This weak radiation is probably caused by internal and external bremsstrahlung as well as excitation of characteristic lead x-rays by the fast beta-rays.

An upper limit for the number of photons for which we were searching was derived in the following way. Our Geiger counter had an average efficiency $\gtrsim 10^{-3}$ for detecting photons of this energy region if they passed through it. A tungsten foil (46 mg/cm^2) reduced the counting rate by 2.4 ± 1.5 counts per minute. If we assume that tungsten would absorb the x-rays with an absorption coefficient of 10 cm^2/g, and allow for the absorption in the lead foil and in the copper and aluminum filters, we find that less than $(8\pm 5)10^3$ photons per min. are emitted "in the direction" of the Geiger counter. Assuming a fluorescence yield close to unity we obtain the result that less than 3 percent of the beta-rays stopped in lead are captured into the K-shell. One can conclude from this experiment that beta-rays, at the end of their path, are identical with atomic electrons.

The C^{14} source was produced in Oak Ridge and allocated by the Atomic Energy Commission. This work was supported by the Office of Naval Research under Contract No. N6-ori-71.

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An Excited State of Be^9 by Inelastic Scattering of Protons

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THE spectrum of protons emitted in the reaction $Be^9(p,p')Be^9$ has been studied in order to locate low lying excited states of Be^9 in the region 0–5.2 Mev. Incident beams of 4.5 and 7.1 Mev were provided by the 27-inch Rochester cyclotron, and observations were made at an angle of 37° using 180-degree magnetic focusing and Eastman NTA photographic plates. The target was a thin evaporated foil of 99.9 percent purity. The resolution of the method, as measured by the energy width of elastically scattered protons, is about 0.15 Mev, and the background is such that a differential cross section 10^{-28} cm^2 leads to an observable yield.

The results, shown in Fig. 1, indicate no bound states above the ground state, a virtual state at 2.41 Mev (0.78 Mev above the dissociation energy), and no other states up to about 5.2 Mev. The possibility that the tracks were made by deuterons or alpha-particles from the reaction $Be^9(p,d)Be^8$ or $Be^9(p,\alpha)Li^6$ was removed by observing that the count was not reduced when the plate was covered with a foil thick enough to stop the heavier particles. The cross section for excitation of the level is about 3×10^{-27} cm^2 at these energies. The experimental width is not significantly greater than the width of the elastic peak, suggesting an actual width less than 0.10 Mev.

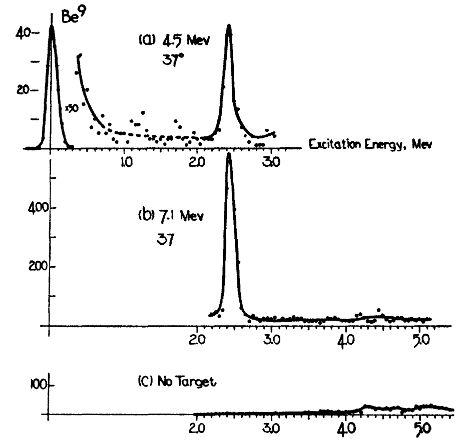

FIG. 1. Energy distribution of protons scattered by Be^9, plotted as number of tracks per 50 kev interval.

Calculations based on the model for Be^9 used by Caldirola[1] account for this state in a qualitative way, giving a value for the position which is in approximate agreement with experiment. However, the indicated width is too great by at least a factor of two. The absence of other states in the neighborhood is confirmed, but the model does not include the effect of the spin dependence of the forces. This model allows one to predict the excitation function and angular distribution for the scattering process; these calculations are being made and the corresponding experiments are under way.

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The Effect of the Composition of the Gas Mixture in Self-Quenching Geiger-Müller Tubes on Their Plateau Characteristics

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THE effect of the composition of the gas mixture in self-quenching G-M counters on the properties of these counters has been described by a number of authors.[1–4] Weisz[2] using ethyl-ether at room temperature and Rochester and McCusker[4] using alcohol at 40°C found the interesting result that at a pressure of 6 cm of Hg of the quenching gas the plateau of a given tube vanishes completely.

This result has been explained in two ways. Weisz[2] suggested that at the higher densities of ethyl-ether the photons formed during the primary discharge near the wire are so strongly absorbed by this vapor that the discharge has difficulty in spreading along the whole length of the wire. One would thus expect the region of limited proportionality to be extended at the cost of the

Geiger-Müller region. Rochester and McCusker on the other hand think that the effect may be caused by the fact that the threshold voltage increases linearly with the alcohol pressure, and that ions in the positive sheath may thus reach the cathode with sufficient energy to cause a liberal emission of electrons.

