from a thermionic source.

*We have designed for this purpose a high-frequency source operating with LiCl vapor. This source will be described elsewhere.

†In view of the small energy difference between the terms $2s^3S$ and $2s^1S$, the additional maxima connected with these states are not separated.

‡We could not establish the position of the additional maximum on the $\sigma_{1-1}(\nu)$ curve for H_2 because of the low intensity of the Li^+ beam at low energies; it is clear from the course of the curve, however, that this maximum does not exist.

[1] Fogel', Mitin, Kozlov, and Romashko, J. Exptl. Theoret. Phys. (U.S.S.R.) **35**, 565 (1958), Soviet Phys. JETP **8**, 390 (1959).

[2] C. E. Moore, Atomic Energy Levels, National Bureau of Standards, 1949.

[3] Ya. M. Fogel' and A. D. Timoveev, Тр. физ.-мат. фак-та ХГУ, (Trans. Phys.-Math. Faculty, Khar'kov State University) **7**, 177 (1958).

Translated by J. G. Adashko
248

ELECTRON-NEUTRINO ANGULAR CORRELATION IN THE BETA DECAY OF THE FREE NEUTRON

Yu. V. TREBUKHOVSKIĬ, V. V. VLADIMIRSKIĬ, V. K. GRIGOR' EV, and V. A. ERGAKOV

Submitted to JETP editor December 25, 1958

J. Exptl. Theoret. Phys. (U.S.S.R.) **36**, 1314-1316 (April, 1959)

WE have determined the electron-neutrino angular correlation in the β decay of the free neutron by studying the decay-electron spectrum for a fixed recoil proton momentum. Figure 1 shows a schematic diagram of the apparatus. A collimated neutron beam 35 mm in diameter from the heavy-water reactor of the U.S.S.R. Academy of Sciences passed into an aluminum vacuum chamber which contained detectors and magnetic lenses to focus the decay electrons and recoil protons.

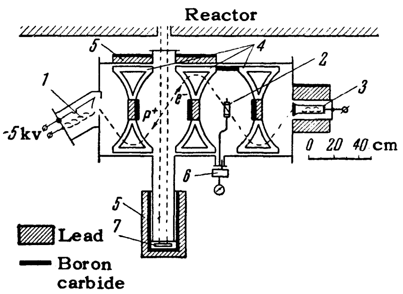

FIG. 1. Experimental setup: 1 – electron multiplier; 2 – Geiger-Mueller counter; 3 – photomultiplier; 4 – magnetic lenses; 5 – shield; 6 – device for filling the Geiger-Mueller counter; 7 – monitor.

The selection of electrons by momentum was done by the two consecutive toroidal magnetic lenses[1] pictured in the drawing to the right of the neutron beam. The resolving power of this system of spectrometers is ±3%. At the intermediate focus of the spectrometers there was a thin-walled (3 mg/cm^2 terelene) Geiger-Mueller counter filled with methylal at 110 mm Hg with forced gas circulation. At the second focus the electrons were detected by a counter consisting of a plastic scintillator 90 mm in diameter and 1 mm thick, a light pipe, and a BS photomultiplier.

With the help of this design only those electrons which passed through both detectors were chosen by means of a double coincidence with 0.2 μsec resolving time. The use of two consecutive lenses to detect electrons permitted us to reduce considerably the background of accidental coincidences and to limit the volume in which the detected decay occurred.

The separation of protons by momentum was done by a single toroidal spectrometer. An electron multiplier described in reference 2 was used to count the protons.

In the experiment we studied triple coincidences between the proton and electron detectors. To compensate for the flight time of the proton, pulses from the double coincidence circuit were delayed by 1.3 μsec relative to pulses from the proton detector. The resolving time of the triple coincidence circuit was 0.7 μsec.

In taking the data we regularly checked the efficiency of the electron multiplier with a calibrated α source and the operation of the Geiger-Mueller counter and the photomultiplier with the help of a Sr^{90} source.

The flow of neutrons was controlled with a monitor. The results of the measurements are shown in Fig. 2. The solid lines show the calculated forms of the electron spectra for different values of the electron-neutrino angular correlation coefficient.

