Production cross section measurements for fragments of ^{70}Zn beam

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We measured the production yields and production cross sections of radioactive isotopes (RIs) in the neutron-rich region with the atomic number $Z = 16 \sim 24$ produced from an ^{70}Zn beam at an energy of 345 MeV/nucleon by using the BigRIPS separator[1]. Neutron-rich RIs were produced through projectile fragmentation on a 10-mm Be target, and the particle identification (PID) of RIs was performed using the TOF-Bρ-ΔE method. The energy loss (ΔE) was measured using an ion chamber at F7. The time-of-flight (TOF) between F3 and F7 was measured using plastic scintillators and the trajectory was measured at F3, F5, and F7 by using Parallel Plate Avalanche Counters(PPACs).

The Bρ of BigRIPS was set to the rigidity corresponding to the center of the momentum distribution of ^{56}Ca, and the PID was confirmed by the isomers of ^{56}Sc and ^{59}Ti. The experimental conditions for ^{56}Ca setting are listed in Table 1. Figure 1 is a PID plot showing the relation between the atomic number (Z) and mass-to-charge ratio (A/Q). Background events were eliminated by the correlations among phase-space profiles by using the PPAC, pulse-height, and timing signals from the plastic scintillators; reaction loss events in the ionization chamber; pile-up events using plastic scintillators and the ionization chamber; particle trajectories between two different foci; and charge state change at F5.

Table 1. Experimental conditions.

Center particle	^{56}Ca
Target	Be 10 mm
F1 degrader	Al 3 mm
F5 degrader	Al 5 mm
Bρ01	7.349 Tm
Momentum acceptance	± 3%

The production cross sections were obtained using the transmission efficiency calculated using LISE++ code[3] and production yields. In Figure 2, the red circles represent the experimental result of RIs produced from the ^{70}Zn beam. The solid and dashed lines in Fig. 2 represent the production cross sections calculated with empirical formulae EPAX3.1a[4] and EPAX2.15[5], respectively. EPAX3 is proposed as the universal empirical formula, and it shows better agreement with experimental data for the most neutron-rich fragments than EPAX2 does. Overall, our experimental measurements of cross sections are in good agreement with the EPAX parameterizations. The production cross sections are consistent with EPAX2.15 for $Z < 20$ and with EPAX3.1a for $Z > 20$.

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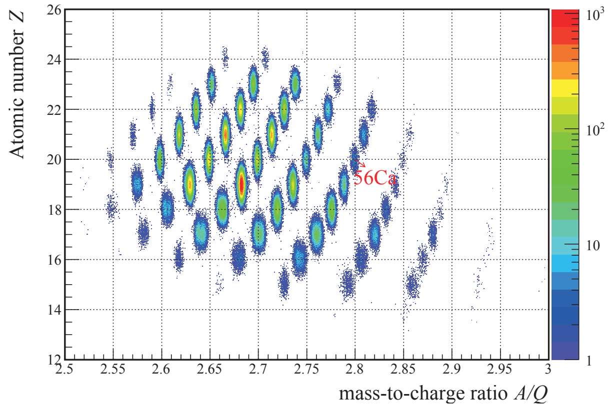

Fig. 1. Particle identification plot of atomic number Z versus mass-to-charge ratio A/Q for projectile fragmentation in the reaction of ^{70}Zn + Be at an energy of 345 MeV/nucleon.

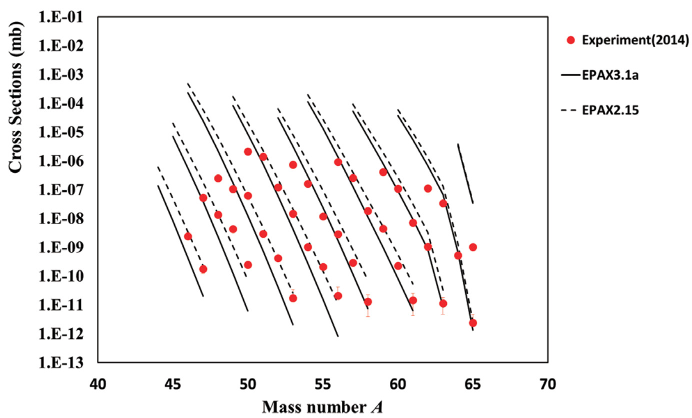

Fig. 2. Production cross section for fragments of the ^{70}Zn beam. The solid and dashed lines represent EPAX parameterizations, and the red circles represent experimental results.

References
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