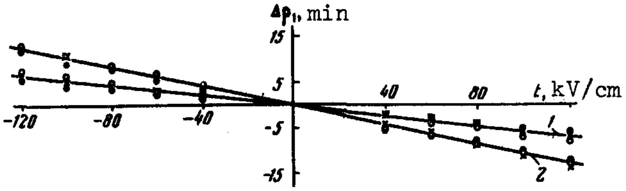

Fig. 3. Dependence of the increment of the angle of rotation of the polarization ellipse $\Delta\rho_1$ on the field intensity E_x: 1 - field on one sample; 2 - field on two samples.

It is important that, in accordance with the symmetry conditions, only a linear spontaneous electrogyration effect can occur in ferroelectric crystals with centrally-symmetrical paraelectric phases, whereas the spontaneous electro-optical effect has a quadratic character in these crystals. In ferroelectrics with an initial acentric ferroelectric phase, the spontaneous electrogyrational effect (like the spontaneous electro-optical effect) can be either linear or quadratic. The conditions for the realization of either effect in the latter case are determined by the form of the axial tensors of the initial symmetry class and by the direction of the spontaneous polarization. When antipolarization occurs, the action of the internal field is equivalent [7] to the influence exerted on the crystal properties by a polar tensor of the third rank, i.e., only quadratic spontaneous electrogyration can be realized. Consequently, the crystal in the paraelectric phase should be acentric - in the case of antiferroelectric phase transitions there can occur only quadratic electrogyration, provided the crystal is acentric in the paraelectric phase. There are no such limitations on the occurrence of the quadratic electro-optical effect in the case of spontaneous antipolarization, i.e., the occurrence of spontaneous antipolarization is accompanied by a spontaneous quadratic electro-optical effect regardless of whether the initial paraelectric phase is centrally-symmetrical or acentric.

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STUDY OF QUASI-TWO-PARTICLE REACTIONS IN PROTON-PROTON INTERACTIONS AT 10 GeV/c

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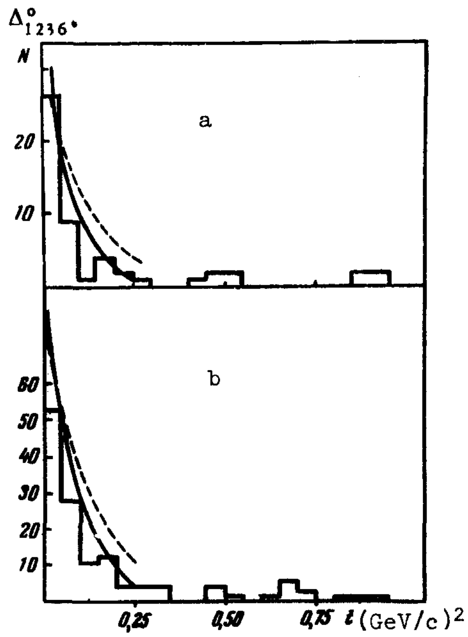
In the study of four-prong proton-proton interactions in the Saclay 81-cm hydrogen bubble chamber irradiated at CERN by 10.01 ± 0.1 GeV/c protons, there were separated quasi-two-particle reactions of the type $pp \to pN^*$ (1), $pp \to p\Delta$ (2), $pp \to \Delta N^*$ (3), and $pp \to \Delta\Delta$ (4).

The procedure for separating quasi-two-particle reactions and the procedure for determining the cross section from the charge states are described in [1]. In this paper we consider certain properties of these reactions. It is of interest to compare the distributions with respect to the squares of the



Distribution with respect to the 4-momentum transferred to the set of particles $p\pi^+$ with effective mass 1.1 - 1.35 GeV/c^2.

4-momenta $t = \Delta^2 - \Delta^2_{min}$ transferred from the primary nucleon to the corresponding resonances. Figure b shows the distribution for Δ^{++}_{1236} from the reaction $pp \rightarrow \Delta^{++}_{1236}p\pi^-$, while Fig. a shows the analogous distribution when the resonance Δ^0_{1236} is observed in the $p\pi^-$ particle system.

