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OBSERVATION AND STUDY OF A NARROW STATE IN A $\Sigma^{-}(1385)K^{+}$ SYSTEM

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We have reported [1-4] the observation of an anomalously narrow resonance N_ϕ decaying into $\Sigma^-(1385)$ and K^+. The small width of the resonance observed indicates its exotic nature. An investigation of the features of this resonance and an additional confirmation of its existence are of obvious interest. The study of the production mechanism and the decay properties of the N_ϕ could also clarify its nature.

Here we report on new results of a search for and a study of the N_ϕ produced in neutron-carbon interactions. This investigation is based on the data obtained in a charm-search experiment at the Serpukhov accelerator using the forward spectrometer BIS-2. A good mass resolution of the spectrometer allowed a reliable registration of known hyperon decays [5] including

$$\Sigma^-(1385) \to \Lambda^\circ \pi^- \qquad (1)$$

and

$$\Lambda^\circ \to p\pi^- \qquad (2)$$

and even the decays of charmed particles with a complex topology [6].

The process studied was:

$$n + C \to \Sigma^-(1385)h^+ + \dots, \qquad (3)$$

where $\Sigma^-(1385)$ and positively charged hadron h^+ were mainly accepted by the set-up in the neutron beam fragmentation region.

1. EXPERIMENTAL CONDITIONS

The experiment has been performed in a neutron beam of the Serpukhov 70 GeV proton synchrotron. The beam was formed from a beryllium target at a scattering angle of 11.3 mrad with respect to the incoming primary proton beam. A lead filter ~ 10 cm thick was installed to reduce the photon component. Charged particles were swept off by a bending magnet. The mean momentum of the beam, consisting mainly of neutrons with a 1.3% K_L° contamination only, was about 40 GeV/c [7].

A schematic view of the BIS-2 spectrometer is shown in fig.1. A scintillation veto counter (A) was used to remove the charged component from the beam. A carbon target (T) 6 g/cm² thick and

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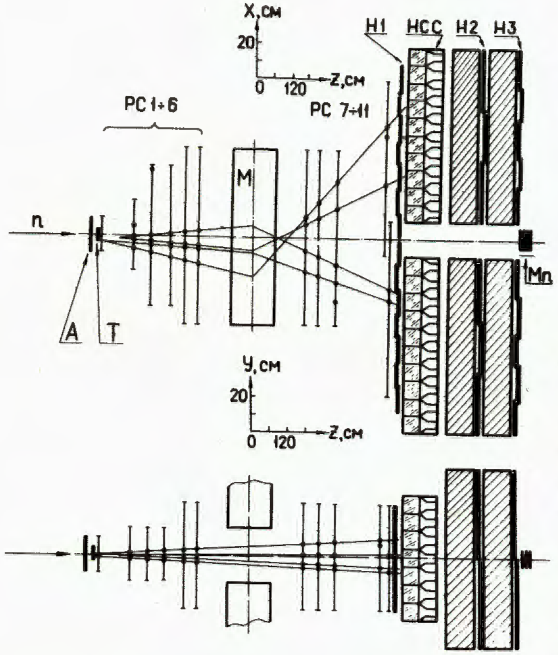

Fig. 1. A scheme of the BIS-2 set-up and topology of a typical event

$$n + C \longrightarrow \Sigma^-(1385)h^+$$
$$\hookrightarrow \Lambda^\circ\pi^-$$
$$\hookrightarrow p\pi^-$$

a small multiwire proportional chamber were followed by a 1.5 m decay volume defining the maximum allowable decay length for Λ°. Two sets of two-coordinate multiwire proportional chambers with a 2 mm wire spacing (PC2-6 and PC7-11) located upstream and downstream a spectrometer magnet (M) were used for the registration of secondary charged particles. The magnet changed the transverse momentum of charged particles by 0.64 GeV/c. A hodoscope of scintillation counters (H1), lead glass counters (HCC), μ -detectors (H2 and H3) and a neutron beam monitor (Mn) were placed behind the PCs.

To trigger the spectrometer, information from A, H1 and the strips of some PCs (1,2,6,7,9-11) was used. The trigger logic required four or more charged particles to pass through the mentioned PCs and H1.

The experimental data have been obtained at three different configurations of the spectrometer. The main differences were the polarity of the magnetic field in M, the position of T and some geometrical parameters of PCs. These changes allowed us to estimate possible systematic errors. $11.4\cdot 10^6$ events of neutron-carbon interactions were recorded at the three spectrometer configurations during ≈ 960 hours of the accelerator running. This corresponds to an integral effective neutron flux of ≈ $6\cdot 10^{11}$ through T.

A more detailed description of the spectrometer and the experimental conditions is presented in ref./8/.

