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Conversion coefficients of the isomeric state in ^{72}Br

J. A. Briz^a, M. J. G. Borge^a, A. Maira^a, A. Perea^a, O. Tengblad^a, J. Agramunt^b, A. Algora^b, E. Estevez^b, E. Nacher^b, B. Rubio^b, L. M. Fraile^c, A. Deo^d, G. Farrelly^d, W. Gelletly^d and Z. Podolyak^d.

^a*Instituto de Estructura de la Materia, CSIC, E-28006 Madrid, Spain*

^b*Instituto de Física Corpuscular, CSIC-Univ. Valencia, E-46071 Valencia, Spain*

^c*Universidad Complutense, E-28040 Madrid, Spain*

^d*University of Surrey, Guildford, GU2 7XH, Surrey, UK*

Abstract. In order to determine the Gamow-Teller strength distribution for the N=Z nucleus ^{72}Kr an experiment was performed with a Total Absorption Gamma Spectrometer. To fully accomplish this task it is crucial to determine the multipolarity of the low energy transitions as the spin-parity of the daughter ground state has been debated. This is done by experimental determination of the conversion coefficients. Preliminary results for the multipolarity and conversion coefficients of the transition connecting the isomeric state at 101 keV with the ^{72}Br ground state are presented.

Keywords: ^{72}Kr , ^{72}Br , beta decay, internal conversion, gamma transition, conversion coefficient.

PACS: 23.20.-g, 23.20.Lv, 23.20.Nx, 23.40.-s, 27.50.+e

MOTIVATION

Far from stability a large part of the Gamow-Teller (GT) strength is within the Q_β -window. Neutron deficient nuclei in the mass region around $A=70$ are characterized by strong deformation with fast changes in the sign and even shape coexistence. Furthermore, in N=Z nuclei, neutrons and protons occupy the same orbits giving the opportunity to study n-p pairing. In this region, theoretical calculations [1] predict very different GT strength distributions for the different possible deformations of the parent nucleus ground state (prolate-spherical-oblate). This gives the opportunity to determine the sign of the deformation of a nucleus by the study of the Gamow-Teller strength distribution obtained from the beta decay with a highly sensitive setup.

In addition, the N=Z ^{72}Kr is interesting from the astrophysical point of view as it is a “waiting point” in the rp-process (fast proton capture), that is, proton capture is not possible because following nucleus is not bound. Thus there is a competition between beta decay and two proton capture.

The beta decay of the N=Z nucleus ^{72}Kr was studied at ISOLDE (CERN) with a Total Absorption Gamma Spectrometer, “Lucrecia”. The on-going analysis of data revealed the need of additional information on the multipolarity of low energy transitions, i.e. on the competition between conversion electrons and gamma emission for low energy transitions in ^{72}Br .

EXPERIMENTAL SETUP

In order to measure the conversion coefficients two HPGe detectors and a Miniorange spectrometer were set up. The spectrometer consists of a Si(Li) detector (300 mm² area and 4 mm thick) and different sets of permanent magnets to optimize the transmission of conversion electrons at the different energies. Figure 1a shows the configuration with four magnets, 4B. The central piece of W blocks gamma radiation.

FIGURE 1. (a) Miniorange spectrometer. (b) ⁷²Kr spectra coming from HPGe (above) and Miniorange 4B (below). Gamma and two electron peaks corresponding to the 101 keV transition are appointed. Electron peaks appear at energy of the gamma transition minus the binding energy of the electron in the corresponding atomic shell (K, L, M...)

ANALYSIS AND PRELIMINARY RESULTS

In order to obtain the conversion coefficients (α), we use the following expression $I_T = I_\gamma + I_e = I_\gamma(1 + \alpha)$, where $\alpha = I_e/I_\gamma$. The areas for the peaks shown in figure 1(b) are corrected by efficiencies and the individual dead time of each detector. Thus, we can determine the gamma and electron intensities (I_γ and I_e) and, consequently, the experimental values of the conversion coefficients given in the table 1.

TABLE 1. Preliminary conversion coefficients obtained for the transition which connects the isomeric state at 101 keV with the ground state in ⁷²Br. The resulting values are compared with the theoretical predictions for the different multiplicities to obtain a preliminary assignment [2]. Expected multipolarity from the level scheme established in [3] and the only experimental determination of a conversion coefficient [4] are shown for completeness.

Gamma transition energy (keV)	Electron transition	Conversion coefficient (preliminary results)	Assigned multiplicity (preliminary)	Previous assignment
101.3	101.3K	0.82 ± 0.31	M2	M2 [3,4]; $\alpha_k(\text{exp}) = 1.4 \pm 0.3$ [4] M2 [3,4]
101.3	101.3L	0.12 ± 0.03	M2	

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