

SIS3316 16 Channel VME Digitizer

Input Range and Resolution Addendum

SIS GmbH
Harksheider Str. 102A
22399 Hamburg
Germany

Phone: ++49 (0) 40 60 87 305 0
Fax: ++49 (0) 40 60 87 305 20

email: info@struck.de
<http://www.struck.de>

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Revision Table:

Revision	Date	Modification
1.00	17.06.2014	First official release
1.01	20.06.2014	Add text
1.02	08.10.2014	Silk screen print with marked capacitors added
1.03	10.12.2014	change document name

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1 Introduction

The availability of lower EMI components and the aim for Germanium detector grade resolution of the 125 MSPS 16-bit version resulted in the design of the V3 revision of the 16 channel SIS3316 digitizer card.

While the expected further improvements were seen right away when the prototype series came out of stuffing –like no more need for the EMI gasket for the regulator next to channel 16- one effect was not remedied by the V3 design changes.

It turned out though, that fluctuations with varying time constants -coming from the analog offset branch- can be greatly reduced by replacing a 10nF capacitor with a 1μF type. The new capacitor for optimized performance is 1μF 10% 10V 0402 X5R, e.g. Murata GRM155R61A105KE15D. The table below lists a couple of catalogue distributors and their respective part number for the capacitor.

Distributor	Part number
Digikey	490-3890-2-ND
Farnell	1735523
Mouser	81-GRM155R61A105KE15
RS Components	723-5199

Following designators are affected:

Ch1: C11E
Ch2: C14E
Ch3: C21E
Ch4: C24E
Ch5: C31E
Ch6: C34E
Ch7: C41E
Ch8: C44E
Ch9: C51E
Ch10: C54E
Ch11: C61E
Ch12: C64E
Ch13: C71E
Ch14: C74E
Ch15: C81E
Ch16: C84E

Note: Due to the fairly small size of the 0402 footprint trained personnel is required to do the modification

This writeup is supposed to illustrate the capacitor related performance enhancements as well as to address SIS3316 resolution related issues in general.

Boards with serial numbers 120, 121, 123 and ≥ 126 have the new capacitors as factory default.

1.1 SIS3316-125MHz -16bit Input Range

The table below shows the resulting input range with the corresponding settings:

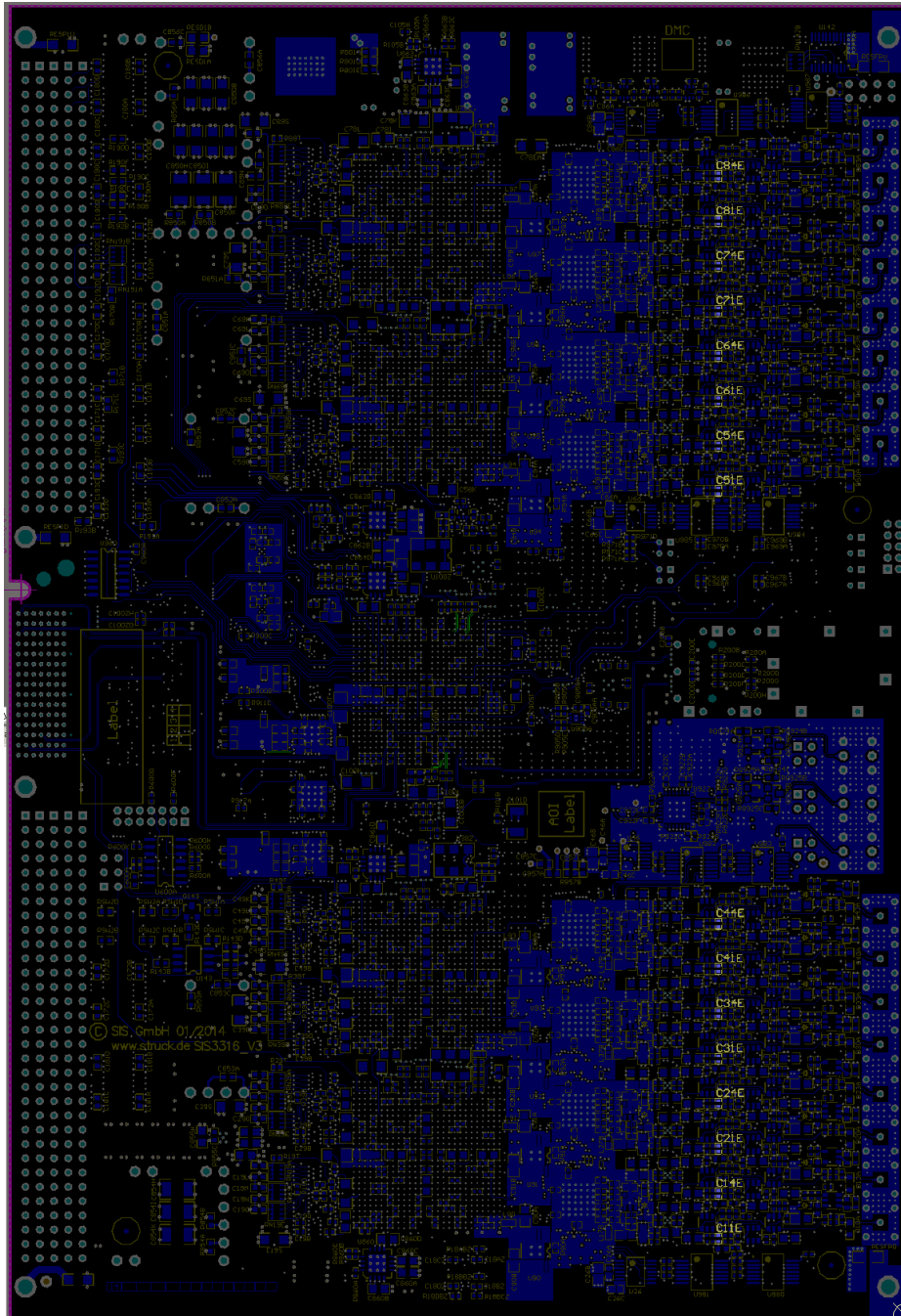


Figure 1. silk screen bottom view

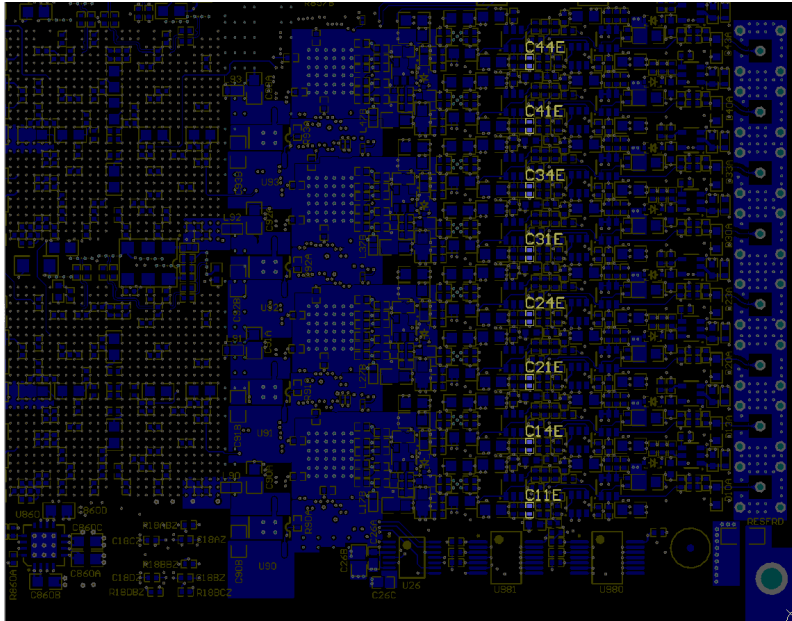


Figure 2. silk screen bottom view, capacitors C11E...C44E

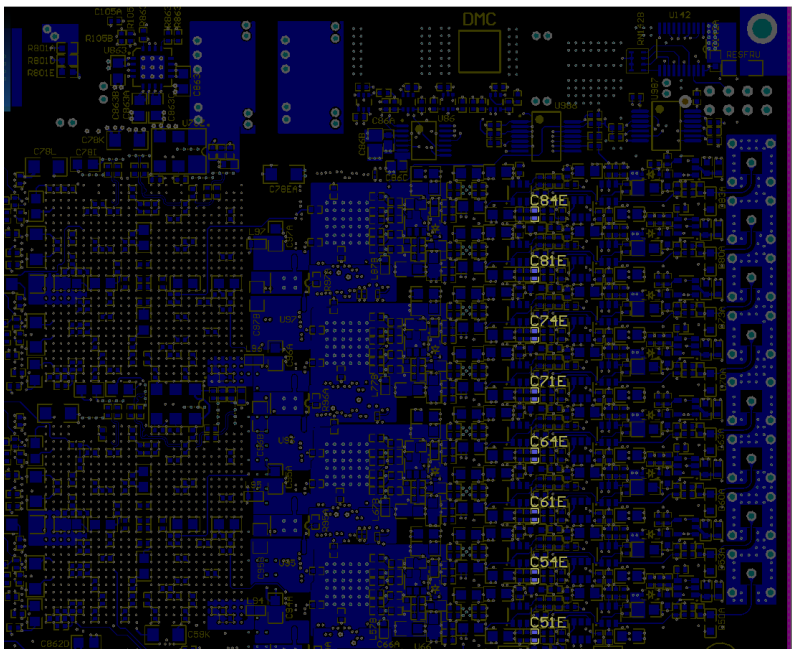
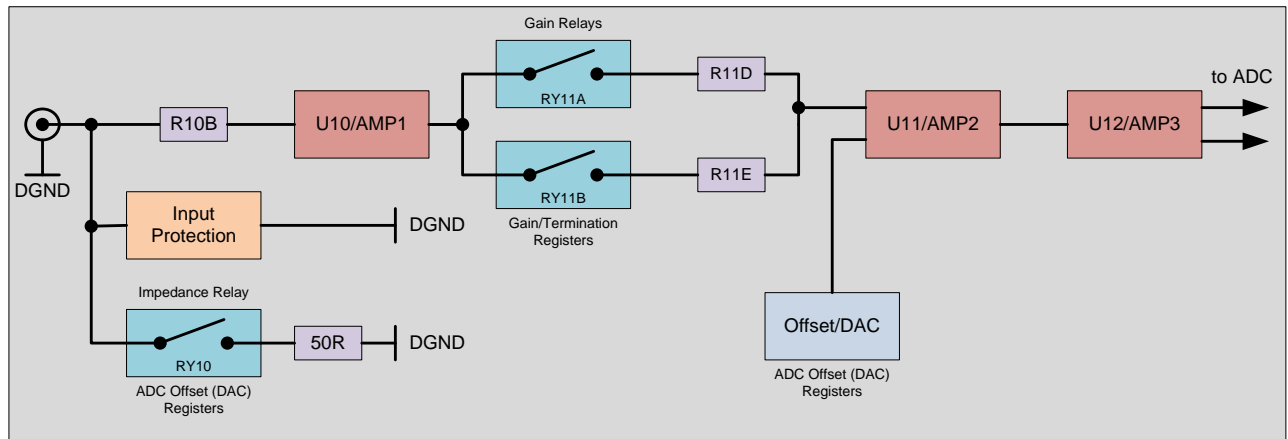


Figure 3. silk screen bottom view, capacitors C51E...C84E

2 Input Range

The analog input stage allows you to select between two gains and 50 Ω or high impedance termination for each channel individually. Two input range settings are available and the selected range can be shifted full scale with an offset DAC for each channel individually, too. A simplified diagram of the input stage is shown below (designators as of channel 1).



The gains and the termination of the channels are programmed via the “ADC Gain and Termination Control” registers”. The Offset of the channels are programmed via the “ADC Offset (DAC) Control” register.

The input range of the ADC chips can be programmed in addition. Be aware, that the default gain setting for the AD9268 (125 MSPS 16-bit) and AD9643 (250 MSPS 14-bit) chips is not identical.

2.1 SIS3316-125MHz -16bit Input Range

The table below shows the resulting input range with the corresponding settings:

ADC chip input range	2V	5V
2.00V (default)	2.24V-2.32V	5.20V-5.32V
1.75V	1.96V-2.02V	4.60V-4.68V
1.50V	1.70V-1.74V	3.88V-3.96V

2.2 SIS3316-250MHz -14bit Input Range

The table below shows the resulting input range with the corresponding settings:

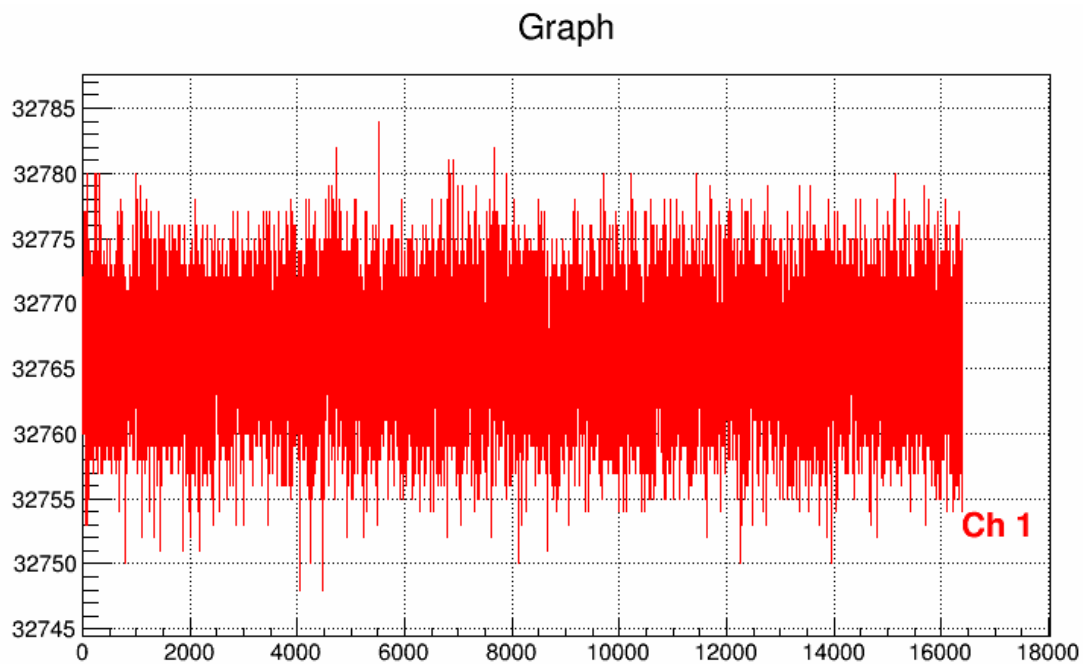
ADC chip input range	2V	5V
2.00V	2.38V-2.46V	5.92V-6.04V
1.75V(default)	2.08V-2.14V	5.20V-5.32V
1.50V	1.78V-1.86V	4.56V-4.68V

3 ADC Output Code

All channels are open and terminated with $50\ \Omega$ internally for the following measurements.

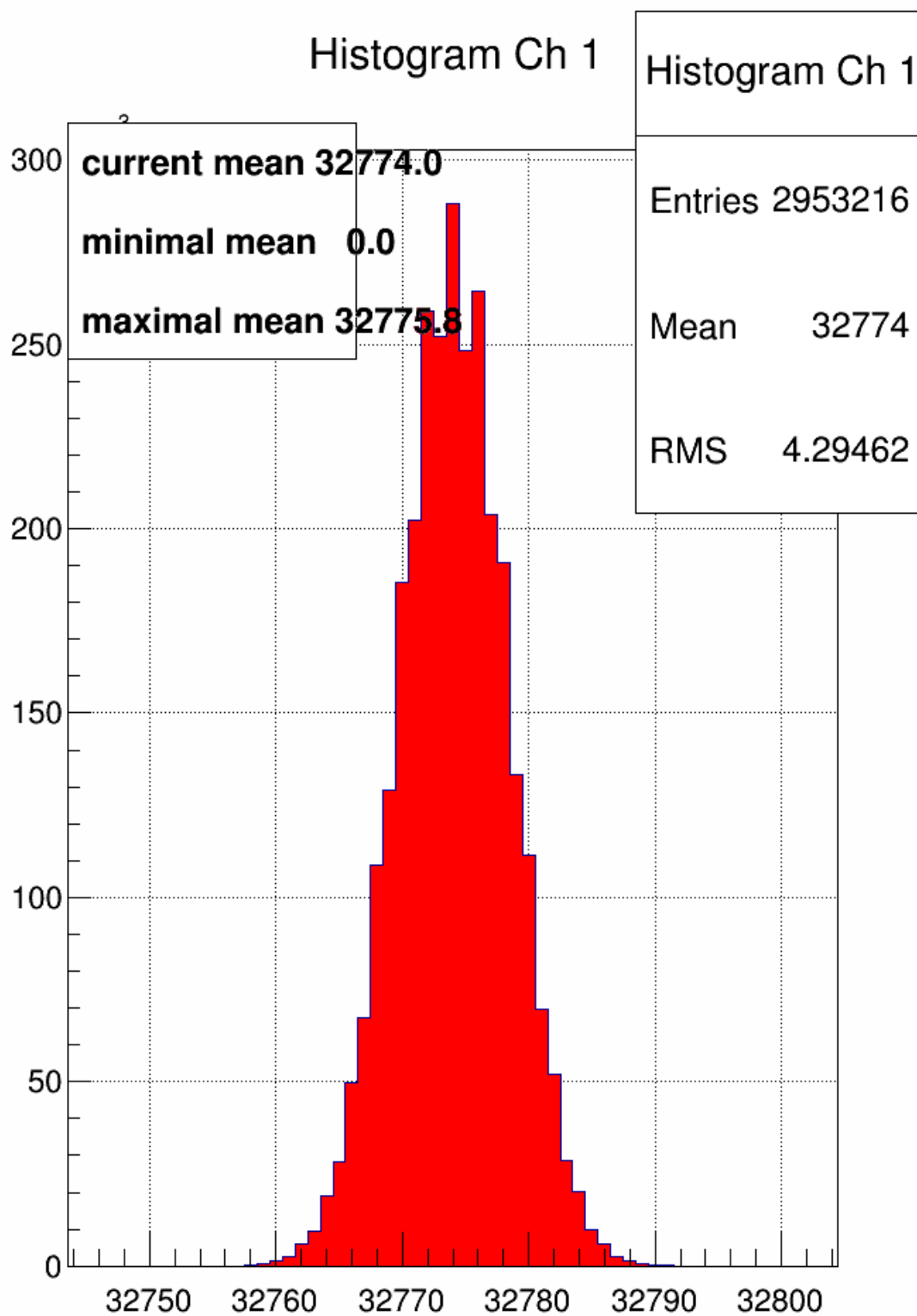
3.1 SIS3316-125MHz -16bit

3.1.1 ADC Output Code Graph Channel 1

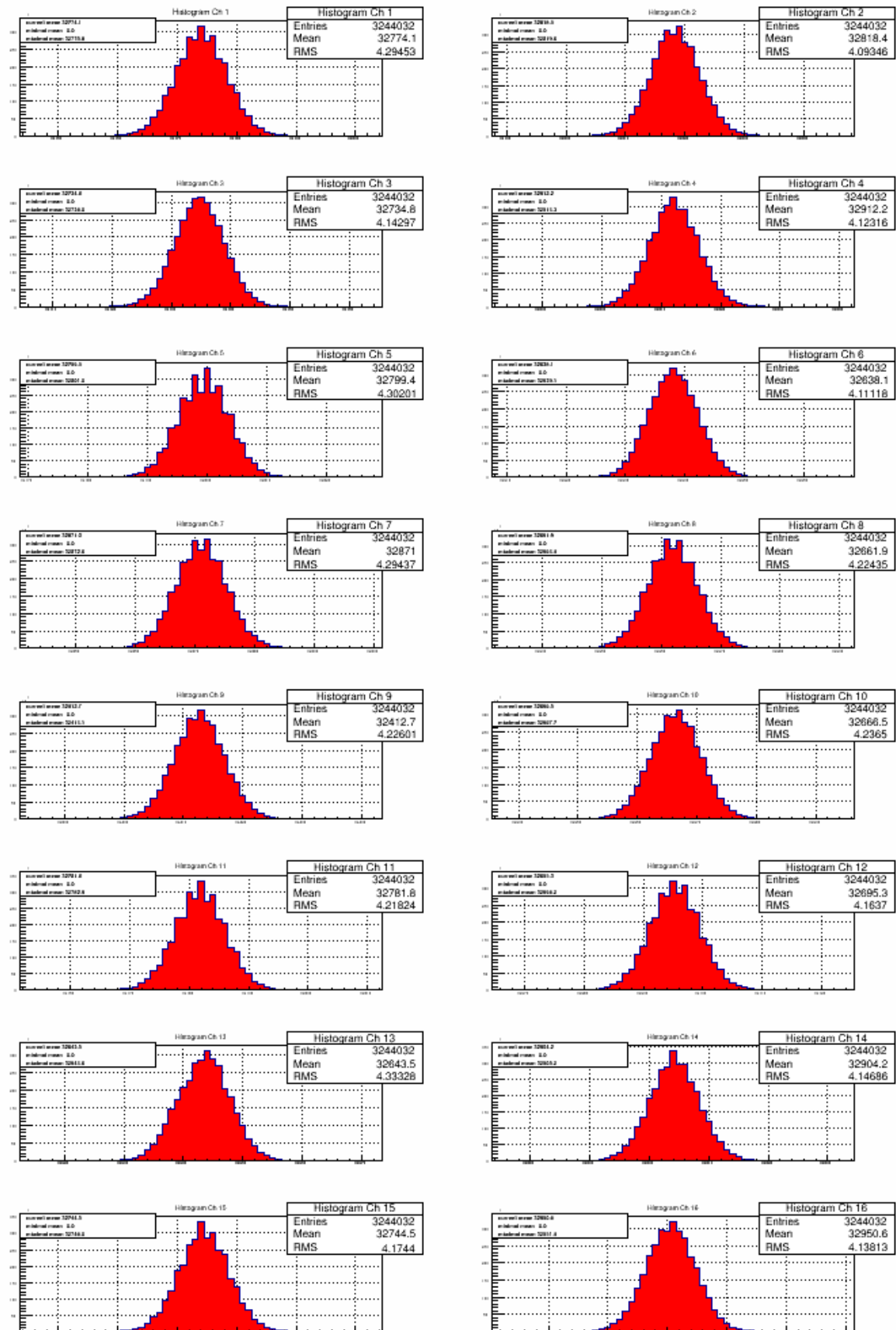


The raw data graph shows the noise of ADC channel 1.
RMS = appr. 4.3 LSB \rightarrow FWHM = 10.1 LSB

3.1.2 ADC Output Code Histogram Channel 1



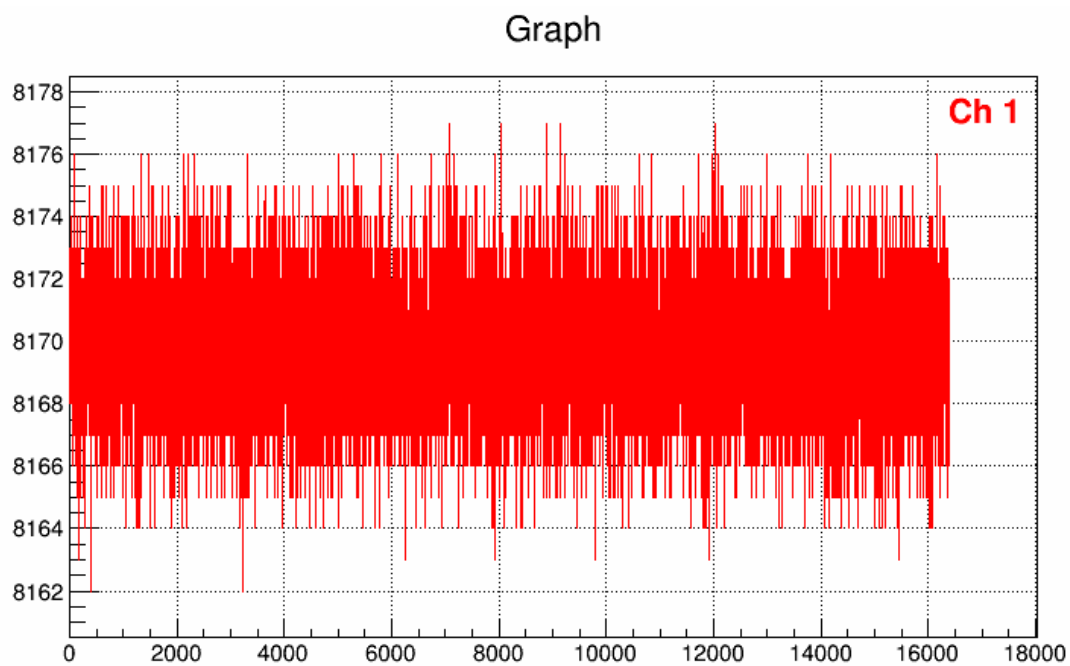
3.1.3 ADC Output Code Histogram all Channels



3.2 SIS3316-250MHz -14bit

All channels are open and terminated with 50 Ω internally for the following measurements.

