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PARTICLE PHYSICS AT PIK REACTOR COMPLEX

Abstract

The Standard Model provides estimations on neutron EDM (nEDM) value on the level inaccessible for the modern experiment: 10^{-30} – 10^{-33} e·cm. CP-violation (and nEDM) arises only in the second order of smallness on the weak interaction constant. SM fails to account for baryon asymmetry of Universe. Search for nEDM is expected to be search for some phenomena beyond the framework of SM. To improve limitation on nEDM accuracy more intense UCN source is needed. UCN source with superfluid He which is preparing at PNPI will make it possible to reach the highest UCN density 10^3 – 10^4 cm $^{-3}$.

Reactor Antineutrino Anomaly gives new average ratio of the observed antineutrino flux to the expected 0.934 ± 0.024 (2σ accuracy). The possible reason for deficiency is oscillations of neutrino into the fourth, sterile state which has considerably less cross-section of interaction with known particles. This assumption requires extension of ideas of the elementary particles interaction, and in case of its detection, a new state of neutrino would be the way to a new physics.

Predicted and discovered electric fields in noncentrosymmetric crystals which may act on a neutron, provide new possibilities for measuring the neutron electric dipole moment (nEDM) by the crystal-diffraction method with the sensitivity about UCN method.

Recent detection of gravitational waves raised the question of the place of this phenomenon in the process of matter generation in the Universe. The project PITRAP proposes to combine a powerful source of exotic nuclides with ultra-sensitive detection of studying this phenomenon for the experimental determination of the mass landscape of exotic nuclides involved in the process of fast neutron capture.

Search for neutron–antineutron oscillations is another possibility of employing UCN in fundamental experiments at new UCN source. A transition of a neutron to an antineutron is possible only under conditions of baryon-number violation, which is one of Sakharov's conditions for the formation of the Universe.

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