Fast Tracker (FTK)
A Fast hardware tracker for the ATLAS Trigger

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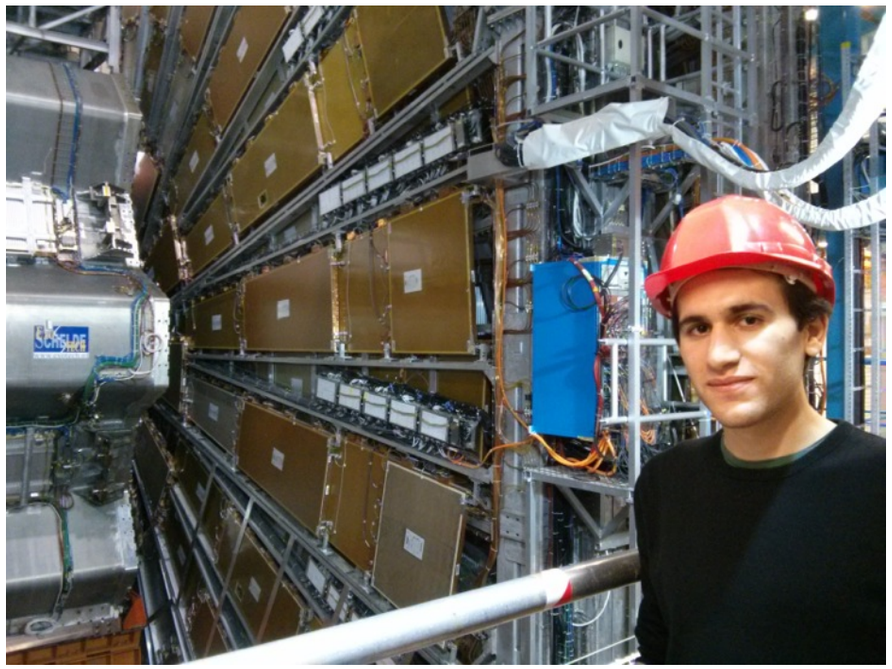
on behalf of the ATLAS collaboration

