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NEW UPPER LIMIT FOR THE BRANCHING RATIO OF THE $K^{\circ}_{s} \to e^{+}e^{-}$ DECAY

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In the paper [1] the upper limit has been established for the branching ratio of the $K^0_s \to e^+e^-$ decay:

$$B.R.(K^0_s \to e^+e^-) \leq 3.4\cdot10^{-4} \quad (90\%\ C.L.).$$

We have determined a new value for this quantity. It has been obtained as by product of the data processing in the experiment on the study of η-meson production [2] in hadron-nucleon and hadron-nucleus interactions at the 10.5 GeV beam energy.

The experimental set-up [3] (Fig. 1) includes a multichannel total-absorption shower detector (SHD), containing 62 lead glass (TF-1-000, 2.5 cm radiation length) counters with the dimensions $10x10x35\ cm^3$(14 r.l. along the beam) and an active converter (AC), made of the same lead glass with the element dimensions $6x10x85\ cm^3$ (2.4 r.l. along the beam). The construction of the SHD counters is in principle the same as described in ref. [4].

The design and basic parameters of SHD and AC will be described in detail in our future papers. Charged particles tracks were registered in the proportional chambers PC (with a 2 mm signal wire spacing) and a scintillation hodoscope H with the elements 35 mm wide. The liquid hydrogen and deuterium targets 27.5 cm long and nuclear targets (Be, C, Al, Cu) of various thicknesses were used in the experiment.

For trigger purpose, the SHD elements were divided into four groups of almost the same area (Fig. 1). The trigger logic required an incoming K^+-meson and a considerable energy release ($\geq$2 GeV) in two or more SHD trigger groups.

The total flux of K^+-mesons during the exposure was $3x10^9$ particles.

<u>In data processing</u> the following criteria were used for selection of events:

1. There are at least two charged tracks, each having initiated a shower in the SHD with the energy greater than 2 GeV. The energy

released in the converter (AC) is greater than 170 MeV for each track. The events with two or more tracks passing through the same AC element were excluded. The tracks, satisfied this conditions could be produced by:

a) single electrons (positrons);

b) e^+e^- pairs with a very small opening angle, from Dalitz decays of π^0 and η-mesons or from conversions of gamma quanta in the target, which look like a single track in the proportional chambers;

c) hadrons interacting in AC elements and initiating a shower in the SHD.

2. When processing the data from nuclear targets, we selected the events for which the point of a possible decay of a neutral particle into two charged ones was at some distance behind the target.

We should like to note that criterion 1 corresponds to suppression of a single hadron shower by the factor of $\lesssim 5 \cdot 10^{-3}$; in this case the losses of electrons (positrons) with the energy 2-8 GeV do not exceed 7-2% respectively.

The distribution of events over the effective mass of pairs of selected tracks is shown in Fig. 2. There are no pairs with effective mass greater than 400 MeV in this distribution.

The effective mass resolution of the detector was determined by analysis of the $\gamma\gamma$-effective mass spectra in the vicinity of the η-meson peak; it is $\leqslant 30$ MeV (R.M.S.).

Thus, no events were found in the vicinity of the K^0-meson mass in the corridor corresponding to the triple resolution of the detector for the effective mass of the e^+e^- pair.

The overall number of K^0_S-mesons produced in the target whose decay $K^0_S \to e^+e^-$ could be registered in our detector was calculated by the Monte-Carlo method using the experimental data on the differential cross section of K^0-meson production in the reaction $K^+p \to K^0X$ at 8.2 GeV /5/. There are no experimental data on inclusive differential cross section for K^0-meson production in K^+n- and K^+A-interactions in our energy region. Therefore we calculated the effective flux of K^0_S-mesons under the assumption that the inclusive cross sections for the reactions $K^+n \to K^0X$ and $K^+p \to K^0X$ coincide and the inclusive differential cross section for the reaction $K^+A \to K^0X$ depends on the mass number A as $A^{\alpha(x_F, P_T)}$. We have taken α equal to 0.4. In the kinematic region which was important for us ($0.5 < x_F < 0.95$; $P_T < 1.0$ GeV) $\alpha = 0.4$ can be considered as a lowest estimation of $\alpha(x_F, P_T)$ /6/, thus underestimating the calculated number of K^0-mesons.

