Inelastic excitation of ^{98}Pb, ^{100}Cd, ^{102}Sn

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Experiment RIBF146 was performed using RIBF at the RIKEN Nishina Center. A primary beam of ^{124}Xe at 345 MeV/nucleon with an intensity of 85 particle nA underwent fragmentation on a Be target. The products of this reaction were then separated and identified in BigRIPS fragment separator. Among the resulting secondary beam, the beams of interest in this study are ^{102}Sn (1%), ^{100}Cd (17%), and ^{98}Pd (1%). The cocktail beam impinged on a CH_2 and C target of 0.5 and 0.3 cm thickness, respectively. The beam-like fragment were subsequently analyzed via ZeroDegree spectrometer. Gamma transitions were detected using DALI2+.

This contribution is focused on the study of excited states of ^{98}Pd, ^{100}Cd, and ^{102}Sn populated via inelastic excitation and decaying through gamma emission. Inelastic excitation is a probe sensitive to protons and neutrons collectivity.[1)] Evidently, a decrease in collectivity is expected while ^{100}Sn is approached, whereas the trend observed via Coulomb excitation suggests a persistence of collectivity when approaching the shell closure.[2)]

One major challenge in the analysis of inelastic excitation gamma spectra is the contribution from the transition of interest, as it is superimposed on several possible sources of background: i) Bremsstrahlung, ii) excitation of C nuclei in the target, iii) decay of isomeric states produced in the primary target. The primary target being 89.5 m upstream the reaction target, all isomeric states with lifetimes ≥100 ns can pollute the prompt gamma spectrum. This last source of background is relevant for ^{102}Sn and, to a less extent, for ^{100}Cd, with isomeric state with lifetime of 367(11) ns and 62(6) ns, respectively. Background sources ii) and iii) can be determined from experimental data: source ii) was fixed on non-Doppler corrected spectra, while source iii) was addressed through dedicated runs where the beam was stopped in a 4-cm plastic target. Bremsstrahlung contribution was parametrized with a double exponential and its four parameters were fitted on ^{100}Cd spectrum. The corresponding contributions were then scaled according to the square of the atomic number of the beam isotopes for ^{98}Pd and ^{102}Sn. Spectra measured on CH_2 target are shown in Fig. 1. The cross-section associated with each transition was calculated with formula:

$$\Gamma^{2^+\to0^+} = \frac{N_\gamma^{2^+}}{N_m(BR,ZD)t_i}, \qquad (1)$$

where $N_\gamma^{2^+}$ denotes the number of γ rays observed in a peak, $N_m(BR,ZD)$ denotes the number of isotopes measured with a gate on BigRIPS and ZeroDegree, and t_i denotes the number of scattering centers in the target. It should be noted that both $N_\gamma^{2^+}$ and $N_m(BR,ZD)$ depend on the transmission of the isotope of interest, making the ratio independent of the transmission. A similar analysis was conducted with the spectra measured on C target, and the cross-section on C target was then subtracted from the one on CH_2 to obtain the contribution associated with the excitation on H. The transition cross-section obtained for the three isotopes of interest are detailed in Table 1. To extract the cross-section to populate the 2^+ state, σ^{2^+}, it is necessary to subtract from the transition cross-section feeding by higher-lying states decaying into it. This procedure is demonstrated in the last line of Table 1 using experimentally observed feeders.

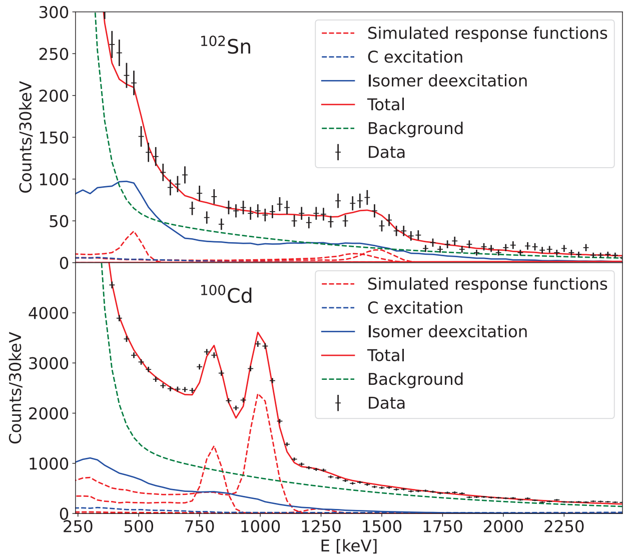

Fig. 1. Inelastic excitation of ^{102}Sn (top) and ^{100}Cd (bottom) on CH_2 target.

Table 1. Cross-sections on H target.

Isotone	^{98}Pd	^{100}Cd	^{102}Sn
$\Gamma_H^{2^+\to0^+}$ (mb)	18.7(24)	14.0(14)	7.3(29)
$\Gamma_H^{4^+\to2^+}$ (mb)	4.9(10)	6.4(11)	5.5(29)
$\sigma_H^{2^+}$ (mb)	9.0(27)	7.7(17)	1.8(4)

A noticeable drop in the cross-section populating the 2^+ state is observed when reaching the $Z = 50$ shell. A similar decrease is also evident when moving from ^{104}Sn, with $\sigma^{2^+} = 5.4(24)$[1)] to ^{102}Sn, *i.e.* approaching the $N = 50$ closed shell.

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References

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