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Dissertation Council
For the Defense of Anatolii Iurevich Egorov
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Report on the PhD Dissertation

« Search for BFKL evolution effects in dijet production with large rapidity separation at energies of the Large Hadron Collider »

Submitted by Mr. Anatolii Iurevich Egorov

in partial fulfillment of the Degree of Candidate of Sciences in Specialization 01.03.15 — Physics of Atomic Nuclei and elementary particles, High Energy Physics

The purpose of this work is to deepen our understanding of the complex phenomena that take place in hadron collisions in the energy domain investigated at CERN-LHC by the CMS experiment, and to develop a description of the processes revealing the novel profound dynamics of QCD in the interaction between quarks and gluons.

The background of these studies is well described, related on one side to the advances of the Gribov-Lipatov-Altarelli-Parisi-Dokshitzer (GLAPD) formalism, and on the other side to the need of developing the Balitsky-Fadin-Kuraev-Lipatov (BFKL) evolution equations beyond the leading logarithm approximation.

The work is well balanced between experimental and theoretical aspects.

The interesting experimental observables such as specific cross sections and dijet production are obtained, for inclusive pp collisions at 2.76 GeV and ratios of cross sections are built. The careful study of the different systematic errors, in particular the jet energy scale and resolution, shows that the analysis is reliable and the effects are under control.

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The experimental results motivate the development of theoretical calculations in the BFKL approach at higher order (NLL), beyond the approaches already implemented in the commonly used Monte Carlo event generators. Important work is necessary to adapt theoretical approaches to the experimental conditions in order of comparing data and theory.

In this respect, the study of the uncertainties that are inherent both to the theory and the experiment is particularly valuable.

The comparison of different cross sections and of their ratios, at different energies allows to characterize and shows the way to disentangle different effects as color coherence at large rapidity separation between jets, allowing to conclude in a convincing agreement of the NLL BFKL calculation combined with the Banfi-Marchesini-Smye (BMS) approach.

Of particular importance is the interplay between data analysis, Monte Carlo simulations and theoretical calculations, which requires a good understanding of different aspects of the experiment. The development of new methods that apply to the specific conditions and regimes where the data are collected is especially valuable.

Especially interesting is the focus on - and the extension of - theoretical methods earlier suggested particularly in St. Petersbourg (Leningrad), that are known and applied worldwide.

This work constitutes an original contribution to LHC physics. The pedagogical introduction and the clear and detailed explanations and derivations will make this manuscript as a reference for the students who will enter in this domain in future.

Therefore, I am in favor of the attribution to Anatolii Iurevich Egorov of the Degree of Candidate of Physical and Mathematical Sciences, specialization 1.3.15, Physics of Atomic Nuclei and Elementary Particles, High Energy Physics.

Saclay, March 5, 2024

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