CV3 Radiation Testing: MGH Post Analysis

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18 March 2021

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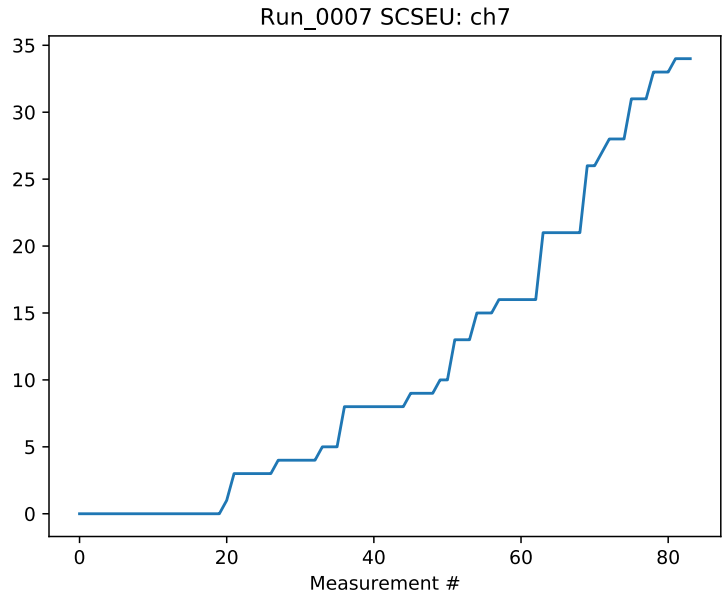
ATLAS EXPERIMENT

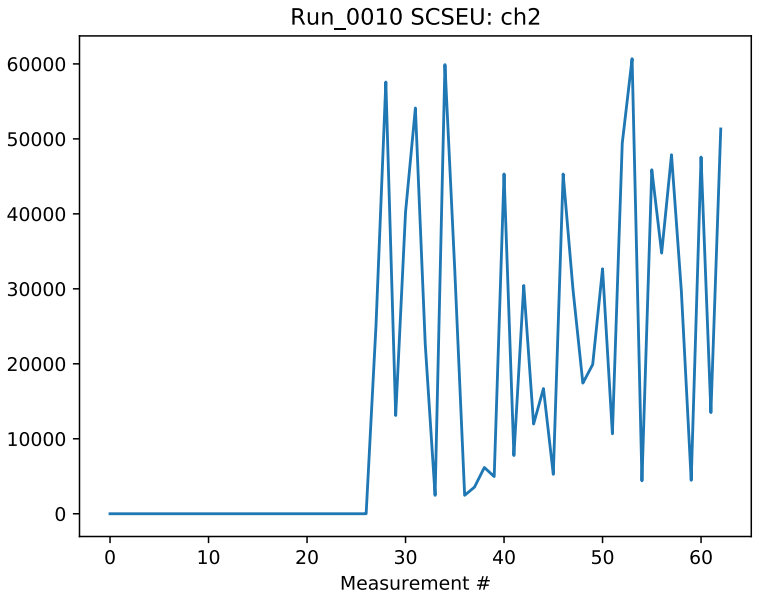
SEU Counters

- Scanning all logs throughout the day, each channel hits about the same total SEU count before breaking down (~60)

