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Background analysis of the large-surface, low-background alpha spectrometer

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To measure low surface and bulk specific activities of alpha emitters a low-background, large-surface alpha spectrometer is needed. In our studies we use the XIA UltraLo-1800 instrument, in which the low background is achieved by using radio-pure construction materials and by application of Pulse Shape Analysis (PSA). The PSA is based on inspection of amplitudes, shapes and rise times of the registered pulses in order to identify and reject unwanted events. There are different types of background sources in the spectrometer: cosmic rays, Rn-220 and Rn-222 decays in the counting gas and alpha particles emitted from the spectrometer walls and from the anode. The anode is in addition surrounded by a guard electrode which is used to reject alpha particles coming from the side walls. The sample serves as the cathode therefore, it needs to be conductive. A „zero"sample (sample with no emission of alpha particles) is needed to determine the background of the instrument, which can be later subtracted from the spectrum obtained for a given sample. Various materials like stainless steel, teflon foil, etched oxygen-free copper and electropolished oxygen-free copper were tested for this purpose. Since we are interested mainly in Po-210 the count rates in energy range 1.5 –6 MeV were analysed. The lowest signal was obtained for the electropolished oxygen-free copper: (19 ± 1) cts/d. This material was chosen for the drawer base. Monte Carlo simulation is used to deconvolute contributions the measured spectra from the bulk and surface contaminations. Taking into the background of the detector the bulk and the surface Po-210 specific activities can be determined down to 50 mBq/kg and 0.5 mBq/m2, respectively. There is also a possibility to reduce further the background by application of an additional outer veto, which should eliminate the miss-identified muons. This effort is ongoing and the expected improvement is at the level of 30%. Moreover, the count rates for the background signals coming from muons, alphas generated in the counting gas, alphas coming from the walls and from the anode were analysed. A time period of about 8 years has been checked during which various measurements were performed The analysis helps to investigate stability of the detector over many years of operations. The details will be presented and discussed in the poster.

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