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ANGULAR DEPENDENCE OF THE ASYMMETRY OF THE CROSS SECTION FOR THE REACTION $\gamma p \to \Delta^{++}\pi^-$ AT A PHOTON ENERGY 650 MeV

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The behavior of the asymmetry of the cross section $\Sigma = (\sigma_\perp - \sigma_\parallel)/(\sigma_\perp + \sigma_\parallel)$ of the photoproduction of the Δ^{++} isobar

$$\gamma + p \to \Delta^{++} + \pi^- \qquad (1)$$

is a very sensitive criterion for different theoretical descriptions, and permits a choice between model representation of the mechanism of the reaction in the case when all the models give a good description of the total and differential cross sections. To this end it is necessaty to study the behavior of the asymmetry in a wide range of angles and energies of the photons. No such study of the angular and energy behavior of the asymmetry near the threshold have been made, and there are no experimental data.

We present here the results of a measurement of the asymmetry of the cross section of the reaction (1) on a linearly-polarized beam of photons at an energy 650 MeV in the π^--meson emission angle interval 45 - 120° in the c.m.s. The polarized photons were obtained from an individual reciprocal-lattice point of a diamond single crystal [1, 2].

The measurements were performed simultaneously with two magnetic spectrometers [3] with solid angles 1.3×10^{-3} and 8.2×10^{-3} sr. The π^- mesons were detected with scintillation-counter telescopes, and the momentum range was 9.4%.

Figure 1 shows the dependence of the pion yield on the orientation of the diamond crystal. One spectrometer was used to measure the asymmetry of the π^- mesons from the reaction of binary production at an angle $\theta = 90°$ and a photon energy $E_\gamma = 650$ MeV, while the other spectrometer measured simultaneously the asymmetry of the cross section of single photoproduction of π^+ mesons for the same energy and angle. The asymmetry for single production under these conditions, according to our measurements, is $\Sigma = 0.6 \pm 0.05$. In the binary photoproduction reaction, a near-zero symmetry is observed in this case.

The asymmetry is defined by the relation

$$\Sigma = \frac{1}{P}\,\frac{R-1}{R+1},$$

where R = C /C is a quantity obtained directly from the measurements, equal to the ratio of the π^--meson yields from the reaction $\gamma + p \to p + \pi^+ + \pi^-$ when the polarization vector of the photon beam is perpendicular and parallel to the reaction plane, and P is the effective polarization of the photon beam. It can be obtained by using the fact that the value of the polarization of the photon

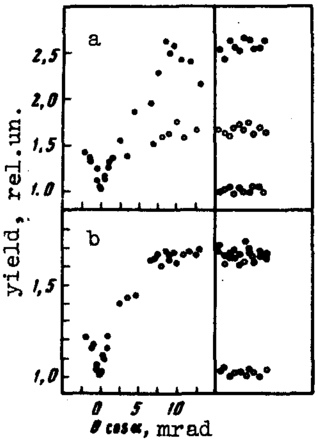

Fig. 1

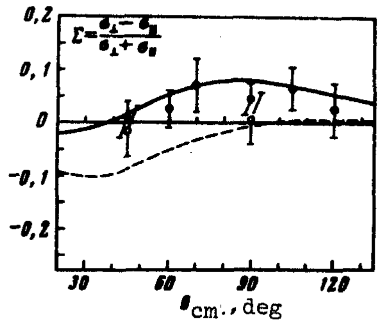

Fig. 2

Fig. 1. Pion yield vs. angle of crystal rotation. E_0 = 1.4 GeV, E_γ = 650 MeV, θ = 90° in the c.m.s. On the right are shown the series of measurements of $C_\perp$, $C_\parallel$, and C_0: a) the reaction $\gamma + p \to n + \pi^+$, b) the reaction $\gamma + p \to p + \pi^+ + \pi^-$.

