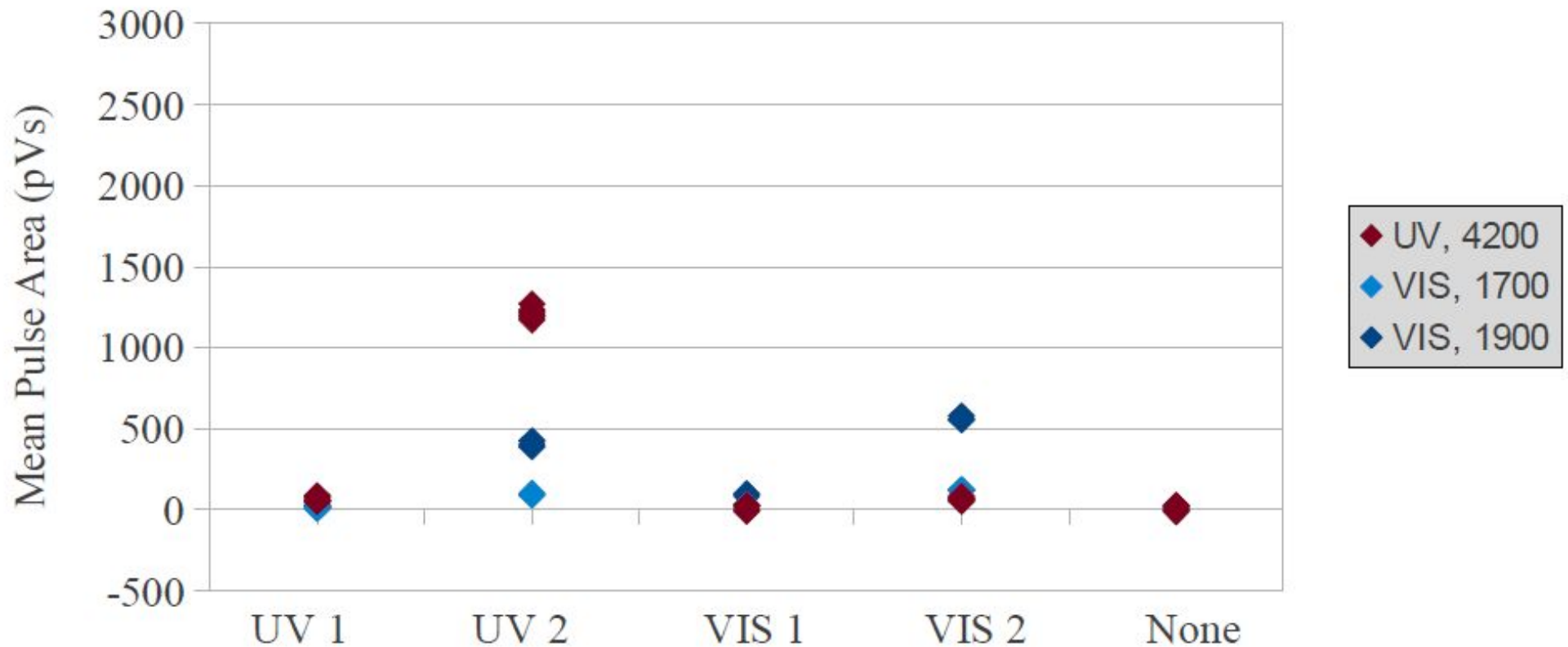


# VST Update

- LED Visibility Tests
- 1 PE measurement for electronics calibration
- Preliminary cosmic late light fits
- Early : late light ratio
- High frequency noise reduction

