Total Absorption Spectroscopy of the β-decay of ^{148}Tb (2^- and 9^+)

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There are few examples in the nuclide chart where the Gamow-Teller β-decay can be studied in detail. Among them, the neutron deficient rare-earth region is privileged for several reasons: firstly, most of the Gamow-Teller strength (B_{GT}) is expected inside the Q_{EC} window, secondly, the nuclei are easily accessible through fusion evaporation reactions, and thirdly, the combination of the UNILAC, the On-line Mass-separator and the Total Absorption Spectrometer (TAS) at GSI [1] provides the best experimental conditions to perform this kind of studies. In particular the TAS has shown to be an excellent experimental tool to measure the B_{GT} distribution along the energy window up to Q_{EC} value [2].

A few years ago we reported on studies for the B_{GT} of the 2^- and 9^+ isomers in the nucleus ^{150}Ho (upper part of Fig. 1, and Ref. [3] [4]). Here we present the B_{GT} data for the 2^- and 9^+ isomers in ^{148}Tb, a nucleus with two protons less than ^{150}Ho. In Fig. 1 the resulting B_{GT} observed in the four decays is presented. In the decay of the 2^- and 9^+ isomers of ^{150}Ho we observed a narrow resonance located at ≈4.5 MeV in the daughter nucleus (upper part of Fig. 1). This was interpreted as the decay of the $(h_{11/2})^2_{0^+}$ pair present in the parent state.

In ^{148}Tb, with only one valence proton (and one valence neutron) outside the ^{146}Gd core, we do not expect to have proton 0^+ pairs with high probability, but a fraction of them could be present due to the scattering of proton pairs across the Z=64 gap. Our observation in the decay of the 9^+ isomer is in good agreement with these expectations. We see a narrow resonance at 4.4 MeV in the daughter nucleus but with less strength than in the ^{150}Ho case: 0.58 $g^2/4\pi$ in the decay of ^{150}Ho(9^+) and only 0.14 $g^2/4\pi$ in the decay of ^{148}Tb(9^+).

One expects the decay of the ^{148}Tb(2^-) isomer to be of similar characteristics, however we did not detect any sizable strength at 4.5 MeV in the daughter nucleus in this case. We observe some strength one MeV higher in excitation energy and very close to the Q_{EC}. The reason for this difference is not yet understood.

Finally, in the decay of the ^{148}Tb(9^+) we observe the decay to the 8^+ two-quasiparticle state in the daughter. The feeding to this state is due to the decay of the valence $\pi h_{11/2}$ present in the parent state. This state is similar to the 8^+ level observed in ^{150}Dy at 2403 keV.

References

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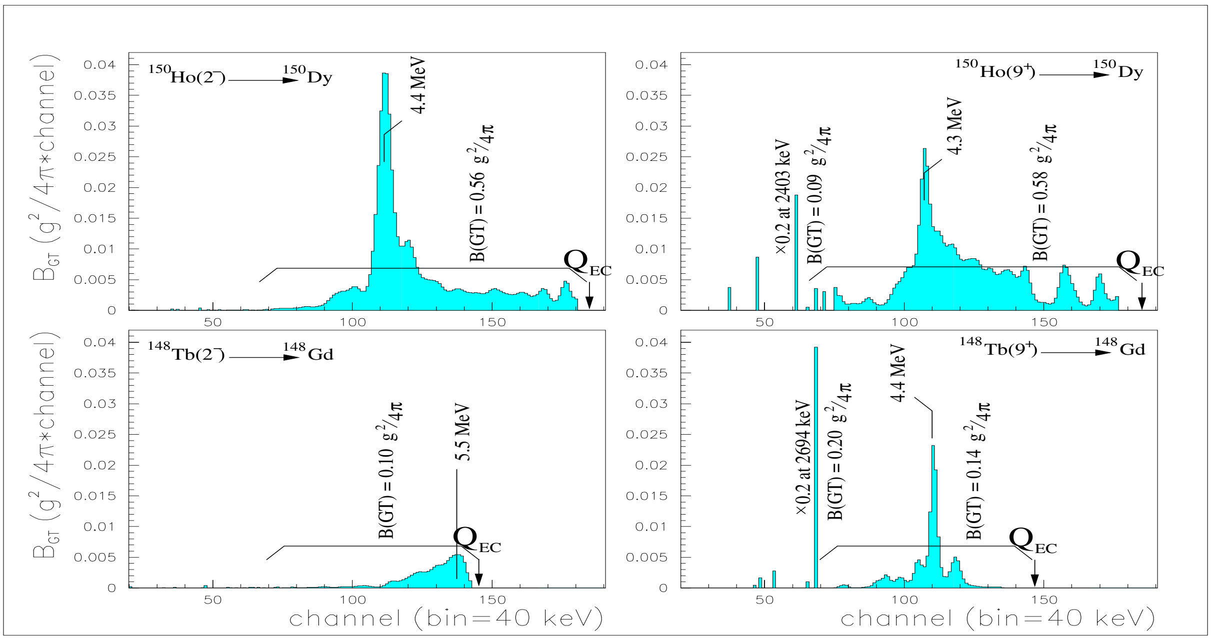

Fig. 1 *Upper panels: Decay of ^{150}Ho (2^- and 9^+) into ^{150}Dy. The resonance at ≈4.5 MeV corresponds to the four q.p. excitations in ^{150}Dy. Lower panels: New results on the decay of ^{148}Tb (2^- and 9^+). The reaction to produce the low spin isomer was ^{93}Nb(^{58}Ni,$3p\beta^+$)^{148}Tb(2^-), whereas for the high spin isomer it was ^{94}Zr(^{58}Ni,3pn)^{148}Tb(2^- and 9^+).*