First Investigation of ^{128}Ba via Two-Neutron Transfer ◇

Gh. Cata-Danil [a], D. Bucurescu [a], A. M. Oros [a], A. Gollwitzer, R. Hertenberger, A. Metz, B. D. Valnion, and G. Graw
[a] Institute of Atomic Physics, Bucharest, Romania

The measurement of excited 0^+ states in nuclei is important to understand the elementary modes of excitations at low energies. A unique tool for very selective excitation of these states are (p,t) reactions. We have focused our interest to the even-even Ba isotopes due to their particular structure [1] and the almost complete lack of information on excited 0^+ states [2].

Our previous (p,t) reaction studies [3] revealed a γ–soft structure for ^{132,134}Ba, in agreement with recent electromagnetic data. These observations are supported theoretically by calculations done in the O(6) limit of the Interacting Boson Model (IBM-1) and in the Geometrical Collective Model. There, we observed as the main experimental feature, a ≈3 larger monopole strength for the second excited collective 0^+ state than for the first excited one. Going to the lighter isotopes, like in the present study, we expect to find a more deformed collective structure, or in the IBA-1 language a "transition" from the O(6) towards the SU(3) dynamical symmetry limit. In the experimental distribution of the monopole strength this does appear as a more uniform excitation of the first two excited 0^+ states, in the strict SU(3) limit of IBA-1 L=0 (p,t) transitions are allowed only to the ground state and the first excited 0^+ state. In order to verify this expectation the ^{130}Ba(p,t)^{128}Ba reaction has been studied at 25 MeV incident proton energy at the Q3D spectrograph of the Munich tandem accelerator. The focal plane detector [4] provides particle identification, focal plane reconstruction and background reduction, accepting only events within the correct angle of incidence. The nucleus ^{130}Ba is the most neutron-deficient stable Ba isotope with only 0.106 percent abundance in nature. Mass separated targets of about 100 and 50 $\mu g/cm^2$ areal density on 40 $\mu g/cm^2$ carbon foils had been prepared at the PARIS isotope separator in Orsay. The negligible contribution of other Ba isotopes has been checked in the $\theta_{lab} = 6°$ spectra where the ground states of the other Ba isotopes appeared with intensities less than 0.1% relative to the transition from ^{130}Ba respectively. The two magnetic settings of the spectrograph covered an excitation energy range up to 4.5 MeV. Because of the poor knowledge about adopted levels in ^{128}Ba, we measured in identical setting of the spectrograph the ^{144}Sm(p,t)reaction for energy calibration. The $\sim$ 10 keV energy resolution obtained for the Ba target was clearly identified to originate from the implanted target, for the Sm target the resolution was better than 6 keV. The data evaluation is ongoing but as can be seen from fig. 1 three new 0^+ states can be identified from the comparison of the spectra at 6° and 15° where the angular distributions for L=0 transfer changes from a large value to the first minimum. They have about the same strength as the L=0 transitions to the first and the second excited 0^+ states, pointing toward an O(6) to SU(3) transition as we are approaching the middle of the N=50–82 neutron shell. The complete analysis of data is underway. We are very grateful to Ch.Briancon, R.Meunier and D.Le Du for preparation of the targets at the Orsay mass separator PARIS. Permanent support of L.Zetta and P.Guazzoni from INFN Sezione di Milano is gratefully acknowledged. One of us (Gh. C.-D.) wishes to express his gratitude to the Sektion Physik of the LMU and acknowledges for the financial support of the International Office in Karlsruhe and Istituto Nazionale di Fisica Nucleare.

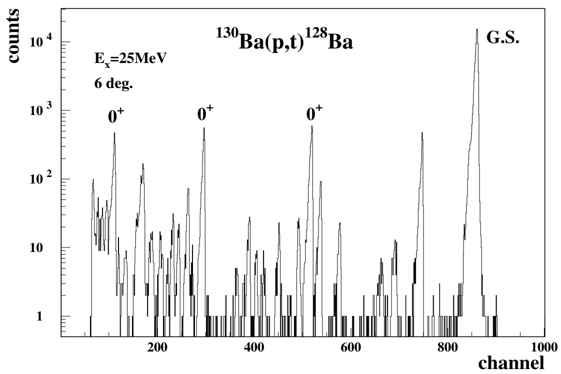

Fig. 1: Spectrum of the reaction ^{130}Ba(p,t)^{128}Ba, $E_p = 25$ MeV, $\theta_{Q3D} = 6°$

References

[1] Gh. Cata-Danil et al., to be published
[2] H.Kusakari et al. Nucl.Phys. **A341** (1980) 206
[3] Gh. Cata-Danil et al., this report p. 28 and to be published
[4] E. Müller-Zanotti et al. Nucl.Instr.Meth. **A310** (1991) 706

◇Work supported in Part by the DFG under IIC4-Gr 894/2 and IFA contract-150B/A4