PROCEEDINGS OF SCIENCE

Recent results from DANSS

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DANSS is a solid state scintillator neutrino spectrometer placed at a small distance from the commercial nuclear reactor of Kalininskaya NPP. The distance from the detector to the center of the reactor core can be changed online in the range 10.9-12.9 m. This fact together with a very high neutrino counting rate (more than 5000 events per day) and low background makes DANSS an ideal detector to search for neutrino oscillations in 1 $eV^2 \Delta m^2$ range.

We report the results based on the statistics of 6 million events, obtained between April 2016 and March 2022. The results include limits in the short range oscillation parameter space, fuel evolution studies and the bump in the neutrino spectrum. The talk will also cover our plans of the detector upgrade.

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Details of the DANSS detector and physics results of the first year of its operation could be found elsewhere [1, 2] as well as the results obtained by the previous year [3, 4]. This short contribution is concentrated over our progress during the last year. Our progress in the inverse beta-decay (IBD) statistics accumulation is illustrated in fig. 1. Now we have data for 3 full fuel campaigns and 4 reactor off periods. An important progress is reached in the understanding of our calibration. In addition to the reactions already used for calibration purposes delayed event spectrum is also analyzed as a calibration source (fig. 2 left). Now the calibration set includes ^{12}B decays from two reactions, induced by atmosphere muons, n+^{12}C→^{12}B+p and μ^- capture by ^{12}C; ^{22}Na and ^{60}Co radioactive sources; neutrons from ^{248}Cm fission and IBD, stopped muons decays. ^{12}B decay data is used to set the scale, because behavior of the produced electron is the most similar to IBD positron we need to measure and this data is accumulated uniformly during the run. No additional smearing is added in the Monte-Carlo simulations any more for a good reproduction of the experimental data. The scale of all the sources in the calibration set agrees within ±0.2 with an exception of ^{22}Na, which has an offset 1.8%. The problem could be in contamination of the sample with ^{26}Al with slightly different energy of the decay. We keep systematic error 2% in the energy scale until we find a solution of this problem.

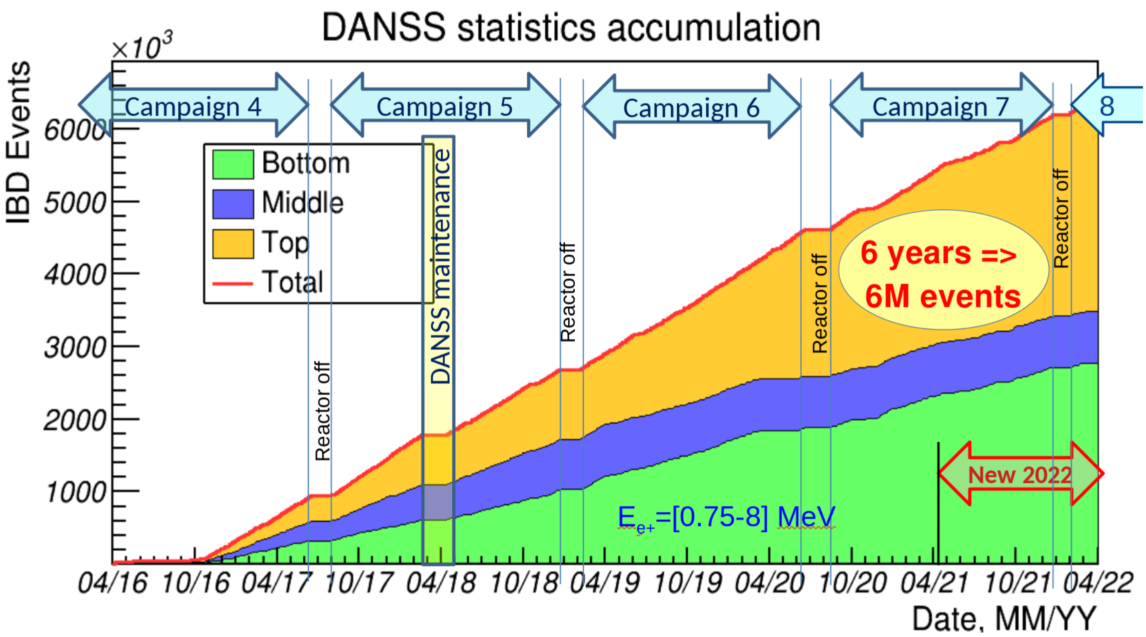

Figure 1: IBD statistics accumulation during 6 years of DANSS operation

Continuous reactor monitoring during 3 full fuel campaigns allows us to make a study of counting rate and neutrino spectrum evolution with the change in the fuel composition. The rate dependence over fission fraction of ^{239}Pu is shown in fig. 2 (middle). Our data demonstrate slope slightly steeper than the slope coming from MC-simulations with HM model [5, 6], while Daya Bay data show less steep slope [7]. We also have new results in light sterile neutrino search. After the new data was included into the analysis the 90% confidence level limit to sterile neutrino parameters in the region of $\Delta m^2 \sim 0.9$ eV^2 became as stringent as $\sin^2 2\theta < 0.004$ (Gaussian CLs method), but two points with close $\Delta\chi^2 \sim -10$ manifested themselves. A Feldman and Cousins method was used to obtain their significance. The result is shown in fig. 2 (right). A dark blue area corresponds to 3σ-limit. Much more conservative 3σ-limit from Gaussian CLs method is shown by red line for comparison. The best fit point has significance 2.35σ, which is much less than we need to claim an indication of the 4th neutrino existence.

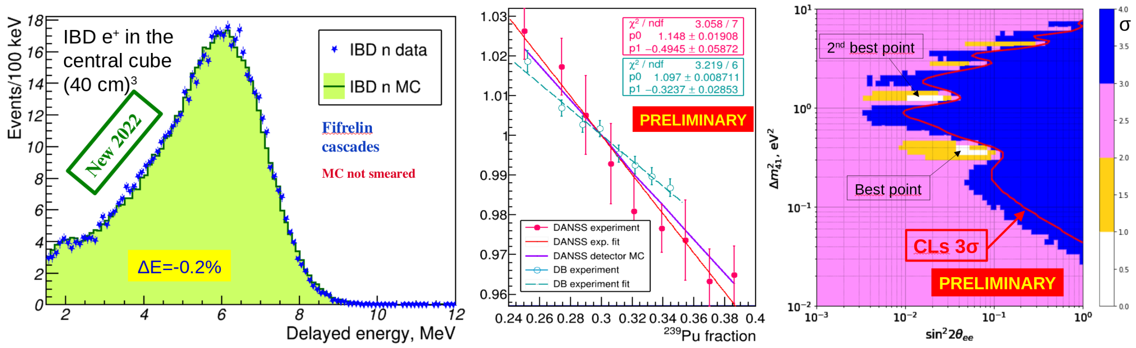

Figure 2: Spectrum of neutron capture for IBD events with positron vertex in the central $(40\text{cm})^3$ cube (left). Neutrino counting rate dependence over fission fraction of ^{239}Pu normalized to the counting rate at 30% fraction (middle). Feldman and Cousins analysis of DANSS data (right).

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