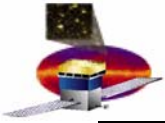


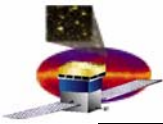
Proposed Flight Trigger Configuration: Engines and Scheduler Table

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Purpose

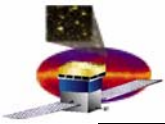
- **Intent: Want to run LAT at SLAC with trigger config as much like flight as possible**
 - **What is flight trigger config? How should it be implemented?**
 - **Trigger Group and SVAC Group proposal**
 - Discussion among Eduardo, Eric, Pat, Anders, Steve, JJ, Mike, Su Dong, etc.
- **Want input from C & A group**
 - **Is this a reasonable first implementation?**
 - **What needs to be tested now or first?**
 - **What have we missed?**
 - **Please estimate some rates identified below...**
- **First, need to understand capabilities of Trigger**
 - **Defining document: LAT-TD-01545**
 - The GLT Electronics Module, Programming ICD Specification



Trigger Logic

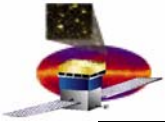
- Specified in “Trigger Engines” from combinations of “Conditions”
 - 8 Trigger Conditions are defined
 - $2^8 = 256$ possible combinations of these Conditions
 - Each can be allowed (or disallowed) to open a trigger window (i.e. start a coincidence)
 - ROI Condition is different (see next page)
 - And be careful not to confuse the ROI Condition with the selection of ACD tiles that make up a Region of Interest (see next page)

Condition	Flight setting	Comment
ROI (ACD)	Tower-local veto, ~0.3 MIP	Not allowed to open wdw
TKR		
CAL-LO	100 MeV single log	
CAL-HI	1 GeV single log	
CNO	~20 MIPs single tile	What is flight threshold?
Periodic	~1 Hz	Gives pedestals
Solicited	Special use	
External	Nothing connected!	Not allowed to open wdw



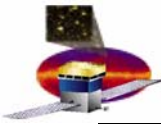
Detail: ROI Condition

- The ROI Trigger Condition is different
 - Can be used as trigger source or veto of TKR
 - Globally applied to all Engines, all “Regions of Interest”
 - One or the other, not both
 - We’ve selected TKR-veto mode
 - Thus $\text{TKR}=\text{False}$ and $\text{ROI}=\text{True}$ should never occur
 - » Forbidden by definition of ROI Condition in GEM
- Regions of Interest
 - Groupings of ACD tiles to be used as trigger or veto of TKR
 - Also called “tile lists”
 - Up to 16 Regions of Interest may be specified at any time
 - Two candidate configs for flight
 - 16 “Tower-local” Regions
 - » Corresponding to tiles nearest each Tower (sorta)
 - 1 “Global” Region
 - » Single region: all top tiles and first 2 layers of side tiles
 - We’ve selected the Tower-local Regions, ok?



More Trigger Logic

- **16 Trigger Engines are available**
 - **For each engine**
 - **Defined readout mode**
 - **Zero suppression on or off** (for ACD and CAL together)
 - **4-range or 1-range readout** (for CAL)
 - **Programmable pre-scale**
 - **User-defined “marker”**
 - **5-bit numerical value to use, e.g., as a label**
 - **We haven't defined any markers, ok?**
- **Scheduler table**
 - **Points each of the 256 combinations of Conditions to a single Engine**
 - **No ambiguity**
- **SVAC and Trigger Group defined Scheduler and Engines**
 - **Please review and think about next few slides**



Trigger Scheduler Table

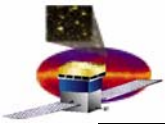
Condition Summary								Engine Theme	Readout
External	Solicited	Periodic	CNO	CAL-HI	CAL-LO	TKR	ROI		
1	x	x	x	x	x	x	x	Should never happen	zero suppressed, 1-range
0	1	x	x	x	x	z	z	JJ solicited events	zero suppressed, 1-range
0	0	1	x	x	x	z	z	Pedestals	unsuppressed, 4-range
0	0	0	1	x	x	z	z	GCR calibration	zero suppressed, 4-range
0	0	0	0	1	x	z	z	High energy photons	zero suppressed, 1-range
0	0	0	0	0	0	1	0	Photons	zero suppressed, 1-range
0	0	0	0	0	1	1	0	Photons	zero suppressed, 1-range
0	0	0	0	0	1	0	0	Cal-only photons	zero suppressed, 1-range
0	0	0	0	0	1	0	1	Should never happen	zero-suppressed, 1-range
0	0	0	0	0	0	1	1	Deliberate leakage	zero suppressed, 1-range, prescaled
0	0	0	0	0	1	1	1	Deliberate leakage	zero suppressed, 1-range, prescaled
0	0	0	0	0	0	0	1	Should never happen	zero suppressed, 1-range
0	0	0	0	0	0	0	0	Should never happen	zero suppressed, 1-range

No prescale!!

