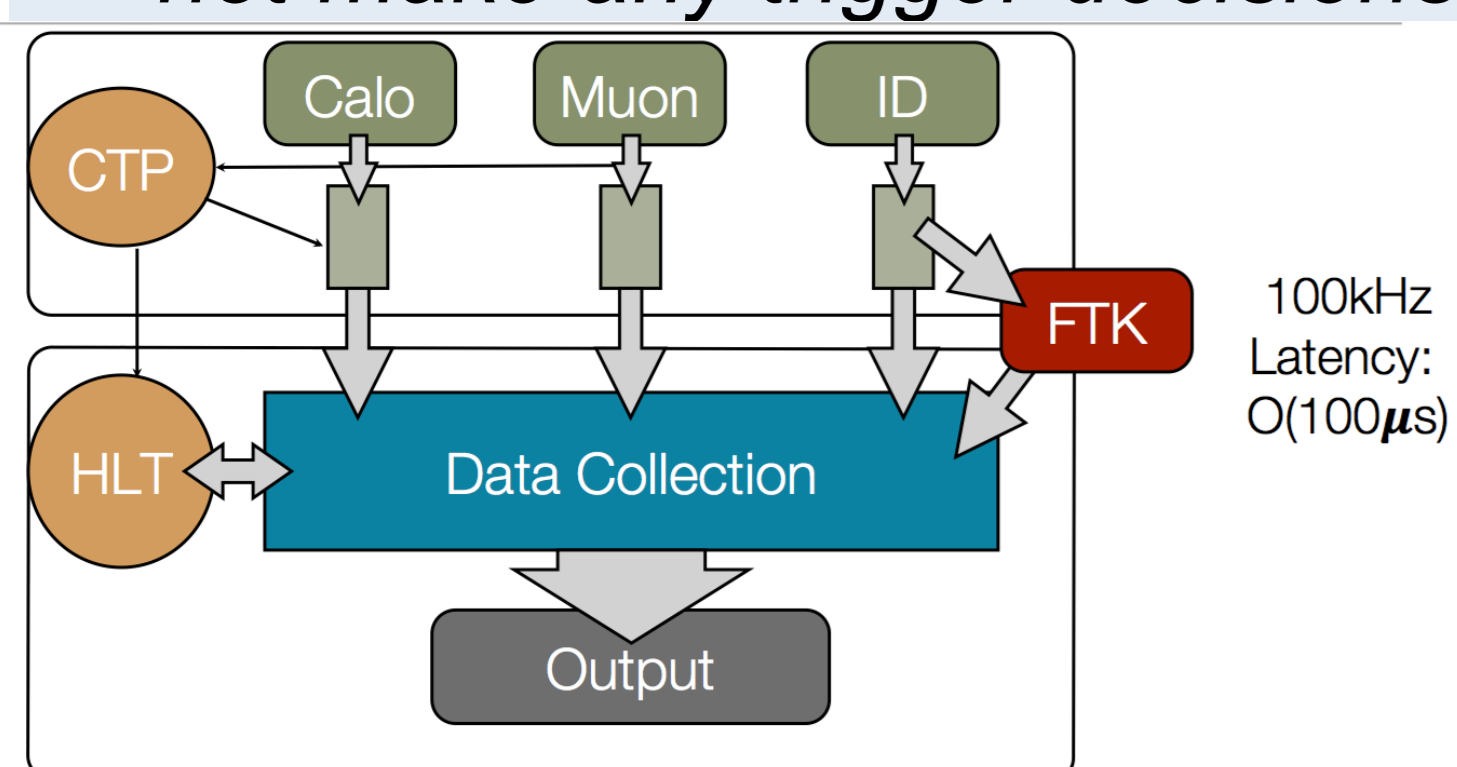# INTEGRATION AND COMMISSIONING OF THE FAST TRACKER (FTK) FOR THE ATLAS DETECTOR

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