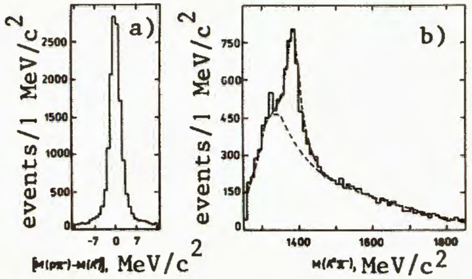

Fig. 2. a) The $p\pi^-$ invariant mass spectrum of "neutral Vees" around $M(\Lambda^\circ) = 1115.6$ MeV/c^2, b) the $\Lambda^\circ\pi^-$ invariant mass spectrum; dashed curves represent the fit to this distribution by resonance and background curves.

II. EVENT SELECTION

To search for the process (3), we have selected events with Λ° each accompanied by only one positively and one negatively charged particles (h^+ and h^-). The geometrical reconstruction of tracks was implemented independently by means of two programs /9/. All the tracks reconstructed were required to differ from one another by their geometric parameters more than three times of the experimental resolution (for details see /1/). To select Λ° according to their decay (2), the corresponding "Vee" should have a minimal distance of < 1 cm between two charged tracks, and the reconstructed decay vertex should lie at > 15 cm down-stream the centre of T. Λ°, h^+ and h^- must have a common vertex within the T region with a root-mean-square distance of < 0.7 cm from all the trajectories. Figure 1 presents two projections of a typical event reconstructed as well as all sparks registered in PCs.

Figure 2(a) illustrates the $M(p\pi^-)$ invariant mass spectrum of "Vees" for the events selected. An explicit signal of Λ° is seen. The experimental mass resolution for reconstructed decays (2) is 1.8 MeV/c^2. If the $M(p\pi^-)$ invariant mass of a "Vee" had been within ±7 MeV/c^2 of $M(\Lambda^\circ) = 1115.6$ MeV/c , it was identified with Λ°. So, 13711 events were selected with Λ° at a background level of 10%.

The $M(\Lambda^\circ\pi^-)$ invariant mass spectrum for the events selected is presented in fig. 2(b). This spectrum has been obtained assuming that h^- is a pion. Two clear peaks are seen: the narrower one for Ξ^- (a detailed description of the selection and study of the decay $\Xi^- \to \Lambda^\circ\pi^-$ is presented in /5/) and the wider one for the decays (1) of $\Sigma^-(1385)$. The dashed curves represent a fit of a Breit-Wigner resonance plus a polynomial background to the spectrum. The mass and the width of the resonance obtained are in good agreement with the known $\Sigma^-(1385)$ data /10/. The events having the $M(\Lambda^\circ\pi^-)$ invariant mass within ±35 MeV/c^2 of the $\Sigma^-(1385)$ mass were identified with decays (1). Using all the above conditions, 3970 events, candidates to the reaction (3), were selected.

III. PEAK OBSERVATION IN THE $\Sigma^-(1385)\,K^+$ INVARIANT MASS SPECTRUM

Figure 3 (solid-line distributions) presents the $M(\Lambda^\circ\pi^-K^+)$ invariant mass spectra obtained under the assumption that h^+ is a kaon. The width of a bin (20 MeV/c^2) was chosen equal to a ~ 5-fold value of the experimental resolution. To graduate the absolute value of mass scale, we used known strange particle decays $K^0_S \to \pi^+\pi^-$, $\Xi^- \to \Lambda^\circ\pi^-$, and $\Lambda^\circ(1520) \to \Lambda^\circ\pi^+\pi^-$ reconstructed separately at each of the spectrometer configurations. Thus, the systematic error in reconstructing the mass under study was reduced to 6 MeV/c^2. The distribution in fig.3(a) has been obtained for the events (3) selected, i.e., when Λ° and π^- are the decay products of Σ^- (1385). Two other distributions, (b) and (c), have been obtained for events selected on condition that Λ° and π^- are not from the decay (1). For these distributions the criteria $1280 < M(\Lambda^\circ\pi^-) < 1350$ MeV/c^2 and $1420 < M(\Lambda^\circ\pi^-) < 1490$ MeV/c^2 have been used, respectively. A pronounced narrow peak centered at 1960 MeV/c^2 is seen in two bins in fig. 3(a), in distinction to figs. 3(b) and 3(c). Approximately 150 events are contained in the peak above ~ 430 events of the background averaged over four neighbouring bins: two on the left and two on the right.

