directly, after the rotation is performed on $i\langle T_{11}\rangle$ and $\langle T_{20}\rangle$.[4] The result is as follows:

$$I(\theta,\phi) = I_0(\theta) + \tfrac{5}{8}\langle T_{20}\rangle A(\theta) + [\tfrac{3}{8}(2)^{1/2}\langle T_{20}\rangle B(\theta) + i\langle T_{11}\rangle C(\theta)]\sin\theta\cos\phi + \tfrac{1}{16}(6)^{1/2}\langle T_{20}\rangle D(\theta)\sin^2\theta\cos 2\phi, \qquad (5)$$

where I_0 is the unpolarized cross section; A, B, C, and D are polynomials in $\cos\theta$, and are dependent upon the reaction matrix elements. Because of the large magnitude of $i\langle T_{11}\rangle$ after the initial scattering and the low energy, one would expect the $\cos\phi$ term in the asymmetry to dominate; the "right-up" type of asymmetry characteristic of spin one would probably be much smaller. Professor W. M. MacDonald has suggested to the author that such deuterons may be a useful tool in investigating (d,p) and (d,n) reactions. Dr. A. S. Langsdorf has pointed out that polarized deuterons of higher energy may be obtained by accelerating He^4 nuclei on a deuterium target, rather than the inverse.

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MAGNETIC PERTURBATION ON CIRCULAR POLARIZATION OF EXTERNAL BREMSSTRAHLUNG

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It is well known that the external bremsstrahlung (EB) produced by β-rays is circularly polarized. The degree of circular polarization, according to theoretical predictions,[1-3] is a function of the quantum energy and attains its maximum value when the quantum has the same energy as the radiating electron. The EB polarization has been measured by some investigators[4-7] whose results appear to agree reasonably as far as concerns the energy dependence. A lack of agreement seems to exist regarding the dependence of the polarization on the atomic number of the absorber. A strong Z dependence has been reported by Cohen et al.[6] but it was not confirmed by Galster and Schopper.[5] Recently we[8] have found that the atomic number of the target affects the EB polarization to an extent which seems to substantiate the calculations of Neamtan[9] on electron depolarization in matter.

With a view to obtaining further information on the influence of matter on EB polarization, we have investigated the circular polarization-energy relation for EB quanta, by using a magnetized iron target as β absorber. The circular polarization of γ-rays was analyzed through Compton scattering with polarized electrons available in magnetized iron. The experimental apparatus and procedure were the same as previously described.[7-8] The source of β-rays (Y^{90}) was placed just behind the target (about 8 mm thick) which was magnetized perpendicularly to the polarimeter axis ($B = 16\,000$ gauss).

The measurements consisted of several 6-minute counting runs, one for each opposite polarimeter field direction, made alternately with magnetized and unmagnetized targets. Every run showed that the asymmetry in the counting rate for opposite polarimeter field direction was lower when the target was magnetized. Taking into account the correction factor of any instrumental effect, and the efficiency of the polarimeter, we obtain the polarization-energy relation for EB quanta produced in the unmagnetized target. The relation for EB quanta produced in the magnetized target is obtained from the preceding relation by multiplying by the ratio of the measured asymmetries. This is right, in view of the fact that the interesting spectral distributions for the two magnetization states of the target have identical shapes. The two relations are shown in Fig. 1. For each curve a total of 6×10^7 pulses were counted. The quoted errors are only statistical.

It is noteworthy that at low energies (E<1.4

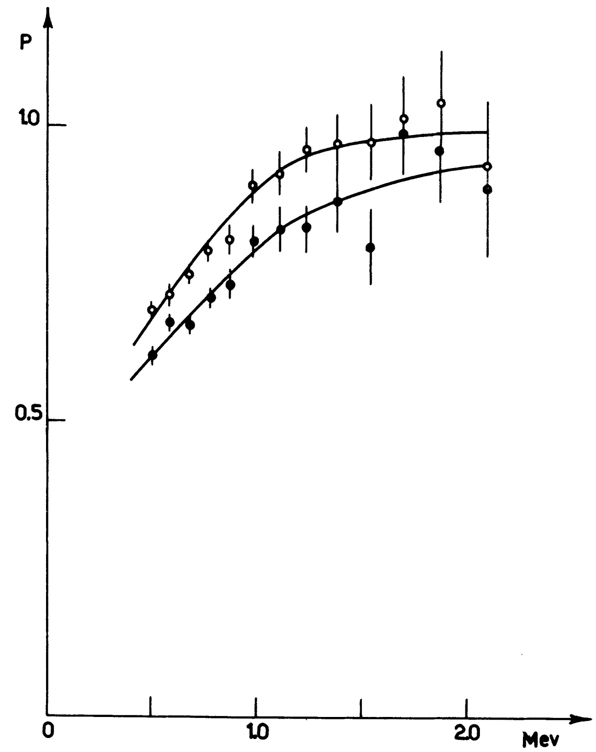

FIG. 1. Circular polarization of external bremsstrahlung quanta from Y^{90} β-rays, produced in unmagnetized (upper curve) and magnetized iron (lower curve).

Mev) the percentage decrease of polarization appears to be nearly constant against E and equal to about 10%. At higher energies the statistical errors prevent a significant conclusion, but the results are not in conflict with the reasonable assumption that the magnetic perturbation vanishes at the high-energy end of the spectrum.

Although a quantitative account of the effect cannot be given at present, the existence of a magnetic perturbation on circular polarization of EB is not surprising. It must not be forgotten that in magnetized iron the β particles are subject to strong inhomogeneous electric and magnetic fields varying on a microscopic scale, which are able to produce electron depolarization. If this hypothesis is correct, the superficial magnetic structure (thickness less than 0.2 mm) of the iron target should play an important role.

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[9]We thank Dr. S. M. Neamtan for making his calculations available to us before publication.

S-WAVE DETECTOR OF DEUTERON POLARIZATION AND 14-Mev POLARIZED-NEUTRON SOURCE

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Recently a great deal of interest[1] has been expressed in the development of polarizing ion sources for use in accelerators. In this connection a convenient analyzer for the resulting polarized beams would be most useful. It is well known that in both scattering and reactions induced by polarized s-wave protons the angular distribution of the scattered protons, or of any reaction product, is isotropic[2] just as they would be for unpolarized s-wave protons.[3] The purpose of this Letter is to point out that the fact that isotropy does not necessarily follow for a reaction induced by polarized s-wave deuterons[4] may enable one to use, for example, the $T(d,n)He^4$ reaction as a sensitive detector of the polarization of a deuteron beam. This reaction will then also serve as a source of polarized, 14-Mev neutrons.

The different results obtained for proton and deuteron beams may be ascribed to the fact that