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A POSSIBLE INTERPRETATION OF A NARROW RESONANCE WITH A MASS OF 1960 MeV/c^2 OBSERVED AT THE CERN-SPS

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A narrow resonance with a mass of ~ 1960 MeV/c^2 in the ΛK^0_s system has been recently observed in the CERN-SPS experiment aimed to study Ξ^* production in Ξ^-Be interactions[1]. The authors have interpreted this resonance as a new excited state Ξ^{0*}. In this paper we show that such an interpretation is in contradiction with the experimental data on Ξ^{-*} production[2], obtained by the same group, and we give arguments in favour of another explanation of the observed resonance.

The ΛK^0_s effective mass spectrum from[1] is shown in Fig.1. Two pearks are seen in this distribution: the first peak is

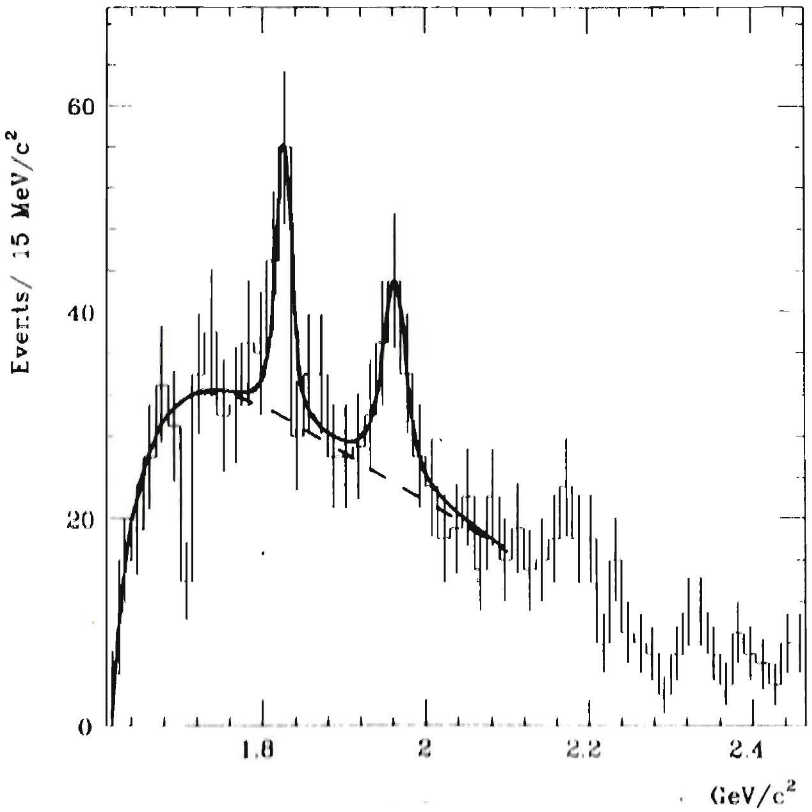

Fig.1. The ΛK^0_s invariant mass spectrum obtained in[1]

caused by the known resonance $\Xi^0(1820)$ and the second one denoted by the authors as $\Xi^0(1960)$. As is noted by the authors, the latter peak establishes the presence of a new relatively narrow resonance. The measured parameters of the resonances are presented in Table 1. The parameters of $\Xi^0(1820)$ are in good agreement with the world averaged data[3].

Table 1

	$\Xi^0(1820) \to \Lambda K^0_s$	$\Xi^0(1960) \to \Lambda K^0_s$
Mass, MeV/c^2	1826 ± 4	1963 ± 5
Width, MeV/c^2	12 ± 14	25 ± 15
Spin-parity	$3/2^-$	$5/2^+$, $7/2^-$, $9/2^+$, etc.
Number of events	54 ± 17	63 ± 24

The authors have assumed that the new resonance has strangeness $S = -2$, i.e. they have observed the decay of an excited hyperon: $\Xi^0(1960) \to \Lambda K^0$. If such an interpretation is correct, it is obvious that the isotopically conjugated state of this hyperon, $\Xi^-(1960)$, must also exist. This can be verified by searching for the decay $\Xi^-(1960) \to \Lambda K^-$ having the same branching ratio as the observed one. For this purpose data on the Ξ^{-*} resonances in the ΛK^- system produced diffractively in a Ξ^- beam can be considered. These data have been obtained by the same authors using the same experimental setup[2].