The experimental points are shown with their standard errors. The results, worked out by the method of least squares, give the value $\lambda = -0.06 \pm 0.13$. Only statistical errors are given here. Possible systematic errors are being studied. The value we found is slightly different from the value of λ obtained by Robson[3] ($\lambda = +0.07 \pm 0.12$). If we assume that in β decay the main contribu-

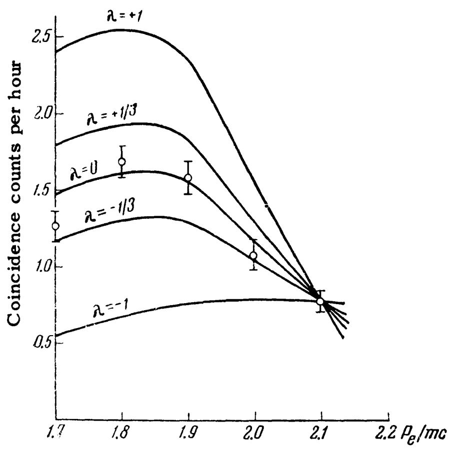

FIG. 2

tions are from the axial vector and vector interactions,[4-7] then our value for λ corresponds to

$$R = g_A^2/g_V^2 = 1.3^{+1.5}_{-0.53}.$$

The large statistical errors do not make it possible to state with assurance that the value R = 1.4 is confirmed, which would follow from the measurements of the neutron lifetime.[8]

In conclusion the authors consider it their duty to express their gratitude to the Academician A. I. Alikhanov for his valuable advice; to E. K. Tarasov for the theoretical calculations; to a group of co-workers, D. P. Zharkov, G. K. Tumanov, and N. I. Afanas'ev for their help in carrying out the experiment; to V. E. Nesterov for help in setting up the equipment; and to the chief engineer of the heavy-water reactor, S. A. Gavrilov, and his co-workers for the uninterrupted operation of the reactor.

[1] Vladimirskiĭ, Tarasov, and Trebukhovskiĭ, Приборы и техника эксперимента (Instruments and Meas. Engg.) **1**, 13 (1956).

[2] Trebukhovskiĭ, Ergakov, and Nesterov, Приборы и техника эксперимента (Instruments and Meas. Engg.) **1**, 75 (1956).

[3] J. M. Robson, Can. J. Phys. **36**, 1450 (1958).

[4] Herrmannsfeldt, Maxson, Stähelin, and Allen, Phys. Rev. **107**, 641 (1957).

[5] Goldhaber, Grodzins, and Sunyar, Phys. Rev. **109**, 1015 (1958).

[6] Herrmannsfeldt, Burman, Stähelin, Allen, and Braid, Phys. Rev. Letters **1**, 61 (1958).

[7] N. A. Burgov and Yu. V. Terekhov, J. Exptl. Theoret. Phys. (U.S.S.R.) **35**, 932 (1958), Soviet Phys. JETP **8**, 651 (1959).

[8] Sosnovskiĭ, Spivak, Prokof'ev, Kutikov, and Dobrynin, J. Exptl. Theoret. Phys. (U.S.S.R.) **35**, 1059 (1958), Soviet Phys. JETP **8**, 739 (1959).

Translated by Genevra Gerhart
249

THE PERMANENT STRUCTURE OF SHOCK WAVES WITH JOULE DISSIPATION

V. A. BELOKON'

Institute for Chemical Physics, Academy of Sciences, U.S.S.R.

Submitted to JETP editor December 30, 1958

J. Exptl. Theoret. Phys. (U.S.S.R.) **36**, 1316-1317 (April, 1959)

If the only factor which changes the entropy of a composite medium is the Joule heat, then the equations of magnetohydrodynamics describing the time-independent uniform flow across magnetic lines of force (see reference 1) determine the evolution of the thermodynamic parameters in accordance with the continuity of mass and momentum flow

$$d(RT/V + H^2/8\pi)/dV \equiv dp/dV = -(\rho u)^2 = -(\rho u)^2_{\pm\infty} \quad (1)$$

and the condition for heat balance is

$$\rho u T\, dS/dx = (c^2/16\pi^2\sigma)(dH/dx)^2 \geqslant 0. \quad (2)$$

Magnetohydrodynamic shock waves, in their proper coordinate system, always represent a transition from hypersonic flow at $x = -\infty$ to a flow at $x = +\infty$ which is moving more slowly than adiabatic sound.[2] A trivial consequence of this is the fact that uninterrupted evolution of the thermodynamic parameters within the shock wave according to Eq. (1) would imply a maximum in the entropy within the compression wave, since at some points the speed of flow will be equal to the local adiabatic speed of sound; on the (p, V) diagram the isentropic lines, which are convex downward, will be tangent to the straight lines (1) at these points for any arbitrary amplitude. Any subsequent decrease in the entropy $S_{max} \rightarrow S_{+\infty}$ is impossible in view of (2). More than this, the whole region where $S \geq S_{+\infty}$ along the line (1) turns out to be forbidden, since in this region it is not possible to reach the final state. On the other hand, it is noteworthy that an attempt to construct a continuous solution would lead to a so-called "backlash" of the wave: (1) and (2) give

$$-(u/V)^3 T\, dS/dV = (c^2/16\pi^2\sigma)(dH/dV)^2\, dp/dx. \quad (3)$$

When $dS/dV > 0$, i.e., when the entropy decreases as the material is compressed, the pressure tends to its final value with a negative gradient, implying an absurd triple-valued nature for the parameters of the flow in space.

In view of the absurdity of a continuous solu-