Tracking with digitised samples

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Introduction

❖ Digitisation + clustering, use just 1 BX.

❖ Phase-0, $\xi=3$

    ❖ 141 positrons in PTARMIGAN

    ❖ 100% clustering efficiency

❖ Phase-0, $\xi=7$

    ❖ 40404 positrons in PTARMIGAN, 66239 weighted

    ❖ Many merged clusters

❖ Background

    ❖ In L1, 7825 hits from Geant4, 6154 clusters

❖ Mean cluster size ~2.6

clusters

❖ Most positrons within acceptance and result in signal clusters.

❖ However, cluster merging becomes problematic at high multiplicity.

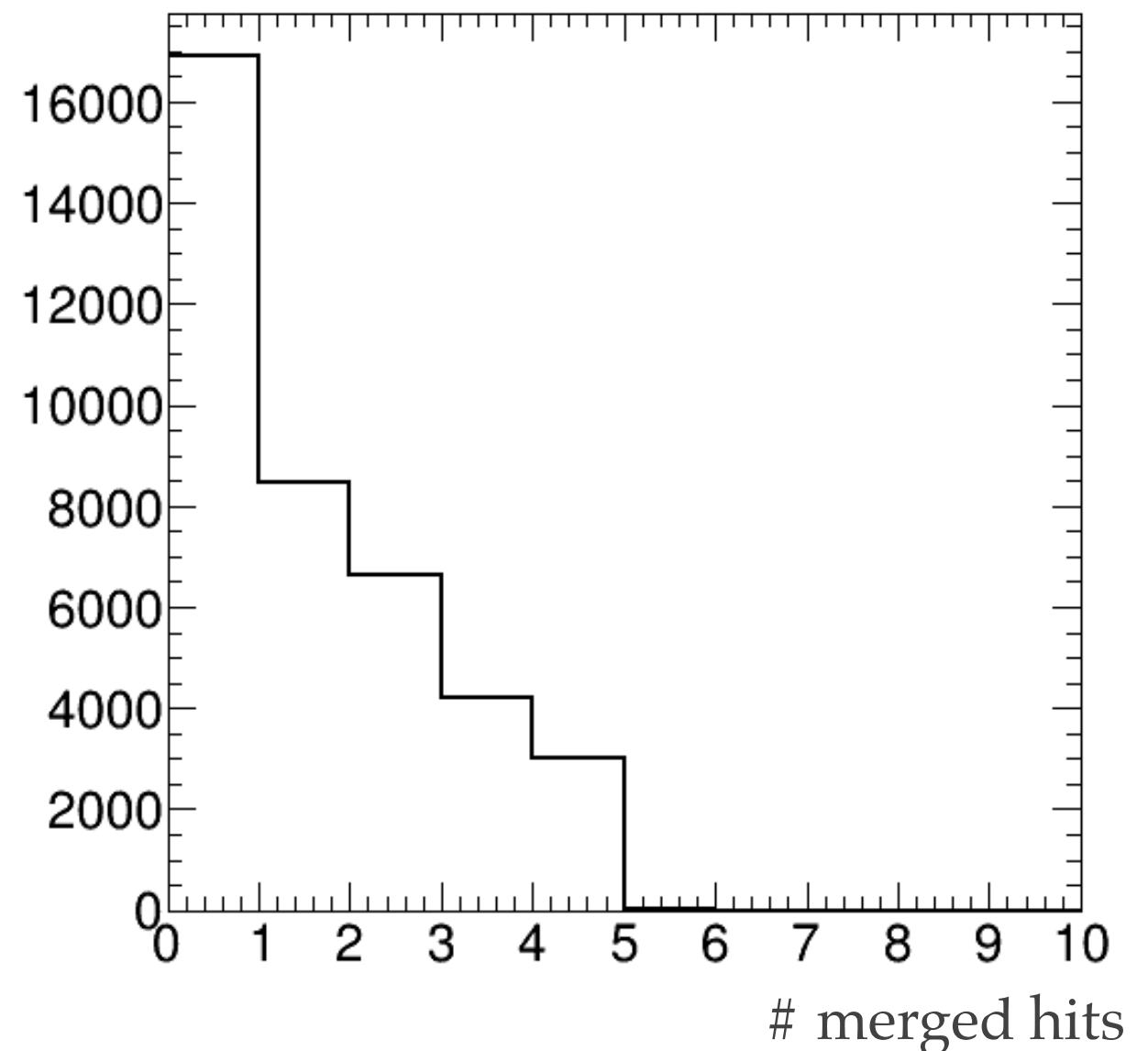|	# e+	# G4 hits / layer	# clusters / layer	#signal clusters / layer	# positrons firing pixels in all layers	# positrons hitting all layers without sharing clusters
$\xi=3$ signal	141	145.25	143.75	141.25	140	140
+bkg			7105.5	141.25		
$\xi=7$ signal	40404	43307.5	36109.25	35633	39241	16912
+bkg			36106.75	35630.5		

