

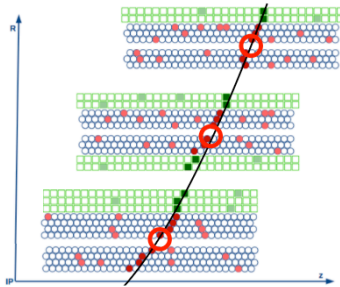
Enhancing the L0 Muon Trigger: project goals and needs



SMARTHEP Edge Machine Learning school (23-27 Sept 2024, CERN)

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L0 MDT trigger: improve the robustness of L0 muon trigger system against the potential loss of performance due to aging RPC detectors and to improve acceptance coverage

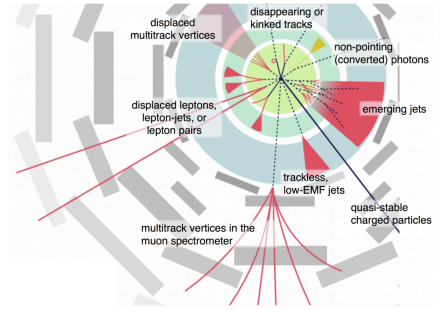


Hit Extraction
 RPCs provide seeds to identify MDT hits from a muon & set up segment fitting step

Segment Fitting
 RPCs provide timing to calibrate hits and derive segments

Momentum Estimation
 RPCs provide 2nd coordinate for the p_T estimate since B-field is non-uniform in phi

Exotic signatures: additional trigger strategies for non-pointing signatures from decay of long-lived exotic particles



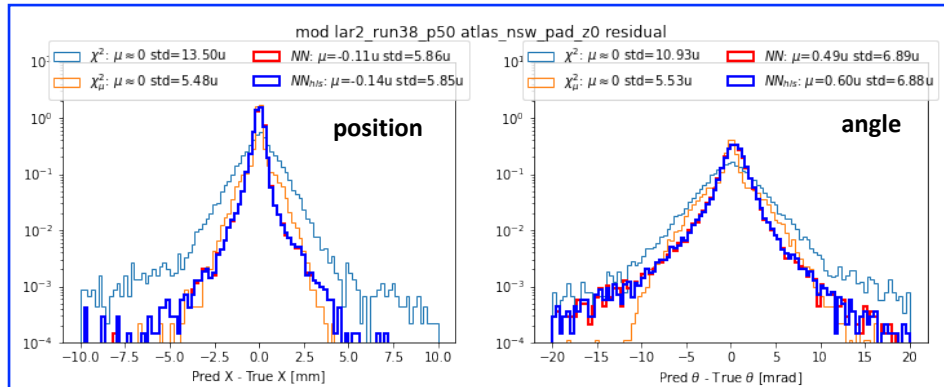
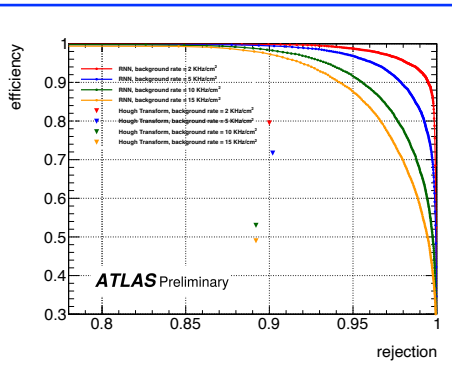
Implement novel trigger strategies in firmware
 Starting from displaced muons, but also interested in closeby muons, high multiplicity signatures, slow moving or highly ionizing particles

Goal is to be forward-thinking and use ML (CNN, RNN, GNN, ...) in FPGAs

Studies on muon detectors toy models for segment reconstruction show promising results

RNN for track hit identification

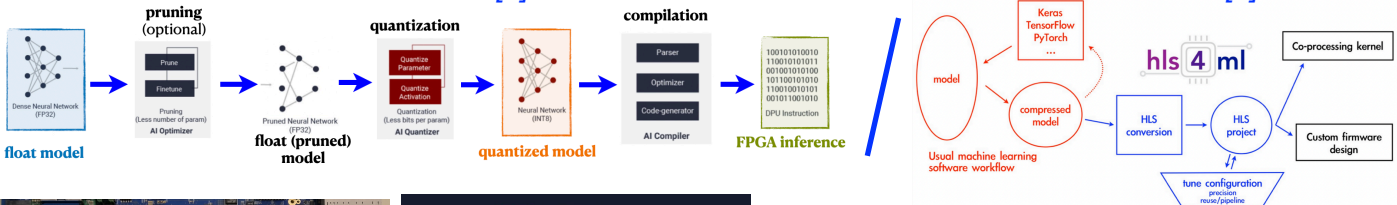
CNN for segment position and angle regression



Use already existing frameworks developed for ML inference on FPGA such as:

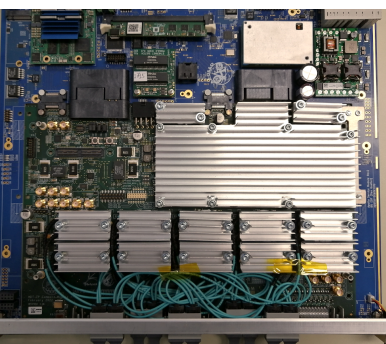
AMD Vitis-AI [1]

HLS4ML [2]



FPGA implementation

- Can target the current L0 Muon trigger hardware (Xilinx VU13P FPGA) using HLS4ML
- Explore potential improvements using different hardware



[1] <https://www.xilinx.com/products/design-tools/vitis/vitis-ai.html>, [2] <https://fastmachinelearning.org/hls4ml/>