PVDIS GEM Occupancies

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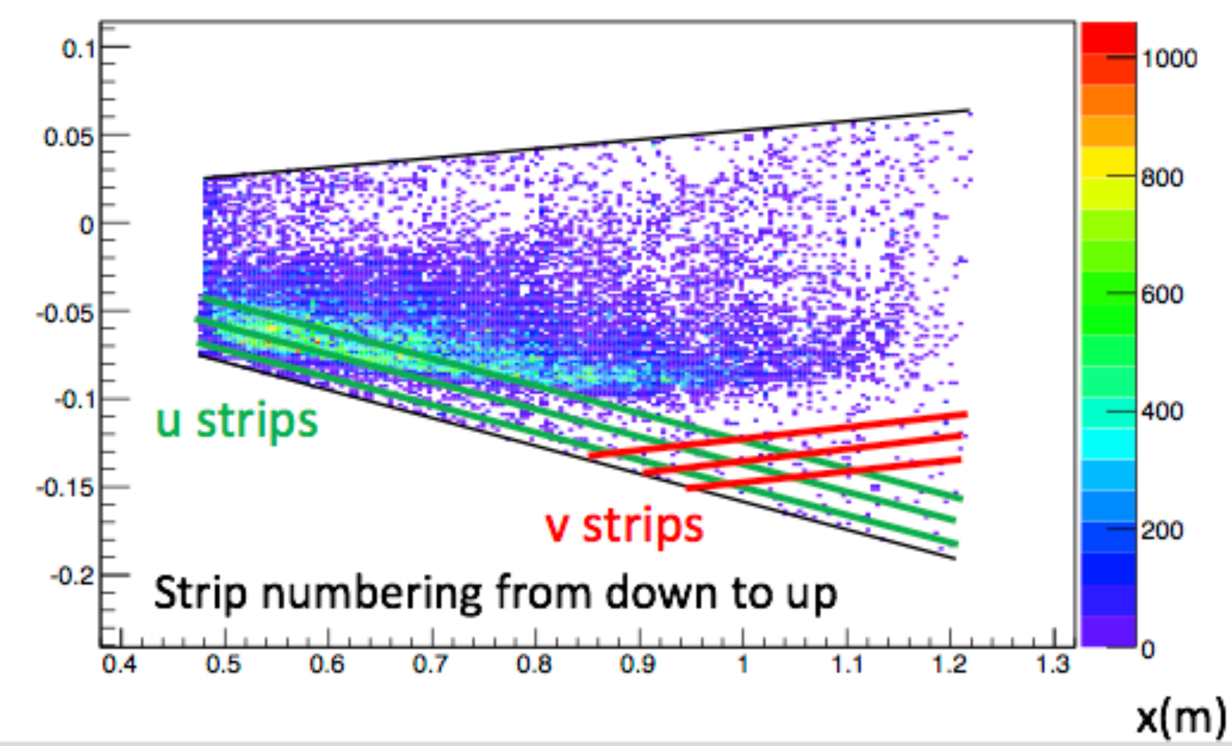
SoLID simulation meeting 9/19/2017

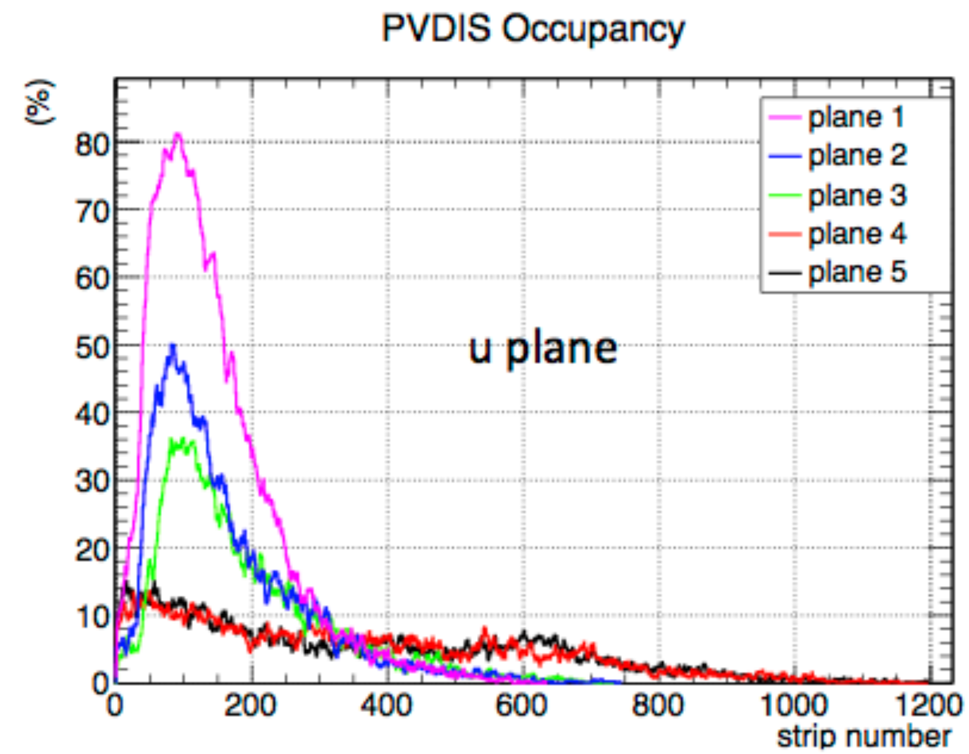
Weizhi’s talk, March 2017 collaboration meeting

