Am241 Source Runs Review

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Two 1 hour runs for Tower A in the Single Bay with source. Any LAT runs are TBD.

a)Tower vertical. Source on front face of tracker. All trigs enabled.

b)Tower vertical. Source on front face of tracker. All trigs disabled. Pulse Gen in external input.

References (All docs are signed off):

LAT-TD-04980-02 Use of an Am^{241} Source for High Rate Trigger …
Motivation
Description of method
EM1 results
Calculation results
Procedure for source use

LAT-TD-04136 VG and CR Data Runs for LAT Integration

Lists the setup for all E2E and SVAC runs

LAT-PS-04511-01 I&T Data Collection Procedure

Detailed procedure specifying the physical setups and scripts to run that execute runs specified in LAT-TD-04136

SLAC Radiation Protection Department JHAM

Use of the Am241 #Y125 source in the Bld 33 Cleanroom

The Source:

.040 mC of AmO
Sealed in a stainless steel case (1 cm diam x 3 mm thick)

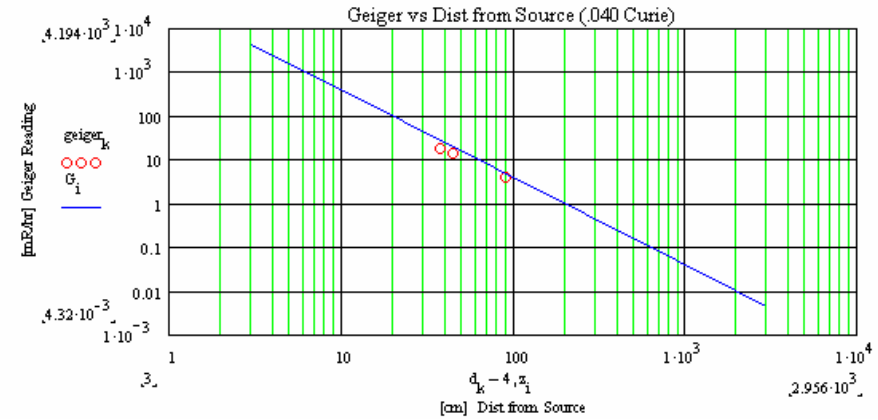
($t_{1/2}$=458 yrs)

$_{95}Am^{241} \rightarrow {}_{2}\alpha^{4} + {}_{93}Np^{237*}$

.86 of Am decays go to a 59.5 Kev Np level.
.94 of this Np level emits a 59.5 Kev xray to gnd state
.06 of this Np level sequentially emits 26, 33 Kev xrays
(26, 33 Kev are absorbed by the tower's first tungsten layer)

5.5 Mev α does not get out of stainless steel case

Radiation dose [mRad / hr]:



The red points were measured with a geiger counter. The blue line is a calculation based on the number of source decays per second from a point source and the amount of energy deposited by the xrays in water (a person). The dose falls off as the square of the distance.

a) The RP JHAM estimates the RP tech who handles the source gets 7 mr whole body for the round trip use of the source. The RP tech (a Rad Worker) is allowed 1500 mr/year.

SLAC Exposure limits:

Table 5-1: Whole-body Dose Limits

	Visitor	Non-radiological	GERT	RWT
SLAC Administrative	100	100	100	1500
DOE	100	5000	5000	5000

Table 5-2: Average Annual Radiation Dose for Various Occupations

Occupation	Dose (mrem/yr)
Airline flight crew member	about 1,000
Nuclear power plant worker	700
Grand Central Station worker	120
Medical personnel	70
DOE/DOE contractors	44

Table 1 Training Requirements for Access to Radiologically Controlled Areas and their Subsets

Area Types	Dose Rate	Training Requirements
Radiologically Controlled Areas	< 5 mrem/h	GERT or RWT
Radiation Areas	5 –100 mrem/h	GERT[a] or RWT
Radioactive Material Areas	varies	GERT[a] or RWT
Radioactive Material Management Areas	varies	GERT[a] or RWT
High Radiation Areas	>100 mrem/h	RWT
Contamination Areas	varies	RWT II

a. GERT-qualified personnel are permitted to enter these areas only if doing so could not result in an annual radiation dose that is greater than 100 mrem. GERT-qualified personnel may enter these areas only when absolutely necessary.

b) Room 140 Bldg 33 is upgraded by the RP tech to a “Radiation Protection Area” while the source is out of its lead case. Everyone except an RWT worker must leave the room.

c) RP has determined that the dose rate outside Room 140 still meets the standard for a public area and GERT is not required.

d) The top layer of silicon which is ~3 cm from the source will get:

.4 (trans of first tungsten layer) x 4 Rad/ hr (dose at 3 cm) = 1.6 Rad/hr

Why are we taking Am Source data?

