The ATLAS FTK system
how to improve the physics potential with a tracking trigger

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The Fast TracKer (FTK) : Motivation and Concept

> Motivation

FTK TDR [http://cds.cern.ch/record/1552953/files/ATLAS-TDR-021.pdf]

✓ In LHC Run2 and Run3 (2015 - 2022), up to 80 overlapping pp collisions per bunch crossing are anticipated.
  → High Level Trigger (HLT) tracking will become difficult and time consuming, due to large number of combinatorials posed by charged particles.

A solution : the Fast Tracker (FTK) !

✓ FTK is a highly-parallel hardware system that rapidly finds and reconstructs high quality tracks in the inner-detector before the start of the High Level Triggers (HLT) processing. The FTK tracks can be utilized for instance for tau and b-jet identifications, either directly or by refitted.

> Concept of FTK functionality

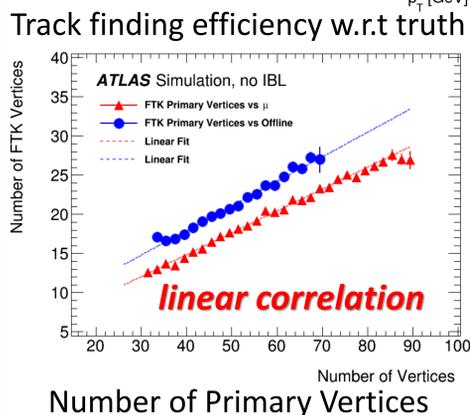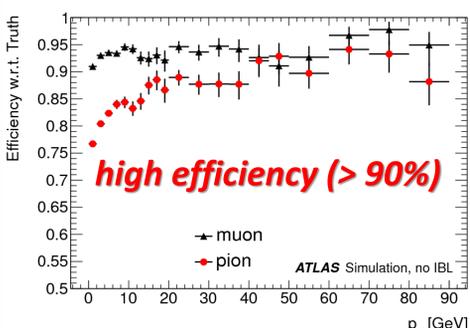FTK performs a fast tracking for every event that passes the Level-1 trigger at a maximum event rate of 100kHz.
The fast tracking is achieved by "Track Finding" and "Track Fitting".

$$p_i = \sum_j C_{ij} \cdot x_j + q_i$$
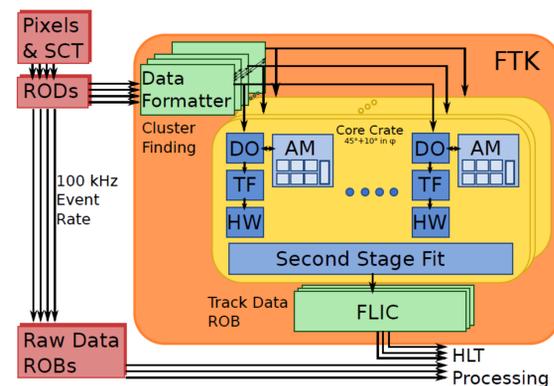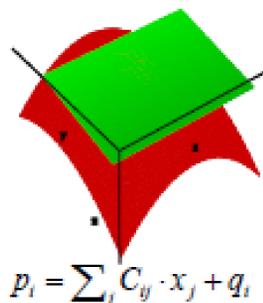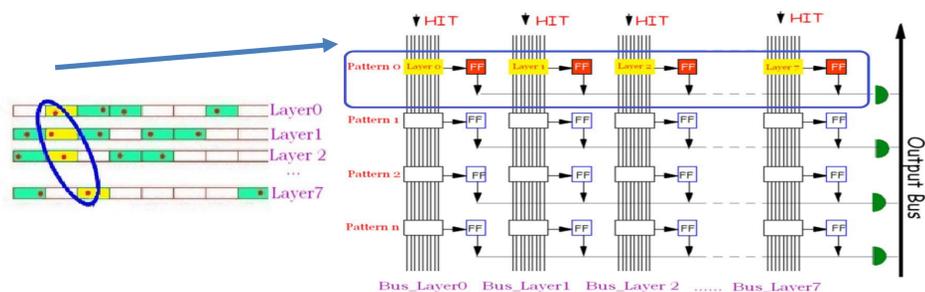
Track Finding : Comparison with pre-stored hit patterns

Track Fitting : linearized track fitting

Quick rejection with the FTK allow more processing time for HLT to pursue more sophisticated algorithms!

Tracking

high efficiency (> 90%)

Track finding efficiency w.r.t truth

*linear correlation*

Number of Primary Vertices

tau-ID

Track multiplicity is important for tau-ID. With FTK tracks, good separation can be achieved between τs and QCD multijets.