# LED Visibility Study

Visibility of UV & VIS light by PMT 2

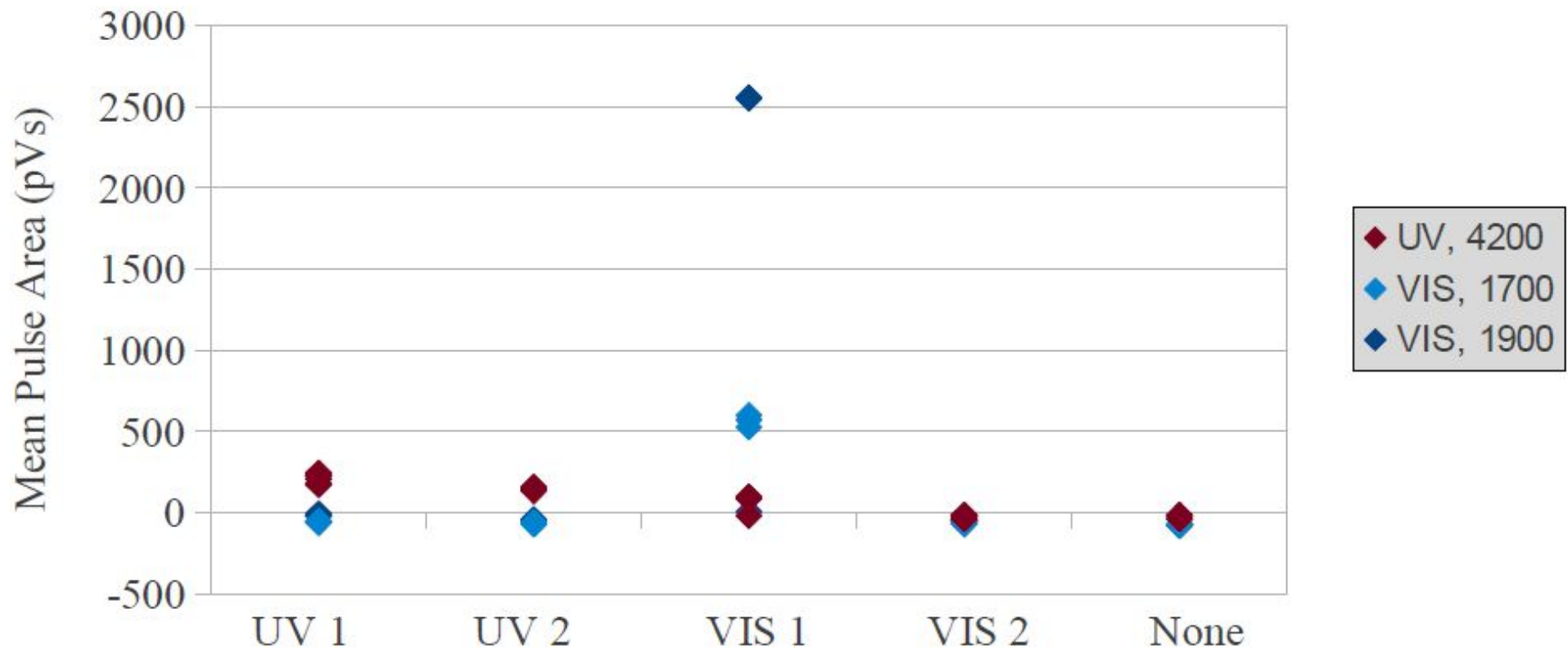


PMT2 detects VIS light only when it is shone at the PMT

PMT2 detects UV light only when it is shone at the plate above the PMT

# LED Visibility Study

Visibility of UV & VIS light by PMT 1

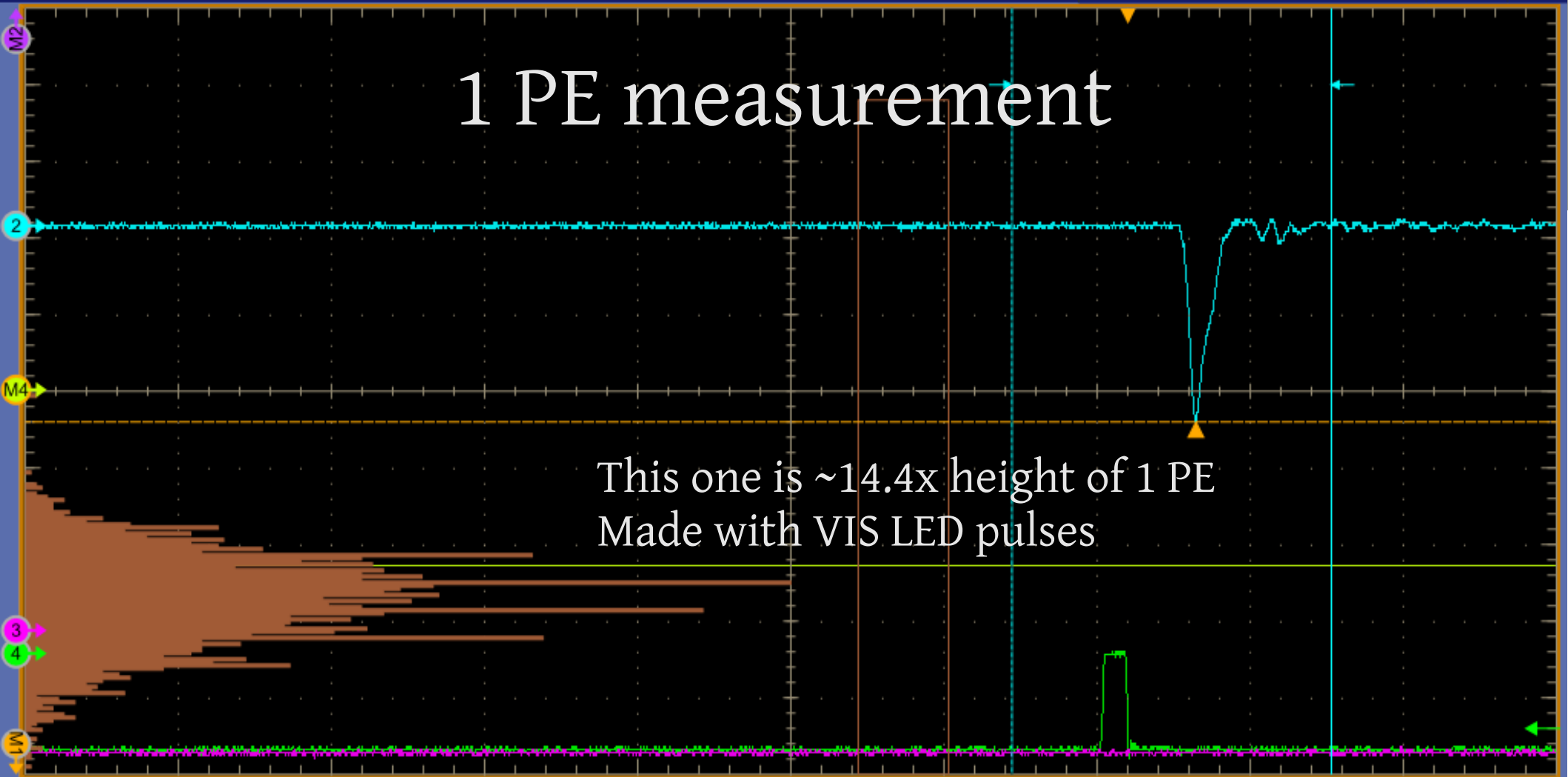


Same results, but UV1 fiber elicits smaller response

UV1 fiber may be loose (OR plate is opaque and terrible shifter, very unlikely)

# 1 PE measurement

This one is ~14.4x height of 1 PE  
Made with VIS LED pulses



C2 90.0mV/div    50Ω  $B_W$ :500M    M2 1.0nVs 100ns  
C3 500mV/div    50Ω  $B_W$ :500M    M4 100mV 100ns  
C4 600mV/div    50Ω  $B_W$ :500M  
M1 1.0    100ns

A' C4  $\setminus$  -588mV  
 None    Normal

100ns/div 5.0GS/s    200ps/pt  
**Stopped**  
 2 765 acqs    RL:5.0k  
 Auto August 01, 2012    17:14:54

