tering of π^+- and π^-- mesons on protons with calculation of the contribution of $S_{1/2}$, $P_{1/2}$ and $P_{3/3}$ waves. The evaluation of the D wave showed that its contribution to the total cross section was less than 10%.

Comparison was made with experiment for energies of incident mesons greater than 400 mev (up to 400 mev results of the present study agree with the results of reference 1). Experimental data are shown on the graph[3]. The results obtained theoretically are given in the Table below. As is evident from comparison, the theoretical values of σ^+ $(\pi^+ + p)$ agree favorably with the experimental data, but the values of $\sigma^-(\pi^- + p)$ were noticeably smaller than those obtained experimentally.

Theoretical Values of Cross Sections

E_π, mev	$\sigma^+(\pi^+ + p) \cdot 10^{27}$ cm^3	$\sigma^-(\pi^- + p) \cdot 10^{27}$ cm^3
600	18.5	22.2
800	22.2	24
1000	23	25.5
1200	22.7	25

It is possible that the experimental values for σ^- $(\pi^- + p)$ are diminished as the result of their being made more precise[4]. But even in this instance agreement with the experiment is to be expected only in the calculation of the state nucleon + two mesons. This state should significantly increase the cross section $\sigma^-(\pi^- + p)$ with an insignificant increase in $\sigma^+(\pi^+ + p)$.

In conclusion the authors express their thanks to I. E. Tamm, Iu. A. Gol'fand and V. Ia. Fainberg for their continuous interest in the work as well as to L. V. Pariski, N. E. Nikulkina and L. I. Grachev, who performed a great computational task.

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The Relation Between our Criterion of Stability for a Homogenious Phase and that of S. V. Tiablikov

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BOGOLIUBOV and S. V. Tiablikov have noted that the criterion for the stability of a homogeneous distribution of particles, given in reference 1, coincides with the similar criterion, given earlier and and in different form by Tiablikov[2] in the case of limit points of the second kind. Equation (9) of reference 2 and the first of Eq. (34) of reference 3 can be put in the same form

$$-\frac{4\pi}{vkT}\int_0^\infty \frac{\sin\beta r}{\beta}\left\{\int_\infty^r \Phi'(t)\,g(t)\,dt\right\} r\,dr = 1, \qquad (1)$$

where $\Phi(r)$ is the intermolecular potential, $g(r)$ is the radial distribution function. This equation must be satisfied by the equation for the determination of β. The second of Eq. (34) in reference 2, which serves for this purpose, similarly to Eq. (1), is written in the expanded form

$$\int_0^\infty (\sin\beta r - \beta r\cos\beta r)\left\{\int_\infty^r \Phi'(t)\,g(t)\,dt\right\} r\,dr = 0. \qquad (2)$$

This condition is absent in reference 2, but a graphical method is applied there to the determination of β, which, as can be shown, is approximately equivalent to the requirement of Eq. (2). The approximation of the graphical method of Tiablikov consists of this, that the temperature on the left side of Eq. (9) in reference 2 is considered as an unknown and variable, while the term on the right is considered given and constant. A general and precise condition for determining β in reference 2 is not given.

The different approach to the problem in references 1 and 2, and, in part, the differences in notation account for the fact that the equivalence of the two stability criteria remained unknown to us. An attempt to determine the sign of the derivative (dv/dt) along the fusion curve by the theory of Tiablikov led us, as a consequence of an admitted error, to the physically inadmissible result of which mention was made in reference 3. Actually, as is clear from the above, the sign of the derivative must be the same in the two cases. It was shown in reference 4 that $(dv/dT)_{\lim} < 0$ for systems of the argon type, in accord with the experimental facts. Therefore the author acknowledges the error of his statement on the unfitness of the stability criterion for a liquid of S. V. Tiablikov, which statement was based on a misunderstanding of what was contained in reference 3.

The author thanks N. N. Bogoliubov and S. V. Tiablikov for their discussion of the question and for pointing out the error.

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Capture of Thermal Neutrons by Isotopes of Lead

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1. CHARACTERISTIC of the capture of thermal neutrons by a natural mixture of lead isotopes is a gamma-ray spectrum consisting of only two lines[1]. The gamma quanta appear as quanta of the electric dipole type, the energies ($E_{\gamma_1} = 7.380 \pm 0.008$ mev and $E_{\gamma_2} = 6.734 \pm 0.008$ mev) being equal to the binding energies of a neutron in Pb^{208} and Pb^{207}, respectively. This simplicity of the spectrum represents the exception among the spectra of heavy elements and is associated with the "magic" attribute of Pb^{208}. An analysis of levels Pb^{208} and Pb^{207} shows that the simplicity of the spectrum can be explained if one assumes that an intermediate nucleus is not created during the capture, but that the process consists of an immediate transition of a neutron from a continuous spectrum into bound states. This same mechanism also specifies the correct magnitude of the cross section for capture of thermal neutrons by lead.

2. Having investigated gamma rays accompanied by beta decay of Tl^{208}, Elliott[2] et al obtained the energy level scheme of Pb^{208} (Fig. 1), from which it is seen that for capture of thermal neutrons by Pb^{207} transitions to excited levels of Pb^{208} are possible for only a high multipolarity. It is necessary to note also that these levels apparently correspond to an excited proton since: 1, spins and parity, shown in Fig. 1, can be obtained from the shell model, assuming that a proton from the filled shell (82 protons) is shifted to the succeeding unfilled shell; 2, lower levels ($E = 2.6$ mev and $E = 3.2$ mev) are not excited in the reaction Pb^{207} (dp) Pb^{208*} (energy of deuteron is 14 mev[3]); 3, these levels arise from beta decay of Tl^{208}, i.e., it can be assumed that radiation results from the transition of a proton from its excited state, arising from the conversion of a neutron into a proton, to its low-lying state.

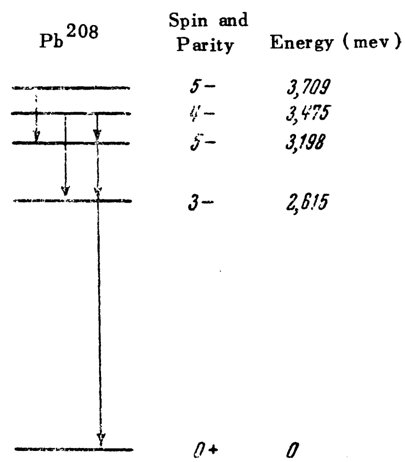

Fig. 1

The first two levels excited in the reaction[3] Pb^{207} (dp) Pb^{208*} have energies respectively equal to 3.37 mev and 3.60 mev. It is assumed that these levels have spins of 4 and 5, and parity opposite to the parity of the ground state of Pb^{208} (spins and parities of levels in (dp) experiments have been identified in accordance with the shell model). The next levels lie near the energy 5-6 mev. Thus it is seen that electric dipole capture must dominate for the ground state of Pb^{208}.

Let us consider Pb^{207}. The scheme of low-lying energy levels of odd nuclei can be divided into three classes[4]: "consecutive" system of levels, "hole" system and mixed system. The excitation of "consecutive" and "hole" levels in nuclei corresponds to the excitation of optical and x-ray terms in an atom. Now one can count it as an established fact[4] that the lower excited levels of Pb^{207} appear "hole like" (Fig. 2). As the figure shows, the spins and parities allow electric dipole transitions to the ground state $p_{1/2}$, and also to the excited state $p_{3/2}$ ($E_{level} = 0.870$ mev). If one assumes that the shell model holds for higher levels, then their spins and parities exclude dipole transitions.