Nanosecond ML for calorimeter segmentation

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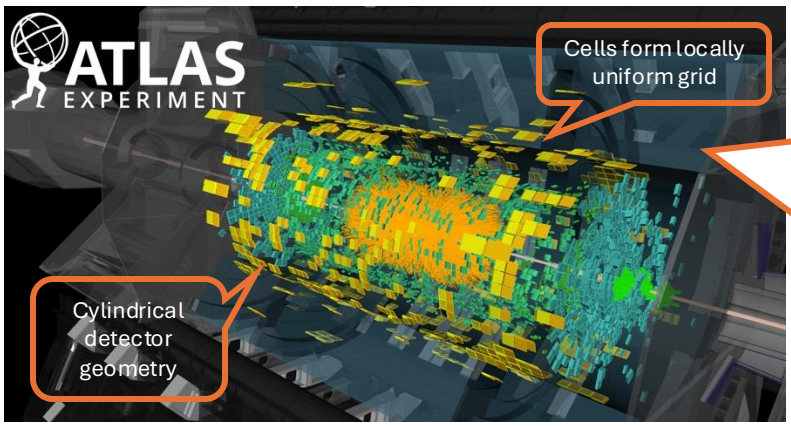
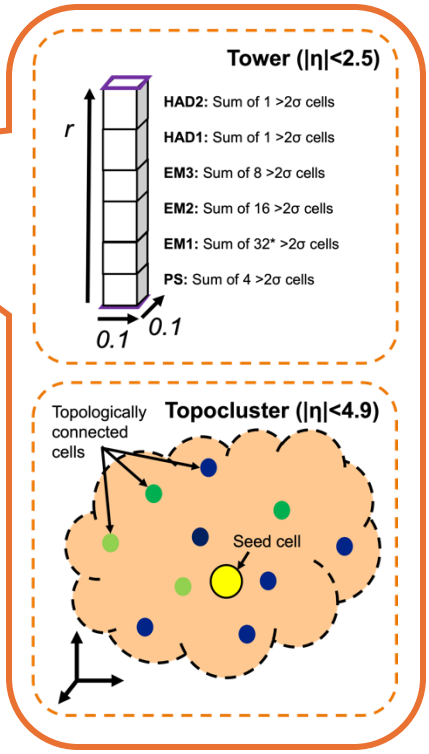
Abstract

Effective pile-up suppression, particle ID and clustering are essential for maximising the physics performance of the Phase-II Global trigger in ATLAS. To address this, we train both convolutional and DeepSets neural networks to exploit cluster topologies to accurately predict calorimeter cell labels, and benchmark performance against existing approaches. We optimise the networks for FPGA deployment and obtain resource and timing estimates.





Raw towers

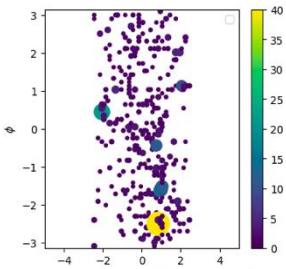
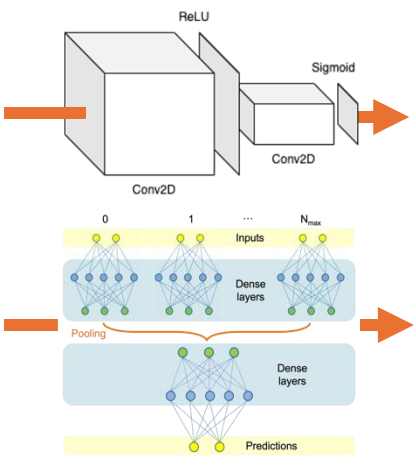
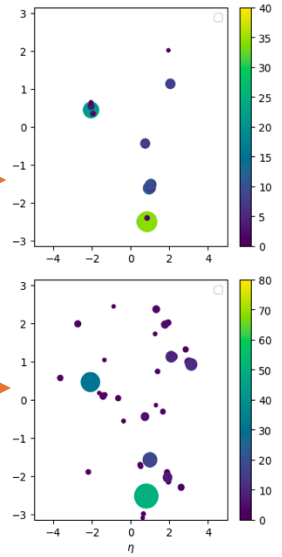


Image segmentation



Result

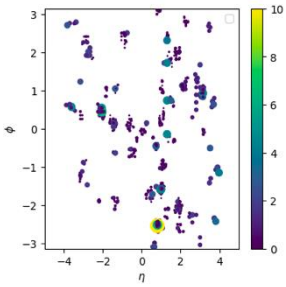


google/qkeras

QKeras: a quantization deep learning library for Tensorflow Keras

hls4ml

Raw clusters



Cluster classification

Result

Resource/timing	CNN	DeepSets
Precision	Fixed <10,5>	Fixed <10,5>
# parameters	494	913
Latency (clk)	5	73
Interval (clk)	2	25
RAM	0	0
DSP	0	16
FF	1883	54478
LUT	33529	270742