TABLES OF EXPERIMENTAL DATA

539.12

# CHECK OF V–A VARIANT IN β DECAY OF NUCLEI

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## 1. ABSENCE OF ADMIXTURES OF S, T, AND P VARIANTS IN THE HAMILTONIAN

| Investigated process | Experimental data | | Theoretical value (V-A variant) | Maximum contributions | | | Literature |
|---|---|---|---|---|---|---|---|
| | Measured quantity | Result | | $\|C_T/C_A\|^2$ | $\|C_S/C_V\|^2$ | $\|C_P/C_A\|$ | |
| Angular correlation of neutrino and electron in $He^6$ decay* | Constant a of correlation $1 + a(v/c)\hat{p}_e\hat{p}_\nu$ ($p_e$, $p_\nu$ – unit vectors)*** | $-0.319\pm0.028$<br>$-0.3351\pm0.0030$ | $-1/3$ | $<0.05$<br>$<0.006$ | | | 1<br>2 |
| The same in $Ne^{23}$ decay* | The same | $-0.33\pm0.03$ | $-1/3$ | $<0.06$ | | | 3 |
| The same in $Ar^{35}$ decay** | The same | $+0.85\pm0.12$<br>$+0.97\pm0.14$ | $\sim1$ | | $<0.1$ | | 5 |
| Angular correlations in the decay of the polarized neutron | Constant A in the correlation $1 + A(v/c)\hat{\sigma}\hat{p}_e$. Constant B in the correlation $1 + B\sigma p_e$*** ($\sigma$ – unit vector in spin direction) | $A = -0.114\pm0.019$<br>$B = +0.88\pm0.15$ | | $<0.1$ | $<0.1$ | | 4 |
| Decay of $Pr^{144}$ | Longitudinal polarization and electron spectrum | | | | | $<5$ | 6 |

*Pure Gamow-Teller transition

**Almost pure Fermi transition. Matrix element $M_{G\text{-}T} = 0.1 \pm 0.05$ for $Ar^{35}$, according to the data of Calaprice et al. [29] (1965)

***According to V-A theory we have for the neutron $a = \frac{1-|\lambda|^2}{1+3|\lambda|^2}$, $A = -2\frac{|\lambda|^2+\lambda}{1+3|\lambda|^2}$, $B = 2\frac{|\lambda|^2-\lambda}{1+3|\lambda|^2}$, where $\lambda = C_A/C_V$.

(It should be noted that according to Bereny [27] numerous data on the K capture and positron decay probability ratio $K/\beta^+$ have made it possible to establish that the limiting value of the coefficient of the Fierz term is $|b| < 0.014$.

## 2. RATIO OF VECTOR AND AXIAL CONSTANTS

| Investigated process | Experimental data | | Value $\lambda = C_A/C_V = \|\lambda\| e^{i\theta}$ | | Literature |
|---|---|---|---|---|---|
| | Measured quantity | Result | $\|\lambda\|$ | $\theta$ | |
| Neutron decay | Constant of $e\nu$ correlation (see Table 1) | $-0.09\pm0.04$ | $1.22\pm0.12$ | | 7 |
| Decay of polarized neutron (angular correlations) | Correlation constants A and B (see Table 1) | Data in Table I. | $1.25\pm0.05$ | | 4 |
| The same | Constant D of triple correlation of the type $1 + D(v/c)\hat{\sigma}[\hat{p}_e \times \hat{p}_\nu]$ * | $+0.04\pm0.05$<br>$+0.023\pm0.04$<br>$+0.007\pm0.013$ | | $175°\pm6°$<br>$177°\pm5°$<br>$179.1°\pm1.6°$ | 4<br>8<br>9 |
| Decay of polarized $Ne^{19}$ nuclei (angular correlations) | Constant D | $+0.002\pm0.014$ | | $180.2°\pm1.6°$ | 10 |
| Comparison of $(f\tau)_n$ with $(f\tau)0^+\to0^+$ ** | Neutron half-life | $11.7\pm0.3$ min<br>$10.8\pm0.15$ min | $1.18\pm0.028$<br>$1.23\pm0.015$ | | 11<br>12 |

*For the variant $D = \frac{M_F M_{G-T}}{\sqrt{3}} \frac{2\,\mathrm{Im}\,\lambda}{M_F^2 + M_{GT}^2|\lambda|^2}$; $M_F$ and $M_{G-T}$ are matrix elements.

