of these two columns by $f_1, f_2, \ldots f_k$ and $f_{k+1}, \ldots f_{n'}$, while the set of arguments in the other columns are denoted by g. The Young operator corresponding to our pattern can be written as

$$Y_{\lambda_1\lambda_2,\ldots,\lambda_p} = A'(g)\,A(f_1\ldots f_k) \times A(f_{k+1}\ldots f_{n'})\prod_{m=1}^{k} S(f_m, f_{k+m})\,S'(f,\ g). \quad (4)$$

$A'(g)$ is the product of the antisymmetrizers for all columns except a and b. We have extracted from the row symmetrizers factors containing the symmetrization with respect to the pairs of arguments in columns a and b, and have denoted the product of the remaining factors by $S'(f, g)$.

We want to show that

$$(1 - \sum_{i=k+1}^{n'} P_{f_i f_k})\, Y_{\lambda_1,\lambda_2,\ldots,\lambda_p} = 0. \quad (5)$$

But once the Young operator for the general case has been put in the form (4), relation (5) follows immediately from the already proven cyclic symmetry for the case of two columns, since the operator (. . .) in (5) commutes with the operator $A'(g)$.

A condition equivalent to (5), namely the impossibility of increasing the antisymmetry of a function which is antisymmetric with respect to groups of $\lambda_1, \lambda_2, \ldots \lambda_p$ arguments by adding to a larger group of arguments some argument from a shorter group (or a group of the same length) was the basis of Hund's[3] classification of the types of permutation symmetry of functions. Hund describes such a symmetry character as having the A-normal form $A(\lambda_1 + \lambda_2 + \ldots + \lambda_p)$. The case of $p = 4$ is of interest in treating the coordinate wave function of the nucleus when the forces are assumed to be independent of the spin and charge of the nucleons.[4]

Thus we have shown in the present note that a function symmetrized according to a general Young pattern has the A-normal form of Hund. The fact that Fock's condition is satisfied for Young patterns with two columns is an important special case of this result.

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Translated by M. Hamermesh
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MEASUREMENT OF THE HALF-LIFE OF THE NEUTRON

A. N. SOSNOVSKII,* P. E. SPIVAK, Iu. A. PROKOF' EV, I. E. KUTIKOV, and Iu. P. DOBRYNIN*

Submitted to JETP editor July 11, 1958

J. Exptl. Theoret. Phys. (U.S.S.R.) **35**, 1059-1061 (October, 1958)

THE present work, the purpose of which is to measure the neutron half-life with an accuracy considerably greater than that of previous experiments,[1-3] was undertaken by us in view of the special interest at present in the form of the β interaction.

The measurements were made in an apparatus shown in longitudinal section in Fig. 1. A well-collimated beam of neutrons from the RFT reactor (Physics and Engineering Reactor) passed through the evacuated chamber 1; decay protons appearing in the part of the beam opposite the diaphragm 2 passed through a field-free space to the grid 3 and were focused on the window of the proportional counter 5 by an electric field applied between grids 3 and 4. The strength of the electric field was considerably greater than the computed value for 100% focusing of the protons. The neutron half-life T, in minutes, is given by the formula $T = Jk\alpha \ln 2/n$, where J is the integral of the neutron density over the cross section of the beam, n is the number of decay protons recorded per minute, α is the transmission of the grids, and k is a coefficient whose value is determined only by the geometry of the apparatus and the distribution of the neutron density in the beam and is independent of the shape of the proton spectrum.

The neutron density was determined from activation of gold targets, making the appropriate corrections for the effect of resonance neutrons, and also from activation of targets of sodium, which follows a 1/v law. In both cases, the standardization was done by absolute β counting on gold.