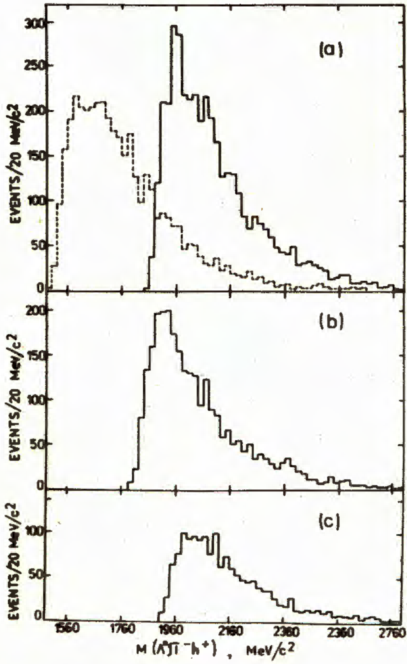

Fig.3. The invariant mass distribution of the $(\Lambda^\circ\pi^-h^+)$ system for the selected events obtained assuming that h^+ is a kaon (solid-line distributions) or a pion (dashed histogram) when: a) Λ° and π^- are the products of Σ^- (1385) decay; b) and c) Λ° and π^- are not the products of Σ^- (1385) decay.

To exclude the hypothesis whether the observed peak is a kinematical reflection of a state with strangeness -1 due to the misidentification of h^+ (K^+ instead of π^+), the $M(\Lambda^\circ\pi^+\pi^-)$ invariant mass distribution has been plotted for the same events assuming that h^+ is a pion (dashed distribution in fig.3(a)). This distribution has a smooth shape without any narrow statistically significant peak. The possibility of reproducing the observed peak by the kinematical reflection of hyperon resonances has been also checked by the procedure of event generation. It has been found that a resonance in the $\Sigma^-(1385)\pi^+$ system with a mass of ~ 1690 MeV/c^2 could lead to a reflected peak near a mass of 1960 MeV/c^2 in the $\Sigma^-(1385)\,K^+$ system, but the width of the reflected signal could be larger than the original one. So, for example, the known resonance $\Sigma(1765)$, decaying via the mode $\Sigma(1385)\pi$, could imitate a peak in the investigated mass spectrum which would be 4 times as wide as the observed one. For other hyperon resonances with close masses the decay mode $\Sigma^-(1385)\,\pi^+$ is unknown and in any case they cannot cause a peak in the $\Sigma^-(1385)K^+$ system close to the observed one either in mass or in width. Consequently, the observed peak is not due to a kinematical reflection of any hyperon. The proton mass assignment to h^+ leads to a smooth spectrum as well. Thus, we conclude that the observed peak is due to the decay of a baryon resonance with zero strangeness which we denote as N_ϕ:

$$\begin{array}{l} N_\phi \longrightarrow \Sigma^-(1385)\,K^+ \\ \qquad\qquad \llcorner\!\!\longrightarrow \Lambda^\circ\pi^- \\ \qquad\qquad\qquad\quad \llcorner\!\!\longrightarrow p\pi^- \end{array} \qquad (4)$$

IV. MONTE-CARLO SIMULATIONS

The geometrical acceptance of the BIS-2 spectrometer has been calculated using the Monte-Carlo method taking into account the set-up geometry, the Coulomb scattering of charged particles, space resolution and efficiency of PCs, decays of secondary particles and triggering conditions. Approximately 8000 events of the N_ϕ decays (4) accepted were simulated at the first stage. At the next stage the simulated events were processed by the same programs using the same selection criteria as for experimental events.

The inclusive production of the N_ϕ in neutron-nucleon interactions was generated in accordance with cross section:

$$\frac{d^3\sigma}{dP_T^2\,dx} \propto \exp(-b\,P_T^2)\,(1-x)^n, \qquad (5)$$

where P_T is the transverse momentum of N_ϕ, $x = P_L^*/P^*$ the Feynman x -variable, P_L^* and P^* are the longitudinal and maximum allowable momenta of the N_ϕ at the centre of mass of reaction (3). The parameters b and n were adapted using the iteration procedure by weighting the simulated events to conform the P_T and P_L (longitudinal momentum of N_ϕ in the laboratory system) distributions between real data and the simulated event. The decay (4) angles, previously generated isotropically, were corrected in the same manner.

The mean total efficiency for N_ϕ observation via its decay (4) was found to be $\epsilon = 1{,}5\ 10^{-8}$. The mass resolutions for Λ° and $\Sigma^-(1385)$ were well reproduced by the simulated events. The mass resolution for N_ϕ decay (4) was estimated to be 3.8 MeV/c^2. The dependence of a $\Sigma^-(1385)K^+$ system detection efficiency on its invariant mass was found to be a smooth and monotonous function. So, neither experimental conditions nor data processing, nor selection criteria could lead to a peak in the $\Sigma^-(1385)K^+$ effective mass spectrum.

