

Fast way to determine pp -collision time at the SPD experiment

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The Spin Physics Detector, one of the two facilities of the future NICA collider at the Joint Institute for Nuclear Research, is for studying the nucleon spin structure and spin-related phenomena with polarized proton and deuteron beams. Understanding how dynamics of the quarks and gluons determine the structure and the fundamental properties of the nucleon is one of the interesting unsolved problems of QCD.

The main task of this work is to determine pp -collision time based on data from the Time-Of-Flight detector. Using the time when a particle intersects the detector and information about reconstructed tracks one can solve this problem. The pp -collision time allows to reconstruct particles' trajectories by the SPD tracker with high accuracy and to make particle identification.

Determination of the pp -collision time is an optimization problem. It can be solved by a brute-force algorithm, where all available variants of particles are checked. It is very slow method. Another approach is by a genetic algorithm, which works faster, for fewer number of steps. The idea of this project is to use fast simple methods to receive unbiased estimation of pp -collision time. We incorporate a priori knowledge about the process to accelerate solution of the problem even faster than the genetic algorithm.

For solving the problem the sliding window method was invented. The pp -collision time's estimation received by this method is unbiased and is expected to have a high resolution about 30 ps. The typical programme execution time is about 300 nanoseconds. It is 10^6 times faster than the brute-force algorithm and outruns the genetic one by a factor 10^3 .

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