

RecHit Efficiency of the Pixel Detector

1

János Karancsi, Viktor Veszprémi

janos.karancsi@cern.ch, vezpvi@cern.ch

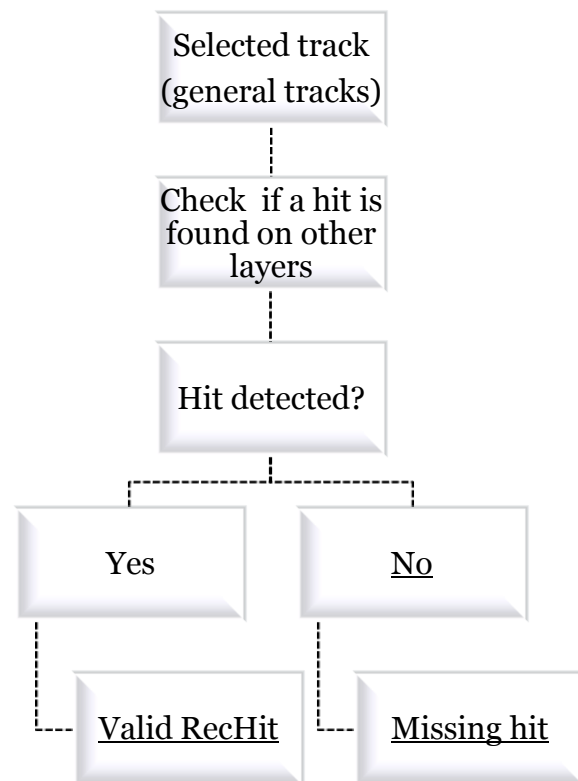
*Institute for Nuclear Research of
the Hungarian Academy of Sciences*

(NKTH MB08-80137, OTKA NK81447)

Introduction

2

- Efficiency is calculated in the fiducial regions of the sensors (no gaps, avoiding edges)
- Whenever a track crosses the detector there is a probability for a hit to be detected on a module = Efficiency
 - Overestimated efficiency for Pixel seeded tracks
 - Need to require valid hits on other layers in order to avoid bias due to seeding



Run info

3

- **Run 135537**
 - 16 May 2010
 - 7 TeV collisions
 - 318013 event → 30.5 million valid RecHits
- **Dataset**
 - MinimumBias/Commissioning10-PromptReco-v9/RECO
- **Project version**
 - CMMSW_3_5_8_patch3
- **Global tag**
 - GR_R_35X_V8B::All

- Trigger selection

- (40 OR 41) AND (NOT 36) AND (NOT 37) AND (NOT 38) AND (NOT 39) AND 0 AND ((42 AND 43) OR (NOT 42 AND (NOT 43)))

- Event selection

- Number of vertices ≥ 1 , where $|z| \geq 15\text{cm}$, $N_{dof} > 4$, $|\rho| > 2.0$

- Track selection

- General tracks consistent with vertex with $|dz| < 1.0$ and $|d_0| < 0.5$
- $P_T > 0.9$ GeV, $N_{stip\ hits} > 10$

- Lumisection selection

- Not yet accounted for, but event and track selection conditions has similar effect

Efficiency Calculation

5

- Efficiency is calculated separately on each module

- Barrel Detector

- Layer 1
$$Eff = \frac{N_{valid\ hits}}{N_{valid\ hits} + R \times N_{missing\ propagated\ hits}}$$

→ R is the correction factor to account for bias from seeding
$$R = \frac{N_{valid\ hits}}{N_{propagated\ valid\ hits}}$$

