TAGS SPECTRA ANALYSIS AND BETA DECAY STRENGTH FUNCTION STRUCTURE

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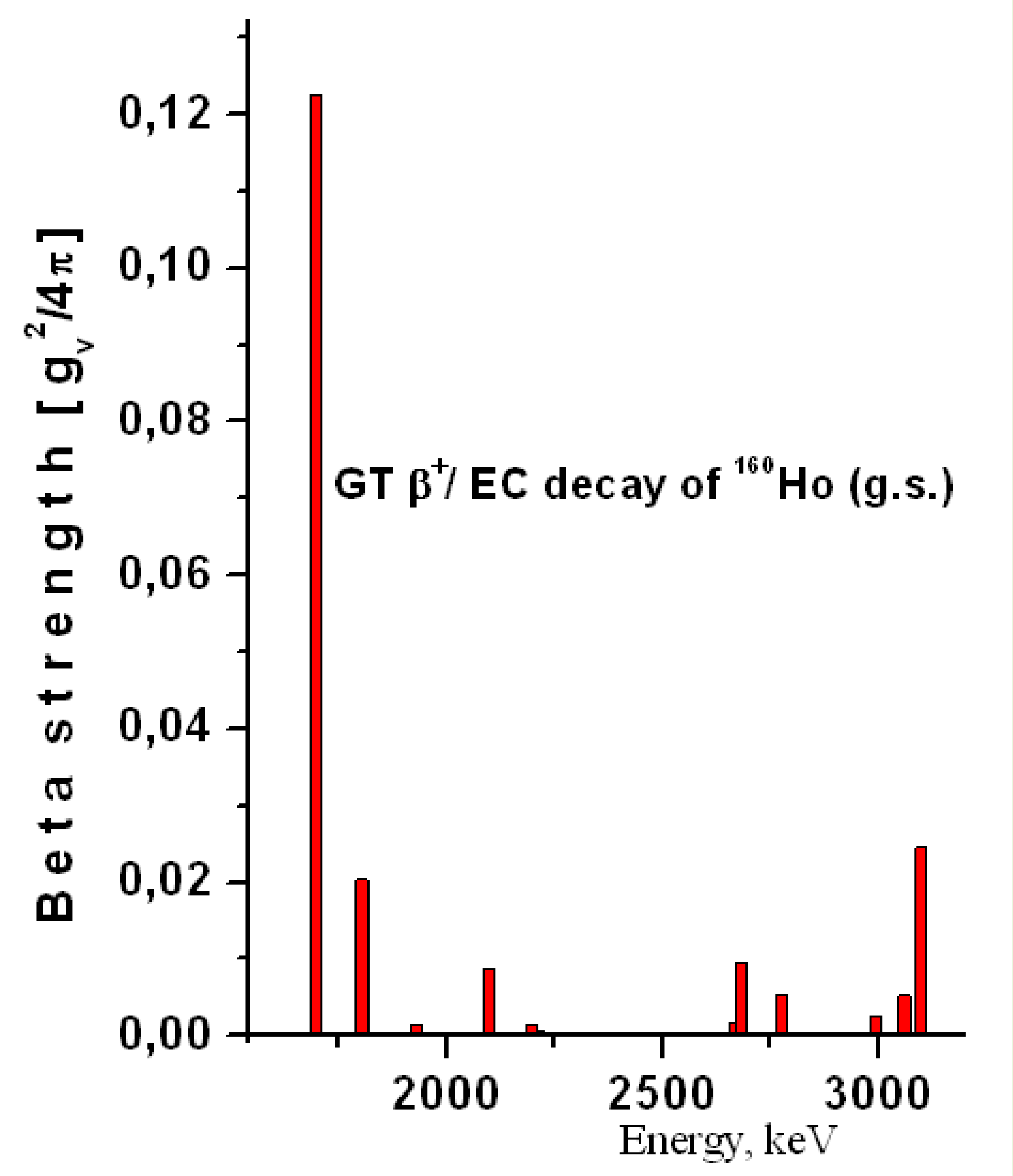
The β–transition probability is proportional to the product of the lepton part described by the Fermi function $f(Q_\beta - E)$ and the nucleon part described by the β-decay strength function $S_\beta(E)$, where E is the excitation energy in daughter nuclei and Q_β is the total energy of β-decay.

Information on the structure of $S_\beta(E)$ is important for many nuclear physics areas. Reliable experimental data on the structure of $S_\beta(E)$ are necessary for predicting half-lives of nuclei far from the stability line, verifying completeness of decay schemes, calculating energy release from decay of fission products in nuclear reactors, calculating spectra of delayed particles, calculating the delayed fission probability and evaluating fission barriers for nuclei far from the β stability line, calculating production of various elements in astrophysical processes, and developing microscopic models for calculation of $S_\beta(E)$, especially in deformed nuclei.

