

REVIEW

of the summary of the dissertation by Pavel Vladimirovich Tereshko, “*Study of Soft Processes in Quantum Chromodynamics and Correlation Phenomena in Proton-Proton Interactions in the ATLAS Experiment at the Large Hadron Collider*”, submitted for the degree of Candidate of Physical and Mathematical Sciences in the specialty 01.04.23 – “*High-Energy Physics*”

The dissertation of Pavel Vladimirovich Tereshko is devoted to a topical subject in experimental high-energy physics, namely, the determination of the energy scale of the iron-scintillator hadron calorimeter in the ATLAS experiment at the LHC, and the study of charged particle distributions and their Bose-Einstein correlations in proton-proton interactions at energies of 0.9–13 TeV. This research allows the investigation of strong interactions at low transferred momenta and the space-time structure of the hadronization region.

The novelty of the scientific results lies in the investigation of the characteristics of the iron-scintillator hadron calorimeter modules using beams of electrons, pions, protons, and muons at the SPS (CERN), and the determination of the electromagnetic calibration constant, as well as the study of the calorimeter’s linearity and resolution. For the first time, the distributions of charged particles in proton-proton interactions at an energy of 13 TeV were studied in the ATLAS experiment in the kinematic region transverse momentum $p_T > 500$ MeV and pseudorapidity $|\eta| < 2.5$, and the results were compared with predictions of a number of Monte Carlo models. For the first time, an analysis of the probability density distributions of charged particle multiplicity in proton-proton collisions over the energy range 0.9–13 TeV was performed. It was shown that the normalized distributions tend to become energy-independent at high energies. For the first time, it was established that KNO (Koba–Nielsen–Olesen) scaling holds in the region where the normalized mean multiplicity is greater than one.

A study of two-particle Bose-Einstein correlations (BEC) in proton-proton collisions at 13 TeV was carried out. The correlation parameters, characterizing the hadron source radius and the correlation strength, were investigated in a record kinematic range as a function of charged particle multiplicity and the average transverse momentum of particle pairs. The effect of flattening of the source radius parameter’s dependence on charged particle multiplicity in the high-multiplicity region was observed.

The reliability of the results and the validity of the conclusions and recommendations are supported by the use of well-established methods for analysing experimental data, as well as by publications in the high-impact specialized journals and presentations at international conferences and seminars.

The results presented in the dissertation have high scientific and practical significance. In particular, the electromagnetic calibration constant (the calorimeter response to 1 GeV of absorbed energy) sets the energy scale of the calorimeter. On the other hand, the studied charged particle distributions are used to refine models and tune algorithms of new Monte Carlo particle generators and the results of the correlation studies will be used for constructing theoretical models of hadronization processes.

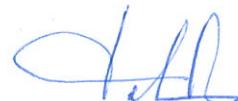
The dissertation reflects the personal contribution of the author to the research undertaken. He developed software tools to solve the tasks set and carried out a detailed analysis of the experimental data. Within the framework of the scientific work, the candidate independently

developed a complex software package using the ROOT environment for primary data processing, analysis, and visualization of results.

It is proposed that the degree of Candidate of Physical and Mathematical Sciences in the specialty 01.04.23 – “High-Energy Physics” be awarded to Pavel Vladimirovich Tereshko in recognition of the new, scientifically substantiated results presented in the conclusion.

I believe that the dissertation summary of Pavel Vladimirovich Tereshko demonstrates that the dissertation is an independently carried out, complete scientific-qualification work, making an important contribution to the field of high-energy physics. The dissertation summary fully complies with the standard regulations accepted in Europe for summary of candidate dissertations, and the candidate is worthy of being awarded the degree of Candidate of Physical and Mathematical Sciences in the specialty 01.04.23 – “*High-Energy Physics.*”

I give my consent for this review to be published in open access on the official website of the State Scientific Institution “*B.I. Stepanov Institute of Physics of the National Academy of Sciences of Belarus.*”



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