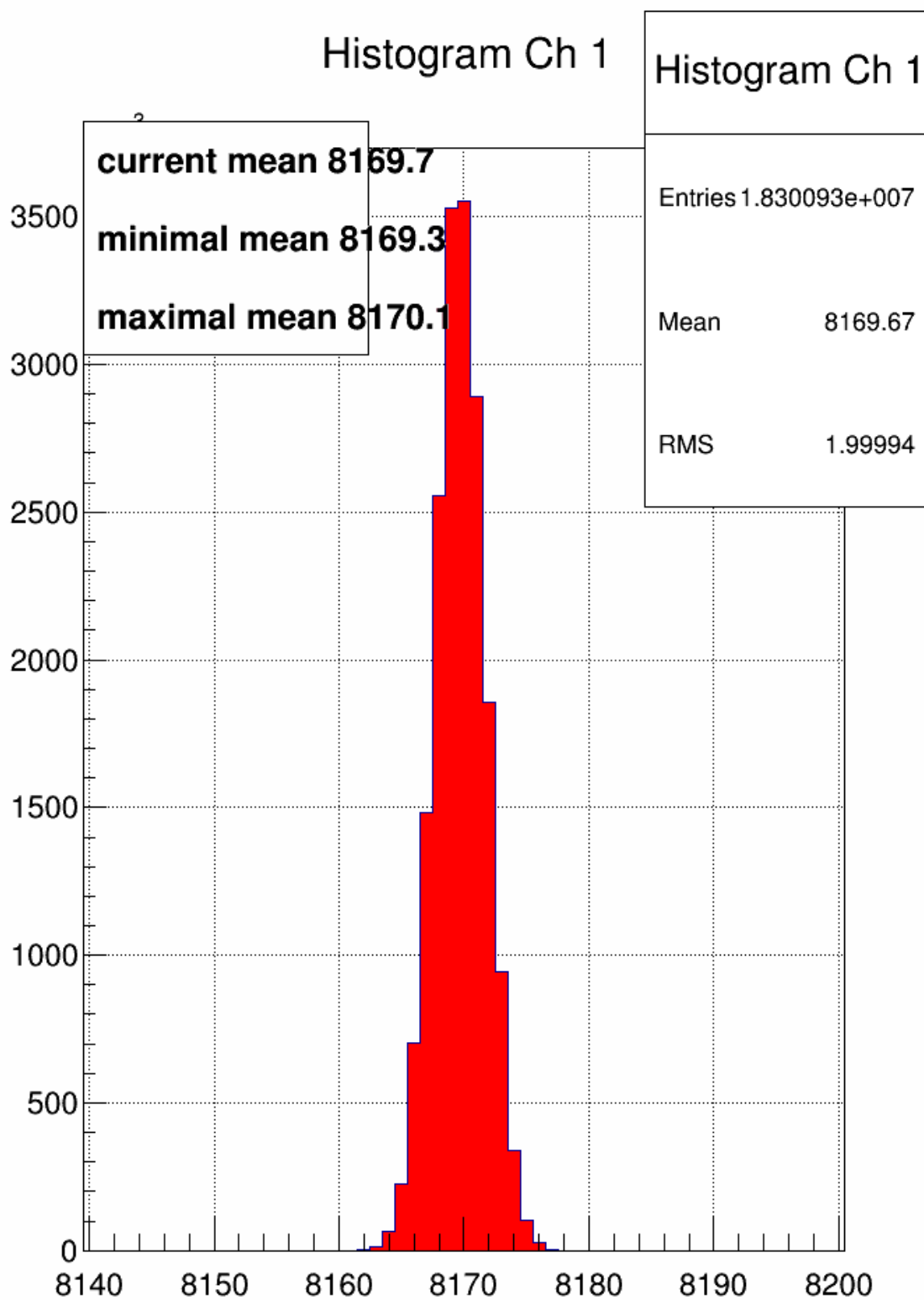
3.2.1 ADC Output Code Graph Channel 1



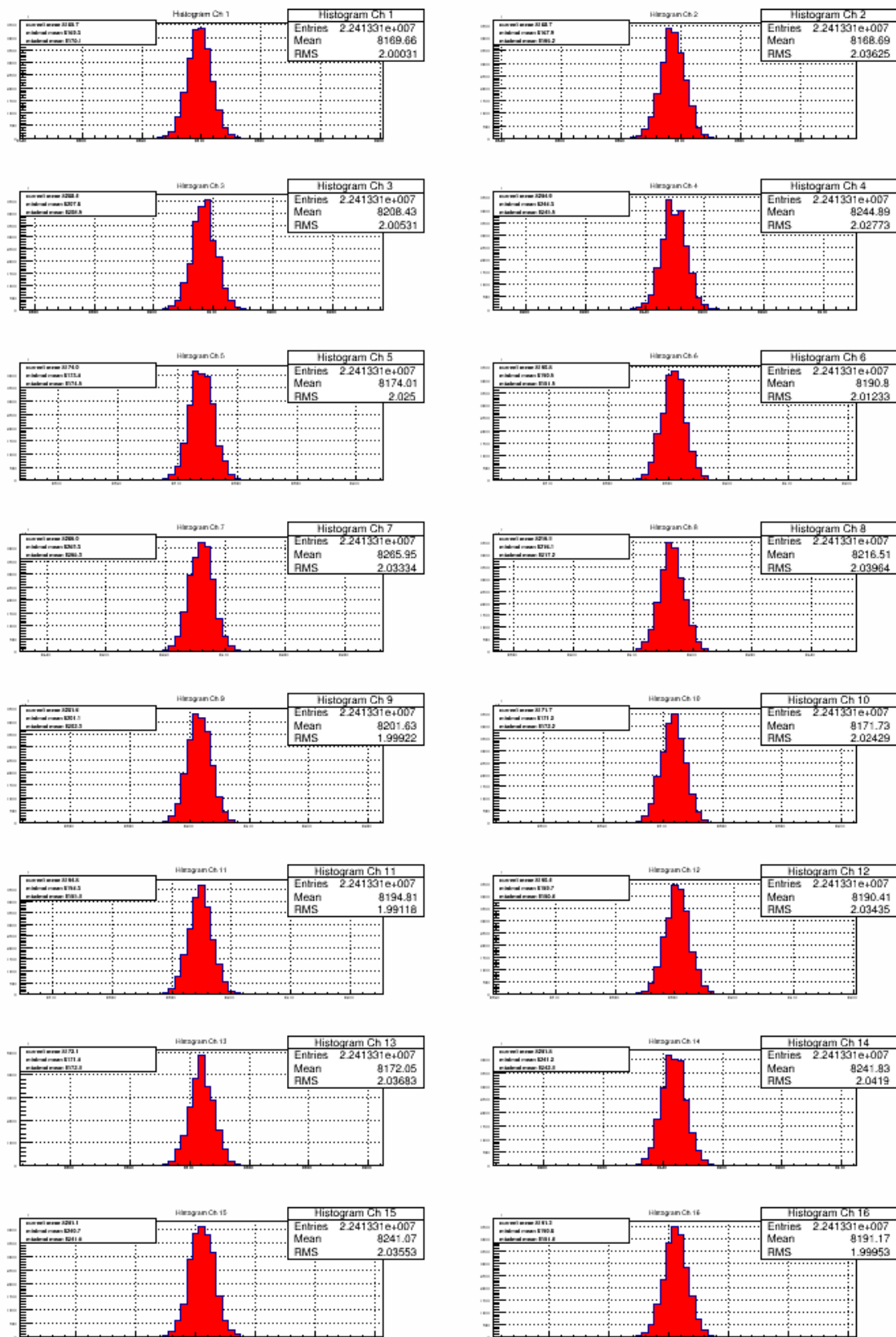
The raw data graph shows the noise of ADC channel 1.

RMS = appr. 2 LSB \rightarrow FWHM = 4.7 LSB

3.2.2 ADC Output Code Histogram Channel 1



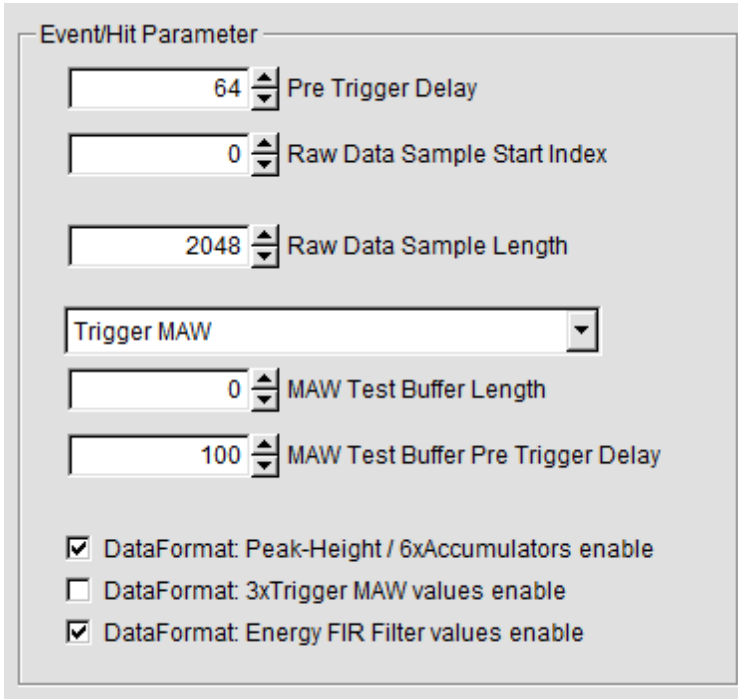
3.2.3 ADC Output Code Histogram all Channels



4 FIR Filter Resolution with Open Inputs

All channels are open and terminated with 50 Ω internally. The input range is 5V. The histograms show the Gaussian distribution of the max. value of the FIR Filter (Max. Energy value during Trigger Gate is active). An offset of 4000 is added on the x-axis !

The tests were run with the following parameter set:



Event/Hit Parameter

64 Pre Trigger Delay

0 Raw Data Sample Start Index

2048 Raw Data Sample Length

Trigger MAW

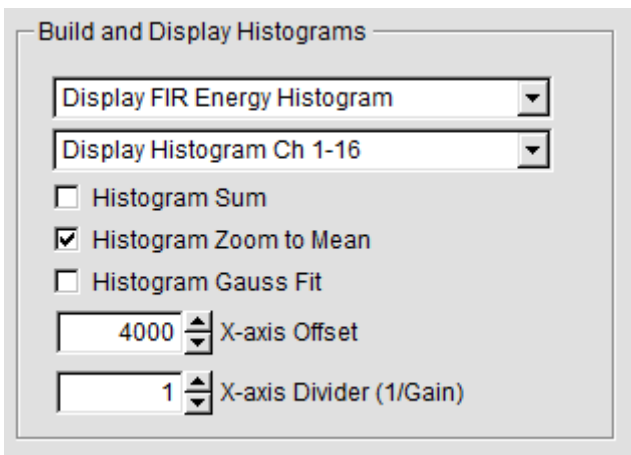
0 MAW Test Buffer Length

100 MAW Test Buffer Pre Trigger Delay

☒ DataFormat: Peak-Height / 6xAccumulators enable

☐ DataFormat: 3xTrigger MAW values enable

☒ DataFormat: Energy FIR Filter values enable



Build and Display Histograms

Display FIR Energy Histogram

Display Histogram Ch 1-16

☐ Histogram Sum

☒ Histogram Zoom to Mean

☐ Histogram Gauss Fit

4000 X-axis Offset

1 X-axis Divider (1/Gain)

4.1 SIS3316-125MHz -16bit

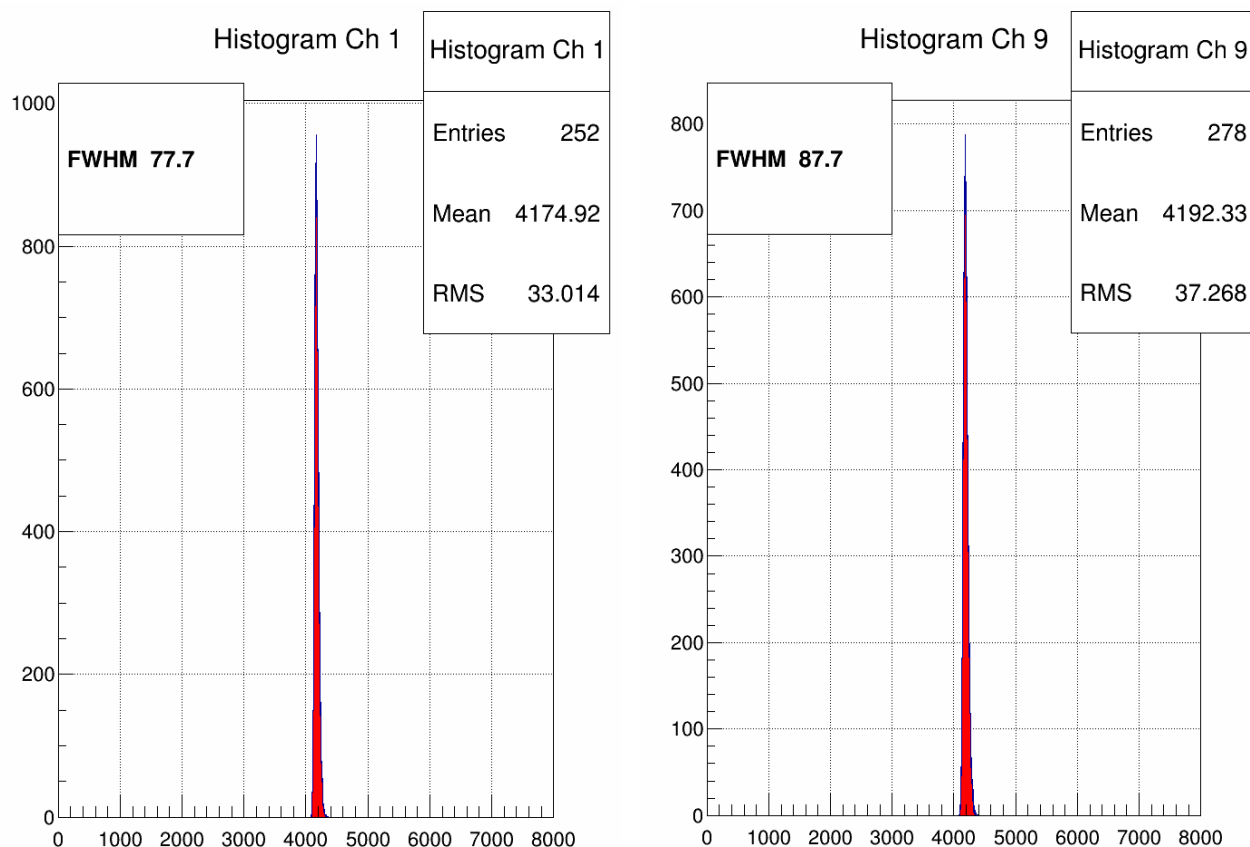
Channels 1 to 8 and 16 are optimized and channels 9 to 15 are not optimized for comparison.
Modules ship with optimized configuration from June 12th 2014 onwards.

Results:

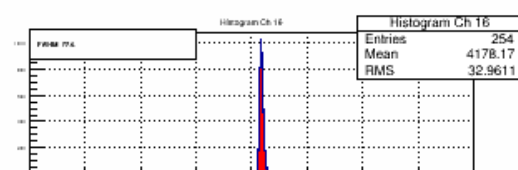
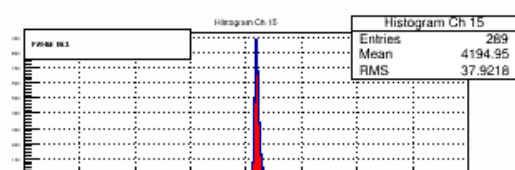
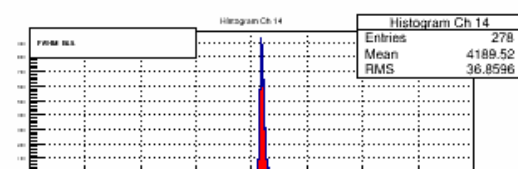
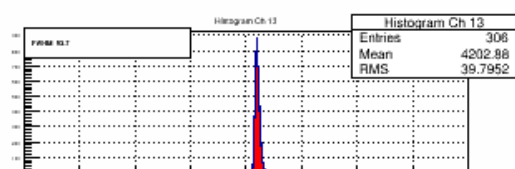
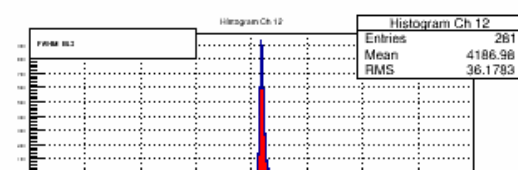
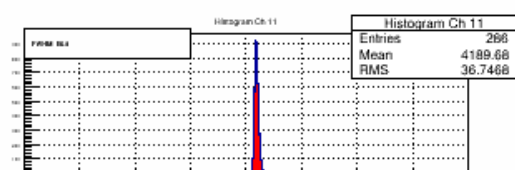
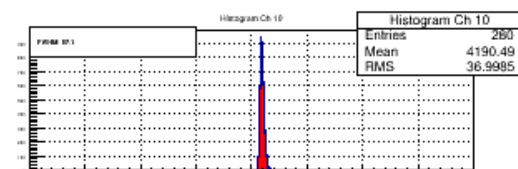
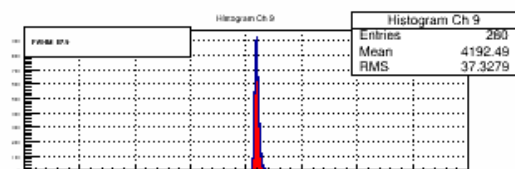
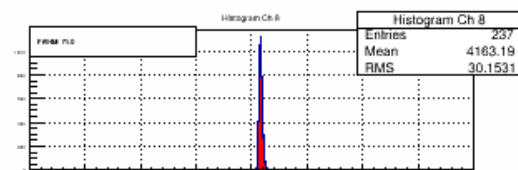
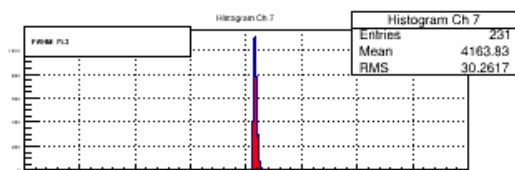
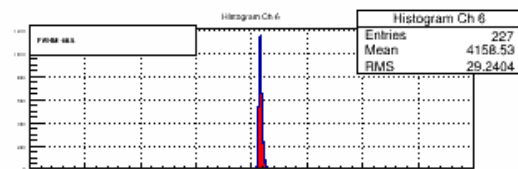
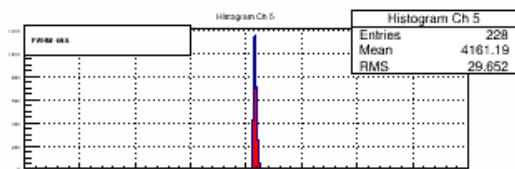
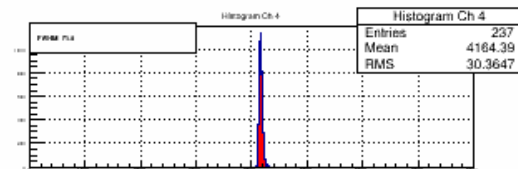
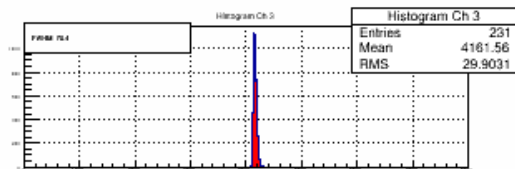
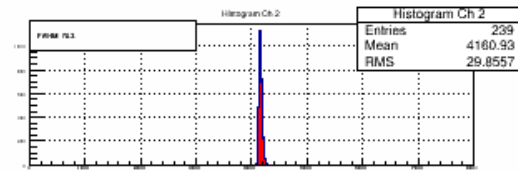
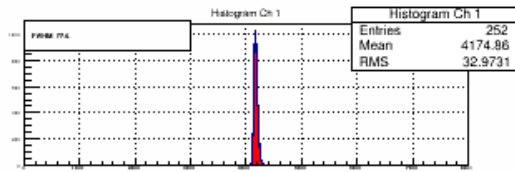
	Not Optimized		Optimized	
	FIR (MAW) FWHM	ADC counts FWHM	FIR (MAW) FWHM (P*LSB)	ADC counts FWHM (LSB)
P = 100	87,5	0,87	77,4	0,77
P = 200	168	0,84	124	0,62
P = 500	406	0,81	251	0,51
P = 1000	767	0,77	497	0,50
P = 2000	1210	0,61	909	0,45

4.1.1 FIR Filter Histograms with P = 100

4.1.1.1 Channels 1 and 9

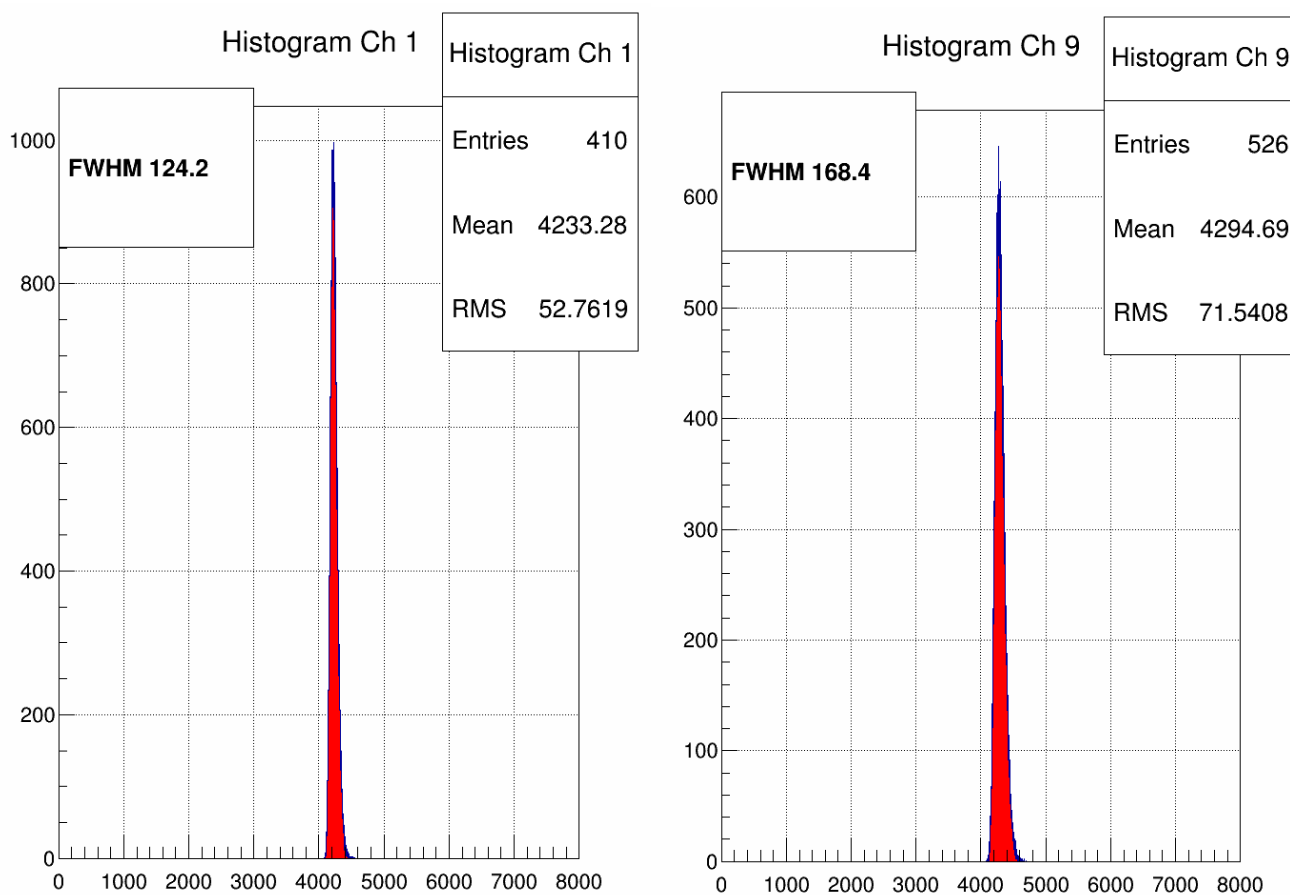


4.1.1.2 All Channels

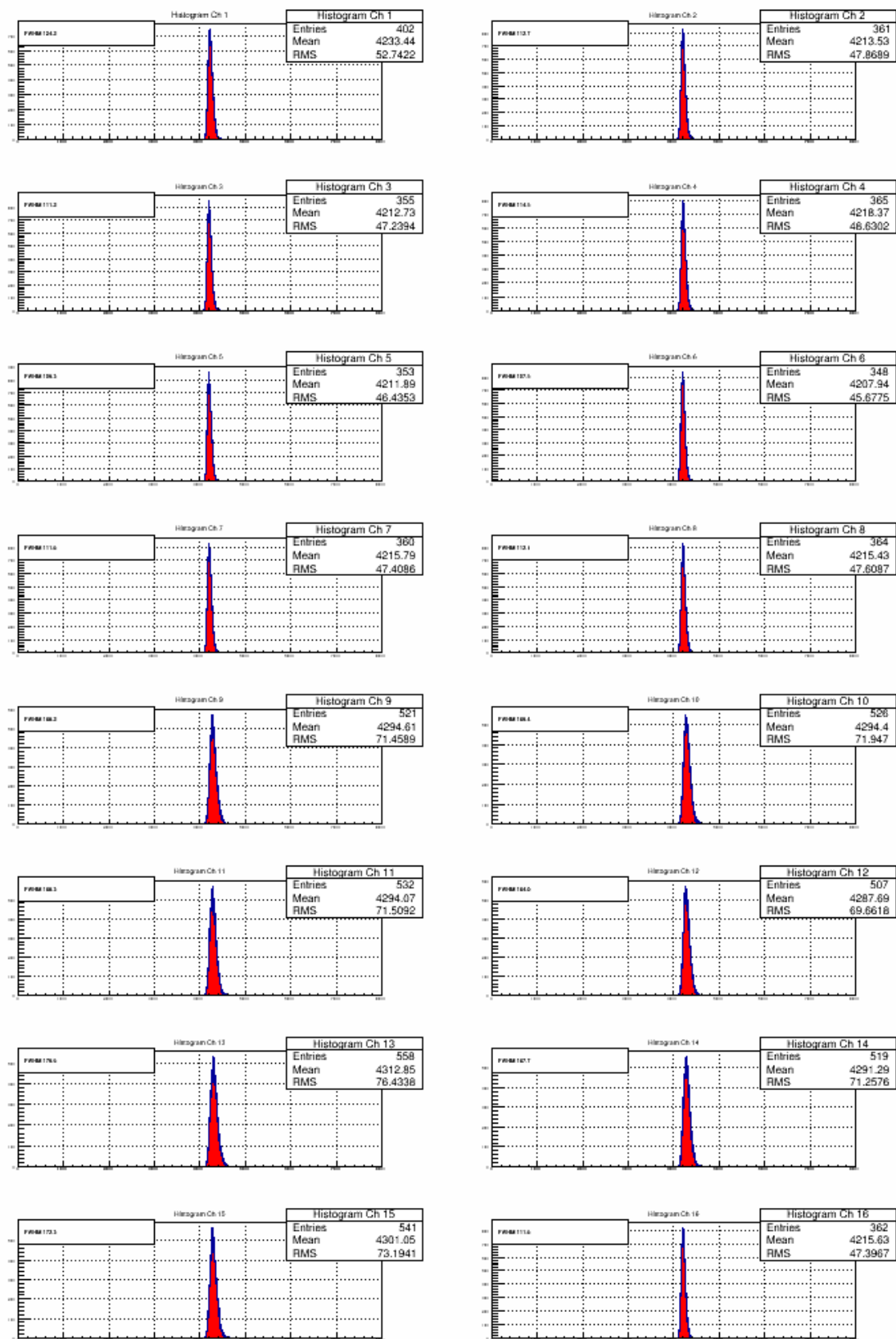


4.1.2 FIR Filter Histograms with P = 200

4.1.2.1 Channels 1 and 9

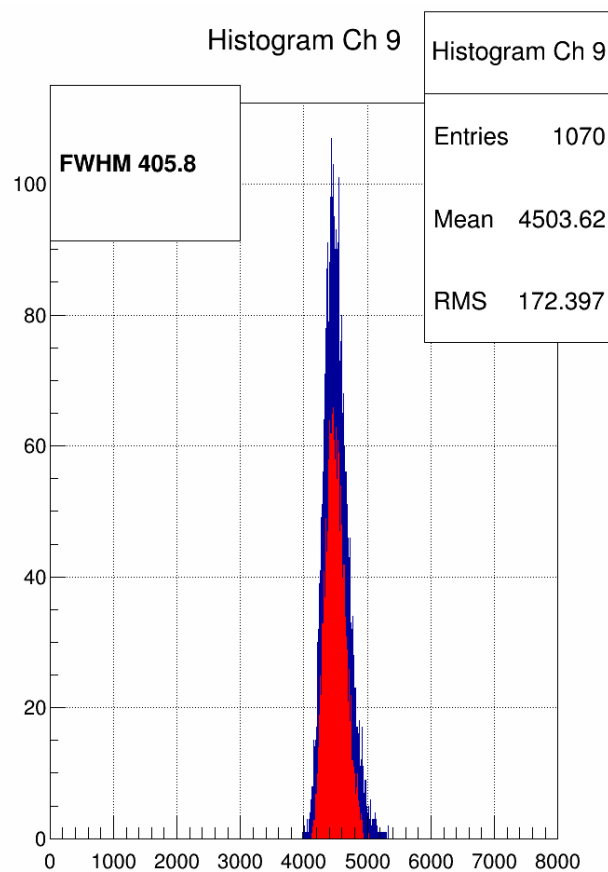
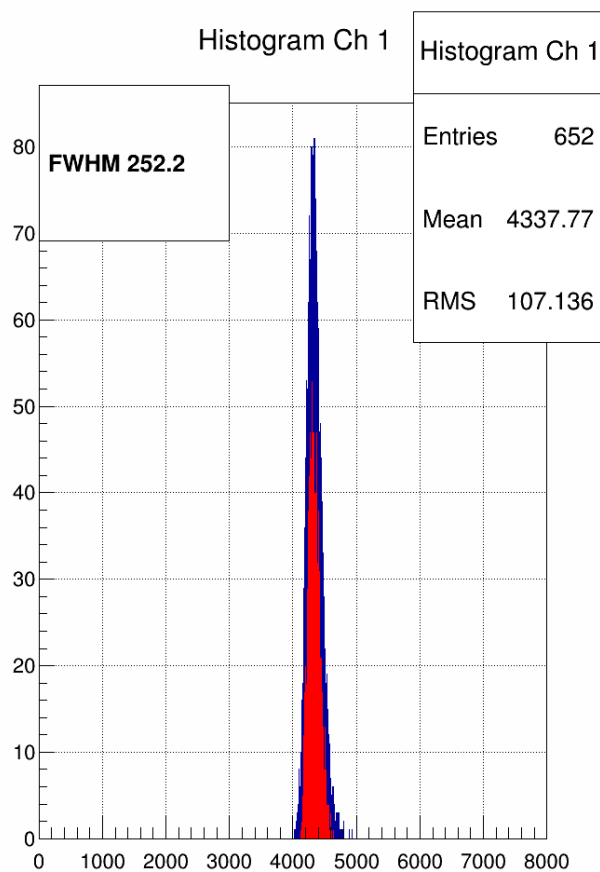