V. N_ϕ SELECTION AND BACKGROUND ESTIMATION

The P_T^2 distribution for the N_ϕ, obtained after background subtraction and correction for the acceptance, is shown in fig.4 (shaded circles). The behaviour of the background events, presented in fig.4 (open circles), has been determined from the two bins on each side of the signal in fig.3(a). The latter distribution is also corrected for the acceptance. The P_T^2 spectra for N_ϕ and the background events are different. The distribution for the N_ϕ has a sharp peak at small P_T^2, whereas the background distribution has a monotonous behaviour over all the range of $P_T^2 < 1.0\ (\mathrm{GeV}/c)^2$ for the events registered. These distributions have been fitted by an exponent $\exp(-b \cdot P_T^2)$ (dashed lines in fig.4). For the N_ϕ distribution in the region of

$$P_T^2 < 0.24\ (\mathrm{GeV}/c)^2 \qquad (6)$$

the slope parameter b is $(9.9 \pm 3.0)\ (\mathrm{GeV}/c)^{-2}$, and for the background events it is $(2.2 \pm 0.3)\ (\mathrm{GeV}/c)^{-2}$.

To improve the signal-to-background ratio, we have used the criterion (6) for N_ϕ selection. The $\Sigma^-(1385)K^+$ invariant mass distribution for 2189 events selected using this criterion is presented in fig. 5(a). The background level has been estimated by fitting the smooth function consisting of an exponent and a 4-order polynomial expression to this distribution (solid curve). Standard deviations from the background level are presented in fig.5(b). 118 ± 19 N_ϕ events in two bins correspond to 7.6 standard deviations. A mean mass of (1956^{+8}_{-6}) MeV/c^2 and width of (16 ± 12) MeV/c^2 have been obtained by fitting the peak by a Breit-Wigner resonance. Using the experimental mass resolution, the full width of the resonance has been found to be (14 ± 12) MeV/c^2.

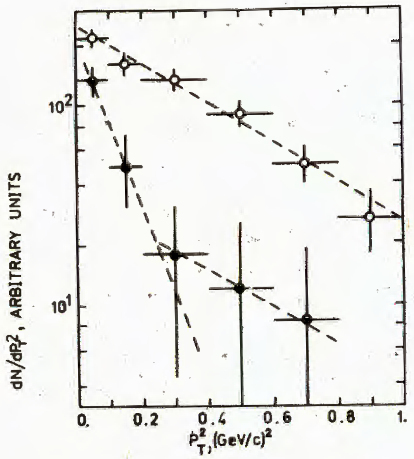

Fig.4. The P_T^2 spectra for resonance (black circles) and background (open cricles) events. Dashed lines represent the fit to these spectra.

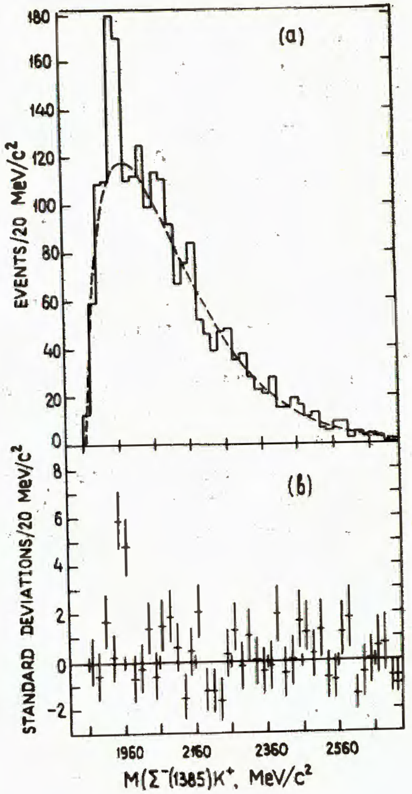

Fig.5. a) The $\Sigma^-(1385)K^+$ invariant mass spectrum for the events selected providing $P_T^2 < 0.24\ (\mathrm{GeV}/c)^2$ (histogram) and the result of fitting to this spectrum by a smooth background function (curve).
b) Standard deviations from this background curve.

