ANGULAR ANISOTROPY OF SCATTERING OF FRAGMENTS IN FISSION OF Am^{241} *BY 14.7-Mev NEUTRONS*

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To explain the influence of nuclear structure on the angular anisotropy of fission it is necessary to study the angular distribution of the fission products of as many nuclei as possible. To extend the investigations[1-3] to include the heavier elements, we studied in the present work the angular distribution of the fragments of Am^{241} fission induced by 14.7-Mev neutrons.

The method previously described[2] was used to determine the relative amount of fragments in directions parallel and perpendicular to the direction of the incident neutrons. Taking into account the effect of the motion of the center of mass, the finite nature of the angular resolution, and the background of scattered neutrons, we found that the degree of angular anisotropy of Am^{241} is 1.08 ± 0.06.

The small anisotropy of Am^{241}, which has a spin $5/2$ and which forms an odd-odd nucleus upon capture of a neutron, is not in contradiction with the ideas of O. Bohr.[4] However, within the framework of these ideas, it is difficult to understand why the anisotropy is weaker in Am^{241} than in Np^{237} (for which the degree of anisotropy is 1.16 ± 0.02, see reference 1), although both nuclei have equal spins and parities.

The value obtained for the degree of anisotropy of Am^{241} confirms the previously noted[1-3] tendency towards reduced anisotropy with increasing value of Z^2/A of the fissioned nucleus. Yet, comparing the anisotropies in the fission of Np^{237}, Tu^{239}, and Am^{241}, with values of 1.16 ± 0.02 (reference 1), 1.15 ± 0.05 (reference 2), and 1.08 ± 0.06 respectively, it is noted that the degree of anisotropy varies relatively slowly in the region of transuranic elements.*

It is possible that the observed reduction in the anisotropy with increasing Z^2/A can be understood within the framework of Strutinskiĭ's statistical theory.[5]

In conclusion, the authors express their gratitude to G. I. Khlebnikov for precipitating the americium on an aluminum foil.

*It appears that the small difference in the value of the energies of the neutrons causing the fission (14.3, 14.8 and 14.7 Mev respectively for the fission of Mp^{237}, Tu^{239} and Am^{241}) is not very significant in this case.

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MEASUREMENT OF THE MASS OF COSMIC-RAY PARTICLES UNDERGROUND

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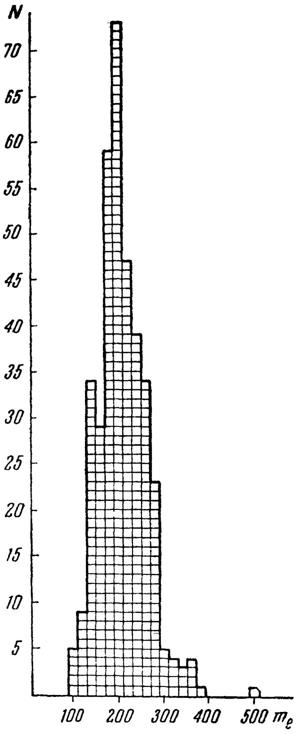
The present note describes the results of experiments to measure the mass of cosmic-ray particles underground by means of a magnetic spectrometer, which was simultaneously used for the measurement of the momentum spectrum and the positive excess of μ mesons at a depth of ~40 m. water equivalent.

The diagrams showing the apparatus, and a short description of it, are given in reference 1. A block of lead 6 cm thick was placed above the instrument to screen it from electrons. A system of lead absorbers separated by trays of hodoscope counters was placed under the telescope. For particles stopping in the absorbers, it was possible to determine the value of the mass from their momentum and range. The purpose of the experiment was not to conduct precision measurements of the particle mass and therefore thick absorbers were used. The absorbers, (V, VI, VII in Fig. 1[1]) were each of 4 cm thickness.

The uncertainty in the determination of a particle mass is due to errors in the measurement of the momentum of the particle and in the determination of its range. The method of accounting for these errors is described in a number of articles. In our case, for μ mesons stopping in the absorbers V, VI, and VII, the expected mean square errors in the determination of the masses are approximately equal to 30, 17, and 12% respectively.

A histogram of the obtained experimental data is shown in Fig. 1. The x axis shows the values of the particle mass, and the y axis the corresponding number of cases. 370 trajectories are included in the given spectrum.



All recorded positive and negative particles having a range 4 cm < R ≤ 16 cm, can be identified as μ mesons. (π and μ mesons were not separated by the instrument). It can be seen that the given data do not indicate the presence, at different observation depths, of particles different from μ mesons (and π mesons). It is, of course, necessary to remember that this method has a limited possibility as far as the detection of short-lived particles is concerned (with lifetime of the order of $\tau \lesssim 10^{-8}$ sec), and that it is impossible to detect neutral particles. Besides, particles having a long-range decay product (for instance K_μ) can, in certain cases avoid detection (being regarded as the penetrating component), and even if they do not, the apparent value of their mass might be lower (in view of an apparent lengthening of the range). However, the amount of such particles detected in our instrument cannot exceed 50% of their number. A more exact identification of such particles can be made using a mass spectrometer in conjunction with a cloud chamber.[2,3]

It should be noticed that, in the mass spectrum, only one particle was observed in which the measured value of mass is much larger than the mass of a μ meson (~ 500 m_e). This particle stopped in the 5th absorber, where the accuracy of mass determination is smallest. The possibility cannot be excluded that random experimental errors might in that case have lead to the increase of the mass of a μ meson, for instance as a result of the particle skipping through the row of counters VI below.

From our data, one can obtain the upper limit for the possible number of protons in the flux. The chosen range interval 4 cm Pb < R < 16 cm Pb corresponds to a momentum interval of protons 6×10^8 ev/c < P < 10^9 ev/c. In this momentum range, about 1500 particles were detected which passed through all absorbers V, VI, VII, and not a single particle stopped in the absorbers. Hence, we obtain the value of 0.06% for the possible number of protons in the flux in the momentum range $6 \times 10^8 < P < 10^9$ ev/c, and this represents the upper limit.

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