Example: Actual Counting



Example: Broken



Total Dose

Board 26

		LOW RATE Run_0002			HIGH RATE Run_0004			Run_0005	
	Msmnts	**SCSEU Counts**	**Rate**	**Msmnts**	**SCSEU Counts**	**Rate**	**Msmnts**	**SCSEU Counts**	**Rate**
Ch1	110	13	**0.118**	52	inf		52	inf	
Ch2	110	7	**0.064**	52	16	**0.31**	52	16	**0.31**
Ch3	110	inf		52	21	**0.40**	52	21	**0.40**
Ch4	110	13	**0.118**	52	11	**0.21**	52	11	**0.21**
Ch5	110	11	**0.100**	52	14	**0.27**	52	14	**0.27**
Ch6	110	13	**0.118**	52	13	**0.25**	52	13	**0.25**
Ch7	110	12	**0.109**	52	13	**0.25**	52	13	**0.25**
Ch8	110	13	**0.118**	52	18	**0.35**	52	18	**0.35**
		82			**106**			**106**	
	Hists	**SEU Candidates - 1s**	**Rate**	**Hists**	**SEU Candidates - 1s**	**Rate**	**Hists**	**SEU Candidates - 1s**	**Rate**
Ch1	173	25	**0.145**	88	26	**0.30**	94	85	**0.90**
Ch2	173	41	**0.237**	88	76	**0.86**	94	158	**1.68**
Ch3	173	0	**0.000**	88	0	**0.00**	94	0	**0.00**
Ch4	173	40	**0.231**	88	56	**0.64**	94	169	**1.80**
Ch5	173	6	**0.035**	88	6	**0.07**	94	23	**0.24**
Ch6	173	54	**0.312**	88	75	**0.85**	94	221	**2.35**
Ch7	173	53	**0.306**	88	88	**1.00**	94	243	**2.59**
Ch8	173	38	**0.220**	88	40	**0.45**	94	97	**1.03**
		257		Total observed SEUs	367		Total observed SEUs	996	
Dose, protons/cm2		**2.92E+11**			**5.76E+11**				
Count, from HDF5	273308	9354276	9080968	1001	12447123	12446122	1105	61388548	61387443
Observed SEUs = counts * 4.27E4	^starting msmnt dose	^ending msmnt dose	***3.877573336E+11***	^starting msmnt dose	^ending msmnt dose	***5.314494094E+11***	^starting msmnt dose	^ending msmnt dose	***2.6212438161E+12***
Predicted SEUs						*407.059933918939*			*1737.32281085012*

Total Dose

Board 24

		Run_0007			Run_0008			Run_0009	
	Msmnts	SCSEU Counts	Rate	Msmnts	SCSEU Counts	Rate	Msmnts	SCSEU Counts	Rate
Ch1	Start time 15_13_48.875279	Stop time 15_53_44.550054							
Ch2									
Ch3									
Ch4									
Ch5									
Ch6									
Ch7									
Ch8									
	Hists	**SEU Candidates - 1s**	**Rate**	**Hists**	**SEU Candidates - 1s**	**Rate**	**Hists**	**SEU Candidates - 1s**	**Rate**
Ch1	134	55	**0.410**	58	71	**1.224**	58	77	**1.328**
Ch2	134	93	**0.694**	58	120	**2.069**	58	115	**1.983**
Ch3	134	91	**0.679**	58	134	**2.310**	58	134	**2.310**
Ch4	134	84	**0.627**	58	126	**2.172**	58	111	**1.914**
Ch5	134	5	**0.037**	58	13	**0.224**	58	13	**0.224**
Ch6	134	100	**0.746**	58	187	**3.224**	58	173	**2.983**
Ch7	134	103	**0.769**	58	206	**3.552**	58	164	**2.828**
Ch8	134	59	**0.440**	58	86	**1.483**	58	81	**1.397**
		590			**943**			**868**	
Dose, protons/ cm2									
Count, from HDF5	344	21073665	21073321	1406	42814735	42813329	3470	47001450	46997980
Observed SEUs = counts * 4.27E4	^starting msmnt dose	^ending msmnt dose	***8.998308067E+11***	^starting msmnt dose	^ending msmnt dose	***1.8281291483E+12***	^starting msmnt dose	^ending msmnt dose	***2.006813746E+12***
Predicted SEUs		***Relative to b26***	***690.57***			***1402.98***			***1540.11***

