FADC scaler rate with simple sum Board 01/2021

Avg. pixel rate vs sum signal rate Simple sum board



- Plot is shown for strong light and LED 2.15 V
- For one pixel, pixel to sum signal scaler rate are comp for all LED voltage and laser frequencies
- Similar result was achieved with MAROC sum board

Avg. pixel rate vs fadc scaler rate Laser OFF (All pixels) Simple sum board

LED (V)	Avg. pixel rate (kHz)	Expected sum rate (MHz) (A)	FADC scaler rate (MHz)	Deadtime (%)	Corrected rate (MHz) (B)	A/B
2.09	45	2.9	2.68	5.6	2.84	1.02
2.12	146	9.34	7.37	18.6	9.05	1.03
2.15	368	23.5	13.82	47	26.07	0.90

- Expected sum rate = Avg. pixel rate x 64
- Deadtime = 1 / [1/(rate x 20 ns)]
- 20 ns is FADC width for a LED pulse
- Corrected rate= FADC rate/ (1- deadtime)



After deadtime correction, the ssp rate and fadc rate agrees within 10%.

Pixel occupancy for different laser setting From Maroc sum data 2021 run period

Runs	Laser fr (MHz)	occupancy		
Wh	eel 2 + paper ("	strong light")		
	20			
1131	5	12.17		
1117	2	10.44		
1105	1	9.6		
1106	0.5	9.18		
1107	0.1	8.86		
Wheel 3 ("medium light")				
1167	20	2.3		
1163	5	2.5		
1157	2	2.2		
1142	1	2.07		
1146	0.5	2.03		
1150	0.1	1.99		

Runs	Laser fr (MHz)	Occupancy
Whee	el 3 +paper ("\	weak light")
1186	20	1.07
1126	5	1.07
1121	2	1.07
1073	0.1	1.07
1074	0.5	1.05
1075	0.1	1.05

Laser wheel 2 + paper ("strong light") LED OFF Simple sum board

Threshold scan



- FADC rate measured with FADC scaler
- Avg. pixel rate measured with TDC scaler
- Pixel occupancy used from TDC CODA data



1000	2.4	145	170	0.85
500	1.2	73	80	0.91
100	0.3	18	16	1.25



Laser_fr (kHz)	Avg. pixel rate (kHz/pixel)	Expected FADC rate (kHZ) (A)	FADC rate (kHz) (B)	A/B
1000	38	1174	942	1.25
500	18	561	470	1.19
100	3.6	115	91	1.26

Simple sum board LED 2.09 V

Wheel 3 + paper ("weak light")			
Laser_fr (kHz)	FADC rate MHz		
0	2.68		
100	2.70		
500	2.75		
1000	2.80		

Wheel 2 + paper ("strong light")		
Laser_fr (kHz)	FADC rate MHz	
0	2.68	
100	2.73	
500	2.97	
1000	3.23	

Wheel 3 ("medium light")		
Laser_fr (kHz)	FADC rate MHz	
LED 0	2.68	
100	2.73	
500	3.01	
1000	3.40	

Simple sum board LED 2.12 V

Wheel 2 + paper ("strong light")		
Laser_fr (kHz)	FADC rate MHz	
0	7.37	
100	7.39	
500	7.86	
1000	7.91	

Wheel 3 + paper ("weak light")		
Laser_fr (kHz)	FADC rate MHz	
0	7.37	
100	7.37	
500	7.41	
1000	7.47	

Wheel 3 ("medium light")		
Laser_fr (kHz)	FADC rate MHz	
0	7.37	
100	7.40	
500	7.50	
1000	7.8	

Measured FADC rates are smaller than sum of FADC rate with LED + FADC rate with laser due to deadtime

Simple sum board LED 2.15 V

Wheel 2 + paper ("strong light")

Laser_fr (kHz)	FADC rate MHz
0	13.82
100	13.46
500	13.66
1000	13.87

Wheel 3 ("medium light")

Laser_fr (kHz)	FADC rate MHz
0	13.82
100	13.55
500	13.68
1000	13.80

Wheel 3 + paper ("weak light")

Laser_fr (kHz)	FADC rate MHz
0	13.82
100	13.76
500	13.77
1000	13.83

- Laser signal arrives at fixed narrow FADC time window
- At LED 2.15 V, it more likely to have a photon from LED in the same time window where the laser signal arrives causing deadtime for laser signal

Conclusions

- With one pixel fired, the sum rate and pixel rates can be related well
- For LED (Laser OFF), the deadtime correction for FADC scaler rate are significant
- Corrected FADC scaler rates can be related to pixel rate
- With pixel occupancy, the pixel rate and FADC sum rate can be related for laser only runs (LED OFF)
- At 2.09 V and 2.12 V the effect on addition of laser can be understood. However FADC rates effected by deadtime
- For LED 2.15 V, we already have large number of photons so addition of laser saturates due to large deadtime
- Pedestal for FADC signal shifts (toward lower value) with increasing light

Backup slides

FADC scaler rate

Threshold scan



- FADC pedestal shift with light condition (smaller pedestal with more light)
- To choose right threshold value for FADC scaler rate first the FADC scaler rate was measured at different threshold value ("threshold scan")
- Threshold value was picked at plateau

Laser wheel 2 + paper ("strong light") LED 2.09 V Simple sum board

LED 2.09 V Laser 0 Laser 1 MHz Laser 500 kHz Laser 100 kHz



Wheel 2 + paper ("strong light")		
Laser_fr (kHz)	FADC rate MHz	
0	2.68	
100	2.73	
500	2.97	
1000	3.23	

Measured FADC rates are smaller than sum of FADC rate with LED + FADC rate with laser due to deadtime 14

Laser wheel 3 + paper ("weak light") LED 2.09 V Simple sum board

Threshold scan



Wheel 3 + paper ("weak light")		
Laser_fr (kHz)	FADC rate MHz	
0	2.68	
100	2.70	
500	2.75	
1000	2.80	

Measured FADC rates are smaller than sum of FADC rate with LED + FADC rate with laser due to deadtime

Laser wheel 3 ("medium light") LED 2.09 V Simple sum board

Threshold scan



LED 2.09 V Laser 0
Laser 1 MHz
Laser 500 kHz
Laser 100 kHz

Wheel 3 ("medium light")		
Laser_fr (kHz)	FADC rate MHz	
LED 0	2.68	
100	2.73	
500	3.01	
1000	3.4	

Measured FADC rates are smaller than sum of FADC rate with LED + FADC rate with laser due to 16 deadtime

Simple sum board LED 2.15 V



- There is no increment in FADC scaler rate with laser on LED at 2.15 V due to dead time
- The FADC rates are with in the within the systematic error

Simple sum board LED 2.12 V



Threshold scan