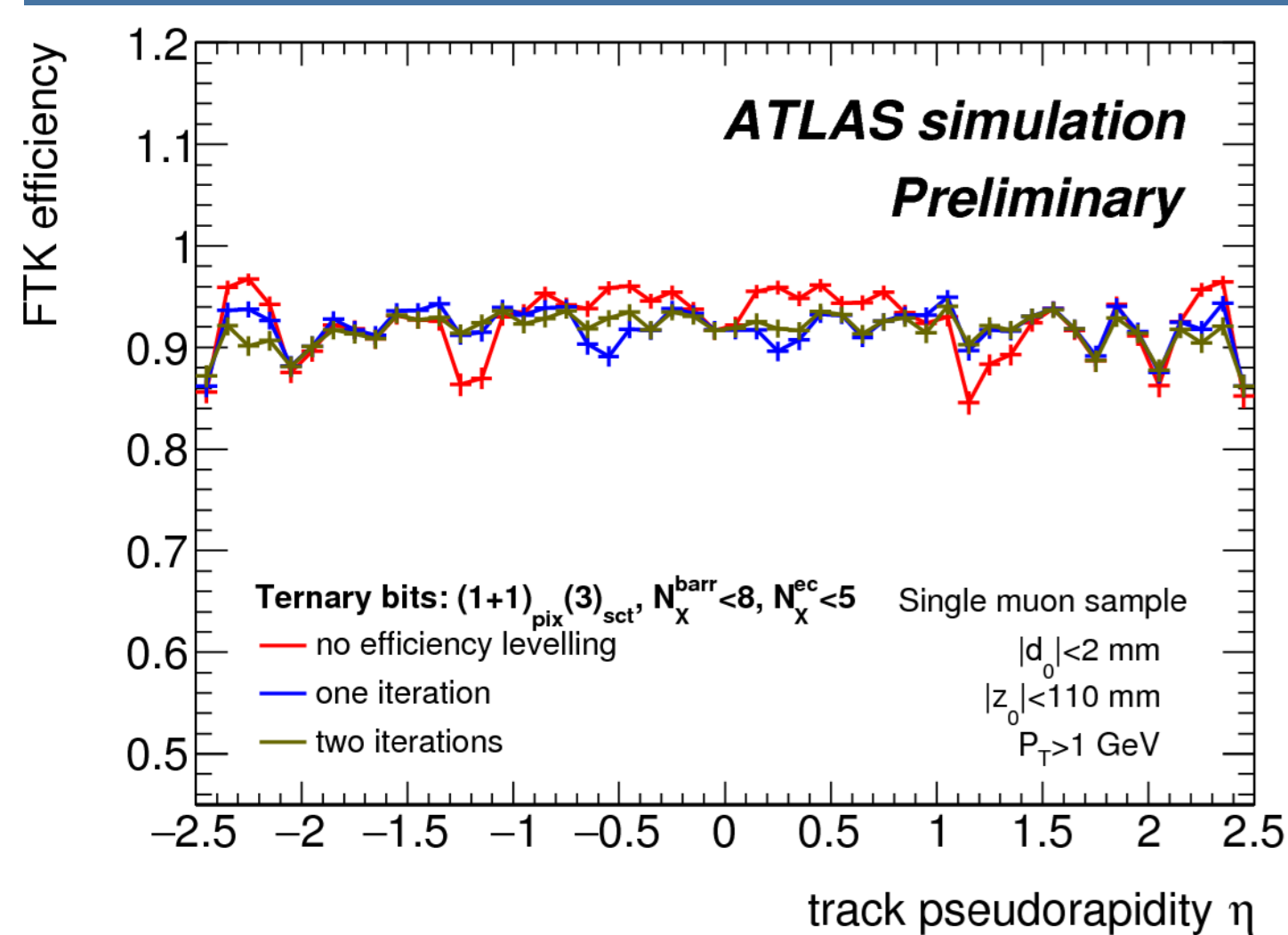

100kHz Latency: O(100μs)

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.

