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Upgrade of the DANSS detector of reactor antineutrino

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The experiment DANSS is located on a movable platform below 3.1 GW industrial reactor of Kalininskaya NPP. The detector is a solid state scintillator spectrometer collecting up to 5000 neutrino events per day with the only 2% background. The experiment is already running for 6 years and more than 6 million inverse beta-decay events are already collected. DANSS already explored a large portion of the possible parameter space of the sterile neutrino oscillations. No statistically significant signal found so far. The strongest limit is set around Δm^2 ~ 1 eV^2 with $\sin^2 2\theta$ = 0.008.

The main drawback of the detector is a moderate energy resolution of 34% at 1 MeV. This limits its sensitivity especially in the region of larger Δm^2. The aim of the upgrade planned is to reach energy resolution of 12% at 1 MeV. We also plan to use SiPM only readout and increase the sensitive volume by 70% keeping the same passive shielding and the platform. The main idea of the upgrade is in a new design of the scintillator strips providing larger light output with much better uniformity. The strips will be read out from both edges which will allow to reconstruct all three coordinates even if only a single strip was hit.

The talk covers the detector design and expected sensitivity, as well as the beam test of the new strip prototypes with the pion beam of the PNPI synchrocyclotron. The new strips demonstrated more than twice higher light output together with fairly flat detector response uniformity. For the better time response of new strips we are going to use newer wavelength shifting (WLS) fiber YS-2 by Kuraray. A dedicated study of this fiber with a 360 nm picosecond laser pulses demonstrated nearly twice shorter decay time (4.0 ns) compare to a mature Y-11 fiber. Light output of YS-2 and Y-11 fibers was also compared using ^{90}Sr source and cosmic rays and the new fiber turned out to be at least as good as the mature one. The timescale of the upgrade is planned for two years. Mass production of the new strips has already nearly finished and we are doing the last tests before the start of their assembly with fibers and SiPM.

In-person participation

Yes

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