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INVESTIGATION OF THE $K_1^0K_1^0$ SYSTEM IN π^-p INTERACTIONS AT 4.0 AND 5.0 GeV/c

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Submitted 23 August 1971
ZhETF Pis. Red. 14, No. 7, 412 - 415 (5 October 1971)

The first investigations of the $K_1^0K_1^0$ system in λ^-p interactions [1 - 3] pointed to the existence of a near-threshold anomaly in the $K_1^0K_1^0$ effective-mass spectrum, with mass $M \simeq 1070$ MeV/c^2. In K^-p interactions at 3.6 - 5 GeV/c [4] and in pp interactions at 1.18 GeV/c [5] and 0.7 and 1.2 GeV [6], a noticeable excess of events over the background was observed in the $K_1^0K_1^0$ effective-mass spectrum at $M = 1030$ MeV/c^2 and $M = 1045$ MeV/c^2, respectively. In [3 - 5, 8, 12], the near-threshold anomaly was regarded as a manifestation of isoscalar S-wave, KK interaction, which can be described with the aid of a complex scattering length. On the other hand, the data of [7, 9, 10, 11] are in better agreement with production of the resonance $S^*(1068) \to K_1^0 + K_1^0$, with $I^GJ^P = 0^+0^+$.

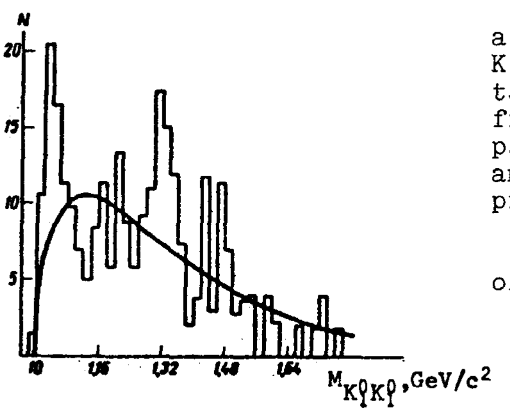

Fig. 1. Distribution of effective masses of the $K_1^0K_1^0$ system produced in π^-p interactions at 4.0 and 5.0 GeV/c.

In the present paper we present results of a study of the effective-mass spectrum of the $K_1^0K_1^0$ system. The experimental data were obtained by processing 230,000 photographs each from a 55-cm [13, 15] and a 1-m [14, 16] propane bubble chamber bombarded with beams of 4 and 5.0 GeV/c pions, respectively from the JINR proton synchrotron.

Figure 1 shows the effective-mass spectrum of the $K_1^0K_1^0$ combinations for events of the type

$$\pi^-p \to K_1^0K_1^0 n\,(m\pi^0)$$
$$\to K_1^0K_1^0\pi^-p\,(m\pi^0)$$
$$\to K_1^0K_1^0\pi^+\pi^- n\,(m\pi^0),$$

where m = 0, 1, 2, ... is the number of π^0 mesons. The phase-volume curve was drawn with allowance for the relations between the cross sections of the reactions indicated above, and

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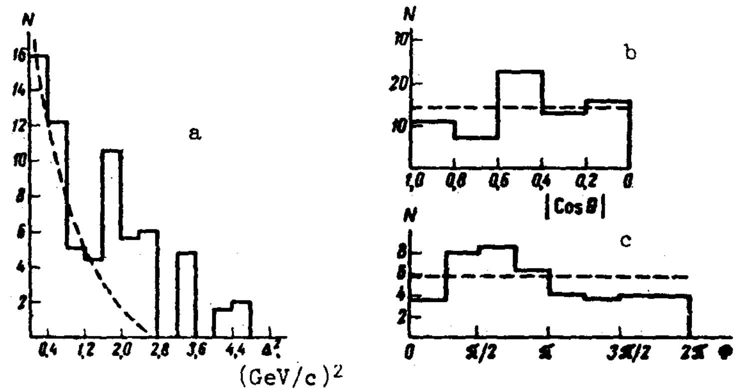

Fig. 2. a) Distribution with respect to the square of the 4-momentum transfer Δ^2 from the π^- meson to the $K_1^0K_1^0$ system for events lying in the effective-mass interval $M_{(K_1^0K_1^0)} < 1.12$ GeV/c^2. b) Angular distribution of K_1^0 meson in the c.m.s. of the $K_1^0K_1^0$ system for the same events. c) Distribution with respect to the azimuthal angle ϕ for events lying in the effective-mass interval $M_{(K_1^0K_1^0)} < 1.12$ GeV/c^2.