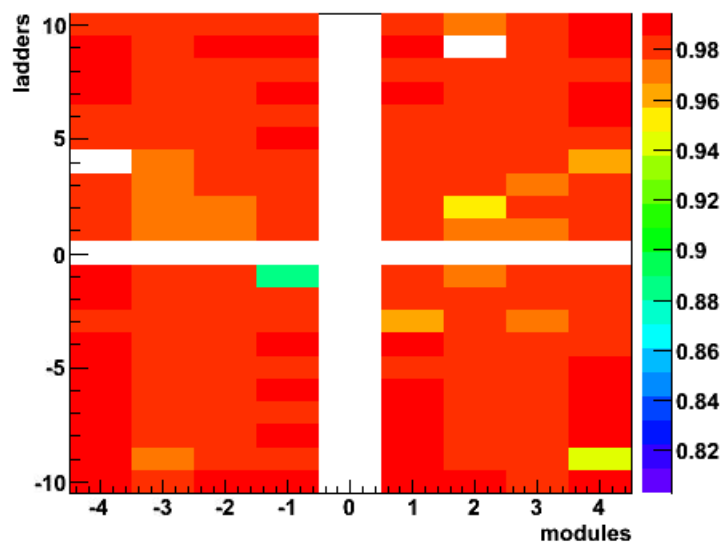
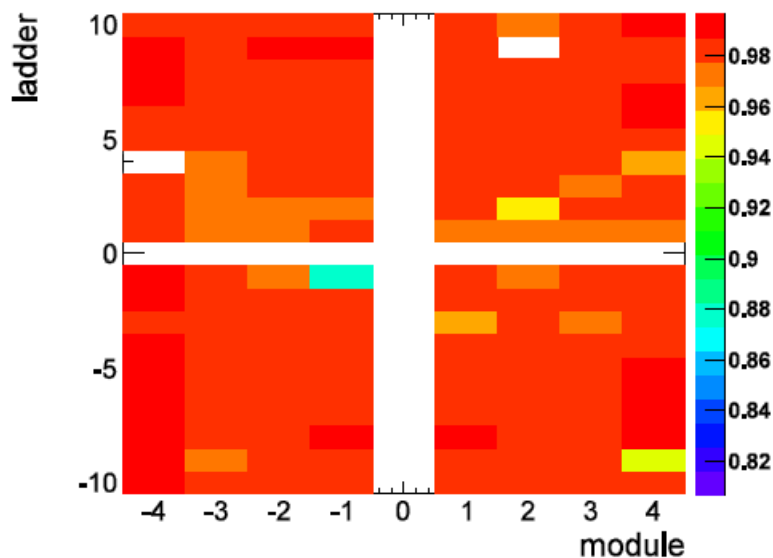
- Layer 2 and 3
$$Eff = \frac{N_{valid\ hits}}{N_{valid\ hits} + N_{missing\ hits}}$$

- Forward Detector

- Disk 1 and 2
$$Eff = \frac{N_{valid\ hits}}{N_{valid\ hits} + N_{missing\ hits}}$$

BPix Layer 1 Efficiency

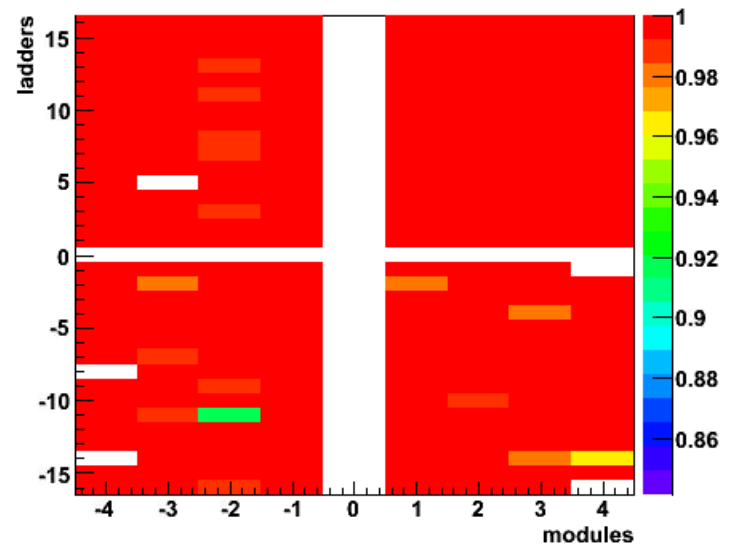
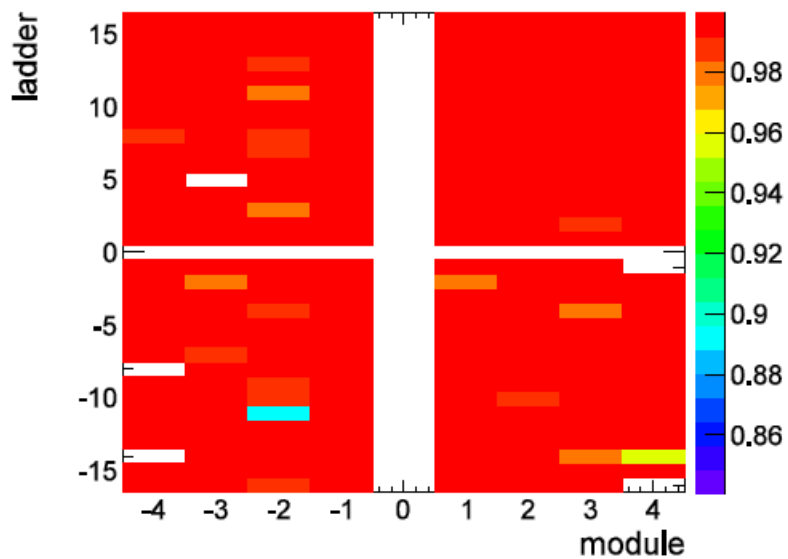
6