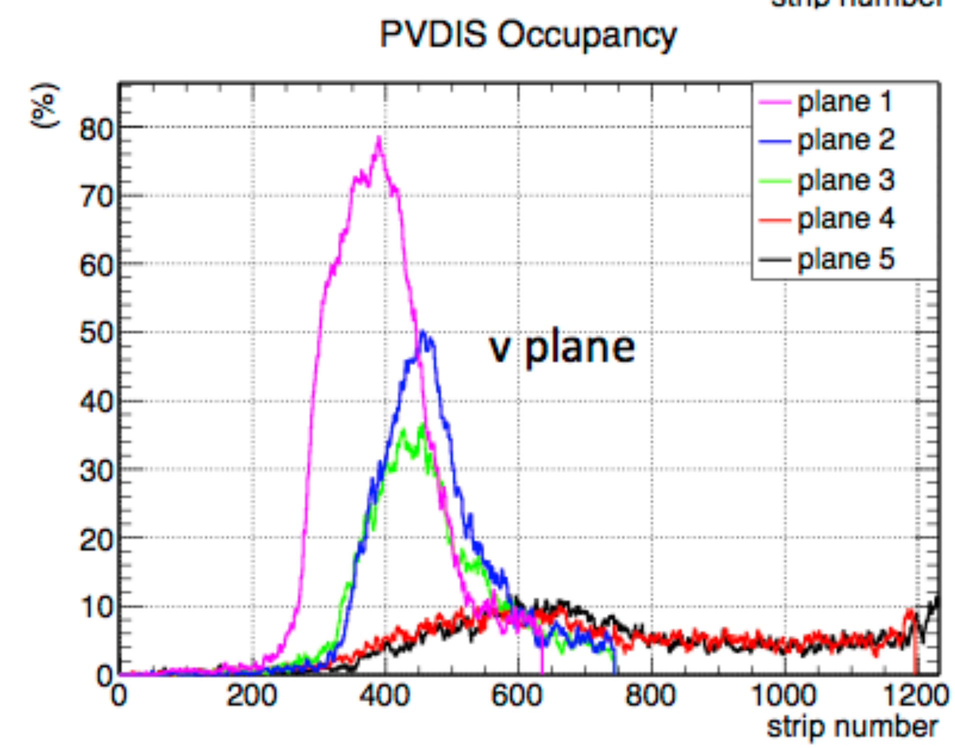
PVDIS Occupancy

- Raw Occupancy with 4 pedestal sigma cut (sigma = 20.7)
- Number of strips for each readout plane:
  - 634 | 743 | 743 | 1195 | 1231
- Mean value of the raw occupancy (in %):
  - u plane: 21.9 | 11.1 | 9.2 | 4.5 | 4.4
  - v plane: 22.1 | 11.1 | 9.2 | 4.4 | 4.4
- 4 sigma cut is used in reconstruction to ensure a better efficiency

Background hit position on first tracker







GEM digitization enhancements

- Dead areas can be arbitrary polynomials (Previously rectangles only; In addition, edges deadened to account for GEM frames)

- Strips can be divided

- Note a problem with previous analysis: Baffle was in its new angular position (rotated slightly in 2016 to put photon hot spots into GEM frames) but GEMs were in old positions

- This has impacts on maximum occupancies

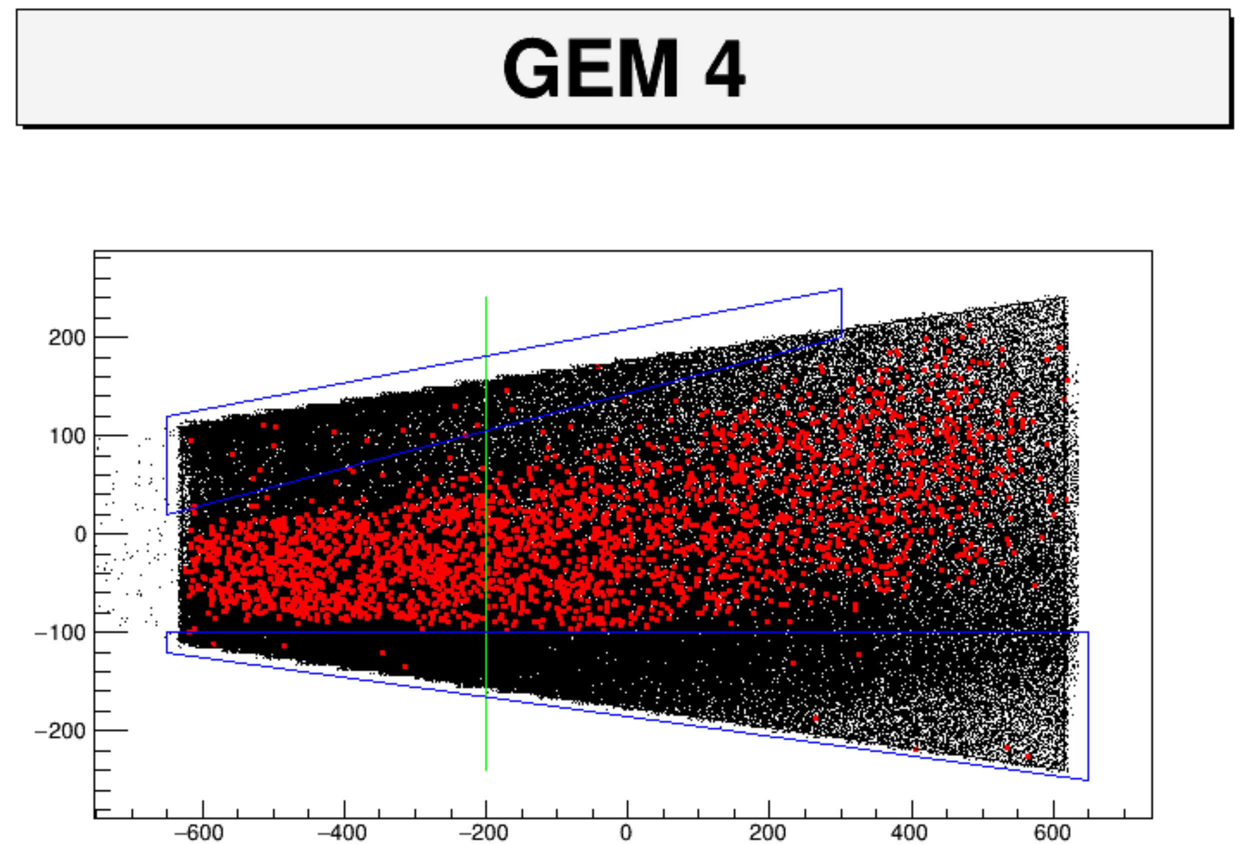
Hit positions in GEM 4 (flux detector)