Total Dose

Board 22

		Run_0010			Run_0011	Very high rate		Run_0012	Lowered rate
	Msmnts	SCSEU Counts	Rate	Msmnts	SCSEU Counts	Rate	Msmnts	SCSEU Counts	Rate
Ch1									
Ch2									
Ch3									
Ch4									
Ch5									
Ch6									
Ch7									
Ch8									
	Hists	**SEU Candidates - 1s**	**Rate**	**Hists**	**SEU Candidates - 1s**	**Rate**	**Hists**	**SEU Candidates - 1s**	**Rate**
Ch1	84	58	**0.690**	84	187	**2.226**	105	120	**1.143**
Ch2	84	75	**0.893**	84	254	**3.024**	105	173	**1.648**
Ch3	84	50	**0.595**	84	290	**3.452**	105	161	**1.533**
Ch4	84	52	**0.619**	84	238	**2.833**	105	166	**1.581**
Ch5	84	3	**0.036**	84	30	**0.357**	105	17	**0.162**
Ch6	84	71	**0.845**	84	464	**5.524**	105	295	**2.810**
Ch7	84	70	**0.833**	84	481	**5.726**	105	318	**3.029**
Ch8	84	30	**0.357**	84	144	**1.714**	105	95	**0.905**
		409			**2088**			**1345**	
Dose, protons/ cm2									
Count, from HDF5	287	9399220	9398933	16988	146896431	146879443	3109	54210972	54207863
Observed SEUs = counts * 4.27E4	^starting msmnt dose	^ending msmnt dose	***4.013344391E+11***	^starting msmnt dose	^ending msmnt dose	***6.2717522161E+12***	^starting msmnt dose	^ending msmnt dose	***2.3146757501E+12***
Predicted SEUs		*Relative to b26*	***308.00***		*Relative to b26*	***6391.54***		*Relative to b26*	***770.60***

Observed SEU Algorithm

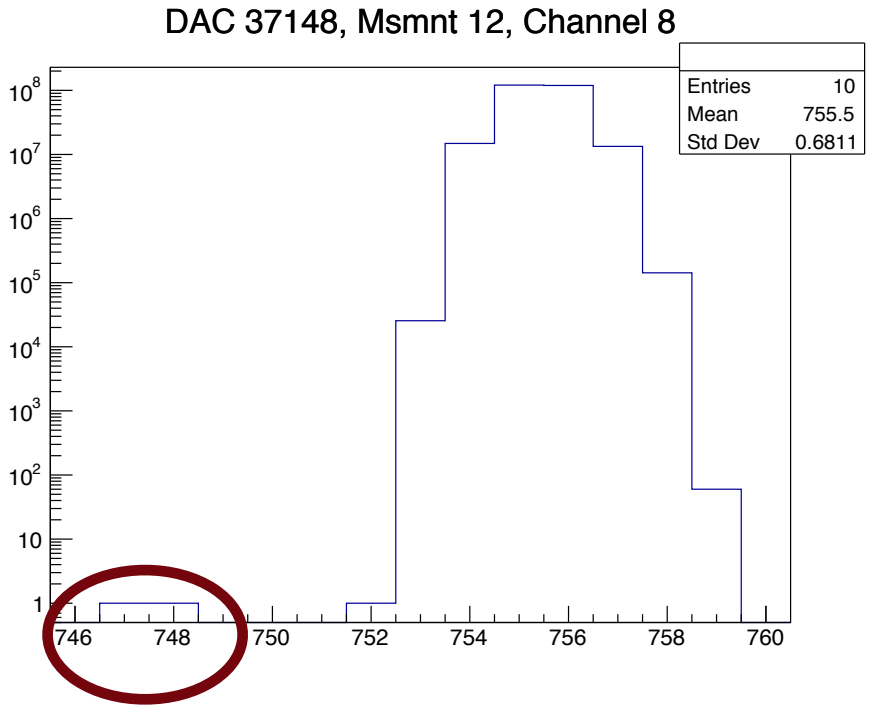
- Issue with current SEU estimate: underpredicts because 2 SEU candidates next to each other do not have a "gap" between them, so won't get counted.
  - ➡In both cases, gaps of 1 are not filled

Old Alg

- Loop through all filled bins in hist
- If current bin and previous bin are not adjacent, fill with the difference between them