- Layer1 Eff: Valid hit required on: layer 2 + 3, layer 2 + disk 1, disk 1 + disk 2
- Original calculations made by Viktor
- Plot recalculated on the full run
- Shows qualitatively good agreement

BPix Layer 2 Efficiency

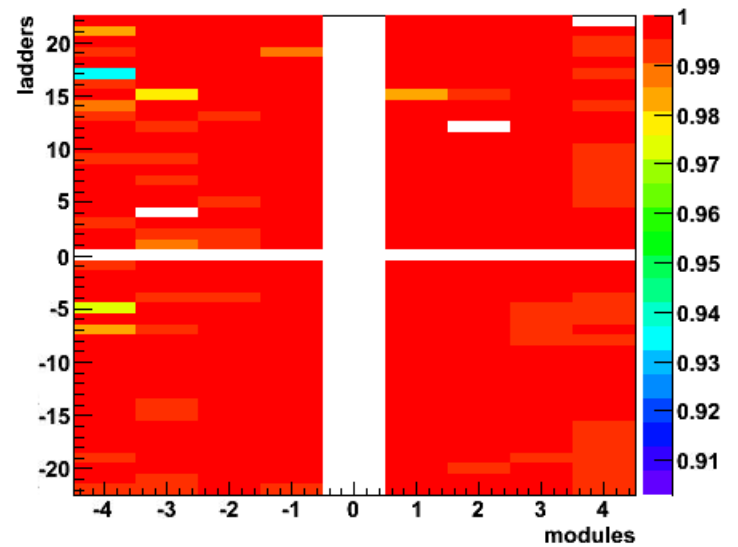
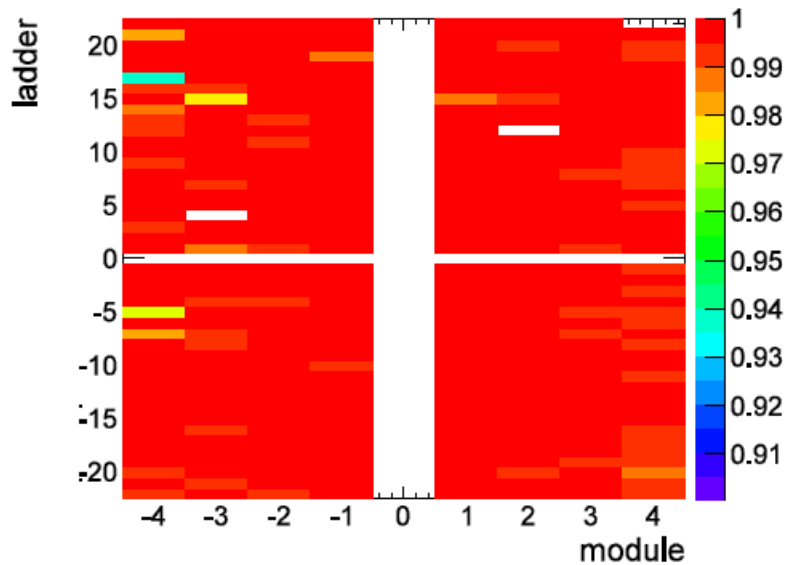
7



