

Progress on PXD efficiency estimation in test beam 2017

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Tracking F2F Meeting



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GÖTTINGEN



Detail of analysis

- Analysis done on current master branch with PXDEfficiency module modified to accept 4 PXD module geometry.
- Offline Analysis Chain: Unpacker → DigitSorter/RawHitSorter → Clusterizer → VXDTF1/2 → DAFRecoFitter → TrackCreator → PXDEfficiency.
- Use only runs with alignment included in *beamtest_vxd_april2017_rev1*, available since 27.06.17.
- All runs taken from the list of long, stable runs, processed up to the first 10,000,000 events for each, if available.
- <https://confluence.desy.de/display/VBTA/Description+of+runs>

PXD Hit Efficiency

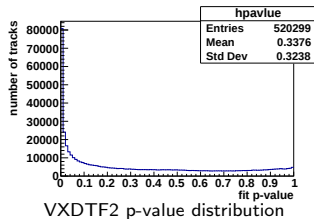
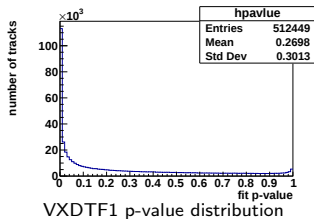
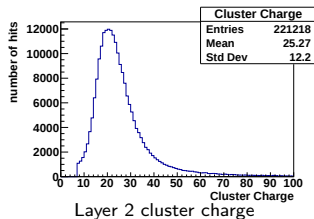
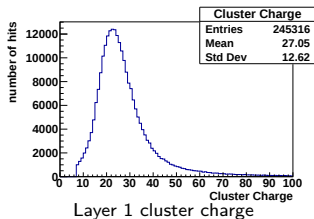
$$\varepsilon = \frac{\text{\#Matched track intersection inside ROI}}{\text{\#Track intersection inside ROI}}$$

- Require events with exactly one fitted track with $1 \text{ GeV} < |p_{fit}| < 8 \text{ GeV}$ and fitted p-value $p > 0.01$.
- Require exactly one ROI on module in question, and require track intersection to lie inside.
- Match track intersections to hits with a distance of less than $400 \mu\text{m}$ on the PXD.

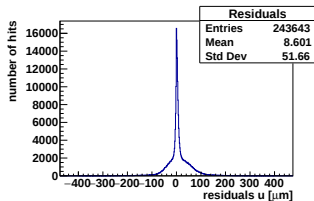
Comments

- Analysis can be performed on any run, observing a decrease in efficiency shows the particular run being problematic.
- Alignment used on HLT and during offline analysis different.
- Offline-tracking can produce more/different tracks than online-tracking. Ignore tracks outside ROIs.

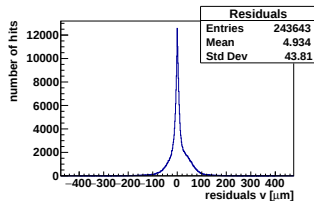
- Magnetic field 0.5T, beam energy 2.4 GeV
- Cross-check of alignment *beamtest_vxd_april2017_rev1*



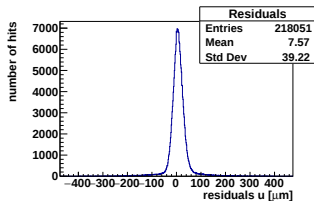
- Residuals for VXDTF1
- Biased residuals
- Cross-check of alignment *beamtest_vxd_april2017_rev1*



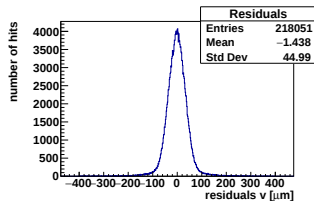
Layer 1 u-direction: $\sigma_{Fit} = 210\mu\text{m}$



