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Charged particle multiplicity and pseudorapidity distribution and forward-backward rapidity correlation at LHC energies

Content :

We extrapolated the multiplicity (N_{ch}) and pseudorapidity distribution ($dN_{ch}/d\eta$) of primary charged particles in $p+p$ collisions at Large Hadron Collider (LHC) energies of $\sqrt{s} = 10$ and 14 TeV from the existing measurements at lower \sqrt{s} . These distributions are then compared to calculations from PYTHIA and PHOJET models. The existing \sqrt{s} measurements are unable to distinguish between a logarithmic and power law dependence of the average charged particle multiplicity (N_{ch}) on \sqrt{s} , and their extrapolation to energies accessible at LHC give very different values. Assuming a reasonably good description of inclusive charged particle multiplicity distributions by Negative Binomial Distributions (NBD) at lower \sqrt{s} to hold for LHC energies, we observe that the logarithmic \sqrt{s} dependence of $\langle N_{ch} \rangle$ are favored by the models at midrapidity. The $dN_{ch}/d\eta$ distribution for the existing measurements are found to be reasonably well described by a function with three parameters which accounts for the basic features of the distribution, height at midrapidity, central rapidity plateau and the higher rapidity fall off. Extrapolation of these parameters as a function of \sqrt{s} is used to predict the pseudorapidity distributions of charged particles at LHC energies. $dN_{ch}/d\eta$ calculations from PYTHIA and PHOJET models are found to be lower compared to those obtained from the extrapolated $dN_{ch}/d\eta$ distributions for a broad η range. The $dN_{ch}/d\eta$ distributions obtained from the extrapolation procedure are found to agree with the new data from LHC at 2.36 and 7 TeV. One way to understand the particle production mechanism in $p+p$ collisions is through studying the forward-backward (FB) charged particle multiplicity correlation. In this work the FB correlation strength, b , as a function of pseudorapidity intervals for experimental data from $p+\bar{p}$ non-single diffractive collisions are compared to PYTHIA and PHOJET model calculations. Strong forward backward correlations are associated with cluster production in the collisions. The average number of charged particles to which the clusters fragments, called the cluster size, are found to increase linearly with $\ln \sqrt{s}$ for both data and the models studied. The rate of increase in cluster size vs. $\ln \sqrt{s}$

from models studied are larger compared to those from the data and higher for PHOJET compared to PYTHIA. Our study indicates that the FB measurements will provide a clear distinguishing observable for the models studied at LHC energies.

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