of (40 ± 12)%. These data agree with the results obtained by Porter and Cook, and also by other authors.[8-10]

*The β radiation of Ru^{106} is completely absorbed by the counter window and by the air, and the character of the absorption of β radiation from Pr^{144} and Rh^{106} in aluminum is approximately the same.

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Translated by J. G. Adashko
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THE REACTION $p + d \rightarrow t + \pi^+$ AT PROTON ENERGY 670 Mev

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Submitted to JETP editor October 15, 1959

J. Exptl. Theoret. Phys. (U.S.S.R.) **38**, 643-644 (February, 1960)

A comparison of the cross sections for the reactions

$$p + d \rightarrow t + \pi^+, \quad (1)$$

$$p + d \rightarrow He^3 + \pi^0 \quad (2)$$

allows us to test the principle of the charge independence of nuclear forces, since, for isotopic spin conservation, the angular distributions for the two processes should be the same, and the ratio of their total or differential cross sections in the center-of-mass system should be 2 : 1.[1,2] A study of these two processes is interesting in itself, since they are connected with analogous processes of meson production in the reactions

$$p + p \rightarrow d + \pi^+, \quad (3)$$

$$p + n \rightarrow d + \pi^0 \quad (4)$$

and they admit of a simple theoretical interpretation.[1,3]

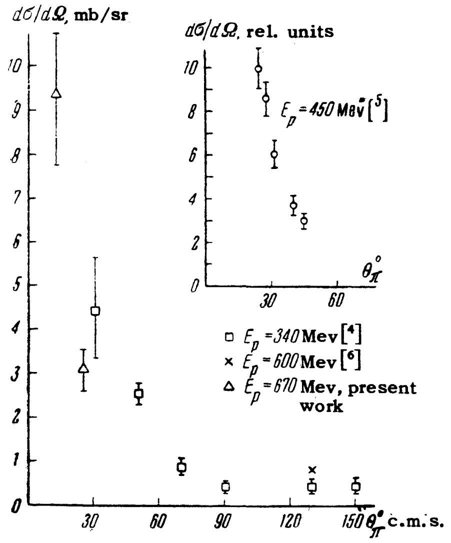
A measurement of the cross sections for reactions (1) and (2) was carried out earlier at energies of 340 Mev,[4] 450 Mev,[5] and 600 Mev.[6] In the present work, measurements were carried out to clarify the conditions for comparing processes (1) and (2) for the incident proton energy $E_p = 670$ Mev.

The examination of the reaction $p + d \rightarrow t + \pi^+$ was carried out on a proton beam with an intensity 10^{11} protons/sec. The secondary charged particles formed in the heavy polyethylene or carbon target were identified by momentum, specific ionization, and range. The selection by specific ionization was made simultaneously by five scintillation counters in a telescope,[7] so that rare emissions of particles with high ionization could be detected against a background of irrelevant particles with smaller ionization. The emission of low-energy tritium nuclei in reaction (1) was measured for angles 5.4° and 11° in the laboratory system. The calibration of absolute cross sections was carried out with the aid of a measurement of the path of the deuterons in reaction (3), since the angular distribution there was well known for an energy of 660 Mev.[8] The differential cross sections for reaction (1), calculated in the center-of-mass system and relative to the pion emission angle, are equal to

$$d\sigma(12^\circ)/d\Omega = (9.3 \pm 1.5) \cdot 10^{-30} \text{ cm}^2/\text{sr},$$

$$d\sigma(25^\circ)/d\Omega = (3.1 \pm 0.5) \cdot 10^{-30} \text{ cm}^2/\text{sr}.$$

These results are shown in the figure, together with the data obtained at different proton energies. As the energy of the incident protons is increased, a change is observed in the differential cross section of reaction (1), which tends to peak more in the forward, meson-emission direction. This kind of change in the differential cross section can be got qualitatively from the relation between the π^+ formation processes in reaction (1) and in reaction (3). This relation was obtained by interpreting process (1) on the basis of a hard-core nucleon model and by application of the impulse approximation.[3]



