given element in the gelatine.[1,2] As can be seen from the table, in the former case $P_f \approx 4$ and in the latter case $P_f \approx 6$, which is impossible. This excludes the applicability of item b) to the gelatine + uranium medium.

To the contrary, the applicability of the Fermi-Teller "Z-law" to the gelatine + uranium medium can be corroborated by comparing P_f for the fission of uranium by π^- mesons and the fission of Th^{232} by protons[6] (experiments with thorium were performed electronically). In either case, isotopes of the same substance are first produced (Pa^{238} and Pa^{233}). In the fission of Th^{232} by protons of energies from 10 to 340 Mev, P_f increases rapidly with energy and reaches a constant value, 0.45 ± 0.07, at approximately 50 Mev. At equal excitation energies (noticeably higher than the fission-threshold energies), P_f is smaller for the isotopes with the larger mass number. Therefore P_f (Pa^{238}) cannot be greater than 0.45.

Nor can P_f (Pa^{238}) be noticeably less than this quantity, as will now be shown. The mean excitation energy of uranium upon capture of slow π^- mesons is 60 to 80 Mev. At such excitation energies, fission of the nucleus is preceded by emission of several neutrons. Upon emission of five neutrons, the nuclear excitation energy diminishes by the amount of the binding energy (~ 25 Mev) and the kinetic energy carried away by these neutrons (~ 10 Mev).[7] The result is the nucleus Pa^{233} (the same isotope as in the fission of thorium by protons) with excitation energy 25 — 45 Mev. It follows from the experiments on the fission of Th^{232} by protons that at such excitation energies $0.35 < P_f \leq 0.45$. If $P_f \approx 0.35$, then by putting the probability of π^--meson capture by the various nuclei to be proportional to Z^n, a value close to unity is obtained for n (n = 1.25).

Thus, the probability of π^--meson capture in a gelatine + uranium medium (which is not a homogenous chemical compound) obeys more readily the "Z-law" than the proportionality to the number of atoms. This conclusion holds also for other types of mesons, since the capture of mesons on the atomic shells does not depend on the nuclear properties of the mesons.

These results, in conjunction with earlier experiments,[1,2] indicate that the probability of meson capture by various atoms in inhomogeneous media depends apparently on the structure of the medium.

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DETERMINATION OF THE COUPLING CONSTANT FOR THE PION-NUCLEON INTERACTION FROM CROSS SECTIONS FOR THE ELASTIC SCATTERING OF 630-Mev NEUTRONS BY PROTONS

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IN reference 1, the differential cross sections for elastic n-p collisions, $\sigma_{np}(\theta)$, for $E_n = 630$ Mev and for the center-of-mass angular interval 160° $\leq \theta \leq 180°$ were used to determine the pion-nucleon coupling constant f^2 by the Chew method.[2] For this the measured cross sections $\sigma_{np}(\theta)$ were multiplied by the quantity

$$x^2 = (1 + \mu^2/2k^2 + \cos\theta)^2$$

(μ is the pion mass, **k** is the nucleon c.m.s. momentum) and the values obtained $x^2\sigma_{np}(\theta)$ by the method of least squares were approximated by a power series of the form

$$x^2 \sigma_{np}(\theta) = A + Bx + Cx^2 + \ldots + dx^m. \qquad (1)$$

According to present meson theory, the coefficient A of this series can be directly expressed by the constant f^2. In order to approximate the experimental values $x^2\sigma_{np}(\theta)$ a series of trial functions was used, beginning from a linear dependence up to and including a fourth-power parabola. Using polynomials of higher order ($m > 4$) was not reasonable, since the number of points $x^2\sigma_{np}(\theta)$ was relatively small. The results of the calculations showed that the best values of f^2 were 0.04 and 0.085. However, the relatively low statistical accuracy and the small number of points on the curve $\sigma_{np}(\theta)$ in the angular interval mentioned above prevented choosing one of these two values of the constant. Here it also appeared that in all the remaining cases (excluding the linear dependence $A + Bx$) $0.04 \le f^2 \le 0.085$. Averaging all the values of f^2 found gave $f^2 = 0.06 \pm 0.02$.

The necessity of getting supplementary information to more accurately determine the constant f^2 led us to continue the measurements and to markedly increase the number of points on the curve $\sigma_{np}(\theta)$ in the angular interval $160° \le \theta \le 180°$ ($0° \le \varphi \le 9°$, φ is the recoil angle in the laboratory system). The measurements of the differential cross sections for n-p collisions at 630 Mev were carried out by two methods: by the method of a ring scatterer[3] and by an ordinary detector which records the recoil proton.

The ring scatterer method, as is well known, has the advantage that for small angular resolutions a detector encompasses a relatively large solid angle. By this method, however, it is possible to investigate only a limited angular region ($2.5° \le \varphi \le 8°$). An ordinary detector of proton recoil can function in the whole angular interval under investigation, but since in our case a small angular resolution (0.5°) and a high-energy threshold were required, after a short time it was impossible to carry through the experiment for the available intensity of the neutron beam. In this way, these two methods supplemented one another. The differential cross sections were measured in relative units. Their absolute values were found from the known differential cross section for elastic n-p scattering at $\varphi = 8°$, measured previously in reference 1.

As a result of the measurements the number of points on the curve $\sigma_{np}(\theta)$ in the angular interval $160° \le \theta \le 180°$ which were suitable for determining the pion-nucleon coupling constant was increased to twice that of the preceding work (ten points were established).

The approximation to the experimentally obtained dependence of $x^2\sigma_{np}(\theta)$ by a power series of the form (1) was carried out by the computing department of the Joint Institute for Nuclear Research. In this, by the method of least squares, curves for trial functions were fitted to the experimental points, the functions beginning with a linear dependence and ending with a fifth-order polynomial.

As has been explained, a further increase in the number of terms of the series was not sensible, since the calculations showed that the coefficients for powers of x higher than the fifth had values small compared with the error, which exceeded 100%. A series of the form $A + Bx^2$, according to the criteria of reliability, seemed the best of the calculated trial series. The coefficient A gives there the value $f^2 = 0.04 \pm 0.005$ for the pion-nucleon coupling constant.

Not long ago we received a letter from Moravcsik, Cziffra, and Larsen at Berkeley, in which they kindly report that, using the data from elastic n-p scattering for $E_n = 630$ Mev[1] which was communicated earlier at the International Conference on High-Energy Physics (Kiev, 1959), they got a most probable value of $f^2 = 0.04 \pm 0.015$. Here, however, at variance with reference 1, they used the whole investigated region of scattering angles $11° \le \theta \le 180°$, just as they had for energies $E_n = 90$ and 400 Mev.[4]

The result of the present work and, equally, the values of f^2 calculated by Cziffra and Moravcsik[4] for values of $\sigma_{np}(\theta)$ at energies $E_n = 90$ and 400 Mev show that, in determining f^2 from the scattering of neutrons from protons by the method suggested by Chew, the constant f^2 takes on an evidently smaller value than the 0.08 obtained from experiments on pion-proton scattering.

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