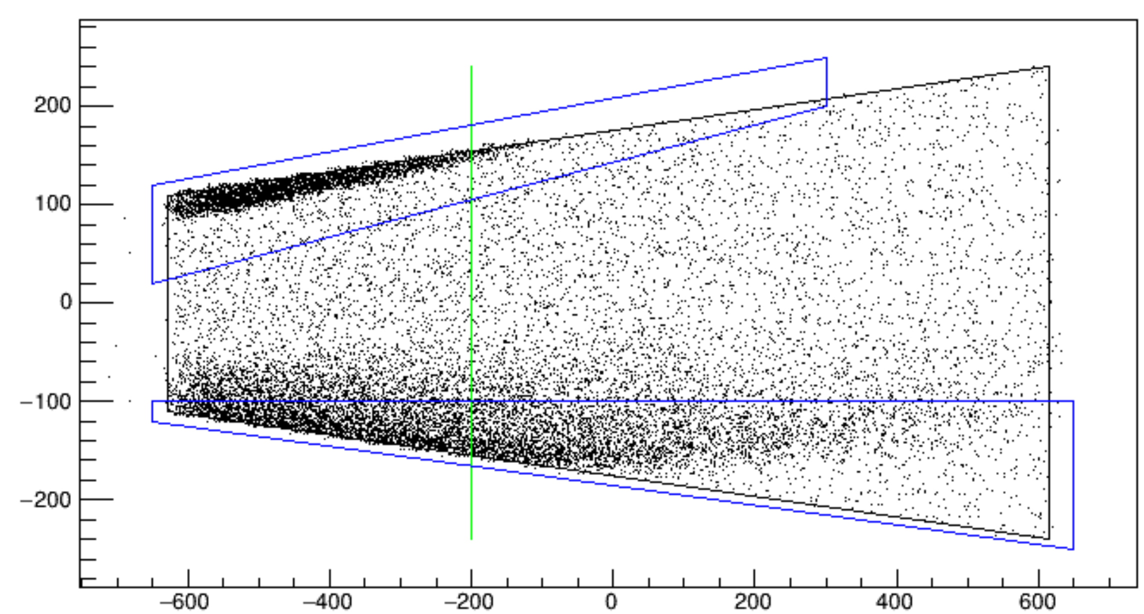
Top: Data from DIS generator, red dots are primary e^- with $Q^2 > 6$ GeV^2, W>4 GeV, x>0.55