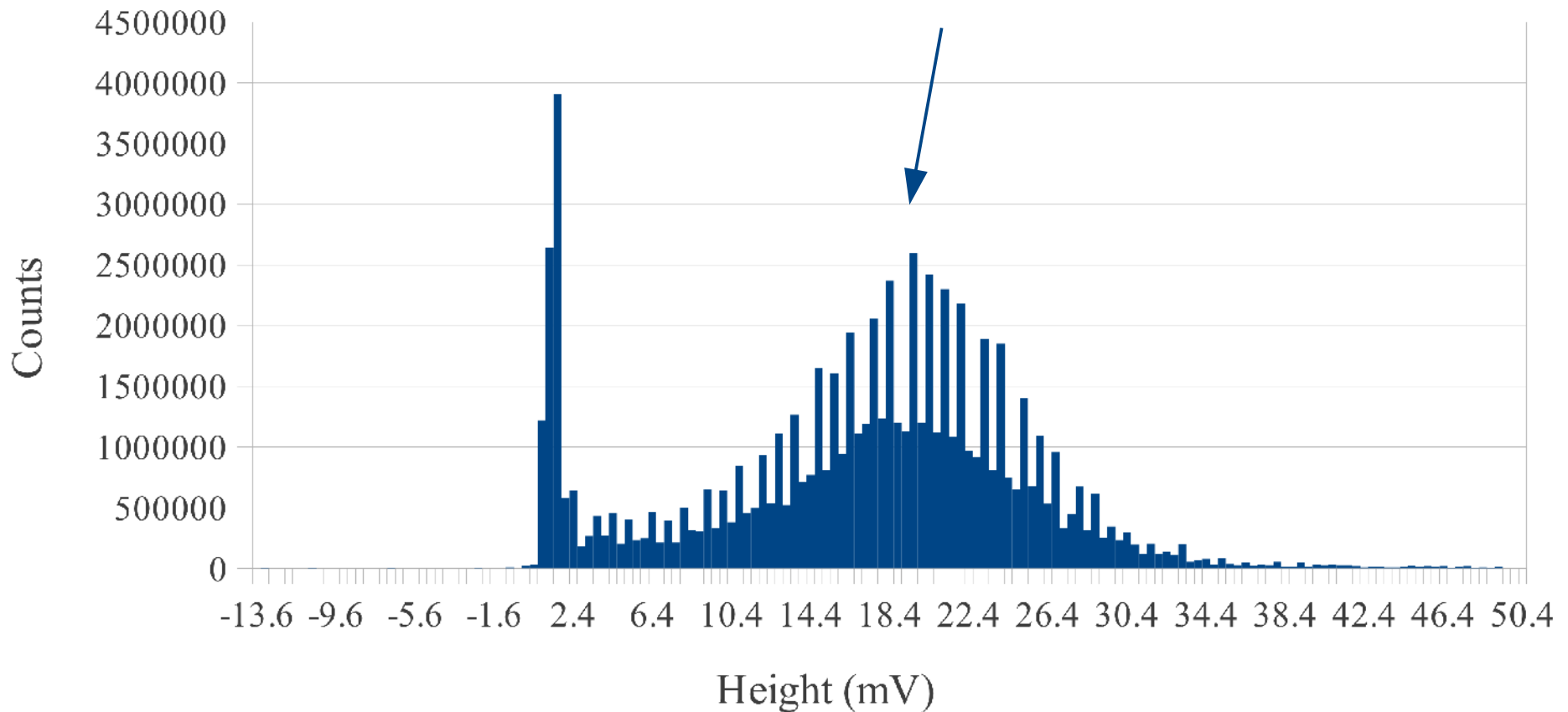
	Value	Mean	Min	Max	St Dev	Count	Info
<span>C2</span> Area	-3.487nVs	-4.4164386n	-40.71n	1.189n	925.1p	2.765k	
<span>H5</span> Mean	-273.6mV	-273.59316m	-279.9m	-6.0m	53.83μ	2.769k	
<span>H5</span> Std Dev	59.15mV	59.040691m	0.0	187.3m	69.12μ	2.769k	
<span>C2</span> Min*	-230.4mV	-273.09668m	-651.6m	-7.2m	68.94m	2.765k	

<span>t1</span>	132.4ns
<span>t2</span>	-76.2ns
<span>Δt</span>	-208.6ns
<span>1/Δt</span>	4.794MHz

