is the (double) Fourier transform of the weight function $\varphi_M(p,q)$ in the "diagonal" representation (1) of T_M,[6] which establishes that the weight function $\varphi_M(p,q) \in \mathcal{S}_2$ for all M, and concludes our proof.

I would like to thank the Physics Division of the Aspen Institute for Humanistic Studies for their hospitality during the initial part of this work.

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POLARIZATION IN p-p ELASTIC SCATTERING FROM 0.75 TO 2.8 GeV*

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In a recent experiment at the Brookhaven Cosmotron we have measured the polarization parameter in p-p elastic scattering at six proton energies in the range 0.75 to 2.8 GeV. The polarization in p-p scattering has been well determined for proton energies below 750 MeV in many cyclotron experiments, but data are meager at higher energies.[1] The purpose of our measurements was to improve the knowledge of this fundamental parameter in the nucleon-nucleon interaction in an energy range inaccessible to cyclotrons.

The experiment employed a double-scattering technique with scintillation counters as detectors. The experimental arrangement is shown in Fig. 1. The proton beam was extracted from the Cosmotron at the desired energy and focused on a 3-in.-long liquid hydrogen target. Elastic events were selected by requiring a coincidence between counter telescopes S_1S_1' and S_0S_2 which detected both the fast and slow (recoil) protons from an elastic event at the proper kinematic angles. The requirements on coplanarity and relative angle thus imposed on the two protons were so stringent that contamination from inelastic events was negligible at all energies and angles studied. The two telescopes were mounted on rails so that both angles could be varied easily. After passing through S_2 the recoil protons were scattered a second time from a graphite target, and the asymmetry of the doubly-scattered protons was measured by telescopes T_1T_2 and U_1U_2. These telescopes could be interchanged by rotating the entire analyzer about the graphite target so that instrumental asymmetries cancelled out. Thick graphite targets and a poor geometry were used in the analyzer to obtain high efficiency for the second scattering. With this arrangement 0.5 to 3% of the protons entering the graphite scattered into either of the telescopes, and the over-all counting rate was about 20 events per beam pulse of $\approx 4\times10^9$ protons incident on the hydrogen target. Each data point required about 60 min of running time.

Important accidental rates were monitored constantly and were always small enough that corrections to the measured asymmetries were unnecessary. The target-empty rate was found to be negligible in all cases. Checks were also made to insure that the external proton beam was unpolarized. The most serious source of potential systematic error in experiments of this type is the possibility of a misalignment of the axis of rotation of the analyzer relative to the proton beam entering it. In this experiment spark chambers were used just before

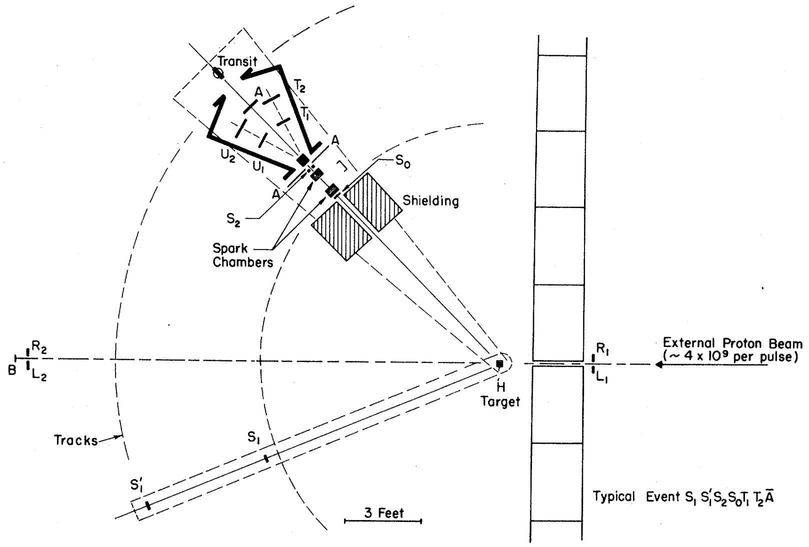

FIG. 1. Experimental arrangement.

the graphite target to sample the spatial distribution of the incoming protons, thus allowing corrections to be made for false asymmetries of this type.[2] The analyzing power for the geometry used in the second scattering was determined for proton energies below 415 MeV by means of a calibration experiment which utilized a polarized beam from the Carnegie Institute of Technology cyclotron.[3] The calibration of the analyzing power was extended to 1000 MeV by taking advantage of the antisymmetry of the polarization about 90° in the c.m. system for p-p scattering.[2] As a result, the normalization of all of our data depends on a single number, the polarization of the proton beam used in the calibration experiment. The polarization of that beam is somewhat uncertain so we have normalized our data to give good agreement with existing polarization data at 740 MeV where the polarization is quite well known.[4]