Bottom: Data from GEANT beam on target

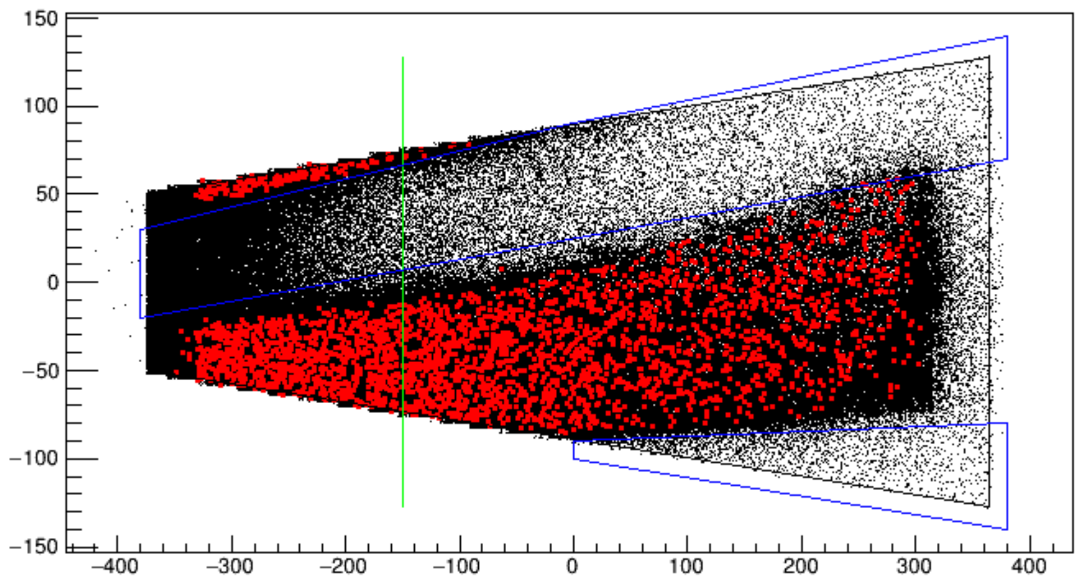
Green line: Division segment

Blue boxes: Dead regions





GEM 1


150
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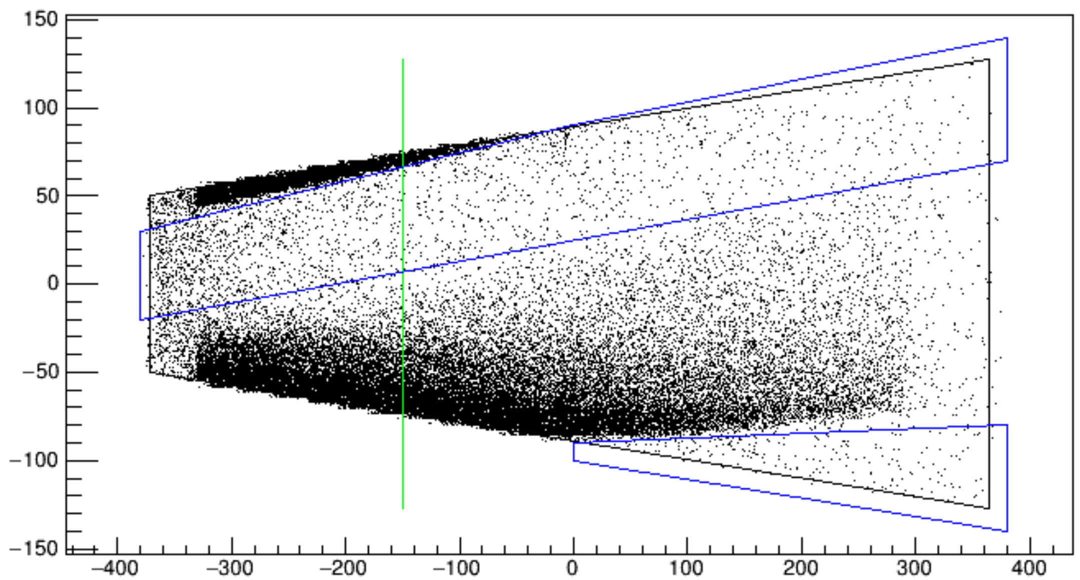
−400 −300 −200 −100 0 100 200 300 