

Observation of sterile antineutrino oscillation in Neutrino-4 experiment at SM-3 reactor

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The experiment Neutrino-4 had started in 2014 with a detector model and then was continued with a full-scale detector. All steps of preparatory work on this experiment are presented. Measurements were carried out in two phases. The first phase measurements with reactor under operation had started in June 2016 and were continued till June 2018. The second phase from September 2018 to July 2019 was carried out mainly in near positions to the reactor, where the signal to background ratio is significantly better. It enabled to increase the statistical accuracy of measurements by factor 1.4. Measurements with the reactor ON were carried out for in total 720 days, and with the reactor OFF - for 417 days. In total, the reactor was switched on and off 87 times. Were obtained the results of measurements of reactor antineutrino flux and spectrum dependence on the distance in the range 6-12 meters from the center of the reactor core at SM-3 reactor (Dimitrovgrad, Russia). Using all collected data, we performed the model independent analysis on the oscillation parameters m_{214}^2 and $\sin^2 2\theta_{14}$. The method of coherent summation of results of measurements allows us to directly observe the effect of oscillations. We observed an oscillation effect in vicinity of $\Delta m_{214}^2 = (7.25 \pm 0.13 \text{ stat} \pm 1.08 \text{ syst}) \text{ eV}^2$ and $\sin^2 2\theta = 0.26 \pm 0.08 \text{ stat} \pm 0.05 \text{ syst}$. We provide a comparison of our results with results of other experiments on search for sterile neutrino. Combining the result of the Neutrino-4 experiment and the results of measurements of the gallium anomaly and reactor anomaly we obtained value $\sin^2 2\theta_{14} \approx 0.19 \pm 0.04$ (4.6σ). Also was performed comparison of Neutrino-4 experimental results with results of other reactor experiments NEOS, DANSS, STEREO, PROSPECT and accelerator experiments MiniBooNE, LSND and results of the IceCube experiment. Mass of sterile neutrino obtained from data collected in the Neutrino-4 experiment (in assumption $m_{24}^2 \approx \Delta m_{214}^2$) is $m_4 = (2.68 \pm 0.13) \text{ eV}$. Using the estimations of mixing angles obtained in other experiments and our new results we can calculate, within 3+1 neutrino model, masses of electron, muon, and tau neutrinos: $m_{\nu e} = (0.58 \pm 0.09) \text{ eV}$, $m_{\nu \mu} = (0.42 \pm 0.24) \text{ eV}$, $m_{\nu \tau} \leq 0.65 \text{ eV}$. Extended PMNS matrix for (3 + 1) model with one sterile neutrino is provided, neutrino flavor mixing scheme with sterile neutrino and global fit of reactor experiments.

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