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Sensitivity of the DANSS detector for a sterile neutrino searches

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A solid scintillator detector DANSS (Detector of Anti-Neutrino based on Solid Scintillator) designed for remote on-line diagnostics of nuclear reactor parameters and a search for short range neutrino oscillation is under construction now. It will be installed at the Kalinin Nuclear Power Plant next year. DANSS is a 1 m³ plastic scintillator detector divided into 2500 cells and surrounded with combined passive and active shielding to suppress external radiation backgrounds. The basic element of the detector is the scintillator strip 4×1×100 cm³ in size with thin gadolinium coating. Light from the strip is collected by wave length shifting (WLS) fibers 1.2 mm in diameter and transported to small-size photomultipliers (PMTs) and multipixel photodiodes operated in the Geiger mode (SiPMs) used to read out scintillation signals. The estimates of the DANSS parameters are presented: efficiency (~70%), counting rate of neutrino events (~8500 per day), and expected background level (below 1%). We demonstrate that a detector with such properties is capable to measure the nuclear reactor thermal power with an accuracy of about 1.3% in one day and to determine the fuel composition and ²³⁹Pu production with an accuracy of ~5%. DANSS is placed on a movable platform. It can change the distance from the detector to the reactor core from 9.6 to 11.9 meters. The detector can be also placed at larger distances from the reactor core but this requires reassembling of the detector in a different hall. Measurements of the neutrino flux and energy spectrum at different distances should allow to study a large fraction of a sterile neutrino parameter space indicated by recent experiments and reanalysis of the reactor neutrino fluxes. DANSSino is a small simplified pilot version of DANSS. It has already taken data under a reactor at the Kalinin NPP. In spite of small dimensions (20 × 20 × 100 cm³), the pilot detector turned out to be quite sensitive to the reactor antineutrino with a counting rate of about 70 events per day and the signal-to-background ratio of about one. This experiment together with the laboratory studies performed with DANSSino confirmed our estimates of the DANSS sensitivity.

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