400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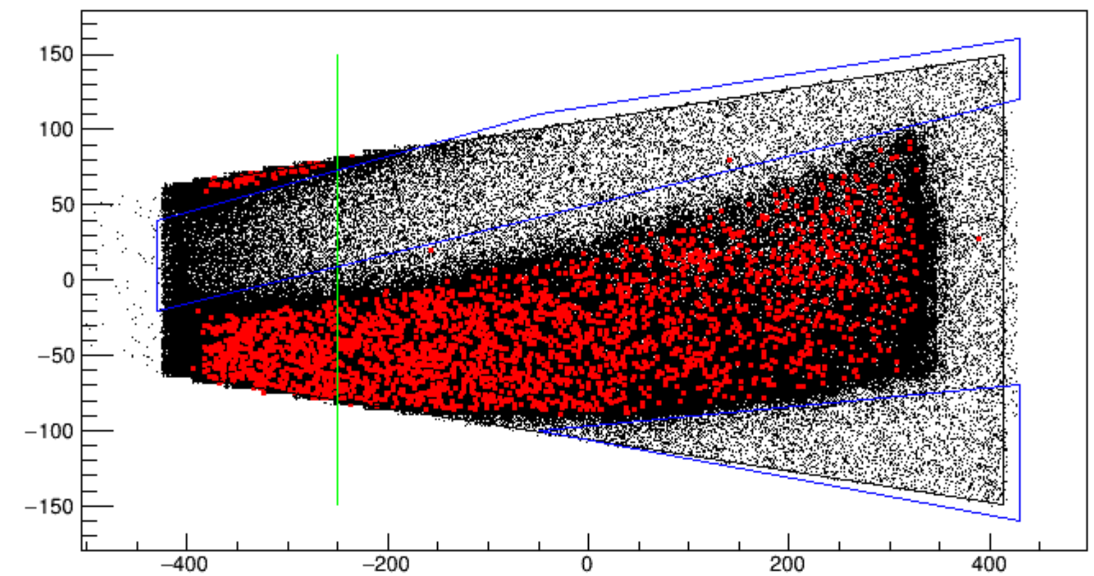
GEM 2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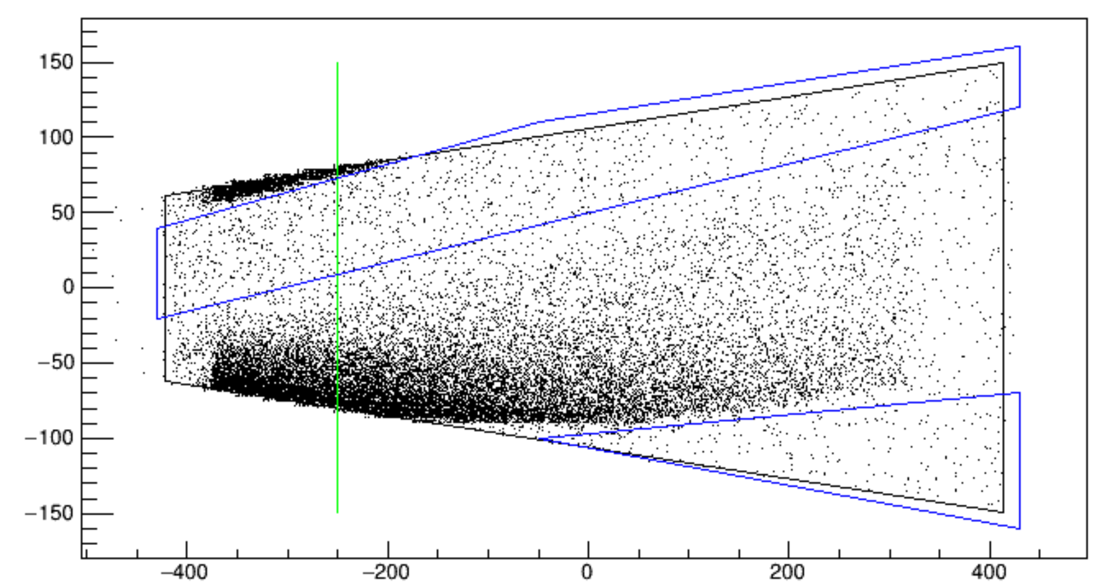
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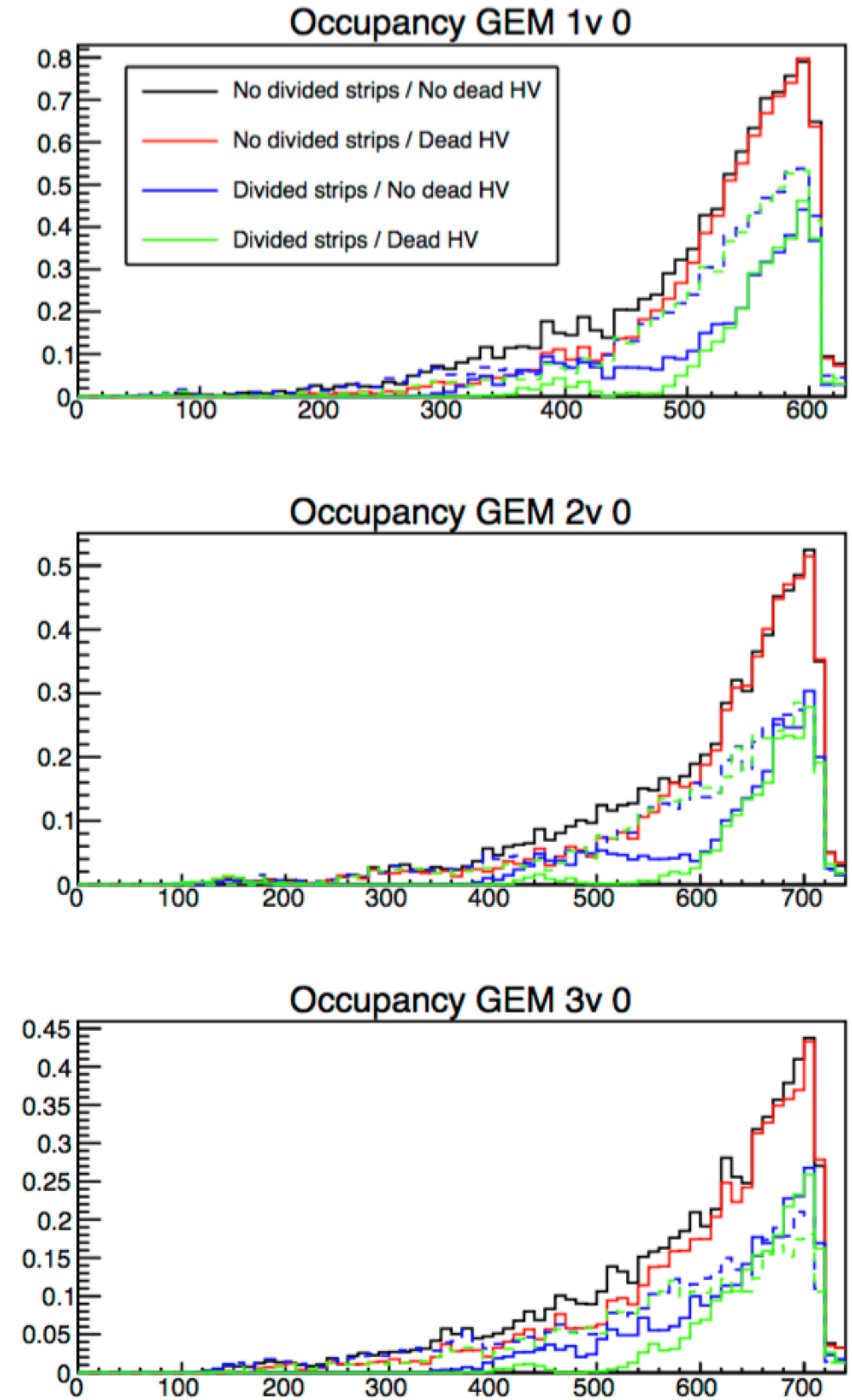
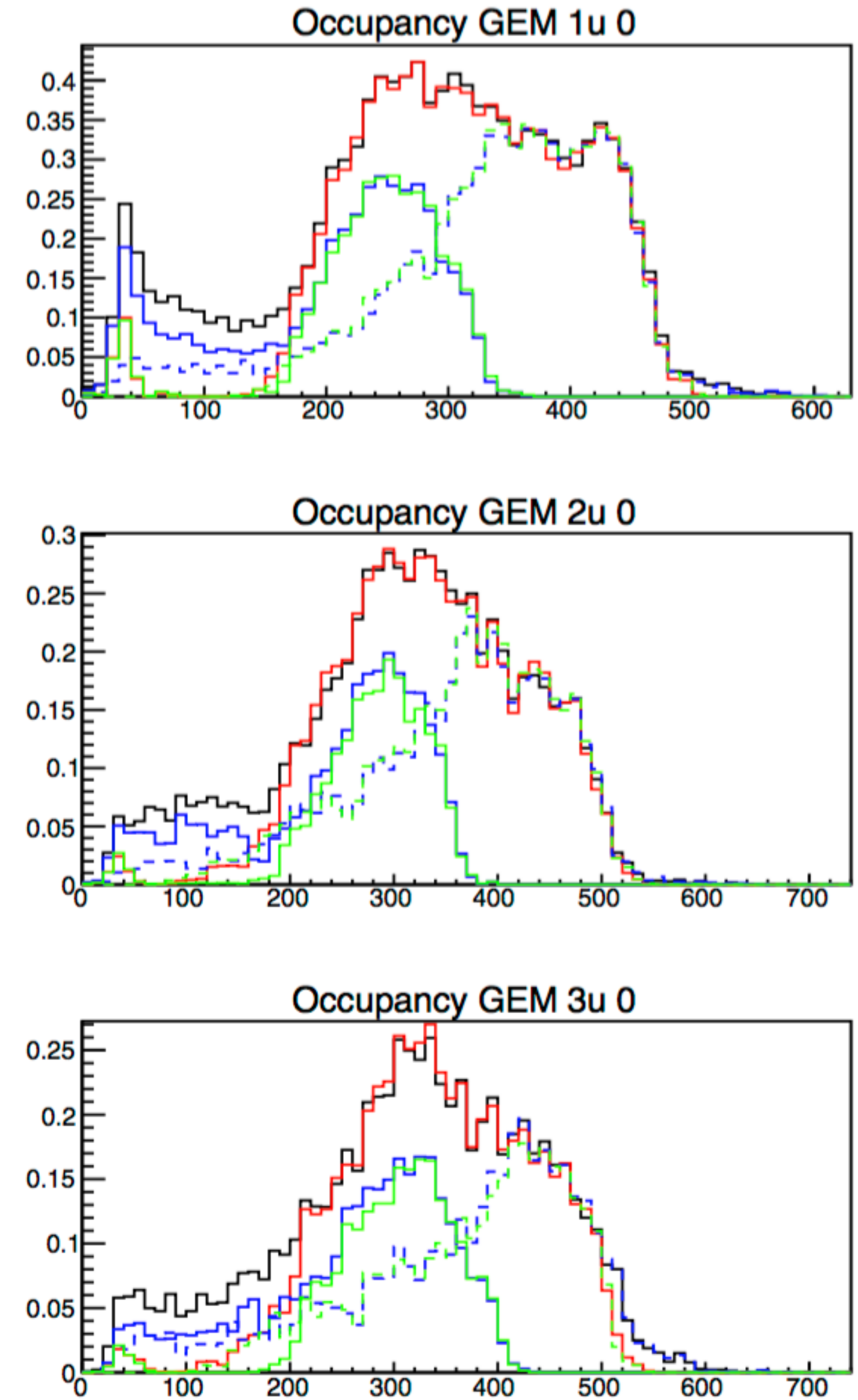
V Strips, GEMs 1–3