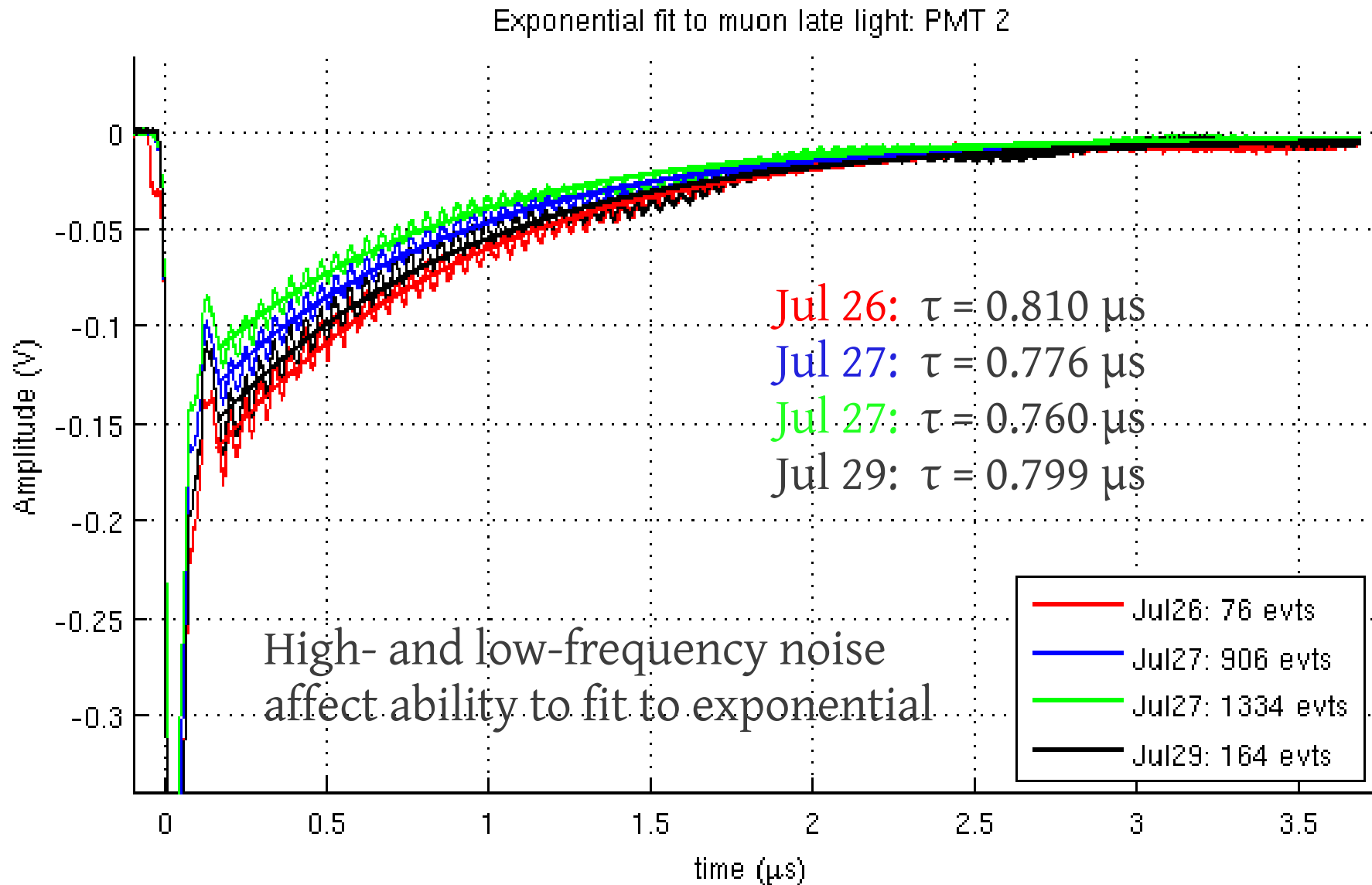
# 1 PE measurement

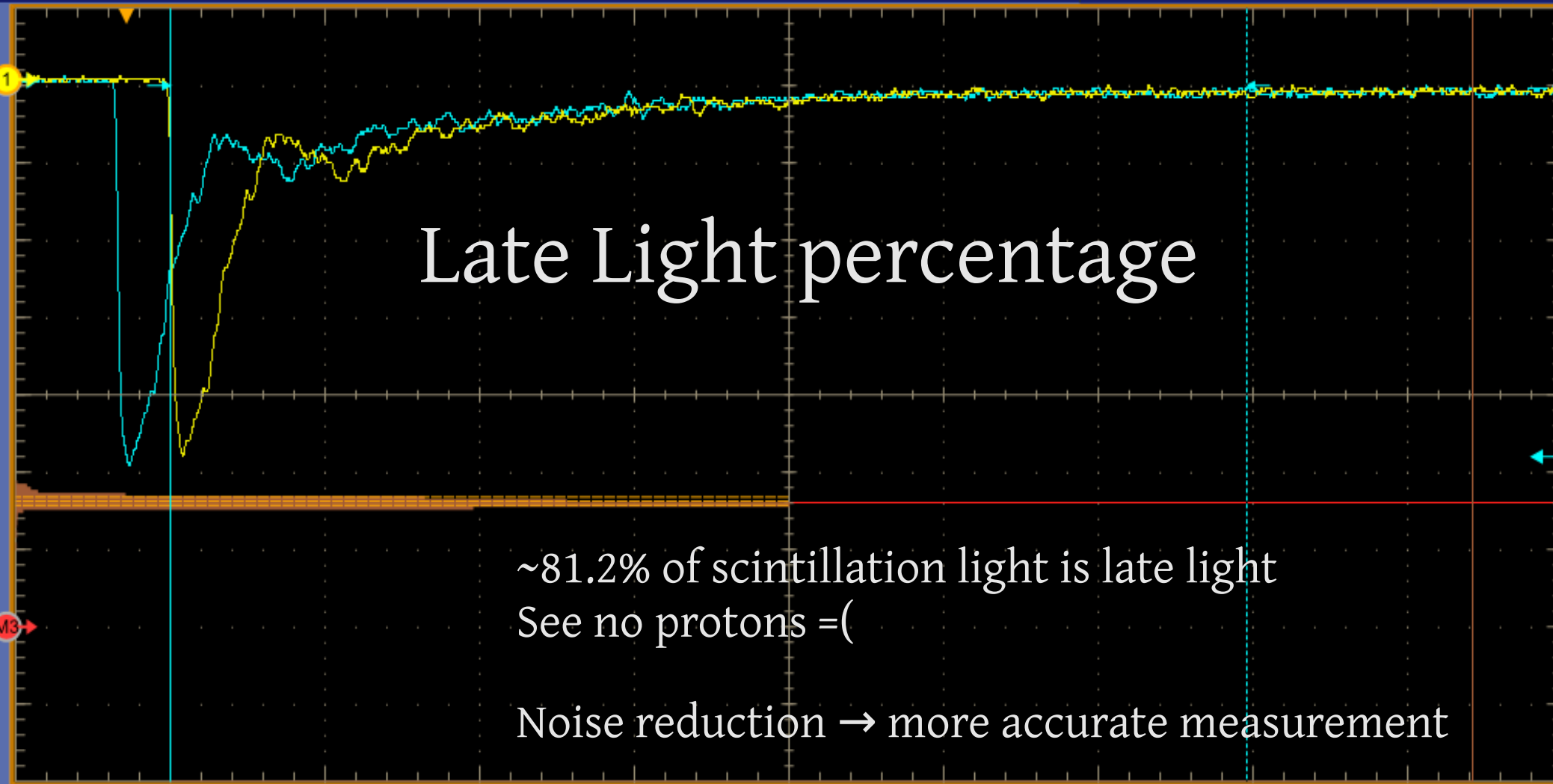
Made from cosmic late light  
(between 3 and 5 us after prompt light)

Average height: 18.9 mV  
(ignore binning issues)