4.1.2.2 All Channels

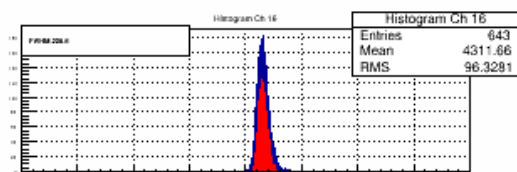
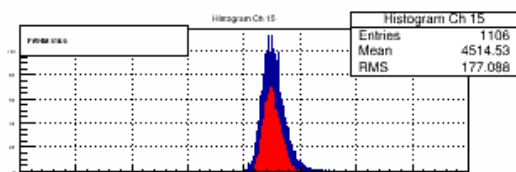
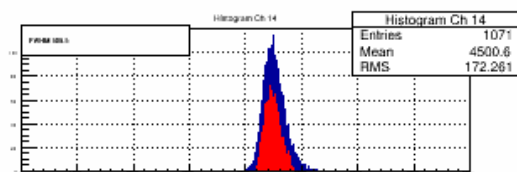
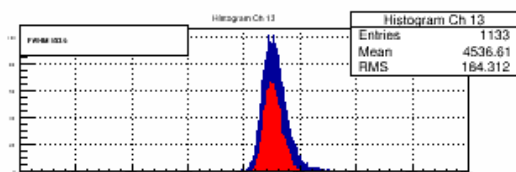
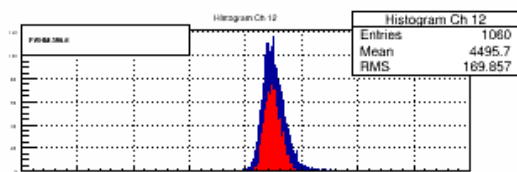
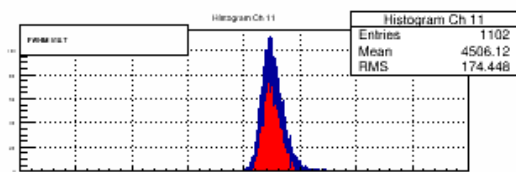
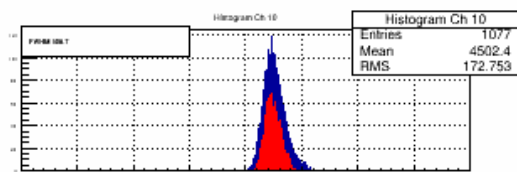
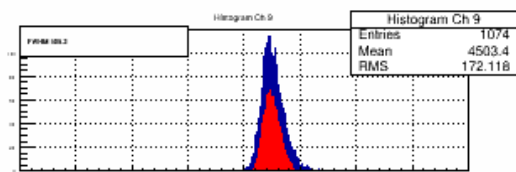
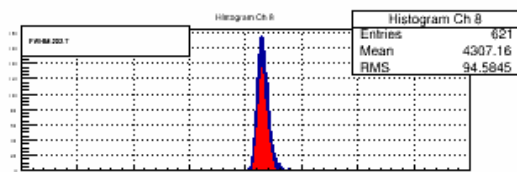
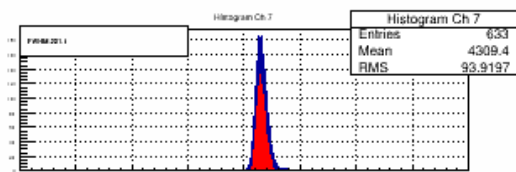
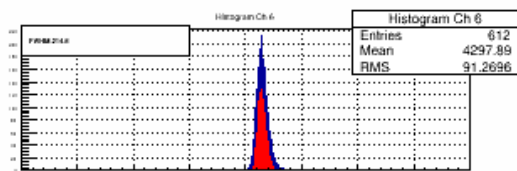
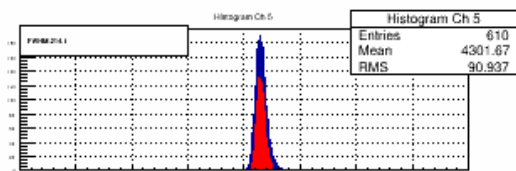
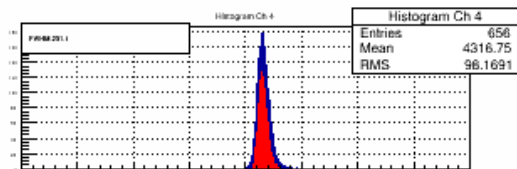
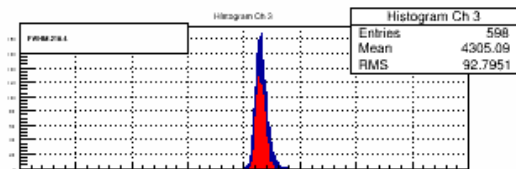
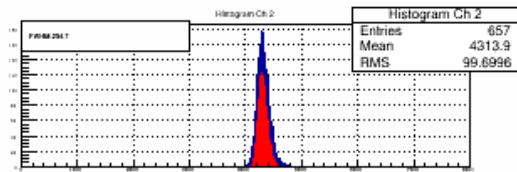
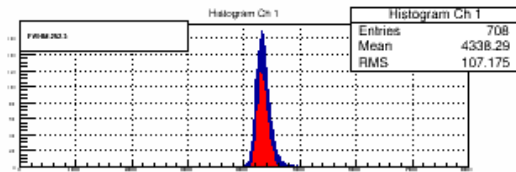


4.1.3 FIR Filter Histograms with $P = 500$

4.1.3.1 Channels 1 and 9

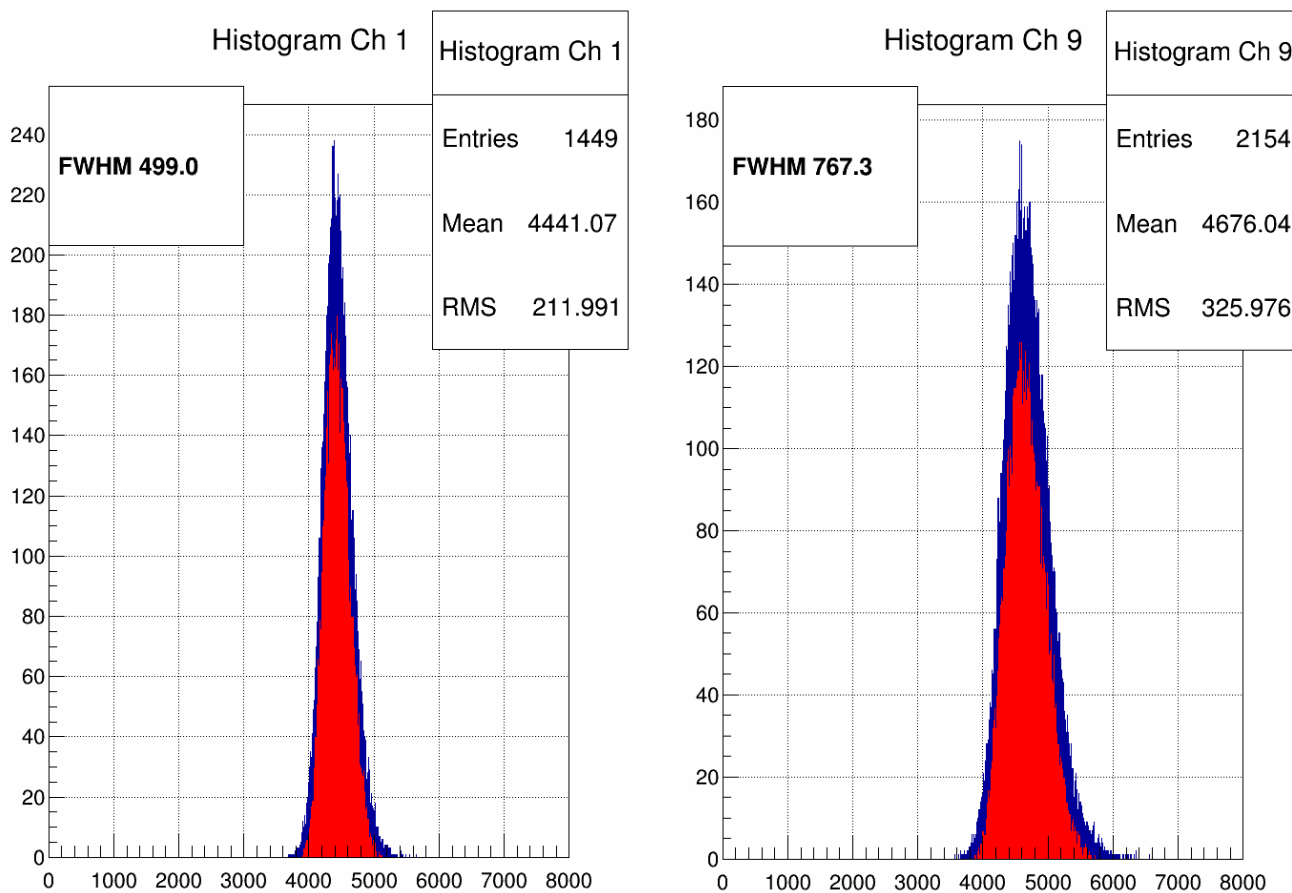


4.1.3.2 All Channels

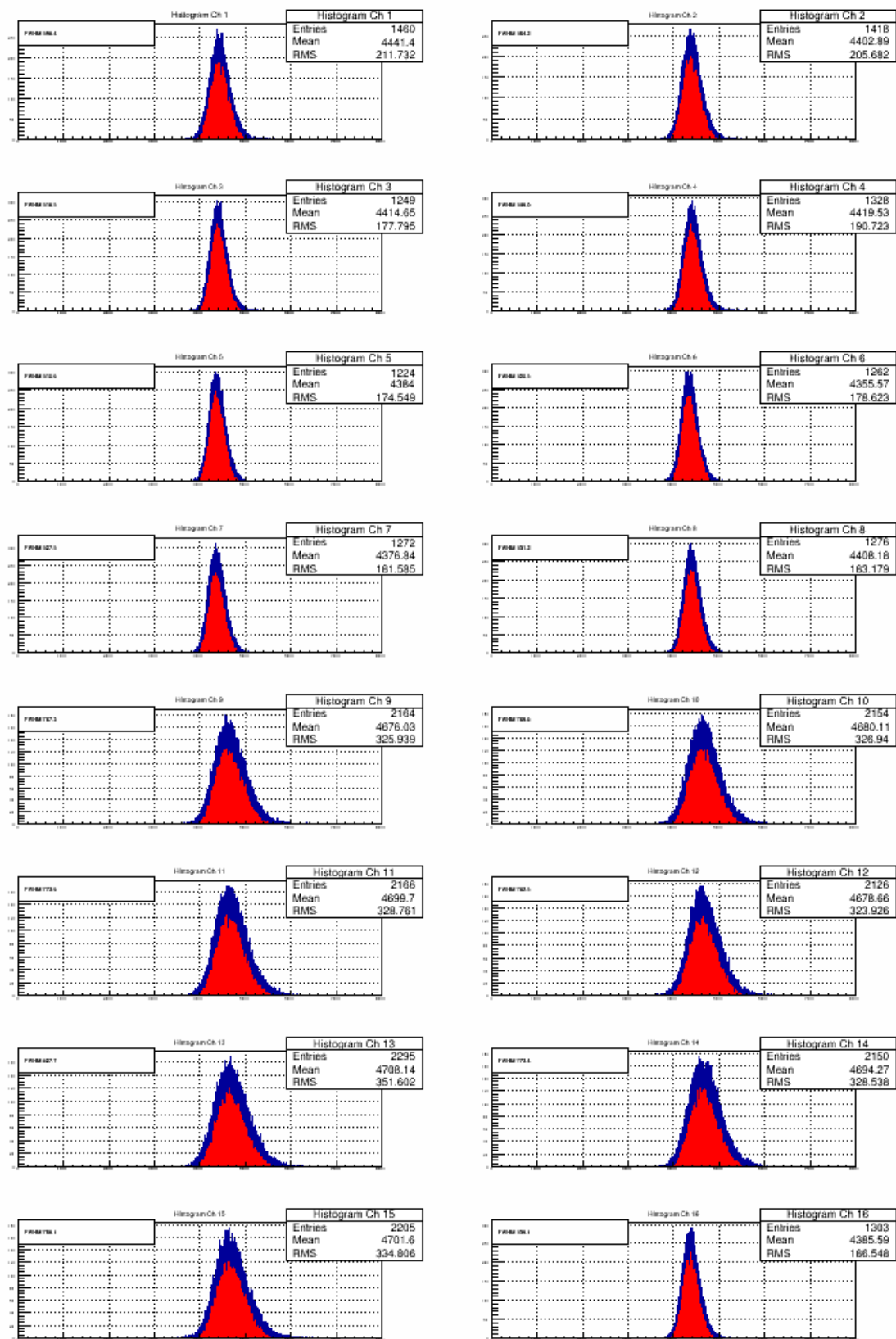


4.1.4 FIR Filter Histograms with P = 1000

4.1.4.1 Channels 1 and 9

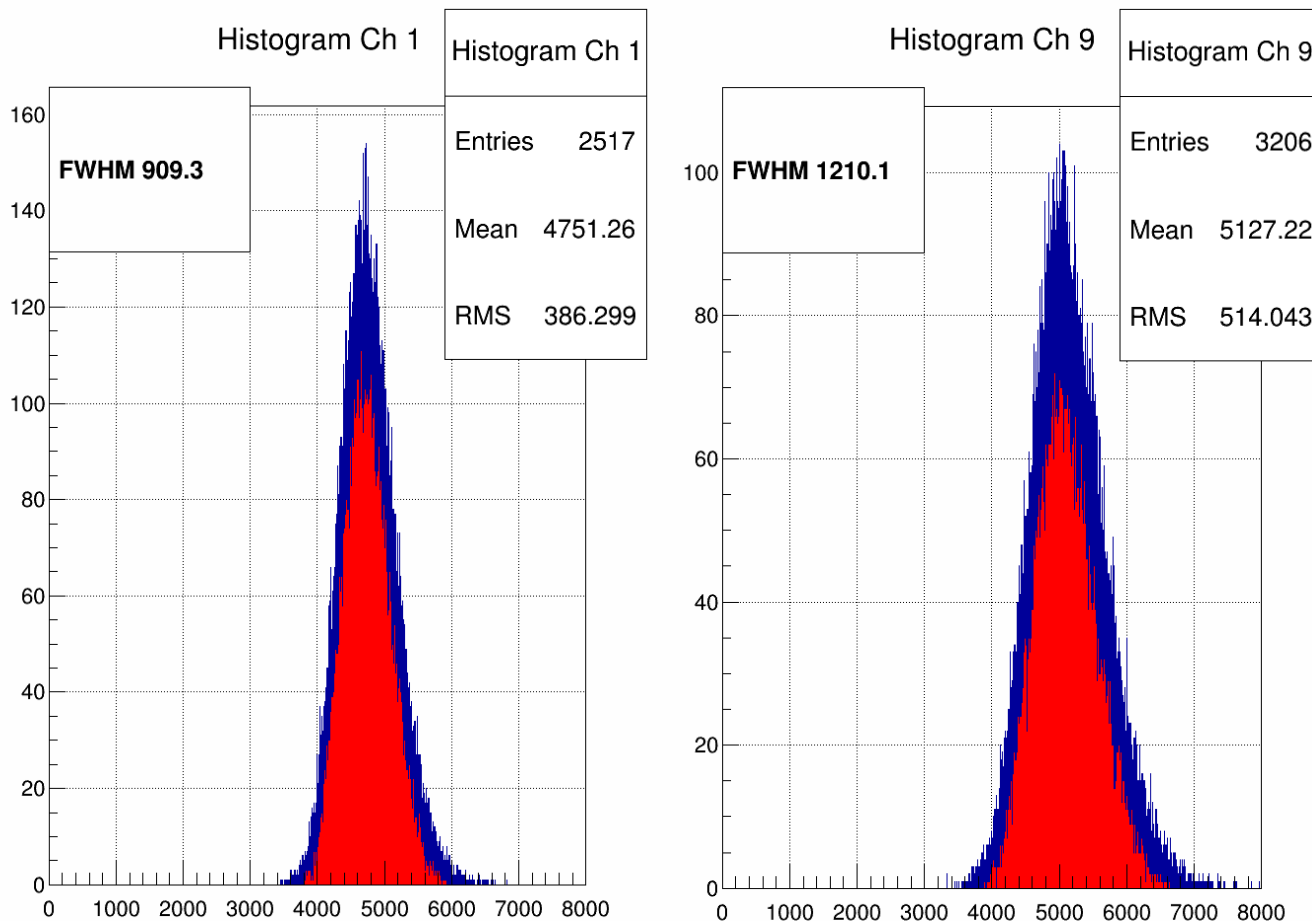


4.1.4.2 All Channels

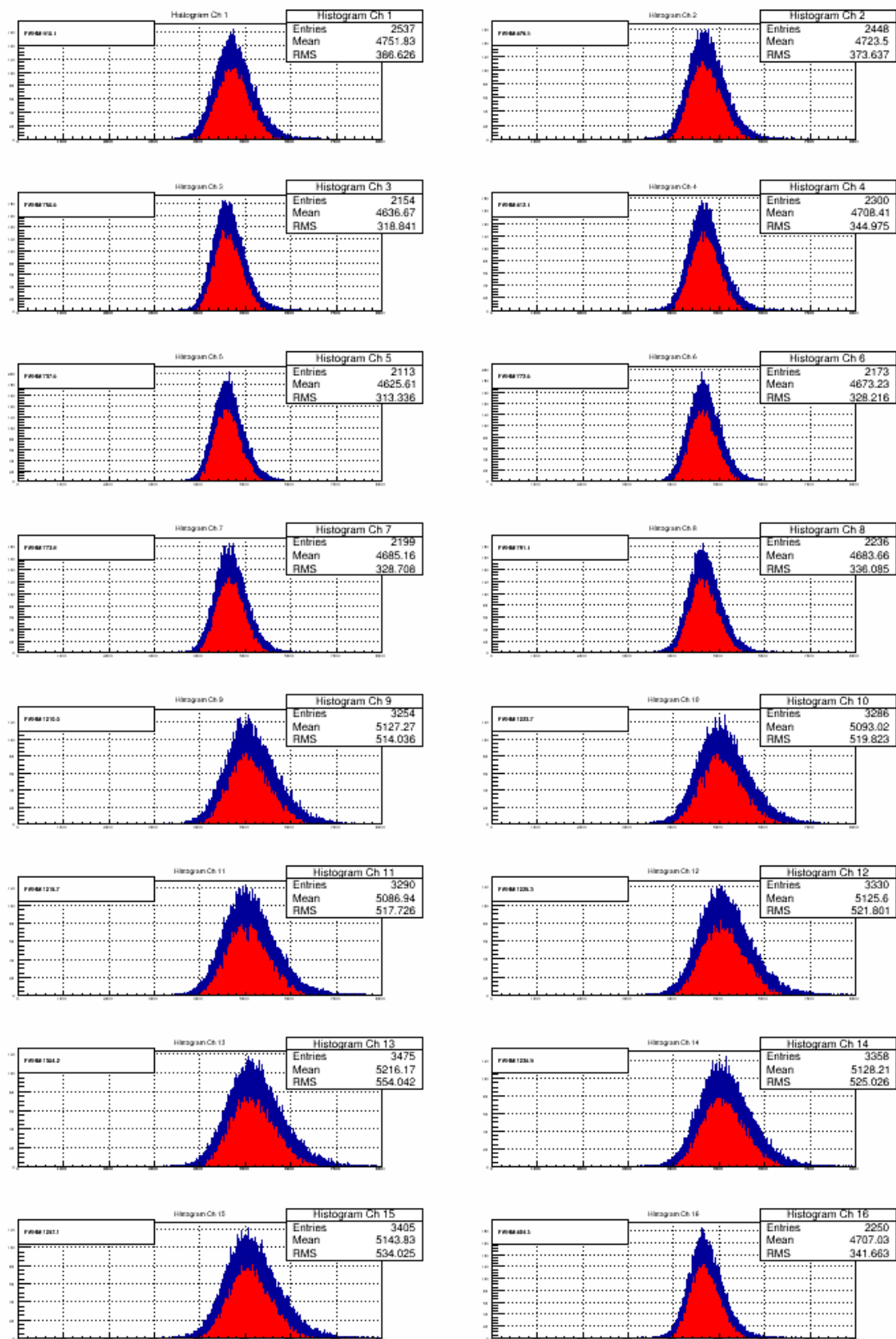


4.1.5 FIR Filter Histograms with P = 2000

4.1.5.1 Channels 1 and 9



4.1.5.2 All Channels



4.2 SIS3316-250MHz -14bit

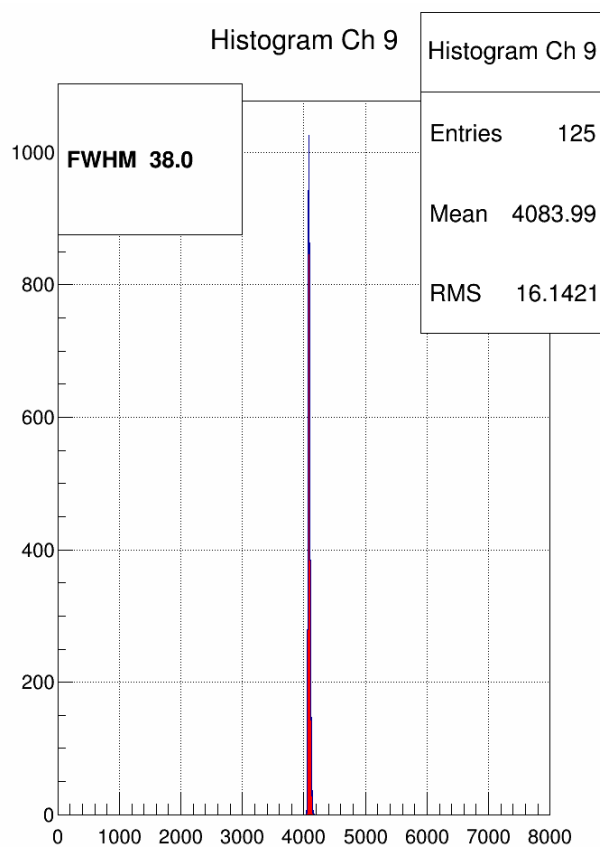
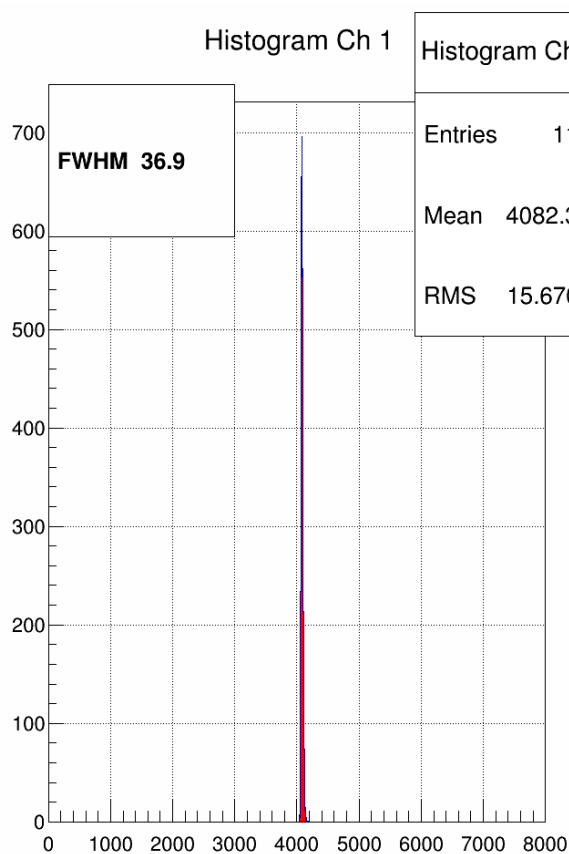
Channels 1 to 8 are optimized and channels 9 to 16 are not optimized.
Modules ship with optimized configuration from June 12th 2014 onwards.