Prudent to test with 3-13 KHz of cosmics like we will see in orbit. Test our instrument like we are going to use it, or assume substantial risk.

Best:	Airplane flight cosmics	Ruled out by management.
Next Best:	High Rate Van de Graaff	VG upgrade ended by management.
Next Best:	Am Source	Scheduled but being reviewed?
Next Best:	Random Pulse Gen	Scheduled.

Nominal Rate Cosmic Ray test required by E2E committee (section 2.2.1.4)

Trigger and Data Flow

Table 1. Source trigger advantages compared to other methods of high rate triggering.

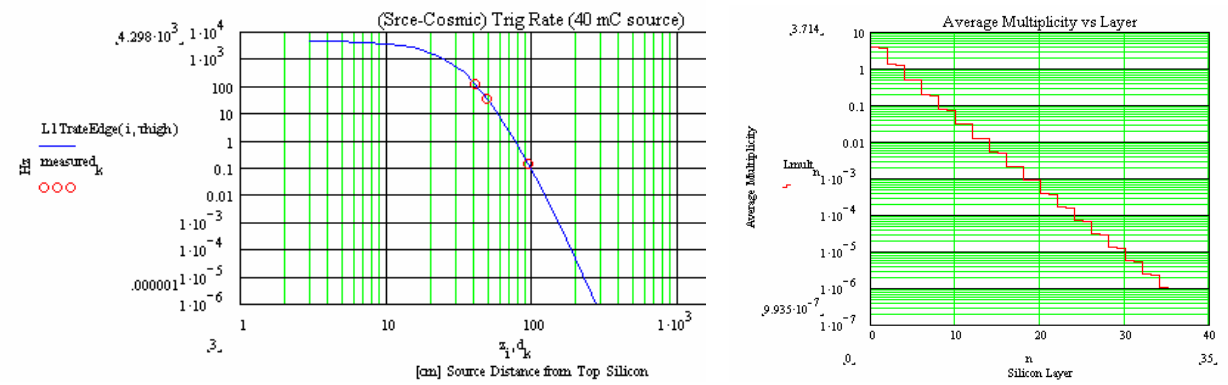
High Rate Trigger	Pros and Cons
Noise triggers from lowered disc or turning some layers on	Triggers always come from the same set of noisy strips or xtals. Since the noise is barely exceeding the disc, the strips that trigger will not be recorded later at the Level 1 Trigger time and thus will not be in the data stream. Maybe some other noisy strips will get recorded depending on noisy strip masking. Data stream loading will be typical of empty events.
Solicited triggers	Data stream loading will be typical of empty events. These high rate triggers are computer generated and therefore are outside the normal in-orbit data taking path.
External triggers (Random Pulse Gen)	Data stream loading will be typical of empty events. These high rate triggers come in through the external trigger input and therefore are outside the normal in-orbit data taking path.
Am^{241}source Tracker Trigger	The hits that caused the trigger are captured in the data stream (60 KeV energy deposition in Si causes the 1/3 mip disc to stay high for ~4 usec). The hits populate many different strips. The data loading ($\geq$6 hits/event) is closer to that of real muons. Unlike muons though, the vast majority of triggers are only in the top 6 layers of silicon closest to the source. The tracker trigger rate is highly dependent on the tracker comparators' time over threshold (a well defined time since 60 KeV is always left in the silicon) and the material thickness of the layers. The measured rate may be compared to calculation.

Additional Source Test Benefits:

The source trigger rate is highly dependent on the time over threshold of the 60 Kev energy deposition pulse in the silicon. The trigger rate is also highly dependent on the transmission of the trays to 60 Kev xrays.

Measurement of the source trigger rate is a cross check that tracker pulse shape, gain, threshold, and converter thickness are as designed. a) The red points are measurements for EM1 and the blue curve is the calculation (expect 4.4 KHz for the the source on top of Tower A). b) Average silicon layer multiplicities for 4.4 KHz (all W layers are 100 um).

(a) (b)



Measurement of the ratio of average occupancy between sequential layers gives the 60 KeV xray transmission of the material between the silicon. This is a cross check on the amount of material in a tower. Use pulse gen triggers to randomly sample the occupancy. To high accuracy it compares the relative thickness of trays. To lesser accuracy it measures the actual thickness of the trays. a) Average transmission of each layer (all tungsten are 100 um). b) Fractional error on tungsten thickness due to statistics only from 1 hour of data at 4.4 KHz.

(a) (b)