Layer 1 v-direction: $\sigma_{Fit} = 220\mu\text{m}$

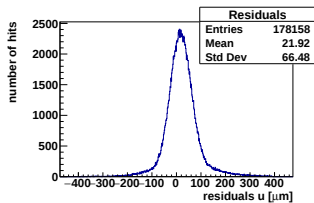


Layer 2 u-direction: $\sigma_{Fit} = 155\mu\text{m}$

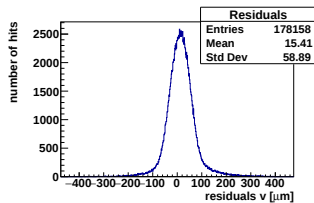


Layer 2 v-direction: $\sigma_{Fit} = 195\mu\text{m}$

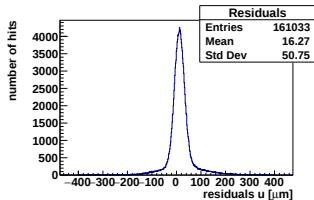
- Residuals for VXDTF2
- Residuals look broader → Alignment was created with VXDTF1



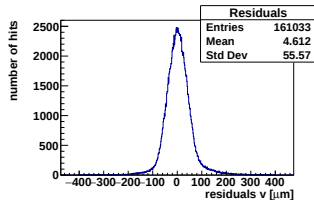
Layer 1 u-direction: $\sigma_{Fit} = 210\mu\text{m}$



Layer 1 v-direction: $\sigma_{Fit} = 170\mu\text{m}$

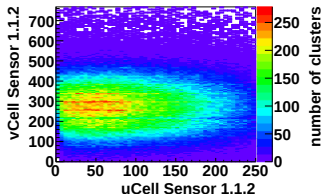


Layer 2 u-direction: $\sigma_{Fit} = 220\mu\text{m}$

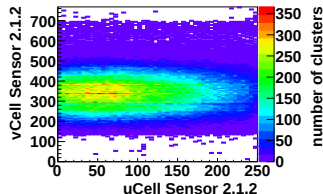


Layer 2 v-direction: $\sigma_{Fit} = 200\mu\text{m}$

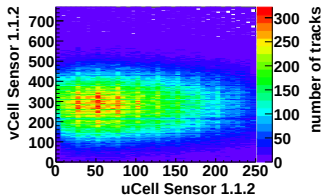
- Magnetic field 0.5T, beam energy 2.4 GeV, VXDTF1
- Beamspot from fitted tracks matches hitmap from sensor very well.



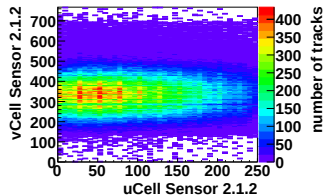
Hitmap of layer 1



Hitmap of layer 2

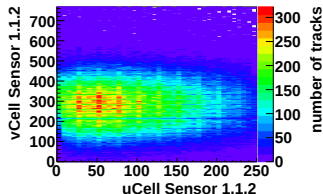


Beamspot from fitted tracks, Layer 1

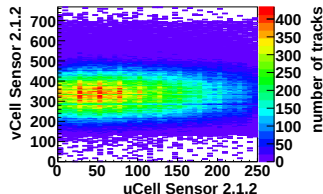


Beamspot from fitted tracks, Layer 2

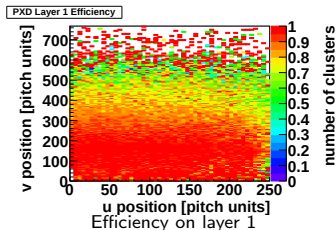
- Magnetic field 0.5T, beam energy 2.4 GeV, VXDTF1
- Efficiency shows gradient in v-direction.