Results:

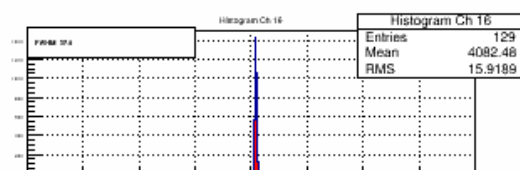
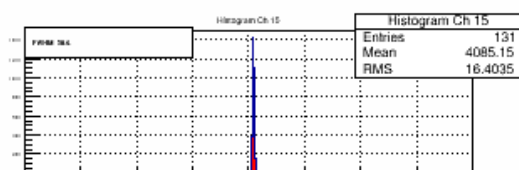
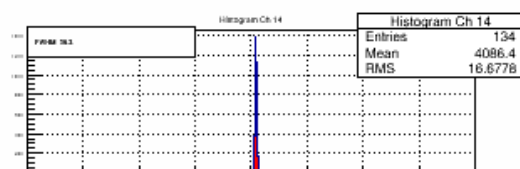
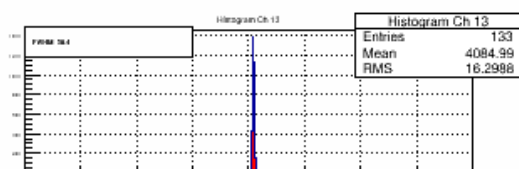
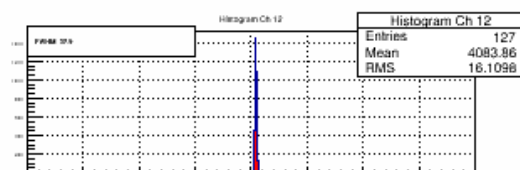
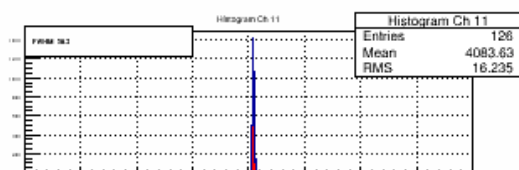
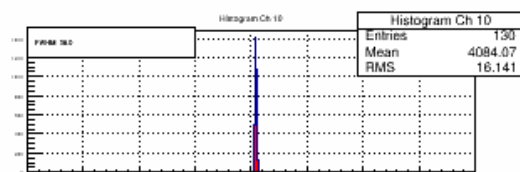
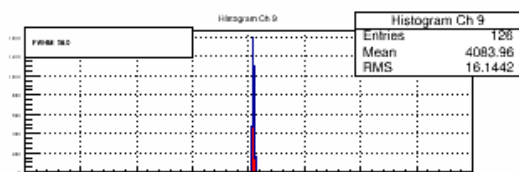
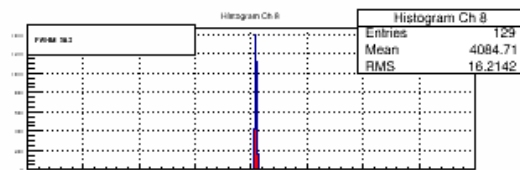
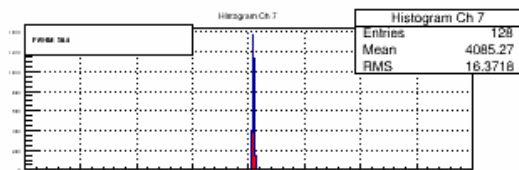
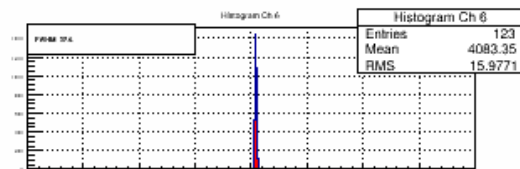
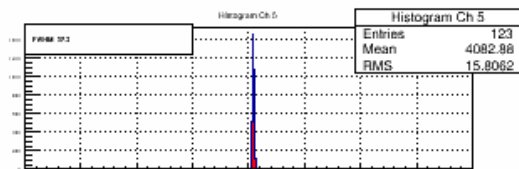
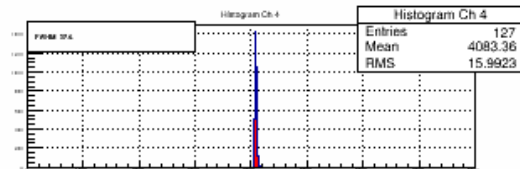
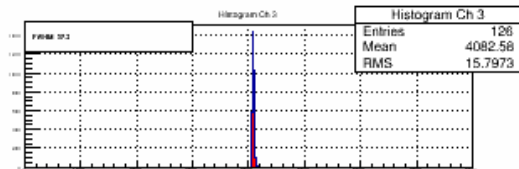
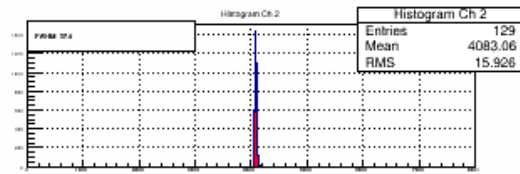
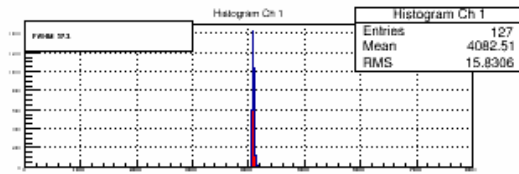
	Not Optimized		Optimized	
	FIR (MAW) FWHM	ADC counts FWHM	FIR (MAW) FWHM (P*LSB)	ADC counts FWHM (LSB)
P = 100	38	0,38	36,8	0,37
P = 200	66	0,33	61,2	0,31
P = 500	156	0,31	129	0,26
P = 1000	290	0,29	232	0,23
P = 2000	540	0,27	445	0,23

4.2.1 FIR Filter Histograms with P = 100

4.2.1.1 Channels 1 and 9

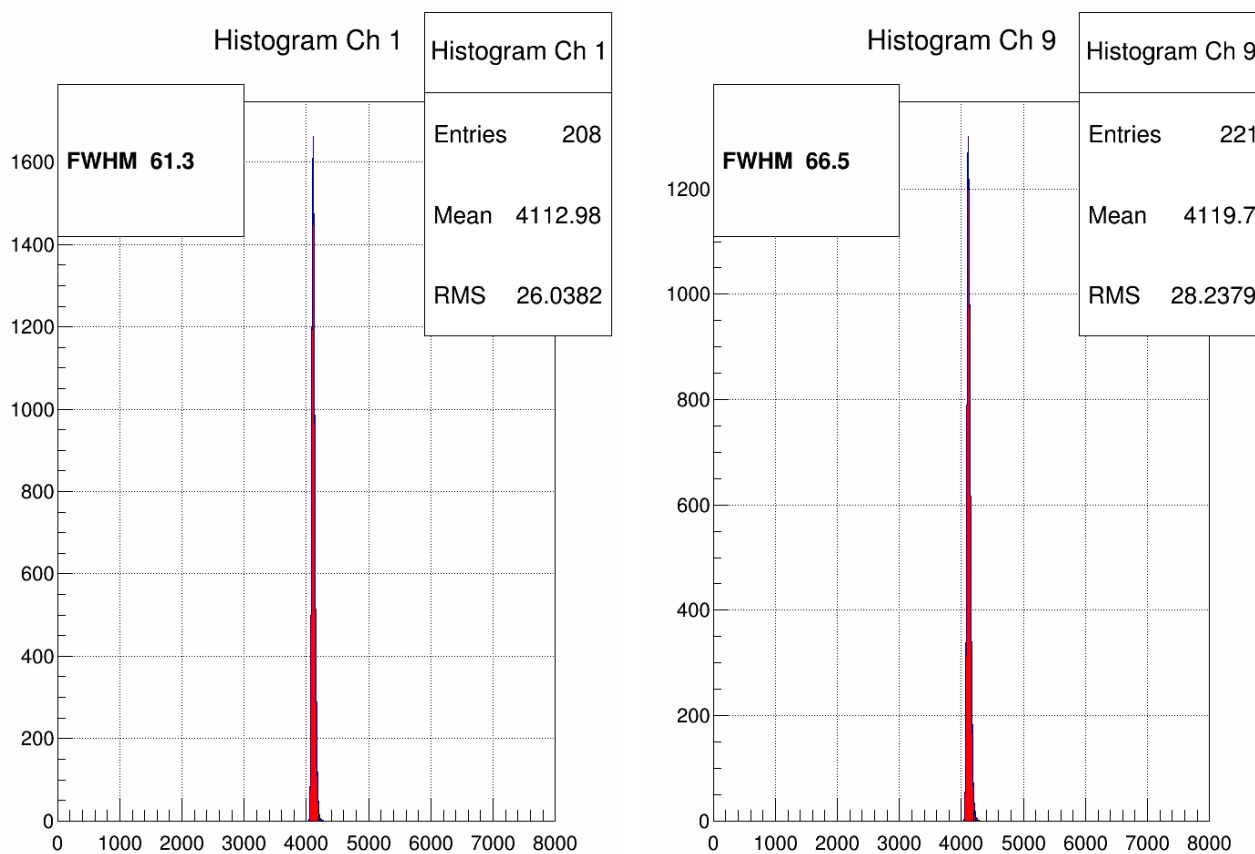


4.2.1.2 All Channels

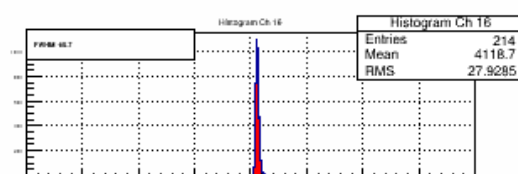
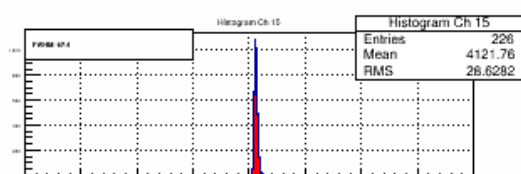
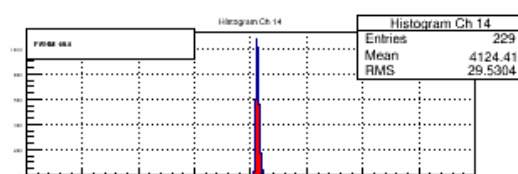
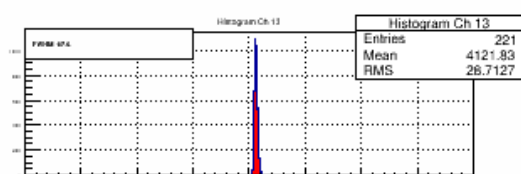
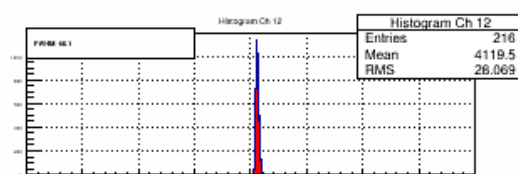
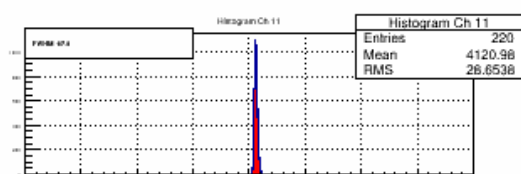
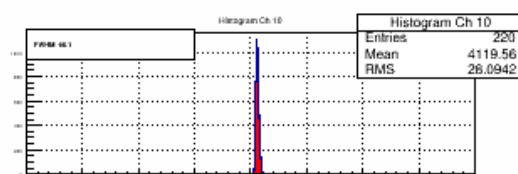
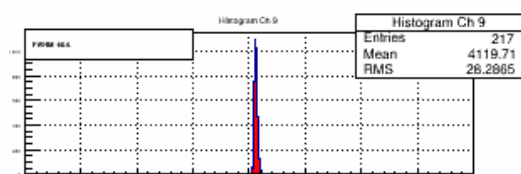
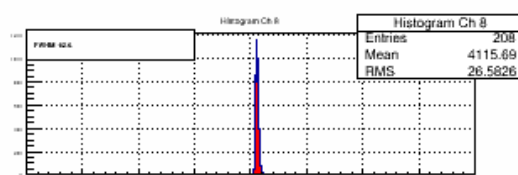
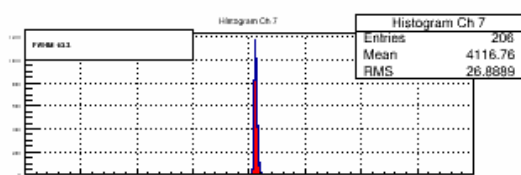
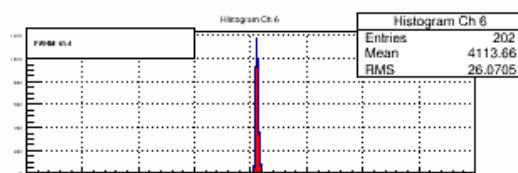
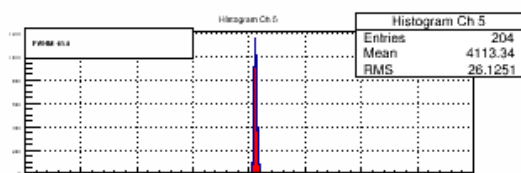
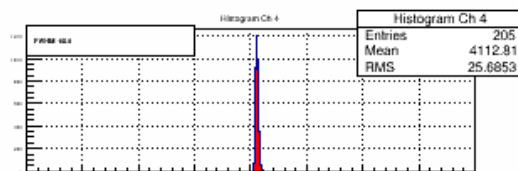
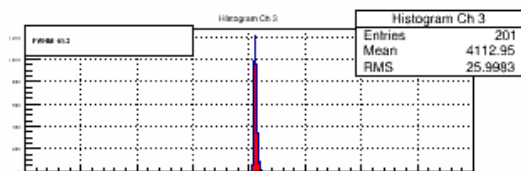
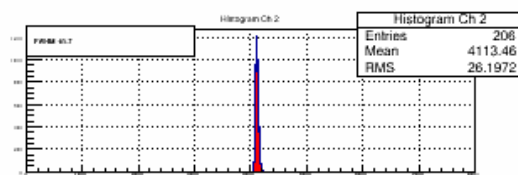
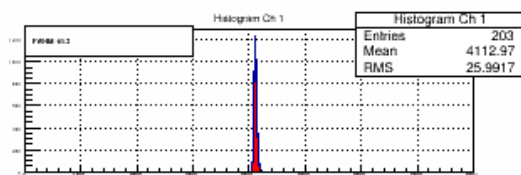


4.2.2 FIR Filter Histograms with $P = 200$

4.2.2.1 Channels 1 and 9

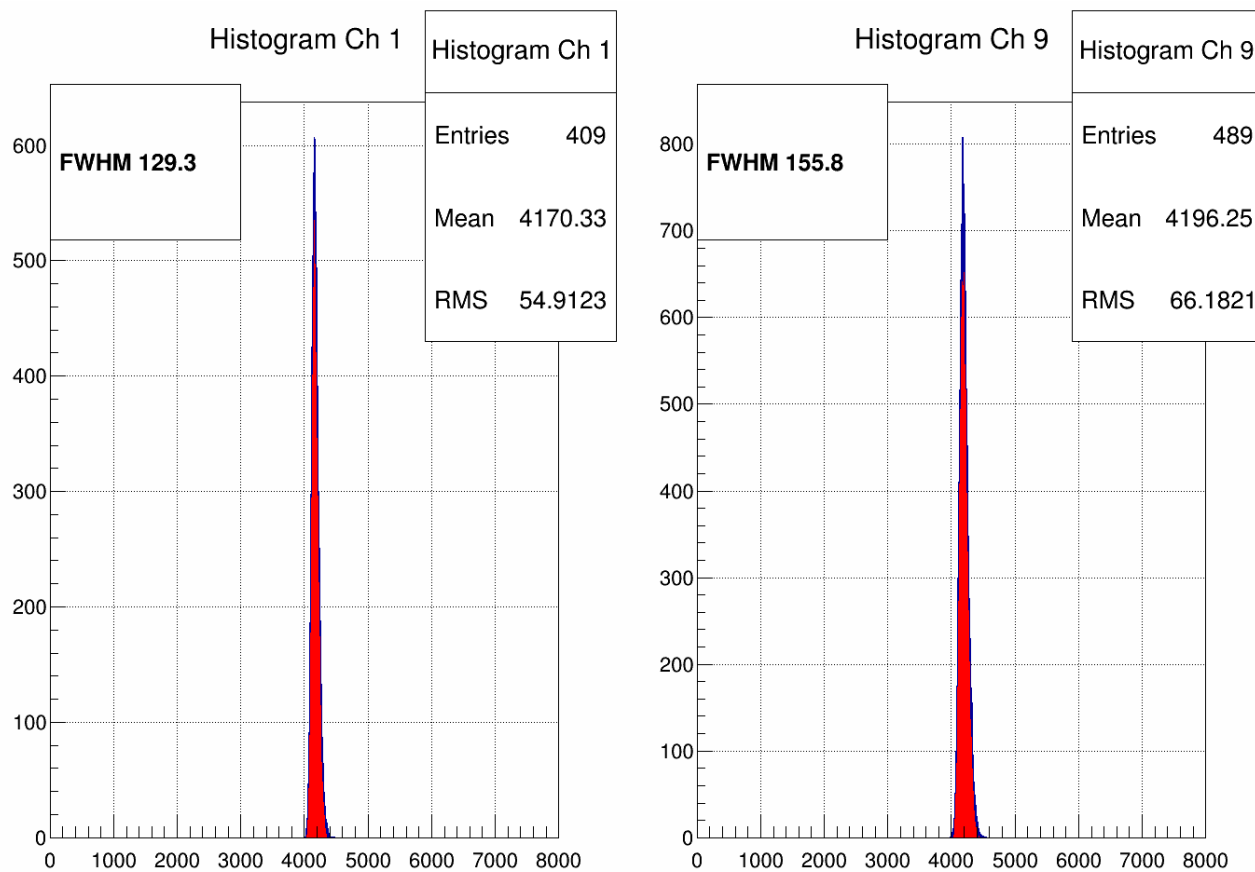


4.2.2.2 All Channels

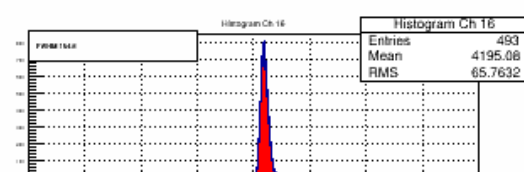
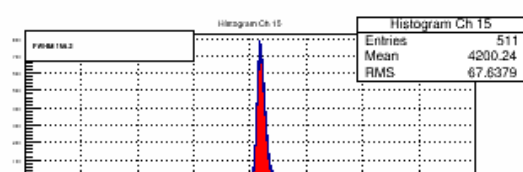
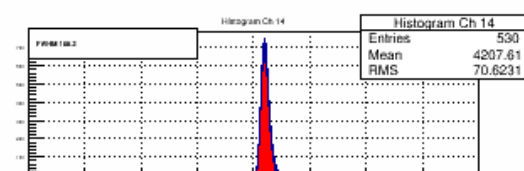
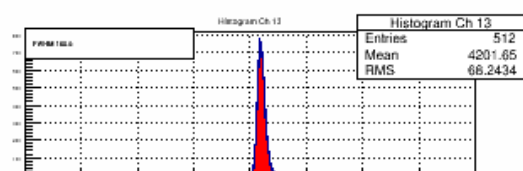
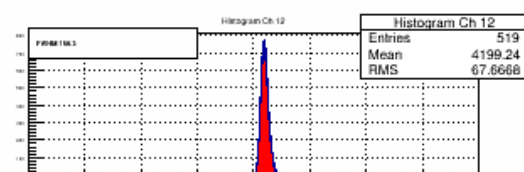
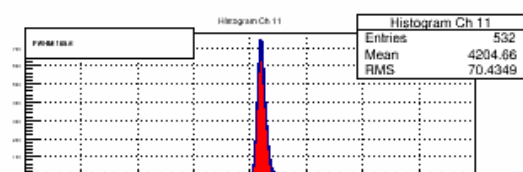
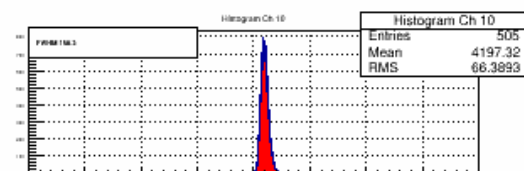
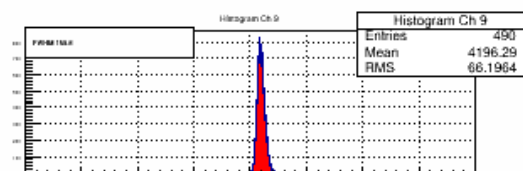
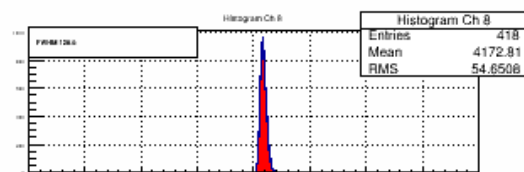
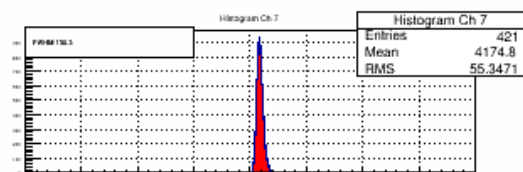
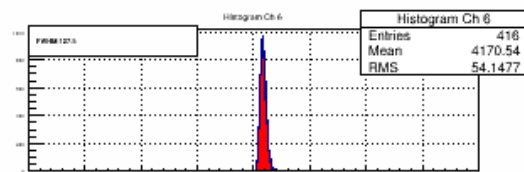
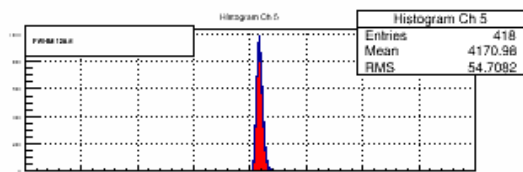
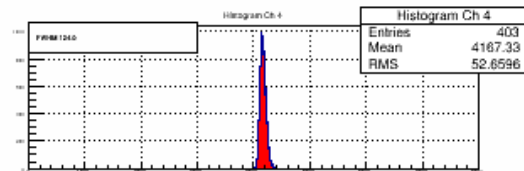
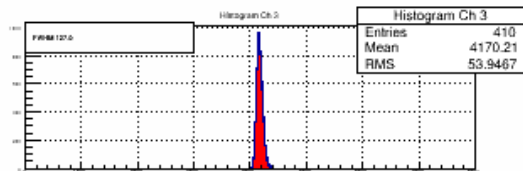
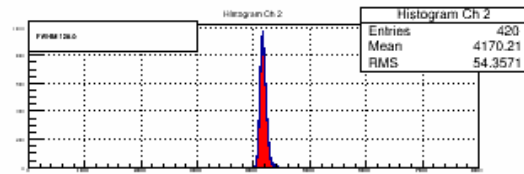
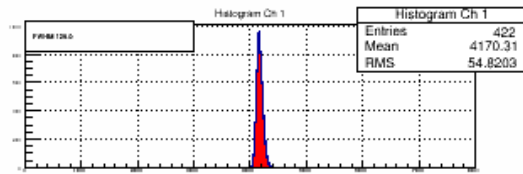