We see that a characteristic feature of these distributions is a sharp peak near $t = 0$. To approximate this distribution we have used an exponential function of the type

$$d\sigma/dt = C\exp(-At). \tag{1}$$

The values of the parameters A were obtained by least squares in the interval $t < 0.25$ (GeV/c)^2. For comparison, the same figures show the curves corresponding to proton elastic scattering (dash). It is seen from the comparison that in the case of a two-particle reaction with isobars $pp \rightarrow \Delta^{++}_{1236}\Delta^0_{1236}$ (Fig. a), a sharper decrease of $d\sigma/dt$ is observed with increasing t ($A = 13.9 \pm 2.7$) (as against $A = 8 \pm 0.4$ for elastic scattering).

The cross sections of the reactions (1) - (4) and the values of the parameter A for all the analyzed two-particle reactions are listed in Table I.

To increase the statistics, we combined all the two-particle reactions with identical isobar masses. From the data given in Table I we can conclude the following: a) If the interaction results in a proton and baryon resonance with spin T = 1/2 ($pp \rightarrow pN_{1470,\ 1518}$), then the smallest value $A = 4.34 \pm 0.70$ is observed. This case can correspond to pomeron exchange. b) The largest values of A (13.88 ± 2.67 and 11.64 ± 1.91) are observed in quasi-two-particle reactions when both isobars are in states with T = 3/2. This case can correspond to exchange of poin, ρ-, or A_2-meson trajectories when the two-particle processes are described by Regge-pole diagrams [2], or to exchange of the corresponding particles if the single-particle exchange model is used [3, 4].

Table I. Cross sections of quasi-two-particle reactions.

Reaction	σ, mb	A
$pp \rightarrow pN^+_{1518}$	0,38 ± 0.06	4,34 ± 0,70
$p\Delta^+_{1640}$	0,34 ± 0,06	9,44 ± 1,62
$p\Delta^+_{1950}$	0,23 ± 0,05	5,49 ± 1,14
$\Delta_{1236}N_{1518}$	0,76 ± 0,09	9,96 ± 1,14
$\Delta_{1236}N_{1688}$	0,31 ± 0,06	6,22 ± 1,12
$\Delta^{++}_{1236}\Delta^{\circ}_{1236}$	0,27 ± 0,05	13,88 ± 2,67
$\Delta_{1236}\Delta_{1950}$	0,37 ± 0,06	11,64 ± 1,91

In the reactions pp → $\Delta(T = 3/2)N^*(T = 1/2)$ the value of A is intermediate: c) For each of the considered types of two-particle reactions, a common regularity is observed, namely, the distributions with respect to the 4-momentum transfers shift with increasing baryon-resonance mass towards larger values (the corresponding values of A increase).

The observed experimental regularities for two-particle reactions are of great interest from the point of view of a theoretical description of the processes of pp interaction.

Table II. Ratio of the cross sections of different charge states of the two-particle reaction pp → $\Delta_{1236}\Delta_{1950}$.

Ratio of reactions	Experimental data	Decay scheme			
		$\Delta \to (\pi\pi)_{T=2} + N$	$\Delta \to (\pi\pi)_{T=1} + N$	$\Delta \to \pi + N^*_{T=1/2}$	$\Delta \to \pi + \Delta_{T=3/2}$
$\frac{\Delta^{++}_{1236}(p\pi^+)\,\Delta^{0}_{1950}(n\pi^+\pi^-)}{\Delta^{+}_{1236}(p\pi^0)\,\Delta^{+}_{1950}(p\pi^+\pi^-)}$	0,92 ± 0,4	1,130	1,13	1,130	1,130
$\frac{\Delta^{++}_{1236}(p\pi^+)\,\Delta^{0}_{1950}(n\pi^+\pi^-)}{\Delta^{0}_{1236}(p\pi^-)\,\Delta^{++}_{1950}(p\pi^+\pi^0)}$	1,84 ± 1,0	2,000	2,00	2,000	2,000
$\frac{\Delta^{+}_{1236}(p\pi^0)\,\Delta^{+}_{1950}(p\pi^+\pi^-)}{\Delta^{0}_{1236}(p\pi^-)\,\Delta^{++}_{1950}(p\pi^+\pi^0)}$	2,00 ± 1,0	1,780	1,78	1,780	1,780
$\frac{\Delta^{++}_{1236}(p\pi^+)\,\Delta^{0}_{1950}(n\pi^+\pi^-)}{\Delta^{++}_{1236}(p\pi^+)\,\Delta^{0}_{1950}(p\pi^-\pi^0)}$	1,37 ± 0,7	0,222	2,00	0,400	1,528
$\frac{\Delta^{+}_{1236}(p\pi^0)\,\Delta^{+}_{1950}(p\pi^+\pi^-)}{\Delta^{++}_{1236}(p\pi^+)\,\Delta^{0}_{1950}(p\pi^-\pi^0)}$	1,50 ± 0,7	0,198	1,78	0,356	1,360
$\frac{\Delta^{++}_{1236}(p\pi^+)\,\Delta^{0}_{1950}(p\pi^-\pi^0)}{\Delta^{0}_{1236}(p\pi^-)\,\Delta^{++}_{1950}(p\pi^+\pi^0)}$	1,30 ± 0,7	1,000	1,00	5,000	1,310

