for the mean life $\tau_0 = 2.15 \pm 0.07$ μsec. by adding all their data collected in various materials. It seems difficult to explain the difference between the two values by a systematic error in the experimental method since the disintegration curve appears linear, and hence the error would have to increase *linearly* with the time interval which has actually been recorded. A shortening of the mean life, however, may be due to a contribution by negative mesotrons decaying in the absorber. The following letter explains why such a contribution might result in an apparent change of the mean life.

The author wishes to express his gratitude to Dr. Walter O. Roberts of the Fremont Pass Station of the Harvard College Observatory at Climax, and to the Climax Molybdenum Company for making available the facilities required for carrying out this investigation.

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[2] H. Ticho, Rev. Sci. Inst. **18**, 271 (1947).
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Errata: The Double Focusing Beta-Ray Spectrometer

[Phys. Rev. **71**, 681 (1947)]

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DR. EDWIN M. McMILLAN has kindly pointed out an error in our article which he discovered by comparing our equations with the results of some earlier unpublished calculations of his own. The error has its origin in the expression for H_z given on page 682. The last term in this equation should read $[-(\beta-\alpha/2)z^2H_0/a^2]$. The subsequent calculations are, we believe, all correct, but this correction introduces changes in certain of the coefficients in the equations. The final result, the expression for r^* given in Eq. (25), must be modified as follows. The coefficient of $(\delta z)^2$ should be $[(4\beta-3)/3a]$ rather than $[(4\beta-2)/3a]$. The coefficient of ϕ_z^2 should be $[(16\beta/3-2)a]$ rather than $[(16\beta/3-2/3)a]$. The remaining terms, as well as Eq. (26), are correct as they stand.

The new expression for r^* is less favorable, since the ϕ_r defocusing may be eliminated for $\beta=\frac{1}{8}$ but not the ϕ_z defocusing. To eliminate the latter, β must equal $\frac{3}{8}$. The correct choice of β will depend upon the baffle system to be employed. It may often be more convenient to allow a wider variation in ϕ_r than in ϕ_z in which case β should be $\frac{1}{8}$. Although the focused image will not be as perfect as that shown in Fig. 1, the conclusion still stands that, with the double focusing spectrometer, the image may be made both more intense and also sharper than with the usual semicircular spectrometer.

Another advantage pointed out to us by Dr. McMillan is that the dispersion ($p\delta r/r\delta p$ where p is the electron momentum) is twice as great as in the semicircular case.

Since submitting our paper we have received a reprint from Dr. N. Svartholm[1] in which the image formed by a point source is discussed. His results are in agreement with our corrected equations.

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On the Magnetic Exchange Moment for H^3 and He^3

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June 23, 1947

RECENT experiments of Bloch and others[1] on the magnetic moment of H^3 gave the value 1.0666 for the ratio of the magnetic moments of H^3 and proton. Assuming a value of 2.789 n.m. for $\mu(p)$, we find $\mu(H^3)=2.975=\mu(p)+0.186$ n.m. This result seemed to be in contradiction to the results of theoretical investigations of Sachs and Schwinger,[2] which require $\mu(H^3)\leqslant\mu(p)$, unless very artificial assumptions on the ^2P and ^4P admixtures to the S-component of the ground-state eigenfunction are made.[3]

However, Schwinger's ansatz[4] for the nuclear Hamiltonian does not allow for taking into account the charge-exchange phenomena connected with the interaction of nucleons. On the other hand, it is well known that these phenomena give rise to exchange moments.[5] Whereas the magnetic exchange dipole moment vanishes in the case of the deuteron (on account of the symmetry properties of the de-eigenfunction), this is not the case for H^3 and He^3, provided that the quantum number T of the total isotopic spin is $\frac{1}{2}$. (It vanishes for $T=\frac{3}{2}$.)

