Recent TAS experiments carried out at the On-line Mass-separator in the Rare Earth Region

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Following the motivation outlined in our previous contribution [1] we have performed measurements of the $\beta-$decays of the ^{152}Tm and ^{147}Dy by using the Total Absorption Spectrometer at the On-line Mass-separator of GSI. ^{152}Tm, with 2^- and 9^+ $\beta-$decaying isomers, has two more protons compared with the very well studied ^{150}Ho [2]. In a first-order approximation one expects the same Gamow-Teller (GT) strength for the $\pi h_{11/2} \rightarrow \nu h_{9/2}$ transition to the 8^+ 2-quasiparticle state in the daughter nucleus and double as much in the $(\pi h_{11/2})^2_{0^+} \rightarrow (\pi h_{11/2} \nu h_{9/2})_{1^+}$ transition to the 4-quasiparticle states in the daughter as compared with the ^{150}Ho case. In Figure 1 we show the raw TAS spectra obtained for the ^{152}Tm 9^+ and ^{150}Ho 9^+ decays gated on the daughter X-rays. In a "perfect" total absorption spectrometer with 100% efficiency these spectra would directly show the EC-feeding as a function of excitation energy in the daughter nucleus. The real data have to be evaluated but the raw spectra give a rough impression about the direct $\beta-$feeding. The data show indeed that there is more GT strength in the decay to the 4-quasiparticle states (pair decay) in the ^{152}Tm than in the ^{150}Ho case as compared with the decay to the 2-quasiparticle state (at 2.2 and 2.4 MeV in the two daughter nuclei respectively).

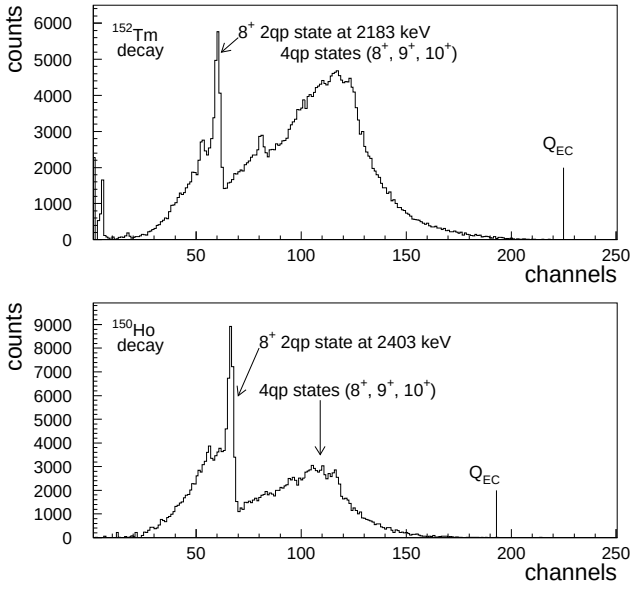

Figure 1: Total absorption EC-spectra obtained for the ^{152}Tm 9^+ and ^{150}Ho 9^+ decays. The nuclei were produced in the $^{102}Pd(^{58}Ni, \alpha 3pn)^{152}Tm(9^+)$ and $^{95}Mo(^{58}Ni, 3p)^{150}Ho(9^+)$ respectively. The contribution of the 2^- decay has been subtracted in both cases.

We also studied the decay of the $1/2^+$ and $11/2^-$ isomers of the N=81 nucleus ^{147}Dy. Most of the decay in these two cases proceeds through the ground-state to ground-state transitions, but some of the GT strength is also expected at high excitation energy in the daughter. These two cases have previously been studied by Collatz *et al.* using Ge detectors [3]. In their work the decay of the proton pair present in the ground state configuration $((\pi h_{11/2})^2_{0^+}(\nu^{-1}s_{1/2}$ or $\nu^{-1}h_{11/2}))$ to 3-quasiparticle states $((\pi h_{11/2}\nu h_{9/2})(\nu^{-1}s_{1/2}$ or $\nu^{-1}h_{11/2}))$ at 3.5 to 5.5 MeV excitation energy in the daughter was observed. Surprisingly the GT strength observed in the decay of the $11/2^-$ isomer was smaller by more than a factor of four than the strength observed in the decay of the $1/2^+$ isomer. It is still unclear if this result reflects the problems inherent to high-resolution techniques. In ref. [3] the authors argue that the problem could be due to the higher level density of ^{147}Tb states with spin $9/2, 11/2$ and $13/2$ and consequently to a higher fragmentation of the GT strength.

Here we present the raw spectrum of the same two decays, but using the powerful total absorption technique. The two resonances, previously observed in ref. [3] are clearly seen in these data (see Figure 2.). The aim of this experiment is to detect and compare the full strength for both decays.

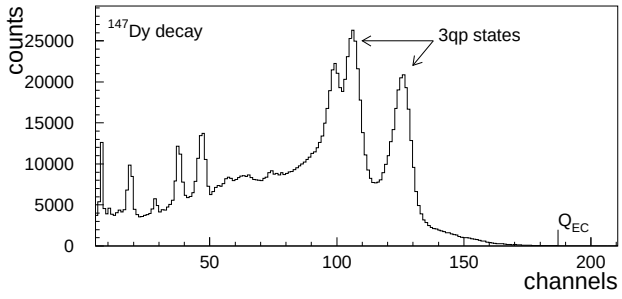

Figure 2: Total absorption EC-spectra obtained for the ^{147}Dy decay. The nucleus was produced through the reaction $^{93}Mo(^{58}Ni, 3pn)^{147}Dy$.

The sorting of these experimental data is being carried out using the new methods developed at GSI, named Go4, which has been adapted to the analysis of the data taken at the On-line Mass Separator. The authors would like to acknowledge the invaluable help of J. Adamczewski in this part of the work.

References

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