Coulomb excitation of ^{130}Cd

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The properties of the nuclei beyond ^{132}Sn have drawn considerable attention recently because this doubly magic nucleus lies far away the line of β stability. The evolution of the $N = 82$ shell gap to the "south" of ^{132}Sn has been discussed in several studies[1,2)]. For nuclear astrophysics, it has been suggested that the $N = 82$ shell closure affects the r-process abundance distribution around mass $A \approx 130$[2)]. However, for the $N = 82$ magicity in the Cd ($Z = 48$) isotopes, the mass and the spectroscopy measurements show contradictory results. The Q_β value of ^{130}Cd was better reproduced by a mass model assuming a quenched shell gap[3)]. However, a good shell closure was suggested from the first 2^+ state as the excitation energy of 1.3 MeV[4)] is close to those in other even-even $N = 82$ isotones. In order to investigate the magic character of $N = 82$ in ^{130}Cd, we measured the reduced transition possibility ($B(E2)$) via the Coulomb excitation.

The secondary beams were produced from an in-flight fission reaction of a U primary beam at 345 MeV/nucleon incident on a 3-mm-thick Be target located at the object point of the BigRIPS fragment separator[5)]. The average beam intensity was about 10 particle nA. The fission products around ^{130}Cd were selected and purified by employing two wedge-shaped aluminum energy degraders with thicknesses of 8 and 2 mm, respectively, located at the dispersive foci. The momentum acceptance of BigRIPS was set to 5%. The secondary beam was identified event-by-event via the TOF $- B\rho - \Delta E$ method using standard BigRIPS detectors. Figure 1 shows a two-dimensional plot of Z versus A/Q for the secondary beam in BigRIPS. The intensity of the ^{130}Cd beam was 15 counts/s with a purity of 1.3%. The beam energy was about 160 MeV/nucleon before the secondary target.

A 1-mm-thick Bi target was used to induce Coulomb excitation reactions. De-excitation γ rays were detected by the DALI2 spectrometer[6)], which surrounded the secondary target. Reaction residues were collected and analyzed by the ZeroDegree spectrometer[5)]. The spectrometer was optimized for the transportation of ^{130}Cd. Particle identification was performed again using the TOF $- B\rho - \Delta E$ method, as in BigRIPS. In addition, a $LaBr_3$(Ce) scintillation detector (Saint-Gobain BrilLanCe^{TM}380) located downstream of the ionization chamber was used for the total kinetic energy measurement.

The analysis for the $B(E2)$ value is currently in progress.

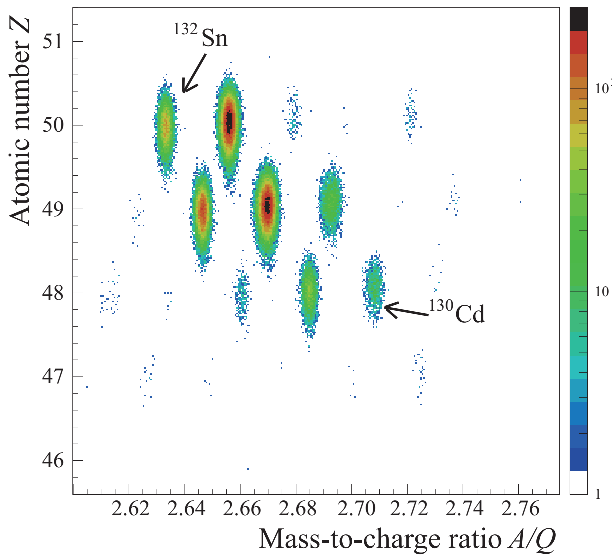

Fig. 1. Particle identification plot of the secondary beams in BigRIPS.

References
1) J. Dobaczewski et al.: Phys. Rev. Lett. 72, 981 (1994).
2) B. Pfeiffer et al.: Nucl. Phys. A 693, 282 (2001).
3) I. Dillmann et al.: Phys. Rev. Lett. 91, 162503 (2003).
4) A. Jungclaus et al.: Phys. Rev. Lett. 99, 132501 (2007).
5) T. Kubo et al.: Prog. Theor. Exp. Phys. 2012, 03C003 (2012).
6) S. Takeuchi et al.: Nucl. Instr. Meth. A 763, 596 (2014).

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