Fig. 2 shows the ΛK^- effective mass spectrum presented in[2]. A clear signal of the $\Xi^-(1820)$ resonance is seen. The parameters of this resonance measured in[2] are shown in Table 2.

Table 2

	$\Xi^-(1820) \to \Lambda K^-$
Mass, MeV/c^2	1819.4 ± 3.1
Width, MeV/c^2	24 ± 5.3
Number of events	280 ± 50

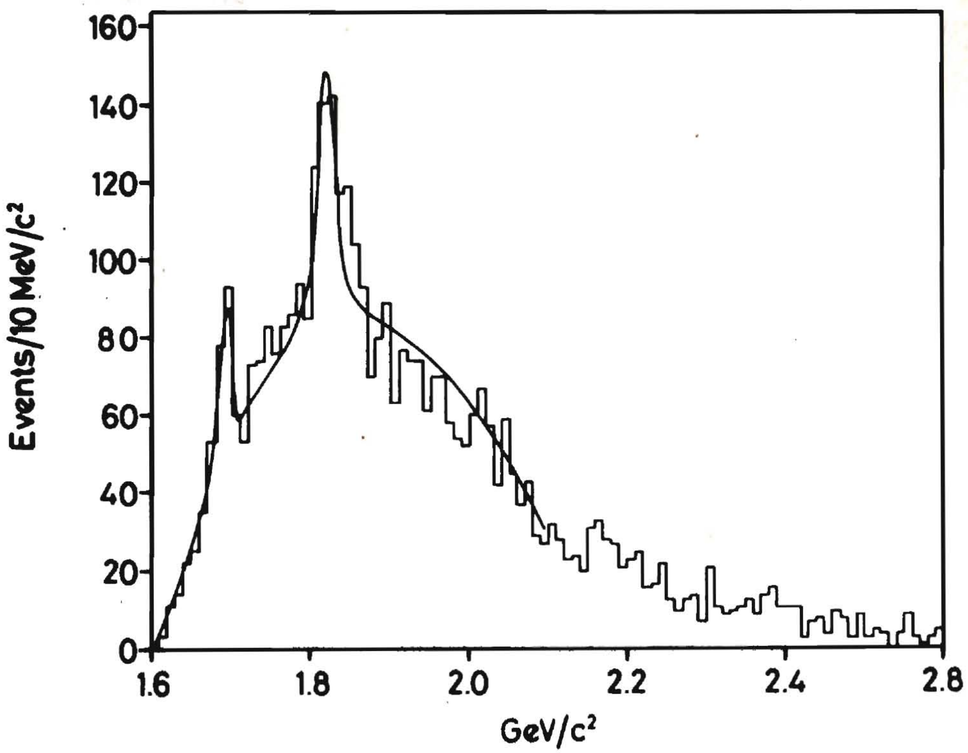

Fig. 2. The ΛK^- invariant mass spectrum obtained in /2/

As is seen from the comparison of Tables 1 and 2, there is a good agreement between the parameters of the $\Xi^-(1820)$ and $\Xi^\circ(1820)$ resonances observed in this experiment. But the numbers of events of each detected state are different. Their ratio $N(\Xi^-(1820))/N(\Xi^\circ(1820))$ is ≈ 5.2. Approximately the same ratio $N(\Xi^-(1960))/N(\Xi^\circ(1960))$ is expected for detection of the $\Xi(1960)$ resonance. This means that ~ 300 resonant events are expected in the ΛK^- mass spectrum at ~ 1960 MeV/c^2*. But as is seen in Fig. 2, there are no peaks in this mass region. This means that the $\Xi^-(1960)$ state of the discussed resonance does not exist. Thus, the assumption that the strangeness of the resonance at ~ 1960 MrV/c^2 equal -2 is in contradiction with the experimental data.

