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FINE STRUCTURE OF β-DECAY STRENGTH FUNCTION

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The β-decay strength function $S_\beta(E)$ governs [1,2] the nuclear energy E distribution of elementary charge-exchange excitations and their combinations like proton particle (πp)-neutron hole (νh) coupled into a spin-parity I^π: $[\pi p \otimes \nu h]I^\pi$ and neutron particle (νp)-proton hole (πh) coupled into a spin-parity I^π : $[\nu p \otimes \pi h]I^\pi$. The strength function of Fermi-type β-transitions takes into account excitations $[\pi p \otimes \nu h]0^+$ or $[\nu p \otimes \pi h]0^+$. Since isospin is a quite good quantum number, the strength of the Fermi-type transitions is concentrated in the region of the isobar-analogue resonance (IAR). The strength function for β-transitions of the Gamow–Teller (GT) type describes excitations $[\pi p \otimes \nu h]1^+$ or $[\nu p \otimes \pi h]1^+$. At excitation energies E smaller than Q_β (total β-decay energy), $S_\beta(E)$ determines the characters of the β-decay. For higher excitation energies that cannot be reached with the β-decay, $S_\beta(E)$ determines the charge exchange nuclear reaction cross sections, which depend on the nuclear matrix elements of the β-decay type.

Successful applications of the total absorption γ-spectroscopy $(TAGS)$ for $S_\beta(E)$ resonance structure study, methods of $TAGS$ spectra interpretation, and results of analysis of $S_\beta(E)$ structure for the GT β^+/EC and GT β^--decays were summarized in [1]. Development of experimental technique allows application of methods of nuclear spectroscopy with high energy resolution for $S_\beta(E)$ fine structure measurement [2-4]. First results of the $S_\beta(E)$ fine structure study were summarized in [2]. The combination of the $TAGS$ with high resolution γ-spectroscopy may be applied for detailed decay schemes construction [2]. It was shown [2-5] that the high-resolution nuclear spectroscopy methods give conclusive evidence of the resonance structure of $S_\beta(E)$ for GT and first-forbidden (FF) β-transitions in spherical, deformed, and transition nuclei. High-resolution nuclear spectroscopy methods [2-4] made it possible to demonstrate experimentally the reveal splitting of the peak in the $S_\beta(E)$ for the GT β^+/EC-decay of the deformed nuclei into two components.

Resonance structure of the $S_\beta(E)$ for β-decay of halo nuclei was analyzed in [6-8]. It was shown that when the parent nucleus has *nn* Borromean halo structure, then after GT β^- - decay of parent state or after $M1$ γ-decay of IAR the states with *np* tango halo structure or mixed *np* tango + *nn* Borromean halo structure can be populated.

In this report the fine structure of $S_\beta(E)$ is analysed. Resonance structure of $S_\beta(E)$ for GT and FF β –decays, structure of $S_\beta(E)$ for halo nuclei, quenching of the weak axial-vector constant $g_A{}^{eff}$, and splitting of the peaks in $S_\beta(E)$ for deformed nuclei connected with the anisotropy of oscillations of proton holes against neutrons (peaks in $S_\beta(E)$ of GT β^+/EC–decay) or of protons against neutron holes (peaks in $S_\beta(E)$ of GT β^- –decay) are discussed.

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