The neutron density measured at the center of the beam was 2.17×10^3 neutrons/cm^3 in these experiments, while the integral of the neutron density over the cross section of the beam was $J = 7.68 \times 10^4 \pm 2\%$. The number of decay protons was determined from the difference of the counter readings with and without electric field. As a result of many series of measurements at the value of J cited above, we found the value $n = 30.0 \pm 0.4$ min^{-1}. The transmission α of the grids,

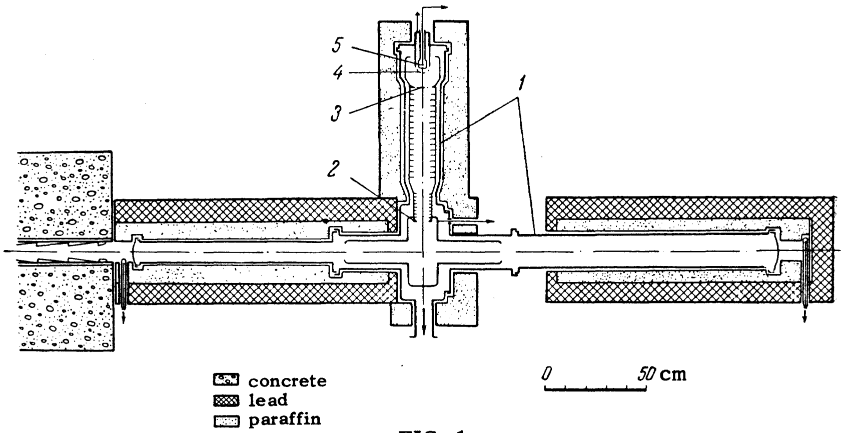

FIG. 1

taking account of the slight correction $(\sim 1 - 1.5\%)$ due to its dependence on the angle of incidence of the protons, was $0.84 \pm 0.5\%$. The coefficient k was determined on a computer† and was equal, to 7.87×10^{-3}. The uncertainty in this number was determined mainly by the lack of precision in fixing the geometry of the apparatus, and did not exceed a few tenths of a percent.

Inserting these values in the expression for T gives a value of $T = (11.7 \pm 0.3)$ min for the neutron half-life. This half-life leads to an ft value for the neutron of 1180 ± 35. If we make use of the relation between the ft value and the ratio of the coupling constants g_{GT} and g_F, we find from a comparison of the neutron ft value and that of O^{14} (ft = 3100[4]) the value $|g_{GT}/g_F|^2 = 1.42 \pm 0.08$ for this ratio.

*Deceased.

†The authors express their thanks to E. S. Kuznetsov, M. R. Shura-Bura, and their co-workers I. G. Krutikov, V. N. Toroptsev and O. B. Moskalev, who made these computations.

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Translated by M. Hamermesh
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POLARIZATION OF RaE *ELECTRONS AND TIME REVERSAL INVARIANCE*

A. I. ALIKHANOV, G. P. ELISEEV, and V. A. LIUBIMOV

Submitted to JETP editor August 20, 1958

J. Exptl. Theoret. Phys. (U.S.S.R.) **35**, 1061-1062 (October, 1958)

In a previous paper by the authors[1] it was shown that for β decays in heavy nuclei corresponding to first forbidden transitions (so-called Coulomb transitions, $\Delta J \neq 2$, as well as unique transitions $\Delta J = 2$, yes) the longitudinal polarization of the electrons should equal $-v/c$ accurate to 5%, and should be energy independent. However there exists a Coulomb transition, namely RaE $(1^- \rightarrow 0^+)$, for which the shape of the β-spectrum is anomalous.

To explain this anomaly, Yamada[2] postulated an accidental cancellation of matrix elements such that the large energy independent terms determining the β spectrum are reduced by destructive interference down to 1% of their value; thus the small energy dependent terms become important and are responsible for the anomaly in the β-spectrum shape. Two parameters, x and y, are introduced, representing the ratios of two matrix elements to a third one and by an appropriate choice of these parameters the normal β-spectrum shape is changed to fit the experimental shape for RaE.

The fit is obtained by the introduction of a correction factor $C(R_0, \epsilon, x, y)$[3-6] where R_0 is the nuclear radius and ϵ the total energy. It is to be expected that if the accidental-cancellation hypothesis is valid the magnitude of longitudinal polarization $(-\langle\sigma\rangle c/v)$ of electrons will also exhibit an anomaly in the exceptional case of RaE.