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# Search for heavy sterile neutrinos in $\beta$-decay of $^{144}$Pr nuclei

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The discovery of solar and atmospheric neutrino oscillations means that at least two from three neutrino mass states are nonzero. The obtained oscillation parameters together with the constraints on the sum of light neutrinos masses obtained from the Planck telescope data limit the most severe mass state of the known types of neutrinos ($\nu_e$, $\nu_\mu$, $\nu_\tau$) up to 70 meV. Heavier sterile neutrinos appear in many extensions of the Standard Model, additionally, they are well-motivated candidates for the role of dark matter particles.
In this work the search for sign of massive neutrinos in the measured spectra of electrons from decays of $^{144}$Ce –$^{144}$Pr nuclei have been performed. The $^{144}$Ce –$^{144}$Pr electron antineutrino source is one of the most suitable for studying neutrino oscillations into a sterile state with a mass of about 1 eV. The decay schemes for $^{144}$Ce –$^{144}$Pr allow to test the possibility of emission in these β-transitions of heavy neutrinos with masses from several keV to 3 MeV. The range of possible investigated masses is determined by the resolution of the $\beta$-spectrometer and end-point energy of $^{144}$Pr $\beta$-decay [1].
The energies of $\beta$-transitions in the $^{144}$Ce and $^{144}$Pr nuclei are 319 keV and 2998 keV, respectively. For the case of heavy neutrino emission, the resulting spectrum $S(E) = (1-|U_{eH}|^2)B(E,0)+|U_{eH}|^2B(E,m_{\nu H})$ is the sum of two $\beta$-spectra $B(E,m)$ with the end-point energy $E_0$ and neutrino masses $m = 0$ and $m = m_{\nu H}$. All 6 most intense $\beta$-transitions to the excited states of daughter nuclei were taken into account in analysis.
The measurements were performed with the original $\beta$-spectrometer with $4\pi$-geometry consisting of two Si (Li) -detectors with a sensitive region thickness of more than 8 mm, which exceeds the range of 3 MeV electrons [2,3]. The measured spectrum, containing $1.5 \times 10^9$ events, was fitted in the energy range (250 - 3030) keV with an acceptable value $\chi^2$ = 1.04 (P-value is 0.014) for the case $m_{\nu H}$ = 0. For different neutrino masses $m_{\nu H}$, the values of emitting probability $|U_{eH}|^2$ were determined by searching for the minimum of $\chi^2$. As a result, for neutrinos with a mass $m_{\nu H}$ in the range (100–2200) keV, new upper bounds on the mixing parameter are set at the level $|U_{eH}|^2 \le (0.1–3.0) \times 10^{-3}$ for 90% C.L., which are in 2-3 times stronger than obtained ones in previous experiments.

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