well, but its ends always project beyond its limits. In the intermediate case $p \sim 1$ we get a point of inflection instead of the rear well and the hump.

It is easy to visualize qualitatively the variation of the dimensions of the bunch in the accumulating system. First, as long as the bunch is large, $p \gg 1$ and the particles perform the ordinary damped oscillations in an almost-parabolic potential. The bunch becomes compressed, the potential (4) is deformed, and the oscillations become distorted. If it becomes possible to compress the bunch in some manner so that $p \ll 1$, the potential will already have two minima. Thanks to the fact that the ends of the bunch project beyond the forward potential wall, the bunch begins to overflow backwards and increases in size. Consequently, there should exist an equilibrium bunch, with angular dimensions of an order of magnitude determined by the condition $p \sim 1$ or

$$\vartheta_0 \sim (2\pi Ne/aV)^{2/3}, \qquad \gamma \gg 1; \qquad \vartheta_0 \ll 1. \qquad (6)$$

In one of the installations now being designed, $N \sim 10^{14}$, $V_0 \sim 10^5$ v, and $a \sim 10^2$ cm (reference 2). It is assumed that the equilibrium angular dimensions of the bunch are determined by the swing of the phase oscillations due to quantum fluctuations of the radiation, and are small at these parameters. Inserting the numerical values in (6) we get $\vartheta_0 \sim 2$. This means that the interaction forces cannot be neglected. However, the estimate (6) itself can no longer be applied. To determine the dimensions of the bunch under these conditions and to answer the question whether the phase stability is disturbed, it is necessary to perform the calculation with allowance for the forces of interaction between the electrons without assuming the bunch to be small, and to take into account the interaction between the bunch and the walls of the chamber and the magnet.

In conclusion, I express my sincere gratitude to Prof. M. S. Rabinovich for valuable advice.

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DETERMINATION OF THE p-p SCATTERING MATRIX AT 90°

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To determine the p-p scattering matrix at 90° it is necessary to perform five experiments. If we measure at this angle of the value of the cross section I, the coefficient of spin correlation C_{nn}, and the Wolfenstein parameters[1] D, R, and A, then the amplitudes and phases of the components of the p-p scattering matrix can be determined from the relations

$$b^2 = |B|^2/4I = {}^1/_2\,(1 - C_{nn}),$$

$$c^2 = 2|C|^2/I = {}^1/_4\,(1 + C_{nn} + 2D),$$

$$h^2 = |H|^2/2I = {}^1/_4\,(1 + C_{nn} - 2D),$$

$$\sin\delta_C = -(R + A)/2bC, \quad \cos\delta_H = (A - R)/2bh,$$

where B, C, and H are given by

$$B = |B|\,e^{i\varphi_B}, \quad C = |C|\,e^{i(\delta_C + \varphi_B)}, \quad H = |H|\,e^{i(\delta_H + \varphi_B)}.$$

The symbols used are the same as in Wolfenstein's paper.[1]

Since the experimental data are incomplete, we can only estimate the region of possible values of the amplitudes. If we assume $D(90°) = -0.75 \pm 0.15$ for an energy of 140 Mev, which follows from an extrapolation of the data of Taylor,[2] then $0 \le b^2 \le 40\%$, $0 \le c^2 \le 20\%$, and $75 \le h^2 \le 95\%$. For 315 Mev, an estimate was made by Wolfenstein.[3] Combining the experimental data at energies of 382 Mev[4] and 415 Mev[5] and referring them to 400 Mev, we obtain $b^2 = (30 \pm 4)\,\%$, $c^2 = (56 \pm 5)\,\%$, and $h^2 = (14 \pm 5)\,\%$. Using the value of the correlation tensor $C_{kp} = 0.63 \pm 0.10$, measured at 90° and 382 Mev,[6] we can determine the phase difference $\delta_C - \delta_H$, which equals 90°. For 635 Mev, as follows from reference 7, $0 \le b^2 \le 24\%$, $76 \le c^2 \le 100\%$, and $0 \le h^2 \le 12\%$. From this we can determine the possible values of the correlation tensor C_{nn} and of the parameters R and A at 635 Mev, namely $52 \le C_{nn} \le 100\%$, $|R| \le 27\%$, and $|A| \le 21\%$.

