counts. A one-shot sweep circuit was used to measure dead time[1] and gave a visual picture of the pulse. In addition, the pulses were examined on an oscilloscope for multiplicity.

Of the four quenching gases ethylene consistently gave the best results. It was found that with a partial pressure of 0.8 to 5 cm of ethylene a plateau was obtained with less than 0.10 percent rise per volt over a length of at least 200 volts. The plateau was definitely flatter than when the other polyatomic gases were used in the same tubes.

The ethylene not only gave long, flat plateaus over a wider range of partial pressures, but also had other decisive advantages over the other polyatomic gases. As a gas rather than a vapor (e.g., alcohol), it was much more dependable under temperature changes and easier to handle. It gave no multiple counts at all whereas occasional multiple counts were obtained on replacing the ethylene by alcohol. Ethylene did not react with counters employing Zapon as a thin window as did alcohol, amyl acetate, and ether. Finally the ethylene-filled counters were very stable with respect to counting rate and recovered rapidly even after a discharge through the counter.

* This work was supported in part by the Office of Naval Research.
[1] H. G. Stever, Phys. Rev. **61**, 38 (1942).

Erratum: Electromagnetic Properties of Nuclei in the Meson Theory

[Phys. Rev. **62**, 118 (1942)]
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IN deriving Eq. (69) from Eq. (65) in our calculation of the exchange magnetic moment, a minus sign was left out by mistake. The result given by Eq. (69) should therefore be multiplied by a factor -1. After this correction this result agrees in magnitude and in sign with the result given in an earlier paper.[1] The present writer (S. T. Ma) was responsible for this mistake in our joint work.

[1] S. T. Ma, Proc. Camb. Phil. Soc. **36**, 351 (1940), Eq. (25).

A Dynamic Method for the Determination of the Velocity Distribution of Thermal Atoms

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July 6, 1948

WE have investigated a new method for the determination of the velocity distribution of atoms evaporated from an oven. It differs from the methods described by Eldridge, Zartman, Estermann, and others[1] in that it can be performed rapidly and is readily adaptable to other measurements connected with atomic beams.

Atoms leaving the oven are pulsed by a single rotating sector disk and detected by a Langmuir-Taylor hot-wire detector[2] about 20 cm away. The velocity distribution of the atoms in the pulses leads to varying transit times for atoms of different velocities, and therefore to a time-dependent current in the detector circuit. This current is a measure of the number of atoms arriving per unit time, and, when it is applied to a cathode-ray oscilloscope with a linear sweep, one can "see" the rate of arrival of atoms at the hot wire. Figure 1 is a photograph of an oscilloscope trace of this curve, using a beam of indium atoms.

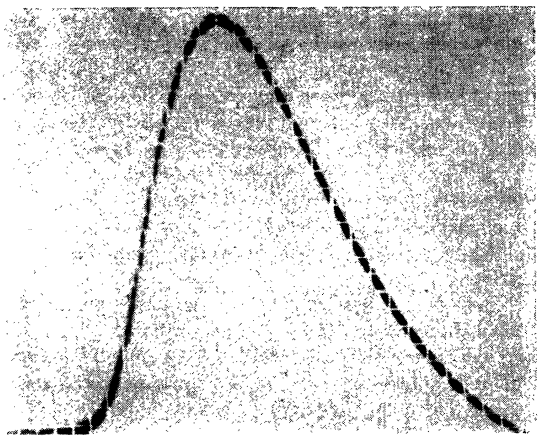

FIG. 1. Sample cathode-ray oscillogram showing the number of atoms arriving at the detector as a function of time.

Further improvements in the method may make it possible to determine the relaxation time, or the mean time an atom stays on the hot wire, if it is assumed that deviations from the atom velocities calculated from the Maxwell-Boltzmann theory are due to this effect. This will be accomplished by placing a photo-tube next to the detector and simultaneously observing the pulses produced on the oscilloscope by both the atoms and the light radiated from the oven. The time difference between the peak of the atom pulse and the peak of the light pulse may then be compared with the theoretically most probable transit time.

[1] J. A. Eldridge, Phys. Rev. **30**, 931 (1927); I. F. Zartman, Phys. Rev. **37**, 383 (1931); I. Estermann, O. C. Simpson, and O. Stern, Phys. Rev. **71**, 238 (1947). The last-mentioned paper contains references to other researches on the subject of the velocity distribution in an atomic beam.
[2] I. Estermann, Rev. Mod. Phys. **18**, 310 (1946).

On the Range of the Electrons in Meson Decay

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June 23, 1948

SOME preliminary data have been obtained in an experiment to determine the range of the electrons resulting from meson decay. The counter arrangement is shown in Fig. 1. The circuits record coincidences in trays 1 and 2, followed from between 0.6 and 4.5×10^{-6} second later by coincidences in trays 3 and 4. Presumably a meson has stopped in absorber 1, disintegrated, and traversed absorber 2. Both absorber 1 and absorber 2 are polystyrene, a hydrocarbon, except for weights of absorber 2 in excess of

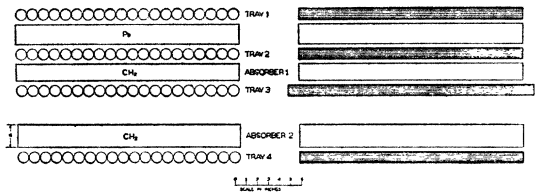

FIG. 1. Arrangement of counters.

