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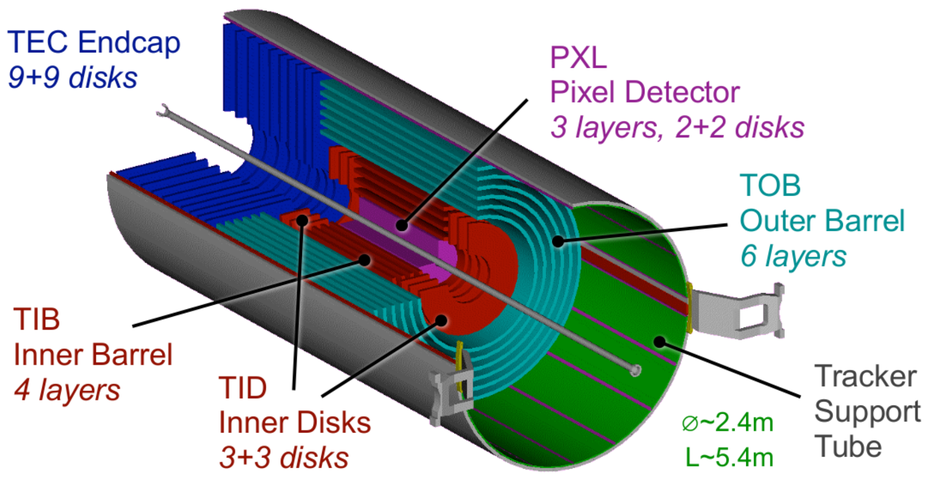
Tracking at High Level Trigger in CMS

The CMS tracker

- immersed in a 3.8 T magnetic field

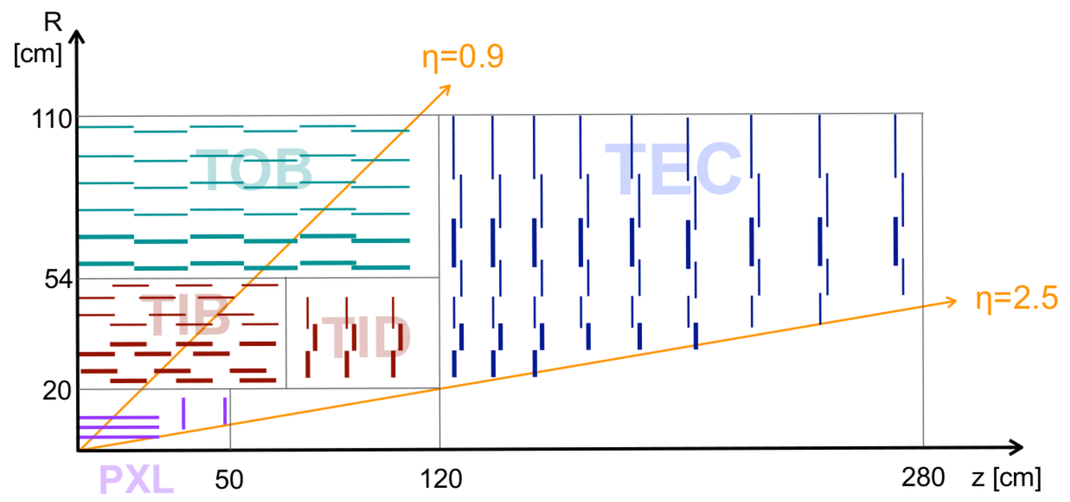


Pixel detector:
- 66M readout channels
- 100x150 μm^2

Strip detector:
- ~9M readout channels
- 80-180 μm pitches

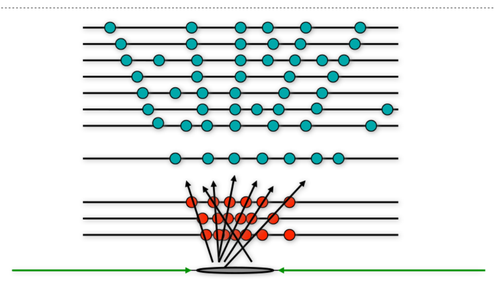
Pixel hits resolution:
10x(20,40) μm

Strip hits resolution:
(10,40)x(230,530) μm



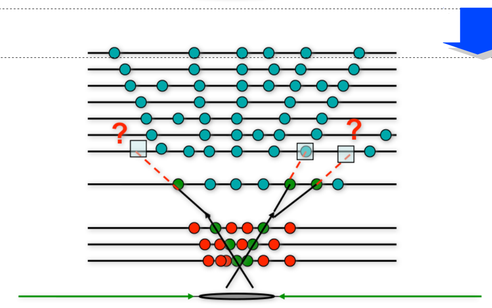
Performance: σ(pT)/pT ~ 1-2% @ 100 GeV/c
σ(IP) ~ 10-20 μm @ 10-100 GeV/c

