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JOINT INSTITUTE FOR NUCLEAR RESEARCH, DUBNA

HUNGARIAN ACADEMY OF SCIENCES
CENTRAL RESEARCH INSTITUTE FOR PHYSICS

BUDAPEST

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Joint Institute for Nuclear Research, Dubna

SUMMARY

The existence of the $\Lambda\gamma$ peak between 1300 and 1400 MeV was supported by our measurements. The explanation of this peak by means of the hypothetical $\Lambda\eta$ /1680 MeV/ resonance can be rejected on a 97 % confidence level.

INTRODUCTION

In studying the Λ production in interactions of negative pions with protons in the 0,5 m propane chamber of the JINR a peak was observed in the effective mass distribution between 1300 and 1400 MeV both at 7-8 GeV [1], and at 4 GeV primary energies [2] /Fig.1a/. The authors concluded that the origin of this peak could be explained by a 1680 MeV $\Lambda\eta$ resonance decaying into a $\Lambda 2\gamma$ final state giving rise to the observed Λ and γ particles. Because of the low γ ray detection efficiency in experiments [1,2] it was not possible to investigate the $\Lambda 2\gamma$ mass distribution in order to check the existence of the $\Lambda\eta$ resonance directly.

The main purpose of the present experiment was to repeat these investigations in a larger chamber having significantly greater γ ray detection officiency.

EXPERIMENTAL

Using the JINR 1 m propane chamber [3] irradiated by a 5,1 GeV/c π^- beam about 100 000 pictures have been taken. The pictures were scanned twice in order to select events with Λ hyperons produced in $\pi^- p$ interactions. The selection criteria used were essentially identical with those described in refs [1,2].*

The selected events were measured on semiautomatic devices. V^0's and γ's passed through a geometrical reconstruction and kinematical fit program [4,5] in order to identify Λ and γ particles and to reject particles not belonging to the event. After this procedure we classified our events according to the number of γ rays associated with the Λ particle. Special care was taken to recognise Bremsstrahlung γ's by comparing the direction of their line of flight with that of other γ rays being supposed to be primary ones.

The $\Lambda\gamma$ invariant mass distribution is shown in Fig.1b. Only events with one or two observed γ rays were used, and both possible combinations were taken from the latter type. One can see an excellent agreement between Figs.1a and 1b, i.e. the peak in the 1300-1400 MeV mass

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*The only difference was, that events in which a Λ hyperon was produced without the appearence of a γ ray were also measured.

interval was reproduced in our experiment. Fig.2 shows the plot of the 2γ invariant masses vs. the $\Lambda\gamma\gamma$ invariant masses, which were calculated using only events with two observed γ rays. One can see on Fig.2 the corresponding projected 2γ and $\Lambda\gamma\gamma$ mass distributions, as well. While there is a clear π^o peak in the 2γ mass distribution no events can be seen in the η^o region.

Using these mass plots we went on classifying our events /Table I./. Events with one γ ray having $\Lambda\gamma$ effective mass between 1300 and 1400 MeV were denoted by $(\Lambda\gamma)$, all other events with one γ ray by $\Lambda\gamma$, events with two γ rays, where there is at least one $\Lambda\gamma$ combination with an effective mass in the region of 1300-1400* by $(\Lambda\gamma)\,\gamma$, and all other events with two γ's by $\Lambda 2\gamma$. The numbers of events included in Table I are corrected for the background.

DISCUSSION OF THE RESULTS

In the following we compare our results with the hypothesis of the existence of a $\Lambda\eta$ /1680 MeV/ resonance suggested in [1,2]. Possibilities for the explanation of the appearance of the peak in the $\Lambda\gamma$ mass distribution between 1300 and 1400 MeV by means of the $\Lambda\pi$, $\Lambda\pi\pi$ and $\Sigma\pi$ decay of well known resonances can be ruled out, as it was shown in refs. [1,2,6].

The method we are going to apply was exposed essentially in ref. [7]. The ratio of the probability for the production of a $\Lambda\eta$ event to that of a $(\Lambda\gamma)\,\gamma$ event is given by:

$$R = \frac{P_{\Lambda\eta}}{P_{(\Lambda\gamma)\gamma}} = \frac{\varepsilon'^2 [\, P_{o\pi} + P_{1\pi}(1-\varepsilon)^2 + P_{2\pi}(1-\varepsilon)^4]}{2\varepsilon' \,(1-\varepsilon')\,[\, P_{1\pi}\, 2\varepsilon\, (1-\varepsilon) + P_{2\pi}\, 4\varepsilon\, (1-\varepsilon)^3]} \qquad /1/$$

where ε and ε' are the average γ ray detection efficiencies for γ rays belonging or not belonging to the peak, respectively. $P_{o\pi}$, $P_{1\pi}$ and $P_{2\pi}$ are the relative probabilities /normalised to unity/ of the production of 0, 1 and $2\pi^o$'s associated with a $\Lambda\eta$ resonance. A separate analysis has shown that $\varepsilon \simeq \varepsilon'$, and we can take for both 0,20.

