GLAST LAT TKR Noise Monitoring

Mutusmi Sugizaki and the TKR team

What we have to know about TKR noise

Average strip occupancy per tower, layer, strip.

Average layer-OR (trigger) occupancy per layer.

Where are the noisy strips? How many strips?

Long-term and transient noise behavior. Noise flare?

Our goal is to derive these noise parameters from nominal-run data and monitor them during the flight operation.

Two methods to derive these noise parameters.

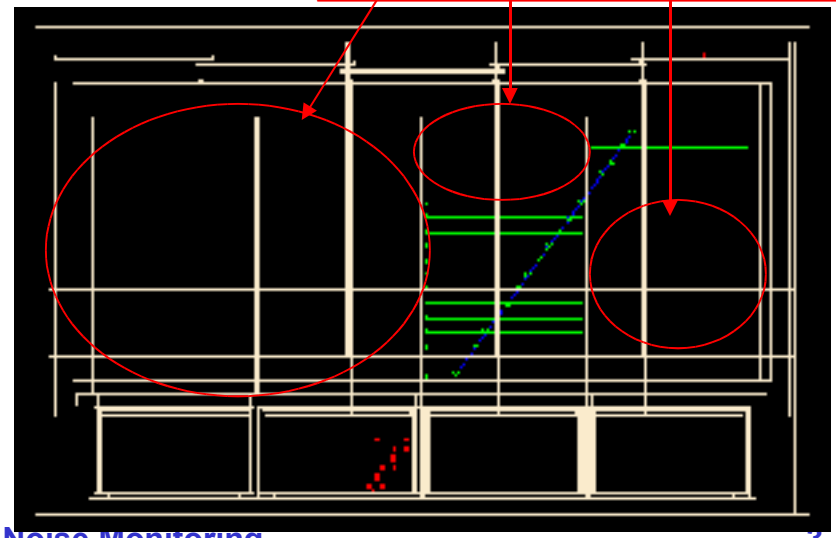
1) Use periodic-trigger data which is taken for a diagnostic purpose.
2) Use data with event tracks excluding the data of layers on which particles pass through.

This talk present current status of these noise studies using SVAC muon-run data.

Two Data Sampling for TKR Noise monitor

1) Periodic-trigger data taken for a diagnostic purpose.
   - Merit: Unbiased sample, good for the noise study.
   - Demerit: Low rate (10 Hz in a current configuration)
     - 3.6×10^4 trigger / hour.
     - Nominal noise occupancy < 10^{-6}. Noisy ~ 10^{-4}
2) Cosmic-ray trigger data excluding the areas on which particles pass through.
   - Merit: High rate (500 Hz in 16-Tower LAT).
   - Demerit: Imperfect screening of real event hit, such as delta rays.
   - The contamination ~ 10^{-6}

Use both methods according to the purpose.



Analysis of SVAC muon-run data

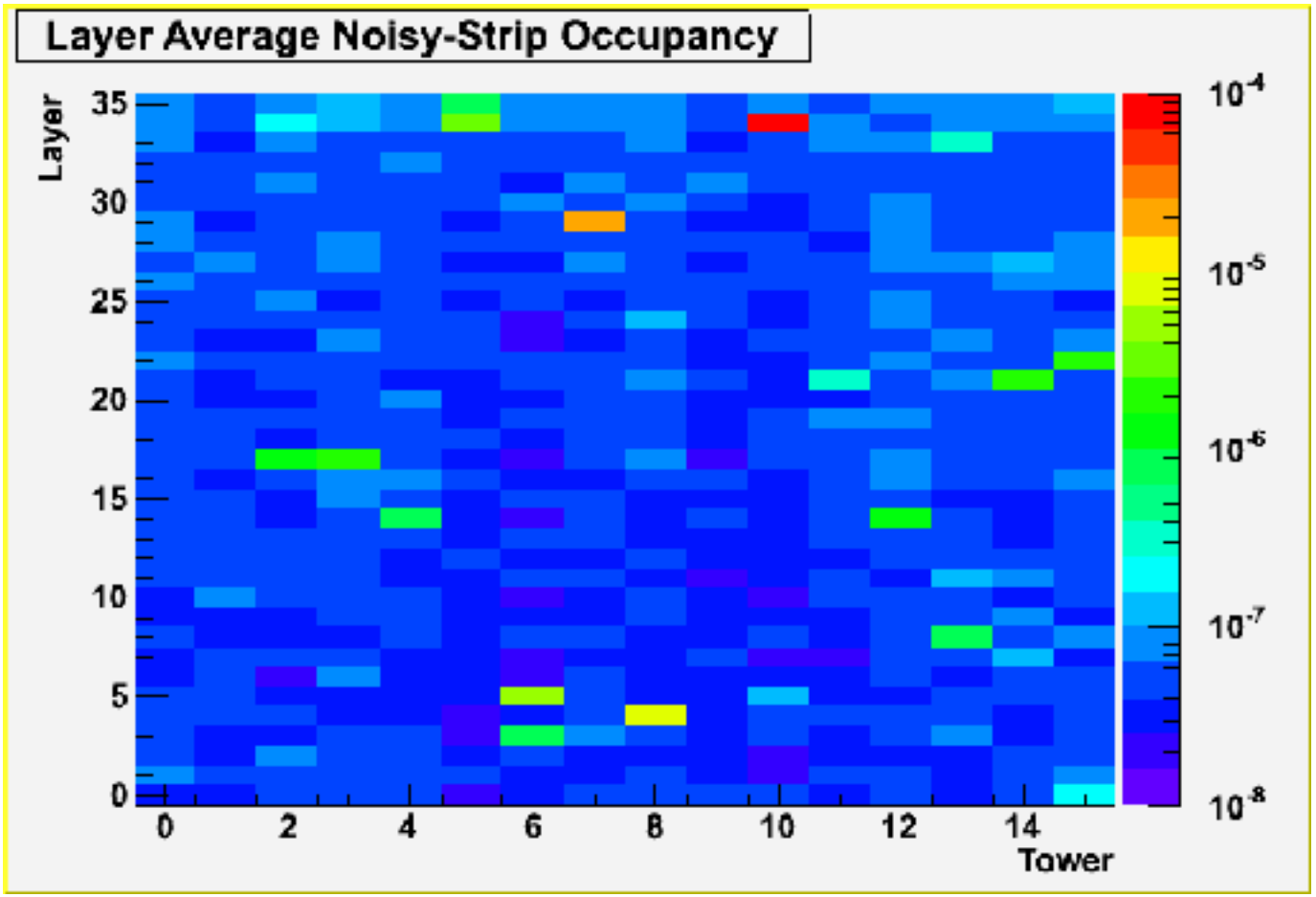
16 Tower SVAC muon-run B/2 and B/30 data