# Cosmic Late Light Fits





# Late Light percentage

~81.2% of scintillation light is late light  
See no protons = (

Noise reduction → more accurate measurement

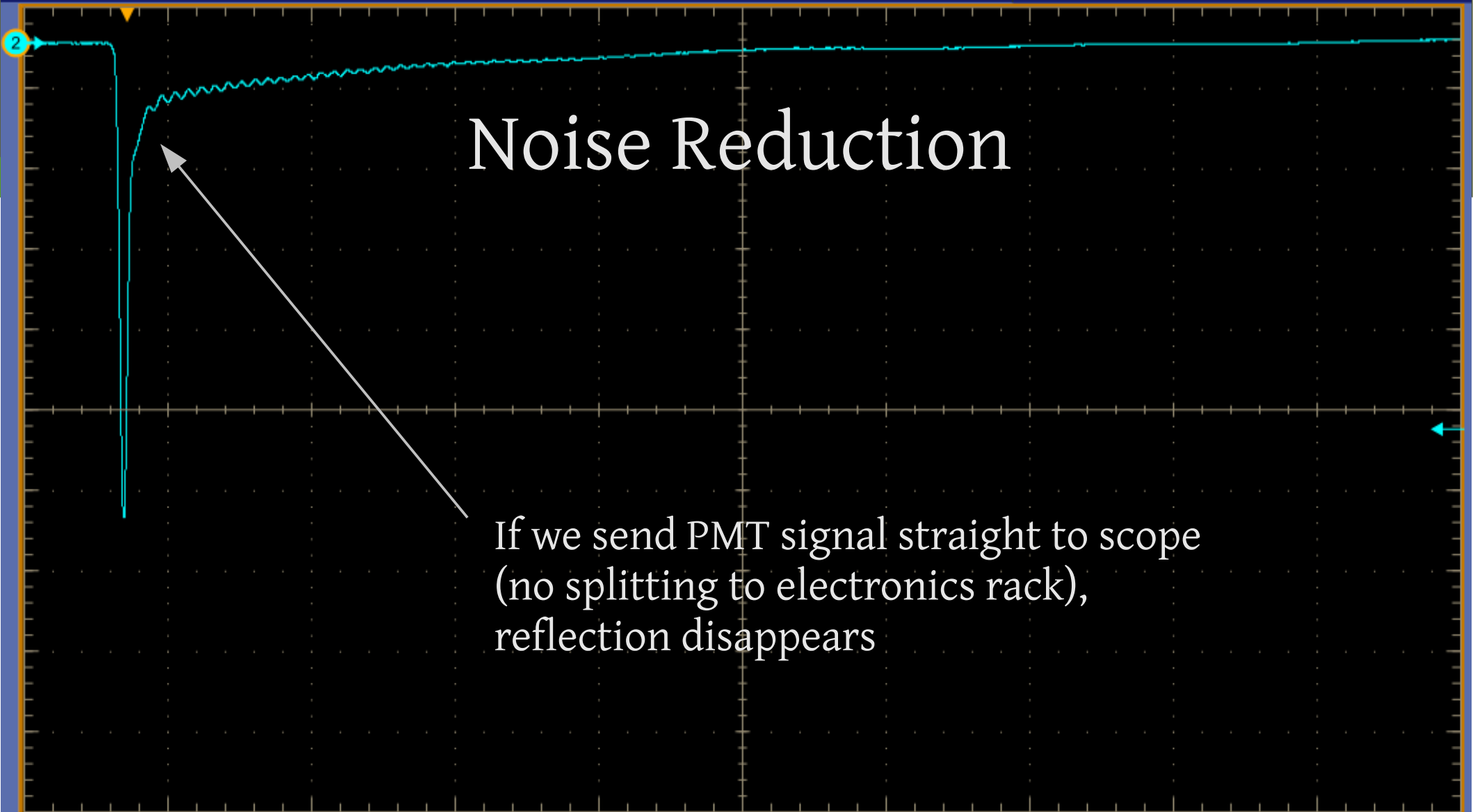
C1 500mV Offset:48.0mV 50Ω B<sub>W</sub>:500M  
C2 500mV/div 50Ω B<sub>W</sub>:500M  
M3 500m 200ns

t1 56.0ns  
t2 1.448μs  
Δt 1.392μs  
1/Δt 718.391kHz

A1 C2 \ -2.43V  
 None Normal

200ns/div 500MS/s 2.0ns/pt  
**Stopped**  
 11 461 acqs RL:1.0k  
 Auto August 06, 2012 16:10:29

	Value	Mean	Min	Max	St Dev	Count	Info
<span style="color: yellow;">C1</span> Area	-377.6nVs	-413.15928n	-1.218μ	-117.3n	65.03n	11.46k	
<span style="color: cyan;">C2</span> Area	-303.3nVs	-336.68724n	-1.137μ	-63.18n	59.19n	11.46k	
Hs Mean	812.0m	812.03646m	800.0m	818.1m	4.054μ	11.44k	
Hs Std Dev*	26.43m	26.437358m	0.0	29.91m	10.05μ	11.44k	



# Noise Reduction

If we send PMT signal straight to scope (no splitting to electronics rack), reflection disappears

