By properly separating the extraordinary Hall effect due to magnetization from the ordinary Hall effect due to a uniform field (the magnetizing force H), a well-behaved Hall constant for ferromagnetics can be measured which should provide considerable information concerning the band structure of ferromagnetics.

[1] Pugh, Rostoker, and Schindler, Phys. Rev. 80, 688 (1950).
[2] A. W. Smith, Phys. Rev. 30, 1 (1910).
[3] P. Weiss and R. Forrer, Ann. phys. 5, 153 (1926).
[4] E. M. Pugh, Phys. Rev. 36, 1503 (1930).

Scattering of 20-Mev Alpha-Particles by Helium

K. B. MATHER*
*Physics Department, Birmingham University, Birmingham, England***
(Received February 9, 1951)

THE angular distribution of alphas elastically scattered from helium gas has been studied using a photographic method. Twenty-Mev alphas from the cyclotron entered the scattering chamber from a collimating slit system. Scattering angles were defined by a number of radial slots (Fig. 1) cut in an iron ring, each

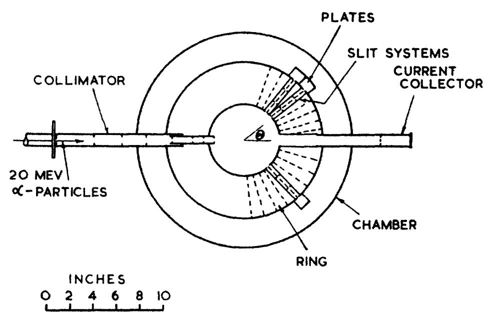

FIG. 1. Schematic of photographic scattering chamber. Angles of scattering are defined by the slits mounted in radial slots cut in the ring (dotted lines indicate positions of slit systems).

mounting a set of defining slits. Particles scattered through these slits were recorded by their tracks in photographic emulsions placed at known angles behind each slot.

The scattering cross section $\sigma(\Theta)$ at any laboratory angle Θ, could be calculated from measurements of slit dimensions, slit distances from the scattering volume, angles of tilt of the photographic plates to the horizontal, the total number of alphas traversing the chamber, and the number of tracks per unit area of plate surface. A noteworthy advantage of the chamber was its dependence predominantly on length measurements which could be made easily and accurately. The number of particles traversing the chamber was determined by collecting the total charge on a Faraday cup connected to a 1.10-μf condenser whose potential was measured with a calibrated quadrant electrometer. The helium gas pressure was obtained from an Apiezon B oil manometer.

The alpha-particle energy was ascertained by measuring the ranges in photographic emulsions of the alphas at each angle of scattering Θ; $E_0=20.0\pm0.3$ Mev.

The data reported here is preliminary only, being based on a single run and with a total track count of only $\sim$7000. Owing to the small alpha-beams produced by the cyclotron; runs were very long, which resulted in trouble from impurity scattering, leakage corrections to the current integrator system, and relatively poor statistics. In proton scattering it is feasible to apply reliable corrections for impurity scattering (air and vapors) based on identifiably different *bona fide* and spurious track lengths. This feature is almost lost in alpha-scattering because of the less favorable mass ratio between scattered and impurity particles.

Table I lists $\sigma(\theta)$, the center-of-mass scattering cross section *versus* center-of-mass angle θ, together with probable errors based

TABLE I. Center-of-mass cross sections $\sigma(\theta)$ for 20-Mev alpha-alpha scattering, and ratio to Mott cross sections.

Θ	θ	$\sigma(\theta)\times10^{25}$ cm² sterad⁻¹		$\sigma_{obs}/\sigma_{Mott}$
7°	14°	*14.1	±0.7	1.53
11	22	* 7.7	0.3	4.85
15	30	3.9	0.1	7.82
16	32	3.7	0.1	9.34
21	42	2.00	0.11	12.8
25	50	1.58	0.06	17.3
30	60	1.23	0.08	21.9
35	70	0.92	0.06	22.4
40	80	1.04	0.07	30.4
45	90	—		—
50	100	0.97	0.08	28.4
55	110	1.06	0.08	25.9
60	120	1.19	0.09	21.2

on the statistics at each angle. By comparison, other errors which affect the relative cross sections are negligible at most angles. However, absolute values of $\sigma(\theta)$ may be in error by as much as 10 percent. The starred values are very uncertain owing to impurity effects at small angles. (They probably can be taken as upper limits.) Column 4 gives the ratio of observed to Mott cross sections:

$$\sigma(\theta)_{\mathrm{Mott}}=\frac{4e^4}{E_0^2}\{\mathrm{cosec}^4\Theta+\sec^4\Theta+2\,\mathrm{cosec}^2\Theta\cdot\sec^2\Theta\cdot\cos(\eta\log\tan^2\Theta)\}$$

$\eta=4e^2/\hbar v=0.282$ for 20-Mev alphas.

As expected, there was no evidence at 20 Mev of inelastic scattering. However, if the alpha-particle has excited states 10 to 20 Mev above ground, an alpha-alpha experiment at 40 Mev could (at least from energy considerations) show inelastic scattering. It is proposed to attempt this with alphas from the Birmingham 60-in. cyclotron.

* Temporarily with the University of Ceylon, Colombo, Ceylon.
** Exposures were made at Washington University, St. Louis, Missouri, in 1949, using the 45-in. cyclotron.

The Discrepancy in the Energy of Annihilation Radiation and the Possibility of Electron-Positron Mass Difference

ARNE HEDGRAN AND DAVID A. LIND*
Nobel Institute of Physics, Stockholm, Sweden
January 20, 1951

THE energies of certain gamma-radiations (Au^{198}, Co^{60}, and annihilation radiation) have been measured with good precision with a crystal spectrometer.[1] Recently, however, it became apparent from measurements on the double focusing spectrometer[2] at this laboratory that there was a discrepancy between the energy of the annihilation radiation measured in terms of the Au^{198} 411-kev line and the value calculated from the Einstein relation $E_0=m_-c^2$ using the best values of the constants.[3]

The comparison of the Au^{198} radiation with the annihilation radiation can be made very accurately because electrons ejected from the L_{III} shell in uranium by the 411-kev radiation have a momentum only 1 part in 1000 less than those ejected from the K shell by the annihilation radiation. The effect of converter thickness is the same for both lines; it is necessary to consider only the effect of the Doppler broadening.

Comparisons were carried out with sources of Au^{198}, Cu^{64}, and Co^{60} mounted in brass tubes to eliminate the continuous beta-spectra. The positrons from the Cu^{64} annihilate in copper or brass. A 0.7-mg/cm² uranium converter was used and the resolution set at 1.6×10^{-3}. For comparison, window curves for thorium I, L, and X lines at 1750, 2603, and 10.000 $H\rho$, respectively, were also taken. These were used to correct for the converter effects.

The shapes of the Au^{198} UL_{III} and Cu^{64} U_K lines, shown as curves A and C, respectively, in Fig. I, were obtained by a suitable