secondary interactions and stave staggering
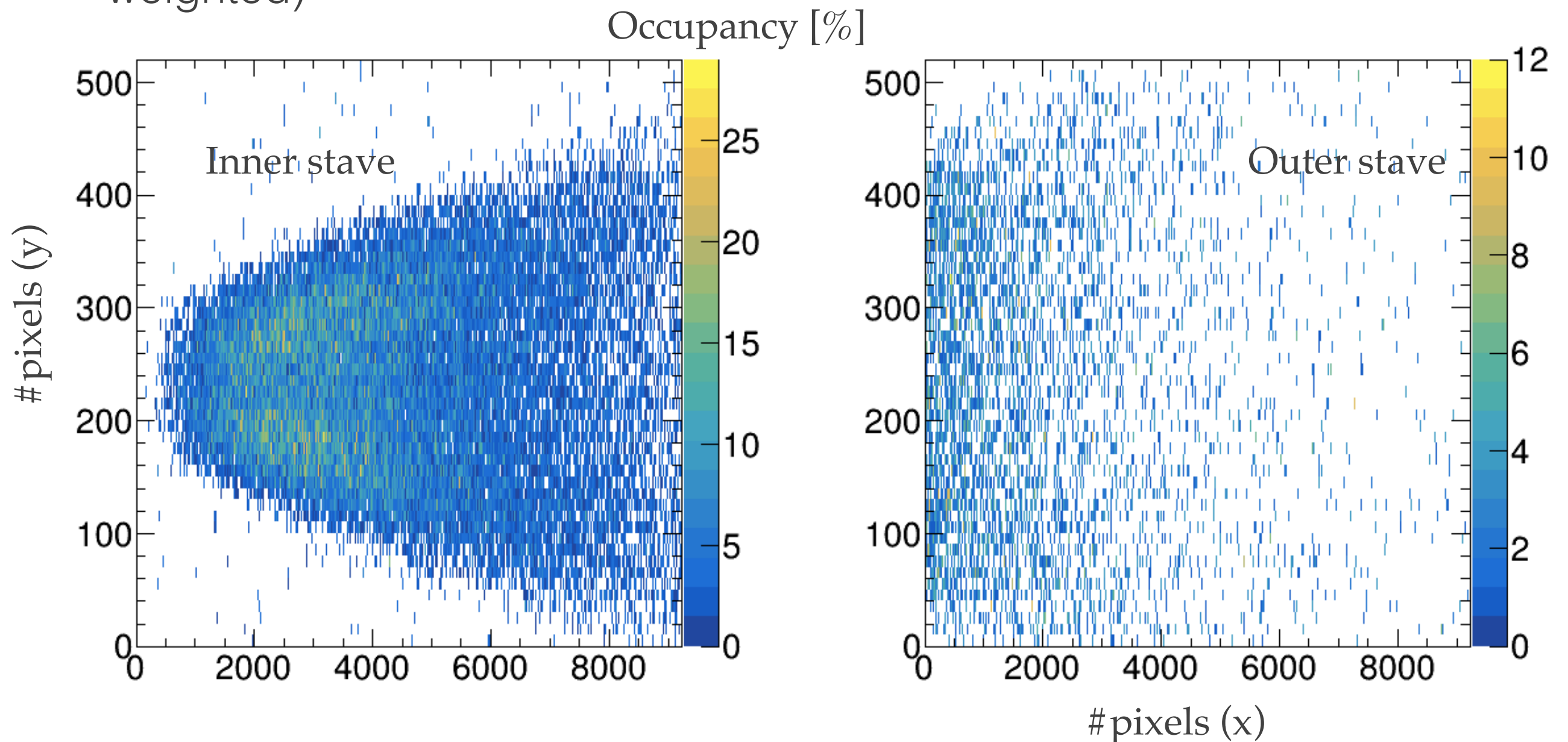
Cluster merging

Small acceptance loss

ξ=7

- ❖ Number of clusters shared with other signal particles by positrons traversing all 4 layers.