C2 600mV/div 50Ω BW:500M

A' C2 -2.88V Normal

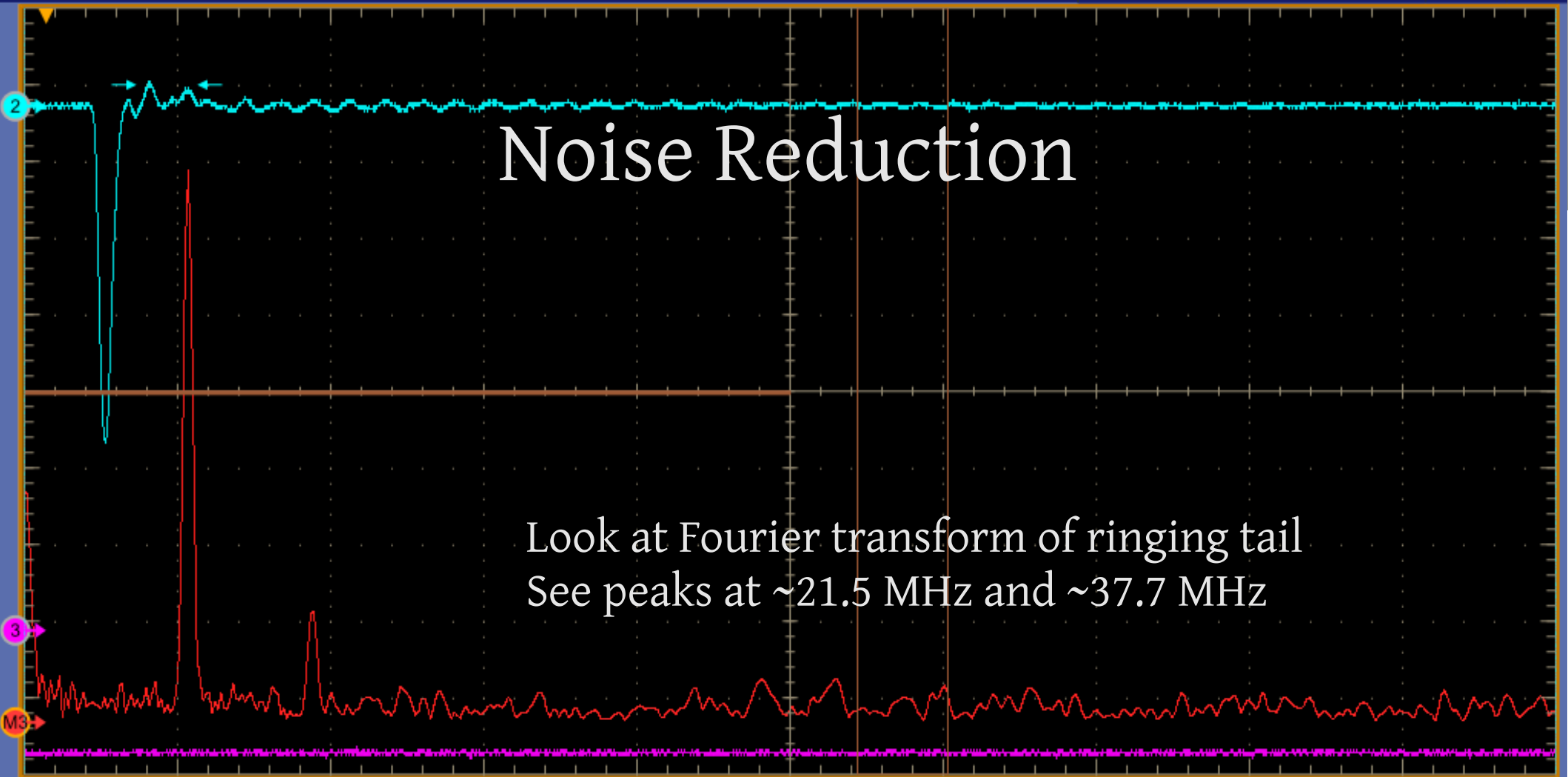
500ns/div 200MS/s 5.0ns/pt  
 Stopped  
 569 acqs RL:1.0k  
 Auto August 08, 2012 10:41:48

	Value	Mean	Min	Max	St Dev	Count	Info
C1 Area	283.8nVs	283.81694n	283.8n	283.8n	0.0	1.0	
C2 Area	-610.8nVs	-610.80224n	-610.8n	-610.8n	0.0	1.0	
H5 Mean	-	?	?	?	0.0	0.0	
H5 Std Dev*	-	?	?	?	0.0	0.0	



# Noise Reduction

Look at Fourier transform of ringing tail  
See peaks at ~21.5 MHz and ~37.7 MHz



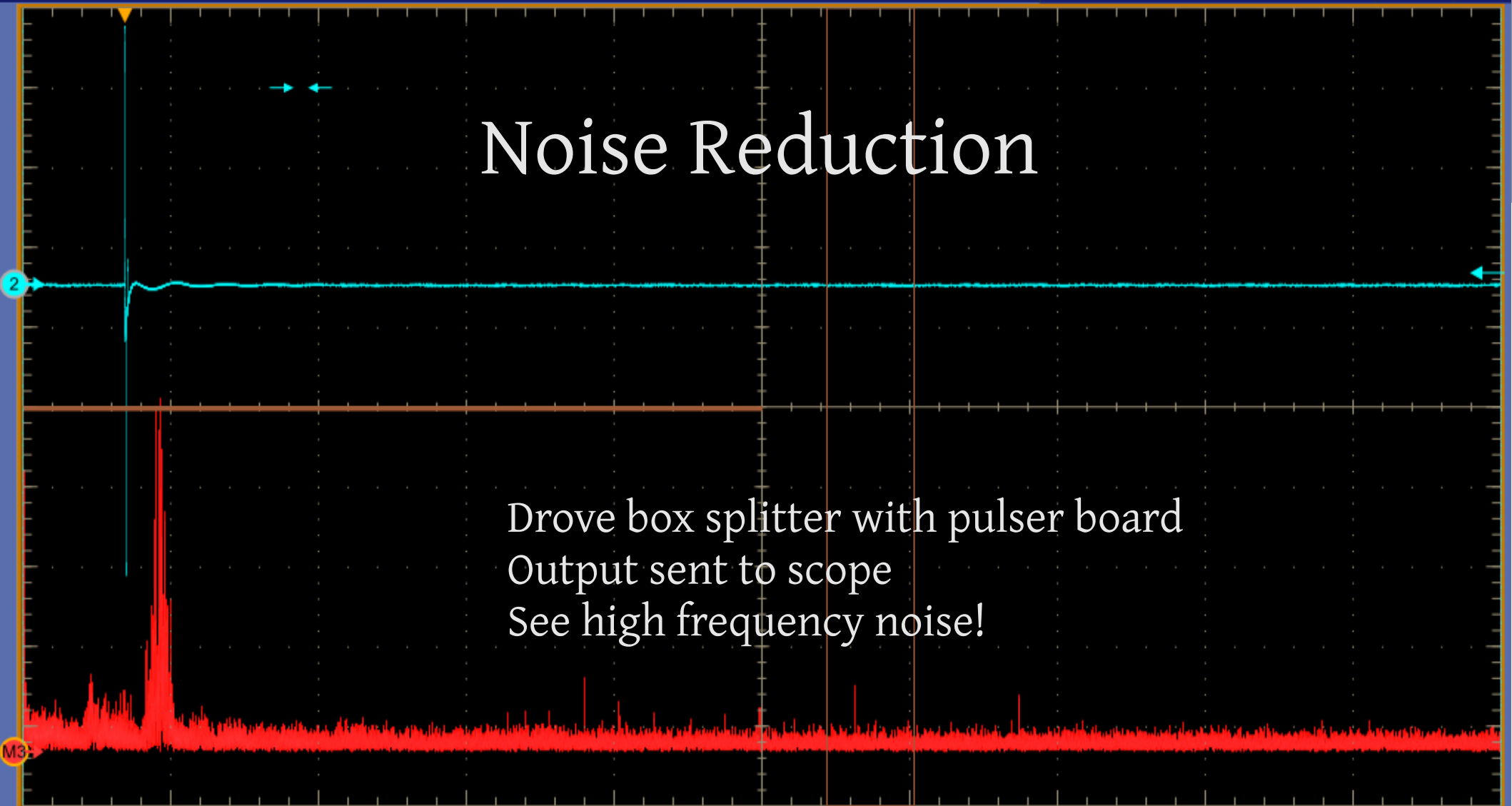
C2 200mV/div    50Ω  $R_W: 500M$   
C3 500mV/div    50Ω  $R_W: 500M$   
M3 531μV 20.0MHz

