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LHCb Tracking Reconstruction and Ghost Rejection at 30 MHz

The new fully software-based trigger of the LHCb experiment operates at a 30 MHz data rate and imposes tight constraints on GPU execution time. Tracking reconstruction algorithms in this first-level trigger must efficiently select detector hits, group them, build tracklets, account for the LHCb magnetic field, extrapolate and fit trajectories, and select the best track candidates to filter events that reduces the 4 TB/s data rate by a factor of 30. Optimized algorithms have been developed with this aim. One of the main challenges is the reduction of "ghost"tracks—fake combinations arising from detector noise or reconstruction ambiguities. A dedicated neural network architecture, designed to operate at the high LHC data rate, has been developed, achieving ghost rates below 20%. The techniques used in this work can be adapted for the reconstruction of other detector objects or for tracking reconstruction in other LHC experiments.

Significance

This presentation covers the new tracking system on GPUs at LHCb, in particular the new downstream algorithm which is new for the 2025 LHC data taking period, and the way ghost tracks are reduced using a fast NN at 30MHz.

References

https://arxiv.org/abs/2503.13092 (submitted to Comput Softw Big Sc.)

Experiment context, if any

LHCb experiment at LHC (CERN)

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