LAT TKR Noise Study
Current Status

(and short comment about TOT=255 event)

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What we have to know about noise of TKR

Average strip occupancy per tower, layer, strip.
Average layer-OR (trigger) occupancy per layer.
Where are the noisy strips? How many strips?
Transient noise behavior. Noise flare? (c.f. a presentation by Mutsumi, IA meeting, Oct. 21, 2005)

Our target is to derive these noise parameters from nominal-trigger event data.
Method of TKR noise study from SVAC cosmic-ray data.

Use cosmic-ray run data excluding data of layers on which cosmic-ray track passes through.

To exclude cosmic-ray hit strips in a robust way, eliminate the data of layers of which alternate X-or-Y layer also has a hit strip.

In average, data of 95% of entire 16x36=576 layers can be used for this noise study.

The module of this noise-analysis program is now involved in the standard process of SVAC Root Analyzer (thanks to Anders).

Entire B/2 and B/30 SVAC muon-run data are now analyzed. The total number of events is \( \sim 3.5 \times 10^7 \).
Output histograms of “TkrNoiseOcc” module

Strip occupancy averaged per layer per 1,000 triggers
Layer occupancy per 1,000 triggers
Hit strip map
Hit-strip multiplicity
TOT

1000 triggers ~ 2 sec in 500 Hz

Normal layer
Layer with noise flare
The occupancy is $< 10^{-6}$ in the most layers.

Requirement: Noise strip occupancy is $< 5 \times 10^{-5}$ in tower average. It is enough satisfied.
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.
Strip profile of each layer (some examples)

Most of all layers are like ‘Normal Layer’.

Tower#8 X2
Warm strips (3 strips) (within requirement)

Tower#6 Y2
Warm strips (within requirement)
Noise Flare

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 \(5 \times 10^{-5}\), 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

![Graph showing noise occupancy over Layer](image)
Noise Hit Map of Flare Layers

TKR Tower2 Layer 17 Noise Hit Map

0 200 400 600 800 1000 1200 1400
Layer

Occupancy

Tower #2
Layer 17(Y8)
1 silicon ladder

TKR Tower7 Layer 29 Noise Hit Map

0 200 400 600 800 1000 1200 1400
Layer

Occupancy

Tower #7
Layer 29(Y14)

TKR Tower10 Layer 34 Noise Hit Map

0 200 400 600 800 1000 1200 1400
Layer

Occupancy

Tower #10
Layer 34(X17)

TKR Tower15 Layer 22 Noise Hit Map

0 200 400 600 800 1000 1200 1400
Layer

Occupancy

Tower #15
Layer 22(X11)
Noise Hit Multiplicity

- Tower#2 Layer 10
- Tower#2 Layer 11 (Normal Layer)
- Tower#2 Layer 17
- Tower#7 Layer 29
- Tower#10 Layer 34
- Tower#15 Layer 22
- Flare layers
Summary

The method to derive TKR noise occupancies from nominal-trigger events is studied. It is confirmed to work well.

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

‘Noise Flare’ is detected on 4 silicon layers. We will need more study about the noise flares.

How often are they in flare state?
Doesn’t it affect on the track reconstruction? (Maybe, No)
How is it modified by changing the limit of readout hit strips per layer on the GTRC configuration register?

Future plan

Integrate these method into the process of determining data/trigger masks (Takuya/Hiro, Dec. 9, 2005, IA meeting).
What does TOT=255 mean?

TOT counter on the GTRC chip saturates at 1000, which corresponds to 250 in data.

TOT=255 does not mean TOT saturation!

But, it is true that this is a pile-up event.

If two TACK are sent within one long trigger signal, TOT in the second readout event shows an illegal number (2044).

(c.f. IA workshop 6/8/2004 presentation by Mutsumi, p.16)

Hiro’s explanation of difference of TOT=255 event rates between B2 and B30 runs last week is still applied with a small modification.