A Aux  $\int$  -200mV  
 None                      Normal

200ns/div 5.0GS/s    200ps/pt  
**Stopped**            Single Seq  
 1 acqs                      RL:10.0k  
 Man    July 30, 2012            11:12:42

	Value	Mean	Min	Max	St Dev	Count	Info
<span style="color: yellow;">C1</span> Area*	2.316nVs	2.3160061n	2.316n	2.316n	0.0	1.0	
<span style="color: cyan;">C2</span> Area	1.385nVs	1.3847995n	1.385n	1.385n	0.0	1.0	
<span style="color: gray;">Hs</span> Mean	0.0Vs	0.0	0.0	0.0	0.0	38.0	
<span style="color: gray;">Hs</span> Std Dev	0.0Vs	0.0	0.0	0.0	0.0	38.0	

# Noise Reduction



Drove box splitter with pulser board  
 Output sent to scope  
 See high frequency noise!

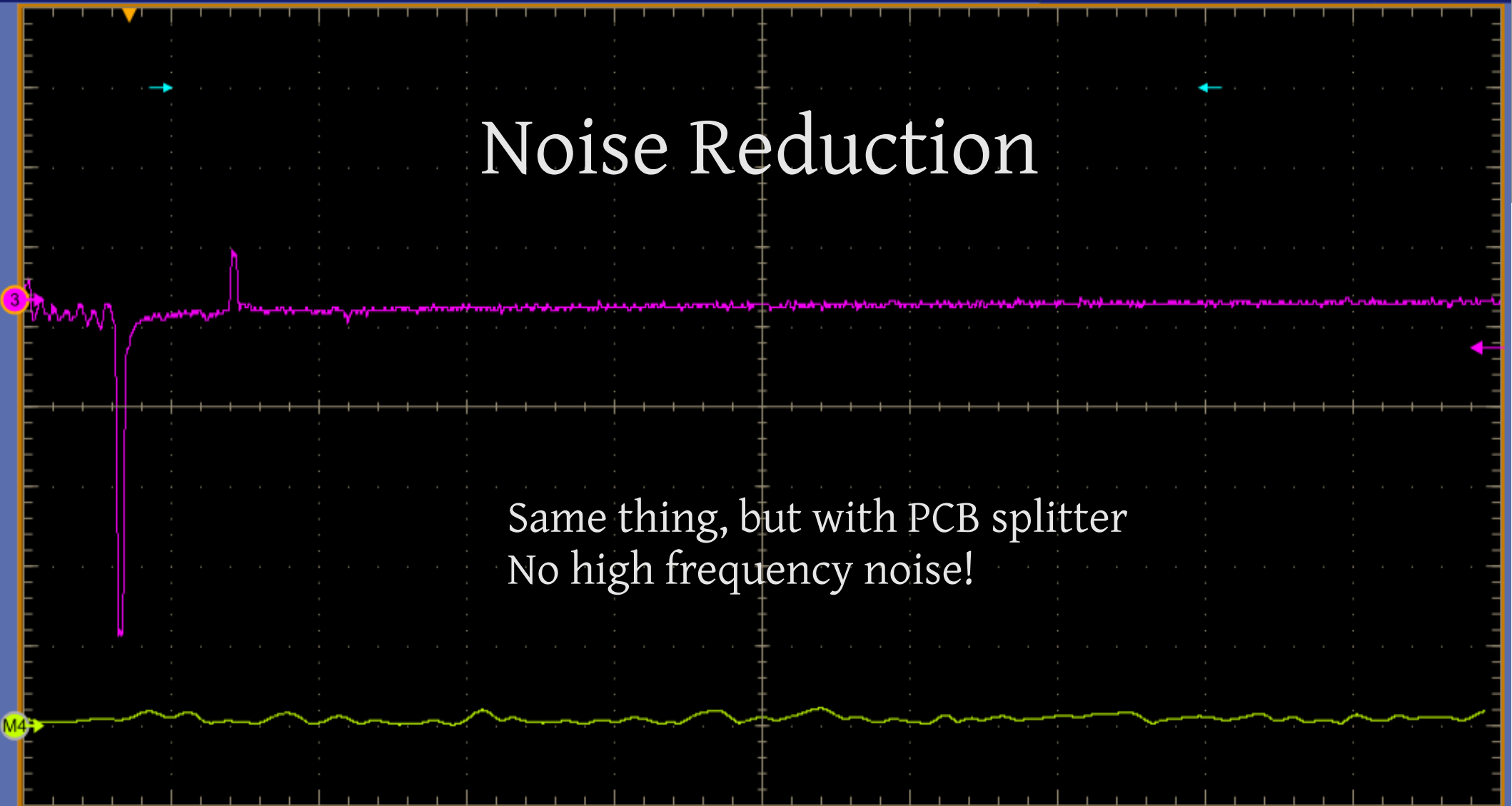
**C2** 90.0mV/div 50Ω  $B_W$ :500M  
**M3** 6.61μV 16.0MHz

**A1** **C2** / 12.6mV  
 Ready Normal

20.0μs/div 5.0GS/s 200ps/pt  
**Run** Average:10000  
 59 acqs RL:1.0M  
 Man July 30, 2012 12:13:33

	Value	Mean	Min	Max	St Dev	Count	Info
<b>C1</b> Area*	57.19nVs	57.186624n	57.19n	57.19n	0.0	1.0	
<b>C2</b> Area	-4.571nVs	-4.5714854n	-4.571n	-4.571n	0.0	1.0	
<b>H5</b> Mean	0.0Vs	0.0	0.0	0.0	0.0	67.0	
<b>H5</b> Std Dev	0.0Vs	0.0	0.0	0.0	0.0	67.0	

