CONCERNING THE ARTICLE BY S. M. BILEN'KIĬ, R. M. RYNDIN, Ya. A. SMORODINSKIĬ, AND HO TSO-HSIU, "ON THE THEORY OF NEUTRON BETA DECAY"

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WEINBERG[1] proved a theorem from which it follows that the full probability for a process of the type $\alpha \rightarrow \beta + l + \bar{\nu}$ (α and β are arbitrary strongly interacting particles and l is a lepton) does not contain V-A interferences. It is easy to see that the expression (12) for the total probability of neutron decay given in our paper[2] satisfies this condition, since the dependence on the first power of λ is only apparent. Indeed, in the approximation $E_0/M = \Delta/M$, which we used, expression (12) may be rewritten as follows:

$$W = \frac{G^2}{(2\pi)^3}(1+3\lambda^2)\Big\{m^4\Big(E_0 - \frac{m^2+2E_0^2}{2M}\Big)\ln\frac{E_0+\sqrt{E_0^2-m^2}}{m} + \frac{2}{15}\sqrt{E_0^2-m^2}\Big[E_0^4 - \frac{9}{2}E_0^2m^2 - 4m^4 + \frac{E_0}{M}\Big(E_0^4 - 2E_0^2m^2 + \frac{49}{4}m^4\Big)\Big]\Big\}.$$

We are grateful to Prof. J. Bernstein for bringing the work of Weinberg to our attention.

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[1] S. Weinberg, Phys. Rev. **115**, 481 (1959).

[2] Bilenkiĭ, Ryndin, Smorodinskiĭ, and Ho Tso-Hsiu, JETP **37**, 1758 (1959), Soviet Phys. JETP **10**, 1241 (1960).

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PRODUCTION OF "SUPERCOLD" POLARIZED NEUTRONS

G. M. DRABKIN and R. A. ZHITNIKOV

Leningrad Physico-Technical Institute, Academy of Sciences, U.S.S.R.

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THE rapidly developing research on "cold" neutrons could be greatly widened if "supercold" neutrons with energies of the order of 10^{-4} to 10^{-6} °K could be successfully obtained. However, at moderator temperatures of 1° K, the yield of neutrons with energies of the order of 10^{-5} degrees K amounts to only 10^{-11} of the total flux. To increase the yield of "supercold" neutrons, a new moderation method is proposed below, based on the interaction of the neutron's magnetic moment with a non-uniform magnetic field.

When a neutron crosses a magnetic field H, the change in the kinetic energy ϵ of the neutron will be equal to

$$\Delta\varepsilon = \int_0^s \mu_{\mathrm{eff}} \frac{\partial H}{\partial s} ds,$$

where μ_{eff} is the component of the neutron's magnetic moment in the direction of the field H, and s is the path traversed by the neutron in the field. Since the region affected by a magnetic field can be separated into two parts, in which the gradients are directed in opposite directions, then for $\mu_{\mathrm{eff}} = \mathrm{const}$ we have $\Delta\epsilon = 0$.

The neutron energy can be changed by a corresponding change in the sign of μ_{eff}, i.e., by a reorientation of the neutron spin at the instant when it passes through the maximum of the magnetic field. For this purpose a uniform magnetic field, falling off to zero at the ends, is applied along the neutron path. When a neutron with its moment opposed to the field enters the field, it is acted on by a retarding force $F = \mu_{\mathrm{eff}}\,\partial H/\partial s$ (neutrons with spins oriented in the opposite direction will be accelerated). At the instant when it reaches the maximum field H_0, where $\Delta\epsilon = \mu_{\mathrm{eff}} H_0$, the change in speed will equal

$$\Delta v_1 \approx \mu_{\mathrm{eff}} H_0 / m v_0,$$

where m is the mass and v_0 the initial velocity of the neutron.

If a field H_1 of radio frequency $\omega = \gamma H_0$ is applied in a direction perpendicular to H_0, and if it satisfies the condition $H_1 \Delta t = \hbar / g\mu_N$ (Δt being the time of flight of the neutron through the field H_1, g the gyromagnetic ratio, and μ_N the nuclear magneton), then the result will be a reversal of the spin of the traveling neutron, and consequently a change in the sign of μ_{eff}. This will cause retardation of the neutron during its exit from the constant-field region as well as during its entrance, and the total loss in velocity will be $2\Delta v_1$. The reorientation of neutron spins can be accomplished in a field H_0 of length 2 to 5 cm, with $H_1 \sim 1$ gauss. The velocity lost by a neutron during a single passage through the field is very small. Thus, if $H_0 = 20{,}000$ gauss and the initial velocity is 2×10^3 cm/sec we have $2\Delta v_1 = 100$ cm/sec.