developed. There is on this problem only the work of Vonsovskii[3], where a theory is given for the high temperature region. In this same work an expression is given (without derivation) for the temperature factor $\varphi(\vartheta, H)$ at low temperatures (for $H = 0$ ). In the corresponding case one can introduce the expression for $\varphi(\vartheta, 0)$ from the quasi-classical theory of Akulov. There dependence is of the form $\vartheta^{3/2}$ in these expressions; however, our dependence (7), while containing $\vartheta^{3/2}$, possesses a more complicated character (for details, see reference 4).

In the comparison of the expressions for the constants of Anisotropy[3] and the constants of magnetostriction of a hexagonal crystal[1] and a cubic crystal Eq. (9), a definite analogy is noted in their temperature behavior at low temperatures. This circumstance points up the deep connection between the phenomenon of anisotropy and that of magnetostriction, and is determined by the character of the energy spectrum of ferromagnetics at low temperatures. The great variation observed in the temperature dependence of the constants of magnetostriction and anisotropy for medium and high temperatures is connected with the fact that the "gas" of quasi-particles (elementary excitations) ceases to be ideal upon increase in temperature, and other quasi-particles (especially phonons), their interaction with ferromagnons begins to play an important role, and the individuality of the lattice appears strongly. These circumstances disrupt the apparent universality at low temperatures and lead to a series of complicated effects.

The theory developed by us, as noted in reference 1, applies primarily to liquid hydrogen temperatures. The development of a systematic quantum mechanical theory of magnetoelastic phenomena for intermediate temperatures and in the region of the Curie point is an important problem of the quantum theory of magnetism that is still unsolved.

[1] A. A. Gusev, J. Exper. Theoret. Phys. USSR **29**, 181 (1955); Soviet Phys. JETP

[2] S. V. Tiablikov, J. Exper. Theoret. Phys. USSR **20**, 661 (1950).

[3] S. V. Vonsovskii, J. Exper. Theoret. Phys. USSR **10**, 761 (1940).

[4] A. A. Gusev, Dissertation, Moscow State University 1954.

Translated by R. T. Beyer
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## The Study of Relativistic Particles by the Use of Nuclear Emulsions in a Pulsed Magnetic Field

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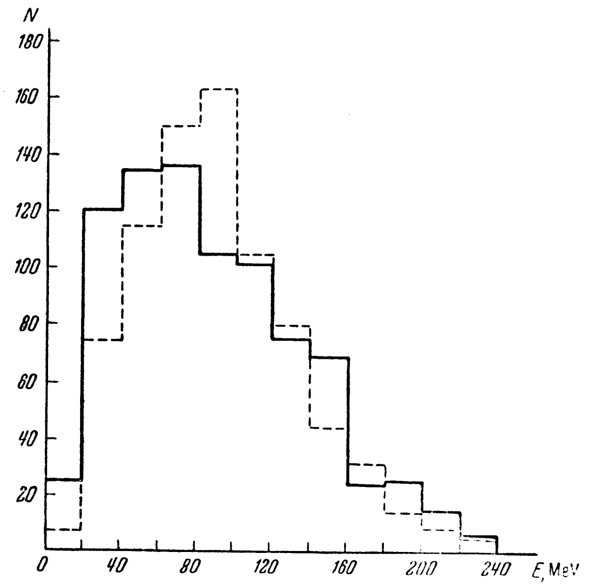
In recent years thick photographic emulsions have been used widely in a large number of physical problems. The study of the tracks left by particles in their passage through an emulsion enable us to derive information about the properties of the particles, the nature of nuclear reactions etc. However, the sign of a particle is seldom determined by this method and in many instances (when the entire track is not contained in the emulsion) the energy is not determined with sufficient accuracy.

A more complete solution of these problems can be achieved if the nuclear track plate is placed in a strong magnetic field during the period of irradiation. A calculation shows that an analysis of the momenta and signs of the particles can achieve sufficiently accurate results only in strong magnetic fields of the order of $1\text{-}1.5 \times 10^5$ gauss and above. It is known that such strong fields can be set up, at least at the present time, only in the form of pulses. However, in working with accelerators which also produce pulsed beams of particles, the use of pulsed magnetic fields seems to us especially advantageous because of the possibility of synchronizing the particle beam with the field*. We have used this kind of pulsed magnetic field to measure the spectrum of photons from the synchrotron of the Physical Institute of the Academy of Sciences of the USSR.

