

Production cross-section measurement and new-isotope search for very-neutron-rich RIs produced from ^{70}Zn beam at 345 MeV/nucleon by BigRIPS separator

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We performed production cross-section measurements and a new-isotope search in the neutron-rich region with the atomic numbers $Z = 12\text{--}19$, located south-east of ^{48}Ca in the nuclear chart. The neutron-rich radioactive isotopes (RIs) were produced by the projectile fragmentation of a 600-particle-nA ^{70}Zn beam at 345 MeV/nucleon impinging on a 10-mm-thick Be target in the BigRIPS separator. Particle identification based on the TOF- $B\rho$ - ΔE method¹⁾ was performed in the second stage of BigRIPS. Three BigRIPS settings were used with ^{45}S , ^{43}Si , and ^{45}Si as central particles. The former two settings were for the cross-section measurements, and the last one was for the new-isotope search. The production cross sections were deduced from the measured production rates and their transmission efficiencies

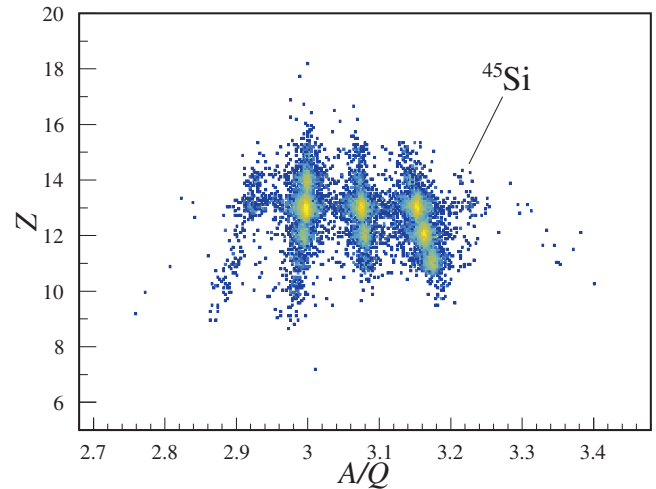


Fig. 2. PID plots obtained in the ^{45}Si setting. Events of a new isotope, ^{45}Si , were clearly observed.

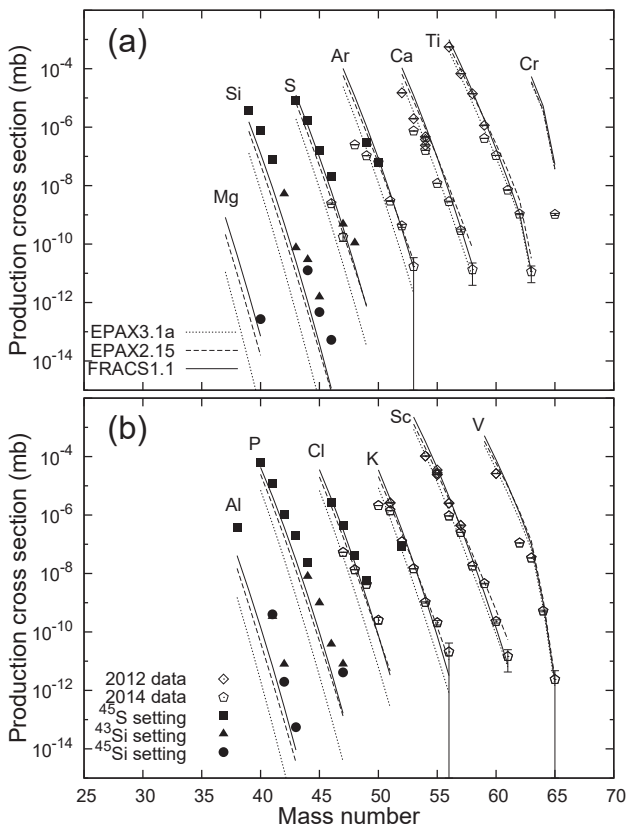


Fig. 1. Measured production cross sections of RIs produced in the $^{70}\text{Zn} + \text{Be}$ reaction at 345 MeV/nucleon with semi-empirical cross-section formulae. (a) Results for even- Z isotopes. (b) Results for odd- Z isotopes.

in BigRIPS, which were simulated with LISE++ calculations.²⁾ In the simulation, parameters that control the momentum and angular distribution^{2,3)} are not changed from the default values in the current preliminary analysis.

Figure 1 shows the production cross sections of RIs obtained in this work (filled symbols), together with measurements in 2012 and 2014 (open symbols). The solid, dashed, and dotted lines show the cross sections predicted by the semi-empirical formula FRACS1.1,⁴⁾ EPAX2.15,⁵⁾ and EPAX3.1a.⁶⁾ Overall, FRACS1.1 best reproduces the measured cross sections among these formulae; however, around the very-neutron-rich region, the discrepancy between the measured and predicted cross sections becomes larger. A new isotope, ^{45}Si , was discovered in this work, as shown in Fig. 2. One event was also observed at the location of ^{46}Si , although more elaborate analysis, such as background removal, is needed for confirmation as a new isotope. The detailed analysis is currently in progress.

References

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