- January 14-16, 2006
- Total exposure time ~ 7.5×10^4 sec = 21 hours
- Cosmic-ray trigger rate ~ 500 Hz
- Periodic trigger rate = 10 Hz
- Total number of events = 3.7×10^7
- Total number of periodic triggers = 7.5×10^5

Noise-monitoring parameters

- Strip occupancy (long and short term stability)
- Layer occupancy
- Hit strip map (strip ID)
- Hit-strip multiplicity
- TOT

Result: Average Strip Occupancy per Layer
(from all SVAC run, periodic-trigger data)

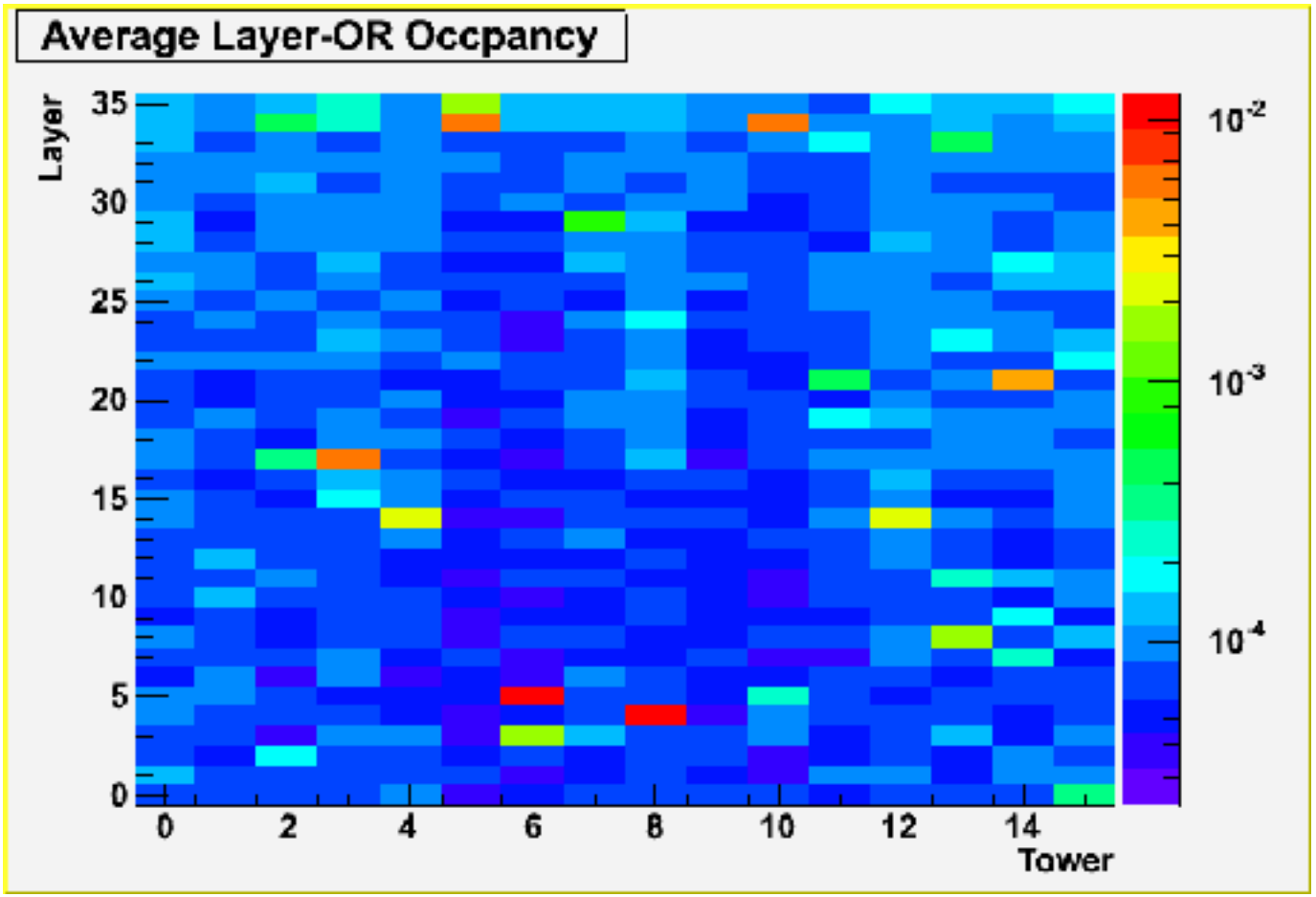


The occupancy is < 10^{-6} in the most layers.

Requirement: Noise strip occupancy is < 5×10^{-5} in tower average.
It is enough satisfied.

Result: Average Layer-OR Occupancy

(from all SVAC run , periodic-trigger data)



Requirement: Single-layer trigger rate < 50 kHz.

Assuming a minimum case that each trigger length is as short as 1.6 μs, the layer-OR occupancy has to be < 0.08. It is still satisfied.

Study of transient noise behavior (Noise Flare)

Use cosmic-ray trigger data (500 Hz)

To detect shot term noise increases (flares), noise occupancies for each 1000 event triggers (~ 2 sec) are investigated.

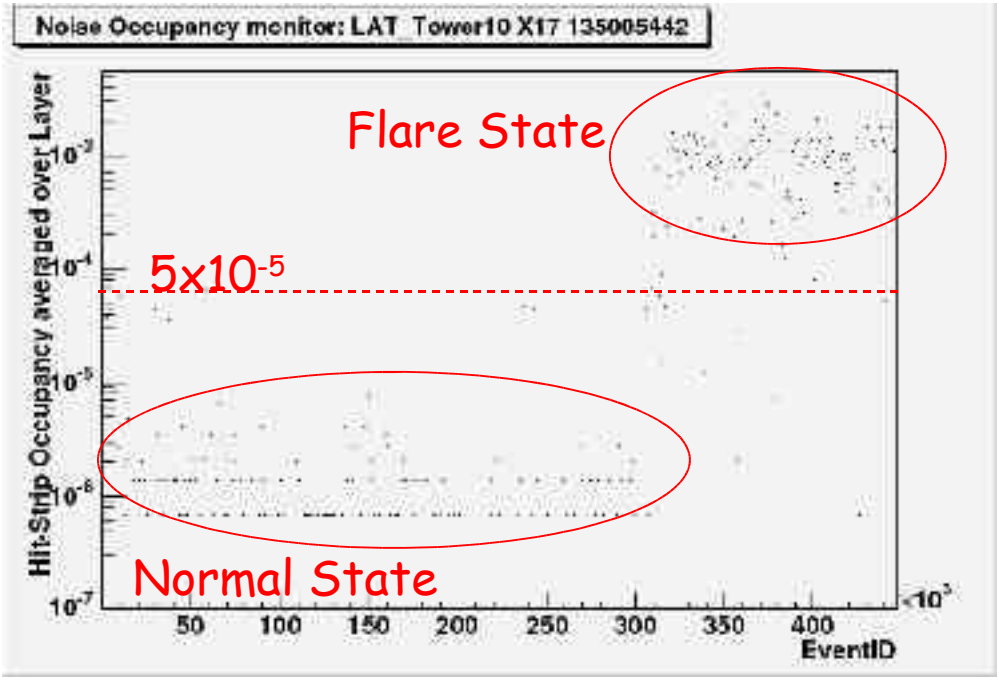
If the layer-average noise occupancy exceeds 5×10^{-5}, it is labeled as 'Noise Flare'.