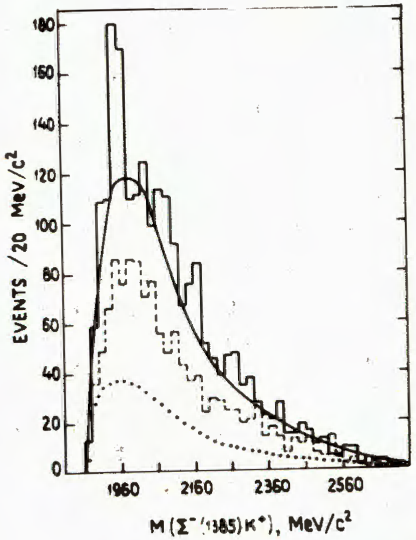

Fig.6. The $(\Sigma^-(1385)K^+)$ invariant mass spectrum for the events investigated (solid-line histogram) and for the events, where additional charged particles are detected (dashed histogram). Dotted curve corresponds to the calculated mass spectra for the processes of diffraction dissociation. Solid curve is the resulting background spectrum.

To study the background composition, we assumed two source of background events. The first one was the diffraction dissociation of neutrons into $\Lambda^\circ\pi^- K^+ + n\pi^\circ$, $\Sigma^\circ\pi^- K^+ + n\pi^\circ$ and $\Sigma^-(1385)K^+ + n\pi^\circ$ where $n = 0,1,2$. All these processes were simulated using the Monte-Carlo program in accordance with the cross sections measured /11/. The accepted $\Sigma^-(1385)K^+$ invariant mass spectrum reproduced by such events is presented in fig.6. (dotted curve). The second source of the background was assumed to be inclusive Λ° production accompanied by two registered charged particles h^+ and h^-. The invariant mass spectrum for these events was obtained from the sample of events where, besides Λ°, three or more charged particles were registered (h^+ , h^- , $h^\pm$, ...). The corresponding distribution for $\Lambda^\circ K^+\pi^-$ combinations satisfying all the above criteria is presented in fig.6 (dashed distribution). This distribution is well fitted by a smooth function and has no significant peaks.

The resulting background spectrum, estimated by combining the two spectra obtained, well reproduces the $\Sigma^-(1385)K^+$ invariant mass spectrum studied over all the range, except the peak interval (solid curve in fig.6).

VI. N_ϕ PRODUCTION STUDY

To study N_ϕ production, parametrization of the form (5) was used with parameter $b = 9.9$ $(GeV/c)^{-2}$ obtained from the P_T^2 spectrum (fig.4).

The P_L distribution for the N_ϕ registered after background subtraction is presented in fig.7. A similar spectrum for the events simulated by the Monte-Carlo method has been fitted to the real data. The best fit (dashed curve in fig.7) leads to parameter $n = (-0.2 \underline{+} 0.2)$. A negative value of n indicates that the N_ϕ is mainly produced at $x = 1$, i.e., in the course of diffraction dissociation of neutrons on quasi-free nucleons of carbon nuclei.

The cross section (σ) for N_ϕ production times the branching ratio (B) of the observed decay mode is $\sigma B = NA/(N_A T\ B_1 B_2 M_n \epsilon)$ = = $(1.15 \underline{+} 0.19)\ \mu b$ per carbon nucleus, where N is the number of N_ϕ observed; A is the atomic number of carbon, N_A is Avogardo number; T is the length of the carbon target; B_1 and B_2 are the branching ratios of decays (1) and (2), respectively; M_n is the neutron flux through the target, and ϵ is the efficiency of N_ϕ observation. A possible systematic error for σB does not exceed 30%.

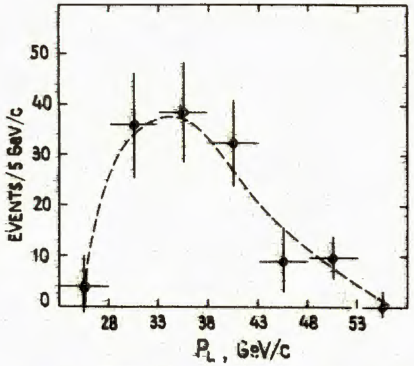

Fig.7. The P_L distribution for the N_ϕ detected (black circles) and the best approximation by simulated events (dashed curve).

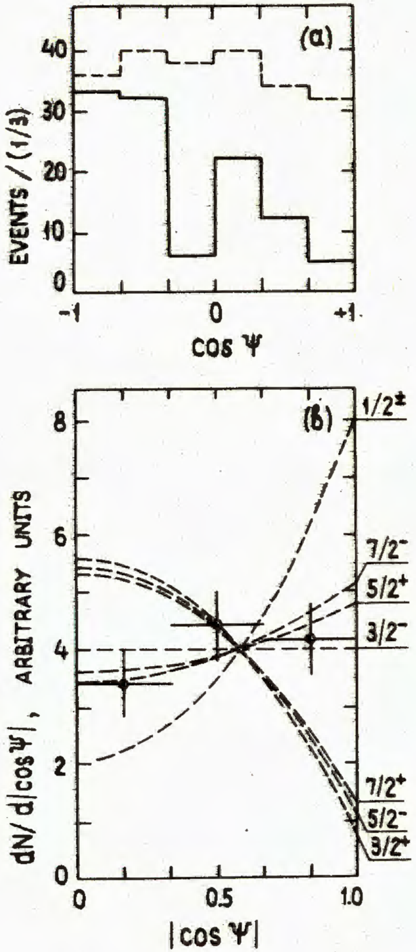

Fig.8. a) The $\cos\psi$ distribution for the N_ϕ detected (solid-line histogram) and for background events (dashed-line histogram). b) The $|\cos\psi|$ distribution for the N_ϕ produced (black circles) and the expected spectra for different spin-parities J^P (dashed curves).

