Coulomb Excitation of Neutron-rich Cd Isotopes ◊

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1. Introduction

Recent studies on isotopes around the shell closure at N=82 show B(E2↑) = B(E2; $0_1^+ \to 2_1^+$) values for Te and Sn isotopes above N=82 lower than expected from a general systematics established as '"Grodzins rule"' [1]. A proposed theoretical explanation for this behaviour is a reduced neutron pairing gap above the shell closure [2]. The aim of the experiment reported here was to measure the B(E2↑) values of neutron-rich Cd isotopes to study the evolution of B(E2↑) values for this element for which stable isotopes are known to be good vibrator nuclei.

2. Experimental Setup

2.1 Coulomb Excitation

The experiment was performed using radioactive beams from REX-ISOLDE. The segmented HPGe detector array MINIBALL has been used for measuring the γ rays from the $2^+ \to 0^+$ transition following Coulomb excitation. A double sided Silicon strip detector (DSSSD) provides angles and energies of both the scattered beam particles and the recoiling target nuclei. Three isotopes have been measured (see table).

beam	target	total intensity [10^4 ions/s]	time [h]	purity [%]
^{122}Cd	^{108}Pd	1.0 ± 0.2	13	(70 ± 10)
^{124}Cd	^{104}Pd	1.7 ± 0.3	38	(38 ± 8)
^{126}Cd	^{104}Pd	1.0 ± 0.5	8	(≈ 9)

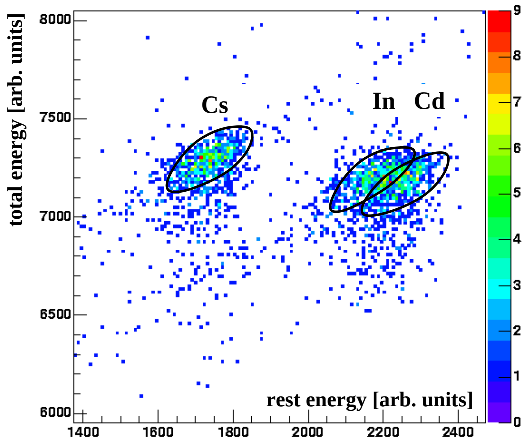

Fig. 1: Total energy vs. rest energy for the Cd beam is shown in arb. units. A contamination from Cs is clearly separated, while the resolution was not sufficient to separate In and Cd clearly.

2.2 Beam Contamination

The beam contamination can be established by the following methods: (i) The laser ion source RILIS has been used either in "laser ON" mode where the Cd isotopes are enriched or "laser OFF" mode without enrichment, (ii) a beam dump detector measured γ rays from decays of radioactive beam components and their daughters and (iii) an ionisation chamber (IC) with Silicon stop detector was used for a $\Delta E - E$ measurement of the beam (cf. Fig. 1). For the latter method the beam had to be switched to another beam line.

3. Results

The runs of ^{122,124}Cd have good statistics and a new, improved measurement of the B(E2↑) value for ^{122}Cd (see. Fig. 2) as well as a first measurement of the B(E2↑) value of ^{124}Cd were possible. The preliminary results agree very well with the phenomenological systematics.

nucleus	B(E2↑) [e^2b^2] this work	B(E2↑) [e^2b^2] [3]
^{122}Cd:	0.37 (12)	0.58 (27)
^{124}Cd:	0.31 (10)	—

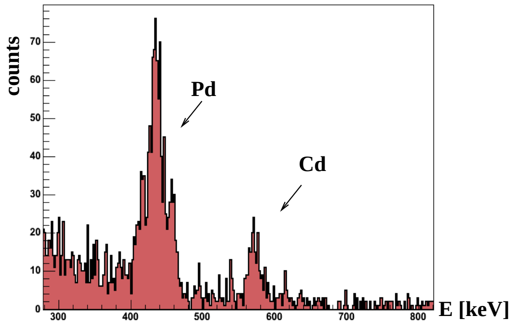

Fig. 2: Gamma energy spectrum (using Doppler correction with respect to cores) with a peak from ^{122}Cd at 569.5 keV. The peak at 433.9 keV results from the excited ^{108}Pd target nuclei used for normalization.

4. Conclusion & Outlook

This experiment has successfully improved the data available for the B(E2↑) value of ^{122}Cd and a B(E2↑) value for ^{124}Cd was measured for the first time. The error of the final values after full analysis is expected to be arround 10%. It has also been shown that the measurement of ^{126}Cd is feasible. This will be performed at REX-ISOLDE in 2005. An improved ionisation chamber for continuous measuring of the beam contamination is currently under development. Still, more light has to be shed on the issue of anomalous behaviour of B(E2↑) values around N=82. Therefore, our studies will be extended to Xe isotopes and later to Ba isotopes towards more collective nuclei.

References

[1] D.C. Radford *et al.*, Phys.Rev.Lett. **88** (2002) 222501
[2] J. Terasaki *et al.*, Phys.Rev. C **66** (2002) 054313
[3] N.V. Zamfir *et al.*, Phys.Rev. C **51** (1995) 98

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