Noise flares are detected in 4 silicon layers.

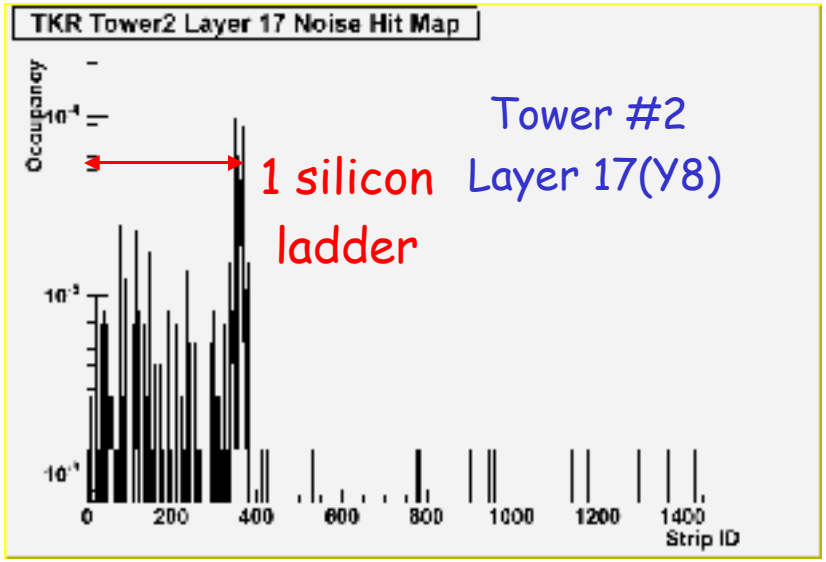
- Tower #2 Layer 17(Y8)
- Tower #7 Layer 29(Y14)
- Tower #10 Layer 34(X17)
- Tower #15 Layer 22(X11)

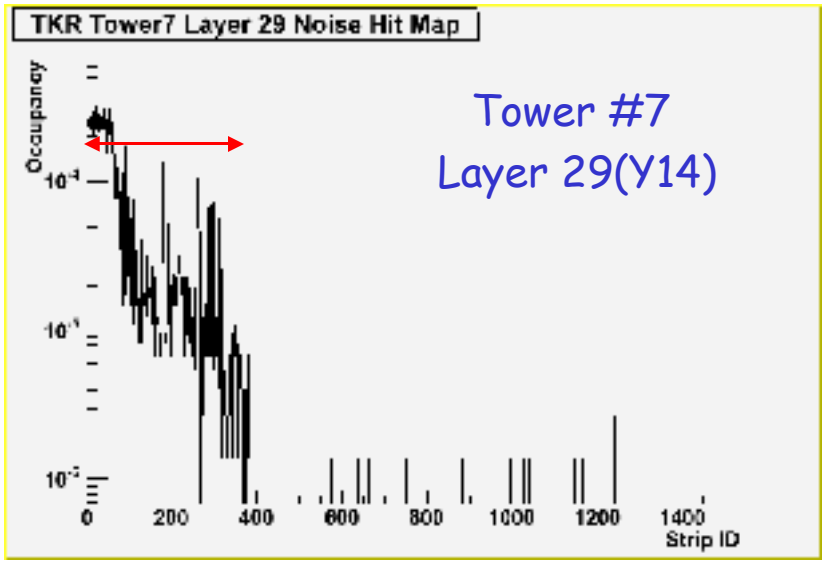
These noise flares have common features.

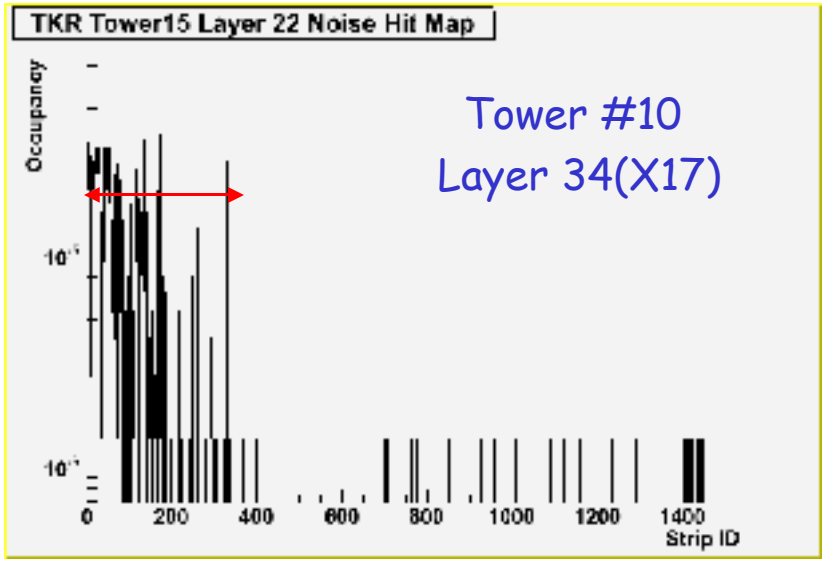
- Related with silicon ladder
- Large multiplicity

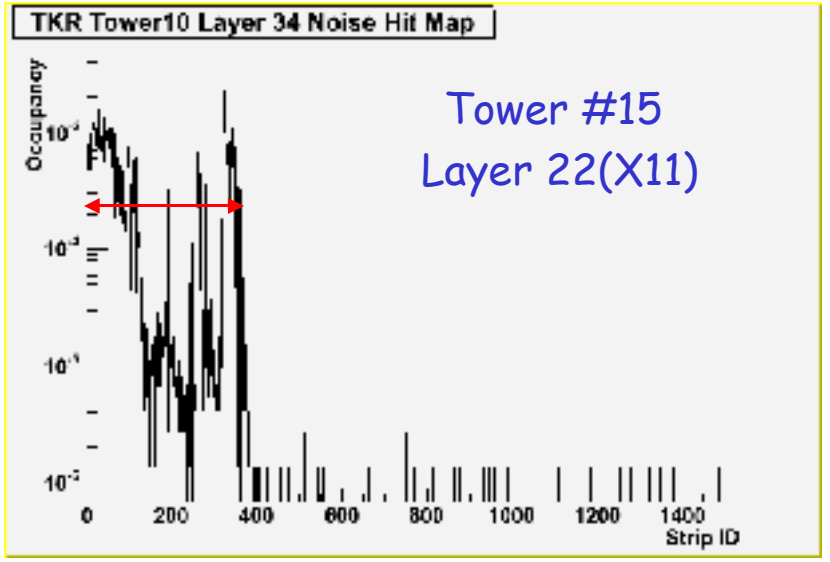


Noise Hit Map of Layers with Noise Flare
(periodic-trigger data)