VII. DECAY PROPERTIES OF N_ϕ

To estimate the spin-parity (J^P) of the N_ϕ, the method described in /12/ has been used. This method can be applicable to the case of two-body decays into $3/2^+$ and 0^- particles if higher allowable angular momenta at fixed J are negligible. In our case the latter condition seems to be satisfied due to a low free energy of the decay. The $\cos\psi$ distribution has been studied, where ψ is the angle between $\Sigma^-(1385)$ momentum vector in the N_ϕ rest frame and Λ° momentum vector in the Σ^- (1385) rest frame. Such distributions(fig.8(a)) for the N_ϕ registered after background subtraction(solid-line distribution)and for the background (dashed-line distribution), are different. Figure 8(b) presents the $|\cos\psi|$ distribution for the N_ϕ corrected for the acceptance

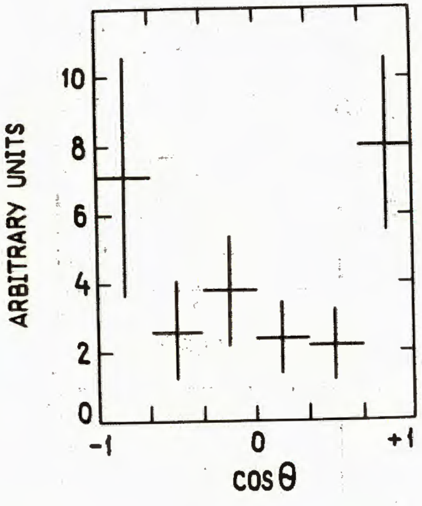

Fig.9. The $\cos\theta$ distribution for the N_ϕ produced.

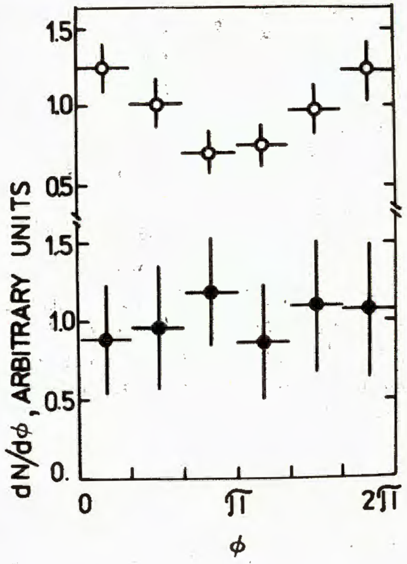

Fig.10. The ϕ distribution for the N_ϕ produced (black circles) and the background events (open circles).

(shaded circles) and the expected spectra for different J^P (dashed lines). It is seen that the N_ϕ spectrum satisfies natural spin-parities: $3/2^-$, $5/2^+$, $7/2^-$ and so on.

Assuming that the N_ϕ are produced in the diffraction dissociation of neutrons on nucleons, as is shown in chapter VI, the azimuthal Treiman-Yang angle (ϕ) and the polar Gottfried-Jackson angle (θ)/13/ (both characterizing the direction of the Σ^- (1385) momentum vector in the N_ϕ rest frame) can be calculated.

Figure 9 presents the $\cos\theta$ distribution obtained for the N_ϕ after background subtraction and correction for the acceptance. This distribution indicates two peaks, forward and backward, which correspond to the Σ^- (1385) direction of flying relative to the neutron beam direction. This distribution is expected to be isotropic if $J^P = 3/2^-$. So $J^P = 3/2^-$ may be excluded, and the spin-parity of N_ϕ can take natural values beginning from $5/2^+$.

Figure 10 presents the ϕ distributions obtained for the N_ϕ after background subtraction (black circles) and for the background (open circles); both distributions are corrected for the acceptance. These distributions are different. The N_ϕ events show the absence of any dependence on ϕ what is expected in the case of t-channel helicity conservation for N_ϕ production. In this case the $\cos\theta$ distribution should have typical peaks as observed in fig.9 if $J^P = 5/2^+$.

