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Real-time, intelligent data processing for the next-generation of particle imaging detectors

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Liquid Argon Time Projection Chamber (LArTPC) particle detectors such as MicroBooNE, SBND, and DUNE produce 3D images of particle interactions using ionization charge collected by anode sensor arrays. One of the physics goals of these experiments is to look for rare and faint signals produced by interactions of beam-produced neutrinos or dark matter particles, or interactions of neutrinos from supernova bursts, or new fundamental physics such as baryon number violation processes. DUNE represents the largest LArTPC detector to be constructed, with millions of readout channels, where data rates can be as large as 5 terabytes per second. To record interactions of interest with 100% live time while meeting data storage and offline processing requirements, it is essential to reduce the data rates by implementing intelligent, real-time data selection techniques so as to preserve those rare signals with high accuracy. Existing LArTPCs such as MicroBooNE or the ProtoDUNE-Single Phase detector and their already collected data sets provide a unique opportunity to demonstrate data selection techniques following the DUNE data-selection strategy, providing an important proof-of-principle for applying such techniques to DUNE and other upcoming LArTPC experiments. This poster will describe the ongoing R&D efforts to also develop and demonstrate more advanced, AI-driven real-time data processing and data selection techniques, using the MicroBooNE and SBND detectors, and discusses real-time data processing challenges and opportunities for the next decade.

In-person or Virtual?

In-person

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