NEW MEASUREMENTS OF ELECTRON — SPIN ASYMMETRY

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Here are presented the preliminary results of angular correlation between electron escape and decaying neutron spin direction measurements. The experiment is carried out at a new intense polarized neutron beam from the vertical channel of the LNPI reactor.

The data of the correlation coefficient $A_0 = -0{,}1114 \pm 0{,}0015$ lead to the value of the fundamental constants ratio $\lambda = g_A/g_V - 1{,}254 \pm 0{,}004$.

The new vertical channel with a record polarized neutron flux — 3.10^{10} 1/s was installed in 1985 at the LNPI [1].

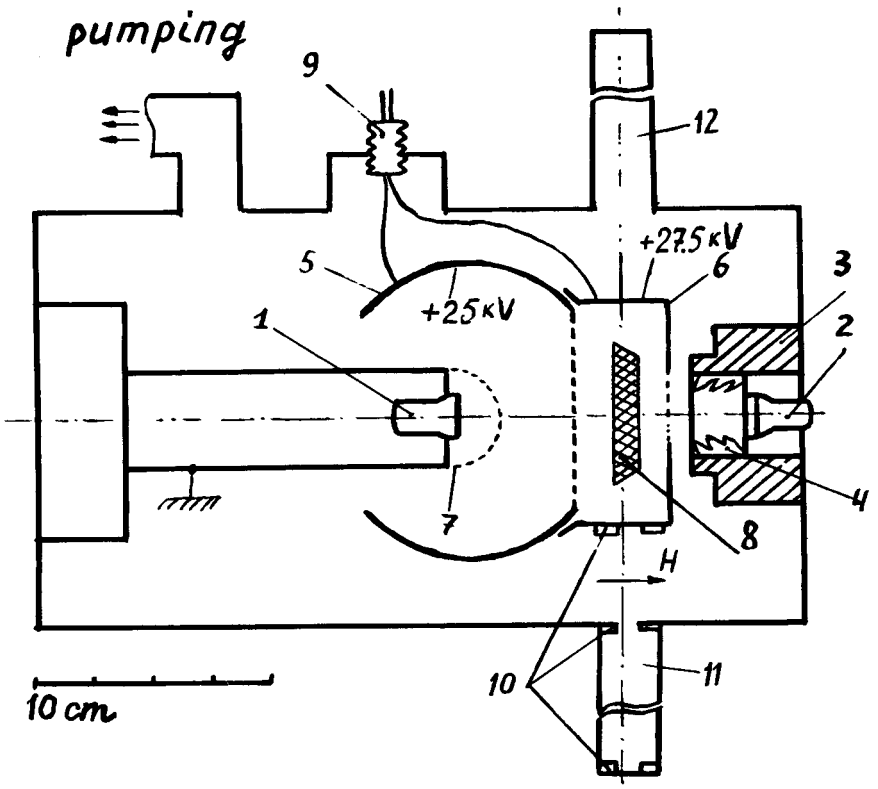

Fig. Scheme of experimental device: *1* — proton detector, *2* — electron detector, *3* — lead, *4* — collimator, *5* — accelerating electrode, *6* — extracting electrode, *7* — grid, *8* — decay region, *9* — high voltage supply, *10* — ^{6}Li

This made it possible to undertake some new investigations of angular correlations in neutron beta decay.

The first experiment of this cycle, which is being performed now, is devoted to the investigation of the electron escape asymmetry, relative to the decaying neutron spin (correlation constant A).

The methodical base of this experiment has been developed in the investigation, carried out at the Kurchatov Institute ten years ago [2] and this is a natural continuation of the latter.

A sketch of the measuring device is presented in fig. Two detectors — a plastic scintillator with a photomultiplier for detecting electrons and a thin CsJ(Tl) layer also with a photomultiplier for detecting recoil protons, accelerated and focused in a spherical electrostatic field with 25 kV of total potential difference, are placed on opposite sides to the decay region of the neutron beam. The beam polarization is directed along the detector axis and is reversed every two seconds with the aid of an adiabatical spin-flipper.

The coincidences of both detector signals are counted; accidental events are registered simultaneously as delayed coincidences in the same electronic set up.

If $N^{\uparrow}$ and $N^{\downarrow}$ stand for counting rates with opposite signs of polarization (with the accidental coincidence background substracted), then we can express the asymmetry

$$X = \frac{N^{\uparrow} - N^{\downarrow}}{N^{\uparrow} + N^{\downarrow}}$$

in the following manner:

$$X = v/c \cdot \cos\Theta \cdot P \cdot A,$$

where

v/c — is a factor averaged over the electron spectrum;

$\cos\Theta$ — is an averaged geometric factor;

P — is mean polarization of the neutron beam [3].

The principle feature of this method of measurements is to make sure of the absence of any dependence of the proton-recoil registration efficiency on the antineutrino escape direction. This saves us from the necessity of taking into account the antineutrino-spin asymmetry (subsequent correlation coefficient $B \approx 1$).

For this purpose the 'decay region' of the neutron beam is separated from the electron detector by a diaphragm, and as a result, the detector can register the betas, created only in the shaded part of the region shown on fig. The electric field between electrodes 5 and 6 (2.5 kV) extracts the recoil protons and pushes them toward the spherical grid 7 and as a result, every proton independently of its initial energy and escape direction hits the proton detector.

The last value of the correlation constant A_0 (corrected for 'weak magnetizm' etc.), obtained now, is $A_0 = -0.1114 \pm 0.0015$, and this leads to $\lambda = g_A/g_V = -1.254 \pm 0.004$.

The statistical error of this result is ± 0.001 in the A-value.

The main part of the methodical uncertainty is connected with the beam polarization measurements (0.7%).

This result is in agreement with the previous data, obtained at the Kurchatov Institute [2] ($A_0 = -0.113 \pm 0.005$, $\lambda = -1.257 \pm 0.013$) but is noticeably lower than the recent ILL result [4] ($A_0 = 0.1146 \pm 0.002$, $\lambda = -1.262 \pm 0.005$).

This experiment is now in progress.

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