- 4 sigma thresholds
- GEM1 maximum occupancy ~80% with no divided strips, no dead regions
- Dead regions have little effect on maximum occupancies
- Reduced to ~40%–50% with divided strips
- GEMs 2–3 maximum ~45% -> ~25%

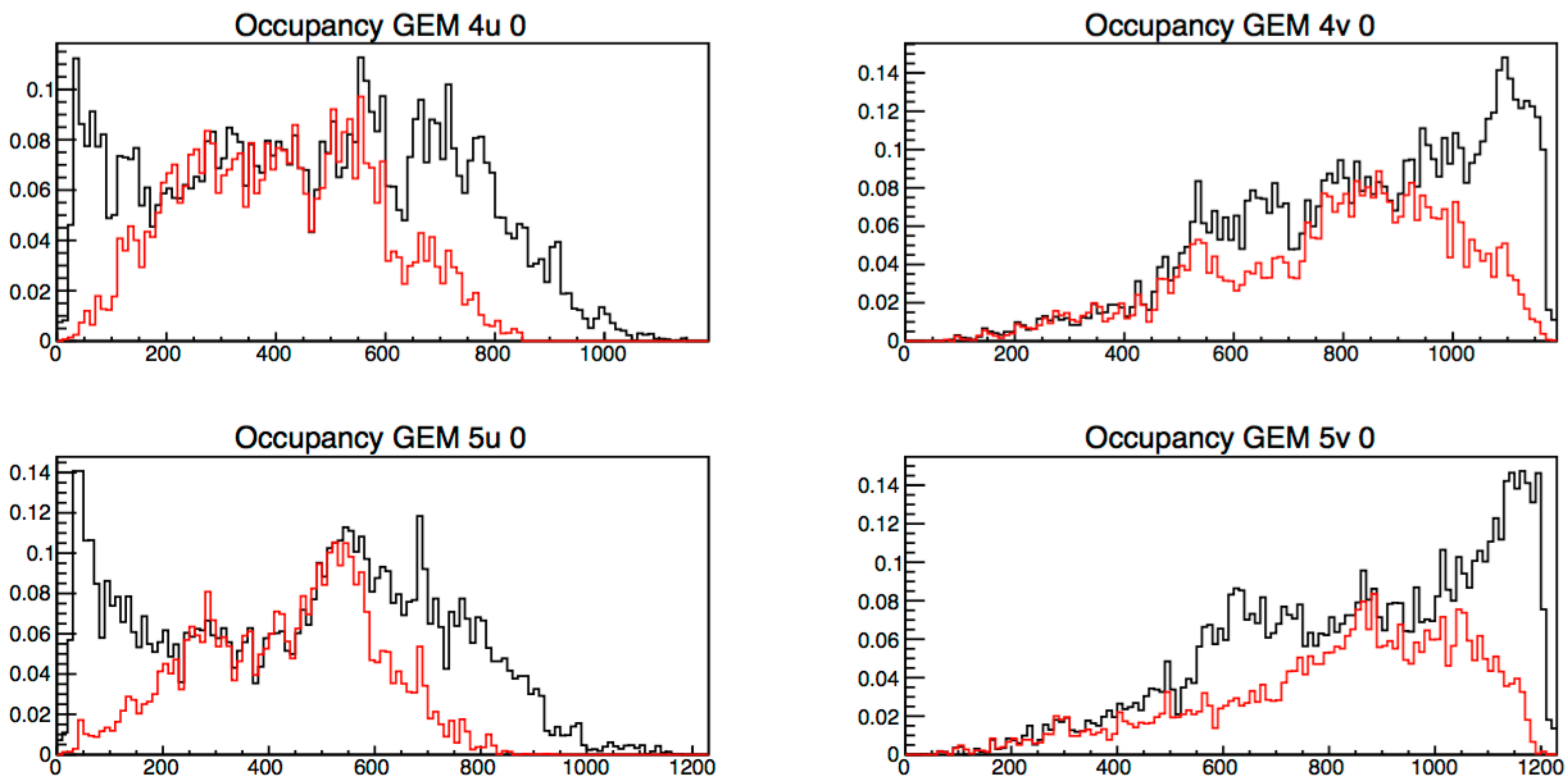


U Strips, GEMs 1–3

- GEM1 maximum ~40% -> ~30%
- GEMs 2–3 ~25% -> ~18%



GEMs 4–5 dead regions (no divided strips) reduce maximum, ~14% -> ~8%

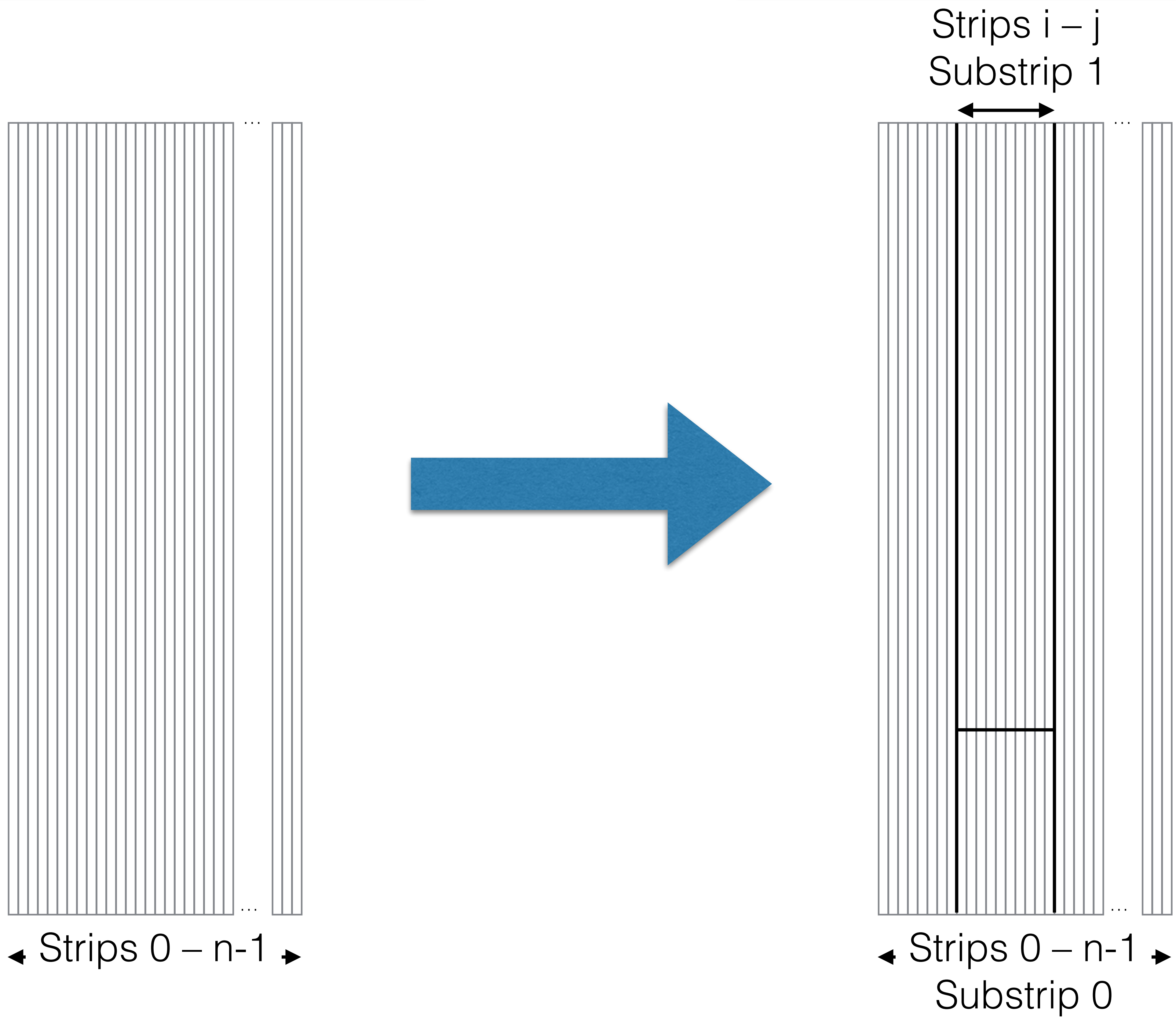


- Dead areas reduce (already low) occupancies downstream.
- Divided strips reduce (high) occupancies upstream — is it enough?
- Should we revisit angular offsets? We lose some signal putting upstream photon hot spots into GEM frames. Better to keep them in live area with divided strips?
- Digitization improvements debugged and ready for tracking studies.