In order to estimate the values of $P_{o\pi}$, $P_{1\pi}$ and $P_{2\pi}$ we assumed that they are equal to the corresponding values obtained for the

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*We found only one $\Lambda 2\gamma$ event, where both $\Lambda\gamma$ combinations had an effective mass between 1300 and 1400 MeV.

production of π^o's associated with Λ^o and Σ^o instead of $\Lambda\eta$. Using the experimental data from ref. [8] we obtained for $P_{0\pi}$, $P_{1\pi}$ and $P_{2\pi}$ 0.55, 0.30 and 0.15, respectively. Inserting these values into Eq./1/ we obtain $R = 0{,}64$. Taking this R value and the experimentaly obtained number of events in classes $(\Lambda\gamma)\gamma$ and $\Lambda\eta$ /see Table I / one can rule out the hypothesis with a confidence level of 97 %, approximating the actual distribution by a Gaussian one. It can be shown that this result is not too sensitive for the choise of the background level. An increase of the background to its highest reasonable value, i.e. the decrease of the number of $(\Lambda\gamma)\gamma$ events up to 5, leads to a result excluding the first hypothesis with a 92 % confidence level.

CONCLUSION

The existence of the $\Lambda\gamma$ peak between 1300 and 1400 MeV was supported by our measurements. A detailed analysis of our experimental results showed that the explanation of this peak by means of the hypothetical $\Lambda\eta$ /1680 MeV/ resonance can be rejected on a 97 % confidence level.

We have to emphasize, however, that there is a possibility for explaining the $\Lambda\gamma$ peak by a Y_o^* resonance state /S = 1 , I = 0/ decaying into Λ and γ , as it was already mentioned in refs. [1,6] . The possible existence of a singlet of this type was considered theoretically in refs. [9,10].

Unfortunately the statistical material presented in this paper does not allow to check this hypothesis. The authors intend to analyse this problem based on a much larger experimental material in a forthcoming paper.

Table I

Type of events	Number of events
$(\Lambda\gamma)$	10 /12/
$\Lambda\gamma$	94
$(\Lambda\gamma)\gamma$	7 /5/
$\Lambda 2\gamma$	22
$\Lambda\eta$	0