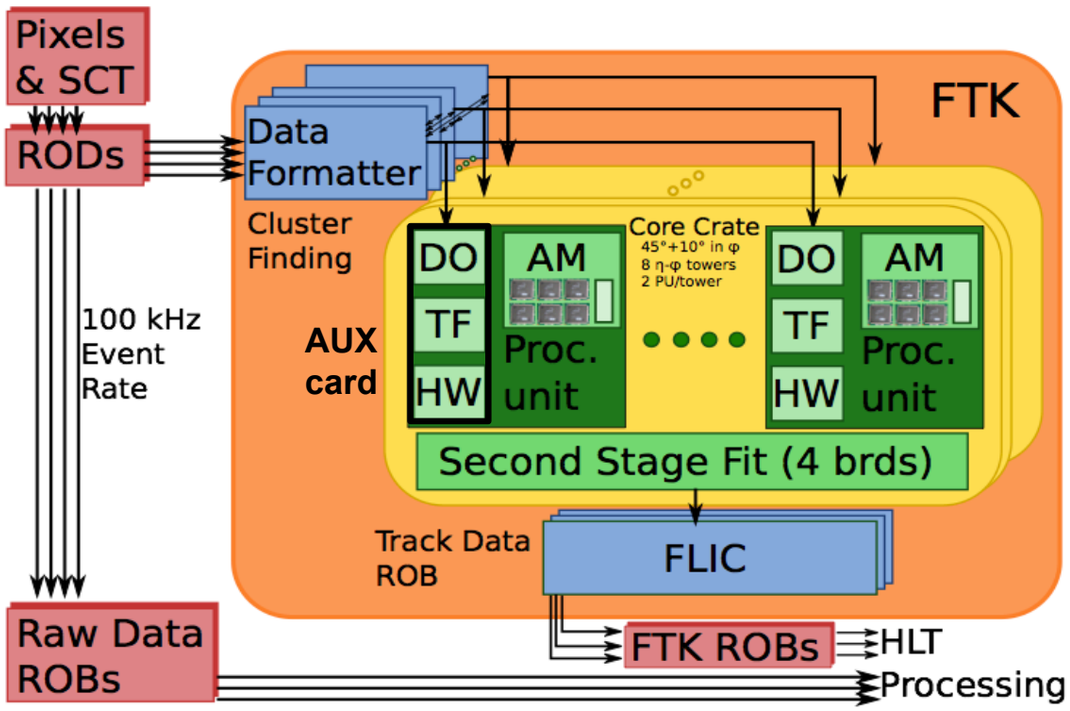


FTK Motivations and Architecture

Tracking at trigger level during LHC Run-2 (2015-2018) and Run-3 (2020-2022)

- high instantaneous luminosity (maximum of $3x10^{34}$ $cm^{-2}s^{-1}$) means high number of simultaneous interactions (~80) per proton-proton bunch crossing
- ATLAS detector trigger system: **hardware-based level-1** + **software-based High Level Trigger** (HLT)
- track reconstruction at trigger level becomes very challenging

Fast Tracker FTK: electronic system that reconstructs tracks in the ATLAS inner detector silicon layers, for events passing the level-1 trigger exploiting massive parallelization to solve the combinatorial challenge



FTK Design: receives data at full level-1 trigger output rate from dual output HOLA cards

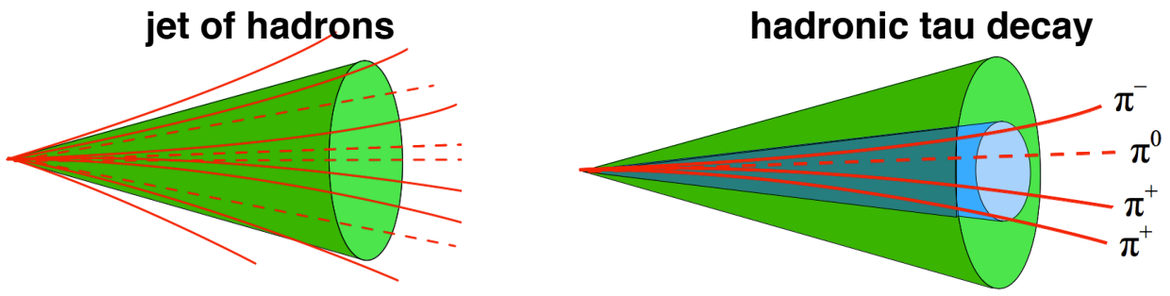
- data are organised in 64 **η-ϕ** regions (**parallelization**) [Data Formatter] and stored as full-resolution hits and coarse-resolution "super-strips" (SS)
- **Associative Memories** (AM) perform simultaneous matching between coarse-resolution tracks and precomputed patterns (pattern = combination of 1 super-strip for each detector layer)
- **Auxiliary Cards** (AUX) takes care of fitting full-resolution hits for the matched track
- Fitted tracks information is sent to the **HLT**

Variable Resolution Patterns: precomputed patterns are built with variable resolutions strips to increase noise/background rejection and limit the size of the pattern banks stored on the AMchip