**$(f\tau)$ for $0^+\to0^+$ transitions is assumed to be $3127 \pm 77$ sec, according to the data in the review of Bhalla [19] (1966).

## 3. LONGITUDINAL POLARIZATION OF ELECTRONS IN β DECAY

(presented in view of the presence of experimental data contradicting the theory)

| | Characteristic examples | | | | Remark |
|---|---|---|---|---|---|
| | Nucleus | $E_\mu$, MeV | $\frac{\|p\|}{v/c}$ | Literature | |
| Group of data confirming the theory: | $P^{32}_{1+\to 0+}$ (*l*-forbidden) | 0.2—0.5 | 0.994±0.006<br>1.00±0.01 | 17 | Averaging over all the results up to 1963. |
| a) $\|p\| = v/c$ | $Pr^{144}_{0-\to 0+}$ | 0.9—1.5 | 1.01±0.02 | 18<br>6 | Analogous decays were obtained with decays of $B^{12}$, $Na^{22}$, $Ga^{68}$, $Sm^{153}$, and $Tl^{203}$ accurate to 3-4%. |
| b) $\|p\| < v/c$, but the spectrum is suitably distorted, making it possible to attribute the position to nuclear effects | $Co^{60}_{5+\to 4+}$ | 0.2<br>0.08<br>0.04 | 0.99±0.03<br>0.92±0.03<br>0.72±0.1 | 20 | Analogous differences were observed in $Cd^{115}$, $Au^{199}$, and $Bi^{240}$ and can be well explained when the spectrum distortions are taken into account (see [23] and [26]) |
| Group of data contradicting the theory | $Pr^{142}_{2-\to 0+}$<br>$Ho^{166}_{2-\to 0+}$ | 1.25<br>1.25<br>0.34 | 0.934±0.015<br>0.94±0.015<br>0.91±0.03 | 21<br>21<br>22 | Analysis of known nuclear effects does not explain such strong deviations [26]. |
| | $Au^{198}_{2-\to 2+}$ | 0.34<br>0.145<br>0.090<br>0.060 | 0.94±0.03<br>0.80±0.05<br>0.71±0.07<br>0.56±0.06 | 23<br>24<br>25 | Strong decrease of polarization in the region $E_\beta < 0.25$ MeV is not accompanied by any deviations in the spectrum (Nazarenko [26]) |
| | $In^{114}$ | 0.340<br>1.250<br>0.540 | 0.93±0.03<br>0.96±0.015<br>1.007±0.026 | 22<br>21<br>28 | Very important case, since the transition is allowed. Unfortunately, the results by various authors are contradictory. |

## 4. MAXIMUM POSSIBLE DEVIATIONS FROM TOTAL NEUTRINO POLARIZATION FOR THE MODEL IN WHICH ν and $\tilde{\nu}$ DIFFER IN THE SIGN OF THE HELICITY

| Investigated process | Experimental data | | Maximum value of the parameter* δ characterizing the deviation from 100% ν polarization | Literature |
|---|---|---|---|---|
| | *Measured quantity* | *Result* | | |
| Double β decay | Half life of $Ca^{48}$ (lower limit) | $>2\cdot 10^{20}$ yrs<br>$>1\cdot 10^{21}$ yrs | <0.05 *)<br><0.02 **) | 13<br>14 |
| Experiment of Davies | Searches for the reaction $\tilde{\nu}_e + Cl^{37} \to Ar^{37} + e^-$ | $\sigma_{exp} \leqslant 0.9\cdot 10^{-45}$ cm$^2$ | <0.12 ***) | 15<br>Calculation of $\delta_{max}$ taken from [16] |

*The parameter $\delta = \frac{\nu_{right}}{\nu_{left}}$, i.e., the relative admixture of right-screw neutrino, or $\delta = \frac{\nu_{left}}{\nu_{right}}$, i.e., the relative admixture of left-screw antineutrino.

**Value of δ is calculated from the formula $\delta = \sqrt{\frac{T_{theor}\text{ (upper limit of neutrinoless decay)}}{T_{exp}\text{ (lower limit)}}}$

***$\delta = \frac{\sigma_{exp}}{\sigma_{theor}}$, where $\sigma_{theor} \cong 7\times 10^{-43}$ cm$^2$ was calculated for the case $\nu \equiv \tau$ (δ = 1) with allowance for the possible formation of $Ar^{37}$ in the excited state [16].


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