Shower Production by Mesotrons in Different Materials[1]

The apparatus used has already been described[2] and comprises a number of Geiger counter trays, each forming a sensitive area 20 by 20 cm, mounted in a vertical column and arranged in relation to the associated electrical circuits in such manner that the apparatus is only allowed to record when a ray passes through all of the trays. Below the top tray is placed a block of lead 18 cm thick, or its mass equivalent in other materials, so that all records by the apparatus are initiated by a ray which is capable of passing through at least this thickness of material. When a ray passes through all of the trays, any shower rays accompanying it are recorded separately by the individual counters which they excite, the record being a photograph of spots of light from the mirrors of a number of electroscopes—one for each counter. The whole apparatus is mounted below a 30-foot column of water contained in a large water tank.

With the above apparatus the authors measured the numbers of one-ray showers, two-ray showers, three-ray showers, etc., produced in lead last August, and the *present experiments extend the measurements to lead, tin, iron, and magnesium.*

In dealing with the various materials, it was necessary to have a thickness sufficiently great to insure that shower production through mesotrons had attained equilibrium. Thus, it was necessary to have the thickness comparable with or greater than the range of the electrons. In order that one might be free from complications involved in variation of mesotron intensity by different absorptions in the different elements, it was arranged that, in the case of each element, the total equivalent thickness as regards mass absorption should be the same, the balance being adjusted for convenience in each case by the choice of a suitable thickness of lead above the material under examination.

Figure 1 shows the results. Horizontally are plotted the atomic numbers of the elements concerned. The ordinates represent the numbers of showers, of the kind cited, associated with the passage of 1000 mesotrons through the apparatus.

The two-electron, and perhaps the three-electron, showers showed frequency of occurrence which is independent of the atomic number within the limits of accuracy of the experiments; but the one-electron showers show a marked dependence upon atomic number, a dependence sufficiently strong to dominate the situation even if we should plot a curve representing the total number of shower rays associated with 1000 mesotrons. These results are not in harmony with the elementary conclusions from Bhabha's theory, which predicts results practically independent of atomic number. As shown in our former paper,[1] however, the data for the actual numbers of showers agree, as regards order of magnitude, with the theoretical predictions.

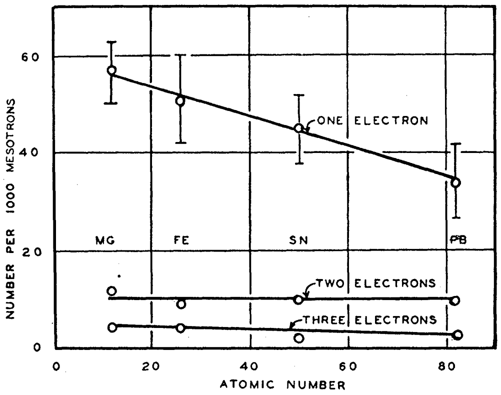

FIG. 1.

It is a curious fact that the regularity of the graphs for the actual data is greater than one might expect on the basis of the statistical uncertainty indicated in the usual way by the vertical. This is a matter which may have a rather profound significance in relation to processes involved.

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[1] Presented at the New York Meeting of the American Physical Society, February 23–24, 1940 (Phys. Rev. **57**, 554(A) (1940)).

[2] W. F. G. Swann and W. E. Ramsey, Phys. Rev. **56**, 378 (1939); W. F. G. Swann, Rev. Mod. Phys. **11**, 242 (1939).

Fission of the Separated Isotopes of Uranium*

Samples of the separated isotopes of uranium have been prepared with a mass spectrograph. UCl_4 was vaporized in a furnace, and the electron source for ion formation was placed inside the furnace. The upper entrance slit of the analyzer was also mounted on the furnace to avoid condensation of UCl_4. With a beam current of U^{238+} of 6×10^{-8} amp., about 1.8 microgram of U^{238} was collected on a Pt strip in three hours. The corresponding amounts of $U^{234+235}$ were collected on an adjacent Pt strip. A third Pt strip, mounted on the opposite side of the U^{238} collector, showed no measurable α-emission. The α-count for the U^{238} sample was 0.6 ± 0.1 per minute, and for the $U^{235+234}$ sample 0.6 ± 0.1 per minute.

The fission of the separated isotopes was tested by bombarding with slow neutrons from the Columbia cyclotron. The $U^{234+235}$ sample gave 3.7 ± 0.4 fissions/minute, and the U^{238} sample gave 0.1 ± 0.1 fission/minute. This shows definitely that U^{238} is not responsible for slow neutron fission in uranium, and confirms the results previously reported.[1]

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[1] Nier, Booth, Dunning and Grosse, Phys. Rev. **57**, 546 (1940).