SIMULATION

FTK efficiency vs η

Pattern bank efficiency 95% vs offline

Simulation matches hardware operations very well

In the process of finding and fixing corner cases

SYSTEM DESIGN

Input Mezzanine (IM):
Clusters Inner Detector hits

Data Formatter (DF):
Distribute clusters among the 64 η-φ regions

Associative Memory Board (AMB):
Performs pattern matching

Auxiliary Card (AUX):
Makes a first stage fit with 8 out of 12 layers
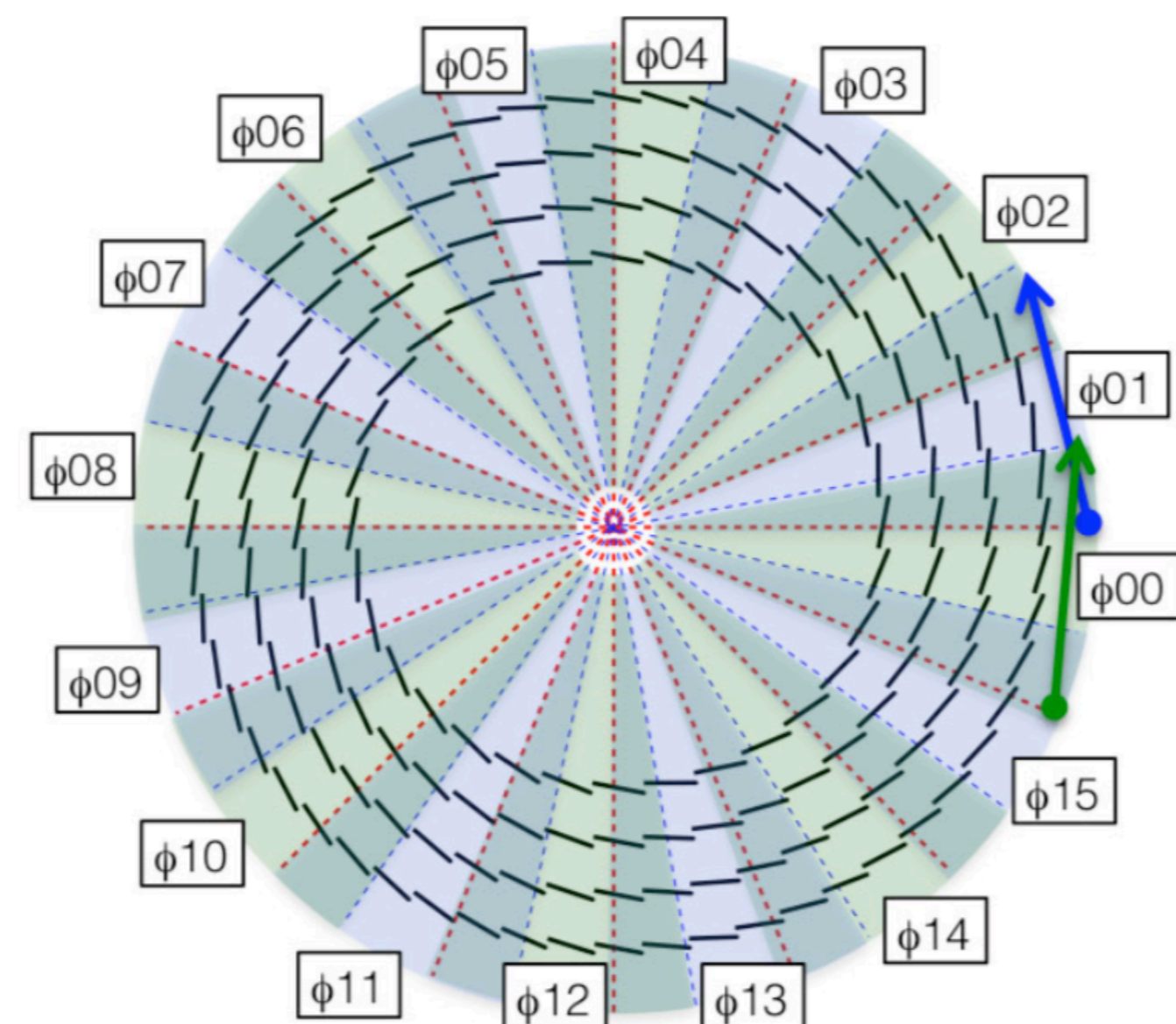
Second Stage Board (SSB):
Extrapolates track to 12 layers and calculates helix params

