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Intelligent experiments through real-time AI: Fast Data Processing and Autonomous Detector Control for sPHENIX and future EIC detectors

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The processing of large volumes of high precision data generated by sophisticated detectors in high-rate collisions poses a significant challenge for major high-energy nuclear and particle experiments. To address this challenge and revolutionize real-time data processing pipelines, modern deep neural network techniques and AI-centric hardware innovations are being developed.

The sPHENYX experiment is the new detector designed to collect data at Brookhaven Lab's Relativistic Heavy Ion Collider. The overall goal of sPHENIX is to study the strong interaction implementing a real-time selection of rare decays of particles containing heavy quarks. The proposal for sPHENIX is to build an intelligent experiment where the control and data acquisition is smart because of AI and ML used in hardware, electronics and algorithm. The goals are:

extraction of critical data via selective streaming from complex data sets through real-time AI and automated control, anomaly detection and feedback for detector operation through real-time AI.

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