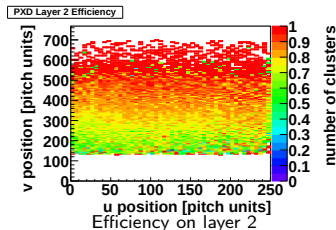
Beamspot from fitted tracks



Beamspot from fitted tracks

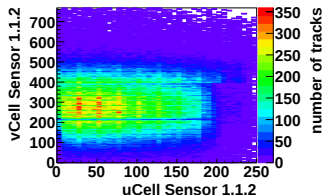


Efficiency on layer 1

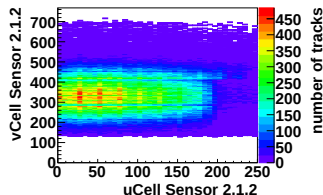


Efficiency on layer 2

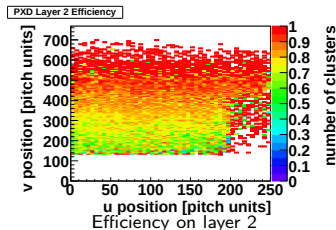
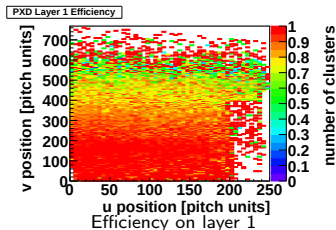
- Magnetic field 0.5T, beam energy 2.4 GeV, VXDTF2
- With VXDTF2 strange area of low efficiency in lower right corner



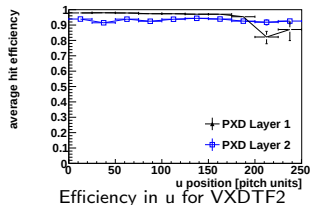
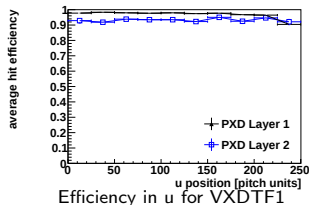
Beamspot from fitted tracks



Beamspot from fitted tracks

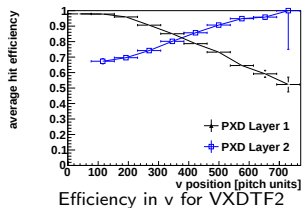
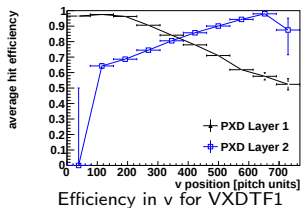
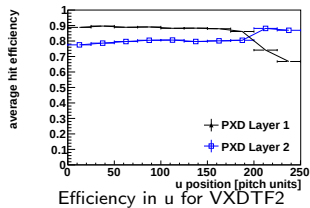
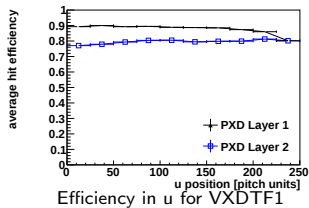


- With requirement on ROI only very little difference in measured efficiency between VXDTF1 and 2
- Constraining the area to sub-range in v-direction:
 - Layer 1: $100 < v < 200$
 - Layer 2: $500 < v$



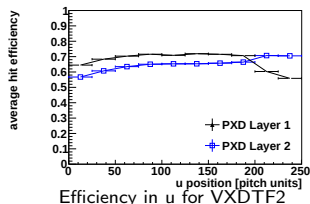
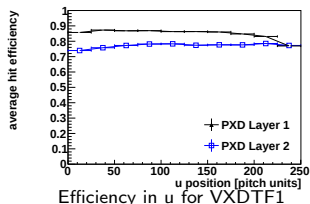
- Lower efficiency outside the selected v-region hard to explain from sensor side.
- Possible causes: Training of sector maps, misalignment, ...
- Open to suggestion for further investigations.

- When removing constraint on v , projected efficiencies are lower.



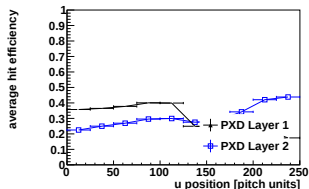
Run 176

- When not requiring the fitted track to lie inside the ROI, measured efficiency with VXDTF2 drops drastically.
- Not applying constraint in v here.

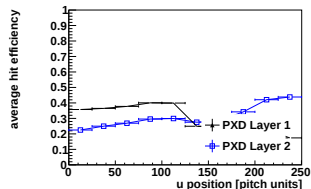


- Even if correct track found, if not passing through a ROI no hit information is saved.
- ROIs are determined with VXDTF1 on HLT, so finds mostly the same tracks as were used there.
- If VXDTF2 finds different tracks than VXDTF1, these will not pass through the ROI and have no chance of being matched.