# Noise Reduction



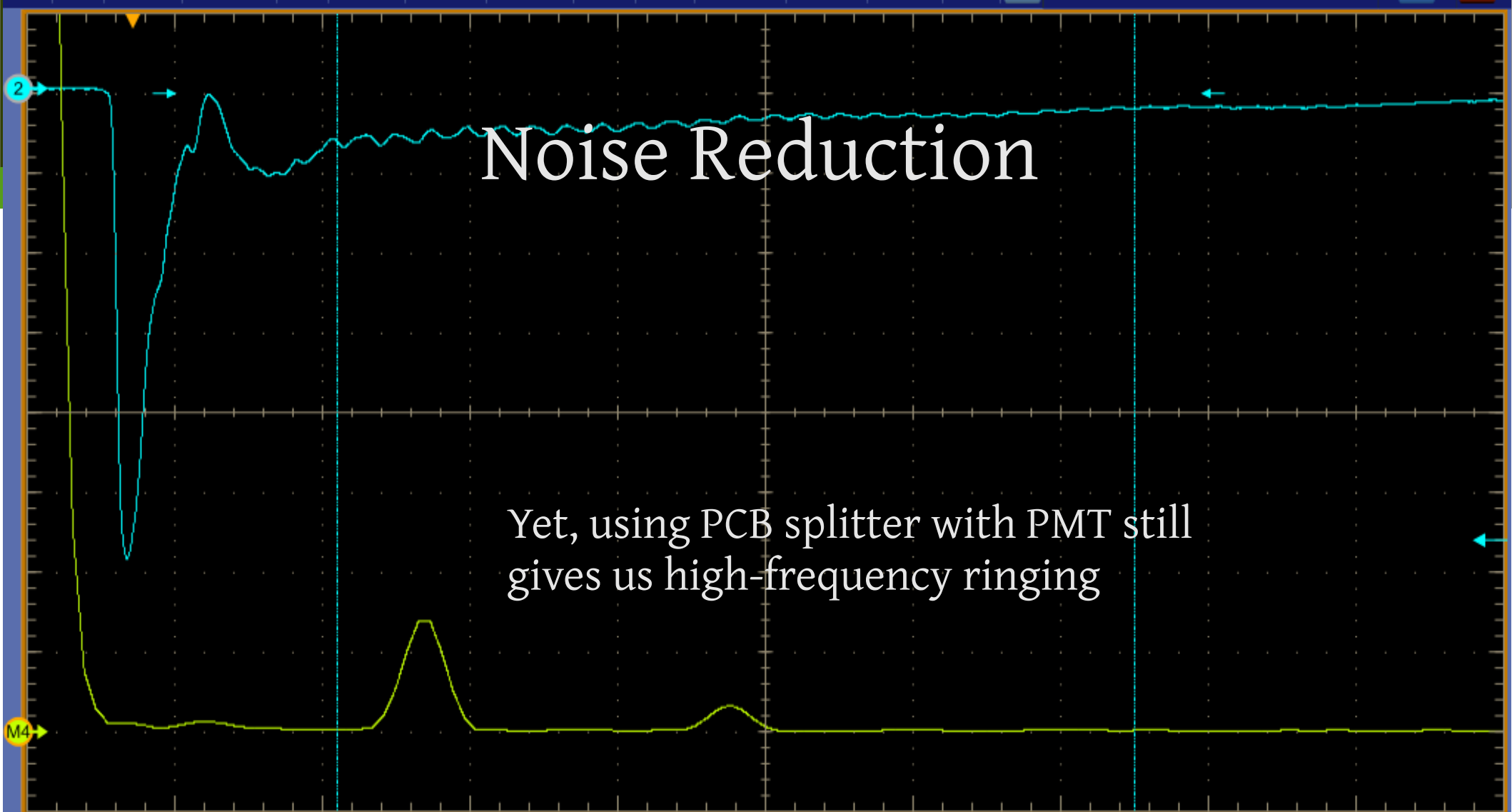
Same thing, but with PCB splitter  
No high frequency noise!

C3 70.0mV/div    50Ω  $R_W$ :500M  
M4 6.5mV 7.84MHz

A C3  $\int$  -42.0mV  
 Ready                      Normal

200ns/div 500MS/s 2.0ns/pt  
**Run**                      Sample  
 103 acqs                      RL:1.0k  
 Auto August 07, 2012 14:24:00

	Value	Mean	Min	Max	St Dev	Count	Info
<span style="color: yellow;">C1</span> Area	59.24nVs	59.003918n	55.16n	62.64n	1.813n	103.0	
<span style="color: cyan;">C2</span> Area	-6.048nVs	-3.7008926n	-7.488n	1.072n	2.014n	103.0	
<span style="color: grey;">H5</span> Mean	-58.72m	-58.16298m	-128.0m	-40.0m	6.505m	103.0	
<span style="color: grey;">H5</span> Std Dev*	33.89m	31.691941m	0.0	40.01m	4.441m	103.0	



C2 400mV/div    50Ω     $B_W: 500M$   
M4 6.5mV    8.0MHz

A C2  $\int$  -2.26V  
 None    Normal

200ns/div    500MS/s    2.0ns/pt  
**Stopped**  
 2 249 acqs    RL:1.0k  
 Auto    August 07, 2012    14:00:40

	Value	Mean	Min	Max	St Dev	Count	Info
<span style="background-color: #00FFFF; border: 1px solid black; border-radius: 5px; padding: 2px;">C1</span> Area	-290.6nVs	-290.59765n	-290.6n	-290.6n	0.0	1.0	
<span style="background-color: #00FFFF; border: 1px solid black; border-radius: 5px; padding: 2px;">C2</span> Area	-263.0nVs	-262.97128n	-263.0n	-263.0n	0.0	1.0	
<span style="background-color: #CCCCCC; border: 1px solid black; border-radius: 5px; padding: 2px;">Hs</span> Mean	901.4m	901.42986m	899.8m	920.0m	1.895f	1.991k	
<span style="background-color: #CCCCCC; border: 1px solid black; border-radius: 5px; padding: 2px;">Hs</span> Std Dev*	4.996m	4.9960131m	0.0	8.002m	260.3a	1.991k	