The results of this experiment are given in Fig. 2 along with data from other experiments.[1,4] Many points were measured two or

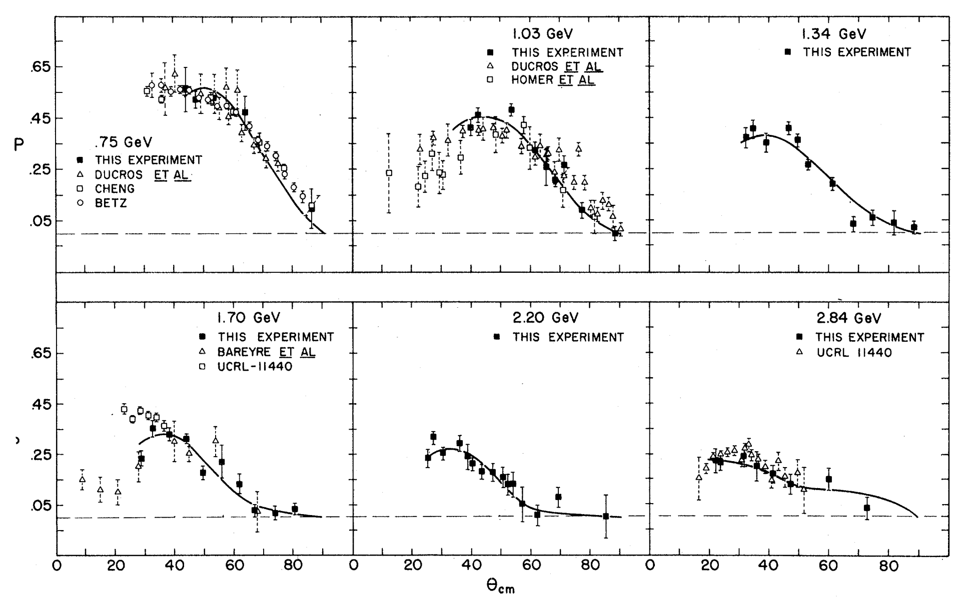

FIG. 2. The polarization as a function of center-of-mass angle for various beam energies.

more times in the course of the experiment and, since the results agreed within statistics, the data have been combined. The errors quoted include statistical errors and preliminary estimates of systematic errors. The smooth curves shown are the results of fitting all our data to an empirical formula of the form

$$P(\theta, E) = \sum_{k=0}^{k=2} \sum_{l=0}^{l=3} b_{kl} \sin\theta E^k P_{2l+1}(\cos\theta)$$

where E is the kinetic energy of the incident proton beam and the P_{2l+1} are Legendre polynomials in $\cos\theta$. The agreement of the fitted curves with all the data is good in view of the large range in energy involved and the simple fitting function. As can be seen from Fig. 2, our results generally agree well with existing data from other experiments. At 1.70 GeV, where a discrepancy in the previous data exists, our results favor those of Bareyre et al. On the whole the data show a rather smooth dependence of the polarization on angle and proton energy. Figure 3 shows the peak polarization attained at each energy plotted versus beam energy. It is interesting to note that the largest polarization occurs near 0.7 GeV where the total inelastic p-p cross section is rising rapidly as single pion production becomes important. This general behavior of the polarization as a function of angle and energy could be explained on the basis of a simple potential model with a real spin-orbit potential at low energies which becomes imaginary as inelastic processes become predominant. For proton energies 1.35 to 2.2 GeV the polarization becomes quite small in the angular range 70° to 90°. The cause of this phenomenon is as yet unknown.

We would like to take this opportunity to acknowledge the invaluable assistance of Dr. Martin Perl in many phases of the experiment, and we also wish to thank the Cosmotron staff for their cooperation and help.

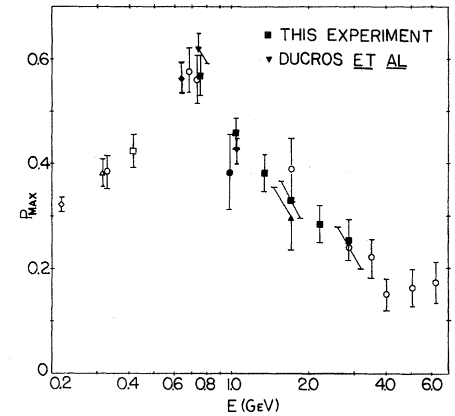

FIG. 3. The maximum polarization at each energy versus kinetic energy of the proton beam. Most of the data are taken from a compilation in Steiner et al., Ref. 1.

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