L. A. Mikaelyan. *Neutrino experiments on the reactor at the Roven nuclear power plant.* Inverse beta decay

$$\bar{\nu}_e + p \rightarrow e^+ + n \quad (1)$$

has been under study in the neutrino laboratory of the I. V. Kurchatov Institute of Atomic Energy at the Roven nucler power plant (RNPP) since 1982.[1]

The absolute cross sections and the positron spectrum (Fig. 1) of this reaction are being measured for the first time in 20 years.[2] In addition to absolute measurements, relative measurements of the cross sections and spectra at distances of 18 m and 25 m from the center of the reactor are also being performed.[3]

There are two types of detectors in the laboratory: a scintillation spectrometer and a detector of the integral type. In the scintillation spectrometer events of the reaction (1) are separated based on delayed coincidences between the positron and neutron. The target for $\bar{\nu}_e$, the neutron moderator, and the e^+ and n detector consists of a gadolinium-doped organic scintillator. In the detector of the integral type the reaction (1) is recorded only based on the neutrons without the use of the coincidence method. The neutrons are formed and moderated in polyethylene and are recorded in gas counters filled with helium-3 (see Table I).

The detectors are insensitive to the direction of the $\bar{\nu}_e$ flux.

Neutron experiments with reactors and detectors are unique. In the last five years only two other groups, carrying out research on reactors in Switzerland and France, have published their results. The number of $\bar{\nu}_e$ recorded on the RNPP equals 75 000, which is 20 000 less than the total sample published by the groups mentioned by the end of 1985.

TABLE I. Basic characteristics of the detectors.

	Spectrometer	Integral detector
Target	190 kg	130–190 kg
Efficiency	32%	54%
Counting rate of events (18 m)	310/10⁵ s	350–550/10⁵ s

Neither the absolute cross sections and spectra, measured 18 m from the center of the reactor, nor the relative measurements at distances of 18 and 25 m exhibit a statistically significant manifestation of the Pontecorvo oscillations. The results are analyzed based on the well-known model of two states, characterized by the parameters $\sin^2\theta$ (θ is the mixing angle) and $\Delta^2 = |m_1^2 - m_2^2|$ (m_1 and m_2 are the masses of the interfering states); the corresponding limits are shown in Fig. 2. As is evident from this figure, the results obtained on the RNPP almost completely exclude the region of parameters presented by the French group, which in 1984 reported the observation of oscillations.

Methods of remote control of the active zone of the working reactor based on its neutrino radiation have been developed for the first time at the Roven nuclear power plant. In particular, the energy generated by the reactor and

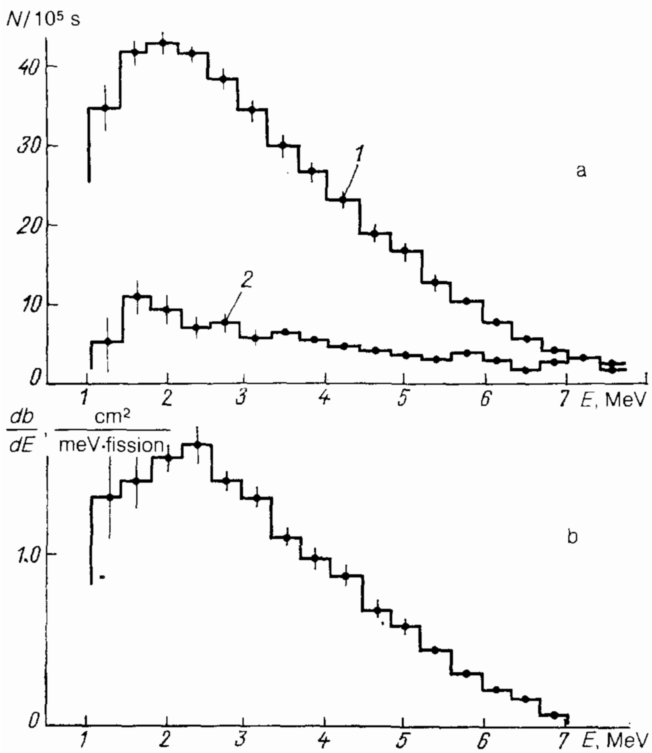

FIG. 1. Positron spectra of the reaction $\bar{\nu}_e + p \rightarrow e^+ + n$. a: 1) Reactor is operating (effect plus background); 2) reactor is stopped (background). b) Positron spectrum (differential cross section of the reaction.

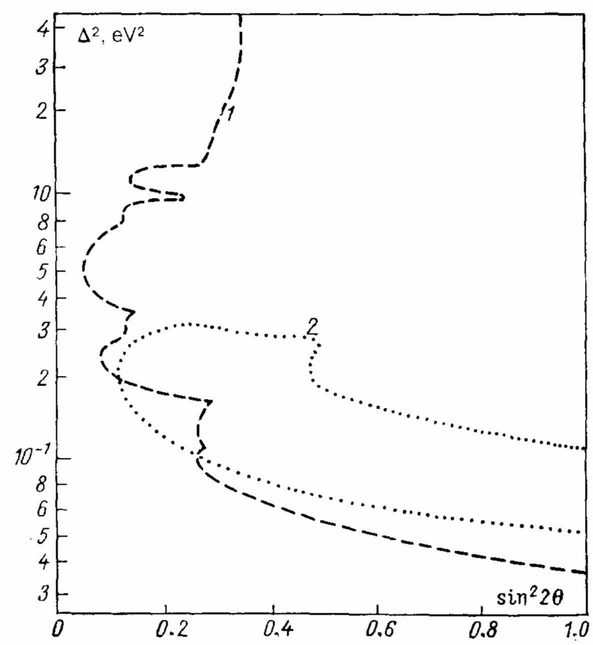

FIG. 2. Limits on the parameters of neutrino oscillations. 1) Results of this paper; the region to the right is forbidden; region 2 (inside) is the region of parameters corresponding to the effect of oscillations [whose observation was reported by the French group (1984)].

the mass of nuclear fuel that has undergone fission were measured.[4]

[1]A. A. Borovoĭ and L. A. Mikaelyan, At. Energ. **54**, 143 (1983).
[2]A. I. Afonin *et al.*, Yad. Fiz. **42**, 1138 (1985) [Sov. J. Nucl. Phys. **42**, 719 (1985)].
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