Coulex of Neutron-rich Xe Isotopes @ REX-ISOLDE ◇

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1. Introduction

Recent studies on isotopes around the shell closure at N=82 have shown that despite decreasing excitation energy $E(2_1^+)$ the B(E2;$0_1^+ \rightarrow 2_1^+$) = B(E2↑) values for Te and Sn isotopes above N=82 are 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]. As a continuation of the experimental campaign in 2004, where Cd isotopes below N=82 were studied, the aim of the experiment reported here was to measure the B(E2↑) values of neutron-rich Xe isotopes above this shell closure to test the evolution of B(E2↑) values in this mass region.

2. Experimental Setup

2.1 Coulomb Excitation

The experiment was performed using radioactive ^{138,140,142}Xe beams from REX-ISOLDE. The segmented HPGe detector array MINIBALL has been used for measuring the γ rays from the $2^+ \rightarrow 0^+$ transition following Coulomb excitation. A double sided Silicon strip detector (so-called CD) provides angles and energies of both, the ejectiles and the recoils. These can be separated and identified very well (cf. Fig.1).

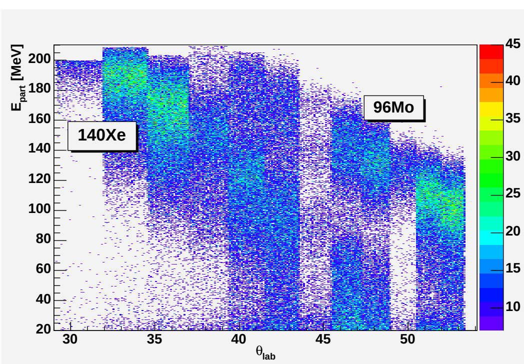

Fig. 1: Particle energy vs. angle θ_{lab} from the CD is shown. The beam particles can easily be separated from the recoiling target nuclei. The inner part of the detector was shielded due to elastic scattering.

beam	target	total intensity [ions/s]	time [h]
^{138}Xe	^{96}Mo	$3.9 \cdot 10^5$	9
^{140}Xe	^{96}Mo	$4.6 \cdot 10^5$	19
^{142}Xe	^{96}Mo	$3.5 \cdot 10^5$	14

2.2 Data Analysis

The data analysis is performed with a code that has been developed at the MPI-K in Heidelberg [3]. It includes kinematical reconstruction of the energy and angle of the remaining nucleus of the collision from the nucleus detected in the CD. It also enables position optimisation for the MINIBALL clusters and the CD detector. Therefore the gamma spectrum can be doppler corrected very well for either the projectile or target excitation.

3. Results

The runs of ^{138,140,142}Xe have good statistics (see table) and will shed new light on the ambiguous measurements of the B(E2↑) value of ^{140}Xe (see [4], [5]). A first measurement of the B(E2↑) values of ^{138,142}Xe will be possible. In the doppler corrected gamma spectrum not only the peak of the first excited 2^+ state is visible but also for the 4_1^+ state (cf. Fig.2). Some test runs on an ionisation chamber have shown no significant beam contamination for all three isotopes.

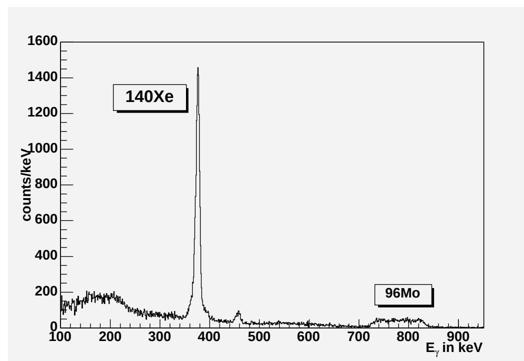

Fig. 2: Gamma energy spectrum (using Doppler correction with respect to cores and background subtraction) with a peak from ^{140}Xe at 376 keV. The 4_1^+ state at 457 keV can also be seen. The peak from the excited ^{96}Mo target nuclei at 800 keV is used for normalisation.

4. Conclusion & Outlook

This experiment has successfully improved the data available for the B(E2↑) value of ^{140}Xe and B(E2↑) values for ^{138,142}Xe were measured for the first time. In 2006 this experiment will be continued with ^{126}Cd and later also with ^{144}Xe. Still, more light has to be shed on the issue of anomalous behaviour of B(E2↑) values around N=82. Therefore, the studies will be extended to Ba isotopes towards more collective nuclei. For this the development of molecular BaF$^+$ beams at ISOLDE has been proposed.

References

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