# On Overcoming the Crisis of Particle Tracking in High-Luminosity Experiments using Deep Learning Methods

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One of the key stages in the processing of experimental data of the HEP is the reconstruction of trajectories (tracks) of interacting particles from measurement data. For modern high-luminosity collider experiments, such as HL-LHC and NICA, a particular challenge for tracking is the very high, megahertz frequency of interactions, leading to an order-of-magnitude increase in the intensity of the data stream to be processed and, in addition, to a significant overlap of event track data when they are registered in track detectors. All these circumstances, recognized by physicists as the "Tracking Crisis", have shown that the tracking algorithms already in use are not efficient, accurate and scalable enough to handle data from high-luminosity experiments.

To overcome this crisis, in 2018 a group of physicists from CERN and other physics centers in the HEPTrkX project [1] staged a TrackML competition [2] to develop new solutions to tracking problems using deep neural networks. A dataset for their training and testing was prepared and published on the Kaggle platform [3]. The TrackML competition stimulated a number of important researches leading to the development of effective tracking algorithms using graph neural networks [4], transformers [5], as well as reanimation of tracking based on Hopfield neural networks, but with application of computational means of adiabatic quantum computers [6].

The experience in the development of tracking algorithms using machine learning methods, accumulated during the last decade by the specialists from MLIT JINR, allowed them to actively engage in research on overcoming the problems of the tracking crisis not only using information from already published publications, but also to propose their original innovations taking into account the specificity of domestic detectors in the high-luminosity experiments of the NICA megaproject at JINR [7]. In the present report a brief review of the ongoing work is made and their prospects are discussed.

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## References


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