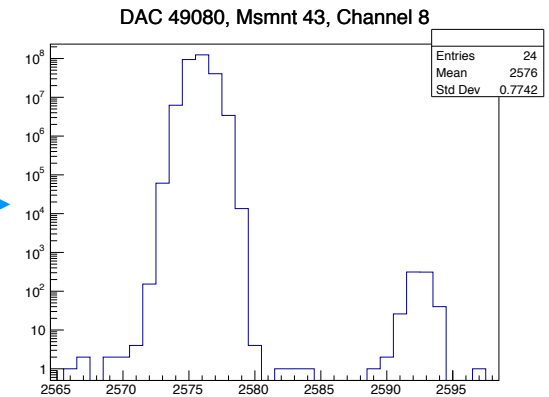
New Alg

- Find hist max bin, and find first empty bin on either side
- From there, go to hist upper & lower bounds, and if any bin is non-empty, fill with its distance to the bulk

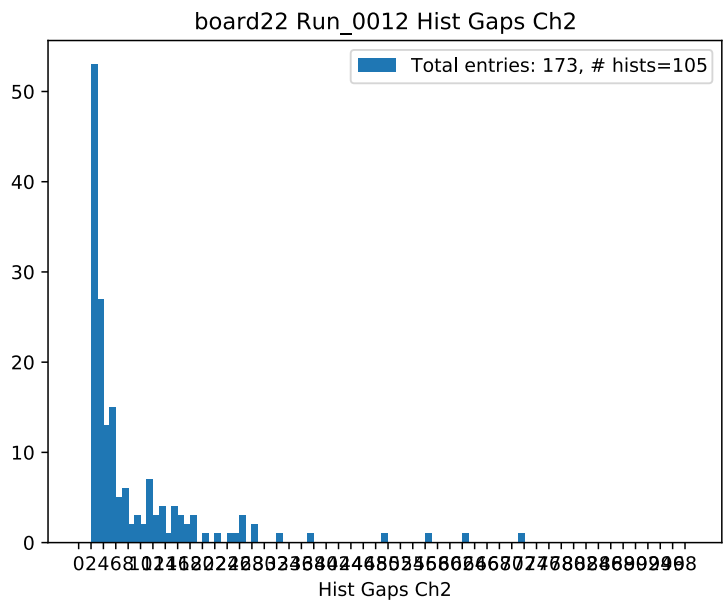
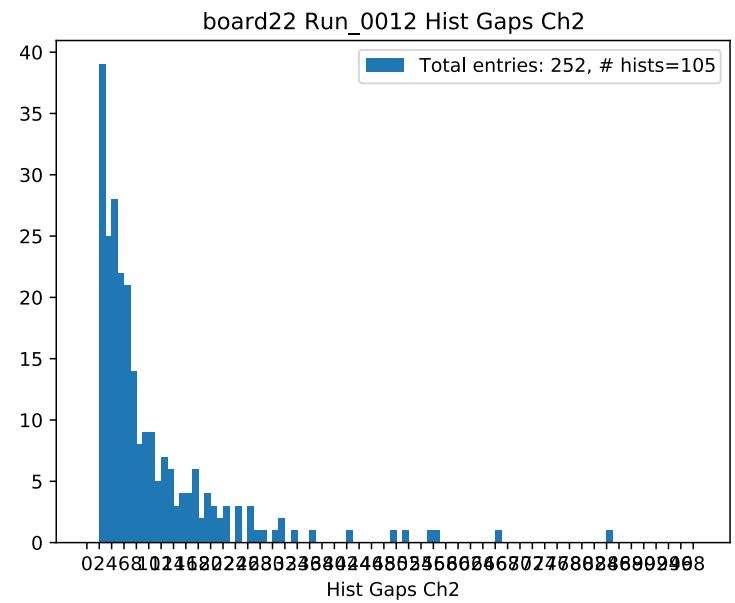


Observed SEU Alg Improvement

- Compare old & new algs in Board 22, Run_0012 (high rate)
- *To do:*
  - Add new bad DAC values (with Dev's input); will lower rate a bit
  - Correct the tables, but this will raise our observed SEU rate considerably & hopefully bring closer to prediction



Old Alg



New Alg