4.2.3 FIR Filter Histograms with P = 500

4.2.3.1 Channels 1 and 9

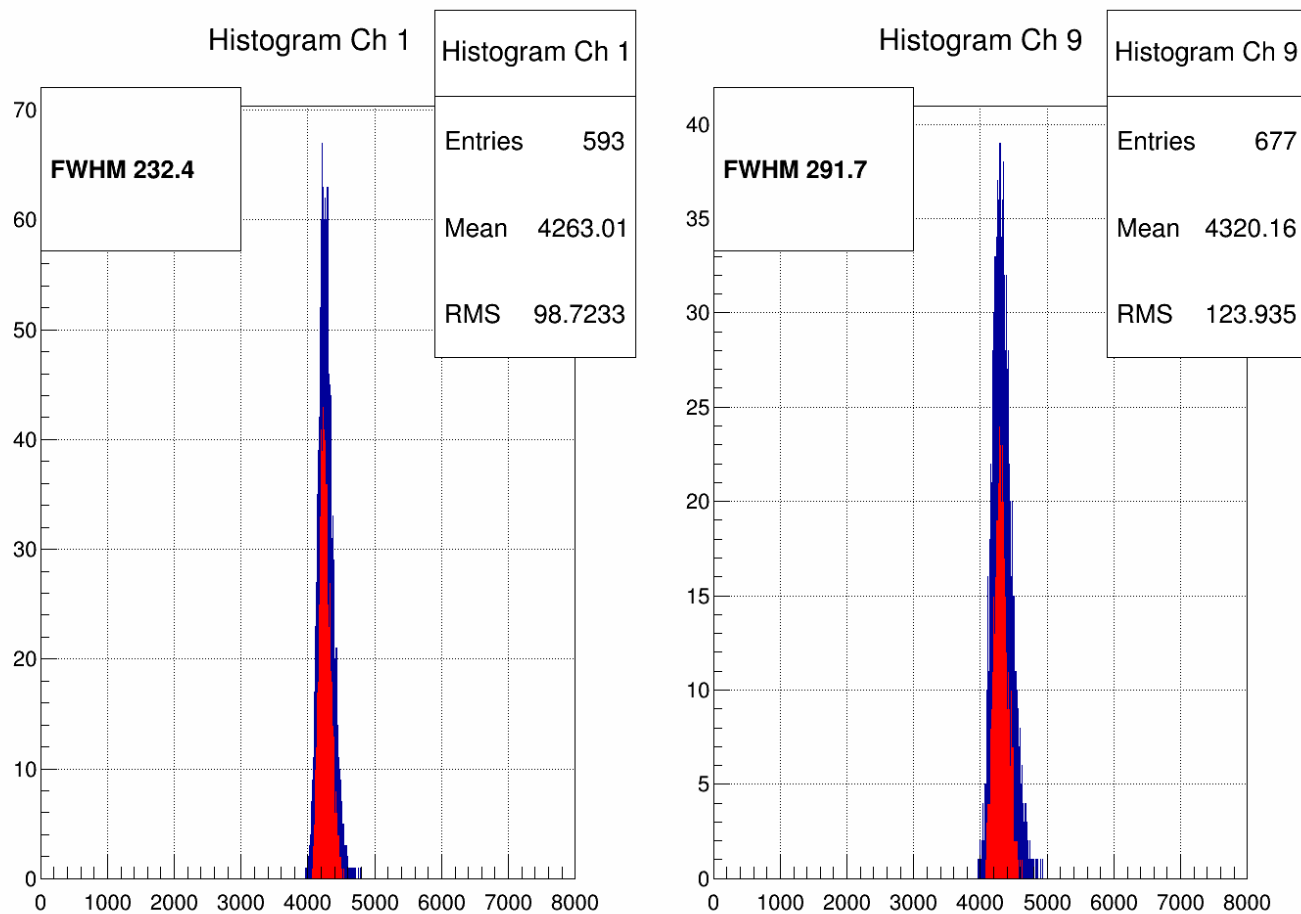


4.2.3.2 All Channels

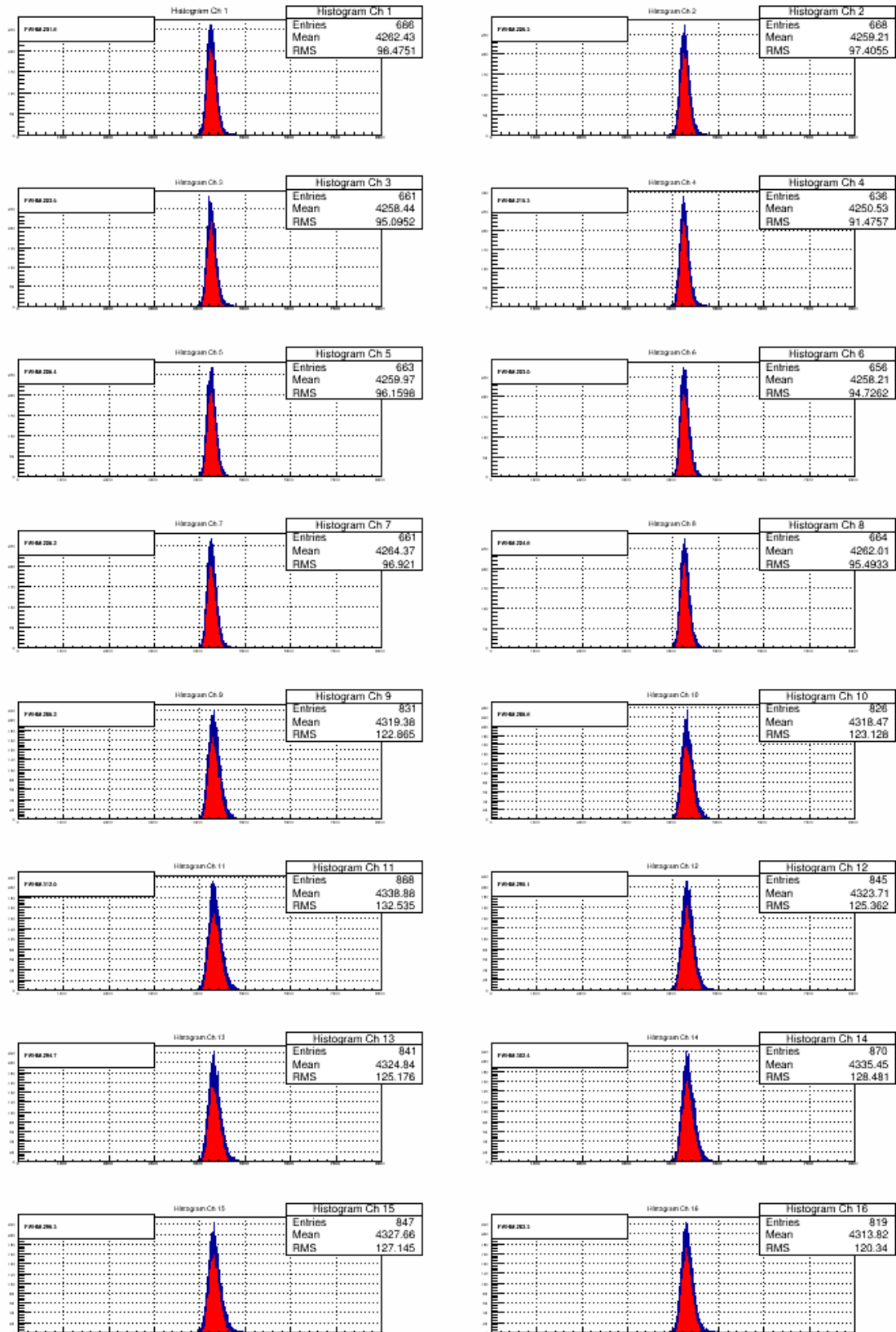


4.2.4 FIR Filter Histograms with P = 1000

4.2.4.1 Channels 1 and 9

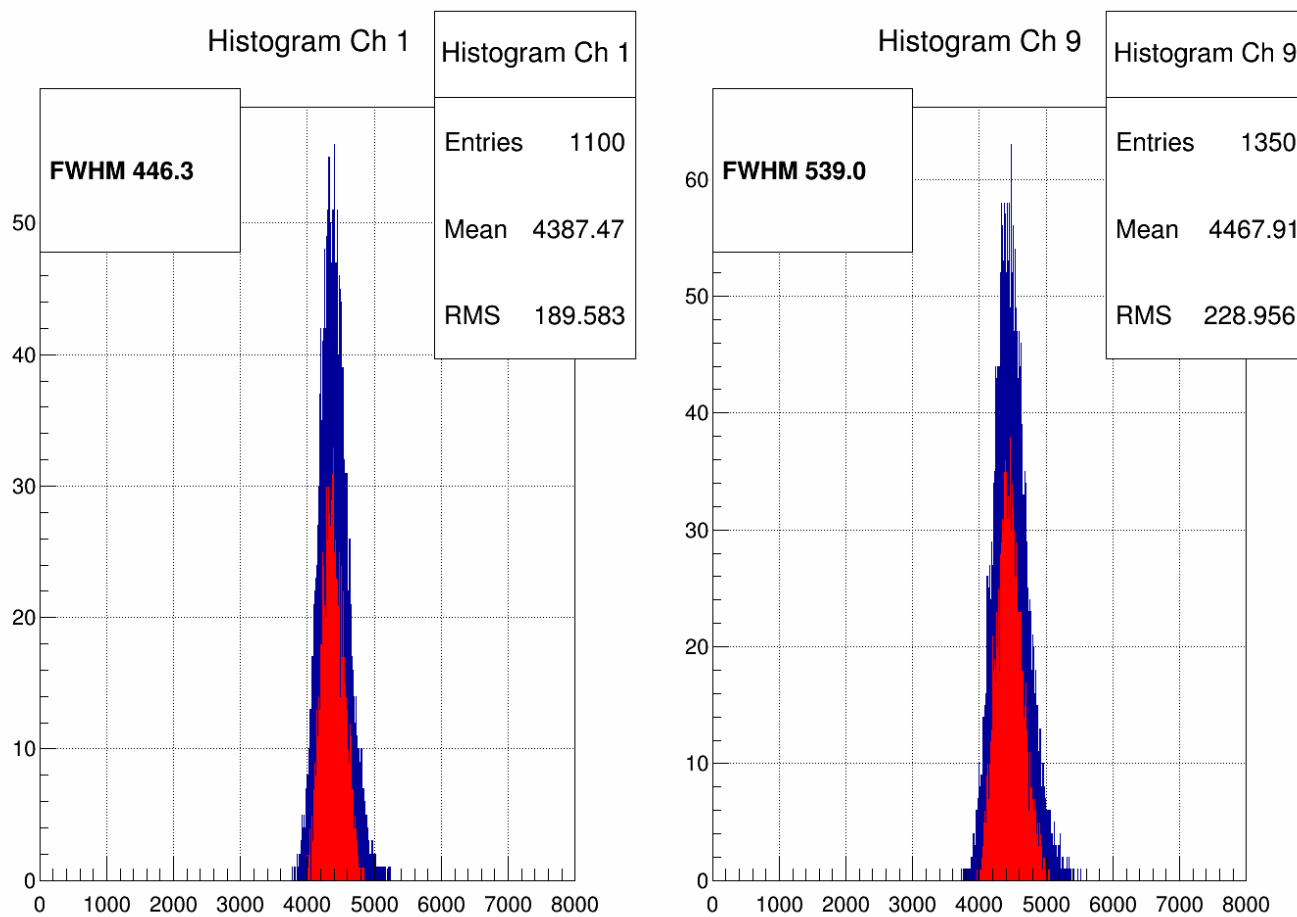


4.2.4.2 All Channels

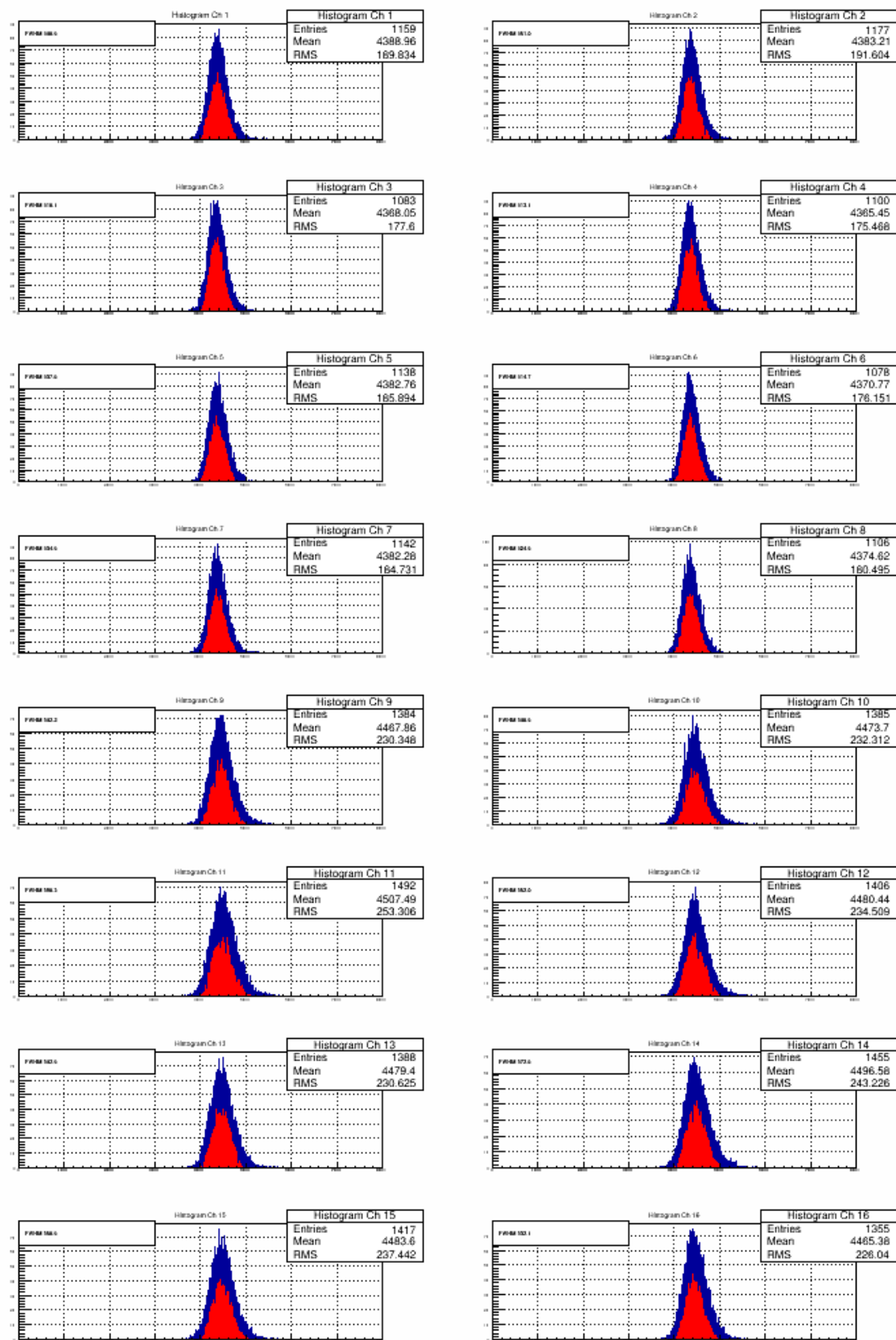


4.2.5 FIR Filter Histograms with P = 2000

4.2.5.1 Channels 1 and 9



4.2.5.2 All Channels



5 FIR Filter Resolution Measurements

5.1 SIS3316 Energy Resolution Measurement Setup

SIS3316-125-16bit Input Configuration

Input Range: ~2.25V (2V setting)	(~34,3 μ V/count)
Input Range: ~5.2V (5V setting)	(~79,3 μ V/count)
Impedance: 50 Ω	

SIS3316-250-14bit Input Configuration

Input Range: ~2.1V (2V setting)	(~128,2 μ V/count)
Input Range: ~5.2V (5V setting)	(~317,4 μ V/count)
Impedance: 50 Ω	

Waveform Generator: Agilent 33522A

Waveform:	Square
Amplitude:	15.9 mV
Rising edge:	120 ns

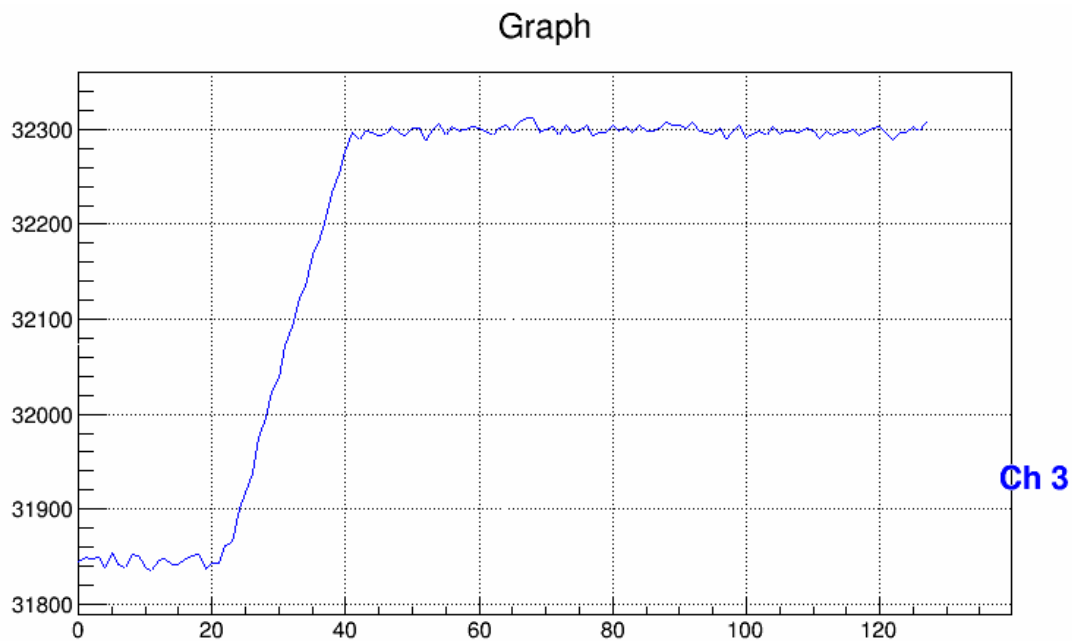
Emulation Energy: FE -> 6360 eV

Preamplifier: 2.5mV / keV -> 6360 eV -> 15.9 mV

5.2 SIS3316-125MHz -16bit Measurements

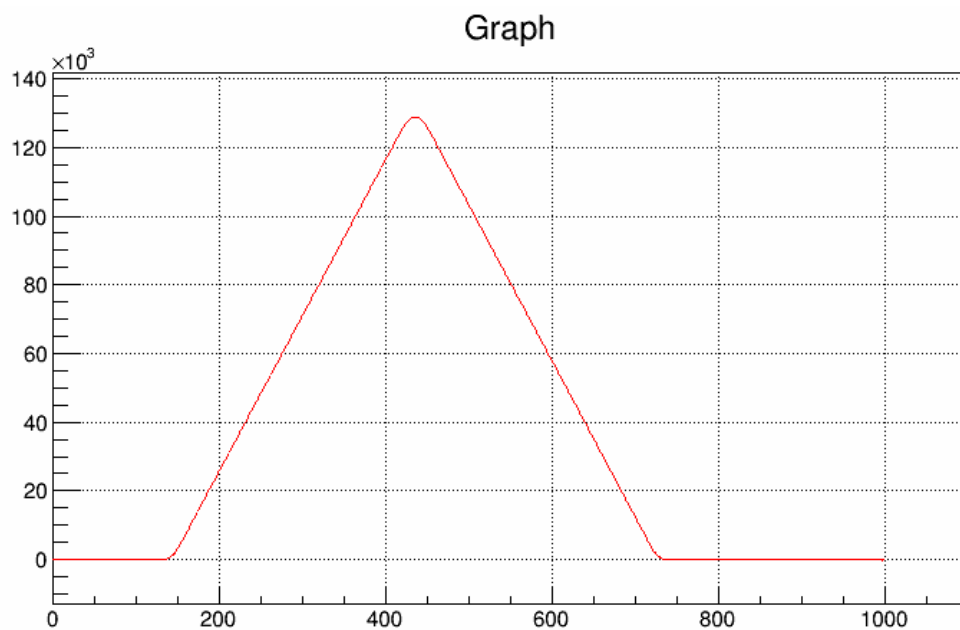
5.2.1 Input Range 2V setting

5.2.1.1 Raw data Graph



Preamplifier: 2.5mV / keV \rightarrow 6360 keV \rightarrow 15.9 mV \rightarrow ~460 counts

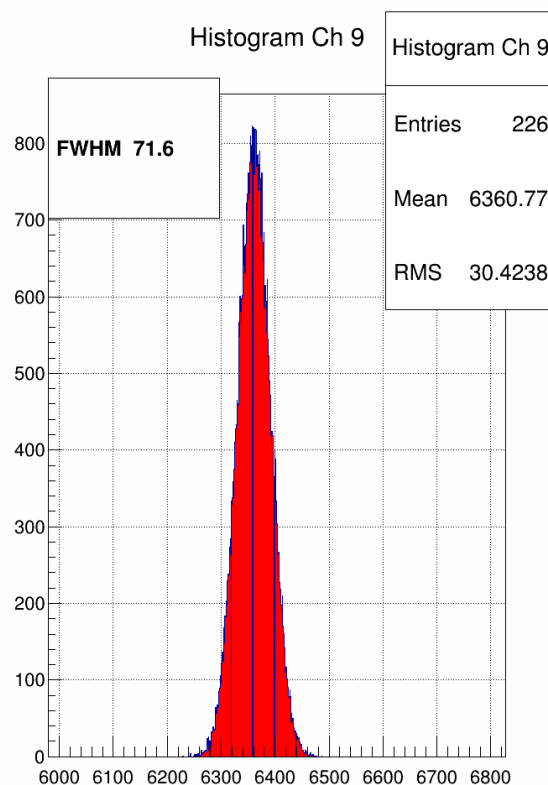
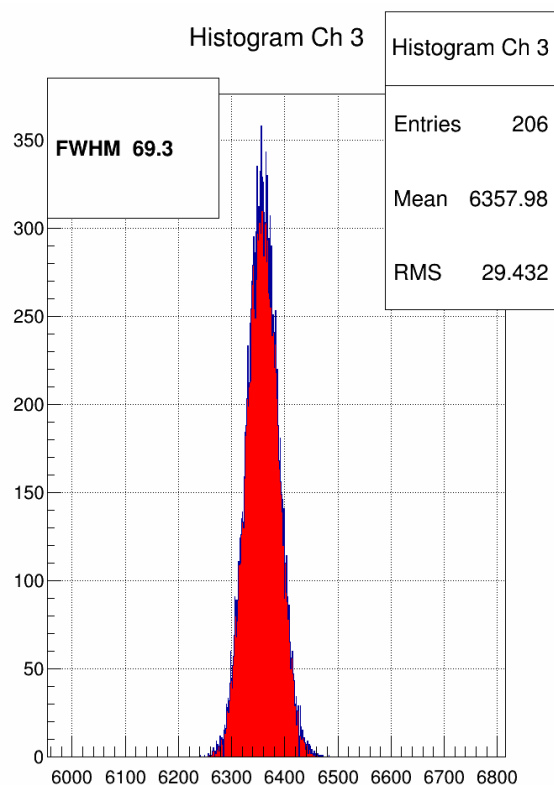
5.2.1.2 Typical Energy FIR Filter Trapezoid



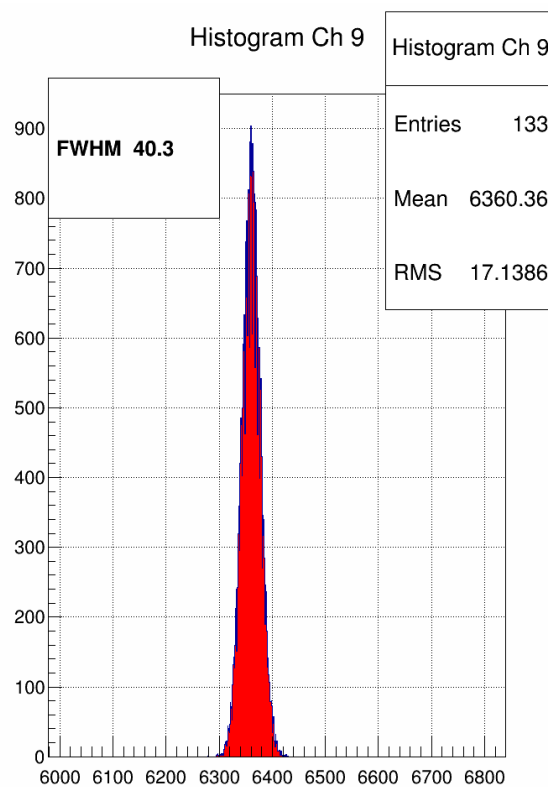
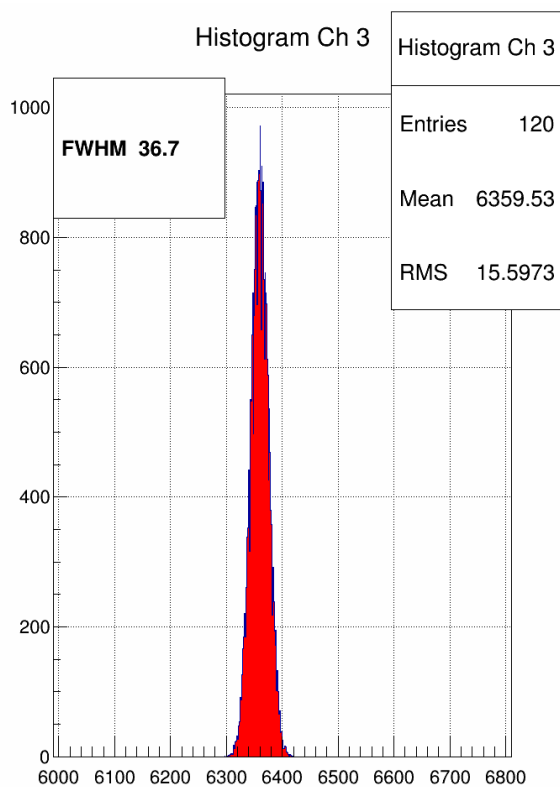
$P = 284$ (2272 ns), $G = 16$ (128 ns) \rightarrow Pulse FWHM = 2.4 μ s \rightarrow Shaping time = 1 μ s
Max value: $P * \sim 460 \text{ counts} = 284 * \sim 460 = \sim 130.640$

5.2.1.3 Energy Histograms

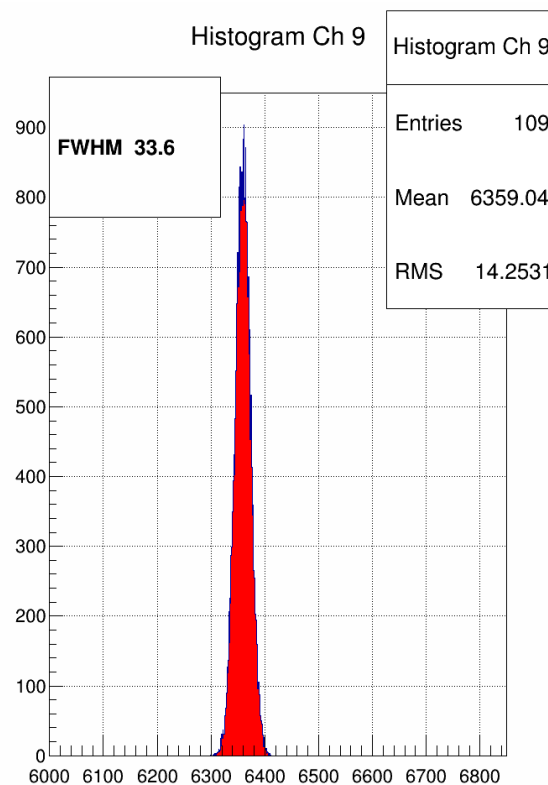
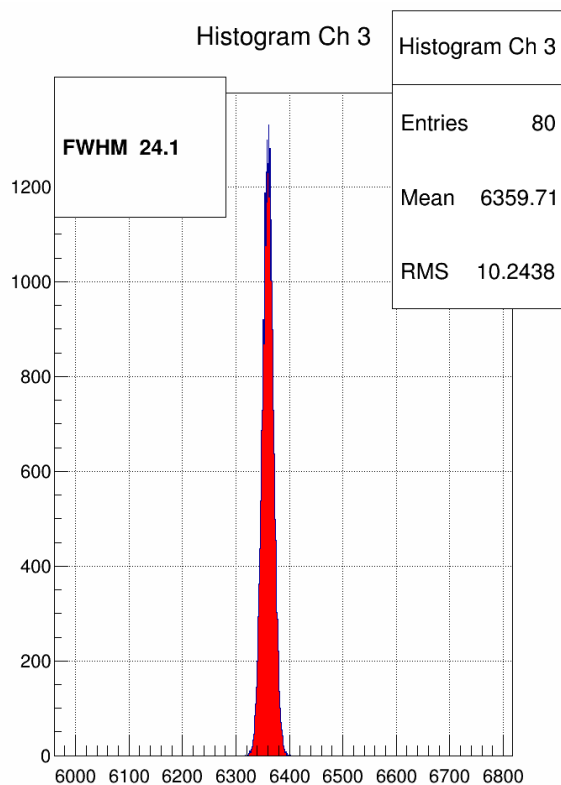
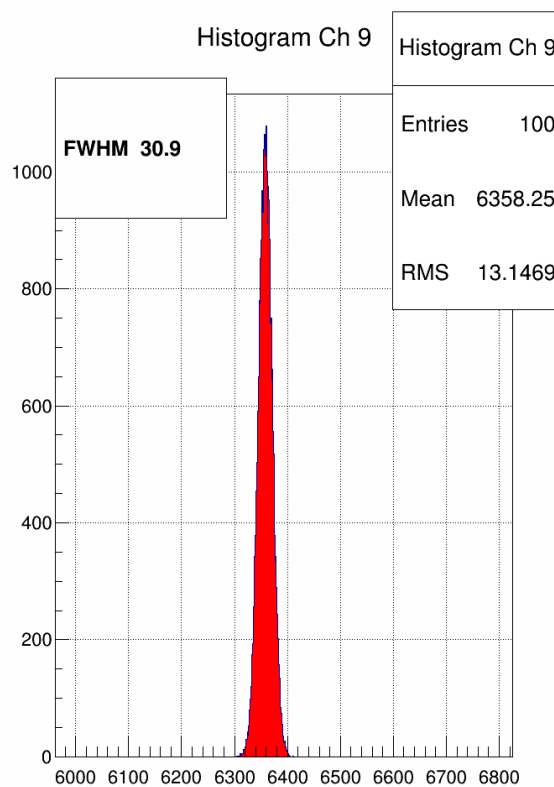
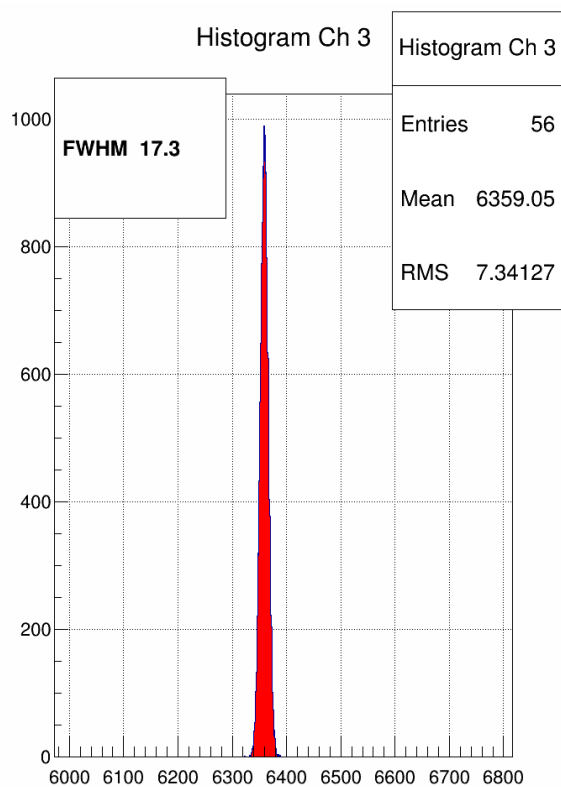
5.2.1.3.1 SIS3316-125MHz -16bit 2V: Shaping Time 100ns



