Application of electron spectroscopy for inverse β-decay study

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The study of the inverse β-decay based on the charge current (CC) $\nu_{e^-} + d \rightarrow p + p + e^-$ reaction with the use of Cherenkov electrons for recording demands huge-size wells with fluorescent liquid (up to 50.000 tons) due to the insignificantly small cross of interaction of the high-energy electron antineutrino $(\bar{\nu}_e)_h$ with energies of several meV with the detector agent (10^{-43}). It is due to the small density of states ($N\bar{\nu}_e$-$(E)_h$) in the overall density of the flow of antineutrino emitted from a source (the Sun, a nuclear reactor), where low-energy antineutrino$(\bar{\nu}_e)_l$ form the main density of states; their density of states is four orders larger than that of the high-energy ones.

The interaction of antineutrino with the agent results in the formation of the Auger-electrons flow, which intensity exceeds the intensity of the Cherenkov electron flow by the number of Auger-transitions, as cherenkov electrons are formed in the quantity of one "glowing" electron per one antineutrino interaction with the agent.

To record the flow of Auger-electrons including Auger-electrons formed due to the internal conversion and electrons of nuclear origin, we offer to use the 100 cm wide-aperture iron-free electronic magnetic spectrometer with double focusing by non-uniform magnetic field, having a focal plane and quadrupole super-conducting lens serving as a detector of antineutrino. This spectrometer was built in the Udmurt State University together with the Physical-Technical Institute and put into operation on 01.03.02. Super-conductivity of the detector of solid body substance for antineutrino in the lens (Pb) is necessary for enlarging the free path of Auger-electrons in the detector, gathering them from the largest volume possible of the antineutrino detector and directing them to the electronic spectrometer.