In this sense, the bilocal quantities are the generating functions of the local Fiertz fields. The latter form the whole irreducible unitary representation of the Lorentz group, and there are, therefore, no other solutions which would be mathematically possible but physically impossible. All other solutions either do not satisfy the supplementary conditions or (for space-like p_μ) are not related to the irreducible unitary representation of the Lorentz group. The solutions with time-like p_μ form a closed system and include all the Hilbert space.

Let us finally say a few words about the problem of the interaction. This problem is so far absolutely unclarified, and the usual requirements applied in the local theory are not applicable when the bilocal interaction is introduced. The same considerations allow us to hope that a criterion for the interaction will be found in the future, which will considerably differ from the (unmistakably wrong) criterion used now.

[1] V. A. Zhirov, J. Exptl. Theoret. Phys. (U.S.S.R.) **30** 425 (1956); Soviet Phys. JETP **3**, 452 (1956).

[2] H. Horvath, *Classical theory of physical fields of second kind in general spaces* (to be published in Acta Phys. Hungar.).

Translated by E. S. Troubetzkoy
142

Effect of Multiple Thermal Ionization on the Specific Heat of Gases

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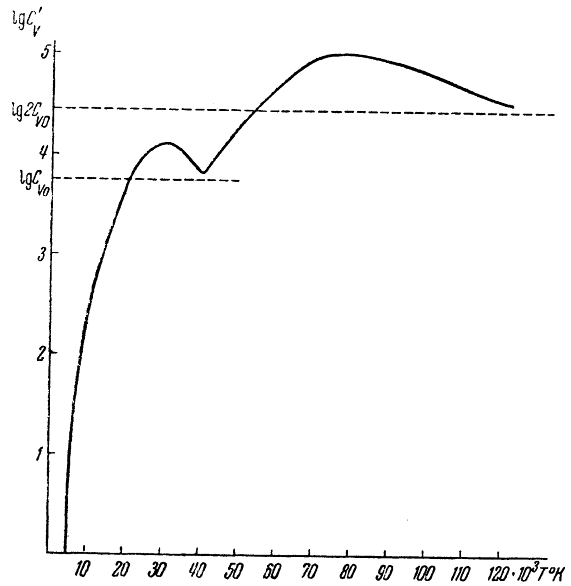
ONE of us[1] has calculated the specific heat of gases at high temperatures, taking into account a single thermal ionization. The purpose of this note is to consider the effect of multiple thermal ionization on the specific heat of gases.

We follow the method used in Ref. 1. The result is that the specific heat of the gas at high temperatures can be calculated from the formula

$$C_V = C_{V0} + C'_V \quad (1)$$



where $C_{V0} = 3/2\, nk$ is the specific heat of the non-ionized gas at constant volume; C'_V is the correction to the specific heat, due to the thermal ionization, with $C'_V = \sum_m C_{Vm}$; in the latter formula, C_{Vm} is the correction to the specific heat, due to the thermal ionization of the gas, with a $(m-1)$-fold ionization; C_{Vm} is determined by the following expression:

$$C_{Vm} = (k/4f(kT)^2L)\{[3kT(2J_m - J_{m-1}) + 2J_m(J_m - J_{m-1})][nf(m+1) - L + 1] + {}^{15}/_2(kT)^2 + {}^{15}/_2(kT)^2(1-L) + {}^{21}/_2 nf(m+1)(kT)^2 + 3nf(kT)^2(m-1)L\}; \quad (2)$$

$$f = (g_{m-1}/2g_m)(2\pi/m')^{3/2} h^3 (kT)^{-3/2} \exp(J_m/kT),$$

$$L = [1 + n^2f^2(m^2+1-2m) + 2nf(m+1)]^{1/2}.$$

It follows from (2) that the specific heat of gases at high temperature has a strong dependence on the temperature. To give an example, we have calculated the effect on the atomic oxygen gas; the correction C'_V is plotted on a logarithmic scale, vs. the temperature, in the range where only single and double ionizations are effective (solid line). One sees from the graph that the dependence of the specific heat on the temperature is represented by a curve showing steps and maxima in the temperature interval where a particular ionization order prevails. These maxima are several times higher than the specific heat of the non-ionized gas. For comparison, the specific heat of the non-ionized gas has been plotted on the same graph, as a dotted line.

