of the medium begins to produce an effect). A more complete theory of the deceleration of neutrons in heavy media was developed by Kazarnovskii[2].

Thus, by carrying out measurements with neutrons at given instants of time after their introduction into the decelerator, it is possible, if we know their energy from Eq. (7), to use this process for the spectral investigation of neutron reactions; moreover, lead which is available in fairly pure form is a very adequate decelerator in this case.

With regard to the possibilities of this method, one may advance the following considerations (these were given in the report by F. L. Shapiro at the Seminar of the Academy of Sciences of the USSR in 1950). At an equal intensity of the source, the neutron current of a given energy inside of a fairly large mass of lead exceeds considerably the current attainable in neutron spectrometers on the principle of time of flight, in which the detector is located at a distance of several meters from the source. In fact, the neutron current in lead in the vicinity of the source is equal to

$$nv = \Phi_1 \approx \frac{Q}{(4\pi\tau_{Pb})^{3/2}} \frac{4\lambda_{s\,Pb}}{\xi v^2}. \quad (10)$$

For the current at a distance R from the source of the fast neutrons surrounded by paraffin, (an arrangement generally used in the time-of-flight method), we have:

$$\Phi_2 < \frac{Q}{(4\pi\tau_{\text{п}})^2} \frac{2\lambda_{s\text{п}}}{v^2} \frac{S}{4\pi R^2}, \quad (11)$$

where S is the area of the paraffin decelerator. Assuming that $\tau_{Pb} = 4 \times 10^3 \text{cm}^2$, $\tau_{paraf} = 60 \text{ cm}^2$, $\lambda_{sPb} = 3\text{cm}$, $\lambda_{s\,paraf} = 0.8\,\text{cm}$, $S = 200 \text{ cm}^2$ and $R = 3\text{m}$, we find:

$$\Phi_1 / \Phi_2 > 2 \cdot 10^3.$$

A more detailed evaluation, taking into account the leakage of neutrons during deceleration in a finite volume, shows that, by using a mass of lead of several ten-folds of tons, a gain in the neutron current can be attained of the order of 3 - 4 as compared with the time-of-flight method. This evaluation was also substantiated experimentally by measuring the densities of neutrons generated by an Ra-Be source inside a lead cube having dimensions of $\sim 1 \text{ m}^3$, and in air at a distance of ~ 1 m from the same source surrounded by paraffin.

The high "luminosity" of the method of decelerating time makes it possible to carry out experiments on the spectrometry of slow neutrons, even if we possess only a comparatively simple and accessible source such as the reaction $D + T$ in an ionic accelerating tube of several hundred kilovolts.

The second advantage of this method of spectrometry by the decelerating time is the simple possibility of measuring the cross sections of the absorption, which is particularly important in the cases when the absorption is small as compared with the scattering. On the one hand, the passage of a thin sample, surrounding the neutron detector, placed in the mass of lead, is dependent only on the cross section of the neutron absorption in the sample. On the other hand, the small γ - background inside a large mass of lead permits us to measure simply the cross section of capture from the intensity of the captured γ - rays.

A disadvantage of the method proposed is the limited resolving capacity ($\sim$ 30% by energy) determinable by the dispersion (8). It may be assumed, however, that owing to the advantages mentioned above the method of the time deceleration, irrespective of its small resolving capacity, will prove to be a useful addition to the other known methods of neutron spectroscopy. The practical realization of this method[2] justified the above considerations.

In conclusion, the authors wish to thank I. M. Frank for valuable discussion.

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* Presented by E. L. Feinberg at a Seminar at the Academy of Sciences, USSR, 1944.

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Diffusion Coefficient of Particles in a Magnetized Interstellar Medium

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THE diffusion of charged particles in a magnetized interstellar medium is very important for the explanation of the properties of the primary cosmic radiation[1]. The mechanism of passage of charged particles through a magnetized interstellar medium is similar to the process of diffusion of particles in gases. It follows from the mechanism of increase of magnetic field in interstellar medium that the interstellar magnetic field will be sufficiently homogeneous in regions of dimensions of the pulsation L_k, which have a kinetic energy density equal to the magnetic energy density of the medium[2-4]. Charged particles moving in an interstellar magnetic field will go from one homogeneous region to another. Because of the turbulent character of the magnetic field, it can be assumed that the directions of the homogeneous regions of the magnetic field are distributed randomly.

We want to examine the dependence of the diffusion coefficient on the particle energy. If the energy is such that the mean radius of curvature of the particle trajectory is much smaller than L_k, then, due to the chaotic structure of the magnetic field, the particle will be moving randomly. For the mean free path we can take the mean dimension of the homogeneous regions of the magnetic field. In this energy interval, we can therefore consider the diffusion coefficient as being constant and equal to

$$D \approx cL_h. \qquad (1)$$

Consider now the case when the particle energy is such that the mean radius of curvature of the trajectory of the particle in the magnetic field is much larger than the dimension of the homogeneous regions of the magnetic field. The scattering will be mostly in the forward direction, and we have first to evaluate the transport mean free path of the particle in the interstellar magnetized medium. It is known[5,6] that the transport mean free path is the mean distance travelled by the particle after it has passed through an infinite number of randomly distributed homogeneous regions of the magnetic field:

$$l = L_k(1 + \overline{\cos\theta_h} + \overline{\cos\theta_k^2} + \ldots) = L_k/(1 - \overline{\cos\theta_k}), \qquad (2)$$

where θ_k is the scattering angle due to one homogeneous region of the magnetic field.

The radius of curvature of the trajectory of a particle with momentum P in a magnetic field H is equal to

$$R_h = cp/eH\sin\theta, \qquad (3)$$

where θ is the angle between the momentum and the magnetic field. The mean dimension of a homogeneous region of the magnetic field is L_k; hence,

$$\overline{\theta_k^2} \simeq \frac{L_k^2 e^2 H^2 \overline{\sin^2\theta}}{c^2 p^2}, \qquad (4)$$

and

$$l = \frac{L_k}{1 - \overline{\cos\theta_k}} \simeq \frac{2L_k}{\overline{\theta_k^2}} = \frac{2c^2p^2}{L_k e^2 H^2 \overline{\sin^2\theta}}; \qquad (5)$$

but for extreme relativistic energies $p \sim E/c$, and

$$l \simeq E^2/L_k e^2 H^2, \qquad (6)$$

therefore, for high energies the diffusion coefficient will be:

$$D \approx cE^2/L_k e^2 H^2. \qquad (7)$$

If one assumes that the dependence of the diffusion coefficient on the energy is monotonic, it is easy to determine the dependence for intermediate energies. It is clear that for some energy interval in the intermediate region, this dependence may be considered as linear. This is to some extent a complementary argument for our assumption of linear dependence for the diffusion coefficient.

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Determination of the Dielectric Constant of Superconductors

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ABRIKOSOV[1] has obtained formulas for the determination of the dielectric constant of superconductors, taking into account its abnormally large value (see, for example, Ginzburg[2]). However, the question of the existence of an anomalously large polarizability in superconductors has not yet received final settlement, since the corresponding calculations, carried out on the results of the measurements by Galkin[3] at a frequency of $\omega = 2.8 \times 10^{11}$ sec^{-1}, have not indi-