Performing the Monte-Carlo calculations, we took into account the geometrical acceptance of the facility, the charged particles detection efficiency and the efficiency of shower reconstruction by the computer program. The calculated number of K^0_S-mesons which could be registered via their decay into e^+e^--pair was $2.15 \cdot 10^4$.

As there are no registered events (including background events) the upper limit for the branching ratio is determined on the basis of the Poisson law for the probability of events registration. At the 90% confidence level we have got

$$\text{B.R.}\ (K^0_S \to e^+e^-) \leqslant 1.1 \cdot 10^{-4}.$$

In conclusion the authors would like to thank Yu.D.Prokoshkin for his support of this work and S.M.Korenchenko for useful discussion.

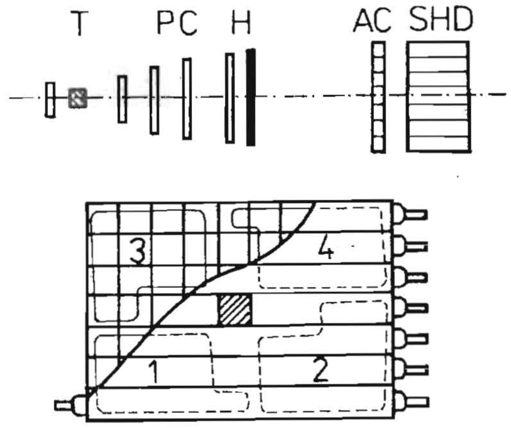

Fig. 1. Experimental set-up and frontal view of AC and SHD.

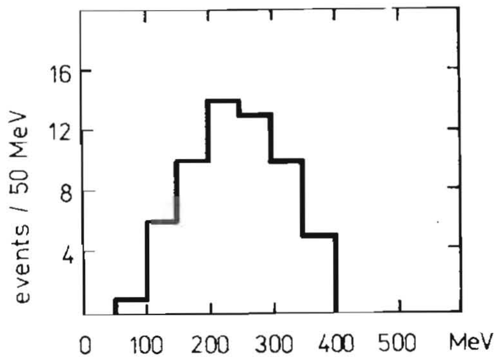

Fig. 2. Effective mass spectrum for selected events.

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Бицадзе Г.С.и др. E1-85-610
Новое значение верхней границы
вероятности распада $K^{\circ}_{s} \to e^{+}e^{-}$

С целью установления нового значения верхней границы вероятности распада K°_{s} на $e^{+}e^{-}$ была произведена обработка данных, полученных в эксперименте по изучению инклюзивного образования η-мезонов в адрон-нуклонных и адрон-ядерных взаимодействиях при 10,5 ГэВ, проведенного на спектрометре ГИПЕРОН. Экспериментальная установка включала в себя многоканальный ливневый детектор полного поглощения и активный конвертор, изготовленные на основе свинцового стекла, и пропорциональные камеры. Установлено новое значение верхней границы вероятности распада K°_{s} на $e^{+}e^{-}$: $B.R.(K^{\circ}_{s} \to e^{+}e^{-}) < 1,1\cdot 10^{-4}$ на 90% уровне достоверности.

Работа выполнена в Лаборатории ядерных проблем ОИЯИ.

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Bitsadze G.S. et al. E1-85-610
New Upper Limit for the Branching Ratio
of the $K^{\circ}_{s} \to e^{+}e^{-}$ Decay

The data from the experiment on the study of inclusive production of η-mesons in hadron-nucleon and hadron-nucleus interactions at 10.5 GeV, obtained on HYPERON spectrometer, have been analyzed with the aim of fixing a new limit on $K^{\circ}_{s} \to e^{+}e^{-}$ decay branching ratio. The experimental set-up includes the multichannel total absorption shower detector and the active converter, both made of lead-glass, and multiwire proportional chambers. The obtained new value of the upper limit for the branching ratio of the K°_{s} decay into $e^{+}e^{-}$ is:
$B.R.(K^{\circ}_{s} \to e^{+}e^{-}) < 1.1\cdot 10^{-4}$ at the 90% confidence level.

The investigation has been performed at the Laboratory of Nuclear Problems, JINR.

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