The dependence of the specific heat on the temperature at higher temperatures will have the same character.

[1] B. L. Timan, J. Exptl. Theoret. Phys. (U.S.S.R.) 27, 262 (1954).

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143

Elastic (p–p)–Scattering and Peculiarities of Interaction between Pions and Nucleons

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STRONG interaction between a pion and a nucleon, which exerts a significant effect on the process of pion production in the collision of a nucleon with a nucleon, may develop also in the process of the elastic (p–p)–scattering. Two mechanisms are possible. One of these can be schematically expressed in the form

$$p+p \rightarrow (\pi + N + p)^* \rightarrow p' + p' \qquad (1)$$

and it corresponds to the process of resonance scattering. The second is inevitably produced as a result of the known optical relationship between elastic and inelastic processes. In so far as the values of the elastic and inelastic cross sections owing to this relationship are of the same order, and the cross section of the inelastic processes

$$N + N \rightarrow \pi + N + N' \qquad (2)$$

is comparatively large at energies beginning with 499 mev, therefore the role of the second factor may be considerable.

The calculation of the probability of the elastic (p–p)–scattering taking into account the virtual mechanism (1), carried out by Austern[1], gives values for the differential cross section differing by two orders from the values observed in experiment. This permits us to draw the initial conclusion that the peculiarities in the elastic (p–p)–scattering, apparently, are completely dependent on the second mechanism.

A juxtaposition of the elastic (p–p)–scattering with the processes of interaction between a pion and a nucleon can be made when these processes are compared at equal values of total energy in a center-of-mass system of the colliding particles. Moreover, it is also necessary to take into account the energy corresponding to the rest mass of the pion. For the value characterizing the probability of scattering at a given angle, it is necessary to consider the derivative

$$k^2\, d\sigma(\theta)\,/\,d\omega = \alpha(\theta), \qquad (3)$$

where k is the wave vector of the colliding particles in a center-of-mass system, and $d\sigma/d\omega$ is the differential cross section of scattering at the angle θ in a c. m. system.

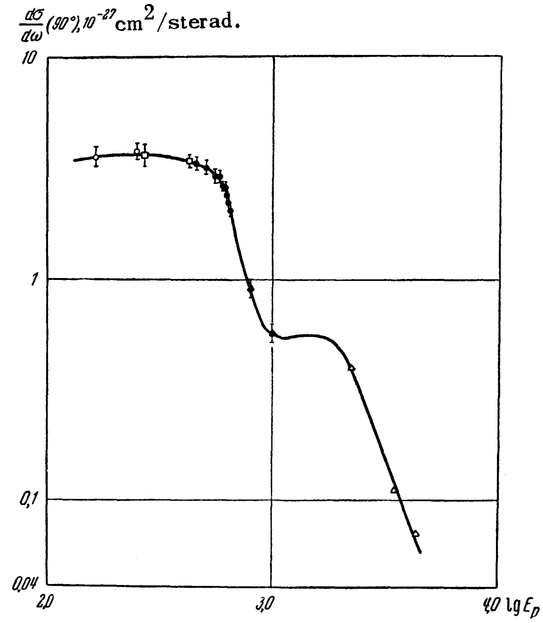

FIG. 1. The energy dependence of the elastic (p–p)–scattering at the angle 90°. ◻ –according to Ref. 2, O–according to Ref. 3, ●–according to Ref. 4, ▲–according to Ref. 5, Δ–according to Ref. 6.

Figure 1 gives the results of measurements of the differential cross section of the elastic (p–p)–scattering at the angle of 90° in the energy region from 160 mev to 4.4 bev taken from the investigations.[2-6] Figure 2 gives the dependence of the value $\alpha(90°)$ on the energy of the incident proton taken from the data of the above-mentioned investigations. As is evident from this figure, the latter curve (90°) has a maximum at total energy in a c. m. system at approximately 280 mev. It is precisely at these values of total energy in a c. m. system that the known peculiarities of the process $p + p \rightarrow \pi^+ + d$ are observed, as well as of the simpler processes $\gamma + p \rightarrow \pi^+ + p$ and $\pi^+ + p \rightarrow \pi^+ + p$. The appearance of this maximum is generally associated with the peculiarities of the interaction between a pion and a nucleon in states with an isotopic spin of $T = 3/2$.