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ЕРЕВАНСКИЙ ФИЗИЧЕСКИЙ ИНСТИТУТ

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G.L.BAYATYAN, A.J.MARGARYAN

ON THE GROWTH OF HADRONIC PHOTOABSORPTION CROSS-SECTION

ЦНИИатоминформ

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Г.Л.БАЯТЯН, А.Т.МАРГАРЯН

О РОСТЕ ПОЛНОГО СЕЧЕНИЯ АДРОННОГО ФОТОПОГЛОЩЕНИЯ

Энергетическая зависимость полного сечения адронного фотопоглощения обсуждается в связи с гипотезой о глюонной природе роста сечений.

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G.L.BAYATYAN, A.J.MARGARYAN

ON THE GROWTH OF HADRONIC PHOTOABSORPTION CROSS SECTION

Energy dependence of total hadronic photoabsorption cross section is discussed in connection with the hypothesis about gluonic nature of cross-sections growth.

Yerevan Physics Institute
Yerevan 1985

The experimental data, obtained at energies up to 20 GeV, indicate that as energy increases there takes place a smooth falling off of hadron interaction cross sections, tending to a constant value following the dependence predicted by the Regge poles for asymptotic region:

$$\sigma_{tot}^{R}(s) = \sigma_{\infty}^{R}\left(1+a/\sqrt{s}\right) \qquad (1)$$

Here S -is the total energy square in center-of-mass system. At energies above 20 GeV total cross sections deviate from the dependence (1) and agree with the Fruassar boundary estimate [I].

$$\sigma_{tot}(s) = \text{const} + A\ln^2(s/s_0) \qquad (2)$$

However, the coefficient A in this equation as practice shows, has the value of about GeV^{-2}, i.e., it turns out to be considerably less than it has appeared from the Fruassar theorem if the growth (2) is determined by the least mass in t-channel reaction ($2m_\pi$).

Gerstein and Logunov [2] have suggested the hypothesis, according to which the increase of total cross sections is due to resonant production of glueballs at central collision

of "sea" gluons-constituents of a hadron. In this case the exchange mechanism in the t-channel, connected with hard gluon states having mass of about (1-2) GeV, gives the scale factor before $\ell n^2(S)$. It naturally appears from this hypothesis, that the total cross section may be expressed as a sum of the "Regge" cross section (1) and the growing (gluonic) part:

$$\sigma_{tot}(S) = \sigma^R_{tot}(S) + \sigma^g_{tot}(S) \qquad (3)$$

Experimental data analysis showed [3], that hadron interaction cross sections can be successfully presented in terms of Eq.(3), and the dependence $\sigma^g_{tot}(S)$ in terms of the expression:

$$\sigma^g_{tot}(S) = \alpha \ell n(S/S_0) + \beta \ell n^2(S/S_0) \qquad (4)$$

where $\alpha = 0{,}46 \pm 0{,}15$ mb, $\beta = 0.27 \pm 0.10$ mb $(\sigma^g_{tot}(S<S_0)=0)$ the dependence σ^g_{tot} on S for various particles differing only by the shift on S-scale, as expected from Ref. [2], i.e., the cross section σ^g_{tot} as a function of a measureless variable S/S_0 is universal and independent of the type of hadrons. The value $S=S_0$ at which σ^g_{tot} starts to grow turns out to be larger for nucleon-nucleon collisions than for meson-nucleon ones ($S_0 = 29 \pm 3$, 48 ± 4 and 82 ± 6 for K^+, π^+ and P, respectively). This fact also testifies in favour of glueball hypothesis [2] - i.e., gluons in a meson are harder than in a nucleon. Further the hadronic photoproduction cross section $\sigma_{tot}(\gamma P)$ is discussed within the framework of this idea. The experimental data obtained at the energies $E_\gamma \leq 20$ GeV [4,5], have Regge behaviour. They may be presented

in terms of the expression [4]:

$$\sigma^R_{tot}(\gamma P) = (98{,}7 + 65/\sqrt{E_\gamma})\,\mu b \qquad (5)$$

where E_γ - is the energy of the incident photon in GeVs. Within experimental errors in this energy range they can also be presented by

$$\sigma_{tot}(\gamma P) = \frac{1}{220}\left(\frac{\sigma_{tot}(\pi^- P) + \sigma_{tot}(\pi^+ P)}{2}\right). \qquad (6)$$

As the energy increases, the experimental data begin to grow and deviate from the dependence (5) and (6). According to the "glueball" hypothesis the total hadronic photoproduction cross section at high energies like hadron-hadron sections can be defined as:

$$\sigma_{tot}(\gamma P) = \sigma^R_{tot}(\gamma P) + \sigma^g_{tot}(\gamma P) \qquad (7)$$

In Fig.1 there are given experimental results [6] together with the values $\sigma_{tot}(\gamma P)$ calculated by the help of Eq. (7). $\sigma^R_{tot}(\gamma P)$ was determined from Eq.(5), and the gluonic part of the cross section- from the following expression:

$$\sigma^g_{tot}(\gamma P) = \frac{1}{220}\sigma^g_{tot} \qquad (8)$$

The values of S_0 in case of photons appear to be 22 ± 6. As can be seen from the Figure, the gluonic mechanism of the cross section increase with increasing energy satisfactorily explains also total hadronic photoabsorption cross sections observed in the experiment in the energy range (20-200) GeV. Future measurements of $\sigma_{tot}(\gamma P)$ with errors of $\lesssim 1\%$ in the energy range

(2-30) GeV will allow to make the values of S_0 more exact and to check up the validity of the dependence (7) at higher energies (Tevatron FNAL,UNK IFVE and other).

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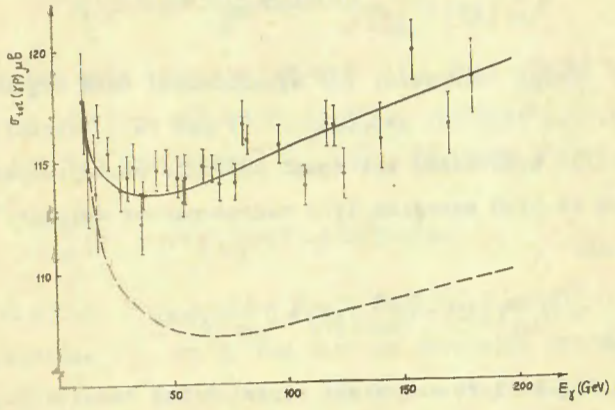

Fig.1. Energy dependence of total cross section of hadronic photoabsorption by protons. The dotted curve corresponds to Eq. (6); the solid one-to Eq. (7). Experimental points are taken from Refs. [4,6].

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