It follows from this estimate that in the energy range under consideration the principal contribution to the cross section is made by the triplet interaction. Furthermore, the tensor-like triplet term h^2 predominates in the lower interval, while the spin-orbit triplet term c^2 predominates in the upper interval.

To determine the phases and to make a numerical estimate of the amplitudes, we obtain the lacking data from the calculations performed for 140 Mev (see reference 8) and for 315 Mev (see reference 9, solution No. 4).

We then obtain the following values for the amplitudes and phases:

E, Mev	b^2,%	c^2,%	h^2,%	δ_C	δ_H
140	5	13	82	0°	60°
315	25	62	13	—90°	143°
400	30	56	14	$\delta_C - \delta_H = 90°$	
635	24	76	12		

If we assume that at energies on the order of several Bev the nucleon is a black sphere, which apparently does not contradict the available experimental data, then only the amplitude B differs from zero, and $b^2 = 100\%$. Consequently, as the energy increases, the contribution of the triplet interaction, due to the terms h^2 and c^2, should decrease.

Similar results are obtained for p-p scattering at 90° from the following type of nucleon interaction. Let the phases of all waves (the number of which is arbitrary) be imaginary and large. Then at 90° only the amplitude B differs from 0, as in the case of a black sphere. But unlike the latter, such a model leads to an angular dependence of the Wolfenstein parameters and of the correlation tensor:

$$D(\theta) = 2\cos\theta \frac{1+\cos^2\theta}{1+3\cos^2\theta}, \qquad R(\theta) = 4\cos\theta \frac{\cos^3(\theta/2)}{1+3\cos^2\theta},$$

$$A(\theta) = -\sin 2\theta \frac{\cos(\theta/2)}{1+3\cos^2\theta}, \qquad C_{nn}(\theta) = \frac{-1+\cos^2\theta}{1+3\cos^2\theta}.$$

In this model there is no polarization at all.

Note added in proof (May 28, 1959). A recent communication on triple scattering at 143 Mev (C. F. Hwang et al., Phys. Rev. Lett. **2**, 210, 1959) reports a different result than in reference 2: D (90°) = 0.3 ± 0.15 at 90° in the c.m.s., hence $30 \le c^2 \le 70\%$ and $0 \le h^2 \le 35\%$.

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PARAMAGNETIC RESONANCE IN POTASSIUM OZONIDE

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KAZARNOVSKIĬ, Nikol'skiĭ, and Abletsov[1] have proposed that the magnetism of potassium ozonide, KO_3, is due to the molecular ozone ion O_3^- and that the latter has the character of a free radical with one unsaturated valence. It is of interest to investigate potassium ozonide by the method of electronic paramagnetic resonance (EPR), in order to investigate in greater detail the nature of its paramagnetism.

We have investigated paramagnetic resonance in polycrystalline specimens, containing approximately 90% KO_3, at frequencies of 2580, 9375, 12,000 and 37,000 Mcs at room temperature and at temperature of liquid nitrogen. At 2580, 9375, and 12,000 Mcs we observed one symmetric absorption line, the width of which was 31 ± 3, 39 ± 2, and 45 ± 3 gausses respectively. At 37,000 Mcs the observed line is noticeably asymmetric and has a width of approximately 77 gausses at the level of half the intensity of the principal peak. For illustration, the diagram shows an oscillogram of the absorption line, observed at 37,000 Mcs at room temperature. The dependence of the width of the EPR line on the frequency, and particularly the asymmetry of the line at 37,000 Mcs, are direct evidence of anisotropy of the g-factor. It is seen from the diagram that this anisotropy is due to the actual symmetry of the electric field of the crystal. Since the investigated specimens were polycrystalline, the relative contribution of the crystals with axis perpen-