approximation in E is inadequate for the calculation of the coefficient Γ. The case of a semiconductor in which the heating of the electrons gas in the electric field is important and the case of a magnetic field in which the absorption and emission of sound has a resonance character can serve as examples. However, these questions go beyond the scope of the present note and will be considered in a special paper.

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MEASUREMENT OF TOTAL CROSS SECTIONS OF (π^-p) *REACTIONS AT* π^- *MESON ENERGY OF* 340 MeV

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THE following reactions were investigated with the aid of a 25-cm liquid-hydrogen chamber placed in a 12,000 Oe magnetic field, with the primary π^- mesons having an energy 340 ± 15 MeV:

$$\pi^- + p \rightarrow \pi^- + \pi^+ + n, \qquad (1)$$

$$\pi^- + p \rightarrow \pi^- + \pi^0 + p, \qquad (2)$$

$$\pi^- + p \rightarrow \pi^- + \gamma + p. \qquad (3)$$

The corresponding total cross sections were found to be

$$\sigma_1 = 1.24 \pm 0.14 \text{ mb}, \quad \sigma_2 = 0.13 {}^{+0.06}_{-0.04} \text{ mb},$$

$$\sigma_3 = 0.09 {}^{+0.03}_{-0.06} \text{ mb}.$$

In the determination of the cross section of reaction (3) we took into account only the cases in which the energy of the emitted γ quantum exceeded 100 MeV.

To gain an idea of the contribution of the different isotopic states to the cross sections of reactions (1) and (2), we write the latter in the form

$$\sigma_1 = \frac{1}{9}\left[\frac{1}{5}\left|A_2^{3/2}\right|^2 - 2\sqrt{\frac{2}{5}}\,\mathrm{Re}\,(A_2^{3/2*}A_0^{1/2}) + 2|A_0^{1/2}|^2\right] + \frac{1}{9}\,[|A_1^{3/2}|^2 - 2\,\mathrm{Re}\,(A_1^{3/2*}A_1^{1/2}) + |A_1^{1/2}|^2],$$

$$\sigma_2 = \frac{1}{10}\left|A_2^{3/2}\right|^2 + \frac{1}{9}\left[\frac{1}{2}|A_1^{3/2}|^2 + 2\mathrm{Re}(A_1^{3/2*}A_1^{1/2}) + 2|A_1^{1/2}|^2\right],$$

where A_k^i —invariant isotopic amplitudes (the upper index pertains to the total isotopic spin of the entire system, while the lower one denotes the total isotopic spin of the two-pion system).

The values obtained for the cross sections of reactions (1) and (2) enable us to judge, under certain extreme assumptions, the magnitudes and phases of the isotopic amplitudes:

a) If we set the amplitudes $A_1^{1/2}$ and $A_1^{3/2}$ equal to zero, then the amplitude $A_2^{3/2}$ turns out to be much smaller than $A_0^{1/2}$:

$$3.1\,|A_2^{3/2}|^2 \leqslant |A_0^{1/2}|^2 \leqslant 5.7\,|A_2^{3/2}|^2;$$

b) If it is assumed that the cross sections σ_1 and σ_2 are determined essentially by the amplitudes $A_1^{1/2}$ and $A_1^{3/2}$, then the phases of these amplitudes are shifted by ~ 180°, and their moduli are related by

$$|A_1^{3/2}| \approx 2|A_1^{1/2}|.$$

When the energy of the incoming pions is 340 MeV, the maximum total energy in the c.m.s. of the two pions is 400 MeV. If variant a) is correct, then we can state that pions with energies from 280 to 400 MeV interact predominantly in states with total isotopic spin T = 0, and not with T = 2. This character of the $\pi\pi$ interaction was first suggested by Korenchenko [1] and experimentally confirmed only near the threshold of meson production. [2] A similar result was obtained in the theoretical papers; [3,4] Schnitzer [3] calculated, in particular, the cross sections of reaction (1) and (2). The results of the calculations do not contradict the values of the cross sections obtained in the present paper.

