

Production cross-section measurements of ^{225}Ac produced via projectile fragmentation of ^{238}U beam at 345 MeV/nucleon

S. Nishizawa,^{*1,*2} T. Sumikama,^{*2} T. Yamaguchi,^{*1,*2} R. Matsumura,^{*1,*2} N. Fukuda,^{*2} H. Otsu,^{*2} H. Sakurai,^{*2} H. Takeda,^{*2} H. Suzuki,^{*2} M. Yoshimoto,^{*2} Y. Shimizu,^{*2} K. Yoshida,^{*2} N. Inabe,^{*2} Y. Yanagisawa,^{*2} J. Tanaka,^{*2} H. Haba,^{*2} A. Nambu,^{*2} Y. Shigekawa,^{*2} X. Yin,^{*2} M. Sasano,^{*2} D. Nishimura,^{*2,*3} H. Takahashi,^{*2,*3} S. Sugawara,^{*2,*3} and K. Higuchi^{*2,*4}

RIBF has successfully developed the capability to produce heavy element radioactive isotope (RI) beams,¹⁾ including ^{225}Ac , which is promising for cancer treatment using alpha radiation.²⁾ These RI beams are produced from a ^{238}U beam through projectile fragmentation reactions. An advantage of this production process involves the use of the fragment separator BigRIPS to enhance the purity of the ^{225}Ac beam.

To evaluate the feasibility of these heavy RI beams for future experiments and applications, it is essential to measure their production cross-sections. The ^{225}Ac beams were produced using the ^{238}U beam accelerated to 345 MeV/nucleon and a Be target (1 mm). The fragments were identified based on their atomic number (Z), using an ionization chamber with a Xe-based gas,³⁾ and mass-to-charge ratio (A/Q).⁴⁾ Figure 1(a) shows the particle identification (PID) plot measured with a 20-mm-wide momentum slit at the dispersive focal plane F1. The plot shows two distinct regions: a high A/Q region dominated by He-like particles between F3 and F7, and a low A/Q region containing both He-like and H-like particles. To remove most H-like particles, we narrowed slits at two momentum dispersive foci, F1 and F5. This is because the beam-position correlation between F1 and F5 differs for He-like and H-like particles. By narrowing the slit widths to 10 mm (0.5%) at F1 and 40 mm (1.3%) at F5, we obtained a cleaner PID plot, as shown in Fig. 1(b). The yield of ^{225}Ac varies as a function of magnetic rigidity, which is selected at the F1 slit. Since a single setting only measured a portion of the yield distribution, we shifted the F1 slit from -25 mm to 30 mm in 5 mm increments to measure the entire range. These measurements resulted in 12 settings. Figure 2 shows the summed PID plot for these settings, normalized by primary beam intensities. The particle identification was possible for many isotopes as the He-like particle.

A detailed analysis of the production cross-sections of heavy element isotopes, including ^{225}Ac , is currently in progress.

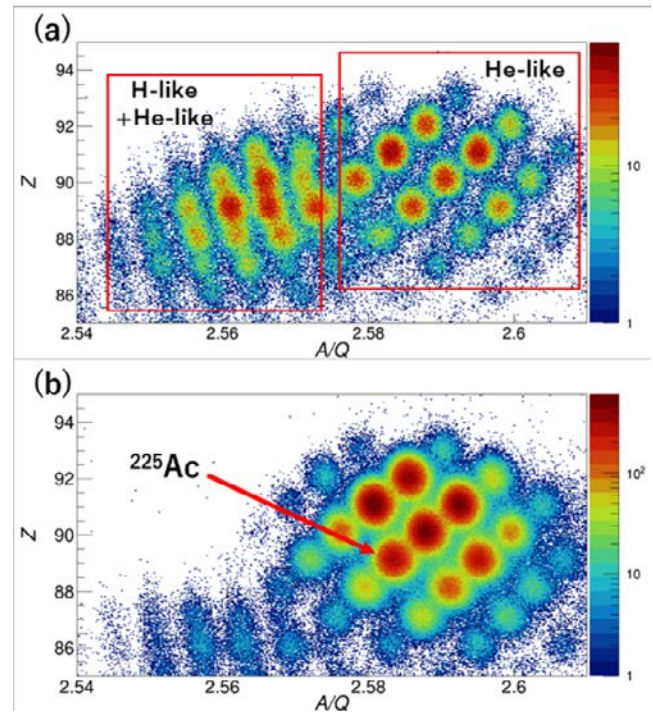


Fig. 1. Z versus A/Q particle identification plot for projectile fragments produced in the $^{238}\text{U} + \text{Be}$ reaction. (a) Wide slit condition set to a 20-mm opening for the F1 slit. (b) Narrow slit condition set to a 10-mm opening.

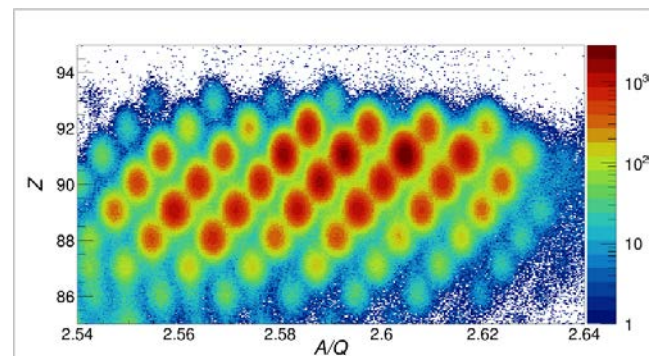


Fig. 2. PID plot summed over the 12 different settings with the 10-mm opening at the F1 slit.

References

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*1 Department of Physics, Saitama University

*2 RIKEN Nishina Center

*3 Department of Natural Sciences, Tokyo City University

*4 Department of Physics, Toho University