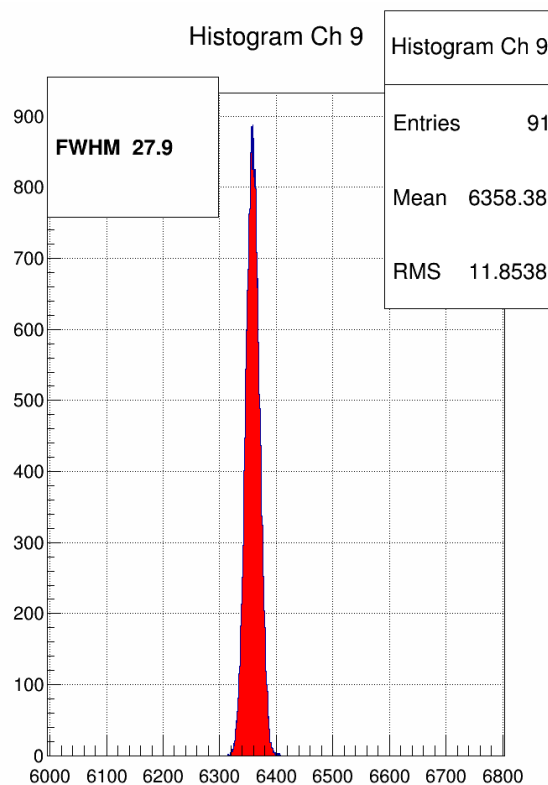
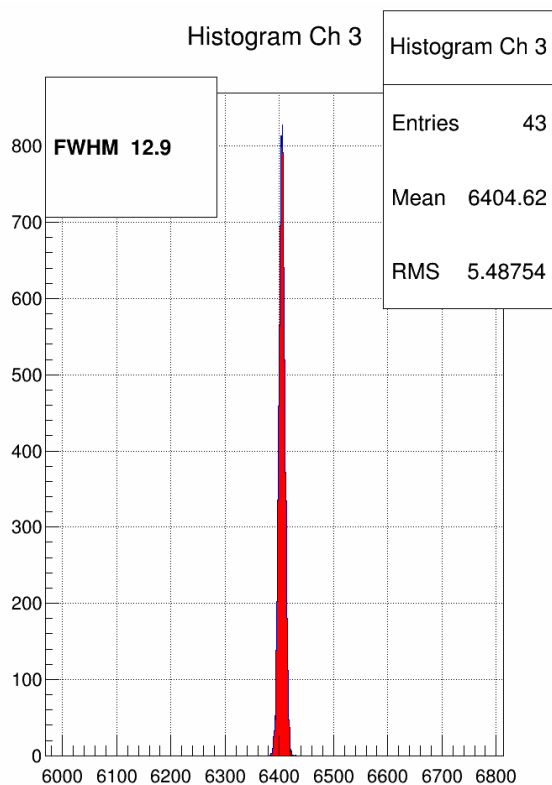
5.2.1.3.2 SIS3316-125MHz -16bit 2V: Shaping Time 250ns



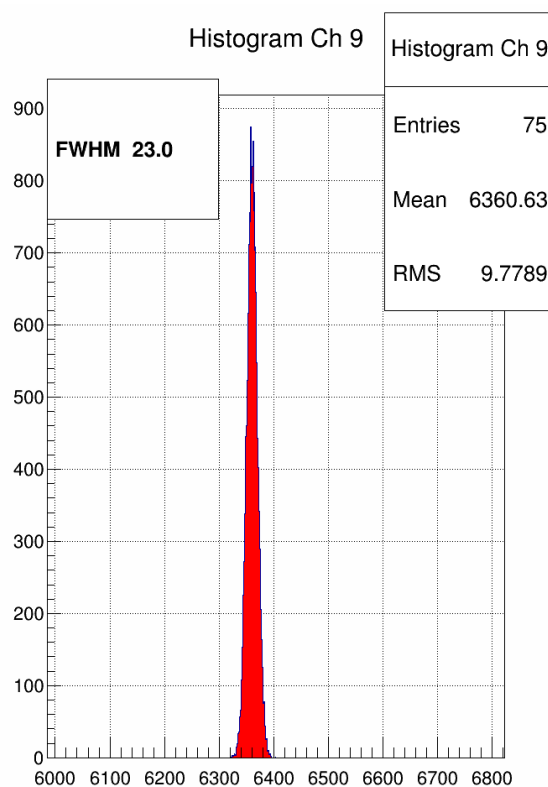
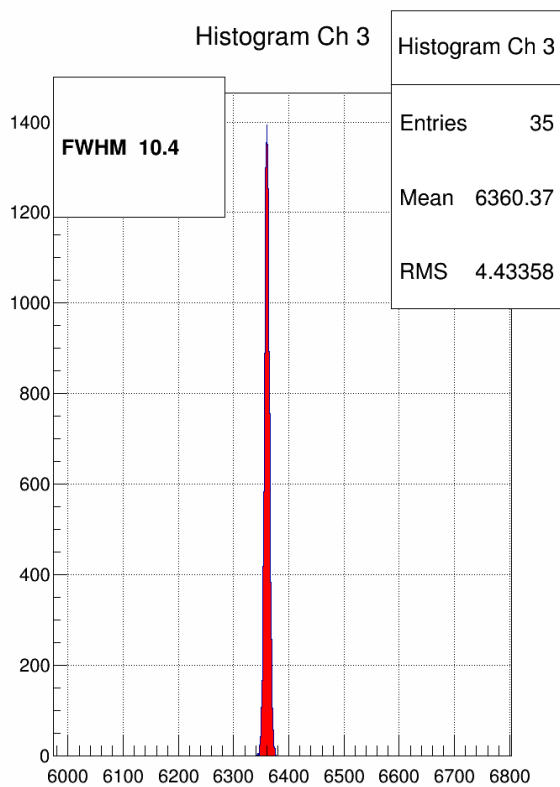
5.2.1.3.3 SIS3316-125MHz -16bit 2V: Shaping Time 500ns

5.2.1.3.4 SIS3316-125MHz -16bit 2V: Shaping Time 1 μ s

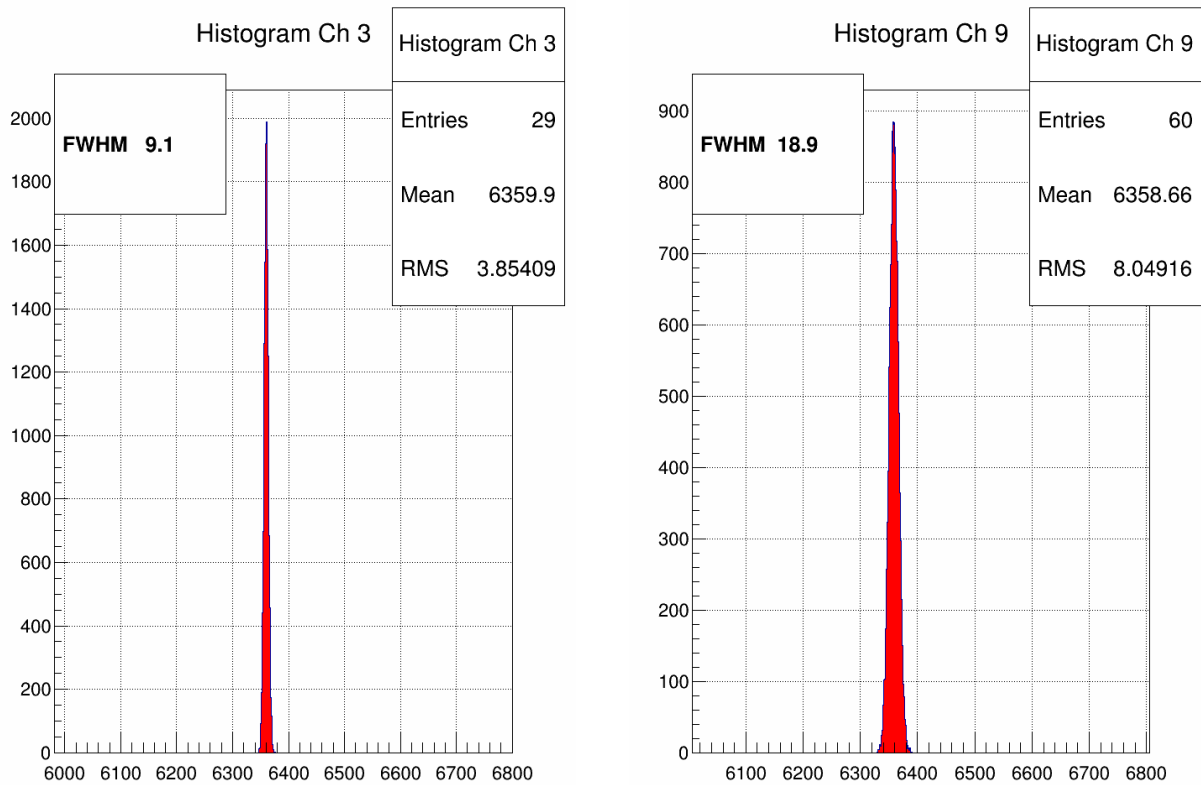
5.2.1.3.5 SIS3316-125MHz -16bit 2V: Shaping Time 2us



5.2.1.3.6 SIS3316-125MHz -16bit 2V: Shaping Time 4us

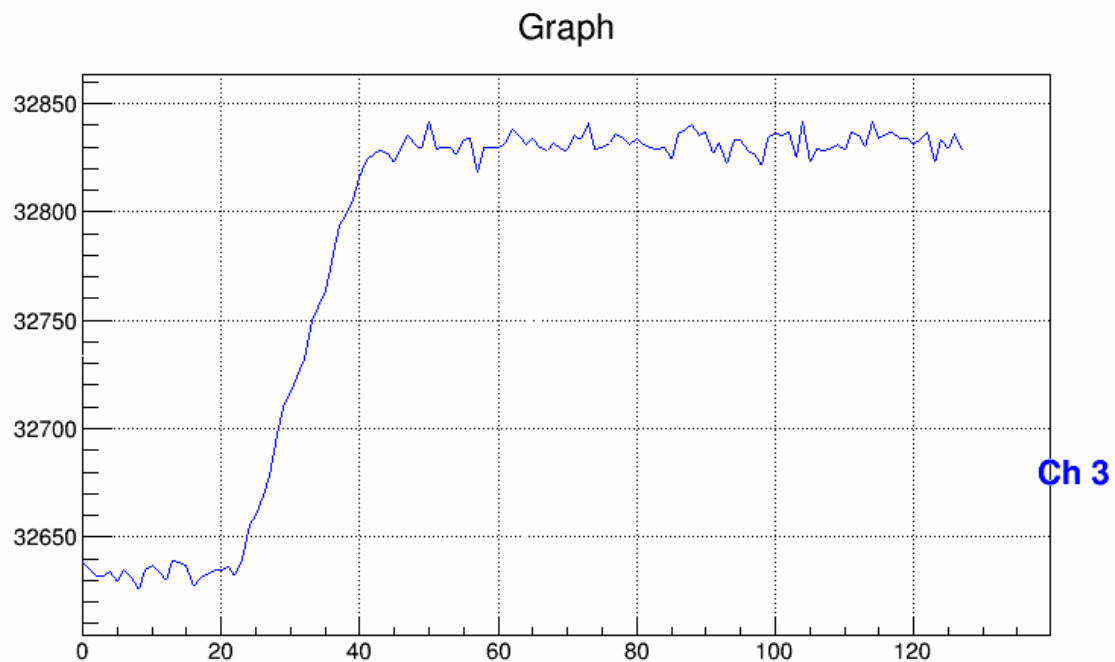


5.2.1.3.7 SIS3316-125MHz -16bit 2V: Shaping Time 7us



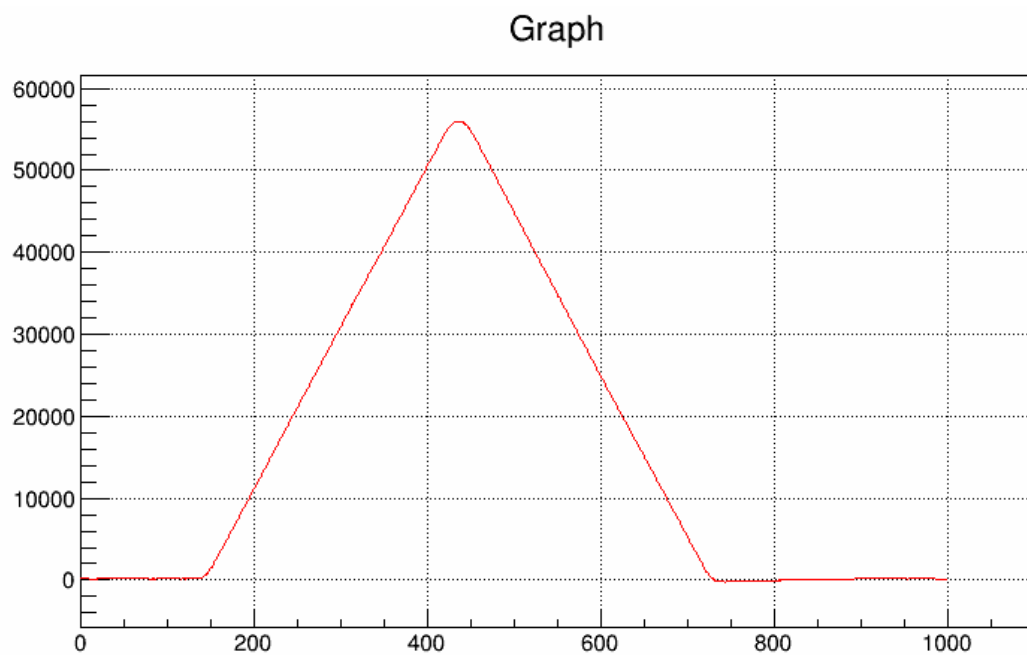
5.2.2 Input Range 5V setting

5.2.2.1 Raw data Graph



Preamplifier: 2.5mV / keV \rightarrow 6360 keV \rightarrow 15.9 mV \rightarrow ~200 counts

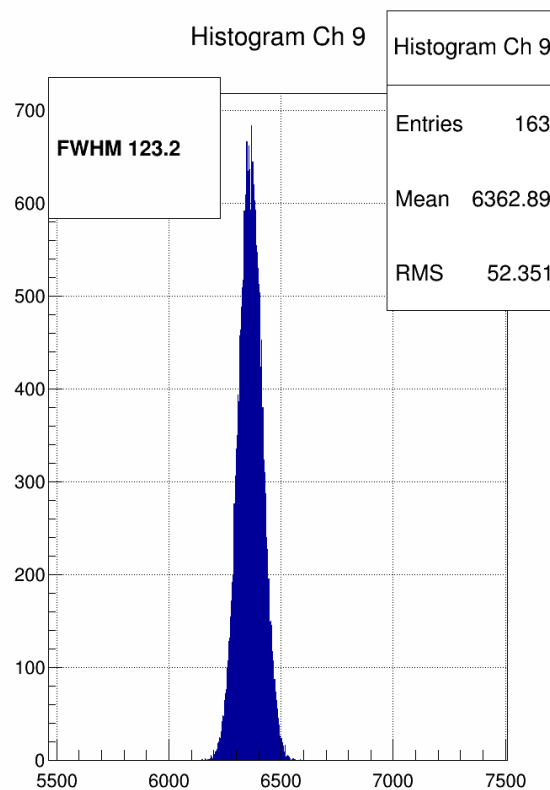
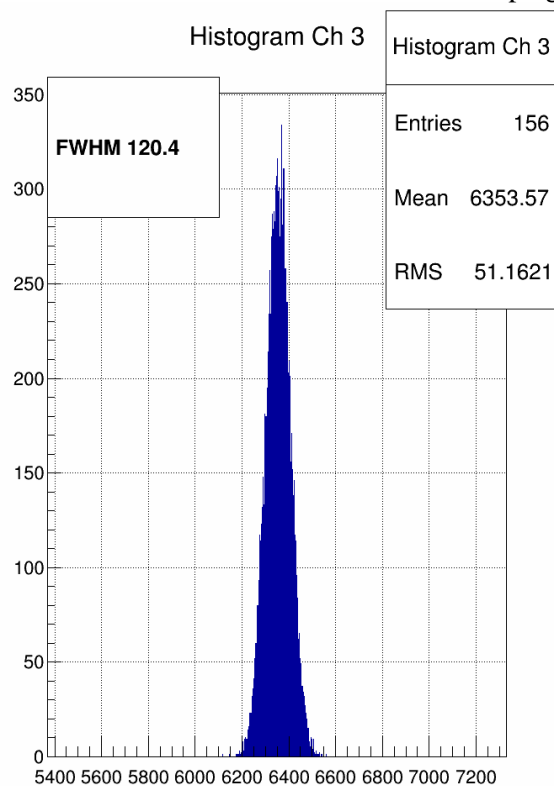
5.2.2.2 Typical Energy FIR Filter Trapezoid



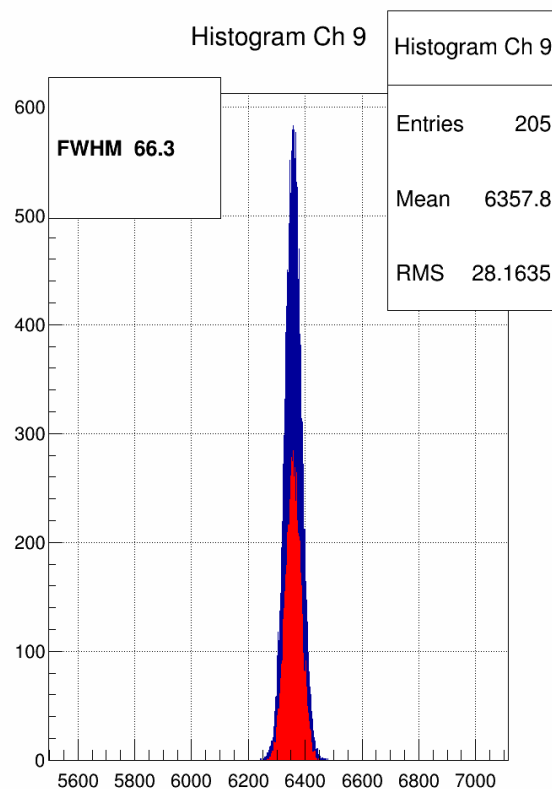
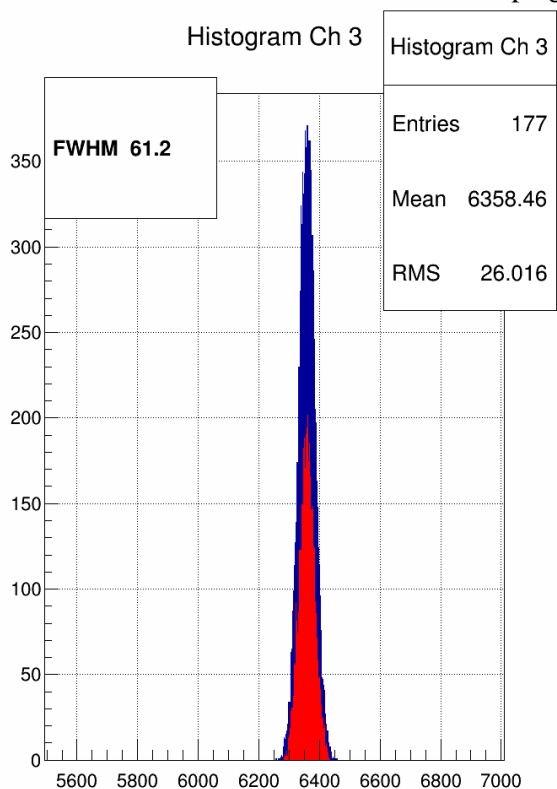
$P = 284$ (2.272 μ s) , $G = 16$ (128 ns) \rightarrow Pulse FWHM = 2.4 μ s \rightarrow Shaping time = 1 μ s
Max value: $P * \sim 200 \text{ counts} = 284 * \sim 200 = \sim 56.800$

5.2.2.3 Energy Histograms

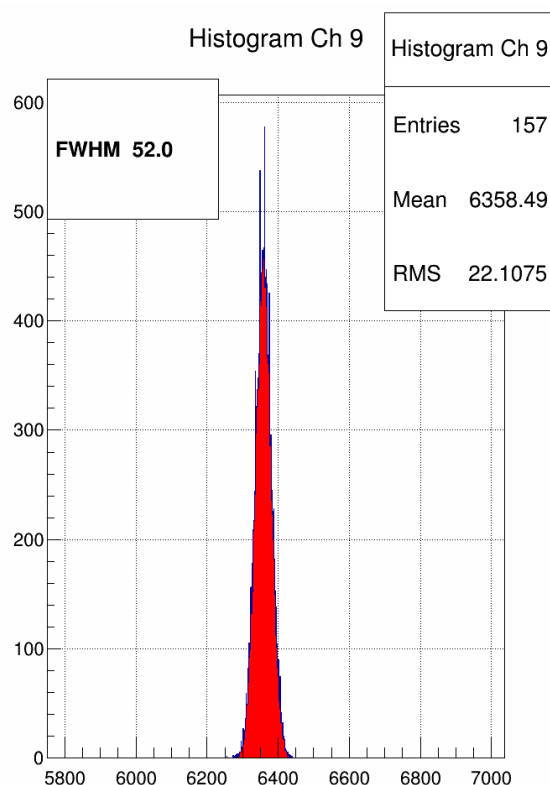
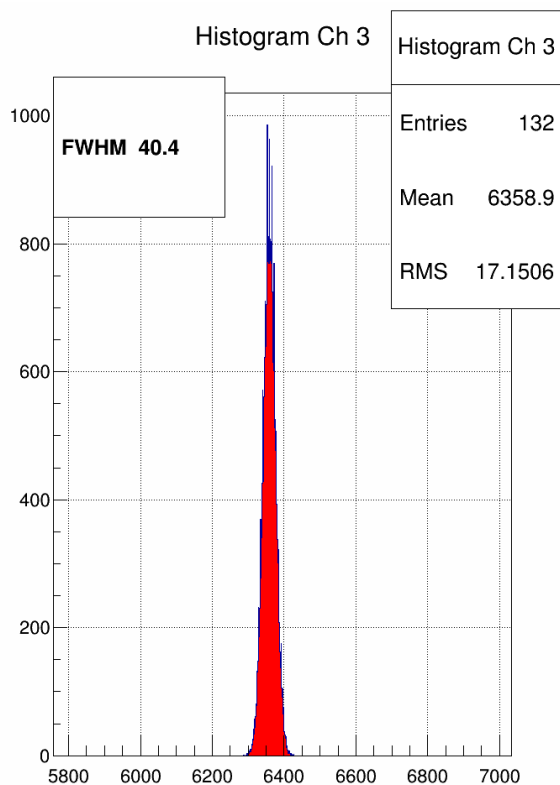
5.2.2.3.1 SIS3316-125MHz -16bit 5V: Shaping Time 100ns



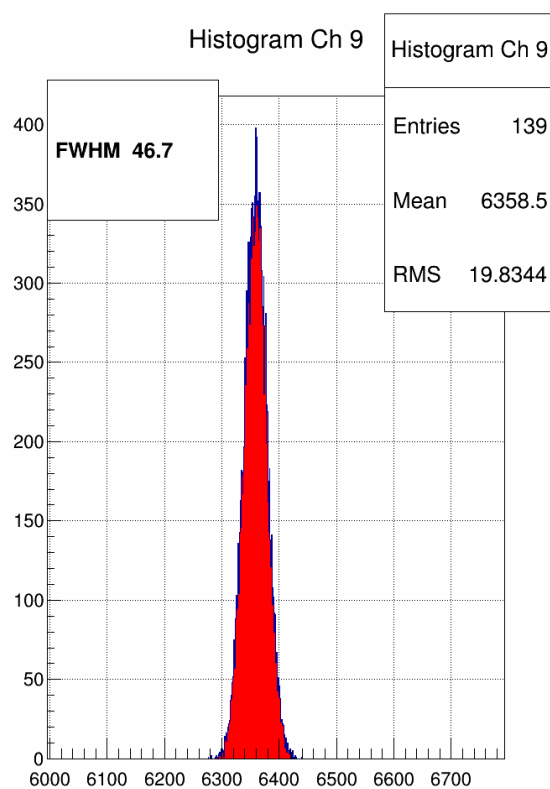
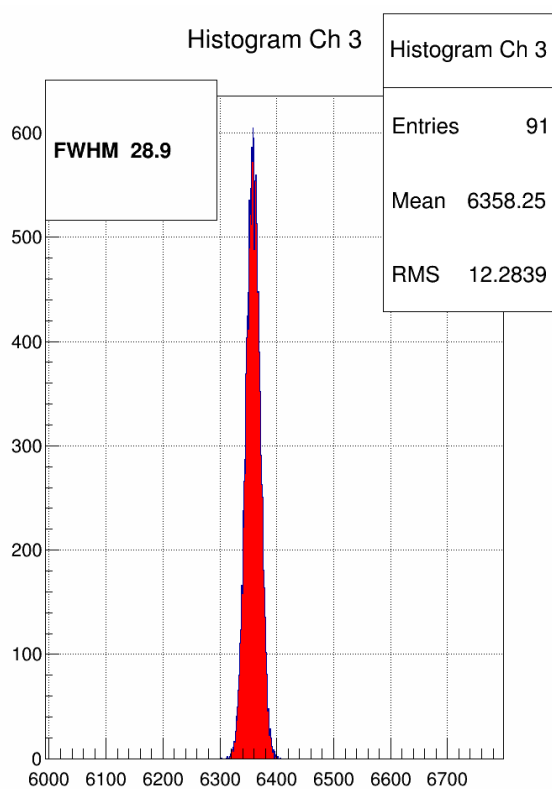
5.2.2.3.2 SIS3316-125MHz -16bit 5V: Shaping Time 250ns



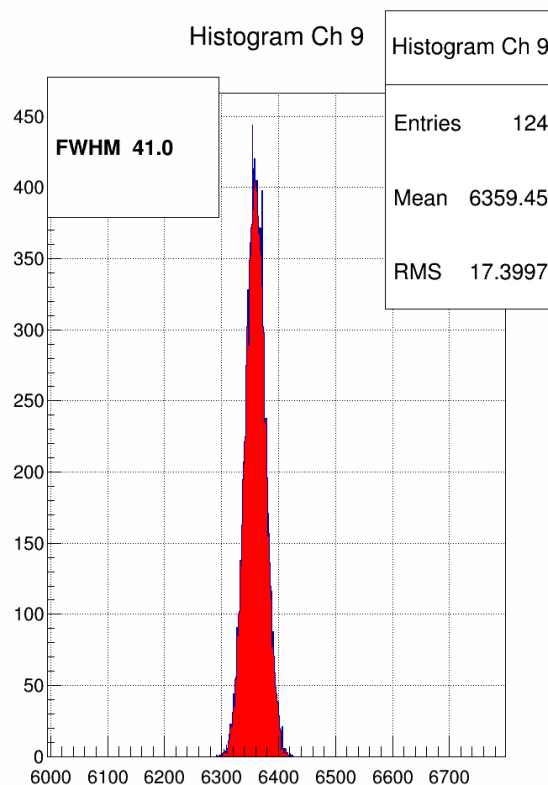
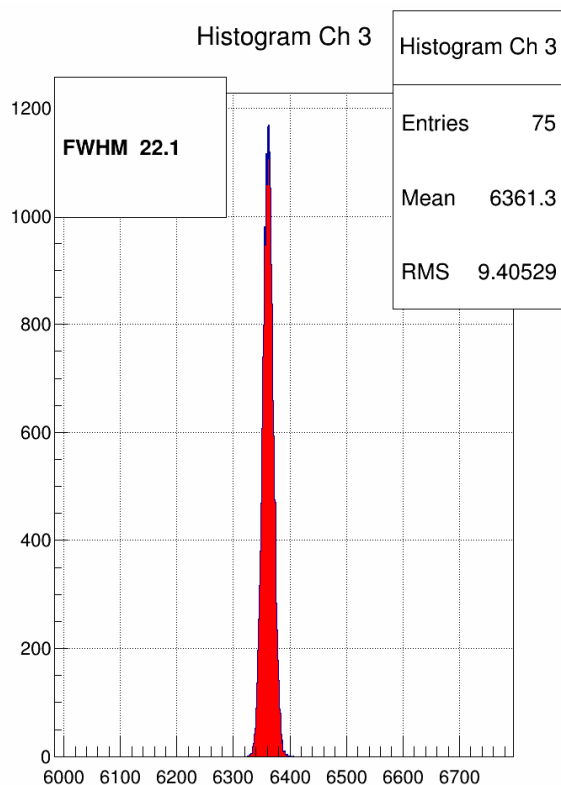
5.2.2.3.3 SIS3316-125MHz -16bit 5V: Shaping Time 500ns