A calculation has been carried out on the basis of the symmetrical pseudoscalar meson theory. According to this theory, the H^3 and He^3 ground states are doublet states both with respect to spin and isotopic spin ($S=T=\frac{1}{2}$) and symmetrical with respect to permutations of the space coordinates of the particles, if we neglect the influence of the tensor force. The latter is responsible for small admixtures of higher states, the influence of which may be neglected here, since there is a non-vanishing expectation value of the exchange moment in the above described S state.

The exchange moment operator is given by $M=M^{(1)}+M^{(2)}$:

$$M^{(1)}=-\frac{ef^2}{2}\mu\sum_{A<B}(\tau^A\times\tau^B)_3\left\{z^{AB}(z^{AB}\cdot\sigma^A\times\sigma^B)\Big/ r_{AB}^2\cdot\left(1+\frac{1}{\mu r_{AB}}\right)-(\sigma^A\times\sigma^B)\right\}e^{-\mu r_{AB}},$$

$$M^{(2)}=+\frac{ef^2}{2}\mu^2\sum_{A<B}(\tau^A\times\tau^B)_3\cdot(z^A\times z^B)\cdot V(AB),$$

where $V(AB)$ is the interaction energy of the nucleon pair AB in the pseudoscalar theory:

$$V(AB)=\left\{\tfrac{1}{3}(\sigma^A\sigma^B)+(3(\sigma^Az^{AB})(\sigma^Bz^{AB})/r_{AB}^2-(\sigma^A\sigma^B))\times\left(\frac{1}{3}+\frac{1}{\mu r_{AB}}+\frac{1}{(\mu r_{AB})^2}\right)\right\}\frac{e^{-\mu r_{AB}}}{r_{AB}}.$$

On account of its symmetry properties, the expectation value of $M^{(2)}$ vanishes, whereas $M^{(1)}$ gives, in units of nuclear magnetons

$$M^{(1)}=(8/3)\gamma(f\mu)^2\cdot T_3\int dv\,\varphi^2\left(\frac{1}{\mu r_{AB}}-2\right)e^{-\mu r_{AB}}.$$

(γ is the ratio of the masses of proton and meson: $\gamma\cong 10$,

$T_3+\frac{3}{2}$ is the charge of the nucleus, φ the orbital part of the ground state eigenfunction, $z^{AB}=z^A-z^B$, $r_{AB}=|z^{AB}|$, $(f\mu)$ the dimensionless coupling constant of the meson field: $(f\mu)^2 \cong \frac{1}{10}$, and $\mu=\mathrm{Mc}/\hbar$.) A rough evaluation of $M^{(1)}$ has been made with the help of gauss functions $\varphi \sim \exp(-\alpha r^2)$, $r^2=\frac{1}{3}(r_{12}^2+r_{13}^2+r_{23}^2)$, with the following result (J is the volume integral in M).

μ^2/α	1.0	1.5	2.0	2.5	0.75
J	-0.14	-0.21	-0.23	-0.23	-0.058
M	$+0.18$	$+0.28$	$+0.31$	$+0.31$	$+0.077$

Thus, with reasonable values of γ, $(f\mu)$, and μ^2/α we obtain both the right sign and right order of magnitude of the correction to be added.

It should be noted that for He^3 the correction is equal in magnitude but opposite in sign. We would, therefore, expect for He^3 a total magnetic moment $\mu \cong \mu(N)-M \cong -2.1$ n.m. Experimental evidence would be very interesting.

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Errata: Theory of Dipole Interaction in Crystals

[Phys. Rev. **70**, 954 (1946)]

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Several misprints have been noticed in the above paper. These are the following:

P. 956, line 7 should read p_x^ν, p_y^ν, p_z^ν, $\nu=1,\cdots,8$.

P. 956, Eq. 7 should read

$$U=-\tfrac{1}{16}\sum_{\mu,\nu=1}^{8}\sum_{xy}F_{\mu\nu}{}^{xy}p_x^\mu p_y^\nu. \tag{7}$$

