

Production of Ψ/J particles in reactions of the charge-exchange type

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(Submitted July 29, 1975)

Pis'ma Zh. Eksp. Teor. Fiz. **22**, No. 6, 331–332 (20 September 1975)

It is shown that the cross section for the production of particles in reactions of the charge-exchange type is strongly suppressed, as follows from the experimental data, in comparison with the cross section for the production of particles consisting of p and n quarks. This offers evidence in favor of the structure $\Psi = (c\bar{c})$.

PACS numbers: 14.40., 12.40.D

The IHEP-CERN experiment^[1] has yielded an upper-bound estimate for the cross section of the production of Ψ (or J) particles in a reaction of the charge-exchange type

$$\pi^- p \rightarrow \Psi n, \quad (1)$$

multiplied by the relative width of the radiative decay $BR_{\eta\gamma} = \Gamma_{\eta\gamma}/\Gamma_{\text{all}}$, viz., $\sigma BR_{\eta\gamma} < 3 \times 10^{-34} \text{ cm}^2$. The value of BR was recently determined in experiment, $BR_{\eta\gamma} \approx 1\%$.^[2] Using this value, we can use the data of^[1] to obtain an upper-bound estimate of the cross section of the reaction (1) at a momentum 40 GeV/c:

$$\sigma(\pi^- p \rightarrow \Psi n) < 3 \cdot 10^{-32} \text{ cm}^2$$

(at a 90% confidence level).

This value is ~ 30 times smaller than the cross sec-

tion expected for the reaction (1) in the case of formation of an ordinary meson (i. e., made up of $p\bar{p}$ and $n\bar{n}$ quarks) with mass 3 GeV. So strong a suppression of the cross section of the reaction (1) is a weighty argument in favor of the assumption that the Ψ particle is a pure (or almost pure) state of charmed $c\bar{c}$ quarks. Its production in the reaction (1) is forbidden by the Zweig rule, just as in the case of a ϕ meson consisting of $\lambda\bar{\lambda}$ quarks, the production of which in a reaction of the charge-exchange type $\pi\bar{p} \rightarrow \phi n$ is suppressed by a factor ~ 50 .^[3]

¹V. D. Apel' *et al.* Preprint IFVE 75-28, Serpukhov, 1975; *Phys. Lett.* **56B**, 190 (1975); Internat. Conf. on High Energy Physics, Paper L-55, Palermo, Italy, 1975.

²G. Wolfetal, Internat. Conf. on High Energy Physics, Paper A2-01, 02, Palermo, Italy.

³E. Bracci *et al.*, CERN/HERZ 72-1, Geneva, 1972.