Problem: limited output bandwidth to record high-rate processes

- 30 MHz
- L1
- 100 kHz
- HLT
- 1-1.5 kHz
- Main physics stream
- ~140 Hz
- Jet triggers
- ~80 Hz
- pA0

Limiting factors driving rates for the ATLAS trigger system

ATLAS physics priorities

in 2018: single jet trigger \( E_T > 380 \) GeV

\( \Rightarrow \) Offline \( p_T > 440 \) GeV

\( \Rightarrow \) DiJet mass \( m_{\text{jj}} > 1 \) TeV

\( \Rightarrow \) Limits sensitivity to low mass dijet resonances

Significance

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ATLAS Trigger Operation

- T1 data taken on 0 October, 2017, \( \sqrt{s} = 13 \) TeV
- T1 data taken on 8 October, 2017, \( \sqrt{s} = 13 \) TeV

Only keep what we need

- L1 selection (J100) efficient by ~20 GeV offline
- CMS [1,3] and LHCb [2]: use trigger for analysis
- New to ATLAS: Trigger-Level Analysis (TLA) stream: jets \( p_T > 20 \) GeV, event & trigger info
- 0.5 kHz/event, vs 1 MB for full event
- Recover large part of dijet mass spectrum

Developments in 2017 and beyond

- Make use of L1 rate at end of fill (below \( 10^6 \) cm/s) to run extra TLA trigger (J50 + L1Topo DETAJ → sensitivity to lower masses

Results: set strongest limits in targeted mass range

- No bumps in spectrum \( \rightarrow \) set limits in Dark Matter mediator (Z') model
- Sets limits down to 450 GeV in \( m_{\text{Z'}} \), vs 1500 GeV for normal dijet search
- Similar sensitivity around 1500 GeV
- Other methods of accessing low masses use ISR \( \rightarrow \) cross-section penalty

ATLAS Preliminary July 2018 \( \sqrt{s} = 13 \) TeV, 3.6-37.0 fb\(^{-1}\)

- Axial vector mediator in Dark Matter model \( m_{\text{Z'}} = 10 \) TeV
- Data-triggered detection

Good performance of trigger jets after calibration

- Excellent agreement with offline dijet mass

Calibrate the jets

- Calibration
  - Origin correction
  - Pileup subtraction
  - Jet energy scale correction
  - Global sequential correction
  - Eta intercalibration
  - In-situ correction

- Purpose
  - Jet origin to vertex
  - Remove contributions from pileup
  - Jet energy scale correction
  - Reduce flavour (quark / gluon) dependence
  - Correct residual (\% level) differences

- Applied to?
  - Offline & TLA
  - TLA specific
  - TLA only
  - Offline only

Save enough HLT information to calibrate jets as close as possible to offline but no tracks (only partial tracking at HLT)

Other figures from https://twiki.cern.ch/twiki/bin/view/AtlasPublic/TriggerOperationPublicResults

1) CMS, Search for narrow resonances in dijet final states at \( \sqrt{s} = 8 \) TeV with the novel CMS technique of data scouting, Phys. Rev. Lett. 117 (2016) 031802
3) CMS, Search for dijet resonances in proton-proton collisions at \( \sqrt{s} = 13 \) TeV and constraints on dark matter and other models, Phys. Lett. B 769 (2017) 620