is bounded. The numerator can be written in the form $\rho^{4s-2} F_2(\vartheta, \phi)$. Hence the integral (11) does not diverge, as claimed. A similar proof shows that in a space of any dimension n, all derivatives up to the $(n-1)$th, inclusive, are continuous.

The above suggests that the presence of a phase transition of the second kind in Onsager's plane lattice is connected with the dimensionality of the space. In particular, we may expect that Onsager's model does not give a phase transition of the second kind in a real three dimensional lattice and hence cannot explain the properties of a ferromagnet. This might indicate that in the three dimensional case not only interactions between neighboring dipoles need to be considered.

In conclusion, I would like to express my thanks to Prof. Iu. B. Rumer for his valuable suggestions and discussions during the course of this work.

Translated by R. Krotkov
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* In the case of a one dimensional lattice, the corresponding function $\cosh 2\theta - \sinh 2\theta \cos\omega$ has no zeros. Hence the theory does not give a phase transition in this case.

[1] L. Onsager, Phys. Rev. **65**, 117 (1944)

[2] Iu. B. Rumer, Usp. Fiz. Nauk. **53**, 245 (1945)

[3] Newell and Montroll, Revs. Mod. Phys. **25**, 353 (1953)

The Spatial Distribution of Nuclear-active Particles in Broad Atmospheric Showers of Cosmic Rays

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In autumn of 1952 we measured the spatial distribution of nuclear-active particles in broad atmospheric showers of cosmic rays at 3860 m of altitude. For this work we used a special arrangement with a considerable number of coincidence counters. This enables us to locate the axis and the number of charged particles of broad atmospheric showers which were of interest to us. The flux of nuclear- active particles was determined by the number of nuclear electron showers, produced in lead by the penetrating particles during the passage of a broad atmospheric shower.

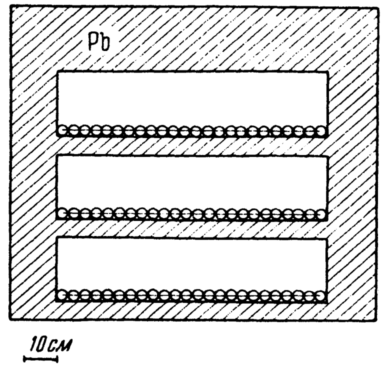

Fig. 1

The equipment for the observation of nuclear electron showers (Fig. 1) consisted of three groups of coincidence counters separated by shields of lead 6 cm thick. The presence of a 20 cm thick lead shield on the top of the counters allowed a reliable separation of penetrating particles belonging to the broad atmospheric shower from its photo-electronic component. The lead shielding on the bottom and the sides was 6 cm and 14 cm thick respectively.

The formation of the nuclear electron shower was characterized by the appearance of a discharge in two or more counters, placed in one row. The correction in lead due to μ mesons has been based on measurements of the number of δ showers produced in this apparatus by the hard component of the cosmic rays.

The relation between the observed number of nuclear electron showers produced by particles from broad atmospheric showers of a given energy at a given distance from the shower axis and the total number of broad atmospheric showers of same energy and same axis location can be expressed by the flux density of nuclear-active particles in the following way:

$$\frac{N_я}{N} = 1 - \exp\{-\rho\sigma(1 - e^{-x/\lambda})\}$$

Here ρ is the flux density of nuclear-active particles, σ is the counter surface recording the nuclear electron showers, x is the amount of matter in which the nuclear electron showers are produced, λ is the interaction path for nuclear-active particles ($\lambda = 160$ gm/cm^2 Pb). It is assumed that the probability of recording a nuclear electron shower originating in lead is unity, which may lower the flux density of nuclear-active particles*. The results of flux density measurements of nuclear-active particles obtained this way for different distances from the broad atmospheric shower axis

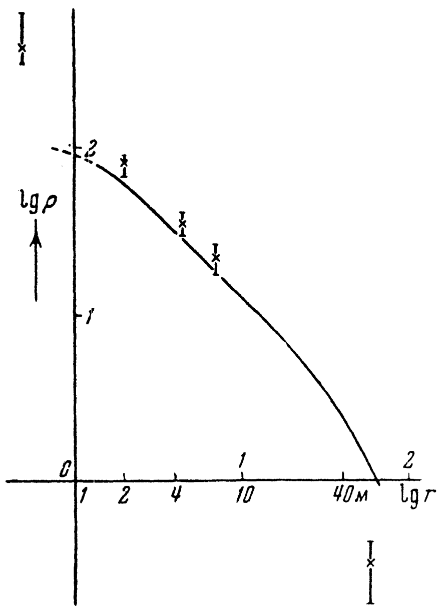

Fig. 2

are presented on Fig. 2. The log of the distance in meters is plotted on the abscissa and the log of flux densities on the ordinate (i.e., number of particles per m^2). The results are averaged around showers with 5×10^{13} to 1×10^{15} ev primary energy ($\overline{E_0} = 1.5 \times 10^{14}$ ev). For the sake of comparison, the spatial distribution of all charged particles in broad atmospheric showers of same primary energy is given in the same Figure (solid curve). The particle flux density is given by the number of particles per square decimeter.

The concentration of nuclear-active particles around the shower axis as compared to the distribution of all charged particles is in accord with the assumption of balance of photo-electron component and the nuclear-active particles in a shower. Let us remark,that as shown by analysis of nuclear-electron showers with many particles, the energy flux carried by nuclear-active particles is even more strongly concentrated around the shower axis. The results obtained for the spatial distribution of nuclear-active particles allow us to determine the portion of nuclear-active particles in the whole shower. It is about 0.3 to 0.5% of the total number of charged particles.

In conclusion the authors express their gratitude to N. A. Dobrotin and G. T. Zatsepin for valuable advice during the design of experiments and the evaluation of results.

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* The single parameter is the effective surface of the apparatus, apparently bigger than the effective surface of the counters, and of which the adopted value can increase the value of ρ.

[1] Iu. N. Vavilov, S. I. Nikol'skii and E. I. Tukish, Doklady Akad. Nauk SSSR **63**, 233 (1953)

The Change in Dielectric Constant and Phosphors Under the Action of Infrared Light

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In this paper results are presented of the investigation of the change of the dielectric constant and losses in unexcited, infrared light sensitive phosphors, irradiated in the wavelength region of $\lambda \approx 0.8\,\mu$ and $\lambda \approx 1.3\,\mu$. Radiation of these wavelengths falls, as it is known[1], in the maximum sensitivity range of these phosphors to the infrared radiation.

Phosphors with ZnS base were investigated. The test samples were prepared in the form of thin polystyrene films in which the phosphor under investigation was introduced (in 1 : 1 ratio by volume). The electrodes, an aluminum disk and a thin metallic grid, coated with polystyrene lacquer to prevent a direct contact between the grains of the scintillator and the electrodes, were pressed upon the film. The change in dielectric constant and the losses were measured during illumination of such a capacitor with infrared radiation through the grid electrode. The measurements were performed with an apparatus having a circuit similar to that of a Q-meter, at frequencies of about 50 kilocycles and field potential in the dielectric of 30-50 V/cm. The necessary wavelength ranges of infrared light were obtained by use of a monochromatic illuminator with wide slits (the width of the transmission range was approximately 100 mμ).

The infrared radiation acts upon the phosphors in the same way as the exciting radiation, causing an increase in dielectric constant and losses in unexcited phosphors (as it is known[2], the dielectric constant and the losses in excited phosphors decrease under influence of infrared radiation, approaching the "dark" values). The change which