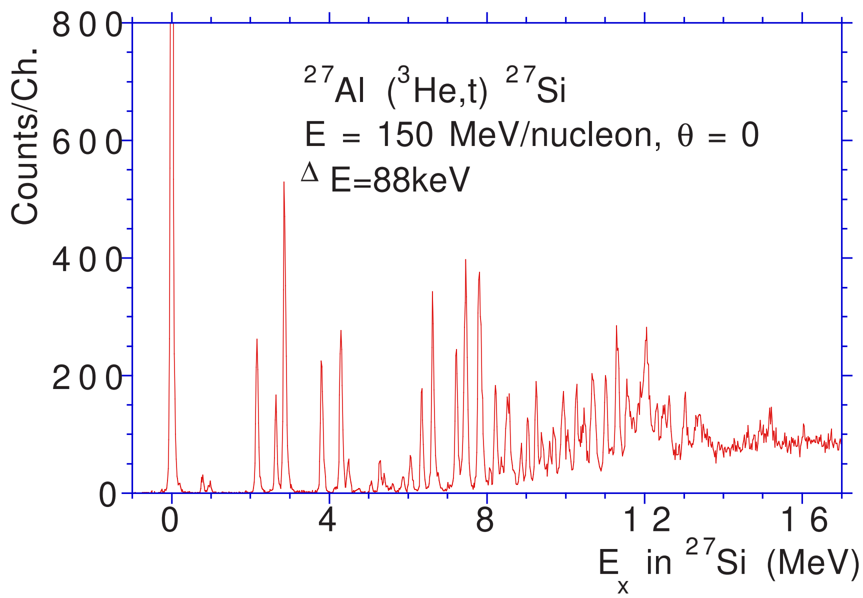

Figure 2: The ^{27}Al(^{3}He,t) spectrum which realized energy resolution less than 90keV.