Fittings to Multiparticle Production for Proton – Antiproton Collisions upto 1 TeV

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Introduction

During last two or three decayed, the nuclear collisions at relativistic energy offer the right kind of environment to explore a variety of phases transitions related to hot and its subsequent expansion result in production of particles along with the disassembly of the expanded nuclear system into multiparticle production which is related to the state of quark gluon plasma (QGP) so that it is predicted by quantum chromo dynamics (QCD) [1-3]

The paper entitled "Fittings to Multiparticle Production for Proton – Antiproton Collisions up to 1 Tev." reviews the facts and problems concerning the multiparticle productions in high energy collisions. Main emphasis is laid on the qualitative and quantitative description of general characteristics and properties observed for multiparticle production in such high energy collisions. Various features of available experimental data including the variations of mean charged multiplicity with centre-of-mass (cm) energies and the collisions centrality obtained from heavy ion collider experiments are interpreted in the context of various theoretical concepts and their implications. Several important scaling features observed in the measurements mainly at RHIC, LHC and CERN experiments are highlighted in the view of these models to draw some insight regarding the multiparticle production mechanism in heavy ion collisions. [4-6]

Present Parameterization

An analysis of the available data on mean charged multiplicity has been considered in the present work with a view to finding whether,

(a) The mean charged multiplicity $\langle n_{ch} \rangle_{p\bar{p}}$ data can be parameterized low as well as high values of the energy by the same parameterization.

(b) Each term may explain the related physical concept of interaction process. For it we have considered that all the parameters A, B, C, and D should be energy dependent so that they may be consistent with associated phenomenology.

In the present work, an attempt is made to modify the earlier parameterization [7-9]

$$\langle n_{ch} \rangle_{p\bar{p}} = A + B\, ln\sqrt{S} + C\left(ln\sqrt{S}\right)^2 + D\left(ln\sqrt{S}\right)^3$$

Calculations

In the present paper, the calculation of mean charged multiplicity for proton-antiproton interactions is based on the given formula in the form as

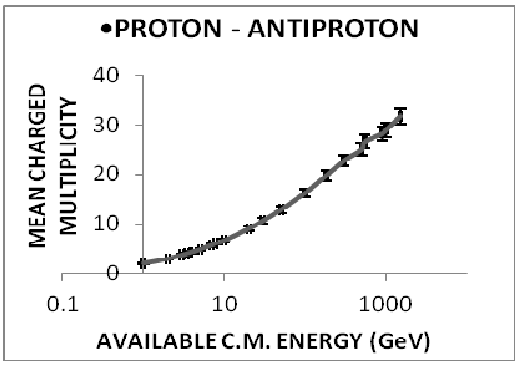
$$\langle n_{ch} \rangle_{p\bar{p}} = A + B\, ln\sqrt{S} + C\left(ln\sqrt{S}\right)^2 + D\left(ln\sqrt{S}\right)^3$$

The various terms of the present parameterization have their own identity and may express the contribution of particular type of interaction process. To predict the experimental data, the value of the parameter A and parameter D are considered to be constant but the values of the parameters B and C are considered to be variable, depending upon some other factors, based on the concerned interaction process. Various calculated values of mean charged multiplicity at different cm energy are given in the Table along with the corresponding experimental data.

The value of parameter B is considered, in this present work, to be dependent on the ratio ρ of the real to the imaginary part of the coulomb amplitude. The value of parameter C is considered, in the present work, to be dependent on the absorption coefficient α_s.

Table:-Mean charged multiplicity $\langle n_{ch}\rangle_{p\bar{p}}$ at different cm energy in the proton – antiproton collisions. Here A = 2 and D = ± 0.01but parameter B and C are calculated as a function of cm energy.

Energy (GeV)	Para meter B	Para meter C	Para meter D	$\langle n_{ch}\rangle_{p\bar{p}}$ Calcu lated	$\langle n_{ch}\rangle_{p\bar{p}}$ Experi mental
2	0.98	0.56	-0.01	2.93	2.92 ±0.20
2.86	0.97	0.56	-0.01	3.62	2.54 ±0.03
3.0	0.97	0.54	-0.01	3.61	3.4 ±0.30
3.55	0.97	0.52	-0.01	4.03	3.39 ±0.04
3.86	0.97	0.52	-0.01	4.22	3.47 ±0.25
4.37	0.96	0.52	-0.01	4.50	3.63 ±0.03
4.93	0.96	0.52	-0.01	4.80	3.92 ±0.10
5.0	0.96	0.50	-0.01	4.79	4.05 ±0.50
5.4	0.96	0.50	-0.01	4.99	4.12 ±0.06
6.6	0.97	0.50	-0.01	5.54	4.68 ±0.06
7.0	0.97	0.47	-0.01	5.58	5.05 ±0.40
7.86	0.98	0.47	-0.01	5.92	4.98 ±0.09
10.0	0.99	0.47	-0.01	6.89	--
13.8	1.00	0.47	-0.01	7.67	6.74 ±0.04
20.0	1.05	0.47	-0.01	9.09	--
30.0	1.10	0.46	-0.01	10.6	9.8 ±0.80
50.0	1.12	0.46	-0.01	12.8	--
100.0	1.12	0.46	-0.01	15.9	--
180.0	1.13	0.44	-0.01	18.3	19.5 ±0.70
300.0	1.13	0.44	-0.01	20.8	--
500.0	1.12	0.43	0.01	27.9	--
540.0	1.11	0.43	0.01	28.4	27.8 ±0.80
900.0	1.10	0.41	0.01	31.5	31.2 ±1.1
1000.0	1.00	0.41	0.01	31.7	--



Graph shows the variation of mean charged multiplicity as a function of cm energy. The curve shows the present work. The experimental data has been taken from ref. [3,5,7].

Result

The mean charged multiplicities $\langle n_{ch}\rangle_{p\bar{p}}$ for proton-antiproton collisions is calculated in this present work, at different energies using present parameterization. The energy range to calculate $\langle n_{ch}\rangle_{p\bar{p}}$ for proton-antiproton interaction is considered between 2.0 GeV. to 1000 GeV., a slow increasement in $\langle n_{ch}\rangle_{p\bar{p}}$ is found as the incident energy increases. Here we take the value of parameter D is – 0.01 up to lower energy (i.e. 300 GeV.) due to presence of Columbian force in compression and 0.01 for higher range of energy due to no effect of Columbian force in rarefaction. The results of the present parameterization are well in consistent with the experimental data. A slight deviation is seen inf experimental data from the proposed fitting is due to some experimental errors.

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