was normalized to the region of the spectrum with $M(K_1^0K_1^0) \geq 1.48$ GeV/c^2. As seen from the figure, a noticeable excess of the number of events over the background is observed in the mass region (0.96 - 1.12) GeV/c^2 and (1.28 - 1.36) GeV/c^2. In the effective-mass region $M_{(K_1^0K_1^0)} < 1.12$ GeV/c^2, the production of the $K_1^0K_1^0$ system is characterized mainly by small momentum transfers (Fig. 2a). For values $\Delta^2 < 1$ GeV/c^2, the experimental data are well approximated by a relation of the type $y = A\exp(-a\Delta^2)$ with coefficients $A = 21.0 \pm 0.9$ and $a = 1.2 \pm 0.6$. The distributions with respect to the Jackson angle θ and the azimuthal angle ϕ (Figs. 2b and 2c) do not contradict isotropy, i.e., the dynamics of the threshold deviation may be due to the production of the $K_1^0K_1^0$ system in the S state via pseudoscalar-pion exchange. The approximation of the near-threshold peak by the Briet-Wigner formula has made it possible to obtain the following values of the masses and the resonance widths: $M = (1032 \pm 24)$ MeV/c^2 and $\Gamma = (40 \pm 20)$ MeV/c^2.

Reaction	Beam and momentum GeV/c	Mass, meV/c^2	Width Γ, meV/c^2	Ref.&Procedure
$\pi^-p \to K_1^0K_1^0n$ $\to K_1^0K_1^0$ + neutron	π^- 1.51 + 2.25	~1020	—	*HBC* [2]
$\pi^-p \to K_1^0K_1^0n$ $K_1^0K_1^0$ + neutron	π^- 6,0	1068 ± 10	80 ± 15	*HBC* [7]
$\pi^-p \to K_1^0K_1^0n$	π^- 5.0 3.0 12.0	1079^{+6}_{-5}	168^{+21}_{-19}	SpC [9]
$\pi^-p \to K_1^0K_1^0n$	π^- 4.0 5.0	1065 ± 10	170 ± 40	SpC [11]
$K^-p \to K_1^0K_1^0(Y)$ $(Y = \Lambda, \Sigma, Y(1385))$	K^- 3.6 + 5.0	1030 ± 10	45^{+35}_{-15}	*HBC* [4]
$\bar{p}p \to K_1^0K_1^0\pi^+\pi^-$	$\bar{p}$ 1.18	1045 ± 9	50 ± 24	*HBC* [5]
$p\bar{p} \to K_1^0K_1^0\pi^+\pi^-$	$\bar{p}$ 0.7 1.2	1046 ± 7	40 ± 20	*HBC* [6]
$\pi^-p \to K_1^0K_1^0n$	π^- 4.0 6.2	1053 ± 5	108^{+39}_{-28}	SpC [12]
$\bar{p}p \to K_1^0K_1^0\pi^+\pi$ $K_1^0K_1^0\pi^+\pi^-\pi^0$	1.18	1042 ± 8 1020 ± 5	22 ± 7 29 ± 8	*HBC* [13]
$\pi^-p \to K_1^0K_1^0n$ K_1^0K + neutron $K_1^0K_1^0\pi^+\pi^-$ + neutron	π 4.0 5.1	1032 ± 24	40 ± 20	Present work *PBC*

Thus, our data are in better agreement with the resonance interpretation of the near-threshold anomaly. The table presents, besides our data, also the results of measurements of the mass and the width of the observed effect in different experiments. As seen from the table, the obtained data do not suffice as yet for an unambiguous interpretation of the near-threshold anomaly in the spectrum of the $K_1^0K_1^c$ system.

The second peak in the $K_1^0K_1^0$ effective-mass spectrum at (1.28 ± 1.36) GeV/c^2 may be connected with the known decays of the f^0 and A_2^0 mesons via the $K_1^0K_1^0$ channel. However, at the present statistics it is impossible to separate the contributions from these mesons.

In conclusion, the authors are deeply grateful to the laboratory group who took part in the reduction of the experimental data, to the various measurement groups, and also to the crew of the JINR proton synchrotron for irradiating the bubble chambers.

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EXPERIMENTAL OBSERVATION OF THE AMPLIFICATION OF LASER RADIATION IN THE INTERACTION OF COLLIDING LASER BEAMS IN A PLASMA

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Submitted 24 August 1971
ZhETF Pis. Red. 14, No. 7, 416 - 418 (5 October 1971)

1. The present paper contains the results of an experimental investigation of the interaction of opposing laser pulses of picosecond duration in a plasma. The formation of a high-temperature dense plasma is connected with multiphoton ionization of the atoms of the gaseous argon in the field of the intense laser radiation [1]. In the case of unequal intensity of the pulses, an increase of the energy of the weaker pulse was observed, and also an appreciable modification of its spectrum.