[3] D. Bohm and E. P. Gross, Phys. Rev. **75**, 1851 (1949).

[4] R. A. Bailey and K. G. Emeleus, Proc. Roy. Irish Acad. **A57**, 53 (1955).

Translated by D. ter Haar
261

POSSIBILITY OF DETERMINING THE CHIRALITY OF THE MUON BY MEANS OF δ-ELECTRON CASCADES FROM MAGNETIZED IRON

A. I. ALIKHANOV and V. A. LYUBIMOV

Institute of Theoretical and Experimental Physics, Academy of Sciences, U.S.S.R.

Submitted to JETP editor February 21, 1959

J. Exptl. Theoret. Phys. (U.S.S.R.) **36**, 1334-1335 (April, 1959)

It is known that the violation of spatial parity in weak interaction causes the muons produced by pion (or $K_{\mu 2}$-meson) decay to be polarized. However, the direction of muon polarization has not been experimentally determined to date. We propose here a method for measuring both the direction and magnitude of muon polarization, and consider possible experiments with accelerators and cosmic rays to solve this problem.

Berestetskiĭ (private communication) derived a formula for the cross section for the scattering of a polarized muon by polarized electrons

$$\sigma d\varepsilon = \sigma_0 d\varepsilon + \mathbf{P}_e\mathbf{P}_\mu \sigma_1 d\varepsilon$$
$$= 2\pi r_0^2 \frac{m d\varepsilon}{\beta^2\varepsilon^2}\left[1 - \beta^2\frac{\varepsilon}{\varepsilon_m} + \frac{1}{2}\frac{\varepsilon^2}{E^2} - \mathbf{P}_e\mathbf{P}_\mu \frac{\varepsilon}{E}\left(1 - \frac{\varepsilon}{\varepsilon_m} + \frac{\varepsilon}{2E}\right)\right],$$

where m, β, and r_0 are the rest energy, velocity, and classical radius of the electron; ϵ and ϵ_m are the energy and maximum energy transferred to the electron by collision with the muon; E is the muon energy; $\mathbf{P}_e$ and $\mathbf{P}_\mu$ are the electron and muon polarization vectors. It is seen from this formula that σ_1/σ_0, the relative magnitude of the cross section that is sensitive to the polarization, will be noticeable, if large energy transfers to electrons colliding with high-energy muons are separated out. This can be done by registering δ cascades with specified number of particles, produced by muons in magnetized iron.

The probability of a cascade with more than n electrons being produced by a polarized muon in magnetized iron can be calculated from cascade theory:[1]

$$b(E, n) = \int_0^{\varepsilon_m(E)} f(\varepsilon, n)\,\sigma(E, \varepsilon)\,d\varepsilon$$
$$= b_0(E, n) + \mathbf{P}_e\mathbf{P}_\mu b_1(E, n),$$

where $f(\epsilon, n)$ is the probability of producing a cascade with more than n particles by a δ electron of energy ϵ, and b_0, b_1 are the polarization-sensitive and polarization-insensitive probability of cascade occurrence.

To obtain a specified accuracy in the measurement of muon polarization it is necessary to register, in minimum time, such cascade in which the number of particles is greater $n_0 = n_0(E)$, a value at which the expression $b_1(E, n)/\sqrt{b_0(E, n)}$ has a maximum.

We give here the values of b_0 and $P_e b_1/b_0$ at 8% polarization of electrons in magnetized iron, as a function of the muon energy, for cascades with more than n_0 particles

E^{-1}_{Bev} =	1.8	3.3	4.6	6.5	8.7	12
n_0 =	1	2	3	4	5	6
$P_e b_1/b_0$ =	2.6%	2.8%	3.0%	3.0%	3.0%	3.0%
$10^3 b_0$ =	8.6	7.5	6.6	6.6	6.6	6.6

If we register δ cascades with more than n_0 particles, produced in iron magnetized along and opposite the direction of motion of muons in an accelerator beam, then, to measure muon polarization with 30% accuracy at $P_\mu = 100\%$, it is necessary to have 1.5×10^6 muons pass through the apparatus.

