emulsion. A total of 31 stars with primary tracks were found by scanning 15 pellicles. None of the primary tracks in these stars differed in ionization density (within 10 per cent) and in direction (within $\pm 3°$) from the tracks of the beam π^+ mesons. These events cannot be attributed to an admixture of π^- mesons in the beam.

All the registered events were in the energy interval 30—80 MeV. Not a single event was obtained in the 0—30 MeV primary π^+-meson energy interval.

We have thus registered in this work the process of double charge exchange on emulsion nuclei ($\bar{Z} = 21$).

The cross section for double charge exchange of π^+ mesons (with allowance for the geometrical correction for the probability of registration of π^- mesons in the stack and the correction for prongless stopping) is $(4 \pm 1) \times 10^{-28}$ cm^2 in the energy interval 30—80 MeV.

The authors are grateful to Prof. V. P. Dzhelepov for a discussion of the results of the work and to V. I. Petrukhin for help with irradiation of the pellicle stacks.

[1] Batusov, Bogachev, Bunyatov, Sidorov, and Yarba, DAN SSSR **133**, 52 (1960), Soviet Phys. Doklady **5**, 731 (1961).

[2] T. Ericson, Inst. Conf. on High-energy Phys. and Nucl. Structure, Preprint CERN, 63-28, (1963) p. 47.

Translated by J. G. Adashko
116

NEUTRINOSCATTERING BY A POLARIZED ELECTRON

S. S. GERSHTEĬN and V. N. FILOMESHKIN

Joint Institute for Nuclear Research

Submitted to JETP editor December 13, 1963

J. Exptl. Theoret. Phys. (U.S.S.R.) **46**, 818 (February, 1964)

IN view of the importance of the experimental discovery of the $(e\nu)(e\bar{\nu})$ interaction, the existence of which is predicted by the Feynman–Gell-Mann scheme[1], it seems useful to note the strong spin dependence of the cross sections for $\nu + e$ and $\bar{\nu} + e$ scattering. The cross sections for the scattering of neutrinos and antineutrinos by a polarized electron are respectively:

$$\sigma_{\nu e} = 2\sigma_0\omega^2(1+\lambda)/(1+2\omega) \approx \sigma_0\omega(1+\lambda), \quad \omega \gg 1,$$

$$\sigma_{\bar{\nu} e} = \frac{1}{3}\sigma_0\omega\left\{\left(1 - \frac{1}{(1+2\omega)^3}\right) + \lambda\left[\left(1+\frac{1}{\omega}\right)\left(1 - \frac{1}{(1+2\omega)^3}\right) - \frac{3}{2}\frac{1}{\omega}\left(1 - \frac{1}{(1+2\omega)^2}\right)\right]\right\} \approx \frac{1}{3}\sigma_0\omega(1+\lambda), \quad \omega \gg 1,$$

where $\sigma_0 = 2G^2m^2/\pi = 8.4 \times 10^{-45}$ cm^2, $\omega = E/m$, E is the neutrino (antineutrino) energy in the laboratory system, m is the electron mass, and λ is the polarization of the electron in the direction of the neutrino (antineutrino) beam. It is possible that the indicated fact could be used in neutrino scattering on polarized iron in order to separate the effects of $\nu(\bar{\nu}) + e$ scattering from the background.

The authors are grateful to B. Pontecorvo and L. B. Okun' for discussions.

[1] R. P. Feynman and M. Gell-Mann, Phys. Rev. **109**, 192 (1958).

Translated by M. E. Mayer
117