From a comparison of σ_2 and σ_3 we can conclude that the results presented in [5] can pertain to the summary cross section of the two reactions (2) and (3).

In conclusion, the authors consider it their pleasant duty to thank Prof. B. M. Pontecorvo for constant interest in the work and for valuable advice, and to P. F. Ermolov for useful discussions.

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FINE STRUCTURE OF NUCLEAR MASSES OCCURRING IN α DECAY

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WE observed that the energy of successive α decays in nuclei with odd $A > 230$ satisfies, within the limits of experimental errors, the following relation:

$$Q_\alpha(A + 4i,\ \ Z + 2i) = Q_\alpha(A,\ Z) + i\xi + m\varepsilon, \qquad (1)$$

where i and m are positive or negative integers. The quantity ϵ, determined by the method of least squares, is equal to 0.174 ± 0.002 MeV. The quantity ξ takes on different values for nuclei with $A = 4n + 1$ and $A = 4n + 3$, namely, 0.154 and 0.049 MeV, respectively. The experimental data (mainly from [1-3], but also from [4-8]) are compared in the table with the results of calculations by formula (1).

Relation (1) expresses the phenomenon whereby not any, but only certain values of the mass difference of various nuclei occur in reality; we call this phenomenon the fine structure of nuclear masses.

Formula (1) relates the energy of the α decays within one α-active decay chain. The differences between chains can be related if we consider the quantity Q_α/ϵ. For each nucleus we could choose an integer N such that the quantity $Q_\alpha/\epsilon - N$ varies linearly, according to formula (1), with a change in A, while for constant A, the dependence on Z is nearly quadratic. In one variant constructed in this way, the parity of the number N is strongly correlated to the parity of the α tran-

Isotopes	$Q_{\alpha calc}$, MeV	m	$Q_{\alpha exp}$, MeV
	Nuclei with $A = 4n + 1$		
Pu^{241}	5.121	—	5.121; 5.120 ± 5 [4] **
Cm^{245}	5.623	2	5.62 ± 0.05
Cf^{249}	6,299	5	6.296; 6.29; 6.30 [5]
Fm^{253}*	6.975	8	7,05 ± 0,04; 6,96 ± 0.04; 7.24
U^{233}	4.900	—	4,900; 4.901 ± 2 [4] **
Pu^{237}	5.750	4	5.74 ± 0.02
Cm^{241}*	6,078	5	6.05 ± 0.02
Cf^{245}*	7,276	11	7.23 ± 0.02
Bk^{249}	5,540	—	5.540 [5]; 5.53 ± 0,05; 5.55
Es^{253}	6.738	6	6,740; 6.747 ± 10 [4] **
Np^{237}	4.954	—	4,950; 4.956; 4.954 ± 3 [4] **
Am^{241}	5.630	3	5.627; 5.628; 5.633; 5.639 ± 2[4]**
Bk^{245}	6.480	7	6.48 ± 0.02
Es^{249}*	6.982	9	6.87
Np^{233}*	5.630	—	5.63
Am^{237}*	6.123	2	6.11
	Nuclei with $A = 4n + 3$		
U^{235}	4.671	—	4.671[6]; 4.638; 4.66; 4.638±15[4]**
Pu^{239}	5.242	3	5.235; 5.238; 5.239 ± 2 [4]**
Cm^{243}	6.161	8	6.163; 6.159; 6.160 ± 5 [4] **
Fm^{251}*	6.955	12	7,00 ± 0.05; 7.35
U^{231}*	5.540	—	5.54
Pu^{235}*	5.937	2	5.95 ± 0.02
Am^{243}	5.428	—	5.428; 5.440 ± 7 [4] **
Bk^{247}	5.825	2	5.85
Es^{251}*	6.570	6	6.58
Md^{255}*	7.489	11	7.46 [7]
Pa^{231}	5.135	—	5.135; 5.140 ± 3 [4]**
Np^{235}	5.184	0	5.183 [8]; 5.15
Am^{239}	5.929	4	5.92; 5.90
Bk^{243}*	6.848	9	6.83

*Decay scheme unknown.

**Average (error in keV).