The apparatus consists of a current source[1] a control circuit and a solenoid within which the photographic films are placed. As a source of energy we use a bank of IM-3/100 pulse capacitors with a capacity of 3300 $\mu$f. The current-switching element is an IG-100/5000 ignitron. The pulse which fires the ignitron is timed so that the field peak coincides with the arrival of the particle beam from the accelerator. In order to avoid exposure of the nuclear emulsion in the absence of the magnetic field the accelerator operates under a so-called single-pulse regime**. The coil, which was made according to our own design, enabled us to set up a magnetic field of $1\text{-}1.5 \times 10^5$ gauss with a 5 mm space between sections of the coil and an inside diameter of 2.5cm. Axial asymmetry in the working part of the coil is 2-3% and radial asymmetry is 5-7%. A test coil was used to measure the field. The field was determined with an accuracy of 5%.

In order to determine the sign of the charge and the energy of the particles, measurements were made of the magnetic curvature and multiple scattering. For analysis of the tracks we used a MBI-8 microscope with a special ocular scale which makes for a great saving of time. Up to the present time we have studied 800 pairs found in an emulsion which was exposed in a magnetic field of 120,000 gauss. The total length of the tracks of these pairs is 221.6 cm. The mean energy per particle as determined by the magnetic method for 1600 components is 43.3 ±2.7 mev; by the multiple scattering method the mean energy is 46.5 ±1.7 mev. The scattering constant per 100 $\mu$ for electrons in a type «P» NIKFI (Cine-Photographic Scientific Research Institute) emulsion is 23.4 ±0.7.

Preliminary data on the spectral distribution of the pairs is given in the figure. The results obtained by the multiple scattering method are shown by the dashed line; the solid line gives the results obtained by measuring the magnetic curvature.




It is of interest that in a total of 78 cm (with 39 cm of the distance for positrons) only 2 instances were observed in which the particles disappeared suddenly without leaving a visible trace. In both cases the "disappearing" particles were positrons. Not a single similar instance was detected for negatively charged particles. We also observed a few cases of single scattering of electrons and positrons at angles above 100° and pair creation in the field of an electron.

In conclusion we wish to express our thanks to Prof. V. I. Veksler for his constant interest and assistance.

* This was first suggested by G. M. Strakhovskii in 1951.

** By the single-pulse regime we mean a regime under which the accelerator emits a single pulse at the appropriate "command" from an automatic device.

[1] P. L. Kapitza Proc. Roy. Soc. (London) A 105, 691 (1924)

Translated by I. Emin
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## Inelastic Scattering of Mesons in the Semi-Phenomenological Theory of the Interaction of $\pi$-Mesons with Nucleons

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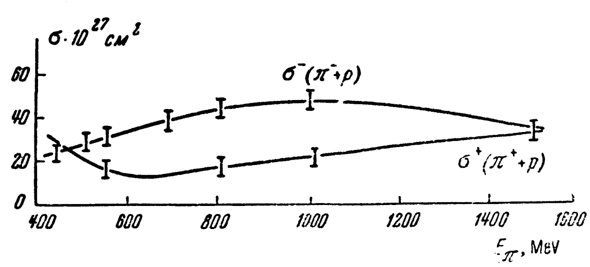
THE problem of inelastic scattering of $\pi$-mesons with nucleons ( inelastic scattering emanating from the energy of incident mesons higher than 400 mev) has been solved on the basis of the semi-phenomenological theory of the interaction of $\pi$-mesons with nucleons[1]. Calculations were carried out according to the first nonvanishing approximation of Heitler's theory of damping[2]. After scattering, the following states were considered: nucleon + meson and "isobar" + meson, but the state of a nucleon + two mesons was not investigated. The creation of the second meson was regarded as the disintegration of the isobaric state of the nucleon. The present study does not contain new constants in comparison with the work.[1]




Total cross sections were obtained for the scat-