Track reconstruction



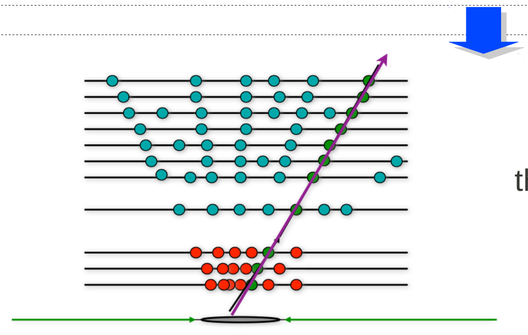
Seeding

Starts from the innermost layers.
Made from hits triplets or doublets compatible with the beamspot.
Seeds not compatible with the luminous region are discarded.



Trajectory Building

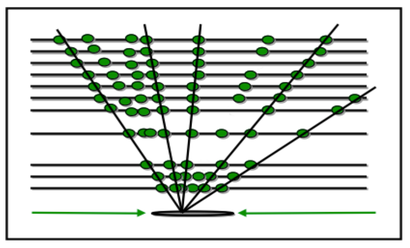
Each seed is propagated to the successive layers, using a Kalman filter technique.
If a compatible hit is found the propagation continues, otherwise it stops.

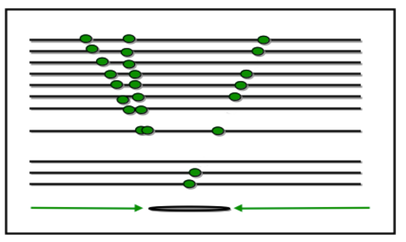


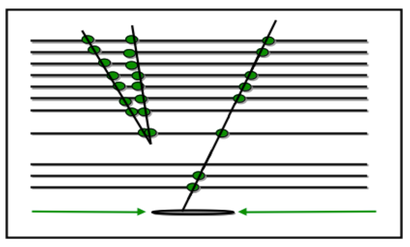
Track Fitting

More hits are added and the track parameters estimation is updated every time a new hit is found.
A final fit is performed to obtain the track parameters value at the interaction point.

Iterative tracking: pattern recognition "step by step"







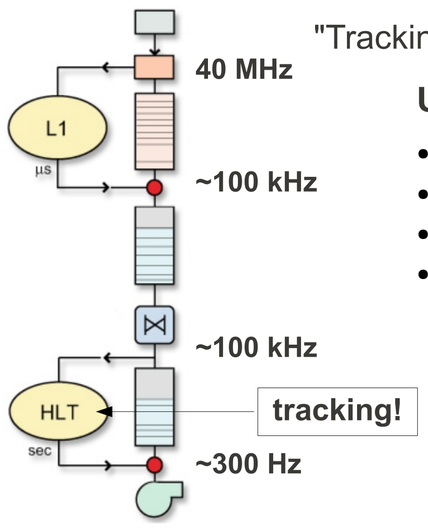
First, pattern recognition of tracks with:
- high pT
- large number of hits
- associated vertex close to the beam-spot region

Tight constraints are required

The clusters associated with the hits of the found tracks are removed

New collections of hits from the remaining clusters are created; pattern recognition is repeated, with looser constraints, in order to reconstruct lower pT tracks or tracks with an associated vertex displaced from the beam-spot

Tracking at HLT

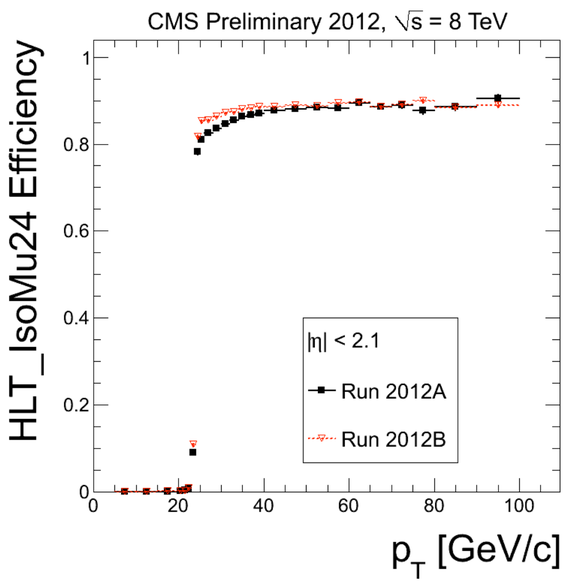


"Tracking" = software algorithms for tracks reconstruction

Using tracking information at HLT:
- reduces the fake-rate
- improves isolation in leptonic trigger paths
- reduces the event rate
- improves efficiency

