

Contribution ID: 548 Contribution code: **contribution ID 548**Type: **Oral**

GPU Acceleration of the ATLAS Calorimeter Clustering Algorithm

Tuesday, 30 November 2021 17:40 (20 minutes)

After the Phase II Upgrade of the LHC, expected for the period between 2025-26, the average number of collisions per bunch crossing at the LHC will increase from the Run-2 average value of 36 to a maximum of 200 pile-up proton-proton interactions per bunch crossing. The ATLAS detector will also undergo a major upgrade programme to be able to operate it in such a harsh conditions with the same or better performance than up now.

The ATLAS Trigger system, responsible for the online processing and filtering of the collisions happening at the LHC, will have to analyse the 40 MHz collisions rate, selecting about 10 kHz for offline analysis. The trigger is a tiered system, consisting in a first selection level made of custom hardware processors, that use reduced granularity from the calorimeters and muon detectors, followed by a High Level Trigger implemented in software, running on a farm of commodity computing and benefitting from the full detector granularity and improved calibrations. The high pile-up conditions expected after the upgrades, will be very challenging for the Trigger system, that will have to cope with increased rates while keeping the same efficiency for the interesting physics processes. This will require the use of advanced, more time consuming algorithms.

The ATLAS Collaboration is currently studying the use of general purpose Graphical Processing Units (GPUs) as hardware accelerators in trigger and offline reconstruction, as a mean to deal with the increasing processing times demands in view of the upgrades. Since the first GPU Trigger Prototype [1], that demonstrated the potential gains (and limitations) of GPUs for the trigger system, a new implementation of the calorimeter TopoCluster [2] reconstruction algorithm for GPU has been done, benefitting from the new multithreaded AthenaMT framework [3] and a simplified architecture.

This communication will describe the new implementation of the calorimeter clustering algorithm, and will present detailed performance studies, including the resulting speed-up of the algorithm processing times.

Significance

References

- [1] ATLAS Collaboration, Technical Design Report for the Phase-II Upgrade of the ATLAS TDAQ System, CERN-LHCC-2017-020 ; ATLAS-TDR-029.
- [2] ATLAS Collaboration, Topological cell clustering in the ATLAS calorimeters and its performance in LHC Run 1, Eur. Phys. J. C 77 (2017) 490.
- [3] C. Legget, J. Baines, T. Bold, et al. on behalf of the ATLAS Collaboration, AthenaMT: upgrading the ATLAS software framework for the many-core world with multi-threading, J. Phys.: Conf. Ser. 898 042009.

Speaker time zone

No preference

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Session Classification: Track 1: Computing Technology for Physics Research

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