The proposed method can also be used to measure the chirality of muons from cosmic rays. If the muons are not separated by energies, but by sign, the probability of producing a shower with more than n cosmic muons can be found as

$$b(n) = \int_0^{\varepsilon_m(E)}\int_E^\infty f(\varepsilon, n)\,S(E)\,\sigma(E, \varepsilon)\,d\varepsilon dE$$
$$= b_0(n) + P_e P_\mu b_1(n),$$

where $S(E)dE$ is the muon spectrum.

We give here the values of b_0 and $P_e b_1/b_0$ for $P_e = 8\%$ as a function of the number of particles in the registered shower:

n =	1	2	4	6
b_0 =	$2.2\cdot 10^{-2}$	$5.8\cdot 10^{-3}$	$1.4\cdot 10^{-3}$	$6.4\cdot 10^{-4}$
$P_e b_1/b_0$ =	1.4%	2.1%	3.0%	3.3%

If the aperture ratio of the apparatus is such that it transmits $\sim 10^3$ muons per minute with polarization $P_\mu > 30\%$, approximately 30 days of measurement would be needed for the performance of the experiment.

We are grateful to V. B. Berestetskiĭ for discussions.

[1] S. Z. Belen'kiĭ, Лавинные процессы в космических лучах, (Cascade Processes in Cosmic Rays), M-L, 1948.

Translated by J. G. Adashko
262

CORRECTION TO THE PAPER BY V. Ya. EĬDMAN "RADIATION OF AN ELECTRON MOVING IN A MAGNETO-ACTIVE PLASMA"

Submitted to JETP editor January 10, 1959

J. Exptl. Theoret. Phys. (U.S.S.R.) **36**, 1335-1336 (April, 1959)

In a paper of the author by this title J. Exptl. Theoret. Phys. (U.S.S.R.) **34**, 131, 1958, Soviet Phys. JETP **7**, 91 (1958) the normalization of the polarization vector $\mathbf{a}_{j\lambda}$ has not been carried out completely. These vectors should be written in the form:

$$\mathbf{a}_{j\lambda} = \zeta_j \{1/\sqrt{2};\ i\alpha_j/\sqrt{2};\ i\beta_j/\sqrt{2}\},$$

where

$$\zeta_j^2 = 2n_{j\lambda}^2 \Big/ \left[\left(1 - \frac{V}{1-u}\right)(1+\alpha_j^2) + (1-V)\beta_j^2 - \frac{2V\sqrt{u}}{1-u}\alpha_j\right],$$

$$\alpha_j = K_j \cos\theta + \gamma_j \sin\theta; \quad \beta_j = -K_j \sin\theta + \gamma_j \cos\theta;$$

$$K_j = \frac{2\sqrt{u}\,(1-V)\cos\theta}{u\sin^2\theta \mp \sqrt{u^2\sin^4\theta + 4u(1-V)^2\cos^2\theta}},$$

$$\gamma_j = \frac{V\sqrt{u}\sin\theta + K_j uV\cos\theta\sin\theta}{1-u-V(1-u\cos^2\theta)}.$$

Taking account of the above correction leads to the appearance of the factor ζ_j in Eq. (7) and the factor $|\zeta_j|^2$ in Eqs. (10), (12) – (17), (24), (25) and the formula following Eq. (22). Hence the last equation in the paper should contain the factor $|\zeta_1|^2/|\zeta_2|^2$. Furthermore, in addition to the expression for W_{1j} [Eq. (24)], we must introduce the expression

$$W_{-1j} = \frac{Te^2\omega_{-1}^2\,d\Omega\,[v_1(-1+\alpha_j) - \beta_j\omega_{-1}n_{j\lambda}r_0\beta_2\sin\theta]^2\,|\zeta_j|^2}{16\pi c^3\,|1-\beta_2\cos\theta\,(n_{j\lambda}+\omega_{-1}\partial n_{j\lambda}/\partial\omega)|},$$

$$\omega_{-1} = \frac{\Omega_0}{|1-\beta_2 n_{j\lambda}\cos\theta|}.$$

Translated by H. Lashinsky
263