TEST OF PARITY DOUBLING IN ^{223}Th*

N. Amzal, P.A. Butler, G.D Jones, D. Hawcroft
R.-D. Herzberg, D.P. Rea

Oliver Lodge Laboratory, University of Liverpool
L69 7ZE, United Kingdom

F. Hannachi, C.F. Liang, P. Paris

CSNSM, Bat.104, F-91405 Orsay Campus, France

B. Gall, F. Hoellinger and N. Schulz

IReS Strasbourg, F-67037 Strasbourg cedex, France

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The level structure of the odd-A nucleus ^{223}Th has been investigated by means of in beam electron conversion and gamma-ray spectroscopy. Measurements of the B(M1)/B(E2) branching ratios for transitions in both positive and negative parity bands in ^{223}Th have been carried out using the GAREL+ facility at IReS Strasbourg.

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1. Motivation

The nucleus ^{223}Th has been often cited as the best case of parity doubling in atomic nuclei, on account of the near degeneracy of the lowest four rotational bands (both signatures of $K = {}^{5}/_{2}{}^{+}$ and ${}^{5}/_{2}{}^{-}$ bands), and the strong E1 transitions connecting the bands of opposite parity. The decay scheme of this nucleus, taken from Dahlinger [1] is shown in figure 1. While the branching of E1 and E2 transitions have been measured up to high spin, there is very little information on the M1 transition intensities which connect the signature partners in each parity band except for the lowest transitions. Comparison of the B(M1)/B(E2) branching ratios will provide a crucial test

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of the hypothesis that the parity doubling arises from octupole deformation of this nucleus, as this model predicts that the g-factors should be identical as they arise from identical intrinsic structure of the rotational bands. This is in contrast to the case if each parity band was built on single particle states having different Nilsson configurations.

Whereas for this mass region there is at present little information on the systematic behaviour of g-factors in odd-mass nuclei, in the mass 150 region the odd-mass nuclei showing low-lying near-degenerate opposite parity bands have very different g-factors for the different parities (*e.g.* [2]), which is indicative that they are reflection-symmetric.

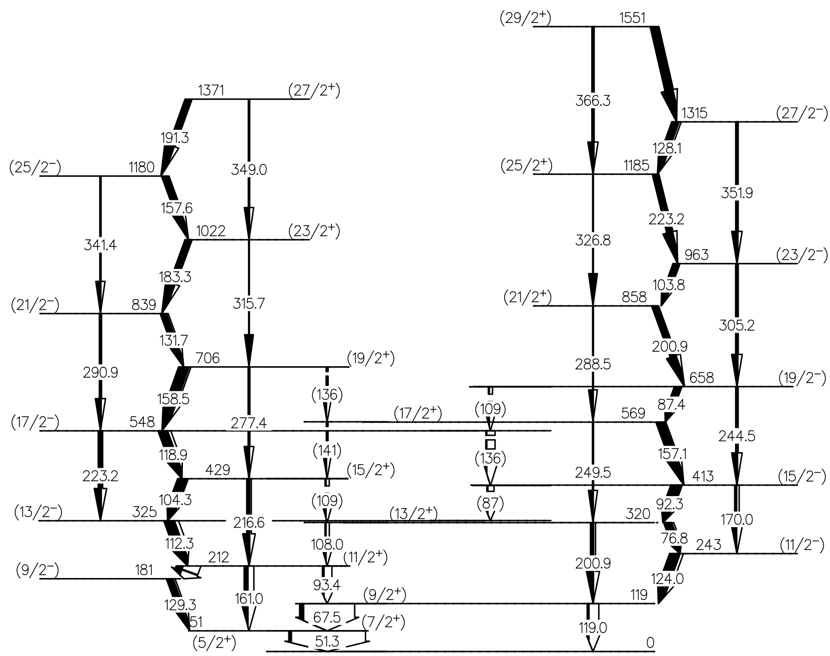

Fig. 1. Partial decay scheme for ^{223}Th taken from Dahlinger [1]. Transition energies are in keV.

2. Experimental details

We have carried out measurements of the $B(\mathrm{M1})/B(\mathrm{E2})$ ratios for transitions in both positive and negative parity bands in ^{223}Th, using the GAREL+ facility at IReS Strasbourg. The nucleus was produced in the reaction ^{208}Pb(^{18}O,3n) at 86 MeV, using a 250μg/cm^2 target. The strongly converted $M1$ transitions were observed using the Betatronic electron spectrometer and a Si(Li) detector ($\sim$ 1 % efficiency) [3]; the E1 and E2 γ-ray transitions were detected in 12 large-volume ($\sim$ 70% relative efficiency) Compton-suppressed Ge detectors and a single LEPS detector. e–γ as well as γ–γ coincidences were recorded during 5 days.

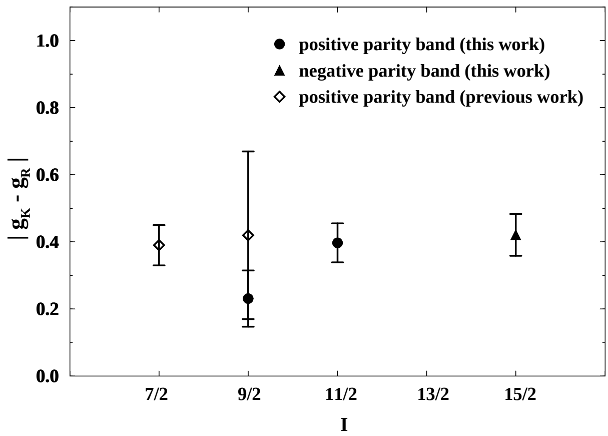

Fig. 2. The size of the parameter $|g_K - g_R|$ obtained from within band B(M1)/B(E2) branching ratios plotted against the spin I of the decaying level. Previous measurements from [1] are shown in the cases for which they are available.

3. Preliminary results

Values of the quantity $|g_K - g_R|$ (where g_K is the intrinsic g-factor and g_R the rotational g-factor) have been extracted, for the $K = \frac{5}{2}^+$ and $K = \frac{5}{2}^-$ bands, from the measured intra band B(M1)/B(E2) branching ratios. Plots of the size of the parameter $|g_K - g_R|$ for the $\frac{11}{2}^+ \rightarrow \frac{9}{2}^+$, $\frac{9}{2}^+ \rightarrow \frac{7}{2}^+$, and $\frac{15}{2}^- \rightarrow \frac{13}{2}^-$ transitions in ^{223}Th are shown in figure 2. The values extracted by Dahlinger [1] for the $\frac{9}{2}^+ \rightarrow \frac{7}{2}^+$ and $\frac{7}{2}^+ \rightarrow \frac{5}{2}^+$ are also shown. Within the errors these values are similar within each band and between the two bands of opposite parity wich is consistent with the interpretation that ^{223}Th is reflection-asymmetric.

Analysis of these data is ongoing.

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