Progress and Status on TDAQ

Zhen-An LIU
CEPC SC Meeting
Oct.19 2020

Outline

- Strategy
- Status/Progress
- Future Perspective

TDAQ Coverage

- Detector Readout

- Hardware Trigger

- Software/High Level Trigger

- Event Building and Storage with Online Control

- Fast Control/TCDS/machine interface

- Slow Control/future trend

Strategy

- Investigate other experiments
  - Trigger based System/Triggerless System
  - Trigger based readout/triggerless readout
  - If Trigger less
    - Continuous Sequential readout/non-sequential readout
- International Exchange/collaboration
- Further understanding with the Bandwidth of Detector Systems
- Determine the requirements from Detector Readout
  - Trigger/triggerless readout
  - If triggerless: Continous sequential/non-sequential readout
- TCDS
  - Time Stamp (BCN/BX, L1, …) for both trigger/triggerless
- Hardware readout Structure(VME/xTCA/PXI,…)
- Networking and Online

Experiments Invited for Investigation

- Data Acquisition for the PANDA Experiment at FAIR by Wolfgang Kuehn

Data Acquisition for the PANDA Experiment at FAIR

- What is FAIR ?

- What is PANDA ?

- What are the challenges for DAQ / Trigger ?

- Concept

- Conclusion

Experiments Invited for Investigation

• Overview of CMS Trigger by Simon Bologna（U Bristol）

Experiments Invited for Investigation

- Overview of CMS Trigger

Readout electronics system for Laser TPC prototype

Hui Gong
Department of Physics Engineering
Tsinghua university

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2020/10/19

Experiments Invited for Investigation

- Over

The LHCb triggerless readout system for LHC

Run 3 and beyond

CepC workshop,
18–20 November 2019,
IHEP Beijing, China

Federico Alessio, CERN
on behalf of the LHCb Collaboration

Experiments Invited for Investigation

- Overview of CMS Trigger

ATLAS Solutions for Phase 2 Storage and Networking

Fabrice Le Goff – 19/11/2019
On behalf of ATLAS TDAQ Collaboration

Experiments Invited for Investigation

Experiments Invited for Investigation

DEEP UNDERGROUND NEUTRINO EXPERIMENT

- Over

DUNE DAQ Plans

Pengfei Ding
On behalf of the DUNE DAQ Consortium

November 19th, 2019

Fermi National Accelerator Laboratory

Fermilab   DUNE

Experiments Invited for Investigation

- O

Experiments Invited for Investigation

- Ove

ATLAS experience with FPGA (TDAQ's perspective)

Weiming Qian

Rutherford Appleton Laboratory

Experiments Invited for Investigation

- Ove

Real-time analysis with LHCb

The 2019 International Workshop on the High Energy
Circular Electron Positron Collider
IHEP, Beijing, China
2019/11/19

SAUR Miroslav
On behalf of the LHCb collaboration

(University of Chinese Academy of Sciences)

Experiments Invited for Investigation

• Over

The LHCb triggerless readout system for LHC Run 3 and beyond

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Federico Alessio, CERN
on behalf of the LHCb Collaboration

International Exchange

- Activities with International Conveners
  - Wolfgang Kuehn (GSI)
  - Federico Alessio(CERN)
  - Stewart Martin-Haugh(RAL)
  - Dave Newbold(Rutherford Appleton Lab)
  - Chris Bee (StonyBrook)
  - Zhen-An Liu (IHEP)

Conveners

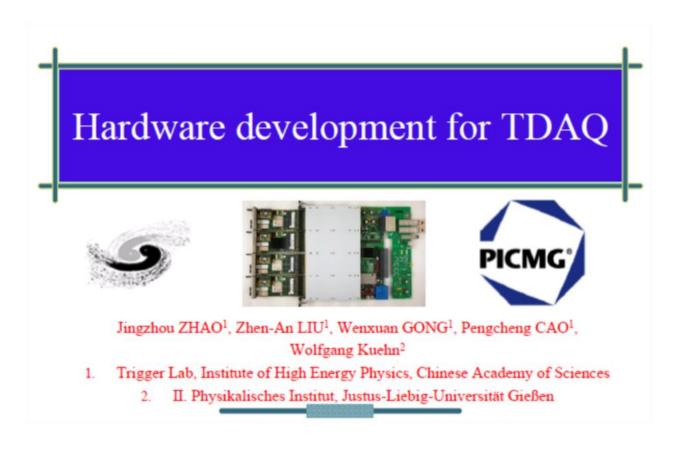- Joint Convener

Welcome and Thanks

- As conveners of this TDAQ session, we warmly welcome your participation to this TDAQ session

- Special thanks to the presenters of talks in this session for their contributions!