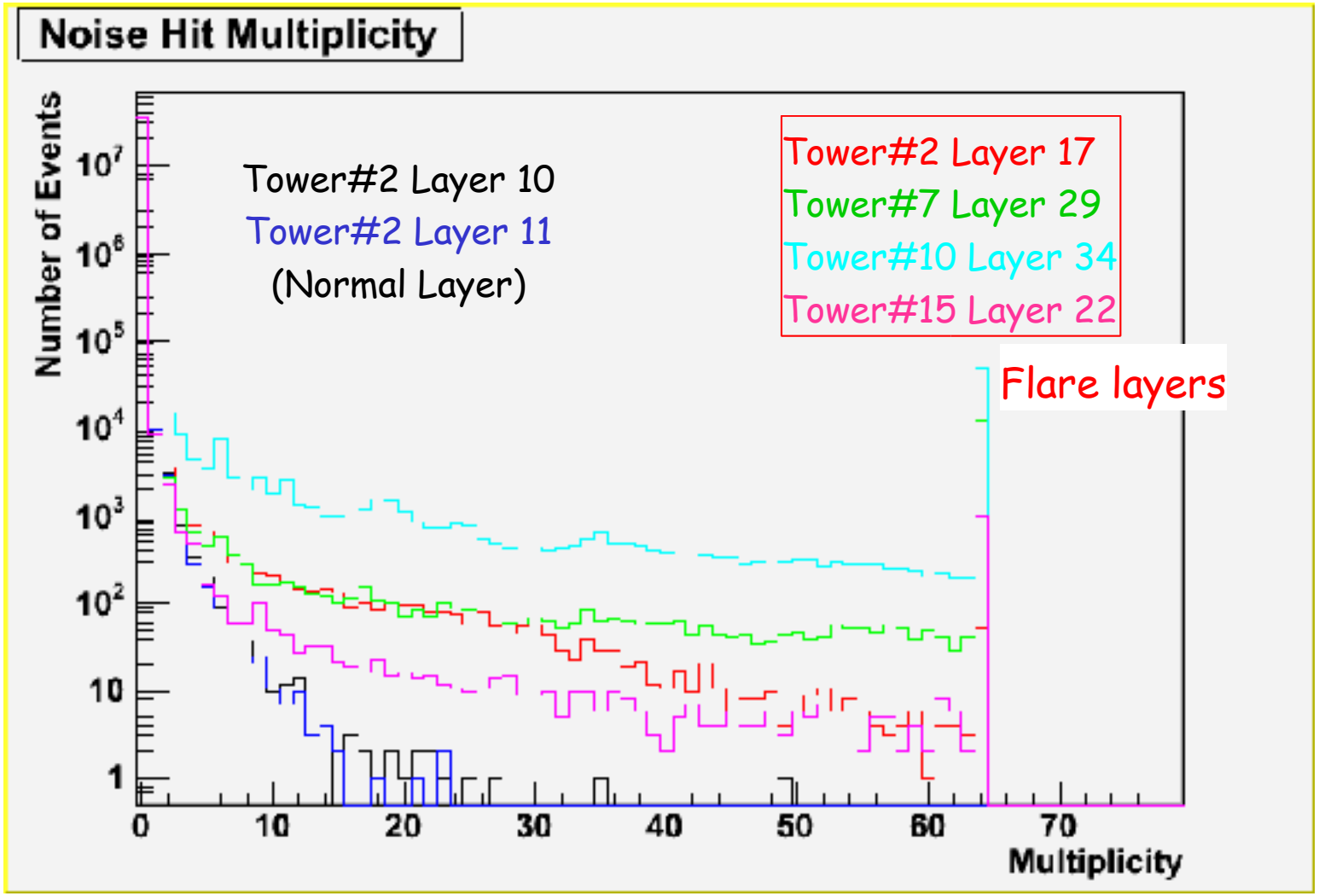




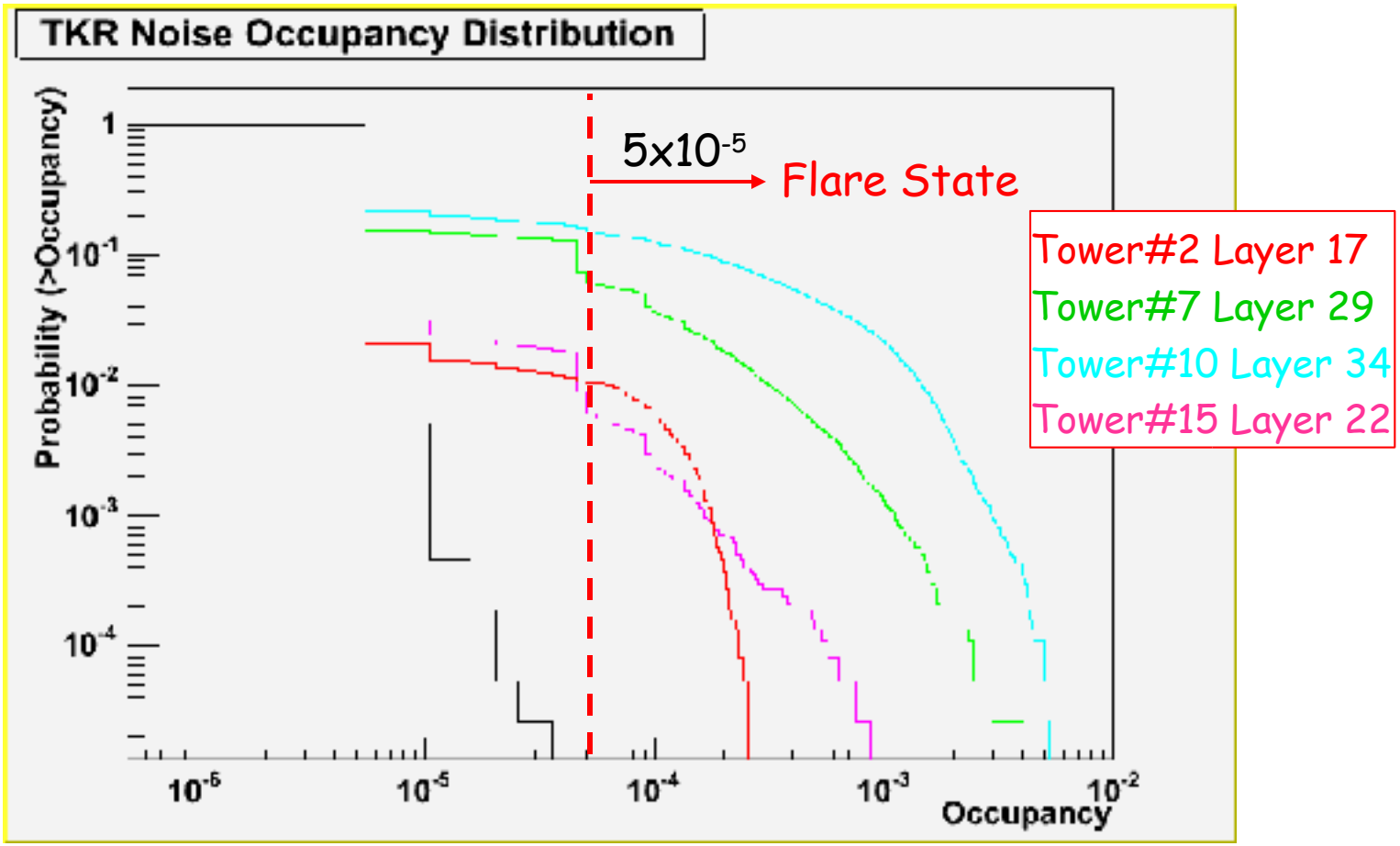




Hit Multiplicity of Noise Flare



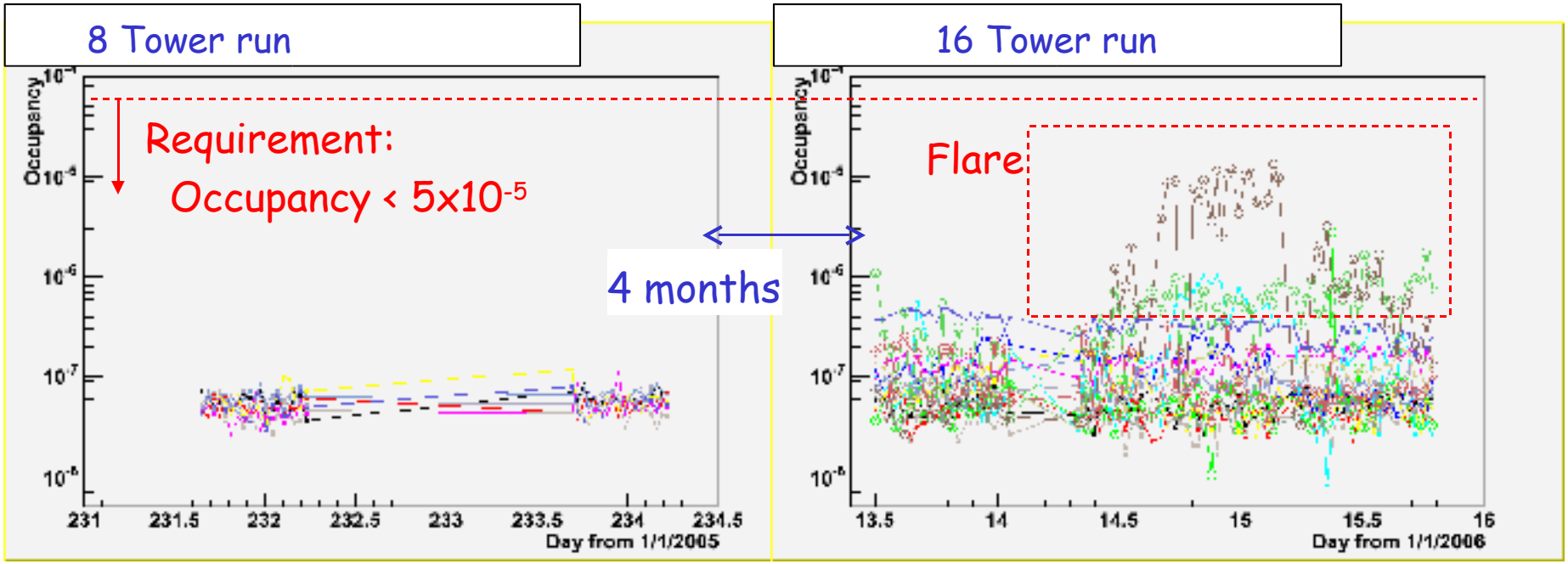
Frequency of Noise Flare



- Tower7 Layer29, Tower10 Layer34: 10-20%
- Tower2 Layer17, Tower15 Layer22: 1-2%

Long Term Stability of the Noise Occupancy