Track multiplicities
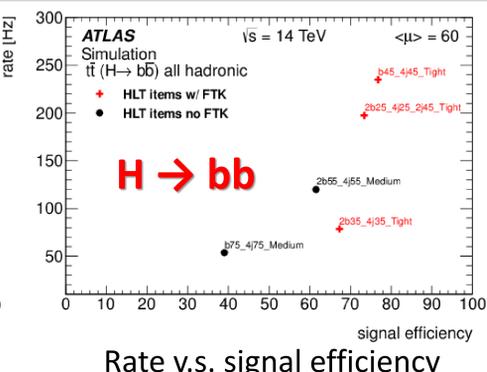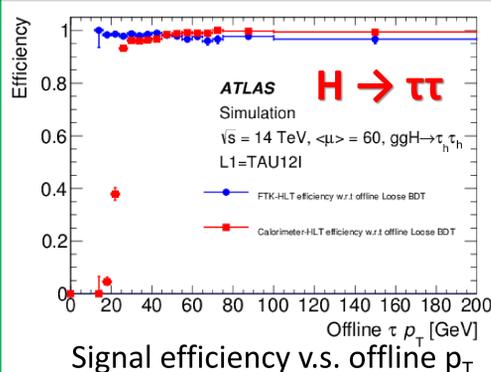
Signal and bkg efficiency
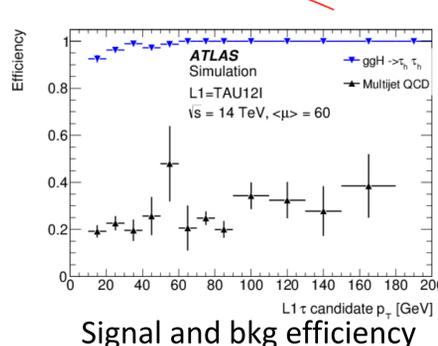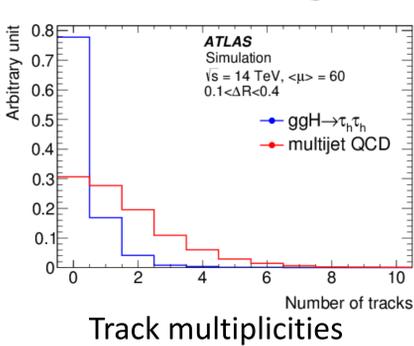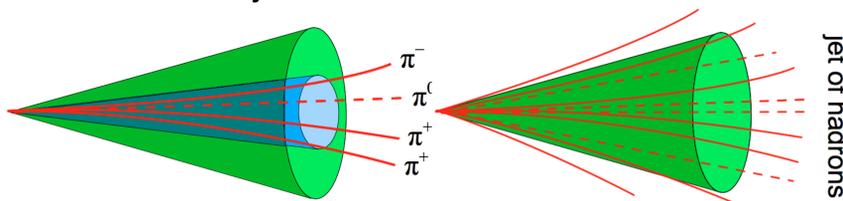
τ is well separated with QCD background

b-tagging

Transverse impact parameter(d_0) is a basic input for b-tagging.

d_0 distribution

d_0 significance

similar distribution w.r.t offline!
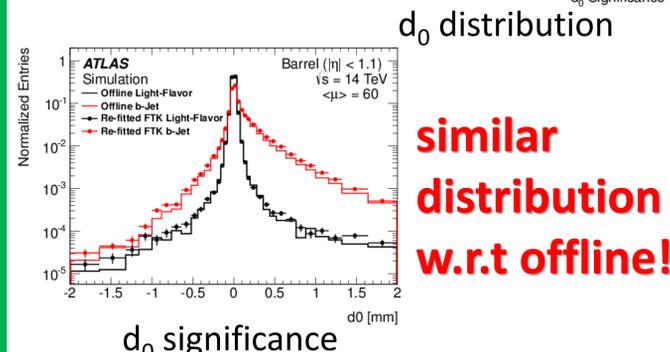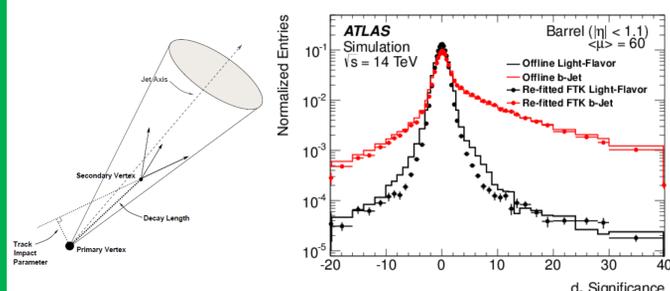
Expected gain in physics channel

H → ττ

H → bb

Signal efficiency v.s. offline p_T

Rate v.s. signal efficiency

We enhance low p_T efficiency thanks to cutting QCD rates.

Summary

✓ FTK provides all track information for any event accepted by Level-1 trigger.
✓ FTK has a potential to improve various physics performance
   -- Primary Vertex Finding, tau-ID, B-tagging…

✓ We can achieve more signal efficiency while rejecting more QCD multijet background.

A part of FTK will be installed late 2015, full coverage 2016.

FTK improves ATLAS physics potentials at Run2 and Run3 LHC !