Wolfgang and Zhen-An

to TDAQ session

Federico Alessio (CERN), Zhen-An Liu (IHEP), Stewart Martin-Haugh (RAL)

Status/Progress : R&D Activities

- Hardware Development at IHEP

Hardware development for TDAQ

Jingzhou ZHAO[1], Zhen-An LIU[1], Wenxuan GONG[1], Pengcheng CAO[1], Wolfgang Kuehn[2]

1. Trigger Lab, Institute of High Energy Physics, Chinese Academy of Sciences
2. II. Physikalisches Institut, Justus-Liebig-Universität Gießen

Status/Progress : R&D Activities

- Pixel Detector Readout

Readout of JadePix-1,
A Prototype CMOS Pixel Sensor for CEPC
Vertex Detector

Jia Tao[1,2](reporter), Na Wang[1,2], Ke Wang[1,2], Liejian Chen[1,2], Ryuta Kiuchi[1,2], Hongbo Zhu[1,2],

Ying Zhang[1,2], Xiaocong Ai[1,3], Yi Liu[3], Chenfei Yang[4], Xin Shi[1,2], Zhenan Liu[1,2], Qun Ouyang[1,2],

Xinchou Lou[1,2]

[1]Institute of High Energy Physics, CAS
[2]State Key Laboratory of Particle Detection and Electronics
[3]Deutsches Elektronen-Synchrotron DESY
[4]University of Science and Technology of China

CEPCWS2018   Nov 13,2018   Beijing

Status/Progress : R&D Activities

- Vertex Readout

Preliminary design of the readout architecture of the CEPC Vertex detector

Wei Wei
On behalf of the CEPC MOST2 Vertex detector design team

Status/Progress : R&D Activities

- Structure of CEPC online

DISCUSSION OF CEPC DAQ

Fei Li
IHEP
2018-11-12

Status/Progress : Re-thinking

1. The total data volume and channel count for their sub-detector under different machine running modes
2. Your current assumptions about readout bandwidths and readout implementation and power consumption
3. Any zero suppression or compression they might carry out at the front end
4. Your need for control and timing signals
5. Any views / preferences on readout style(triggered or trigger-less readout)
    - Continuous sequential readout
    - Trigger sequential readout
    - Non-sequential readout

Status/Progress : Bandwidth Re-Estimation + Requirement (Setp.30+Oct.12 2020)

0. Introduction of the TDAQ requirements, Z.-A. Liu (IHEP) 10min
1. Requirements from the Vertex Dedector, Wei Wei (IHEP) 15min
2. Requirements from the Silicon Tracker, Jens Dopke (STFC Rutherford Appleton Lab) 15min
3. Requirements from the TPC, Huirong Qi (IHEP) 15min
4. Requirements from the Drift Chamber, Francesco Grancagnolo (INFN-Lecce) 15min
5. Requirements from the ECAL, Yong Liu (IHEP) 15min
6. Requirements from the HCAL Yong Liu (IHEP) 15min
7. Requirements from DR Calorimeter, Roberto Ferrari (INFN) 15min
8. Requirements from the Muon Detector, Paolo Giacomelli (INFN-Bo) 15min
9. Requirements from the LumiCal, Suen Hou (IPAS) 15min

Future Perspective

- Further Discussion in TDAQ sessions in the coming CEPC Workshop in Shanghai
- Both the Bandwidth and requirement Updates
- Experiences from other System
  - For Example: Hybrid System as in CMS

Others

- Accelerator inputs
  - Clocks
  - Timestamps (Reset, BCN,...)
  - ...
- ACC requirement
  - Interlock Signal
  - Lumi
  - ...

TDAQ and TCDS

- Structure
- Key components
- Technologies
  - Hardware
  - Firmware
  - Software
- Prototypes
- Demo System

Talks to be invited

- 1.   LHCb software-only trigger (commenting on implementation, performance requirements, tech choices) [Dorothea vom Bruch]

  2.ATLAS HLT tracking optimization (commenting on how performance was estimated and improved) [Mark Sutton]

  3.Pixel readout technologies and the challenges for the future [Maurice Garcia-Sciveres]

  4.Precision timing distribution systems and their current performance [someone from CMS]

  5.Machine interface (provision of timing / synchronization; feedback for bunch alignment [Dave was finding someone]

Technical Discussion in Shanghai Workshop

- You are welcome to the discussion

Summary

- Investigation on other experiments went well
- Some progress achieved
  - Hardware development(CMS adaptive)
  - Prototype system development(JadePix)
  - DAQ Online （Li fei）
- Bandwidth re-thinking(done)
- Requirements from Detectors(started)
- Converging (Shanghai Workshop planned)