(from all SVAC run , periodic-trigger data)

Tower Average noise occupancy



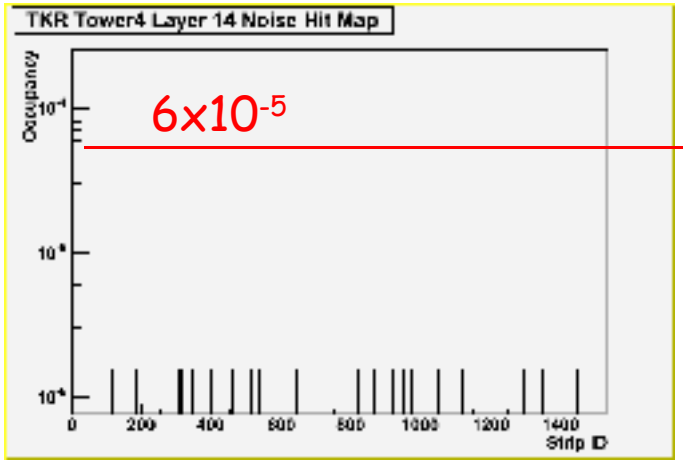
4 TKR towers with noise flares appeared in the 2nd half of 16 towers.

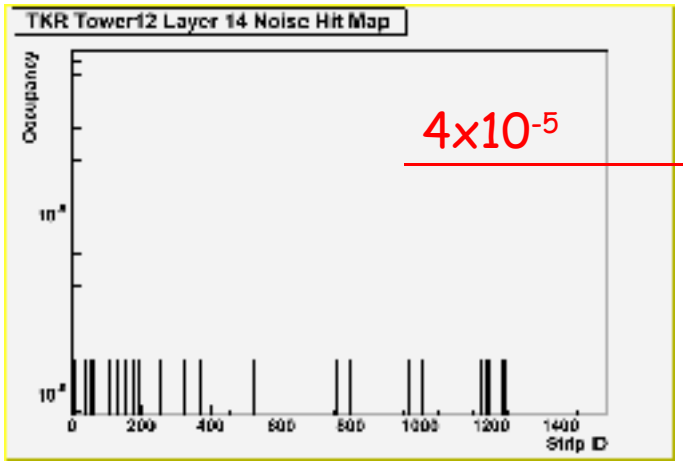
The noise level is largely stable if the tower does not have noise flare.

