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ON THE RADIAL EXCITATIONS OF THE LIGHT MESONS

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The difficulties of theoretical considerations of radial excitations of the light mesons are discussed. It is suggested to perform the partial-wave analysis of the experimental data on the diffractive $K\pi\pi$ production in the effective mass region of 900—1200 MeV to obtain the information on the first K-meson radial excitation.

The investigation has been performed at the Laboratory of Particle Physics, JINR.

Радиальные возбуждения легких мезонов

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Обсуждается проблема радиальных возбуждений легких мезонов. Предлагается провести парциально-волновой анализ экспериментальных данных по дифракционному $K\pi\pi$ рождению в области эффективных масс 900—1200 МэВ с целью получения сведений о первом уровне радиального возбуждения K-мезона.

Работа выполнена в Лаборатории сверхвысоких энергий ОИЯИ.

At present there is a great amount of experimental data on diffractive production of $K\pi\pi$ system everywhere in the world. The author emphasizes the necessity to perform the partial-wave analysis (PWA) of the data wherever they exist to get an information which should witness the existence of radially excited K-meson in the $K\pi\pi$ effective mass region 900—1200 MeV. The suggestion has the following grounds.

In the last years the radial excitations of light mesons (π and K) have been discovered in the experiments on diffractive production of 3π and $K\pi\pi$ systems at different energies. For instance, in the 5-th joint CERN—JINR experiment (Bologna—Dubna—Milan collaboration) at the IHEP accelerator the reactions

$$\pi + A \to 3\pi + A$$

and

$$K + A \to K\pi\pi + A$$

were investigated in 1977—1984. The PWA has been performed in the mass region above 900 MeV for 3π and above 1100 MeV for $K\pi\pi$ systems. The reason to begin analysis from 900 and 1100 MeV is historical: the PWA initially was performed to look inside A_1 and A_3 «bumps» in 3π system (A_1 starts from 900 MeV), and Q_1 and Q_3 «bumps» in $K\pi\pi$ system (Q_1 starts from 1100 MeV). Two resonances $\pi(1240)$ and $\pi(1770)$ in the 3π system with the quantum numbers of the pion [1] and one resonance $K(1460)$ in the $K\pi\pi$ system with the quantum numbers of K-meson [2], have been observed. Resonances $\pi(1240)$ and $K(1460)$ have been interpreted as 2^1S_0 states — the first radial excitations of π- and K-mesons, accordingly. The other groups (see [3] or [4], for example) have presented the PWA in the same region.

In 1985 a relativistic quark model of hadron states was developed and compared with the experimental data [5]. But the above mentioned assignment of the $\pi(1240)$ as 2^1S_0 state to tune parameters of the model, created a problem to identify the 2^3S_1 state — the first radial excitation of ρ-meson: the ρ level predicted by the model at 1450 MeV, was not compatible with the data. Moreover, to obtain a sensible fit the authors were made attribute masses 150 MeV to pion and 470 MeV to kaon instead of real masses.

Another approach ($\pi(1240)$ is considered as 3^1S_0 state — that is as the second radial excitation of pion) was suggested in paper [6]. In this case the model requires that there should be one more pion radial excitation level with a mass in the region 700—800 MeV.

The recently performed partial-wave analysis of the data on diffractive 3π-production in the effective mass region 600—900 MeV has shown [7] that indeed there is an indication of existence of a new radially excited state in the 3π system with a mass 749 ± 30 MeV and width 32 ± 17 MeV.

For $K\pi\pi$ states the model [5] predicts the state $K(1450)$ as the first radial excitation of kaon if the 3π state $\pi(1240)$ is considered as the first radial excitation of pion. But the same model with the $\pi(749)$ as 2^1S_0 state, will identify the $K(1460)$ of ref. [2] as 3^1S_0 state and will require new additional resonance 2^1S_0 which should be the first radial excitation in the $K\pi\pi$ system.

One can hope that the PWA of the existing data in the region 900—1200 MeV will give an indication on existence of this resonance. If it is so it should

be desirable to come back to experiment and collect more $K\pi\pi$ data, concentrating attention (with the help of a more strict trigger system, for instance) in the region below 1200 MeV.

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