VIII. CONCLUSION AND DISCUSSION

1. A new baryon decaying into Σ^- (1385) K^+ has been observed. This is substantiated by:

a) A narrow statistically significant peak is presented in the $\Sigma^-(1385)K^+$ invariant mass spectrum. The overall behaviour of this spectrum, besides the peak region, is described by the known reactions dominating at the energies under study and is well fitted by a smooth function;

b) The peak events and the events from both sides of the peak in the mass spectrum are different in nature. The behaviour of the P^2_T, ϕ and $\cos\psi$ distributions is different for the peak and background events;

c) The observed peak could not be due to the kinematical reflection of any known hyperon resonance caused by the misidentification of h^+;

d) As the events giving rise to the peak are produced due to the diffraction dissociation of neutrons (see below), the Σ^- (1385) identified should be accompanied by K^+ to form a neutral nonstrange baryon state. Thus, for these events h^+ must be indentified with K^+ as has been assumed previously;

e) The observed peak cannot be identified with the known nonstrange resonance Δ (1950)/10, 14/ because the width ((200 - 300) MeV/c^2) and the spin-parity ($7/2^+$) of the latter are excluded in our case. The Δ (1950) has isotopic spin 3/2 and cannot be produced by the diffraction dissociation of neutrons like the peak events do.

2. The N_ϕ is produced by the diffraction dissociation of neutrons. The evidence for this and the characteristics of the production process have been obtained:

a) The total charge and baryon number of N_ϕ decay products and of the neutron are the same;

b) The longitudinal momentum distribution of the N_ϕ corresponds to the Feynman x-variable distribution with the maximum at $x = 1$;

c) The N_ϕ production is observed only in the case when there are no additional charged particles produced and registered in the neutron beam fragmentation region, and it is not observed in other cases (see fig.6);

d) The slope parameter $b = (9.9 \pm 3.0)$ GeV/c^{-2} obtained for the P^2_T spectrum is close to a typical value for the diffraction dissociation of nucleon on nucleon at the mass value considered/15/;

e) The N_ϕ-channel helicity conservation indicated for the N_ϕ production is compatible with the process of diffraction dissociation;

f) The $\cos\theta$ distribution indicates preferable decays of N_ϕ along the incident beam momentum vector;

g) The N_ϕ production cross section in neutron-carbon interactions times the branching ratio is (1.15$\pm$0.19) μb per carbon nucleus with a possible systematic error less than 30%. Taking into account the dependence $\sigma \sim A^{2/3}$ typical for diffraction processes, we obtain $\sigma B = (0.22 \pm 0.04)$ μb per nucleon.

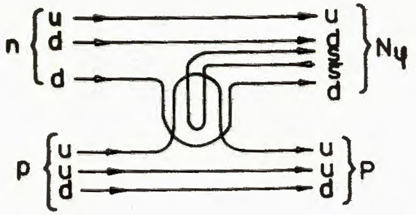

Fig.11. The diagram for the diffraction production of the N_ϕ in the case of its five-quark (udds$\bar{s}$) structure.

4. If the N_ϕ is produced in the process of diffraction dissociation, its isotopic spin is identical with the neutron (I = 1/2) and the N_ϕ may decay into $\Lambda^\circ K^\circ$ as well. The limit of the ratio of the branching ratios $B(\Lambda^\circ K^\circ)/B(\Sigma^-(1385)K^+) < 2.7$ has been obtained at a confidence level of 90% using the result of a search for the $\Lambda^\circ K^\circ$ decay presented in /16/.

5. Possible spin-parities of the N_ϕ are natural values: $5/2^+$, $7/2^-$, etc. These values obey the Gribov-Morrison rule for the diffraction dissociation of neutrons.

6. The narrow width of the N_ϕ cannot be explained in the frame of conventional three-quark baryon structure. Therefore, taking into account the decay into two strange particles, a possible five-quark nature of N_ϕ can be assumed. In such a model, besides three valence quarks of the neutron, there are two strange quarks forming the state (udds$\bar{s}$). The possibility of existence of such states as narrow baryons is discussed in some papers /18, 19/. A natural mechanism of the production of such five-quark systems may be a diffraction process, e.g., the process shown in fig.11. For the diffraction production of five-quark state one can also consider the model of "intrinsic flavours" proposed by S.Brodsky et al. /20/.

The considered model can explain both the narrow width of the N_ϕ and its production mechanism and does not contradict all the properties obtained. Nevertheless, other possible hypotheses are not excluded.