To test the last hypothesis three tubes, 1, 2, and 3, with wire diameters 0.1 mm, 0.25 mm, and 0.5 mm, respectively, and 3 cm outside diameter, were placed in an incubator together with an argon reservoir, alcohol tube, and manometer and the plateaus determined for various alcohol and argon pressures at 40°C.

The field strength at the cathode is determined by the relation $F=V/(b \log b/a)$ (V=voltage, b=cathode radius, a=wire radius). Thus at the same voltage the counters 3, 2, and 1 will have field strengths at their cathodes in the proportion 0.163:0.142:0.117. If Rochester and McCusker's hypothesis is correct, counter 3 would loose its plateau at a lower voltage, and thus also at a lower alcohol pressure than 2, and 2 at a lower voltage than 1. The plateaus were determined with the help of an oscillograph, the threshold being taken as the voltage that makes all the pulses of equal amplitude, and the end of the plateau as that region where multiple pulses come fairly regularly. The tubes used were made according to the evaporation technique,[5,6] gold being evaporated instead of the copper previously used as this gives a more permanent cathode, and photoelectric threshold of shorter wavelength. These advantages were also independently realized by Ramm.[7] The results of the measurements may be summarized as follows:

(1) On increasing the density of a filling of pure alcohol, the plateaus disappear at more or less the same pressure, and with a very much higher voltage on tube 3 than on 2, and a higher voltage on 2 than on 1.

(2) The addition of as little as 0.5 cm of argon changes the phenomenon. On adding increasing pressures of alcohol vapor to 0.5 cm of argon, the plateau of tube 1 vanishes at 0.5 cm argon+7.5 cm alcohol, that of tube 2 at 0.5 cm argon+5 cm alcohol and of tube 3 at 0.5 cm argon+3.1 cm alcohol. With 16 cm of argon added to various pressures of alcohol the result is in general the same, the plateaus of tubes 1, 2, and 3 being again reduced to nil when the alcohol pressure rises to 7.5, 5.8, and 3 cm, respectively.

In case (1) it thus looks as though the disappearance of the plateau is not caused by the positive ions striking the cathode with too high an energy, but more probably by the photon absorption becoming too high (Weisz) whereas in case (2) it looks as though secondary emission from the cathode at the threshold voltage is responsible for the plateau becoming zero (Rochester and McCusker).

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The Emission of Alpha-Particles from Different Faces of a Radioactive Crystal

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Several authors, many years ago, sought to find a difference in the number of α-particles emitted from the various faces of a crystal of a substance containing radioactive nuclei. It is almost unthinkable that the direction of emission of α-particles would bear any relation to the lattice in which the atom containing the radioactive nucleus is situated. However, considering the credence with which the results of Mühlestein were regarded by Rutherford[1] it seemed worth while to examine this point again. Mühlestein,[2] using a crystal of uranium nitrate, found differences between the numbers of α-particles from the various faces of as much as 15 percent when using electrical methods and 32 percent when counting scintillations.

Having at hand a crystal of $ThSO_4$, originally prepared by Boltwood, an examination of the rate of emission of α-particles from its several faces was made. The crystal is a parallelepiped about 2 mm on a side, and thus has three crystallographically different sides. The crystal was laid on a thin piece of plastic through which a 0.04-in. hole had been drilled and this assembly was set on an Ilford C2 nuclear emulsion plate for a given time. This was repeated, on the same plate, for each of the other two faces. Many α-particle tracks were observed going into the emulsion. When counted, under the microscope, the differences in tracks per unit area among the three faces were within the statistical errors caused by the finite number of tracks counted (about 800). It is therefore concluded that the observations of Mühlestein must have been somehow in error. Our thanks are due to Mrs. K. B. Mather who did the actual track counting. This work was supported by a grant from the Research Corporation to one of us (FNDK) and by the Office of Naval Research under Contract N6ori-117.

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The D+D Cross Section at Low Energies

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In a paper recently published,[1] measurements are described of the thick target yield of the $D(d,p)$ reaction between 15 and 105 kev. In order to derive cross sections from these observations, use is made of an energy-range relation for deuterons in D_2O, arrived at from a synthesis of published data. By an unfortunate oversight, the work of Crenshaw[2] in this field was not included in our survey. If the results of his experiments are taken into consideration, the D+D cross section at any energy becomes approximately 10 percent lower than is stated in our paper.

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