Couple of strips are found to turn warmer between the 8-Tower and the 16-Tower configurations. However, the tower-average noise occupancies are still much lower than the requirement, ($5x10^{-5}$).

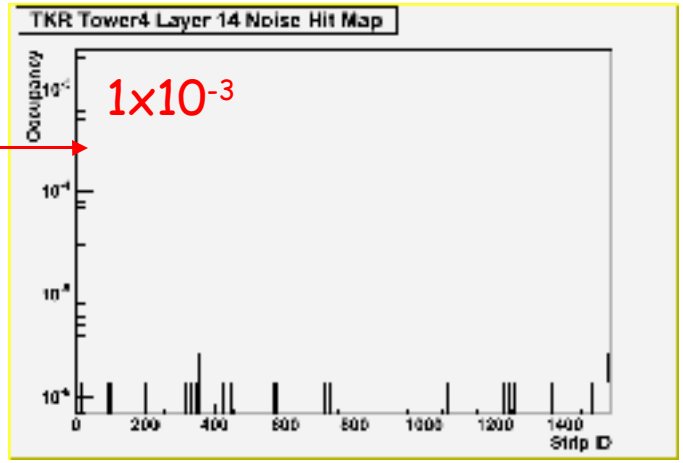
Examples of developing noisy strips

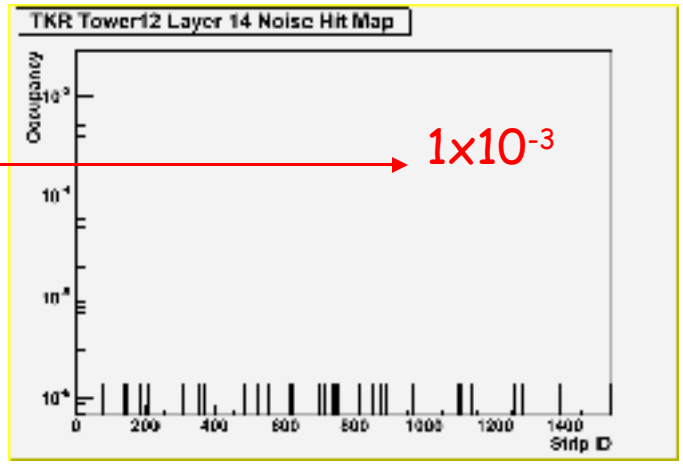
8 Tower run





16 Tower run





Summary

The methods to monitor TKR noise from nominal-run data is studied. They are confirmed to work well.

The noise strip occupancy and the layer-OR occupancy of the LAT TKR are well within the requirements.

The noise levels are largely stable.

'Noise Flare' is detected on 4 silicon layers. The noise level is below the requirement. We keep monitoring these layers.

Future plan

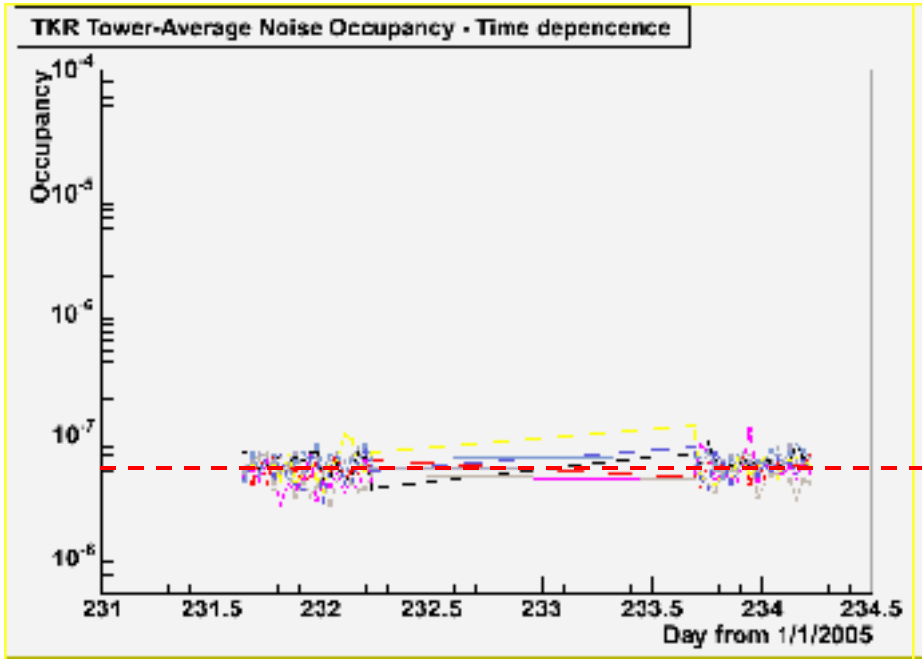
- Integrate these method into the process of determining data/trigger masks (Takuya/Hiro, Dec. 9, 2005, IA meeting).

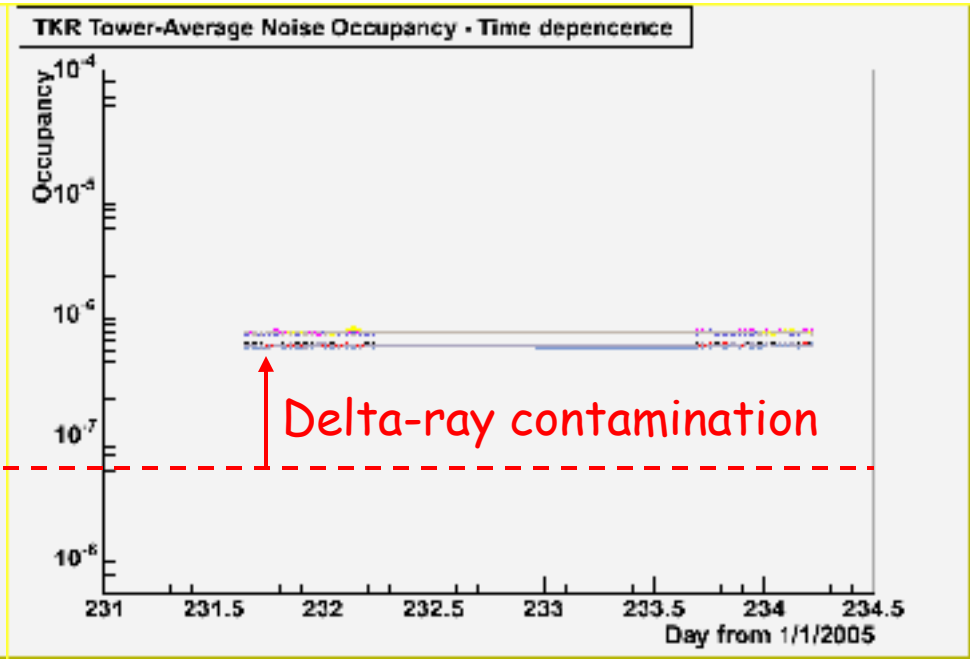
Backup

Comparison of two data-sampling method (8 Tower)

Noise Occupancy estimated from periodic trigger data.