Fig. 2. Angular dependence of the asymmetry of the cross section of the reaction $\gamma + p \to \Delta^{++} + \pi^-$ for E_γ = 650 meV: ● - our data, o - data of [5], continuous curve - calculation [4] with allowance for the resonances N(1400) and N(1525), dashed curve - calculation [4] in the Born approximation.

beam. It can be obtained by using the fact that the value of the polarization of the photon beam in the interference peak from an isolated reciprocal-lattice site, is connected with the coherent effect by the following relation

$$P = \frac{2(1-x)}{1+(1-x)^2}\,\frac{v-1}{v},$$

where $x = E_\gamma/E_0$ is the relative energy of the photon at the interfernece maximum, E_0 and E_γ are the energies of the primary electron and photon, and v is the value of the coherent effect and equals the ratio of the intensity at the interference maximum to the amorphous level. We used for v the quantity $(C_\perp + C_\parallel)/2C_0$, where C_0 is the yield of the π^- mesons corresponding to the amorphous level. This quantity determines the effective polarization P, under the assumption that the background of the accompanying reaction is incoherent.

The results of the measurements are given in the table and are shown in Fig. 2 together with the theoretical calculations of [4] in the Born approximation without and with allowance for the resonances N(1400) and N(1525). The errors in the asymmetry are due to the error in R and the ensuing error in the determination of the polarization P.

$\theta_\pi^{c.m.}$	45°	60°	75°	90°	105°	120°
Σ	0,01±0,04	0,025 ± 0,035	0,070 ±0,055	0,045 ±0,030	0,06 ±0,03	0,027±0,050

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MAXIMUM RESISTIVITY OF FERROMAGNETIC CONDUCTORS, DUE TO CARRIER SCATTERING BY GIANT MOMENTS OF MAGNETIC CLUSTERS

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As is well known from the experiment, in most cases ferromagnetic conductors have a maximum of resistivity ρ near the Curie point T_c. At first glance, this maximum is naturally attributed to critical scattering of the carriers by the fluctuations of the magnetic-moment density. There are, however, experimental data that show convincingly that the critical scattering in perfect ferromagnetic crystals does not lead to a maximum of ρ, but only to a singularity of $d\rho/dT$, of the same type as in the specific heat. On the other hand, the maximum of ρ near T_c is the result of distortion of the crystal lattice [1], i.e., of the smearing of the phase transition. Nonetheless, there is no simple connection between the degree of smearing of the transition and the maximum of the resistivity. For example, according to the data of [2], the height of the peak of the relative resistivity drops sharply with increasing defect content, starting with a certain value of the latter; in addition, the maximum may be located far enough from T_c [3]. Thus, the trivial explanation of the nature of the maximum of ρ as a function of T in the region $T \sim T_c$ is patently inadequate.

The purpose of the present article is to show that in ferromagnetic conductors with defects the temperature minimum of mobility can be attributed to the formation in them of microscopic regions with giant magnetic moments that scatter the carriers anomalously strongly. With further rise of temperature, such giant moments vanish and the carrier mobility increases. The existence of such clusters is due to the uneven distribution of the electron density in the crystal with defects.

Let us consider, for example, a ferromagnetic semiconductor. The electrons of the partly filled d (or f) shells are localized in this conductor each on its own atom, and take no part in the charge transport. Only the electrons of the outer shells (s electrons in the s-d model terminology [4]) can transport charge. If the crystal contains donor impurities, the s electrons can be not only in states of the conduction bands, but also in localized states whose orbit radius R can greatly exceed the lattice constant a. The s electrons on the donor levels effect indirect exchange between the localized d spins in the vicinity of the defect, increasing the ferromagnetic coupling between them [5, 6]. Therefore the local ferromagnetic ordering in the vicinity of the defect is disturbed at higher temperatures than on the average in the crystal, i.e., a cluster with an anomalously large moment K is produced in the vicinity of the defect.

The relaxation time for the scattering of the conduction s electrons by the fluctuations of the d spins in a nondegenerate impurity-containing semiconductor is calculated by constructing the single-electron Green's function. The Hamiltonian used in the calculation differs from the usual s-d model Hamiltonian [4] in that the part describing the interaction between the d spins