INTEGRATION AND COMMISSIONING OF THE FAST TRACKER (FTK) FOR THE ATLAS DETECTOR

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**OVERVIEW**

Ongoing upgrade to the trigger system that will reconstruct all tracks from every event passing the Level 1 (L1) trigger at the L1 accept rate (100 kHz) for use by the High Level Trigger (HLT)

FTK is a preprocessor and does not make any trigger decisions

FGPAs used for processing and Associative Memory Chips for pattern matching

Will improve ability to identify objects with track based signatures: b-jets, taus, and MET; mitigate the effects of pileup.

**SYSTEM DESIGN**

**Input Mezzanine (IM):** Clusters Inner Detector hits

**Data Formatter (DF):** Distribute clusters among the 64 \( \eta \phi \) regions

**Associative Memory Board (AMB):** Performs pattern matching

**Auxiliary Card (AUX):** Makes a first stage fit with 8 out of 12 layers

**Second Stage Board (SSB):** Extrapolates track to 12 layers and calculates helix params

**FTK to Level 2 Interface Card (FLIC):** Formats tracks for the HLT

**SIMULATION**

FTK efficiency vs \( \eta \)

Pattern bank efficiency 95\% vs offline

Simulation matches hardware operations very well

In the process of finding and fixing corner cases

**RUN 2 CONFIGURATION**

Divide \(|\eta| < 2.5\) into 64 overlapping \( \eta \phi \) regions.

**128 IMs and 32 DFs** process data from ID and send data to 64 Processing Units (PUs, AUX+AMB pairs), each processes one tower. These then feed into 32 SSBs, which then send final tracks to 2 FLICs.

Majority of boards at CERN and installed at Point 1

**COMMISSIONING**

**Scaling up**

Connect one of each board type to process a single tower to form a slice.

Two slices at Point 1 spying on data and/or testing with pseudodata

**Slice 2:** Does not include SSB and FLIC. Provides 8 layer tracks

**Slice A:** Includes all boards. Primarily used for SSB debugging

**Scaling out**

Stable running of multiple DFs together with data and pseudodata

2 ATCA crates with 16 DFs, covering half the Run 2 configuration

Stable simultaneous running of 8 PUs with pseudodata

1 VME crate with 8 AUXs and 8 AMBs

Majority of boards at CERN and installed at Point 1

**2017 HIGHLIGHTS**

During 5 TeV run (November 19-20), FTK ran stably for ~6 hours with 50\% prescaling in one tower.

Processed ~1 billion events and ~200 million tracks

Most of these tracks are fake because we only have the first stage fit, but we were still able to learn a lot about our system and work still to do

Scaled up system in both dimensions

Development of online monitoring tools and functionality to run with ATLAS

**2018 GOALS**

- Run Multi DF feeding into Multi PU
- Integrate slices into ATLAS
- Test integration with HLT and Inner Detector (ID) during cosmics running
- Carefully study efficiency
- Build out slices to cover the full system
- Develop robust error handling to maintain continuous running!