16 g/cm², when it is partially carbon and partially polystyrene. The experiment consists of measuring the rate of occurrence of delayed coincidences as a function of the thickness of absorber 2.

The results are shown in Fig. 2. The solid curves show how 25- and 50-Mev electrons would appear in this apparatus. It can be seen that the majority of the electrons have an energy of ~25 Mev, but that an appreciable number have a larger energy. For energies greater than ~65 Mev, the counting rate is approximately that of the calculated background.

In computing the solid curves, the range distribution caused by scattering and geometry were taken into account. The effect of scattering was deduced from a measurement on the range in water of 16.5-Mev electrons. This was kindly communicated to me by Professor Skaggs. The energy loss of electrons has been taken to be 1.72 Mev/g/cm². This is an average value for this energy region for carbon, calculated by Halpern and Hall.[1]

The dashed curve in Fig. 2 is drawn on the basis of an electron spectrum given by

$$\{E[(\mu^2-\mu_0^2)c^4-2E\mu c^2]\}^4(\mu c^2-E)/[(\mu c^2-2E)\mu c^2]^3$$

where $\mu c^2=100$ Mev is the mass of the decaying meson, $\mu_0 c^2=45$ Mev the mass of a neutral meson, and E is the energy of the electron. The formula is obtained by making a phase space calculation for the three-particle disintegration meson$^{\pm}\rightarrow$meson^0+electron$^{\pm}$+neutrino.

Apparently the spectrum of decay electrons is quite complex. In drawing conclusions from the data, it should be kept in mind that the counting rate for the higher energy electrons is only about twice background, and the statistical errors are large. However, it seems as if the possibility that the meson decays via two competing processes should not be overlooked.

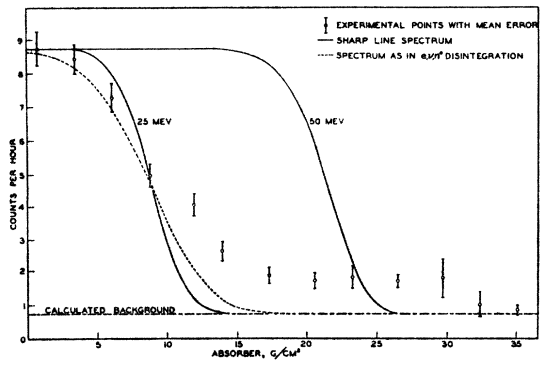

FIG. 2. Counting rate of delayed coincidences as a function of the weight of absorber 2.

I should like to thank Professor E. Fermi and Mr. H. Ticho for much help and advice, and Mrs. N. Woods for filling the counters.

[1] O. Halpern and H. Hall, Phys. Rev. **73**, 447 (1948).

Rate of Production of Helium in Meteorites by Cosmic Radiation

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July 2, 1948

THE evidences that cosmic radiation has produced helium in the metallic meteorites are: (1) The rate of production of helium by cosmic radiation in a small meteorite[1] is sufficient to produce the maximum observed helium content (4×10^{-5} cc/g) in a time less than the previously assigned "age" (7.6×10^9 yr.);[2] (2) this process gives a logical explanation to the mass-helium content diagram;[3] and (3) it completely resolves the severe difficulties introduced by the previously assigned "ages," namely, (*a*) the exceedingly great "age" of the "oldest" meteorites, (*b*) the great range in the "ages" of meteorites (from 60 million to 7600 million years), (*c*) the dividing of otherwise completely associated and similar meteorites into two or more groups on the basis of their helium contents alone,[2] (*d*) the variation of the helium content from point to point within the same meteorite,[4] and (*e*) the absence of a dependence of these "ages" on the nickel content of the meteorites and thus on their radial positions within the metallic core of their parent planet.

The 51 Bethany meteorites were all found in a limited region of Great Namaqualand, Southwest Africa. Table I gives, for five Bethany meteorites, the classification of the crystal structure, the percentage of nickel, Paneth's measurements[2] of the uranium, thorium, and helium contents, and his assigned ages. The similarity of these five masses in location, structure, and composition almost certainly establishes them as representing the same fall. However, Amalia (Krantz) has been assigned to a different fall because its helium content is so much greater than the others. These observations can be more satisfactorily accounted for by the assumption that cosmic radiation has produced the helium in Bethany, and therefore the difference in the helium contents of the different fragments arises from the difference in their radial positions within the original preatmospheric mass. The helium content of Goamus is equal to that predicted[3] at the center of a spherical preatmospheric mass of 50,000 kg. For this preatmospheric mass, Amalia (Krantz) must have been about 80 cm from the center, i.e., just on the edge of a spherical mass of 15,000 kg, the total known mass of the Bethany meteorites.

In Bethany Amalia (Krantz) two regions separated by about 7 cm have helium contents[4] that differ by 0.25×10^{-6} cc/g. If the two points were along a radial line and at a distance of 80 cm from the center of a 50,000-kg mass, the