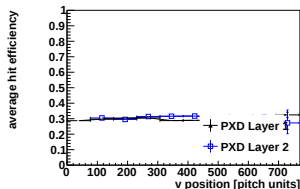
- Magnetic field 1T, beam energy 2.4 GeV
- Many runs are like this: Efficiency much lower.
- Although classified as long and good run, some problem seems to have occurred.



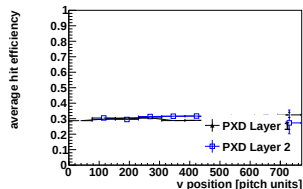
Efficiency in u for VXDTF1



Efficiency in u for VXDTF2

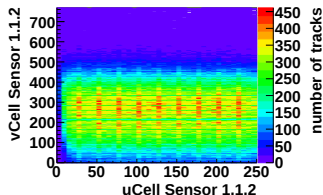


Efficiency in v for VXDTF1

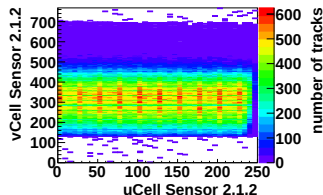


Efficiency in v for VXDTF2

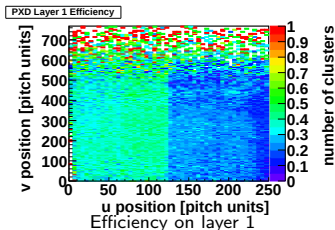
- VXDTF1
- Sharp edge with different efficiency: Problems during module operation?



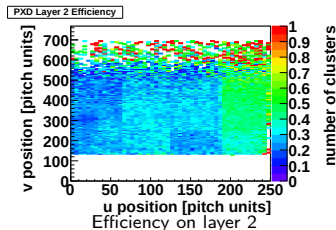
Beamspot from fitted tracks



Beamspot from fitted tracks

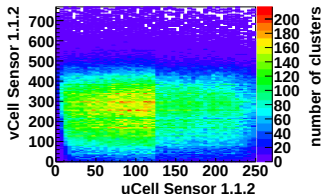


Efficiency on layer 1

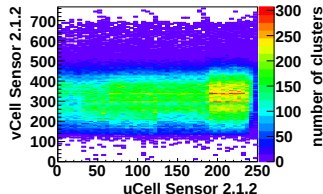


Efficiency on layer 2

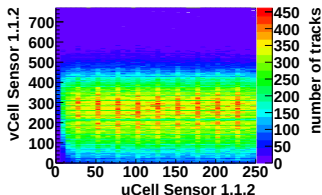
- VXDTF1
- Same effect observed on hitmap



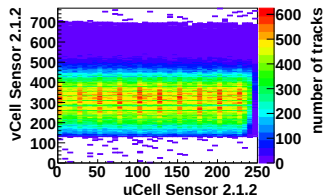
Hitmap on sensor, Layer 1



Hitmap on sensor, Layer 2

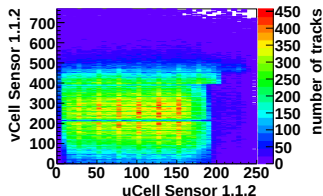


Beamspot from fitted tracks, Layer 1

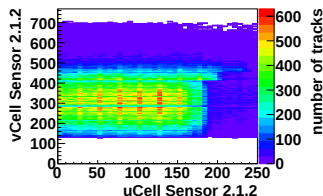


Beamspot from fitted tracks, Layer 2

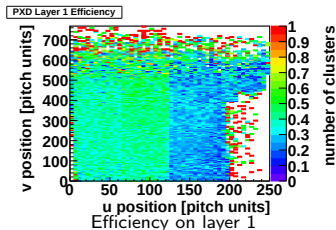
- VXDTF2
- Again observe lower right corner as much less efficient: Some sector-map effect?



