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High-performance optimization of event simulation and track reconstruction software in the BM@N NICA experiment

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BM@N experiment of the NICA accelerator complex at the Joint Institute for Nuclear Research, Dubna is aimed at studying heavy ion collisions with fixed targets. The BmnRoot software package [1, 2] is used in the BM@N experiment and it plays a crucial role both in event simulations and in track and event reconstruction [3]. Event reconstruction may take significant time per event. Time of reconstruction depends on the kind of the colliding particles, the beam energy, the collision centrality and other parameters. Event simulations with realistic Monte-Carlo generators are also time-consuming. Processing of big amount of data which is produced in physical runs of the accelerator takes significant time, so the software performance should be optimized to make the data processing efficient [4].

We have performed high-performance optimization of the simulation and reconstruction modules of the BmnRoot software package. The optimization is based on the performance analysis [5] of the BmnRoot package on representative test cases and on localization of the performance bottlenecks in the software source code. Several approaches have been tested and the most suitable approaches to the BmnRoot optimization are chosen. Parallelization of some modules has been performed. Numerical estimates of the scalability and speedup of the parallelized modules for event simulation and reconstruction demonstrate good efficiency of parallelization.

Other approaches to high-performance optimization such as adaptation of the BmnRoot software package for hybrid computing systems, its vectorization and algorithmic optimization are also considered.

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