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NON-STATISTICAL EFFECTS IN BETA & GAMMA DECAYS AND BETA-DELAYED FISSION ANALYSIS

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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.
The previously dominant statistical model assumed that there were no resonances in $S_\beta(E)$ in Q_β-window and the relations $S_\beta(E) = Const$ or $S_\beta(E) \sim \rho(E)$, where $\rho(E)$ is the level density of the daughter nucleus, were considered to be a good approximations for medium and heavy nuclei for excitation energies $E > 2 \div 3MeV$.
The effect of the non-statistical resonance structure of the $S_\beta(E)$ on the probability of delayed fission was first investigated in [1]. Then the method developed in [1] for the description of delayed processes by considering the $S_\beta(E)$ structure was used to analyze delayed fission of a wide range of nuclei [2–6]. Ideas about the non-statistical structure of the strength functions $S_\beta(E)$ have turned out to be important for widely differing areas of nuclear physics [4].
When studying delayed fission, (i.e., fission of nuclei after the β-decay) one can obtain information on fission barriers for nuclei rather far from the stability line [1-3]. The delayed fission probability substantially depends on the resonance structure of the $S_\beta(E)$ both for β^- and β^+/EC-decays [1-6]. It can therefore be concluded from this analysis of the experimental data on delayed fission [1-6] that delayed fission can be correctly described only by using the non-statistical β-transition strength function reflecting nuclear-structure effects.
In β-decay the simple (non-statistical) configurations are populated and as a consequence the non-statistical effects may be observed in γ-decay of such configurations. In delayed fission analysis the γ-decay widths Γ_γ calculated using the statistical model, which, in general, can only be an approximation. Non-statistical effects in (p, γ) nuclear reactions in the excitation and decay of the non-analog resonances, for which simple configurations play an important role, were analyzed in [5]. The strong non-statistical effects were observed for $M1$ and $E2$ γ-transitions. Because the information about γ-decay is very important for delayed fission analysis, it is necessary to consider the influence of non-statistical effects on delayed fission probability not only for β-decay, but also for γ-decay.
In this report some features of β-delayed fission probability analysis are considered. It is shown that only after proper consideration of non-statistical effects both for β-decay and γ-decay it is possible to make a quantitative conclusion about fission barriers.

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Primary author: IZOSIMOV, Igor (Joint Institute for Nuclear Research)

Presenter: IZOSIMOV, Igor (Joint Institute for Nuclear Research)

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