P. 957, Eq. 12 should read

$$Z_i=(-)^{\alpha_i l_1+\beta_i l_2+\gamma_i l_3}\quad i=1,\cdots,8. \tag{12}$$

P. 960, last equation. The denominator should be raised to the 5/2 power.

P. 960, Table II, first line should read

$$f_2=-\tfrac{1}{2}[S_z(0,\tfrac{1}{2},\tfrac{1}{2})-S_z(\tfrac{1}{2},0,0)].$$

P. 960. The small table under Table II contains several inversions and a sign error. It is correctly given by:

$$\begin{array}{ll} S_z(\tfrac{1}{2}\ \ 0\ \ 0)=-15.040 & S_y(0\ \ \tfrac{1}{4}\ \ \tfrac{1}{4})=31.521 \\ S_z(0\ \ \tfrac{1}{2}\ \ \tfrac{1}{2})=\ \ 4.334 & S_y(\tfrac{1}{2}\ \ \tfrac{1}{4}\ \ \tfrac{1}{4})=\ \ 2.599 \\ S_y(\tfrac{1}{4}\ \ \tfrac{1}{4}\ \ \tfrac{1}{4})=\ \ 10.620 & S_z(0\ \ \tfrac{1}{4}\ \ \tfrac{1}{4})=12.329 \end{array}$$

Lastly, in Table V, p. 963, lines 4 and 5 should be exchanged (which moves a minus sign down one line), and line 12 should read $-2\mathbf{X}_8-\mathbf{Y}_8+\mathbf{Z}_8$.

The authors would like to thank Professor L. W. McKeehan for having pointed out several of the above misprints.

Burst Production by Penetrating Cosmic-Ray Particles*

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A tray of Geiger-Mueller tubes, G, and an ionization chamber, C, were arranged, respectively, above and below a lead block 6 in. thick, as shown in Fig. 1. The

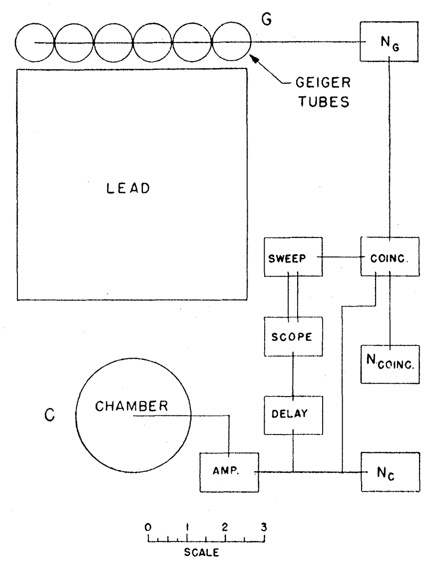

FIG. 1. Schematic arrangement of equipment.

Geiger-Mueller tubes were connected in parallel. Each was 1 in. in diameter and 20 in. long. The chamber was cylindrical in shape, 3 in. in diameter, 20 in. long, and was filled to 7.3 atmospheres with highly purified argon so that "fast" electron pulses would be recorded quantitatively. The pulses of the ion chamber were applied to the vertical deflecting plates of a cathode-ray oscilloscope through a linear amplifier and a delay line. The oscilloscope was provided with a fast horizontal sweep (5 microseconds per inch) which was triggered by the coincidences between the (undelayed) pulses of the ionization chamber and the pulses of the Geiger-Mueller tubes. The oscilloscope screen was photographed on a moving film. The individual counting rates of the chamber (N_c) and of the Geiger-Mueller tubes (N_g) were also recorded.

A polonium source of α-particles was placed on the wall of the chamber for the purpose of calibration. The resolving time $(\tau_1+\tau_2)$ for the selection of coincident pulses was determined both by direct observation of the pulses on the oscilloscope screen and by counting chance coincidences between pulses in the Geiger-Mueller tubes and α-particle pulses in the ionization chamber. Its value was found to be 50 microseconds.

For the main experiments, the circuits were adjusted so as to record only pulses greater than 1.1 times a Po