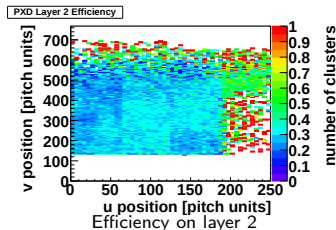
Beamspot from fitted tracks



Beamspot from fitted tracks



Efficiency on layer 1



Efficiency on layer 2

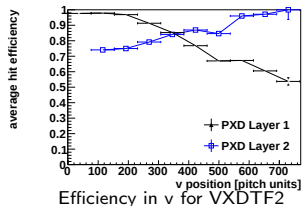
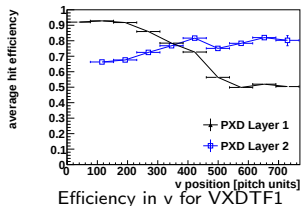
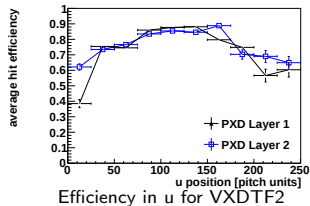
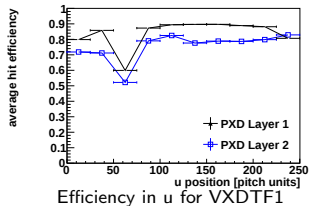
Conclusion

- In some runs with appropriate cuts, observe high PXD efficiencies ($> 97\%$)
- Measured efficiency is highly run-dependant. Some changes between runs hard to follow afterwards.
- VXDTF2 shows problems with memory usage in several runs.
- Extension to generate plots for PXD validation and express reco on hit efficiency planned.

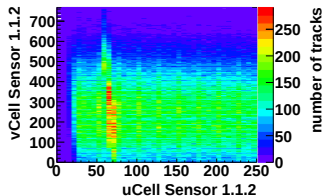
Additional runs

Some with less statistic

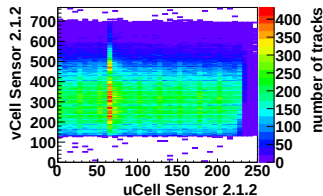
- Magnetic field 1 T, beam energy 1 GeV
- Minimal fitted momentum reduced to 0.5 GeV



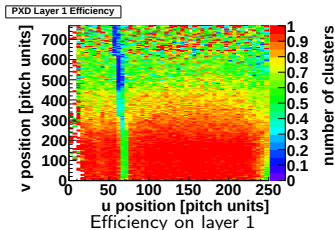
• VXDTF1



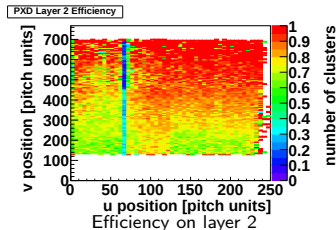
Beamspot from fitted tracks



Beamspot from fitted tracks

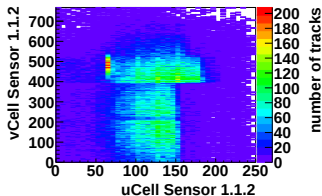


Efficiency on layer 1

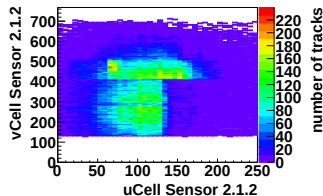


Efficiency on layer 2

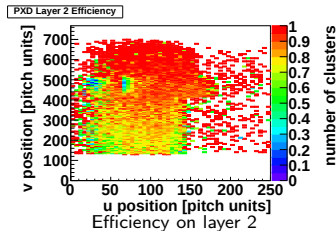
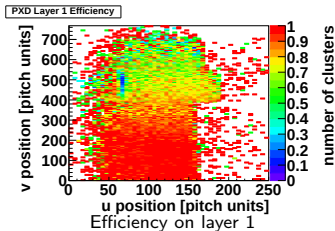
• VXDTF2



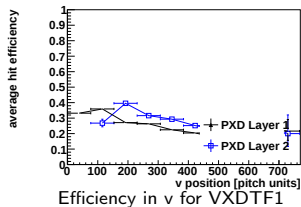
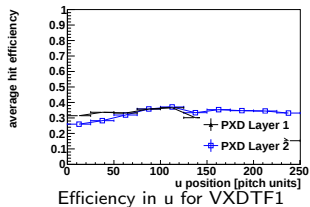
Beamspot from fitted tracks