Noise Occupancy estimated from normal-trigger data excluding track hits.



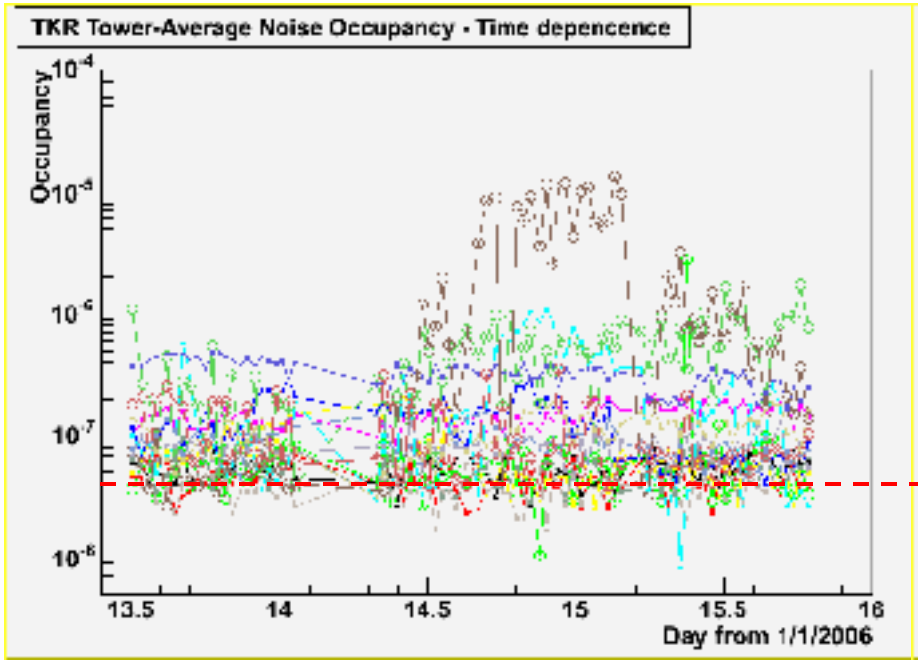


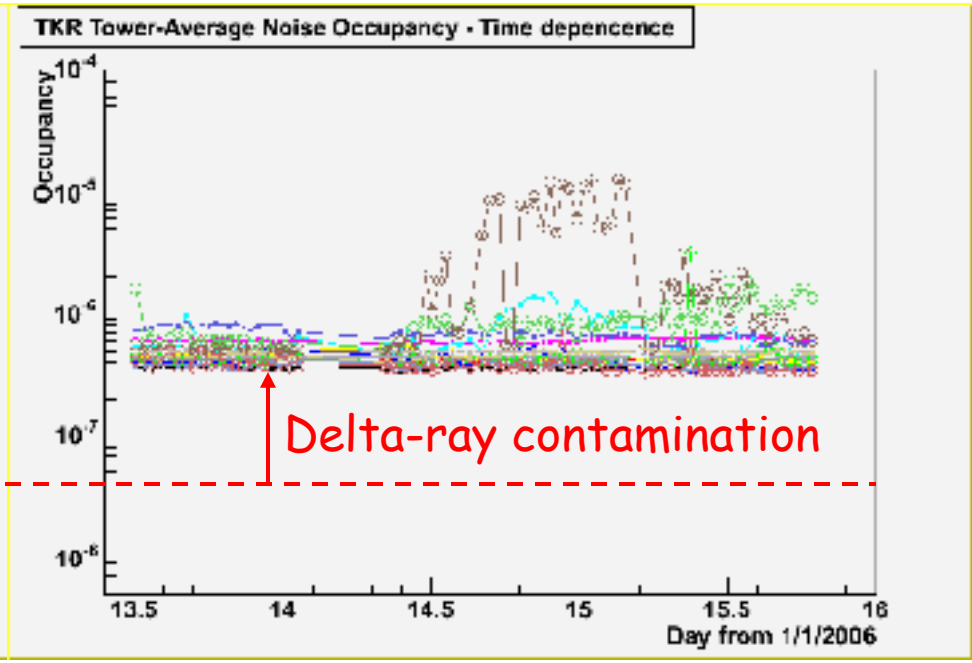
12	13	14	15
8	9	10	11
4	5	6	7
0	1	2	3

Comparison of two data-sampling method (16 Tower)