Since, for example, if the ratio of the pion formation cross sections in reaction (1) for incident proton energy 340 Mev for 0° and 180°, calculated on the basis of this theory with a core radius $0.5\hbar/m_\pi c$ is equal to ~ 10, then this ratio for 670-Mev protons increases to ~ 120 if the same wave function parameters are used and if the dependence of the angular distribution of reaction (3), which is indispensable for the calculation, is obtained by extrapolating the data for the inverse reaction for the meson energy region 174 to 370 Mev.[9] The differential cross sections calculated by this model for the incident proton energy 670 Mev, is

$$d\sigma(12^\circ)/d\Omega = 3.1\cdot 10^{-30}, \quad d\sigma(25^\circ)/d\Omega = 2.4\cdot 10^{-30}\,\mathrm{cm}^2/\mathrm{sr}$$

The quantitative disagreement between the calculated values and the experimental data is evidently due to the fact that in all these calculations one looks at the formation of positive pions from the collision of the incident proton with the proton of the deuteron only as reaction (3), and one does not take into account the contribution from pion formation in the reaction $p + p \rightarrow n + p + \pi^+$, whose total cross section exceeds by a factor of a few tens the total cross section for (3) in the incident proton energy region near 900 Mev, that used in the impulse approximation theory calculations.

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Translated by W. Ramsay
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ON THE MAGNETIC SUSCEPTIBILITY OF A RELATIVISTIC ELECTRON GAS

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Submitted to JETP editor October 24, 1959

J. Exptl. Theoret. Phys. (U.S.S.R.) **38**, 645-646 (February, 1960)

LANDAU[1] was the first to show that a gas consisting of free electrons is diamagnetic, if one neglects the electron spins, and that its diamagnetism is equal to one third of the spin paramagnetism. Landau evaluated the magnetic susceptibility of an electron gas, starting from the expression of the energy spectrum of a non-relativistic electron in a magnetic field.

To evaluate the magnetic susceptibility of a relativistic electron gas one could use the solution of the Dirac equation for an electron in a magnetic field.[2] It is, however, simpler to use the method of the quantum transport equation with a self-consistent interaction.[3] Starting from the Dirac equations for an electron in an external transverse electromagnetic field, we obtain the following transport equation with a self-consistent interaction for the quantum distribution function which depends on the momentum $\mathbf{p}$, the coordinate $\mathbf{r}$ and the spin indices α, β, γ

$$\frac{\partial}{\partial t} f_{\alpha\beta}(\mathbf{p},\mathbf{r}) = \frac{1}{(2\pi)^6}\frac{i}{\hbar}\int d\tau\, d\eta\, d\mathbf{k}\, d\mathbf{r}_1 e^{i\tau(\eta-\mathbf{p})+i\mathbf{k}(\mathbf{r}_1-\mathbf{r})} \times\Big\{\Big[\Big(\alpha, c\Big(\eta+\frac{\hbar\mathbf{k}}{2}\Big)-e\mathbf{A}\Big(\mathbf{r}_1-\frac{\hbar\tau}{2}\Big)\Big)+\beta\mu\Big]_{\beta\gamma} f_{\alpha\gamma}(\eta,\mathbf{r}_1) - \Big[\Big(\alpha, -c\Big(\eta-\frac{\hbar\mathbf{k}}{2}\Big)+e\mathbf{A}\Big(\mathbf{r}_1+\frac{\hbar\tau}{2}\Big)\Big)-\beta\mu\Big]_{\gamma\alpha} f_{\gamma\beta}(\eta,\mathbf{r}_1)\Big\}, \quad (1)$$

where α and β are the Dirac matrices, $\mu = mc^2$, $\mathbf{A}$ is the vector potential of the transverse electro-