No prescale?

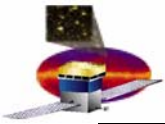
Note: Events with ROI and no TKR are all mapped to the “Should never happen” engine
 (TKR,ROI) = (z,z) means (0,0), (1,0), and (1,1) but not (0,1)

Note: On ground, same map, but always set prescale to unity



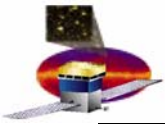
Comments

- **Pedestals: Two purposes**
 - “Clean” pedestals (only Periodic=True)
 - “Unbiased” sample of typical LAT state (Periodic=True and other stuff True or False)
 - Random sample: Preserve as much info as possible
 - Unsuppressed, 4-range readout
 - No on-board filtering or prescaling
- **There are other options for the GCR Calibration Engine**
 - **GCR calibration**
 - **Logic: Should we use CNO or throttle with CNO & TKR & CAL-LO?**
 - Readout: zero-suppressed, 4-range, with **NO** prescaling
 - We are assuming that there is no prescaling since rate < 100 Hz
 - CNO events are intended for CAL calibrations
 - **Sideways (ACD-TKR-ACD) “not useful”. Discard them.**
 - Any uses for sideways CNO?
 - What is the rate of sideways CNO?
- **The combination TKR=False and ROI=True should never occur**
 - ROI is defined to be coincidence between TKR signal and tower-local veto
 - We’ve put all of these in one engine with minimal readout



More comments

- **Trigger efficiency studies are complicated**
 - **Be careful with prescaling**
 - Need to account for missed events
 - Don't want to miss a rare condition
 - We've prescaled only the Deliberate Leakage of particles engine
 - **Need some knowledge of effect of filter**
 - Leak some events to ground
- **TKR trigger efficiency, readout efficiency**
 - **The obvious TKR efficiency test is a special case and NOT included here.**
 - CAL-LO in coincidence with ACD acting as trigger, allowed to open the window
 - **Need to use standard data mode for any continuous efficiency study**
- **Rates**
 - **What are the rates of each of the Trigger Engines, as defined here?**
 - **Is no prescaling acceptable? Can we allow FSW filter to do it all?**



Appendix: Scheduler in text form

- **Eight trigger engine definitions in order of precedence (high to low)**
 1. **Should never happen (external triggers)** (128 entries)
 - Logic: External condition set with anything else
 - Readout: zero-suppressed, 1-range, no prescale
 2. **JJ's special-purpose solicited triggers** (63 entries)
 - Logic: Solicited condition set with any of the remainder
 - Readout: zero-suppressed, 1-range, no prescale
 3. **Pedestals** (31 entries)
 - Logic: Periodic condition set
 - Readout: unsuppressed, 4-range, no prescale
 4. **GCR calibration** (15 entries)
 - Logic: CNO
 - Readout: zero-suppressed, 4-range, no prescale

Or should there be more Conditions?
 5. **High energy photons** (7 entries)
 - Logic: CAL-HI
 - Readout: zero-suppressed, 1-range, no prescale
 6. **Photons, primary science data** (2 entries)
 - Logic: TKR && notROI && (CAL-LO || notCAL-LO)
 - Readout: zero-suppressed, 1-range, no prescale
 7. **Photons that don't convert in TKR (i.e. CAL only)** (1 entry)
 - Logic: CAL-LO && notTKR && notROI
 - Readout: zero-suppressed, 1-range, no prescale
 8. **Deliberate leakage of protons and He** (2 entries)
 - Logic: TKR && ROI && (CAL-LO || notCAL-LO)
 - Readout: zero-suppressed, 1-range, prescaled

prescale changes for GND system tests
 1. **More Should never happen** (7 entries)
 - Logic: notTKR && ROI
 - Readout: zero-suppressed, 1-range, no prescale