Search for new isotopes in the region around Z = 33 using the in-flight fission of a ^{238}U beam at 345 MeV/nucleon

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A new isotope search experiment in the neutron-rich region around $Z = 33$ was performed in November 2014, aiming to expand the frontier of accessible neutron-rich exotic nuclei. In this experiment, the nuclei of interest were produced by the in-flight fission of a 345 MeV/nucleon ^{238}U beam colliding with a 4.00-mm-thick Be target. The primary beam intensity was 10.8 particle nA on average. Fission fragments were separated and identified using the superconducting in-flight separator BigRIPS[1]. In order to separate and purify the RI beams, two wedge-shaped energy degraders were placed at the F1 and F5 dispersive foci. The typical counting rate at the F3 and F7 achromatic foci were 30.1 kHz and 1.88 kHz, respectively. Table 1 summarizes the experimental conditions.

Table 1. Summary of the experimental conditions.

Target (mm)	Be 4.00
Bρ [a] (Tm)	8.087
Degrader at F1 (mm)	Al 2.82
Degrader at F5 (mm)	Al 2.99
F1 slit (mm)	+64.2 / −64.2
F2 slit (mm)	+20.0 / −12.0
F5 slit (mm)	+120.0 / −120.0
F7 slit (mm)	+15.0 / −15.0
Central particle	^{94}As
Irradiation time (h)	97.3
Live time of DAQ (%)	66.1
Trigger rate (kHz)	1.24
Total dose	2.35×10^{16}

[a] The values from the magnetic fields of the first dipole magnet.

Particle identification (PID) was performed using the ΔE-TOF-$B\rho$ method in which the energy loss (ΔE), time of flight (TOF), and magnetic rigidity ($B\rho$) were measured to allow the event-by-event determination of atomic number Z and mass-to-charge ratio A/Q of fragments[2]. The PID was confirmed by measuring the delayed γ-rays emitted from short-lived isomers, such as ^{95}Kr and ^{94}Br, by using two clover-type high-purity germanium detectors placed at the F7 achromatic focus; this technique is called isomer tagging.

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Figure 1 shows a two-dimensional PID plot of Z versus A/Q. The solid red line indicates the limit of previously identified isotopes. The relative root mean square (rms) Z resolution and the relative rms A/Q resolution achieved were typically 0.57% and 0.055%, respectively. We can see some candidates for new isotopes such as ^{93}As, ^{96}Se, and ^{99}Br.

Detailed analysis is currently in progress.

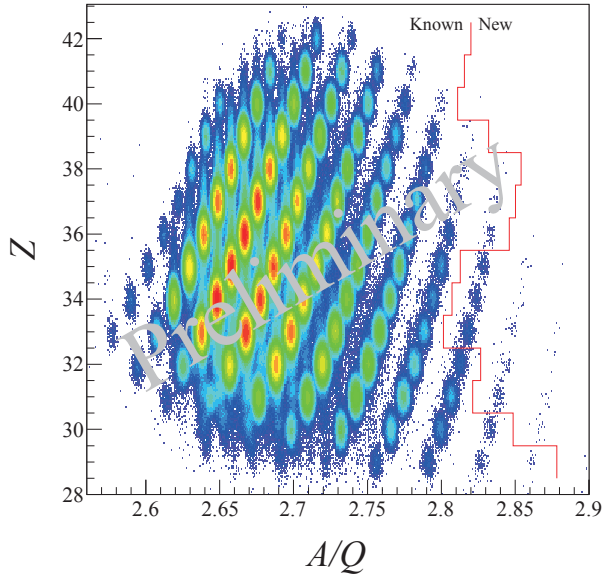

Fig. 1. Two-dimensional PID plot of Z versus A/Q. Red line indicates the limit of known isotopes.

References

1) T. Kubo et al.: Nucl. Instr. Meth. B **204**, 97 (2003).
2) N. Fukuda et al.: Nucl. Instr. Meth. B **317**, 323 (2013).