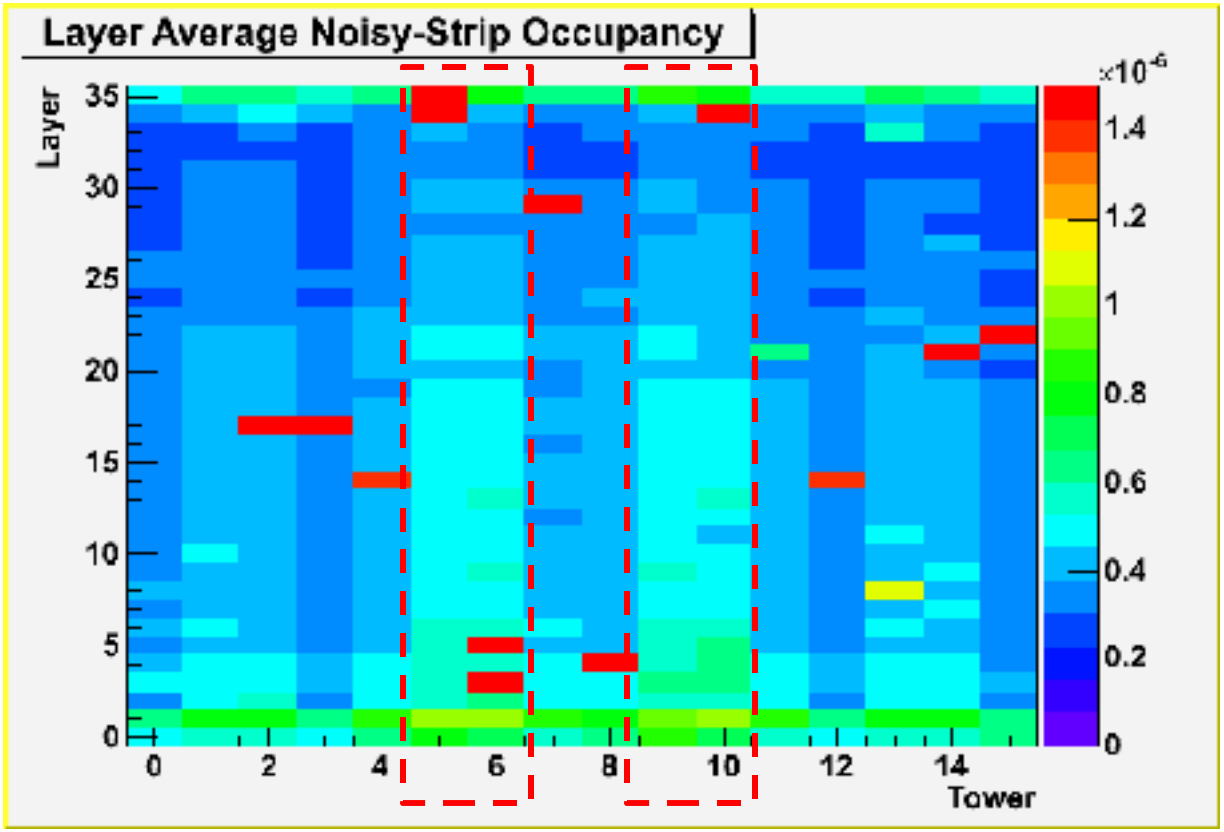
Noise Occupancy estimated from periodic trigger data.

Noise Occupancy estimated from normal-trigger data excluding track hits.





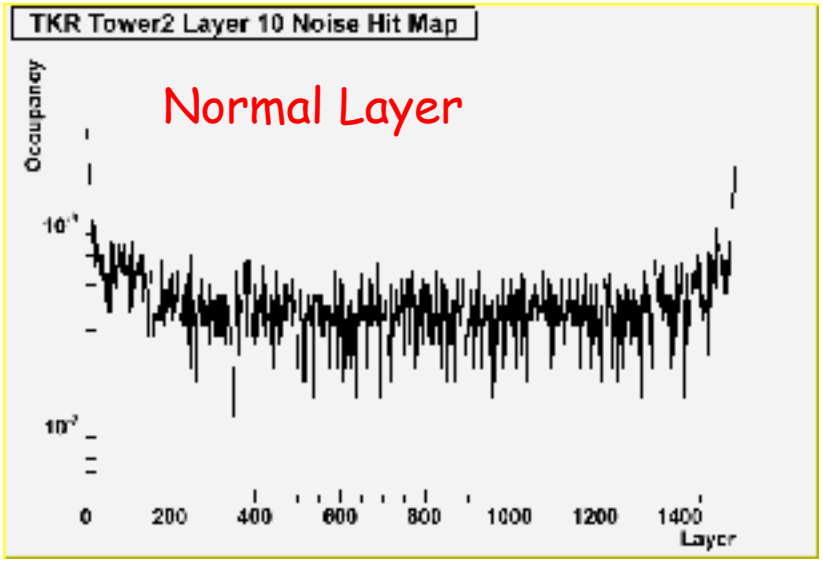
Contribution of Delta-Ray

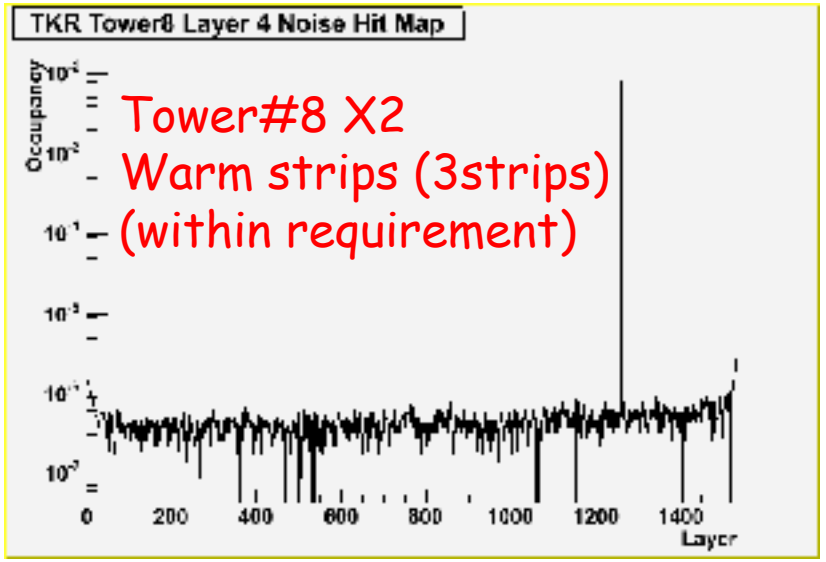


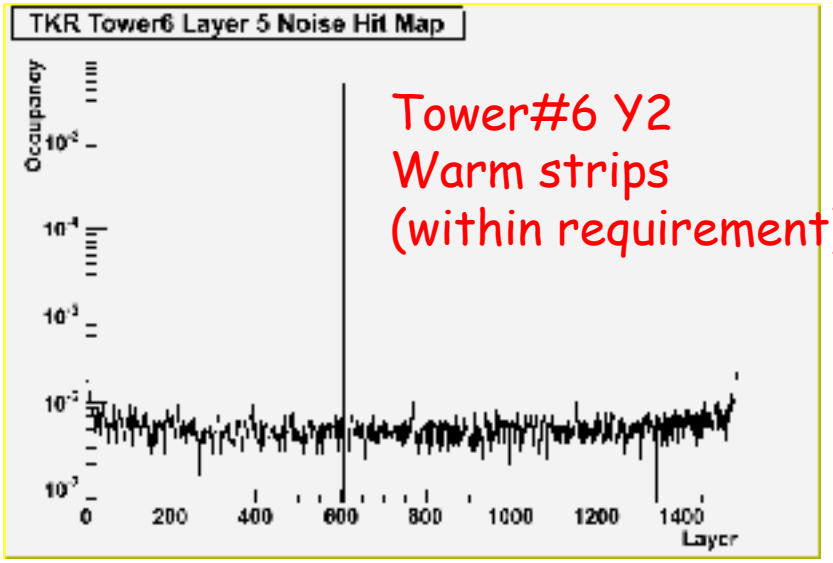
12	13	14	15
8	9	10	11
4	5	6	7
0	1	2	3

Strip profile of each layer (some examples)

(from all SVAC run , normal-trigger data)







Most of all layers are like 'Normal Layer'.