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MC simulations of beam-beam collisions monitor for event-by-event studies at NICA

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The colliding beams of heavy ions (Au+Au, Pb+Pb or Bi+Bi), currently planned for NICA at JINR with the average luminosity at the level of 10^{27}cm^2/s, will provide the vast amounts of precise data at the center-of-mass energies up to 11 GeV per pair of nucleons. This will give the possibilities for the detailed, event-by-event studies of properties of high-density baryonic matter in the region of the expected onset of deconfinement, as well as for the search of the critical first-order end-point of the phase diagram of strongly interacting matter and of some signals of chiral symmetry restoration. With the aim of selection the events of interest, it was proposed in [1] to create a fast beam-beam collisions monitor, which would determine the time and space of each ion-ion collision, providing also the event-by-event information on the relevant multiplicity of charged particles. Circular (segmented ring-shaped) detectors on the microchannel plates (MCP) with high timing characteristics (signal duration below 1 ns) were suggested to be placed in vacuum of the beam-pipe at some distance from the interaction of the ion beams. The multipad readout system has to ensure the time-of-flight measurements with the accuracy below 50 ps, and multiplicity and azimuthal distributions of particles produced in collision.

In this report, we present our results of MC simulations of the beam-beam collisions monitoring system at NICA based on the MCP detectors. Different generators SMASH 1.8 [2], UrQMD [3], DQGSM [4] were used with the purpose to estimate the accuracy in determination of the position of the interaction point and multiplicity in the event. The assessments take into account the arrival times of particles to the detector, the rising edge of the current pulse in the MCP channels, the influence of communication lines, electronic equipment, and information retrieval technology.

The performed calculations show that it is the signal formation time in the microchannel plates that brings the main contribution to the error in determination of the interaction point. Calculations confirmed also the possibility of determining by this compact detector system the event multiplicity by using MCP detectors in the counting mode. The possibilities of event-by-event measurements of arrival times for different types of charged particles coming from the interaction point are also discussed.

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