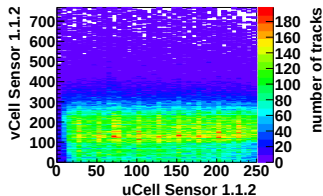
Beamspot from fitted tracks



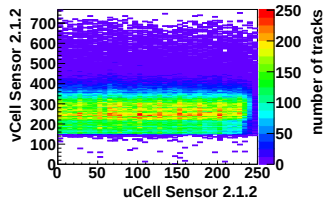
- Magnetic field 1 T, beam energy 2.4 GeV
- Analysis fails with VXDTF2



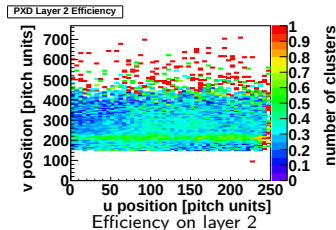
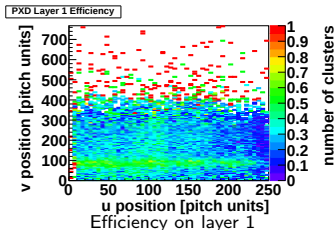
• VXDTF1



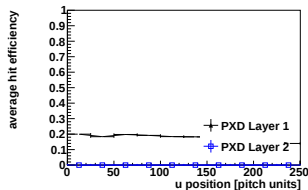
Beamspot from fitted tracks



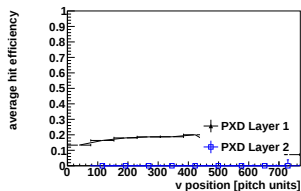
Beamspot from fitted tracks



- No magnetic field, beam energy 5 GeV
- Only layer 1 taking data, full-frame dummy ROIs sent
- BASF2 exhausts all memory on my machine and freezes when using VXDTF2.

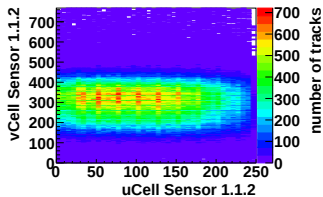


Efficiency in u for VXDTF1

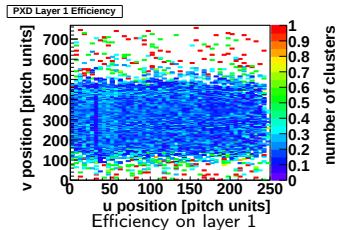


Efficiency in v for VXDTF1

• VXDTF1

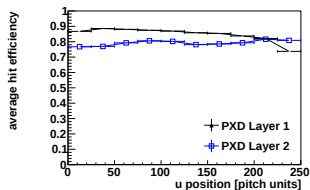


Beamspot from fitted tracks

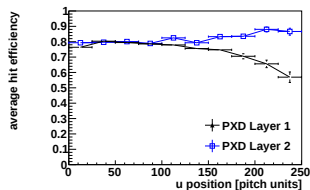


Efficiency on layer 1

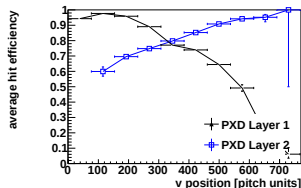
- Magnetic field 0.25 T, beam energy 2.4 GeV