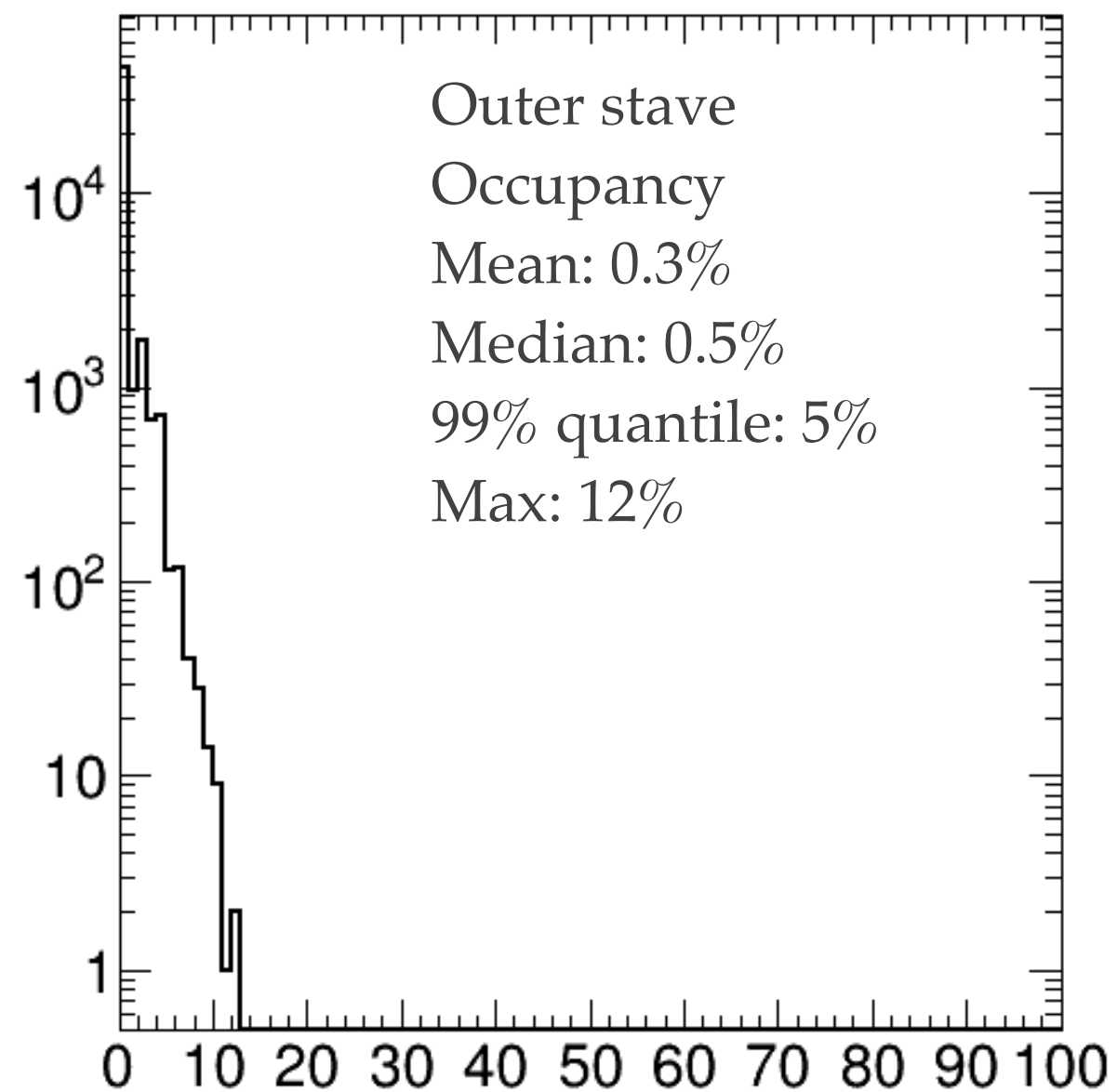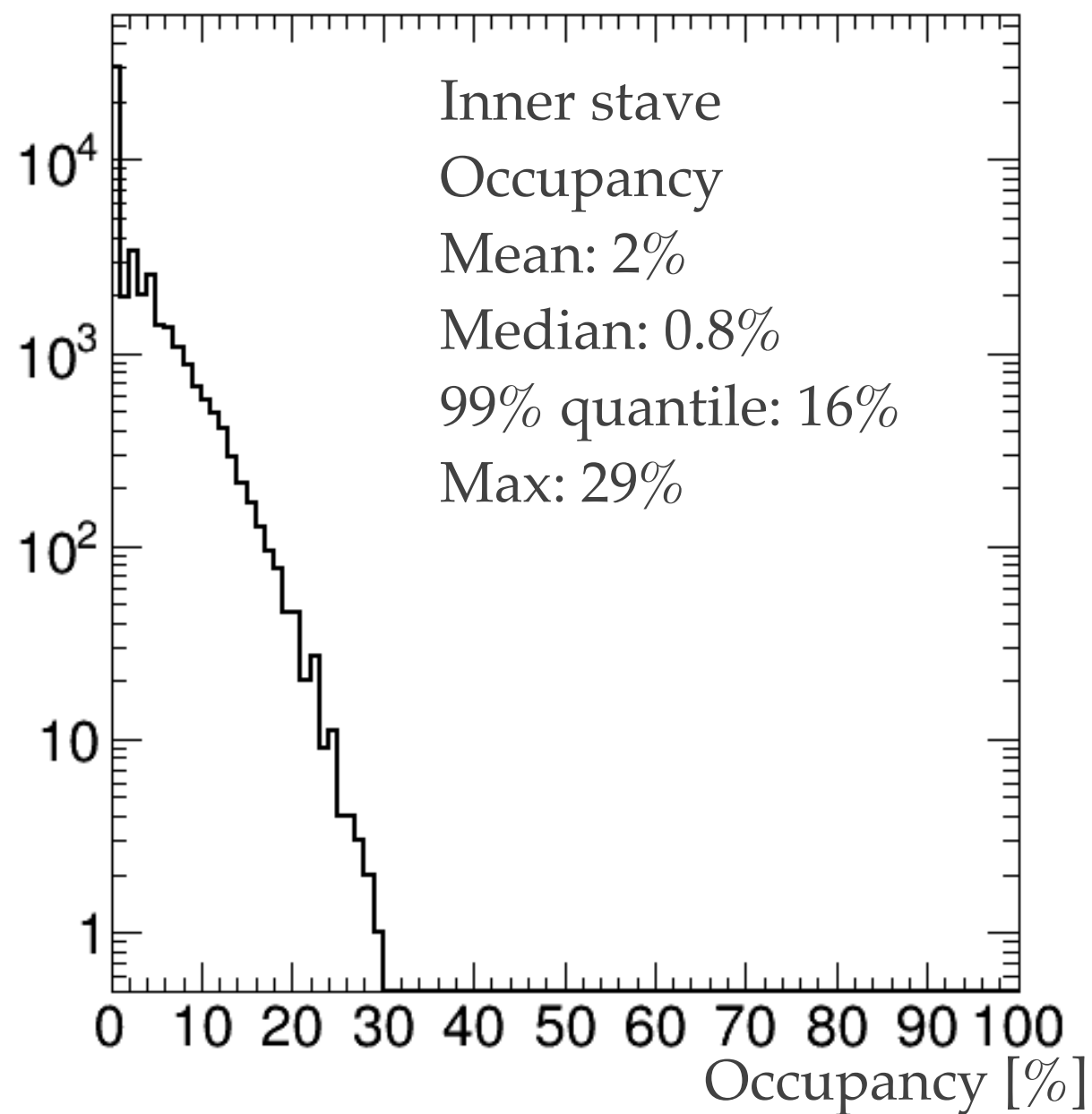- ❖ Only 43% of positrons within acceptance don't share clusters.

