

ATLAS High-Level-Trigger Rates and Cost analysis

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CHIPP Winter School of Particle Physics 2023 January 20th, 2023







We acknowledge funding from the European Union Horizon 2020 research and innovation programme, call H2020-MSCA-ITN-2020, under Grant Agreement n. 956086

ATLAS Trigger System



- 1 PB/s of data produced by LHC detectors
- Trigger systems needed to select in real-time the most interesting collisions

ATLAS Trigger System

- Level-1 (L1) hardware-based trigger
 - reduces rate from 40 MHz to 100 kHz
- High-Level-Trigger (HLT) software-based trigger
 - reduces rate from 100 kHz to 1 kHz

ATLAS Trigger System

Level 1 (L1)

- L1Calo and L1Muon: Trigger OBjects (*TOBs*: type, location, energy, isolation)
- L1Topo: geometric + kinematic selections on the TOBs
- L1 Central Trigger Processor (**CTP**): final L1 decision
- Up to 512 trigger selections
- Selections have *prescale* $n \ge 1$
 - The CTP accepts at random 1/n events satisfying the trigger selection



High-Level-Trigger (HLT)

- 40 000 CPU cores
- Event selections: sequences of selection steps, called **chains**
- Steps: feature-extraction algorithms, terminating with *hypothesis algorithm*
- Collection of all the trigger chains: trigger menu
- Chains activated by set of L1 TOB seeds
- Chain with **prescale** n: 1/n probability of activating when seeded



- **Cost analysis**: monitor the CPU cost of the elements of the HLT (e.g. algorithms and chains execution)
 - prediction of the needed resources in advance of collisions
 - \circ identify slower algorithms/chains \rightarrow optimize or change slow algorithms when possible
- **Rates analysis**: prediction of the trigger menu rates in advance of collisions
 - necessary for the calculation of the prescale sets
- During data-taking: validation if monitored values are as expected
- Data-driven procedure, based on the *Enhanced Bias (EB)* data sample



Enhanced Bias (EB) data

- Most interesting selections from processes with $\sigma << \sigma_{TOT,inel} \rightarrow$ too large data sample if data are recorded with zero trigger bias (e.g. triggered at random)
- EB data samples (1M events) are collected using several L1 triggers and events which are likely to be selected by the trigger (e.g. with high p_T) are overweighted
- Invertible trigger menu → event weights applied to restore the effective zero bias spectrum



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