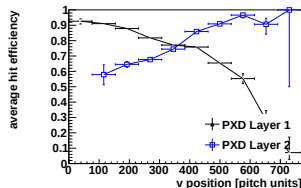
Efficiency in u for VXDTF1



Efficiency in u for VXDTF2

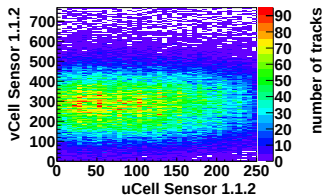


Efficiency in v for VXDTF1

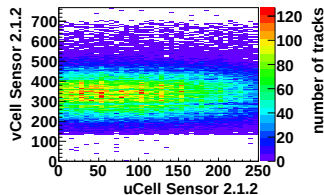


Efficiency in v for VXDTF2

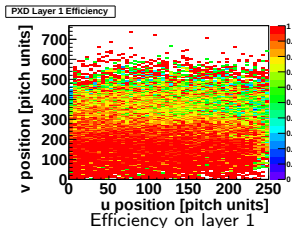
• VXDTF1



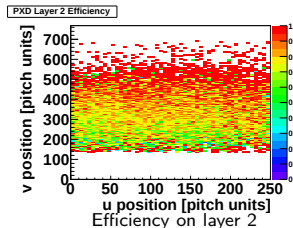
Beamspot from fitted tracks



Beamspot from fitted tracks

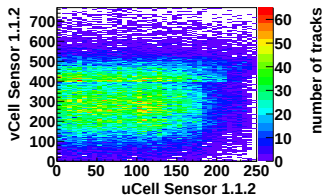


Efficiency on layer 1

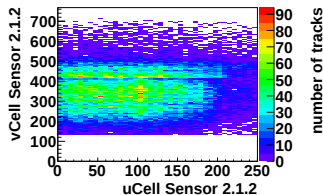


Efficiency on layer 2

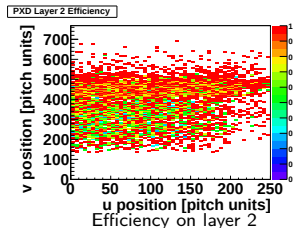
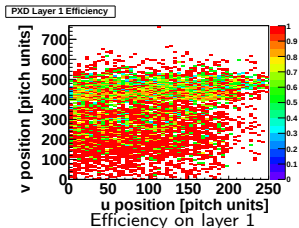
• VXDTF2



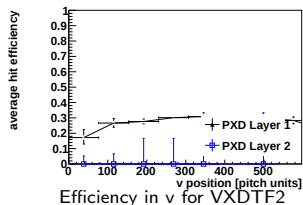
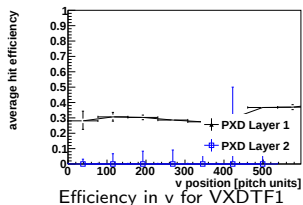
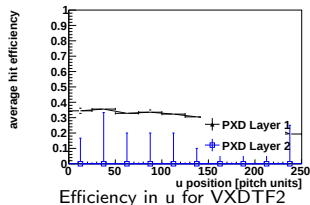
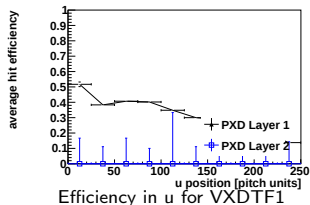
Beamspot from fitted tracks