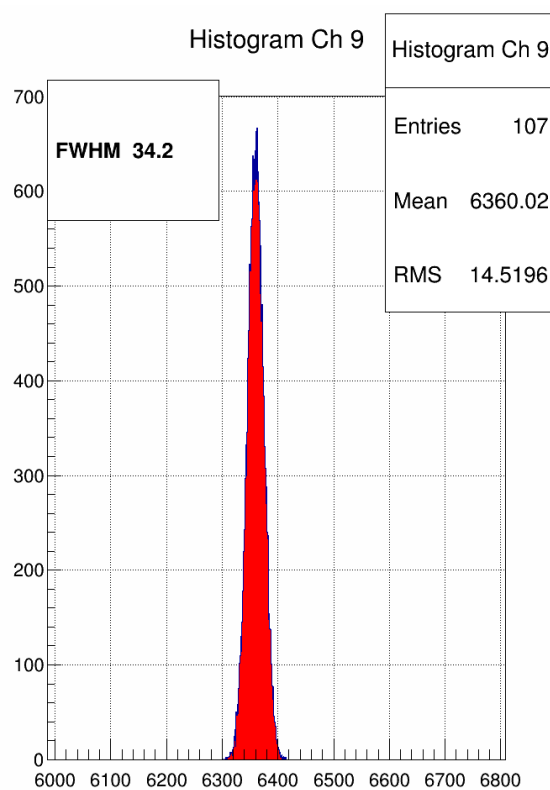
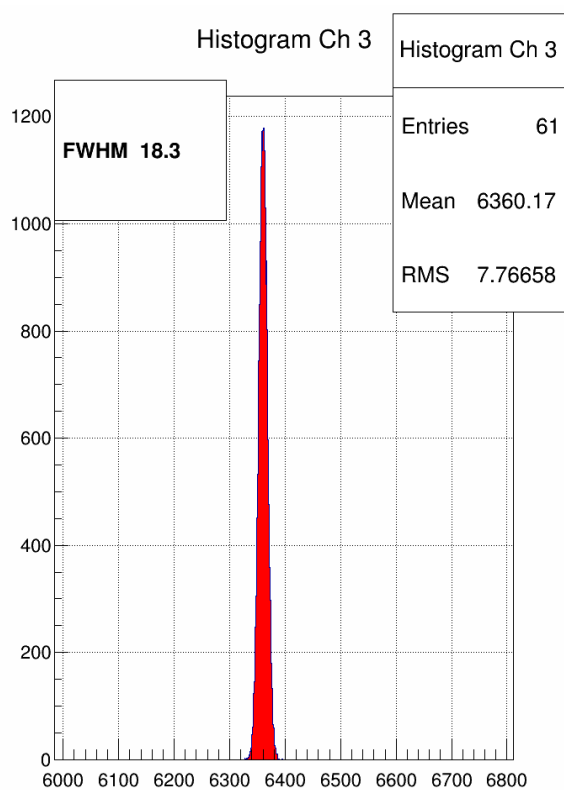
5.2.2.3.4 SIS3316-125MHz -16bit 5V: Shaping Time 1us



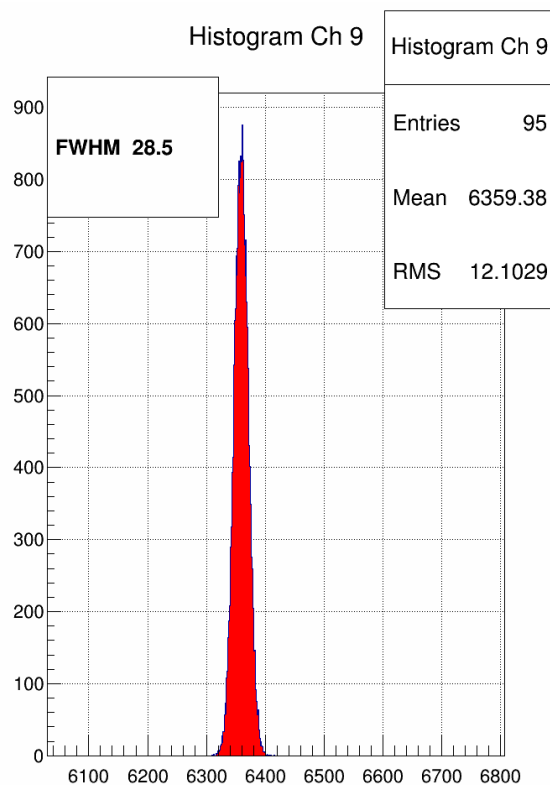
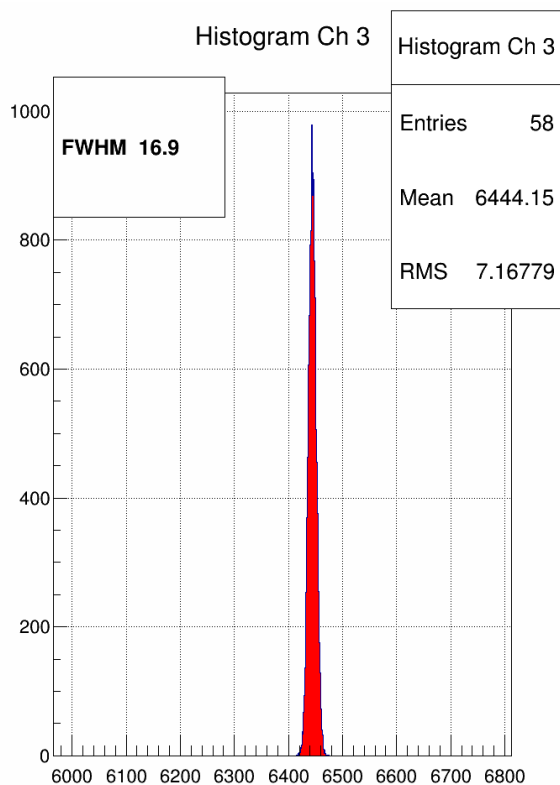
5.2.2.3.5 SIS3316-125MHz -16bit 5V: Shaping Time 2us



5.2.2.3.6 SIS3316-125MHz -16bit 5V: Shaping Time 4us



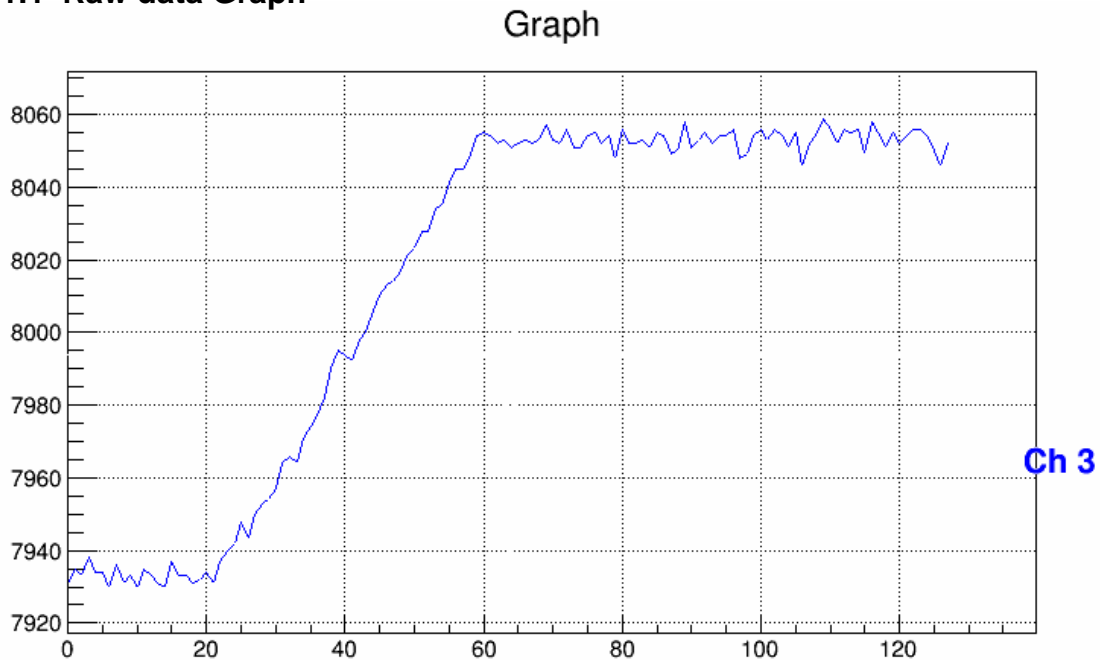
5.2.2.3.7 SIS3316-125MHz -16bit 5V: Shaping Time 7us



5.3 SIS3316-250MHz -14bit Measurements

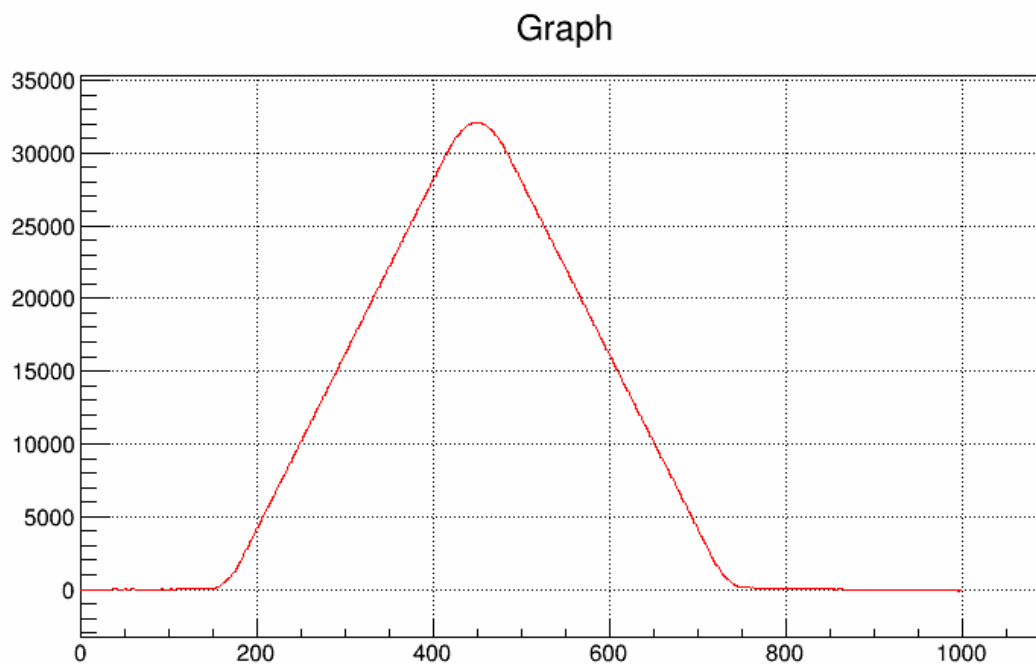
5.3.1 Input Range 2V setting

5.3.1.1 Raw data Graph



Preamplifier: 2.5mV / keV \rightarrow 6360 keV \rightarrow 15.9 mV \rightarrow ~124 counts

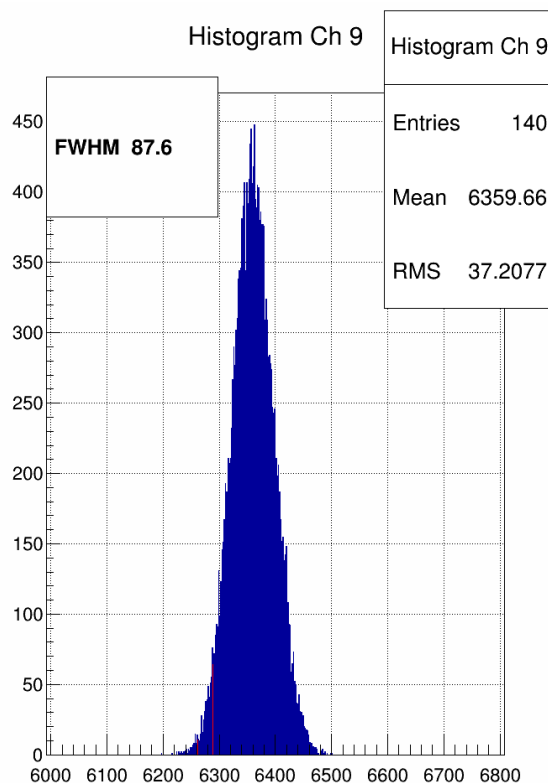
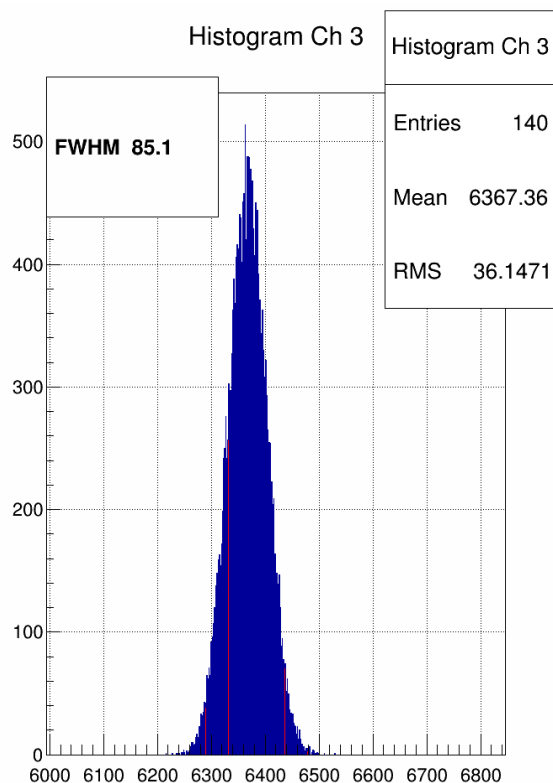
5.3.1.2 Typical Energy FIR Filter Trapezoid



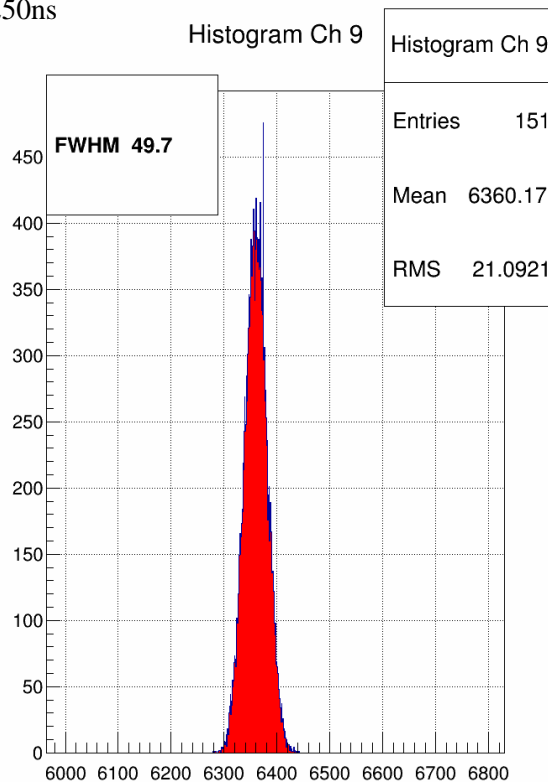
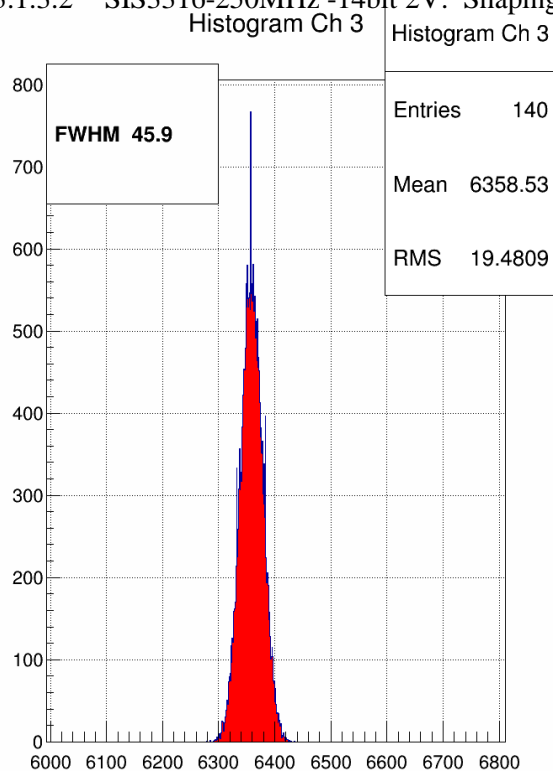
$P = 268$ (1072 ns), $G = 32$ (128 ns) \rightarrow Pulse FWHM = 1.2 μ s \rightarrow Shaping time = 500 ns
Max value: $P * \sim 124 \text{ counts} = 268 * \sim 124 = \sim 33.232$

5.3.1.3 Energy Histograms

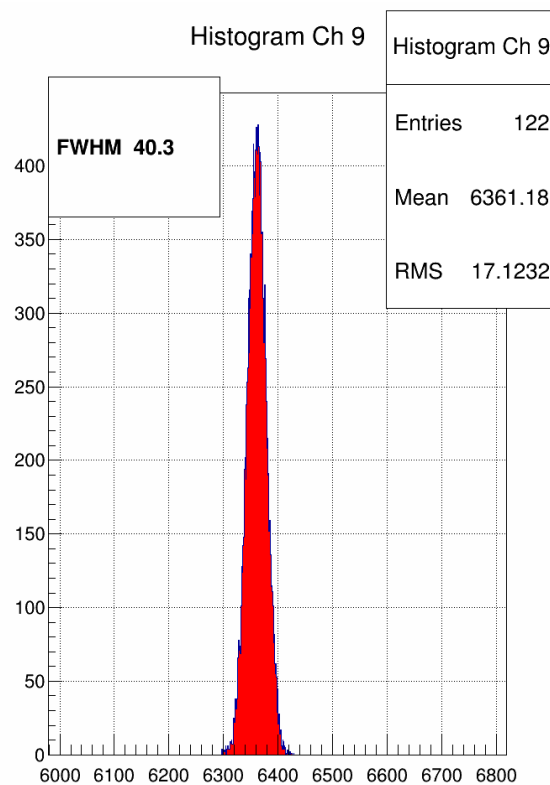
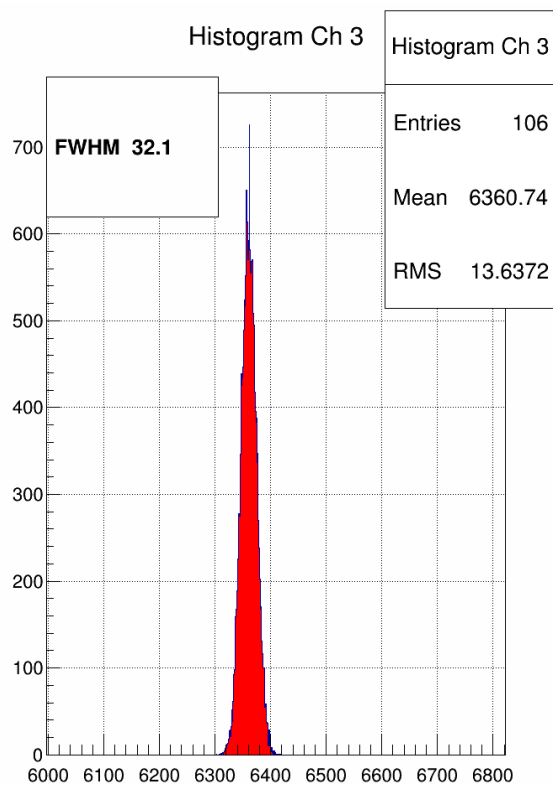
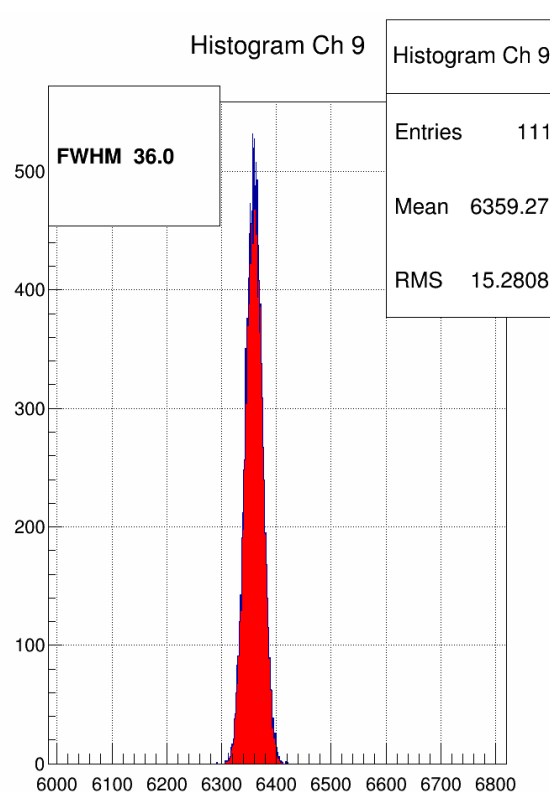
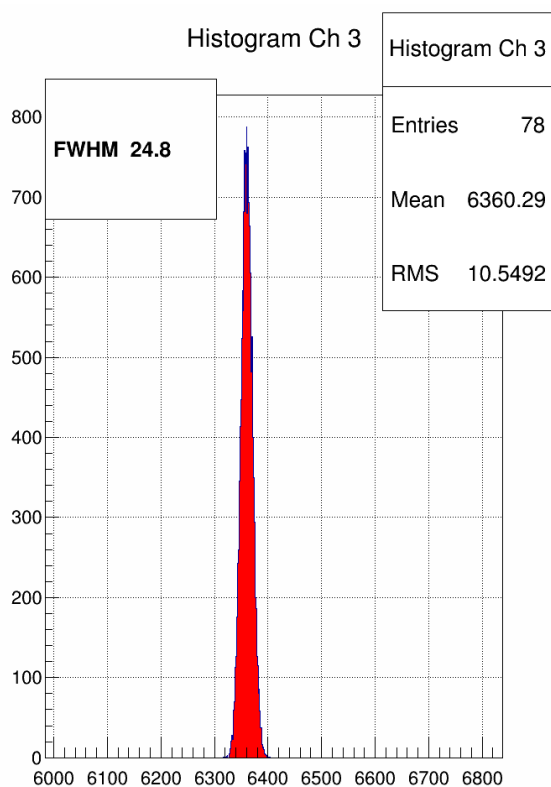
5.3.1.3.1 SIS3316-250MHz -14bit 2V: Shaping Time 100ns



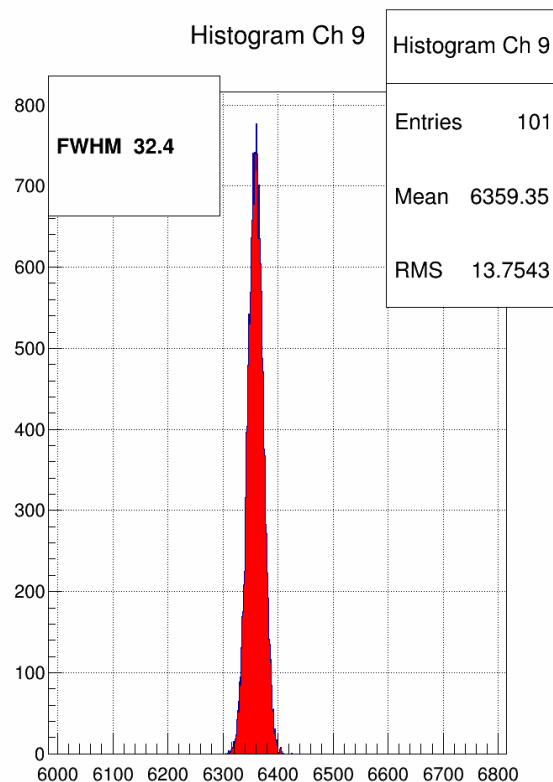
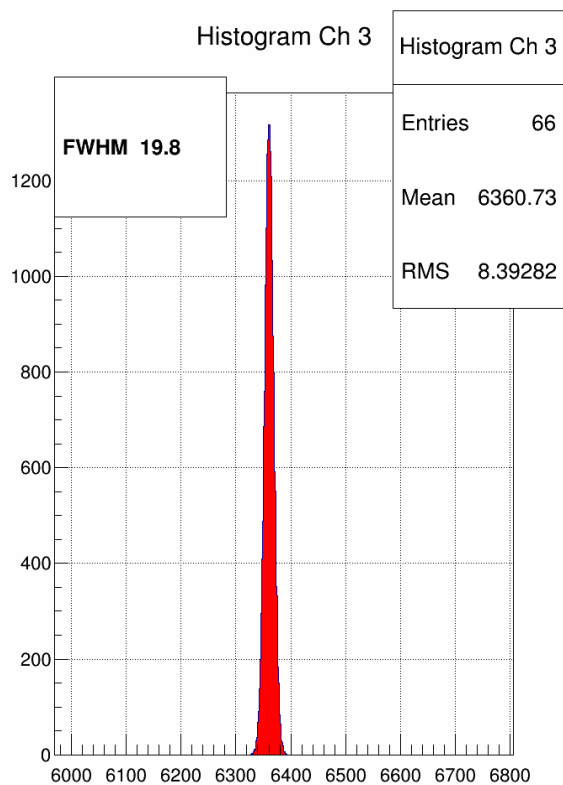
5.3.1.3.2 SIS3316-250MHz -14bit 2V: Shaping Time 250ns