Table II gives the experimental values of the ratio of the cross sections of the different isotopic projections of the two-particle reaction pp → $\Delta_{1236}\Delta_{1950}$. They are compared with calculations performed for the possible isobar decay $\Delta_{1950} \to N\pi\pi$.

It was assumed here that the isospin of the exchange particles is equal to unity. In the first three rows we chose projections such that the ratio of the cross sections depends only on the value of the exchange isospin. It is seen from the comparison that the experimental data are in good agreement with the assumed hypothesis concerning the isospin of the exchange particle. From a comparison of the remaining rows we can see that the experiment does not contradict the two hypothetical decays $\Delta_{1950} \to (\pi\pi)_{T=1} + N_{T=1/2}$ and $\Delta_{1950} \to (\pi)_{T=1} + \Delta(\pi N)_{T=3/2}$, the latter decay mode being in somewhat better agreement with the average experimental values.

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INDUCED RADIATION OF $Y_3Al_3O_{12}$-$(Nd)^{3+}$ EXCITED BY AN ELECTRON BEAM

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The use of pulses of electrons with energy of several dozen keV to excite semiconductors [1] has made it possible to obtain stimulated emission with a quantum energy close to the width of the forbidden band, and with an approximate efficiency 30%. Great interest attaches, from our point of view, to lasing by electron excitation of doped ionic crystals. These materials have a wide selection of radiation frequencies in the visible and the ultraviolet regions of the spectrum, and in addition have much narrower emission lines than semiconductors. Although cathode luminescence of activated ionic substances (such as ruby [2, 3]) has been under study for several decades, we know of no reports that stimulated emission of these materials has been attained.

There is a fundamental difference between the optical excitation used to generate radiation from doped ions in ionic crystals and electron excitation. In the case of optical pumping, the electron shells of the activator ions are directly excited, whereas electronic pumping first produce electron-hole pairs in the allowed bands of the ionic crystal, and only then is their energy transferred to the activator ions. To assess the pumping efficiency of new crystals by electron beams, the energy yield (the ratio of the radiation power produced in the sample to the electron-beam power) and the quantum yield (the ratio of the number of photons emitted by the activator ions to the number of electron-hole pairs produced by the beam) of the emission of single crystals $Y_3Al_5O_{12}$-$(Nd)^{3+}$(0.3 wt.%) were determined with the aid of F4 and F5 photocells by the

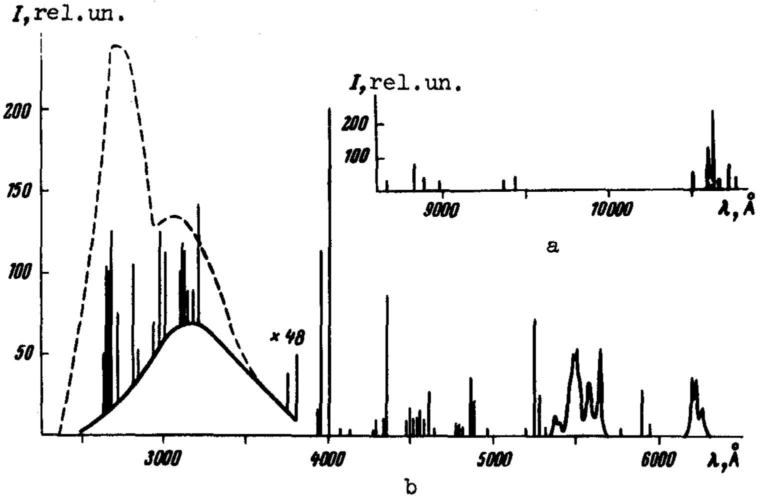

Fig. 1. Emission spectrum at 293 and 80° K (dashed line). The straight lines denote the emission lines with Δ < 25 Å.