The Inelastic Cross Section versus the Centre-of-Mass Energy for Proton-Proton Collisions

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Abstract: Here, applying the Scale-Symmetric Theory (SST), we calculated the inelastic cross section versus the centre-of-mass energy for proton-proton collisions. For centre-of-mass energies lower than 34.2 TeV, the obtained theoretical results overlap with the Standard-Model predictions but for energies of proton higher than 17.1 TeV, contrary to the Standard-Model prediction, there appears the asymptote: cross-section = 82.4 mb = constant. It follows from the fact that due to the production of the 17.1 TeV Higgs-boson-like particles, the protons cannot be accelerated above energy 17.1 TeV. Just whole surplus proton energy is instantaneously emitted. It is associated with the internal structure of the core of baryons. Emphasize that calculated here the cross section for energy 13 TeV (73.1 mb) is the central value obtained in the ATLAS experiment.

1. Introduction and motivation

According to the Scale-Symmetric Theory (SST), [1], the asymptotic freedom for the strong interactions follows from the fact that the absolute rest mass of virtual pions decreases with increasing energy of nucleons [2]. It means that with increasing energy/temperature, effective radius of nucleons, so characteristic wave length as well, increases. In the luminal Einstein spacetime, [1], the moving nucleons have the four degrees of freedom (the moving neutrinos, which are the non-relativistic objects, [1], have the two degrees of freedom [3]) so temperature is directly proportional to four powers of the characteristic length. On the other hand, the cross section is directly proportional to two powers of the characteristic length. Applying the Stefan-Boltzmann law for total emitted energy of a black body, E, we obtain

$$E \sim T^4 \sim \lambda_{Charact.}{}^{16} \sim \sigma_{Cross\text{-}section}{}^{8}. \qquad (1)$$

It leads to following relation

$$\sigma_{Cross\text{-}section} = F\, E^{1/8}. \qquad (2)$$

Calculate the factor F from the initial conditions. We know that the muon radius of proton is $R_{proton(muon)} = 0.84074$ fm [4], i.e. the cross section is $\sigma_{Cross\text{-}section} = \pi\, R_{proton(muon)}{}^2 =$

22.206 mb – this value is for the rest energy of proton i.e. for E = 0.93827 GeV. Applying formula (2) we obtain

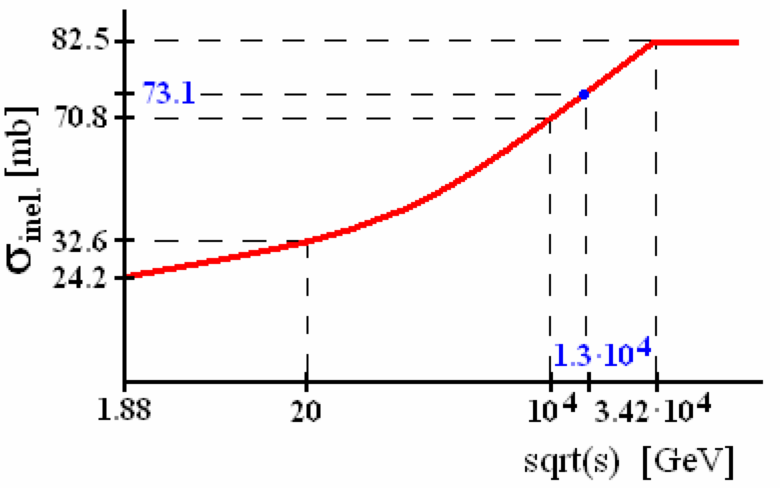
$$F = 22.384\ \text{mb/GeV}^{1/8}. \quad (3)$$

Calculate a few inelastic cross sections for different centre-of-mass energy for proton-proton collisions, E = sqrt(s)

$$\sigma_{\text{Cross-section}} = F\ \text{sqrt(s)}^{1/8}. \quad (4)$$

For sqrt(s) = 2 M_{Proton} is $\sigma_{\text{Cross-section}}$ = 24.2 mb, for sqrt(s) = 20 GeV is $\sigma_{\text{Cross-section}}$ = 32.55 mb, for sqrt(s) = 10^4 GeV is $\sigma_{\text{Cross-section}}$ = 70.78 mb, for sqrt(s) = 13 TeV is $\sigma_{\text{Cross-section}}$ = 73.1 mb (it is the central value obtained with the ATLAS Detector (!) [5]), for sqrt(s) = 2·17.1 = 34.2 TeV is $\sigma_{\text{Cross-section}}$ = 82.5 mb.

For centre-of-mass energies lower than 34.2 TeV, the obtained theoretical results overlap with the Standard-Model predictions, [6], but for energies of proton higher than 17.1 TeV, contrary to the Standard-Model prediction, there appears the asymptote: $\sigma_{\text{Cross-section}}$ = 82.5 mb = constant. It follows from the fact that due to the production of the 17.1 TeV Higgs-boson-like particles, the protons cannot be accelerated above energy 17.1 TeV [1]. Just whole surplus proton energy is instantaneously emitted. It is associated with the internal structure of the core of baryons [1].



The total inelastic cross section versus the centre-of-mass energy for proton-proton collisions within the SST.

References

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