

# Realtime Anomaly Detection in the CMS Experiment

*Tuesday 15 October 2024 17:30 (15 minutes)*

We present the development, deployment, and initial recorded data of an unsupervised autoencoder trained for unbiased detection of new physics signatures in the CMS experiment during LHC Run 3. The Global Trigger makes the final hardware decision to readout or discard data from each LHC collision, which occur at a rate of 40 MHz, within nanosecond latency constraints. The anomaly detection algorithm, AXOL1TL, makes a prediction for each event within these constraints, selecting anomalous events for further analysis. The implementation occupies a small percentage of the resources of the system Virtex 7 FPGA, fitting seamlessly into the existing trigger logic. AXOL1TL was integrated into the Level-1 Trigger menu in May 2024, allocated bandwidth primarily in the High-Level Trigger scouting data streams. We describe the methodology to achieve ultra low latency anomaly detection, show the integration of the algorithm into the trigger system, as well as the monitoring and validation of the algorithm required to commission the trigger for data-taking. Finally, we present the first data recorded in 2024 by the anomaly detection trigger.

## Focus areas

HEP

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