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

RUN 2 CONFIGURATION

Divide |η| < 2.5 into 64 overlapping η-φ 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
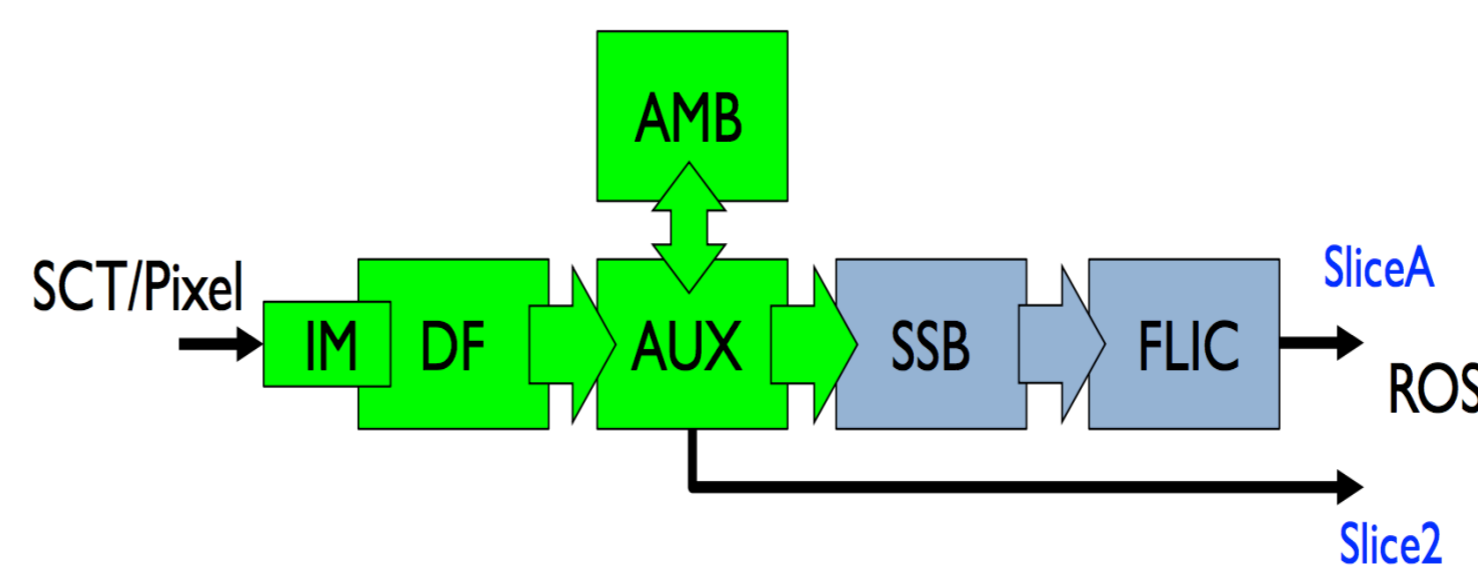
32 SSBs, which then send final tracks to

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

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!**

Input Mezzanine/ Data Formatter

Auxiliary Card

Associative Memory Board

Second Stage Board

FTK to Level 2 Interface Card

Lesya Horyn (University of Chicago) on behalf of the ATLAS Collaboration

ATLAS EXPERIMENT