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INCREASE OF TOTAL CROSS SECTIONS AND SLOPE OF DIFFRACTION PEAK

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Predictions for the behavior of the total cross sections are obtained on the basis of the available experimental data on hadron-hadron collisions and the general principles of quantum field theory.

This article[1)] examines the possibility that the growth of the total K^+p-interaction cross section, observed at Serpukhov [1], and the rapid growth of the pp cross section recently observed at CERN [2], may have the same physical nature. Experimental consequences for the verification of this possibility are indicated. It is shown that the behavior of the slope parameter of the diffraction peak does not contradict the considered mechanism.

The CERN measurements have shown that the total cross section of the pp interaction begins to increase starting approximately with 100 GeV, and its behavior in the range 50 - 1500 GeV is given by

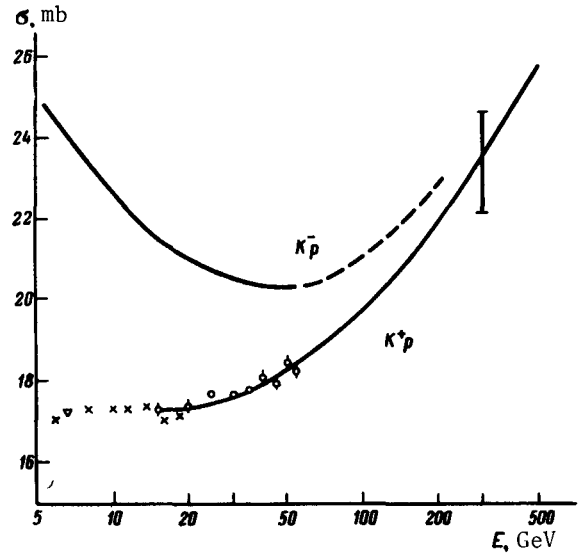
$$\sigma = \sigma_0 + \sigma_1 [\ln (E/E_0)]^\nu, \qquad (1)$$

where $\sigma_0 = 38.4 \pm 0.3$ mb, $E_0 = 100$ GeV, $\sigma_1 = 0.9 \pm 0.3$ mb, and $\nu = 1.8 \pm 0.4$. The last number does not contradict the assumption that the cross section reaches the Froissart limit [3]. The parameter σ_1 decreases to 0.7 if the terms that decrease with energy are taken into account in (1). For concreteness, we consider

$$\sigma_1 = 0{,}7 \pm 0{,}2 \text{ mb}, \quad \nu = 2. \qquad (2)$$

The Froissart limit, as is well known, corresponds to saturation of the partial waves up to the maximum moment compatible with analyticity. It is natural to assume that this mechanism, if it operates at all, is universal for all elastic hadron processes and has an asymptotic value $\sigma_1 \ln^2 E$ as $E \to \infty$ for all total hadron cross sections.

In the case of finite energies, of course, the next terms in the asymptotic series, which depend on the reaction, are important. In a final



Predicted behavior of total K^+p cross section in the case of the universal Froissart mechanism. The vertical bar at 300 GeV corresponds to the errors of the parameter σ_1 (formula (2)) and of the K^+p cross section [1]. The tentative behavior of the total K^-p cross section is also indicated.

energy interval they can be approximated by ln E and a constant, which yields formula (1), where σ_1 and ν are universal while σ_0 and E_0 depend on the process. The parameter E_0 is determined by the region where the cross section begins to increase. For the K^+p cross section we have $E_0 \simeq 17$ GeV, i.e., several times smaller than for pp. Formula (1) with $\sigma_0 = 17.2$ mb and $E_0 = 17$ GeV, and with the sama parameter values as in (2), describes well the K^+p-cross section growth observed at Serpukhov, and predicts a rather fast growth of this cross section at Batavia (see the figure).

If the total cross section increases like $\ln^2 E$, then it follows from the general axioms [4] that the diffraction-peak slope parameter should increase in accord with the same law, $b \to b_1 \ln^2 E$. It is easy to estimate, however, that the coefficient b_1 is very small. We consider, for example, the rigorous inequalities as $E \to \infty$ (see [4])

$$\sigma \leqslant (4\pi/t_0)\ln^2 E, \qquad (d\sigma/dt)_{t=0} \leqslant (\sigma_{el}/4t_0)\ln^2 E, \tag{3}$$

where σ_{el} is the total elastic-scattering cross section. If saturation obtains, then the inequalities (3) can be replaced by equalities, and by virtue of (1) we have $4\pi/t_0 = \sigma_1$. Hence as $E \to \infty$ we have

$$b \equiv (d\sigma/dt)_{t=0}/\sigma_{el} = (\sigma_1/16\pi)\ln^2 E, \tag{4}$$

i.e., $b_1 = \sigma_1/16\pi = 0.04$ $(\text{GeV/c})^{-2}$. If, as above, we take into account the next terms of the asymptotic expressions, then

$$b = b_0 + 2\alpha' \ln(s/s_0) + b_1[\ln(E/100\ \text{GeV})]^2, \tag{5}$$

where the first two terms are the usual ones (in particular, $b_0 = 7.0 \pm 1.2$ $(\text{GeV/c})^{-2}$) and the last term does not exceed 0.4 $(\text{GeV/c})^{-2}$ in the 10 - 2000 GeV region, i.e., it is much smaller than the experimental errors.

Thus, the available data do not contradict the universal Froissart growth of the total cross section, and the measurement of the total cross sections in Batavia, particularly the K^+p cross section, is of great interest.

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POSSIBILITY OF LARGE RADIOELECTRIC EFFECT IN A CHOLESTERIC DIELECTRIC

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It is shown that a radioelectric effect, due to the dependence of the pitch of the cholesteric helix on the magnetic field, can be produced in a cholesteric dielectric. The field can be much stronger than in conducting media.

The radioelectric (optoelectric) effect, i.e., the production of a constant electric field E^0 by passage of electromagnetic waves through a medium, has been investigated so far only in