Is it possible to assign another strangeness to this state? The peak at ~ 1960 MeV/c^2 was observed in the ΛK°_s system, where the strangeness assignment of the final state is ambiguous because the K°_s, decaying into $\pi^+\pi^-$, may be both $\bar{K}^\circ$ and K°. The strangeness of the final state may be $S = -2$ or $S = 0$. If the strangeness of this state is 0, the above-mentioned contradiction vanishes because such a baryon with isotopic spin $I = 1/2$ has no conjugated states with negative electric charge.

Is the possibility of having zero strangeness for the resonance at ~ 1960 MeV/c^2 allowed by the experimental data? From /1/ it follows that a contamination of $S = 0$ states in the final sample of events can reach the level of a few per cent. The real number of $S = 0$ events, entering into the histogram of Fig. 1, cannot be estimated from the data presented in /1/. However, it seems that ~ 60 resonance events with $S = 0$ do not contradict the overall upper limit of the admixture of such states in the sample. So, we come to a conclusion that the assignment of the strangeness $S = 0$ to the resonance at ~ 1960 MeV/c^2 is compatible with the experimental data presented in /1/ and /2/. In this case the resonance decays observed in /1/ proceed via ΛK°.

A narrow baryon resonance ($S = 0$) at a mass of ~ 1960 MeV/c^2 decaying into strange particles, denoted by $N_\phi(1960)$, has been observed earlier in a BIS-2 experiment at the Serpukhov accelerator /4/. The parameters of the $N_\phi(1960)$ resonance determined in this experiment are presented in Table 3.

Table 3

	Mass, MeV/c^2	Width, MeV/c^2	Spin-parity	Strangeness
$N_\phi(1960)$	1956^{+8}_{-6}	27 ± 17	$5/2^+, 7/2^-, 9/2^+ \ldots$	0

The parameters of the 1960 MeV/c^2 states observed in two different experiments (Tables 1 and 3) are in good agreement (if we assume that the peak from Ref. /1/ is due to the $S = 0$

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* *If $\Xi(1820)$ and $\Xi(1960)$ belong to different SU(3) multuplets, a nonrealistic model can be invented to suppress the production of $\Xi^-(1960)$. But it seems that such a suppression is no larger than a typical value of SU(3) isoscalar factors.*

events). The isotopic spin of the $N_\phi(1960)$ may be 1/2 or 3/2 because it decays into $\Sigma^-(1385)K^+$. From the arguments given in [4] it follows that the $N_\phi(1960)$ resonance is produced in a diffraction-like process of incident neutrons and its isotopic spin is preferable to be 1/2. Thus, we have a coincidence in all the measured parameters for the two states observed in different experiments and in different decay modes. Thus, it is natural to assume the identity of these states.

Summing up, the existing discrepancy in the experimental data for $\Xi^\circ(1960)$ production leads to a conclusion that this state is caused by the $S=0$ events, and so it is not an excited $\Xi^{\circ *}$ state but a nucleon resonance. The comparison of the resonances observed at the CERN SPS and the Serpukhov accelerator leads to a conclusion that they may be the same object denoted in [3] as N(1960).

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О возможной интерпретации узкого резонанса с массой 1960 МэВ/c^2, наблюденного на СПС ЦЕРНа

Показано, что узкое состояние с массой 1960 МэВ/c^2, распадающееся на Λ и K°_s, которое было обнаружено на СПС ЦЕРНа в Ξ^-Ве взаимодействиях и интерпретировано авторами как $\Xi^{\circ *}$ резонанс, более вероятно является состоянием со скрытой странностью N_ϕ/1960/, обнаруженным ранее на серпуховском ускорителе с помощью установки БИС-2.

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