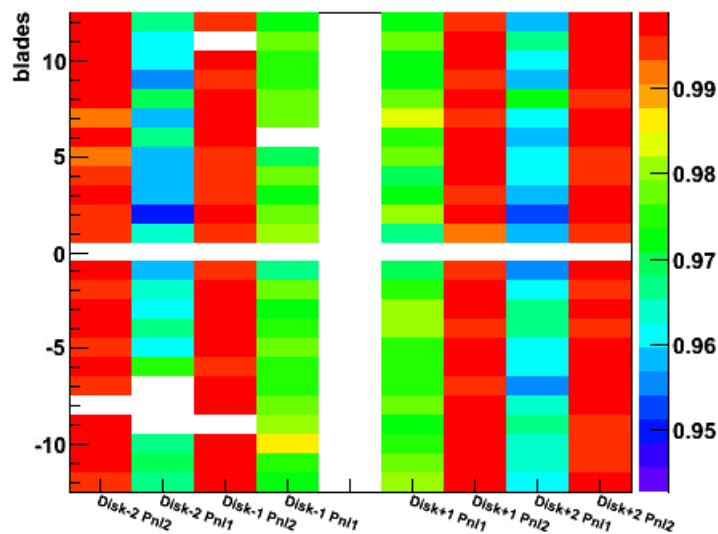
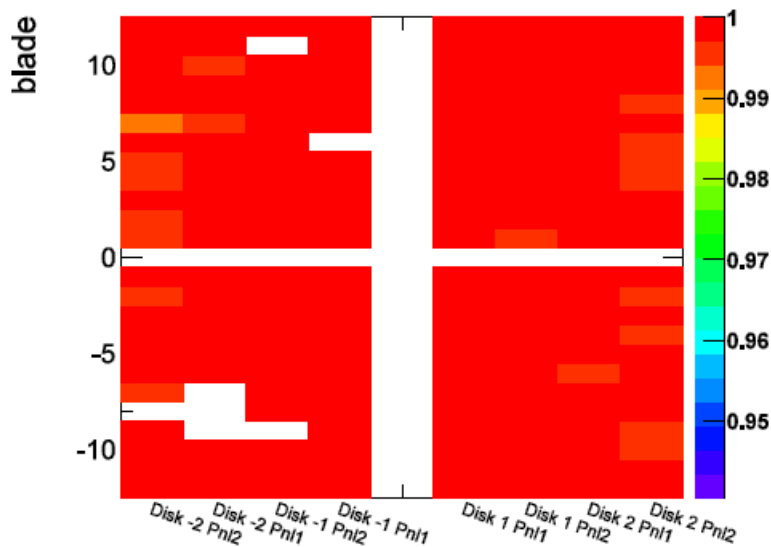
- Layer 2 Eff: Valid hit required on: layer 1 + 3, layer 1 + disk 1

BPix Layer 3 Efficiency

8



- Layer 3 Eff: Valid hit required on: layer 1 + 2



- Disk 1 Eff: Valid hit required on: Layer 1 + Disk 2, Layer 2 + Disk 2
- Disk 2 Eff: Valid hit required on: Layer 1 + Disk 1
- Difference is not yet corrected
 - The inner panels of each disk has 4 modules, from which the outer ones can be excluded
 - Some tracks on these outer chips has to be propagated to the strip tracker which is much more ambiguous than propagating to a nearby disk

Current objectives

10

- Large statistics:
 - Calculate efficiency on the ROC level
 - Investigate track and RecHit selection:
eg. Pt dependence, tighter track vertex association
- Currently only the fiducial (non-overlapping) regions are used
 - → Extend calculations where modules overlap inside a layer
(where a track crosses 2 neighbouring ladders in the same layer)
- General tracks are seeded from the pixel detector
 - Investigate impact
- Optimize cluster-trajectory state matching
(currently it is down due to tracking)
- Check calculations on Monte-Carlo data
- Prepare a note on Pixel Efficiency