On the Double Focusing Beta-Ray Spectrometer

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IN a recent article,[1] Shull and Dennison developed a mathematical analysis of the double focusing beta-ray spectrometer. By means of this analysis, as corrected by the same authors,[2] a study has been made of the focused images for several values of β, under the same initial conditions: $a=10$ cm, slit size 20×2 mm, $(\phi_r^2+\phi_z^2)^{\frac{1}{2}}\leqslant 0.1$ radian. It was found that for $\beta=\frac{1}{4}$, the image width is a minimum, being 2.67 mm as against 3.33 mm for $\beta=\frac{1}{8}$ or $\frac{3}{8}$. The image area was also found to be smaller, so that both intensity and resolving power are increased. A point source at $\delta r=\delta z=0$ has a triangular image, with apex at $\delta r=\delta z=0$ and center of gravity at a radius less than the equilibrium radius a. A line source 20 mm long at $\delta r=0$ has, roughly, a rectangular image of width 0.67 mm, as compared to 1.33 mm for $\beta=\frac{3}{8}$ or $\frac{1}{8}$, and of half-height 10.7 mm, compared to 10.0 mm for $\beta=\frac{3}{8}$ and 11.3 mm for $\beta=\frac{1}{8}$. An incidental result with $\beta=\frac{1}{4}$ is that the correction term $[-(\beta-\alpha/2)Z^2H_0/a^2]$ in H_z becomes zero.

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[1] F. Shull and D. Dennison, Phys. Rev. **71**, 681 (1947).
[2] F. Shull and D. Dennison, Phys. Rev. **72**, 256 (1947).

On the Proton-Proton Scattering at 14.5 Mev

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AN investigation of the recent experiments[1] on the anisotropy of proton-proton scattering at 14.5 Mev was made by superimposing the nucleonic potentials, as given by the current meson theories, on the Coulombian one. A preliminary indication of the theoretical character of this anisotropy was obtained by the Born approximation. The scalar, pseudoscalar, and vector (in the single-force assumption) symmetrical meson theories give too low values for $\sigma(\theta)$ as compared to the experimental points, $\sigma(\theta)$ being the differential cross section in the center-of-mass system. If one assumes the pseudoscalar and vector meson masses equal to 177m, the Møller-Rosenfeld theory gives too large values for $\sigma(\theta)$, the experimental values being less than one-half the theoretical ones, except for $\theta=90°$ where they are in agreement. This theory gives a better curve for a meson mass of the order 250m. If one assumes the meson masses and the coupling constant as calculated by Jauch and Hu[2] for the deuteron problem, the symmetrical Schwinger theory is the one which is in better agreement with the experimental points. The values of $\sigma(\theta)$ in this theory, together with those of the Møller-Rosenfeld theory for $\mu=250$m, are listed in Table I. It is seen that in the Schwinger theory $\sigma(\theta)$ is larger for small θ than the experimental values. Since, however, Born's approximation overestimates the P-wave contribution to the scattering cross section in comparison with the S-wave scattering, one may expect $\sigma(\theta)$ to be smaller for small θ than the values indicated in Table I. If this is true, our results indicate that there probably exists a non-singular tensor force acting between protons in the triplet P state. Experiments at higher energies are needed for a definite conclusion about this point. We should also remark that the symmetrical Schwinger theory predicts[3] an anisotropy for the neutron-proton scattering at 14 Mev which is probably in good agreement with the latest experiments.[4]

Table I. Proton-proton scattering anisotropy according to M-R and Schwinger theories (at 14.5 Mev and in Born approximation).

	$\sigma(\theta)\cdot 10^{26}$ (in cm^2)		
θ	M-R ($\mu=250$ m)	Schwinger ($K=177$ m; $\mu=283$ m)	experim.
90°	1.5	2.9	3.34 ±0.2
36	2.7	4.1	3.0 ±0.3
28	3.3	4.4	3.5 ±0.4
24	3.9	4.8	3.0 ±0.2
20	5.2	5.6	4.4 ±0.3

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[1] R. R. Wilson, *et al.*, Phys. Rev. **71**, 560 (1947).
[2] J. M. Jauch and N. Hu, Phys. Rev. **65**, 289 (1944).
[3] J. M. Jauch, Phys. Rev. **67**, 125 (1945).
[4] J. S. Laughlin and P. G. Kruger, Phys. Rev. **71**, 736 (1947).

Proton-Proton Scattering at 10 Mev

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IN a recent letter to the editor of the Physical Review,[1] R. E. Peierls and M. A. Preston present an analysis of the recent experimental results of R. R. Wilson[2] on proton-proton scattering at 10 Mev which they find to be at variance with preliminary conclusions of Wilson based on independent calculations of L. B. Eisenbud and myself. Since the analysis of these results is of considerable importance and since a check of my calculations has not uncovered any error, I should like to comment briefly on this matter.

Peierls and Preston begin their analysis with a determination of the S-wave phase shift from the scattering cross section at 90° given by Wilson. However, this value is not an *experimental* value. Wilson states that the experimental points were adjusted to give this value at 90°. This value was, in fact, computed on the basis of a square well of range $e^2/mc^2=2.8\times 10^{-13}$ cm and a depth of 10.5 Mev, without interior Coulomb potential for which the phase shift has indeed the value $K_0=52.5°$, as found by Peierls and Preston from the cross section. From this phase shift in combination with that derived from the data of Wilson and Creutz[3] at 8 Mev, the above authors then calculate the range of the proton-proton force, obtaining a value of 2.48×10^{-13} cm. While this value is not ruled out by any available information, since it if based on a theoretical rather than an experimental cross section at 10 Mev, it has no more claim to validity than the value 2.8×10^{-13} cm derived by Breit[4] from low energy proton-proton scattering data.

It is in connection with P-wave phase shift K_1 that a