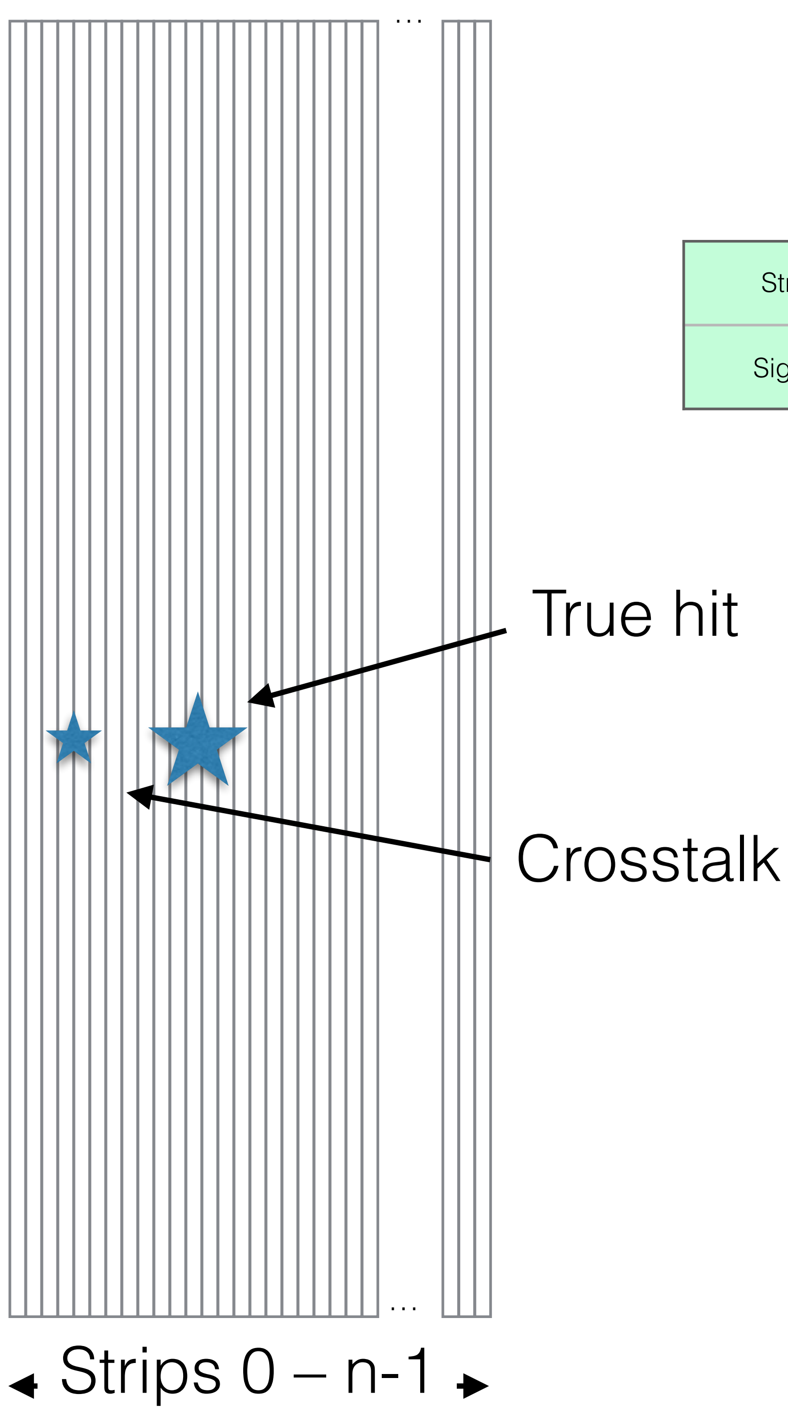
Extra

Undivided strips

Divided strips



Crosstalk — Undivided strips

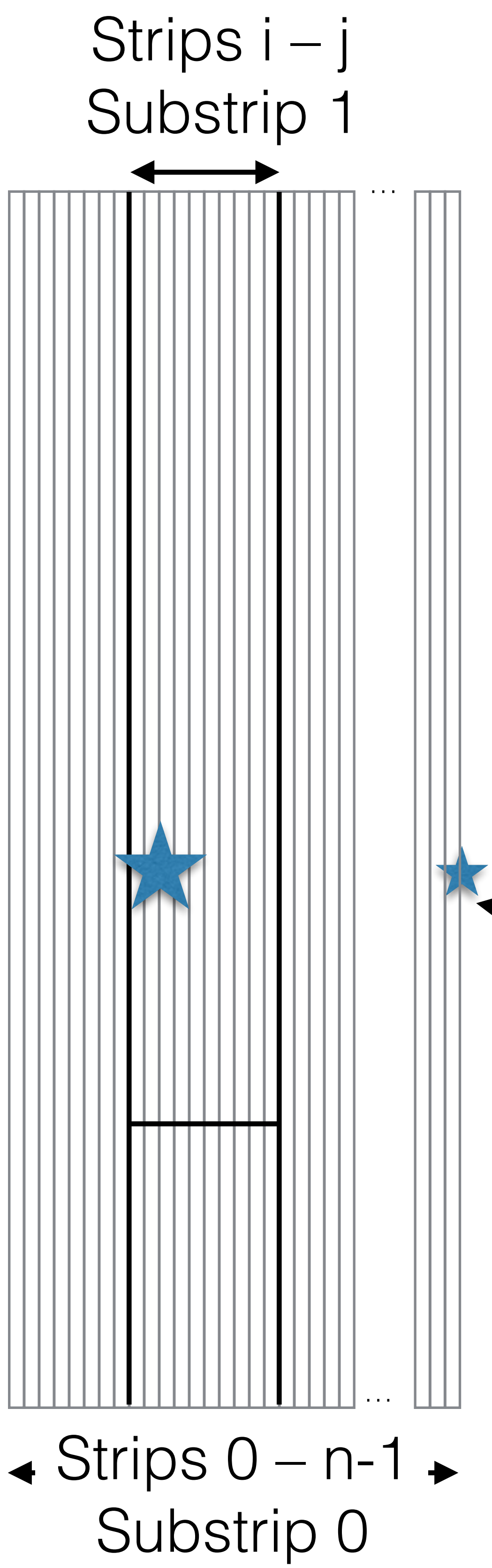


Strip	0	1	2	3	4	5	…	30	31	32	33	34	35	36	37	38	39	…	n-2	n-1
Signal	0	13	77	45	19	24	…	43	84	123	89	102	94	72	31	32	29	…	6	10

Crosstalk, any two strips separated by 32

(Really should be only between strips in one APV.)