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REFERENCES

1. Aleev A.N. et al. Yad.Fiz., 1981, 34, p. 386; JINR, E1-80-726, Dubna, 1980.
2. Aleev A.N. et al. Yad.Fiz., 1982, 36, p.1420; JINR, D1-82-116, Dubna, 1982.
3. Aleev A.N. et al. JINR, D1-82-921, Dubna, 1982.
4. Aleev A.N. et al. JINR, D1-83-602, Dubna, 1983.
5. Aleev A.N. et al. JINR, P1-82-353, Dubna, 1982;
   Aleev A.N. et al. PHE-82-7, Berlin-Zeuthen, 1982.
6. Aleev A.N. et al. Yad.Fiz., 1982, 35, p. 1175; Yad.Fiz., 1983, 37, p. 1474; JINR, P1-81-693, Dubna, 1981; JINR, D1-82-895, Dubna, 1982; JINR, P1-82-343, E1-82-759, Dubna, 1982; JINR, E1-83-417, Dubna, 1983.
7. Aleev A.N. et al. JINR, 1-81-67, Dubna, 1981.
8. Eichner G. et al. JINR, 1-80-644, Dubna, 1980; Maksimov A.N. et al. JINR, 1-81-574, Dubna, 1981.
9. Burilkov D.T. et al. JINR, 10-80-656, Dubna, 1980;
   Burilkov D.T. et al. JINR, 10-81-772, Dubna, 1981.
10. Roos M. et al. Phys.Lett., 1982, 111B, p.1.
11. Baksay L. et al. Phys.Lett., 1976, 61B, p. 405;
    Göttgens R. et al. Z.Phys.C - Particles and Fields, 1983, 19, p. 283; Givernaud A. et al. Z.Phys.C - Particles and Fields, 1981, 8, p. 291.
12. Button-Shaffer J. Phys.Rev., 1965, 139, B607.
13. Jackson J.D. Nuovo Cimento, 1964, 34, p. 1644; Gottfried K., Jackson J.D. Nuovo Cimento, 1964, 33, p. 309; Treiman S.B., Yang C.N. Phys.Rev.Lett., 1962, 8, p. 140.
14. Ansorge R.E. et al. Phys.Rev., 1974, D10, p. 32;
    Ansorge R.E. et al. Nucl.Phys., 1976, B103, p. 509.
15. Albrow M.G. et al. Nucl.Phys., 1976, B108, p.1;
    Babaev A. et al. Nucl.Phys., 1976, B116, p. 28.
16. Aleev A.N. et al. PHE 83-1, Berlin-Zeuthen, 1983.
17. Gribov V.N. Yad.Fiz., 1967, 5, p. 197;
    Morrison D.R.O. Phys.Rev., 1968, 165, p. 1699.
18. Hogaasen H., Sorba P. Nucl.Phys., 1978, B145, p. 119;
    De Grombrugghe M. et al. Nucl.Phys., 1979, B156, p. 347.
19. Strottman D. Phys.Rev., 1979, D20, p. 748.
20. Brodsky S.J. et al. Phys.Lett., 1980, 93B, p. 451;
    Brodsky S.J. et al. Phys.Rev., 1981, D23, p. 2745;
    Bertsch G. et al. Phys.Rev.Lett., 1981, 47, p. 297.

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Наблюдение и исследование узкого состояния в системе Σ^- /1385/K^+

Получены новые данные по наблюдению и исследованию узкого резонанса, распадающегося на Σ^-/1385/K^+. Масса резонанса равна /1956^{+8}_{-6}/ МэВ/с^2, а его ширина - /14 ± 12/ МэВ/с^2. Резонанс рождается в процессе дифракционной диссоциации нейтрона на квазисвободных нуклонах углеродной мишени. Параметр наклона дифференциального сечения по P_T^2 равен /$9,9\pm3,0$/ /ГэВ/с/$^{-2}$. Произведение сечения его рождения на вероятность распада по наблюдаемому каналу равно /$0,22\pm0,04$/ мкб на нуклон. Спин-четность резонанса имеет одно из натуральных значений $5/2^+$, $7/2^-$ и т.д.

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Observation and Study of a Narrow State in a $\Sigma^-(1385)K^+$ System

New data on the observation and study of a narrow resonance decaying into $\Sigma^-(1385)K^+$ have been obtained. The mass of the resonance is (1956^{+8}_{-6}) MeV/c^2, and its width is (14 ± 12) MeV/c^2. The resonance is produced in the diffraction dissociation of neutrons on quasi-free nucleons of carbon nuclei. The slope parameter of the differential cross section in P_T^2 is (9.9 ± 3.0) (GeV/c)$^{-2}$. The cross section times the branching ratio is (0.22 ± 0.04) μb per nucleon. The resonance has one of the natural spin-parities: $5/2^+$, $7/2^-$ and so on.

The investigation has been performed at the Laboratory of High Energies, JINR.

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