FTK Performance and Integration at CERN

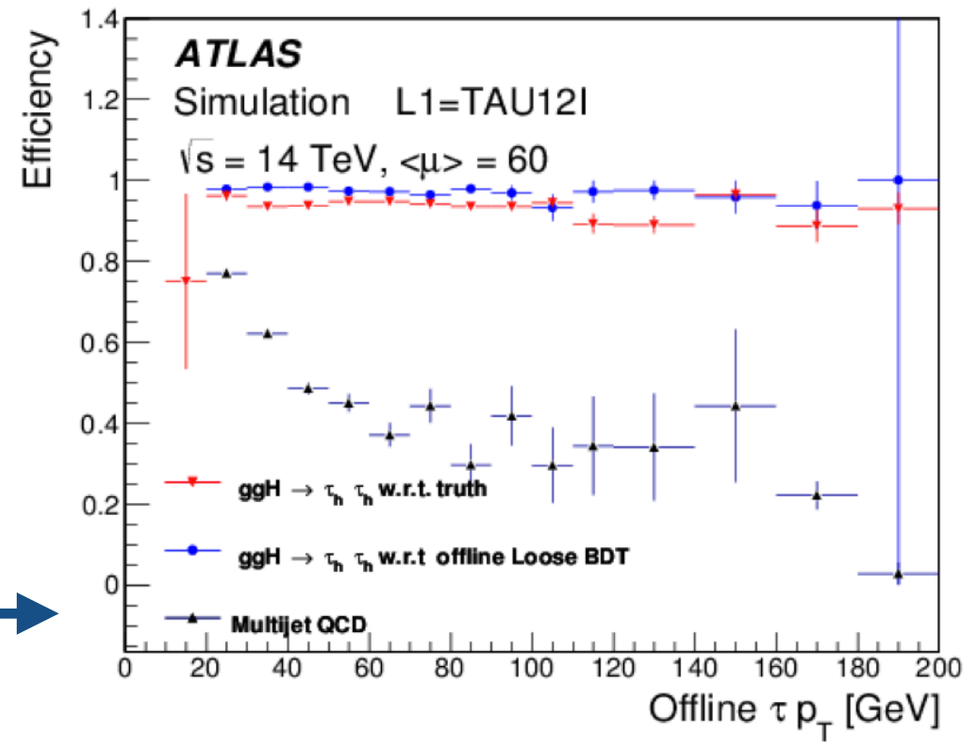
Example of FTK expected performance: tau lepton identification

Tau lepton identification exploits track multiplicity to distinguish hadronic tau decays from QCD multijet processes



→ **HLT selection** can already suppress QCD background using **full-scan track information provided by FTK**

Identification efficiency for a sample for Higgs decaying to two hadronic tau leptons (red triangles, blue circles), compared to multijet background (black triangles).

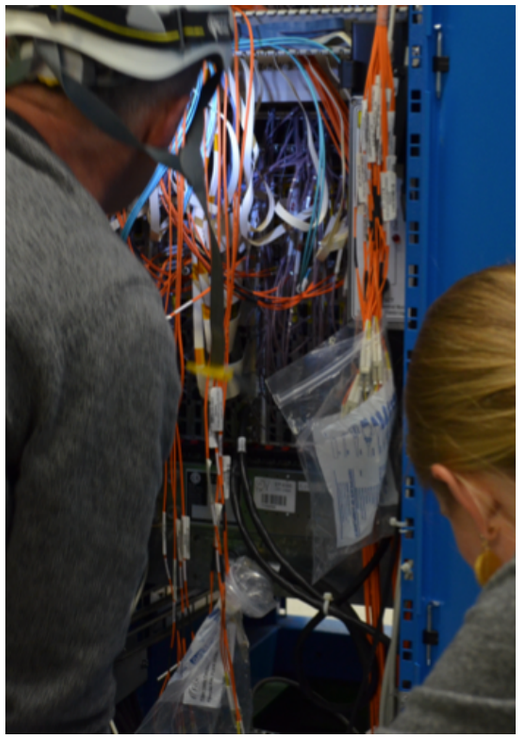


FTK integration at CERN

All prototype boards have been tested at home institutions, and are currently integrated and tested at CERN:

- all FTK parts are integrated in the **ATLAS Trigger and Data Acquisition system** (**AM** and **SSB** working in pass-through mode), with some connections between FTK systems to be completed
- test of the full FTK system working together, interfaced to the ATLAS Inner Detector
- test online software infrastructure and control/monitoring procedures

FTK will provide full pseudorapidity coverage of the Inner Detector by 2016, but will start working on a limited region by late 2015



Fiber connections to the inner tracker Read Out Drivers