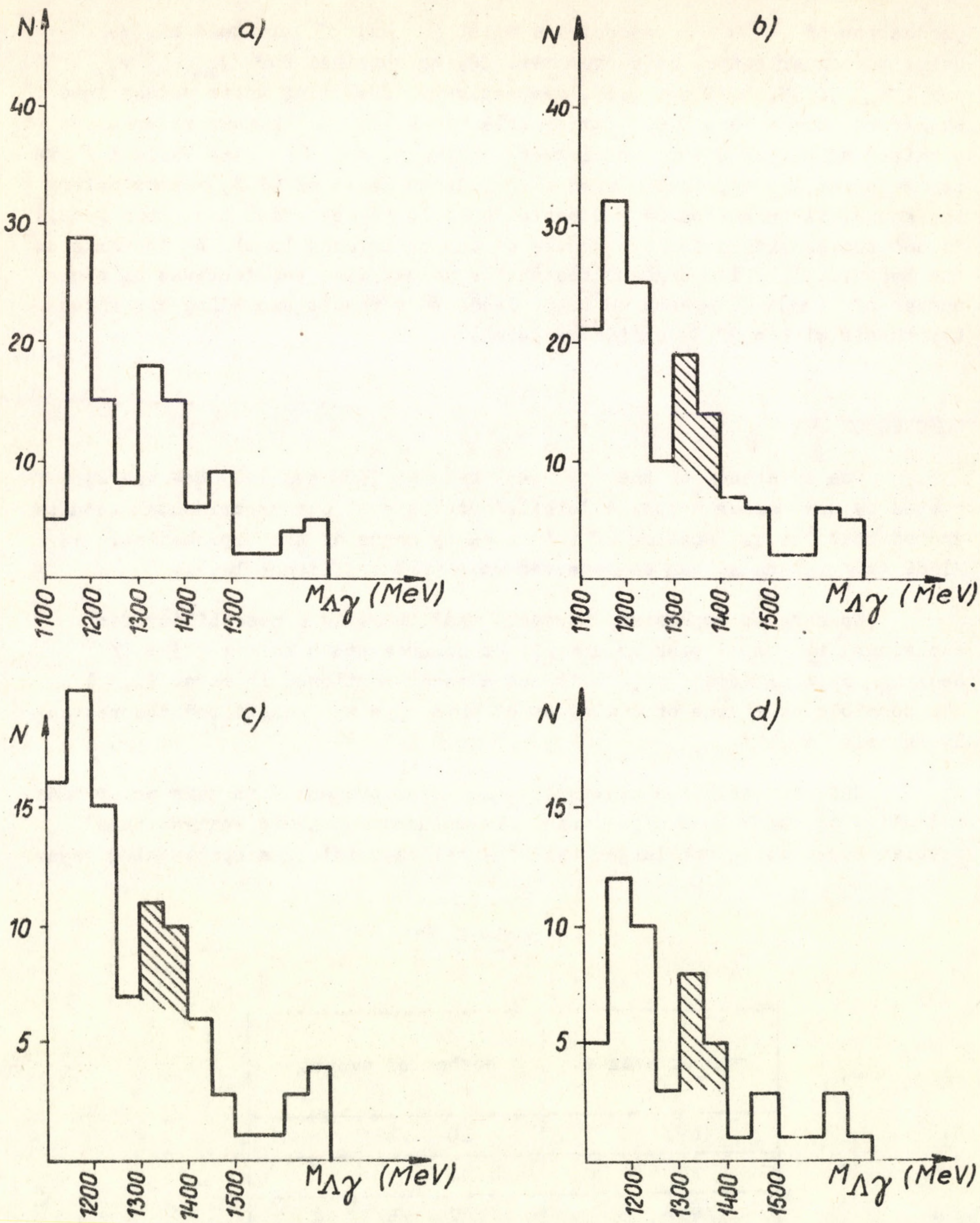

Fig. 1 The $\Lambda\gamma$ effective mass distribution

a/ Taken from ref. [2]; b/ Our experiment /all events/; c/ Events from Fig.1b, where only events with 1γ ray were used; d/ Events from Fig. 1b belonging to the $\Lambda 2\gamma$ class.

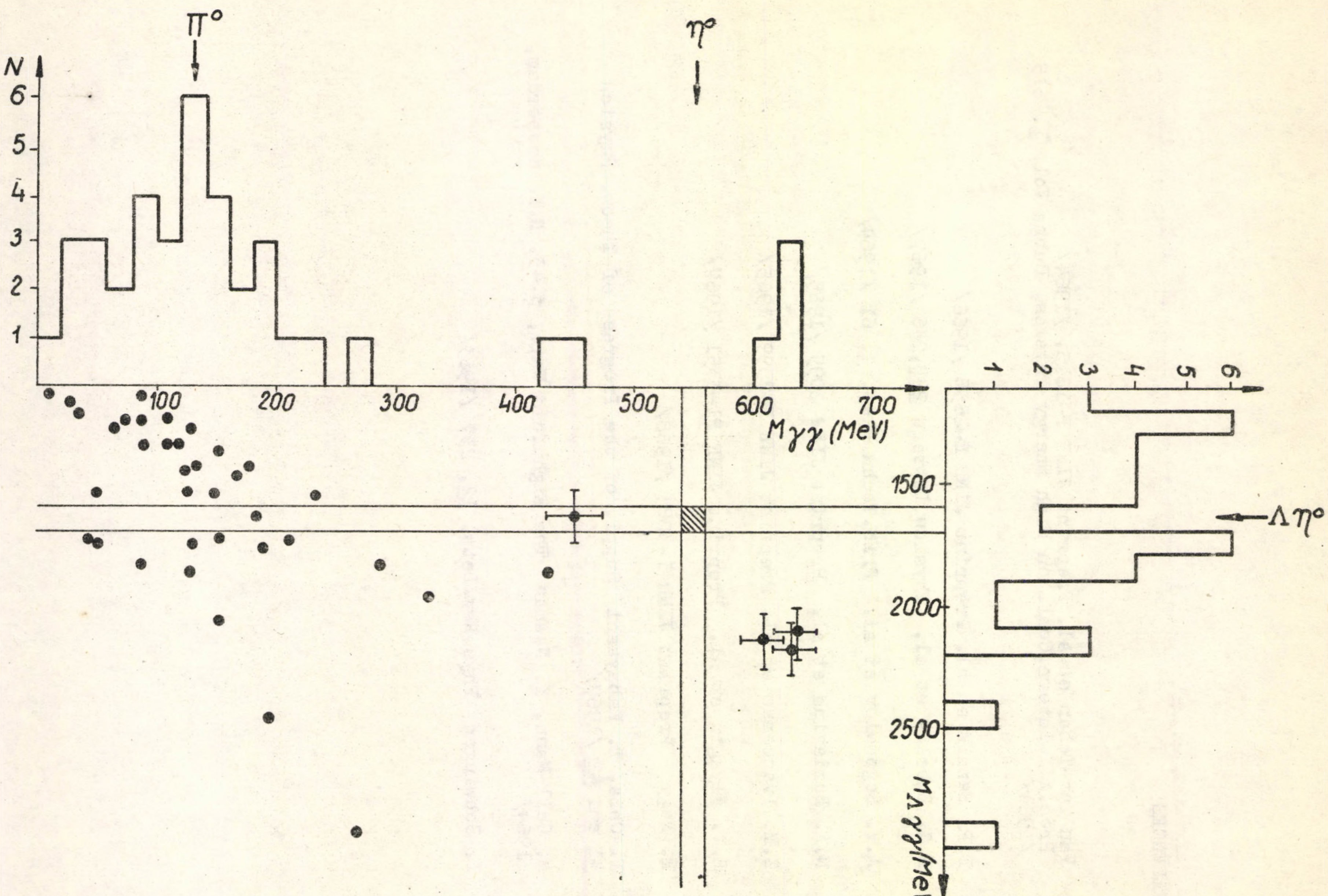

Fig. 2. The γγ vs. Λγγ effective mass plot with the corresponding projected distributions

61.790

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