merged hits

Occupancy (phase-0, ξ=7)

❖ 40404 positrons, 66239 weighted. Occupancy reaches ~30% (50% if weighted)

Occupancy [%]

Inner stave

Outer stave

#pixels (y)

#pixels (x)

Occupancy (phase-0, ξ=7)

Inner stave
Occupancy
Mean: 2%
Median: 0.8%
99% quantile: 16%
Max: 29%

Occupancy [%]

Outer stave
Occupancy
Mean: 0.3%
Median: 0.5%
99% quantile: 5%
Max: 12%
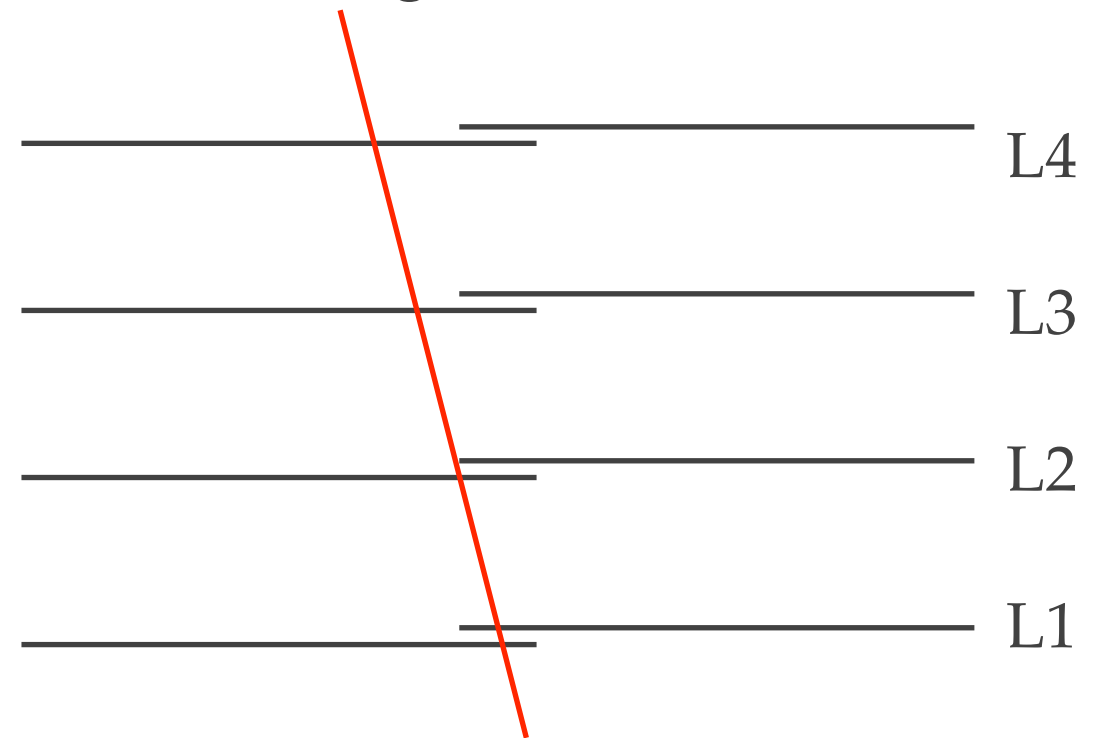
Tracking

* Use full geometry information (staggered stave design, 100 microns gap between chips).

* Tracking using cluster centre.

* Seed using three hits from L1-L3.

* CKF track finding+fitting.

* Ambiguity resolving: reject shared hits.

* Selected tracks required to have at least 4 hits and satisfy chi2 requirements.

* Strict track matching: all associated hits must belong to same particle.

L4

L3

L2

L1

Tracking results

❖ Impact of background quite small.

❖ Allowing shared hits increases efficiency.

	# e$^+$	No shared hits		1 shared hit allowed	
		# tracks selected	Of which #matched	#tracks selected	Of which # matched
ξ=3 signal	141	136	136	136	136
+bkg		140	136	140	136
ξ=7 signal	40404	22604	19930	33770	24032
+bkg		22628	19412	33688	23258

Conclusions

❖ Phase-0 ξ=7 represents maximum of our tracking capabilities.

    ❖ Up to 50% occupancy.

    ❖ Many merged clusters.

    ❖ Due to weights, results are actually optimistic.

❖ Possible tracking improvements:

    ❖ x-dependent chi2 and shared hits requirements.

    ❖ Use cluster size information?

❖ Checked raising pixel charge threshold to split clusters and reduce cluster size (not shown, impact minor, <10% at cluster level).