those charged V particles originating in the plate, which is quite near the illuminated region, are a mixture of the long- and short-lived particles. From the marked positive excess of this group we may conclude that the short-lived particle is predominantly (if not always) positive.

A more direct indication that the charged V particles are composed of both (long-lived) K particles and (presumably short-lived) heavier particles is given by measurements on two positive V particles with origins in the lead plate. These proved to be of special interest because the mass of the charged secondary particle was in each case much greater than that of a π-meson. The pertinent data for these two events are contained in Table II, and a photograph of the first case is reproduced in Fig. 1. In both cases the primary track was to short to permit a momentum measurement, but is heavily ionizing. The secondary particles have masses lying in the range 1300–2300 m_e and are consistent with the mass of a proton.[5] The possibility that these events might be interpreted as the scattering of protons is ruled out by the high transverse momentum P_T of the decay and the absence of a recoil nucleus at the decay point. It is natural to suggest that this new decay follows the scheme

$$V_1^+ \rightarrow P + \pi^0 + (Q \sim 40 \text{ Mev}),$$

which is a charged counterpart of the well-known neutral V particle decay scheme: $V_1^0 \rightarrow P + \pi^- + (Q = 35 \text{ Mev})$.[6,7] It is to be noted that the observed transverse momenta are consistent with the most probable values to be expected from this decay scheme.

One would naturally expect that an alternate mode of decay of this heavy V particle might be $V_1^+ \rightarrow N + \pi^+ + (Q \sim 35 \text{ Mev})$, and indeed one can deduce, using the above arguments, that about 12 of the positive particles from the lead plate should be of this type. However, without accurate estimates of the masses of the primary particles it would be difficult to distinguish this type of decay from that of a K particle in any individual case.

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Meteorites as Cosmic-Ray Meters

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The production of helium in iron meteorites by cosmic rays[1] has been treated quantitatively in a recent publication.[2] In addition, a method was described there for separating the contributions from cosmic rays and from radioactivity (uranium and thorium) to the total helium content of the meteorite; namely, it has been calculated that the cosmic-ray produced helium consists of ~30 percent He^3 isotope.[2] The He^3 is produced mainly in evaporations of the iron nuclei, both directly and through beta-decay from tritium.

The actual presence of He^3 in iron meteorites has now been established experimentally;[3] hence, it becomes possible to apply corrections to previously determined "ages"[4] (time since last solidification) by subtracting the cosmic-ray produced helium. One may also be able to place limits on the times of break up of the parent bodies and the dates of creation of the meteorites.[5]

It has also been pointed out[2] that this accumulating property of He^3, in effect, allows one to consider the meteorite as a kind of cosmic-ray meter which integrates the cosmic-ray flux it encounters over its path from the time it becomes exposed to cosmic rays to the time of its fall on earth. On the basis of certain assumptions,[2] it may thus be possible to gain information about the prehistoric cosmic-ray intensity.

The integrating-meter properties of meteorites are, of course, due to the fact that both He^3 and He^4 are stable. One may, however, also consider the possibility of using a radioactive species produced by cosmic rays as an indicator of the (essentially present-day) cosmic-ray intensity existing in the region from which the meteorite came.

Tritium nuclei are released in considerable quantities during evaporations of iron nuclei. Their rate of production (near the surface of a large meteorite) is calculated to be $\sim 2.5 \times 10^5$ tritons per g of meteorite material per year under the same conditions as before.[2] With a constant rate of production secular equilibrium is soon established; after several half-lives the tritium content becomes $\sim 5 \times 10^6$ atoms/g.

In a freshly fallen meteorite the tritium activity should be within range of detection. Immediately after fall the activity per g in the region of maximum tritium production (2–15 cm from the "pre-atmospheric"[6] surface) should be ~0.01 counts/sec; this activity decreases by only 5.8 percent every year. Should the cosmic-ray intensity experienced by the meteorite in the years just preceding its fall be different from the intensity near the earth, the *measured* activity would differ from the expected value in the same manner.

It may not be necessary to rely on an absolute measurement, since, in addition to calculating the activity expected, one could actually calibrate it to the cosmic-ray intensity near the earth. With successive flights in high altitude balloons one can easily achieve an exposure of 0.1 year for a 10^3 g mass of iron; it should then contain $\sim 2.5 \times 10^7$ atoms of cosmic-ray produced tritium.

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[6] That is, before any part of the surface is removed by ablation in the earth's atmosphere.

Orbital Effect in Neutron-Electron Magnetic Scattering*

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The spin-spin part ($\mathcal{H}_{SS}$) of the neutron-electron magnetic interaction has been considered in some detail in the literature,[1] while the spin-orbit part ($\mathcal{H}_{SL}$) associated with the interaction between the neutron magnetic moment and a moving electron has not. It is worth while to consider both of these in detail from the viewpoint of exploiting the scattering of thermal neutrons from magnetic materials as a tool for investigating the electronic structure of matter.

The magnetic Hamiltonian is

$$\mathcal{H}_{SS} + \mathcal{H}_{SL} = -\boldsymbol{\mu}_n \cdot \mathbf{H}^{(S)} - \boldsymbol{\mu}_n \cdot \mathbf{H}^{(L)}, \qquad (1)$$

in which $\boldsymbol{\mu}_n = g_n(m/M_p)\beta \mathbf{s}_n$ is the neutron magnetic moment, and the magnetic field at the neutron generated by electrons of the scatterer is given by

$$\mathbf{H}^{(S)} = \Sigma_j \{ -\boldsymbol{\nabla}_j \times [\boldsymbol{\mu}_j \times (\boldsymbol{\nabla}_j r_{nj}^{-1})] \}, \qquad (2)$$

$$\mathbf{H}^{(L)} = \frac{e}{mc} \Sigma_j (\boldsymbol{\nabla}_j r_{nj}^{-1}) \times \mathbf{p}_j, \qquad (3)$$

where $\boldsymbol{\mu}_j = -2\beta \mathbf{s}_j$ is the magnetic moment, $\mathbf{r}_j$ the position, $\mathbf{p}_j$ the momentum, and $\mathbf{s}_j$ the spin angular momentum (in units of $\hbar$) of the jth electron, the summation being over all electrons; $\mathbf{r}_n$ is the position, $\mathbf{s}_n$ the spin, and $g_n = -3.83$ the g factor of the neutron; m/M_p is the electron-proton mass ratio; $\beta = e\hbar/2mc$ is the Bohr magneton; $r_{nj} = |\mathbf{r}_n - \mathbf{r}_j|$. These expressions for $\mathcal{H}_{SS}$ and