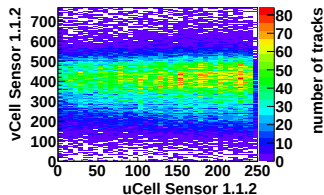
Beamspot from fitted tracks



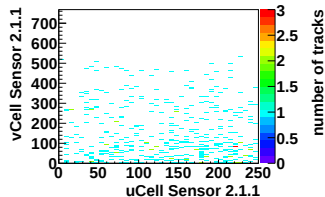
- Magnetic field 0 T, beam energy 5 GeV



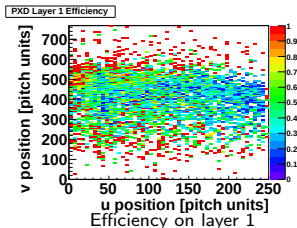
- VXDTF1



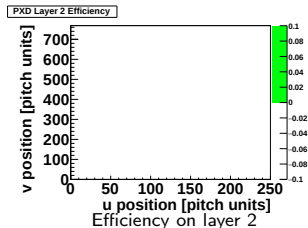
Beamspot from fitted tracks



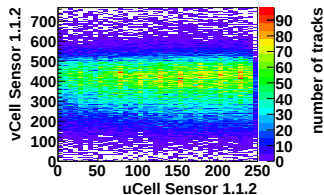
Beamspot from fitted tracks



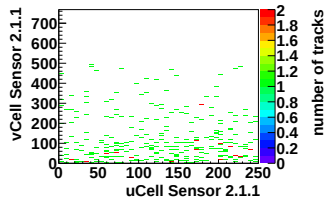
Efficiency on layer 1



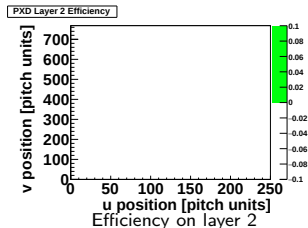
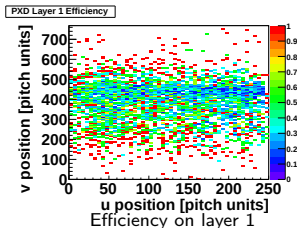
• VXDTF2



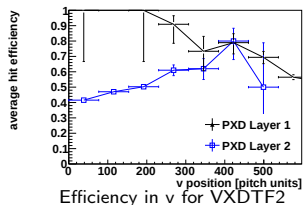
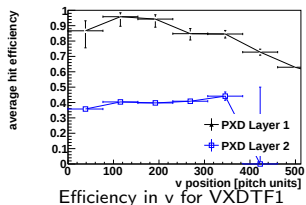
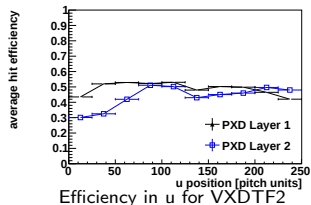
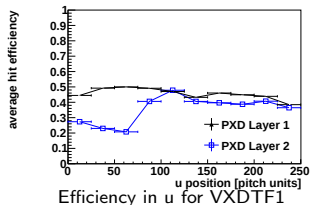
Beamspot from fitted tracks



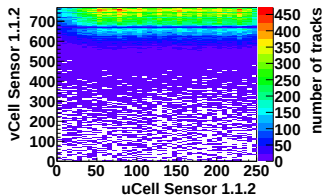
Beamspot from fitted tracks



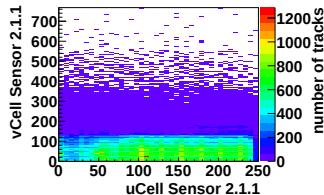
- Magnetic field 1 T, beam energy 4 GeV



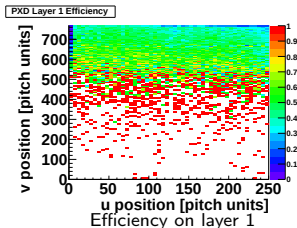
• VXDTF1



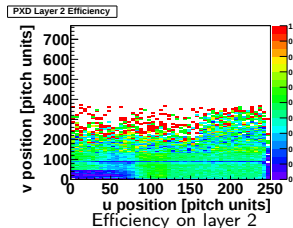
Beamspot from fitted tracks



Beamspot from fitted tracks

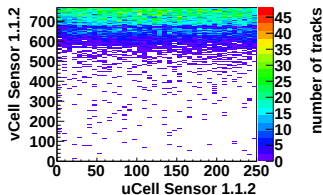


Efficiency on layer 1

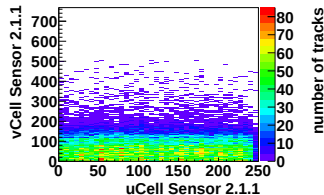


Efficiency on layer 2

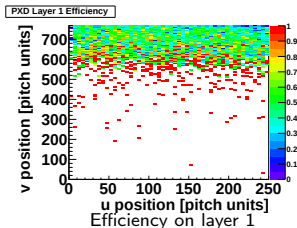
- VXDTF2



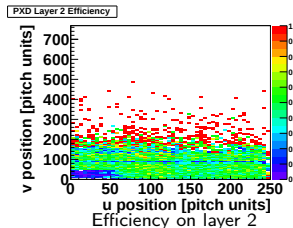
Beamspot from fitted tracks



Beamspot from fitted tracks



Efficiency on layer 1



Efficiency on layer 2