Study of Single Particle Excitations in ^{129}Ba via the ($\vec{d}$,t) Reaction

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The neutron-deficient Ba isotopes belong to a transitional region and the even-even isotopes have been proposed to undergo a $0(6) \to SU(3)$ transition. In the odd-A istopes, coupling a particle to such a core should induce specific structural features. Details on the low spin structure of these nuclei are rather important in order to disentangle the contributions of various single particle orbitals. In particular, there are four positive-parity orbitals ($d_{5/2}$, $g_{7/2}$, $s_{1/2}$, $d_{3/2}$) which contribute to these states and they mix in various degrees in different states. A recent study of the isotopes $^{121-131}$Ba in the frame of the IBFM [1] has shown the need of richer and more precise data on the lower spin states, in order to offer a real testing ground for the predicted admixture of these orbitals.

Such information can be obtained, with specific limitations, from beta decay, or from particle transfer reactions. Unfortunately, the availability of stable targets prevents the later approach for the lighter Ba isotopes. ^{129}Ba is the lightest odd-A Ba isotope that can be reached by a one particle transfer reaction. It was the purpose of the present work to complete a study of its single particle excitations by a neutron pickup reaction.

Prior to this study, ^{129}Ba was known from β-decay, (heavy ion, x n γ) reactions and the (d,t) reaction [2]. The previous (d,t) study [3] evidenced 12 excited states up to 0.9 MeV excitation, for some of them transferred ℓ-values being attributed, which left, nevertheless, ambiguous spin assignments [2,3].

In the present experiment we have measured the ^{130}Ba ($\vec{d}$,t) reaction at 25 MeV incident energy, using the polarized beam of the Munich tandem accelerator (150 nA on target), the Q3D magnetic spectrometer, and the focal plane detector from ref. [4]. The ^{130}Ba targets were prepared by mass separation at the PARIS isotope separator in Orsay; they had an areal densitiy of 50 to 100 μg/cm^2, on 40 μg/cm^2 carbon support. The contamination from other Ba isotopes was found negligible [5]. An excitation energy range of up to 2.5 MeV was covered with one magnetic setting of the spectrograph. The energy resolution of about 10 keV FWHM was limited due to the quality of the implanted target. The energy calibration has been performed at two angles by comparison with ^{144}Sm($\vec{d}$,t) using identical magnet settings. Spectra for both spin orientations have been measured between 6° and 35°.

An example is shown in fig. 1. The present resolution allowed, e.g., to evidence the doublet formed by the g.s. and the first excited state at 8.4 keV [2]. Between 1 and 2 MeV excitation energy we observe more than 40 excited states; some of them correspond to levels known from β-decay [2] with unknown spin-parities, but most of them are newly observed. The evaluation of the data is in progress. Many unambiguous J$^\pi$ assignments will for the first time allow a detailed comparison to the theoretical calculations from ref. [1].

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