Crosstalk — Divided strips



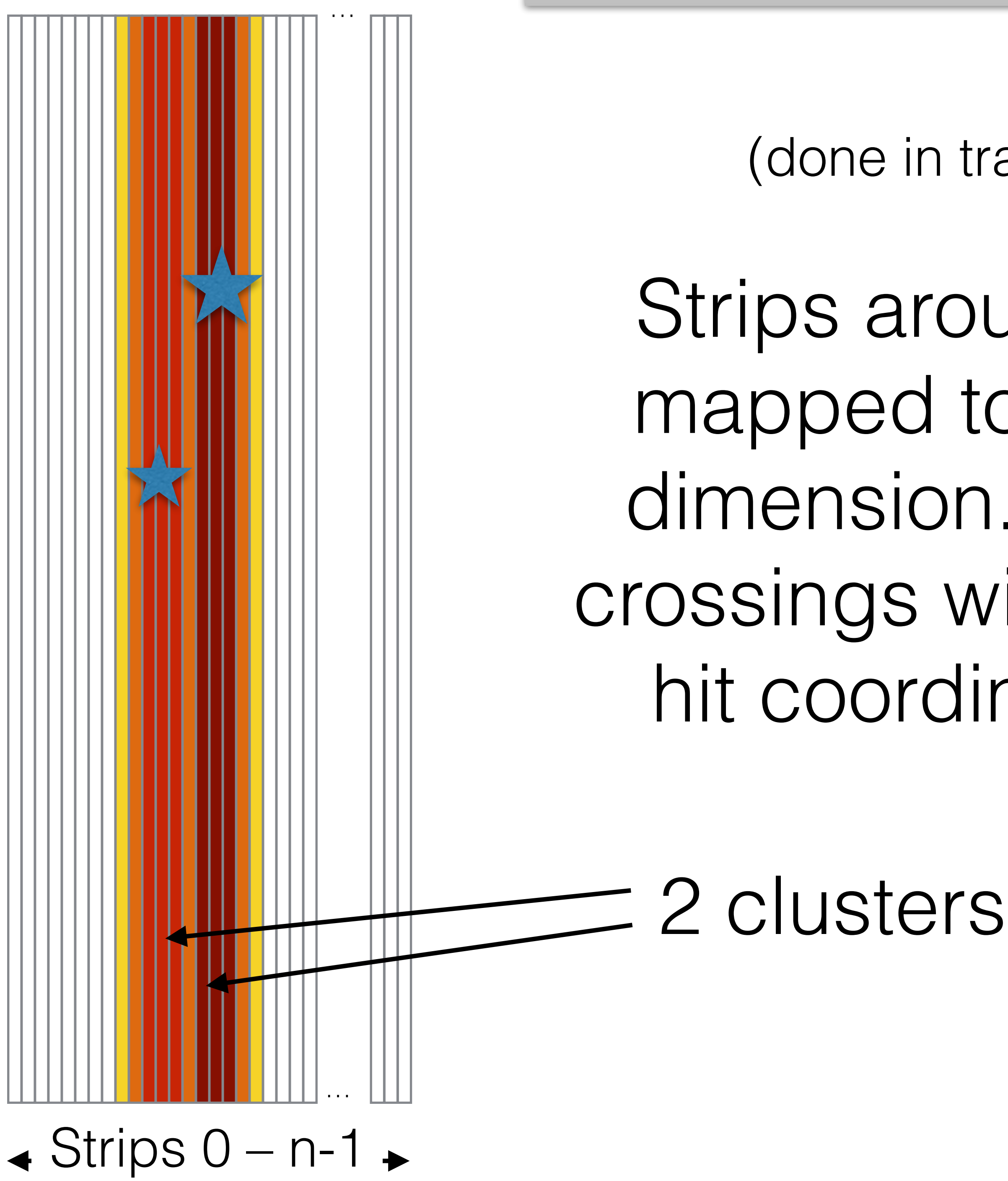
Strip	0	1	2	3	4	5	…	n-2	n-1	i	i+1	i+2	i+3	i+4	…	i+28	i+29	i+30	…	j
Substrip	0	0	0	0	0	0	…	0	0	1	1	1	1	1	…	1	1	1	…	1
Signal	0	13	77	45	19	24	…	43	84	123	89	102	94	72	…	32	29	13	…	10

Crosstalk far from true hit

Crosstalk, any two channels separated by 32

(An arrangement that interleaves substrips 0 and 1 would be easy to code and give less goofy results, but still not entirely realistic.)

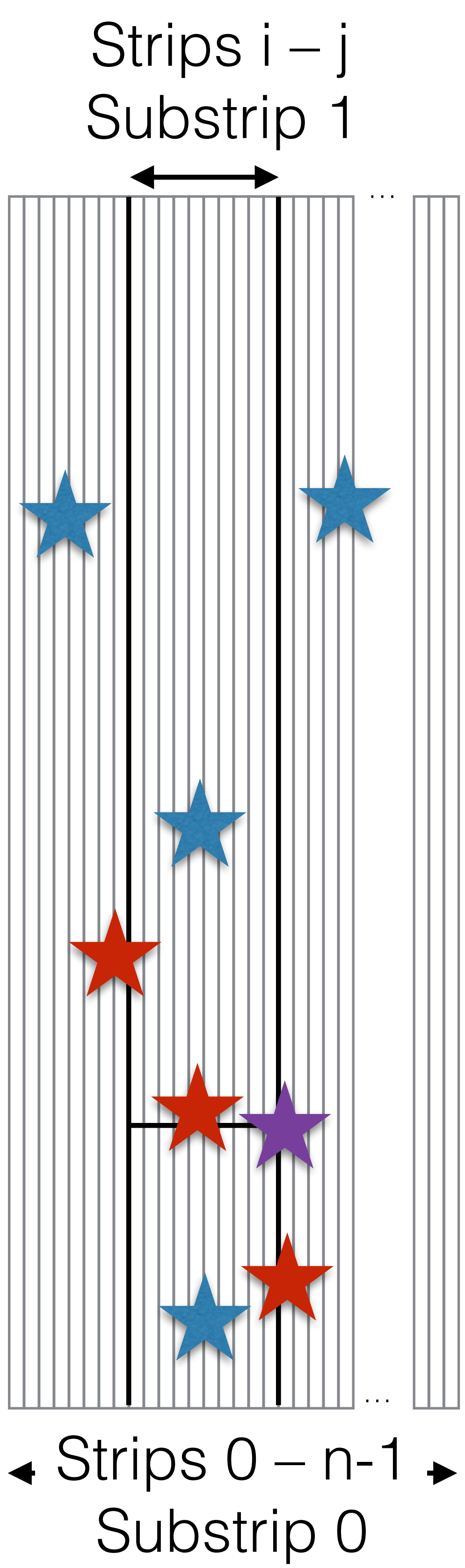
Clustering/Matching — Undivided strips



(done in tracking package, not digitization)

Strips around a local maximum are mapped to a coordinate in a single dimension. Matched based on strip crossings with other plane to generate hit coordinates in two dimensions.

Clustering/Matching — Divided strips



Must develop clusters from non-homogeneous substrip groups

- Cluster in homogeneous substrip group
- Cluster in two substrip groups
- Cluster in three substrip groups

Partial 2-dimensional information to be matched with partial 2-dimensional information from other plane

Non trivial changes to matching and clustering algorithms