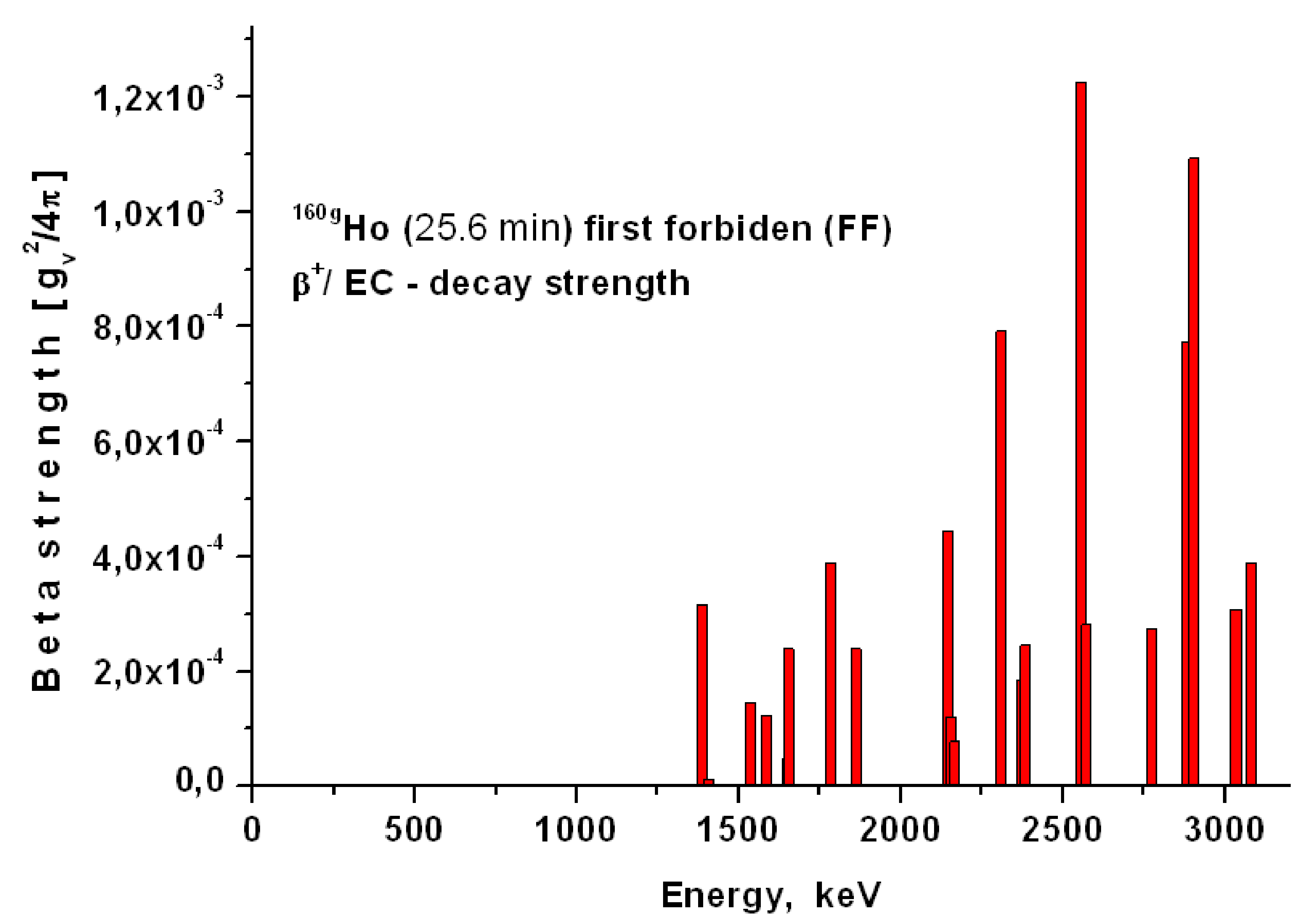
There are two methods of the TAGS spectra analysis.

In the first one it is necessary to identify the total absorption peaks in TAGS spectra and have 4π-spectrometer with exponential energy dependence of the photoefficiency (i.e., the ratio of the number of pulses in the total absorption peak to the number of γ-ray incident on the detector) for γ-ray registration. Only in this case the efficiency of TAGS peak registration does not depend on the details of decay scheme. This method gives the good results, but can be applied for nuclei with total β-decay energy Q_β less than 5-6 MeV. **Quantitative** characteristics may be obtain as a rule only for **one (β^-- decay) peak** and for **two peaks (β^+/EC-decay)** in $S_\beta(E)$.

The second method is based on so called **response function application**, but a lot of assumption must be done for extraction the $S_\beta(E)$ shape from the TAGS spectrum shape. Analysis depends on the assumptions about the decay scheme which as a rule is not known. It is very difficult to estimate the associated systematic errors of such analysis and **only qualitative** information about $S_\beta(E)$ may be obtained.



$S_\beta(E)$ for Gamow–Teller transitions in the β+/EC decay of the deformed nucleus ^{160g}Ho (5^+ ;25.6 min), Q_{EC} = 3286(15) keV.



$S_\beta(E)$ for Gamow–Teller transitions in the β+/EC decay of the deformed nucleus of the isomer ^{160m}Ho (2^-; 5.02 h), Q_{EC} = 3346 keV

The **second** method is based on so called **response function application**, but a lot of assumption must be done for extraction the $S_\beta(E)$ shape from the TAGS spectrum shape. Analysis depends on the assumptions about the decay scheme which as a rule is not known. It is very difficult to estimate the associated systematic errors of such analysis and **only qualitative information** about $S_\beta(E)$ may be obtained.

TAGS can't distinguish the GT and FF transitions and don't take into account the **conversion electron** emission, which give the **systematic uncertainties**, especially for high *Z*.

CONCLUSION

1. Only **combination of TAGS with high resolution nuclear spectroscopy** methods may give the **quantitative** information about $S_\beta(E)$.
2. When one analyze the TAGS spectra it is necessary to **indicate systematic errors** for $S_\beta(E)$ and for decay heat evaluation, **especially** by using the **second method** of TAGS spectra analysis.