with sufficient accuracy from the data of Fock and Petrashen[3].

$$\psi_a(r) = 0.727\,(4\pi a_0^3)^{-1/2}\,(r/a_0 - 1)\,e^{-0.71r/a_0}.$$

The result is

$$E_1 = (0.01873 \cdot 10^{-16}\alpha^2 + 0.07221 \times 10^{-32}\,\alpha^4 + \cdots)\,e^2 c\alpha.$$

For example, for the crystal NaCl $\alpha = 1.109 \times 10^8$ and the error in Pekar's[1] energy evaluation due to smoothing out of the potential is about 15%, which lowers the computed energy value after Eq. (1) is brought to a self-consistent form. We note, however, that using the approximation of strongly bound electrons increases somewhat the estimate of the energy error, and in reality this error is only about 10-12% for NaCl.

Tolpyg[2] considered higher order terms in the E.M.M. and showed that the E.M.M. of Pekar overstates the energy values, for NaCl in particular by 12-13%. Thus, the above errors are approximately equal and in opposite directions, which verifies the applicability of E.M.M. for calculation of energies, even when r_p is greater than a by a factor of 2 or 3.

The author expresses a deep gratitude to K. B. Tolpyg for his help in carrying out the present work.

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Translated by M. J. Stevenson
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On Annihilation of Antiprotons with Star Formation

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(Submitted to JETP editor November 29, 1955)
J. Exptl. Theoret. Phys. (U.S.S.R.) 30, 595-596
(March, 1956)

Collision of the antiproton with the proton and the annihilation of both particles results in the liberation of not less than 1.8×10^9 ev (if the velocities of both particles are small). This energy is sufficient for the formation of 13 π-mesons. It seems natural to apply to the investigation of stars of such high energy the statistical theory of multiple particle formation (see Refs. 1 and 2). The theory of thermodynamic variants leads to the following formula for the complete number of the formed particles[2,3].

$$N = k\,(E/Mc^2), \tag{1}$$

where M denotes the mass of the nucleon and k is a coefficient determined from experiment. For large energies ($E \geq 10^{12}$ ev) $k \sim 2$. If this value of k is used with the energies of interest, $N \sim 2$. For such a small value of N the application of thermodynamics is not justified and we, therefore, turn to a variation of statistical theory suggested by Fermi[1] for the investigation of stars with the formation of not too many particles.

We shall start with the following formula (see Refs. 1, 4 and 5):

$$S(n) = f_{n,T}\,[\Omega / 8\pi^3\hbar^3]^{n-1}\,W_n(E_0). \tag{2}$$

The value of $S(n)$ determines the probability of meson formation, Ω the effective volume in which the energy of the colliding nucleons is concentrated and where the formation of particles takes place, E_0 the full energy of star formation, $W_n(E_0) = dQ_n(E_0)/dE_0$, $Q_n(E)$ the volume of the momentum space corresponding to the energy E_0, $f_{n,T}$ a factor accounting for the conservation of isotopic spin and the equivalence of particles (see Refs. 4 and 5), T the isotopic spin of the system. The effective volume was taken as $(4\pi/3)(\hbar/\mu c)^3$, where μ is the mass of the π^--meson. Justification for this selection was the fact that similar computations for multiple formation of particles for p-n and π^--p collisions result in a satisfactory agreement with experiment when the same expression is used for the evaluation of the effective volume[6]. It should be noted that the energy E_0 in these cases ~ 1 bev, i.e., not strongly different from the energy ~ 2 bev under consideration.

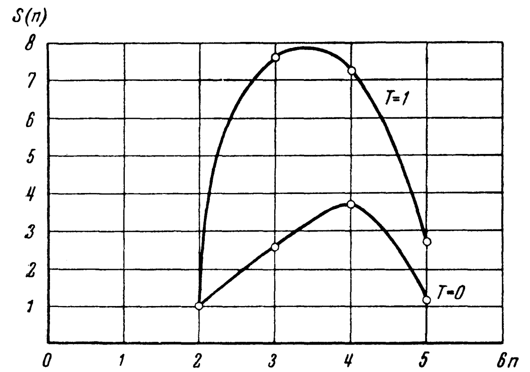
The magnitude of $W_n(E_0)$ has been computed in Ref. 7 with consideration for conservation of energy and momentum but on the assumption that the formed particles are ultrarelativistic. As it will be shown further this assumption is approximately correct in our case. The formula for $W_n(E_0)$ is given as:

$$W_n(E_0) = \frac{\pi^{n-1}}{2^{n-1}} \frac{(4n-4)!\,(2n-1)}{[(2n-1)!]^2\,(3n-4)!} E_0^{3n-4}. \qquad (3)$$

The factor $f_{n,T}$, accounting for the preservation of isotopic spin and the identity of particles is given by the following formula (see Ref. 8): $f_{n,T} = g_n(T)/n!$, where

$$g_n(T) = (2T+1) \sum_i \frac{(-1)^{n+i}}{2i+1} \binom{n}{i} \binom{2i+1}{i-T}. \qquad (4)$$

Values of $g_n(T)$ for different d and T are computed in Ref. 8.



In the collision of two particles, proton and antiproton, the values of the isotopic spin may be equal only to 1 or 0. Indeed, the eigenfunctions $(p\tilde{p})$ (p--proton, $\tilde{p}$--antiproton), $(n\tilde{n})$ (n--neutron and $\tilde{n}$--antineutron), (np) and (pn) can be expressed in the following manner through the eigenfunctions of states with a given value of T (upper index) and its z component T_z (lower index):

$$(p\tilde{n}) = \Phi_1^1; \quad (p\tilde{n}) = \Phi_{-1}^1; \qquad (5)$$

$$(pp) = 2^{-1/2}\,(\Phi_0^0 + \Phi_0^1);$$

$$(n\tilde{n}) = 2^{-1/2}\,(\Phi_0^1 - \Phi_0^0).$$

In the Figure are shown the probability $S(n)$ for the distribution of the n-meson formation for values of isotopic spin $T = 0$ and $T = 1$. It is seen from the presented data that on the average four particles are formed, thereby making the energy per particle of the order of 0.5×10^9 ev. This justifies the assumption made that the particles are relativistic*. It is also of interest to investigate the distribution of the formed mesons according to charge. For the case of 2 and 3 meson formation this type of investigation was carried out by others (see Refs. 9 and 10).

In conclusion, we express our thanks to Messrs. M.I. Podgoretski and I.E. Tamm for their participation in the discussions of questions pertaining to this work.

* Computation of the statistical weight by the exact formula for the case when two particles are in the final state (see Ref. 11) showed that Eq. (3) gives values different from the exact values by about 1%.

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Translated by J.L. Herson
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Concerning Papers of S. E. Khaikin, S. V. Lebedev and L. N. Borodovskaia Published in the J. Exptl. Theoret. Phys. (U.S.S.R.) in 1954-1955

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(Submitted to JETP editor June 15, 1955)
J. Exptl. Theoret. Phys. (U.S.S.R.) 30, 621-622 (March, 1956)

IN the works of S. E. Khaikin, S. V. Lebedev and L. N. Borodovskaia, a presentation was given of the results of experiments in which processes occurring in metallic wires during the passage through them of large impulsive currents were studied. From an analysis of the results obtained, the authors came to two conclusions of significance in the physics of metals: