junction, due to the alternating $\Delta(d, t)$, can be easily obtained from [1]

$$\delta F(t, t_1) = \delta F^*(t, t_1) = \sin\Delta_0 (t + t_1) \sin\Delta_0 (t - t_1) \int d\eta_p \frac{g(d)\Delta_0}{4\epsilon_p} \times$$
$$\times \exp[-i\epsilon_p (t - t_1)], \quad t > t_1$$
$$\delta G(t, t_1) = \cos\Delta_0 (t + t_1) \sin\Delta_0 (t_1 - t) \int d\eta_p \frac{g(d)\Delta_0}{4\epsilon_p} \times \tag{2}$$
$$\times \exp[-i\epsilon_p (t - t_1) \operatorname{sign}(t - t_1)],$$

where $\epsilon_p^2 = \eta_p^2 + \Delta_0^2$, $\eta_p = p^2/2m - \mu$, and μ is the chemical potential. Using (2), we obtain the additional current $\delta J = \delta J_1 + \delta J_2$ through the junction:

$$\delta J_1 = \frac{g(d)}{8eR} \{[I_2(v) - I_2(-v) - I_2(v + 2\omega) + I_2(-v - 2\omega)] \times$$
$$\times \cos(2\omega t + 2vt - \phi) + [I_1(v + 2\omega) - I_1(v)] \sin(2\omega t + 2vt - \phi) + \omega \to -\omega\},$$
$$\delta J_2 = \frac{g(d)}{16eR\Delta_0'} \left\{ \left[vI_2(v) - (v + 2\omega) I_2(v + 2\omega) \right] \frac{\sin 2\omega t}{\omega} + \omega \to -\omega \right\},$$

where R is the resistance of the junction in the normal state, v is the potential difference across the junction, ϕ is the phase difference between the superconductors (we have written out explicitly the depencence of the phase difference on v), an expression for I_1 is given in [3] (formula (23)), and

$$I_2(v) = \frac{2\Delta_0\Delta_0'}{\sqrt{v^2 - (\Delta_0 - \Delta_0')^2}} K\left(\sqrt{\frac{v^2 - (\Delta_0 + \Delta_0')^2}{v^2 - (\Delta_0 - \Delta_0')^2}}\right) \theta(v - |\Delta_0 + \Delta_0'|).$$

It is seen from (3) that an alternating tunnel current of frequency $2\Delta_0$ and $2|\Delta_0 \pm v|$ sets in. We note that the current δJ_1 is connected with simultaneous pair tunneling through the barrier. This is clearly seen from the time dependence of δJ_1 as a function of v, whereas δJ_2 is in essence a single-particle current. The current δJ_1 experiences a jump not only at $v = \Delta_0 + \Delta_0'$, but also at $v = \Delta_0' - \Delta_0$, whereas the tunnel current in the absence of a field experiences no jump at this value of the potential difference ($\Delta_0' - \Delta_0$). We note that these jumps are due to the same cause as the jumps of the Josephson current at $v = \Delta_0 + \Delta_0'$.

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CORRELATIONS IN THE MULTIPERIPHERAL MODEL AND RESONANT PARTICLE PRODUCTION

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The dynamics of multiple particle production has been attracting particular interest of late. The presently employed models can be divided into two groups:

1) Models of the multiperipheral type (MPM) [1], where the particles decrease the relative momentum by emitting particles in succession in cascade fashion; the correlations here are large only for particle pairs having relatively close momenta, and decrease rapidly when the particles are separated by momenta (it is more convenient to use the "rapidity" $y = (1/2)\ln[(E + p_{||})/(E - p_{||})]$).

2) Models in which the particles are produced relatively isotropically around one or several centers, for example, the pionization model or the diffraction production of particles. In such models the connection between the correlation and the separation of the particles by kinematic variables is not so strong.

The question of the validity of any particular multiple particle production model is at present quite pressing, so that a comparison of the theoretical predictions with experiment is at present particularly important.

Such a comparison is presented in a recent paper by Friedman et al. for the MPM and the pionization model. The conclusions of [2] favor the pionization model, while the MPM disagrees with experiment.

We report here an investigation of the correlations in the multiperipheral model with allowance for resonant production of particles. A comparison of our results with experiment favors the multiperipheral model.

A measure of the correlation of a pair of emitted particles is the distribution $N(\phi)$ of the angle ϕ between the transverse components (relative to the momentum of the primary particles) of their momenta

$$\phi = \arc\cos \frac{q_{\perp 1}\, q_{\perp 2}}{|q_{\perp 1}|\,|q_{\perp 2}|} \quad . \tag{1}$$

If we consider $N(\phi)$ averaged over different pairs of emitted particles, then it follows from the conservation of the transverse component of the total angular momentum that $N(\phi)$ should increase when ϕ increases from 0 to 180°, since the average transverse momentum of all the particles but one is directed opposite to the transverse momentum of this particle.

What factors influence the form of $N(\phi)$ for the kinematically singled-out particle pair?

1. "Locality" of the Conservation of the Transverse Momentum.

In models in which there are no appreciable correlations between particles having strongly differing longitudinal momenta (for example in MPM, where the correlation decreases rapidly with increasing particle-separating multiperipheral chain), the total transverse momentum is conserved not only for all the particles as a unit, but on the average also for particle groups with relatively close y. In such models, therefore, $N(\phi)$ should depend strongly on ϕ for particles with "close" y, and this dependence should become strongly smoothed out when the particles are grouped in accordance with y.

At the same time, in models of the pionization type, where most of the particles are produced relatively isotropically, the form of $N(\phi)$ for any pair of particles should depend little on the choice of such a pair, since the total transverse momentum is conserved in such a model only for the particles as a whole (or for a large part of all the particles).

2. Allowance for Resonant Production of Particles

There are two different aspects here:

2.1. Decrease of the effective multiplicity. This leads to an increase of the correlation "in the mean." In the MPM this effect is important, mainly for the particles that are "remote" with respect to y; it takes place also in models such as pionization or diffraction production.

2.2. For a particle pair produced by decay of one and the same resonance, the form of $N(\phi)$ is strongly influenced by the distribution with respect to the transverse momentum of this resonance. If its average transverse momentum is small in comparison with the momenta of the produced particles in the rest system of the resonance, then this effect leads to an additional increase of $N(\phi)$ with increasing ϕ.

If, however, the average transverse momentum of the resonance is larger than or of the order of the momenta of the produced particles in their c.m.s., both emitted particles can travel in the same direction as the resonance that produces them, and the angle between their transverse momenta is acute. This is precisely the situation in the production of π and p from the 1236 isobar. The average transverse momentum of this isobar is $\sim$0.4 - 0.5 GeV/c, whereas the momenta of π and p in their c.m.s. are in this case equal to 0.23 GeV/c. This effect takes place to a lesser degree also for the production of π and p from the 1920 isobar, where their c.m.s. momenta are equal to 0.72 GeV/c.

Inasmuch as the contribution of the resonant production of π and p is quite appreciable for fast protons and relatively fast pions [3], correct allowance for this contribution may turn out to be decisive in a comparison of theory with experiment. In particular, no correct allowance for the resonant production of the particles was made in [2].

A particularly large difference between the predictions of the indicated models was observed in [2] for the correlations between the emitted protons and the proton and pion having the largest momentum in the process $p + p \to p + p + 4\pi$ (see Fig. 1, where the solid lines correspond to the calculations of [2] in the pionization model and agree well with experiment [4], while the dashed lines correspond to calculations of the same authors in the MPM. Figure 1a shows the correlations between the protons and Fig. 1b the correlation between the proton and the pion).

In the former case (correlaton between protons) allowance for the resonances in the final state reduces to a considerable decrease of the effective multiplicity and to a strengthening of the $N(\phi)$ dependence. The predictions of the pionization model, however, no longer agree with experiment, and the MPM predictions become close to the experimental data.

The second case (correlation between the proton and the pion with the largest longitudinal momentum) is even more interesting. It is precisely in this case, in the opinion of the authors of [2], that a serious disparity arises between the MPM and experiment.

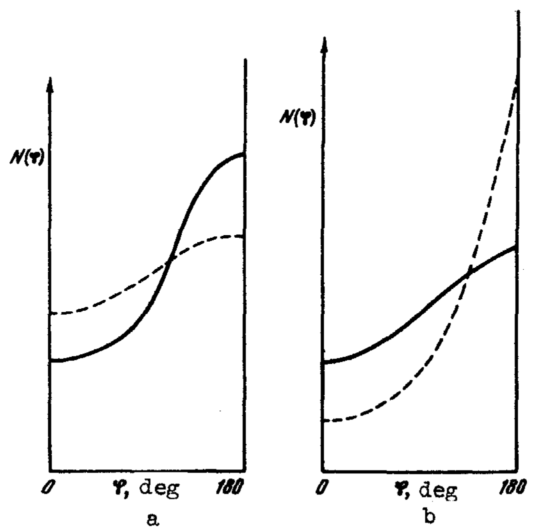

Fig. 1

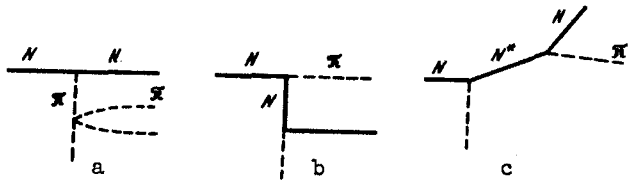

Fig. 2

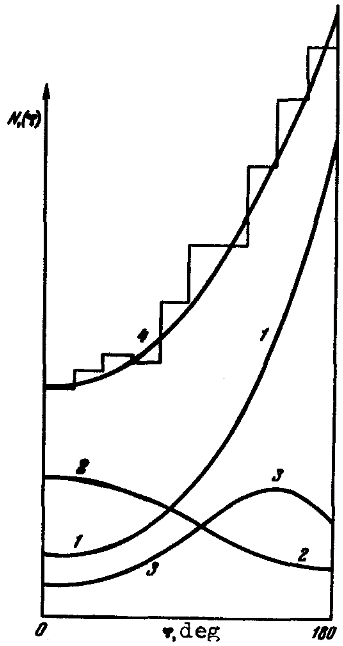

Fig. 3

From the point of view of the MPM, three types of diagrams are important in our case (see Fig. 2). Diagrams 2a and 2b describe "true" peripheral production of a proton and pion, the contribution of diagram 2a being decisive in this case. Figure 3 (curve 1) shows the correlation due to the peripheral production of the proton and pion.

Diagram 2c describes resonant production of a proton and pion. Figure 3 (curves 2 and 3) shows the correlations due to the 1236 and 1920 isobars, respectively. These correlations were calculated using the results and technique of [3]. We see that in the case of resonant production we can obtain an "inverse" asymmetry in the N(ϕ) distribution. Curve 4 of Fig. 3 describes the summary correlation for the diagrams of Fig. 2 and agrees well with experiment.

We note that a similar analysis in the pionization model leads to disagreement between theory and experiment.

Further experimental verification of the predictions of the multiperipheral model are of considerable interest.

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SPIN-ORBIT INTERACTION AS A CAUSE OF THE ANISOTROPY OF THE SPONTANEOUS MAGNETIZATION OF TRANSITION METALS AT LOW TEMPERATURES

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As shown by Borovik-Romanov [1], Dzyaloshinskii [2], and later by Treves [3] and Moriya [4], spin-orbit interaction, together with indirect exchange, is the cause of the weak ferromagnetism of magnetodielectrics having a definite crystal-lattice symmetry. The spin-orbit interaction leads in this case to small deviations of the magnetic moments of the sublattices from the direction