Contribution ID: **442** Type: **Poster report**

Glauber Monte-Carlo model at partonic lever for pp-collisions in a wide energy range

Wednesday 14 October 2020 18:50 (20 minutes)

At present, experiments devoted to studying collisions of hadrons and nuclei at high energy are being performed at various facilities, including the LHC and SPS (CERN) and RHIC (BNL). Due to the peculiarities of the strong interaction, constructing a collision model from the first principles of the QCD theory is a rather difficult task. Therefore, various empirical models are developed based on the available experimental data. The basic model for describing interactions involving hadrons and nuclei is the Glauber model [1-2]. For the more detailed description of nuclear interaction features, this model is increasingly being used at the parton level [3-5], however, usually, pp-interaction is given insufficient attention. Before the transition to the nucleus-nucleus collisions, one should ensure that the major features of the pp interaction are adequately described.

In this regard, the work is devoted to a systematic study of pp collisions in a wide energy range at the parton level.

The Glauber Monte Carlo model was developed and implemented for a detailed description of pp collisions at the parton level. Various types of spatial parton distributions in the proton are considered. It is shown that, within the framework of this model, such quantities as the total, elastic, and inelastic cross sections, the slope of the diffraction cone in the energy range from SPS to LHC are satisfactorily described, while the best agreement with experiment is obtained for the exponential form of the spatial parton distribution.

The self-consistency of the model is checked regarding the transition to a moving reference frame. An explicit form of the dependence of the number of initial partons on the beam energy is obtained, which ensures the exact Lorentz invariance of the cross sections and the slope of the diffraction cone, and the values of its parameters are determined. The behavior of proton-proton cross sections in the high-energy limit is analyzed. The developed approach can be applied not only to pp interaction but also can serve as the basis for more advanced models of both pp and AA collisions.

References

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Session Classification: Poster session 4 (part 2)

Track Classification: Section 4. Relativistic nuclear physics, elementary particle physics and high-energy physics.