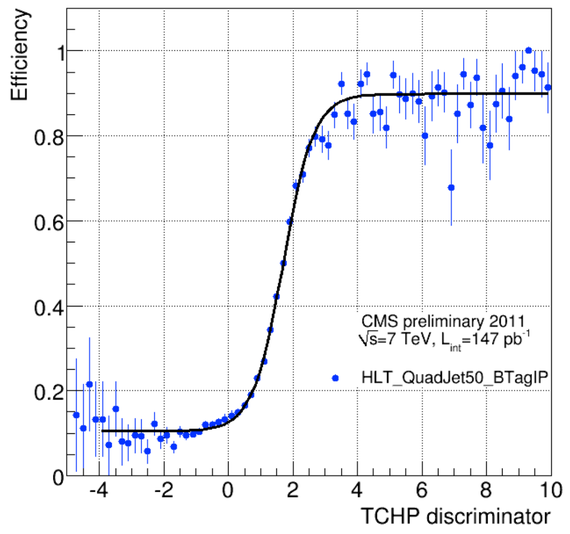
Using *iterative* tracking at HLT:
- reduces the combinatorics
- reduces the CPU-time
- allows PF reconstruction at HLT level

Muon track reconstruction



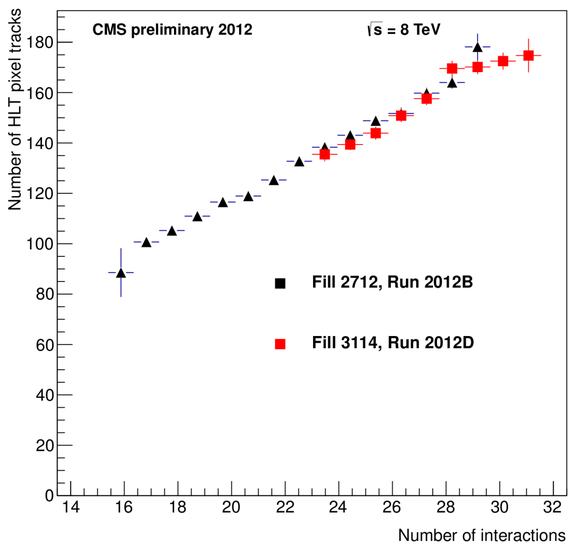
Also thanks to muon tracking,muon triggers have very steep turn-on curves

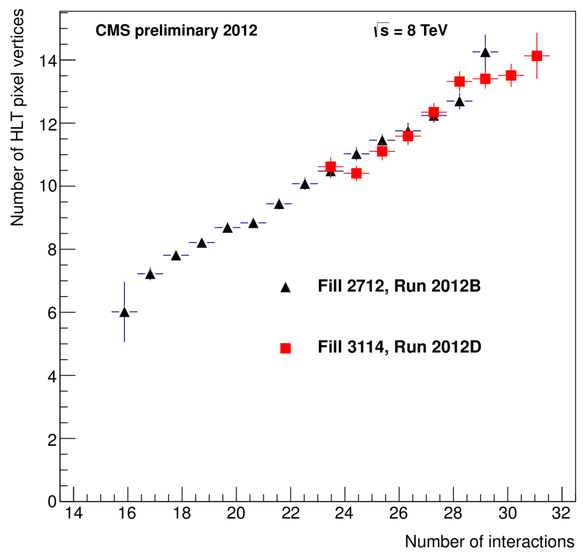
b-tagging



Tracking allows to trigger events at low rate and with low CPU timing.

Number of tracks and vertices with PU





Number of interactions calculated from bunch luminosity measured with HF

References:

- The CMS Collaboration, ***Description and performance of the CMS track and primary vertex reconstruction***, CMS PAPER TRK-11-001
- The CMS Collaboration, ***The Trigger and Data Acquisition project, Technical Design Report***, CERN/LHCC 2000-38, CMS TDR 6.1, Dec 15, 2000
- The CMS Collaboration, ***The Tracker System project, Technical Design Report***, CERN/LHCC 98-6, CMS TDR 5, April 15, 1998
- The CMS Collaboration, ***Addendum to the CMS tracker TDR***, CERN-LHCC-2000-016, Feb 2000