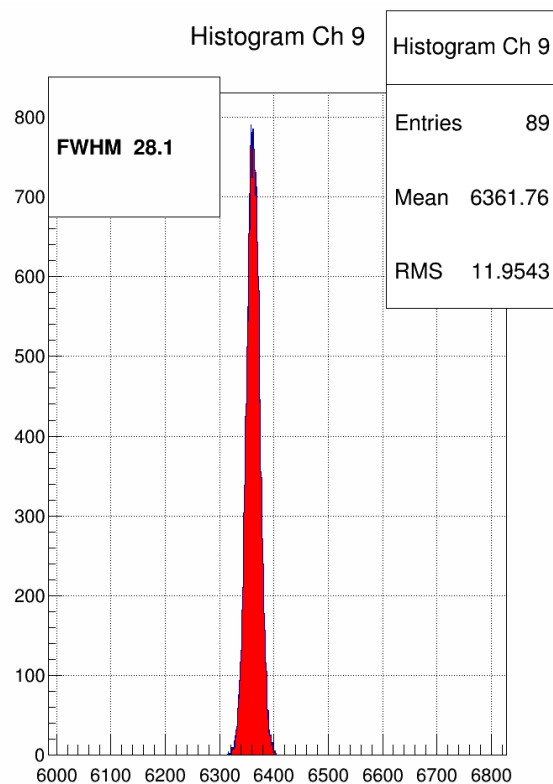
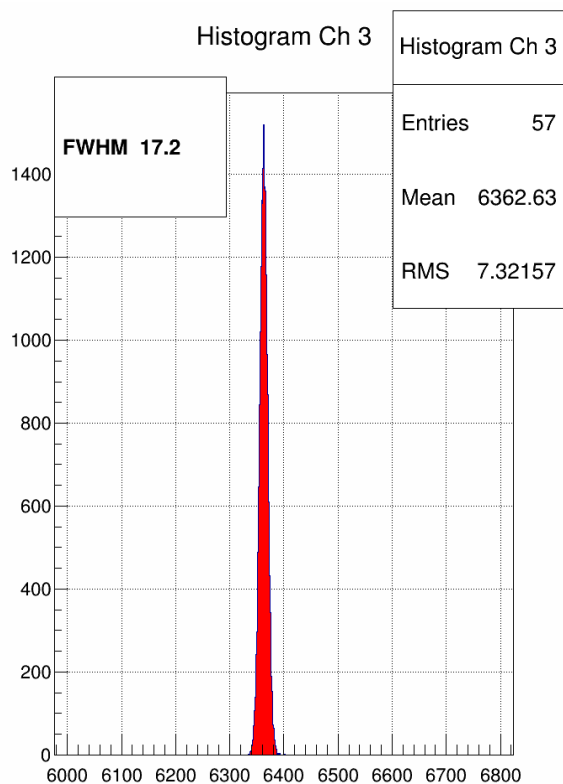
5.3.1.3.3 SIS3316-250MHz -14bit 2V: Shaping Time 500ns

5.3.1.3.4 SIS3316-250MHz -14bit 2V: Shaping Time 1 μ s

5.3.1.3.5 SIS3316-250MHz -14bit 2V: Shaping Time 2us

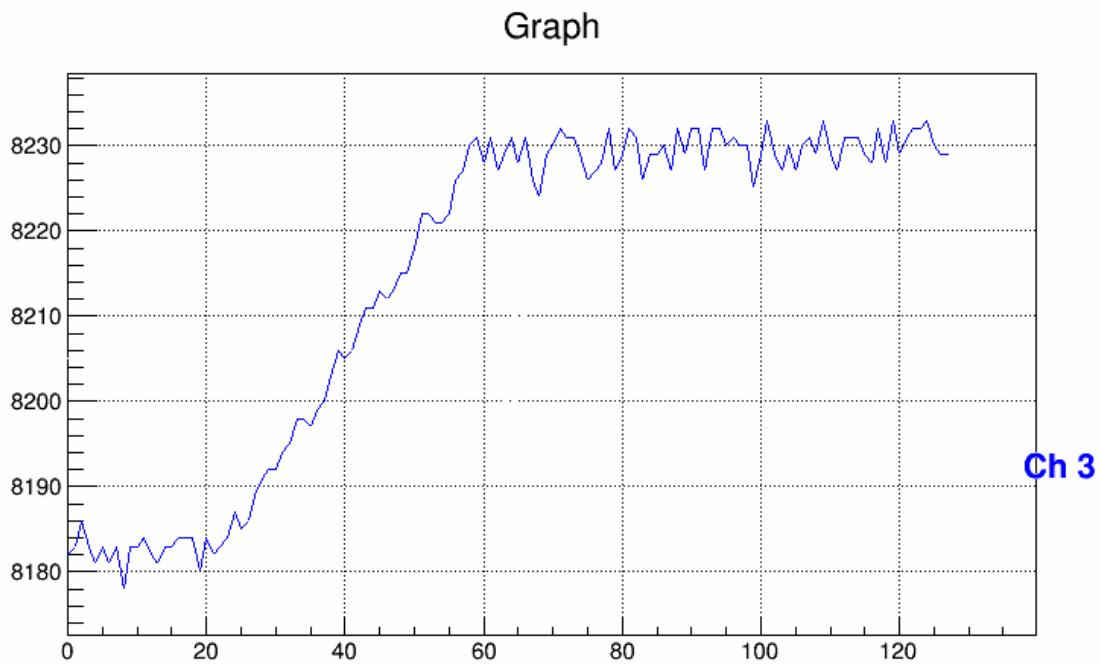


5.3.1.3.6 SIS3316-250MHz -14bit 2V: Shaping Time 4us



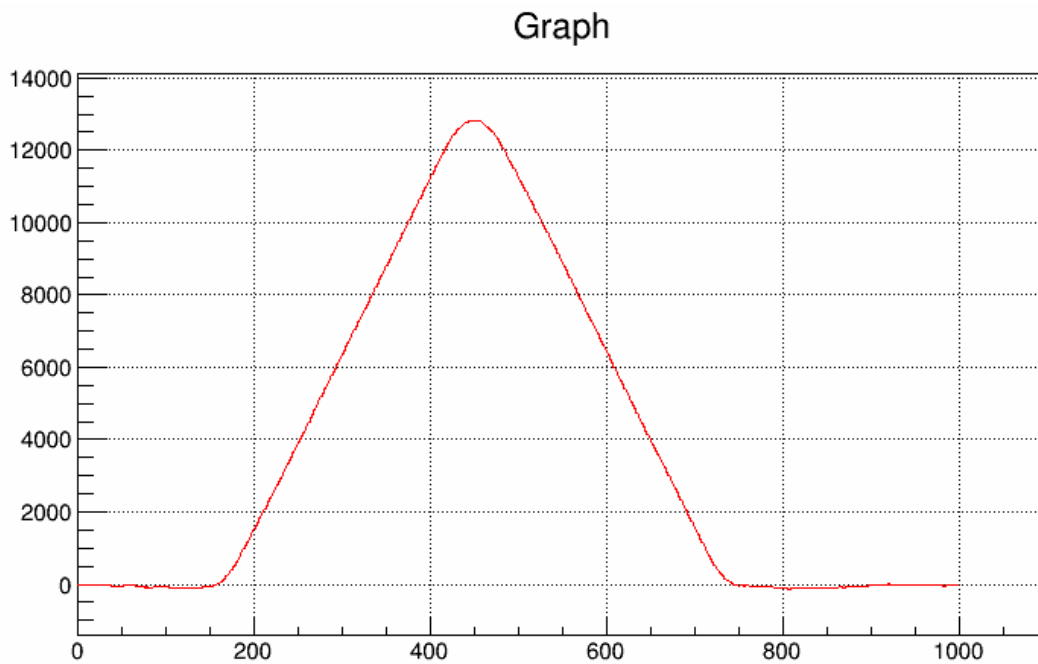
5.3.2 Input Range 5V setting

5.3.2.1 Raw data Graph



Preamplifier: 2.5mV / keV \rightarrow 6360 keV \rightarrow 15.9 mV \rightarrow ~50 counts

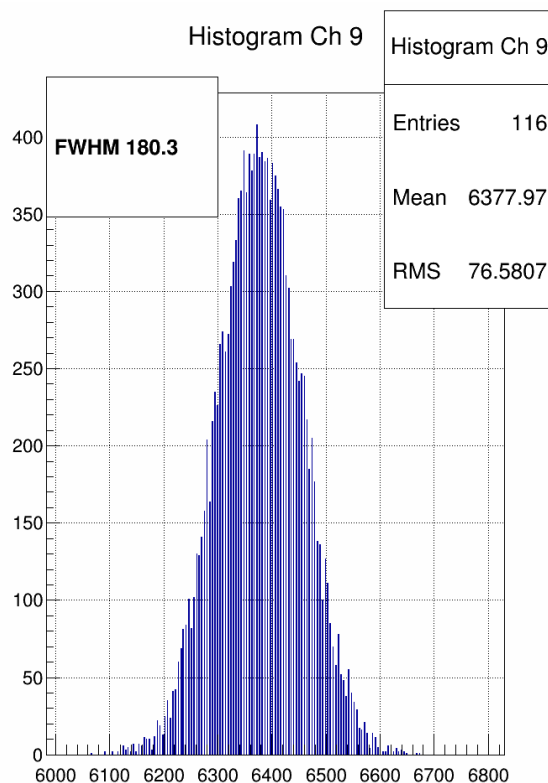
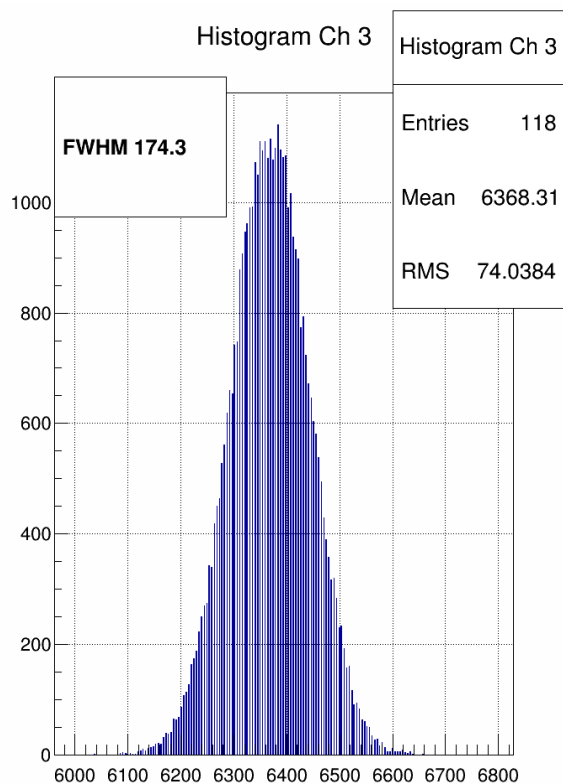
5.3.2.2 Typical Energy FIR Filter Trapezoid



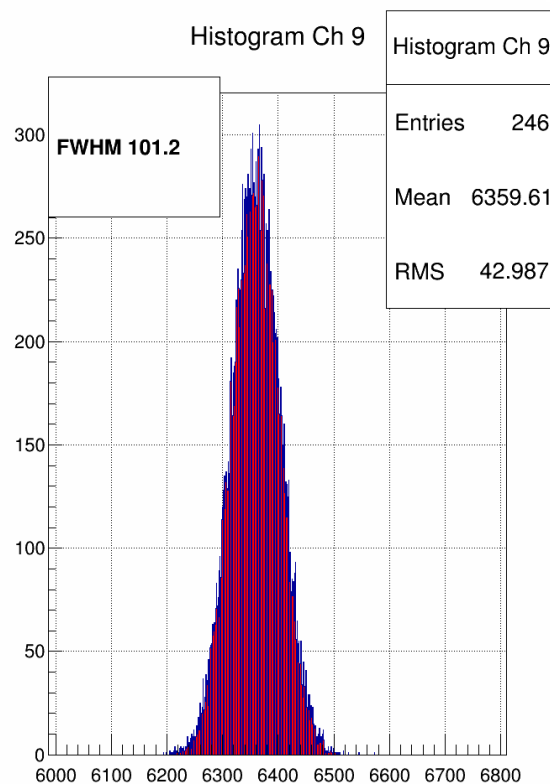
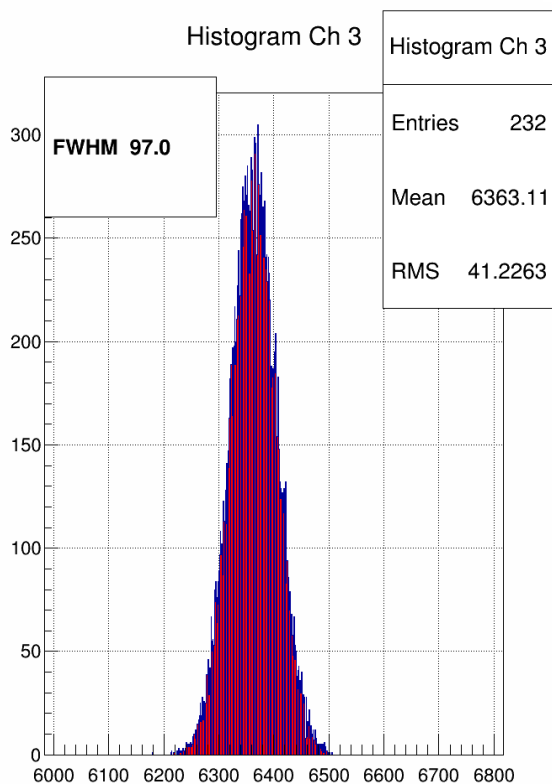
$P = 268$ (1072 ns) , $G = 32$ (128 ns) \rightarrow Pulse FWHM = 1.2 μ s \rightarrow Shaping time = 500 ns
Max value: $P * \sim 50$ counts = $268 * \sim 50 = \sim 13.400$

5.3.2.3 Energy Histograms

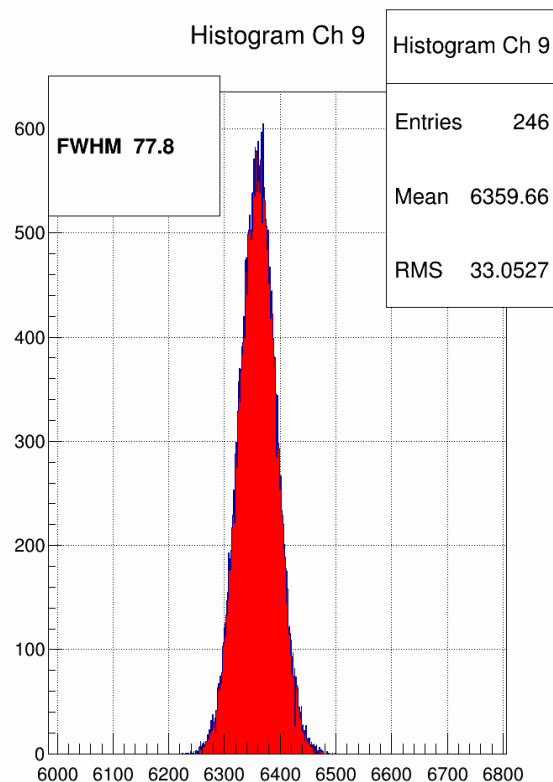
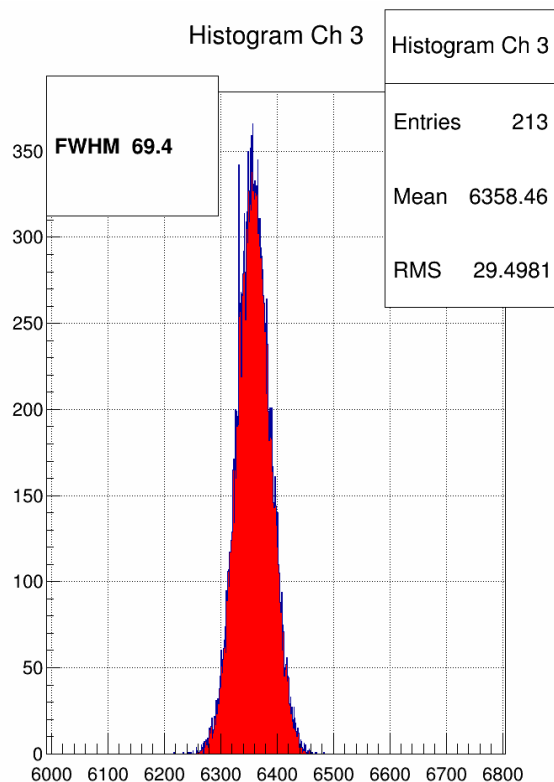
5.3.2.3.1 SIS3316-250MHz -14bit 5V: Shaping Time 100ns



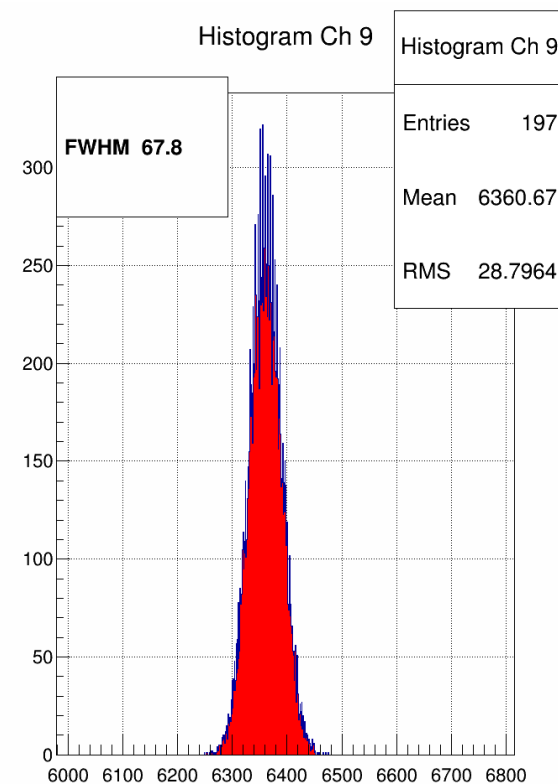
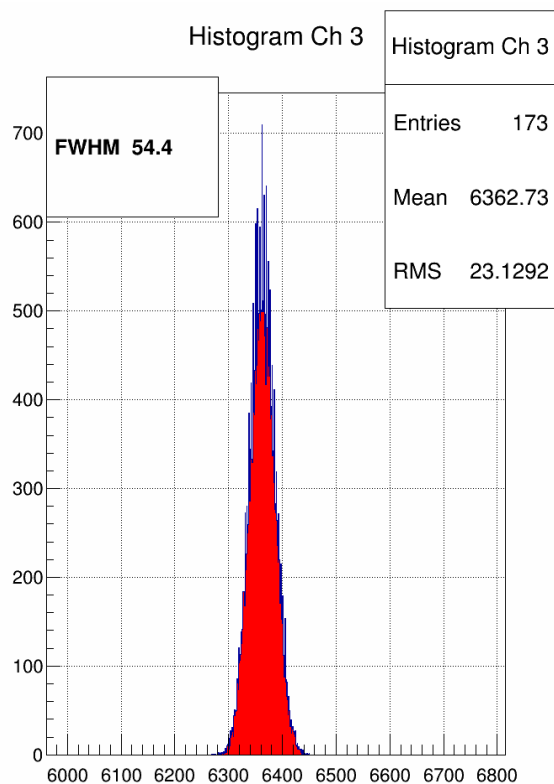
5.3.2.3.2 SIS3316-250MHz -14bit 5V: Shaping Time 250ns



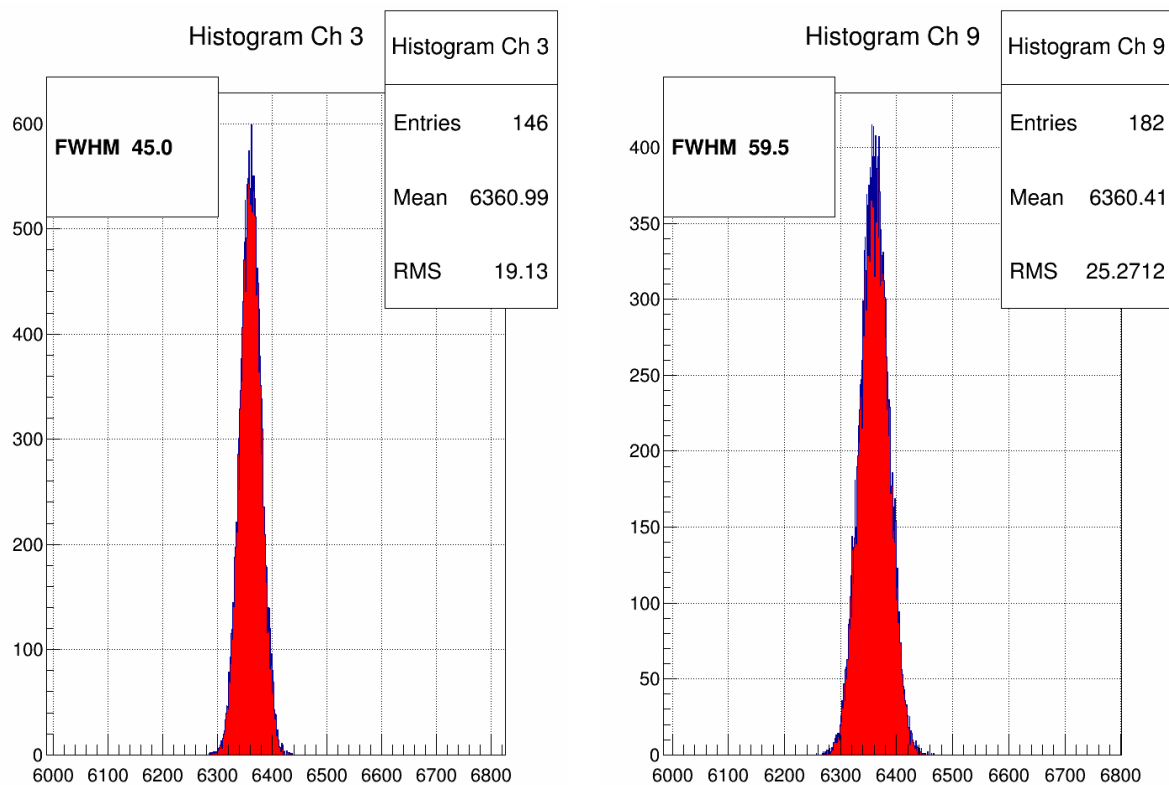
SIS3316-250MHz -14bit 5V: Shaping Time 500ns



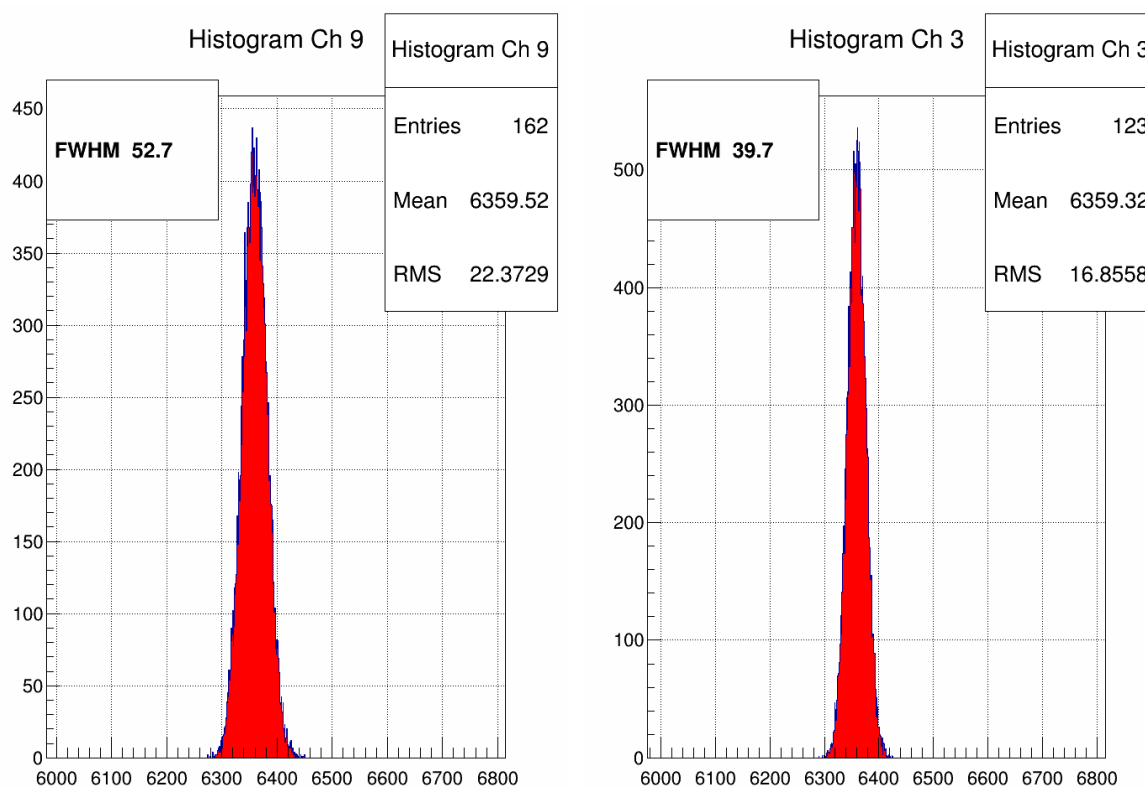
5.3.2.3.3 SIS3316-250MHz -14bit 5V: Shaping Time 1us



5.3.2.3.4 SIS3316-250MHz -14bit 5V: Shaping Time 2us



5.3.2.3.5 SIS3316-250MHz -14bit 5V: Shaping Time 4us



5.4 Measurement Results

*Definition of Shaping time: the time-equivalent of the “standard deviation” of a Gaussian output pulse.

Shaping time = 2,4 x FWHM of the pulse.

5.4.1 SIS3316-125MHz -16bit

5.4.1.1 SIS3316-125MHz -16bit: Resolution Conclusion:

Preamplifier: 2.5mV / keV -> 6360 eV -> 15.9 mV

Shaping Amplifier Shaping time*	Shaping Amplifier Output Pulse width FWHM	SIS3316 Energy Filter P / G	Channel 3 FWHM (at 6360 eV)				Channel 9 FWHM (at 6360 eV)			
			Input Range 5V		Input Range 2V		Input Range 5V		Input Range 2V	
			in eV	%	in eV	%	in eV	%	in eV	%
100 ns	240 ns	14 / 16	120,4	1,89%	69,3	1,09%	123,2	1,94%	71,6	1,13%
250 ns	590 ns	54 / 16	61,2	0,96%	36,7	0,58%	66,3	1,04%	40,3	0,63%
500 ns	1.2 us	134 / 16	40,4	0,64%	24,1	0,38%	52,0	0,82%	33,6	0,53%
1 us	2.4 us	284 / 16	28,9	0,45%	17,3	0,27%	46,7	0,73%	30,9	0,49%
2 us	4.8 us	584 / 16	22,1	0,35%	12,9	0,20%	41,0	0,64%	27,9	0,44%
4 us	9.6 us	1184 / 16	18,3	0,29%	10,4	0,16%	34,2	0,54%	23,0	0,36%
7 us	16.7 us	2044 / 16	16,9	0,27%	9,1	0,14%	28,5	0,45%	18,9	0,30%

5.4.1.2 SIS3316-125MHz -16bit Table: Measurements Channel 3 Input Range 2V

15,94 mV/6360eV	Energy (eV)	Resolution	Resolution in mV	Resolution in ADC counts
Energy FE	6360	100,00%	15,9	460
FWHM (Shaping time 100ns)	69,3	1,09%	0,173	5,012
FWHM (Shaping time 250ns)	36,7	0,58%	0,092	2,654
FWHM (Shaping time 500ns)	24,1	0,38%	0,060	1,743
FWHM (Shaping time 1 us)	17,3	0,27%	0,043	1,251
FWHM (Shaping time 2 us)	12,9	0,20%	0,032	0,933
FWHM (Shaping time 4 us)	10,4	0,16%	0,026	0,752
FWHM (Shaping time = 7 us)	9,1	0,14%	0,023	0,658

5.4.1.3 SIS3316-125MHz -16bit Table: Measurements Channel 9 Input Range 2V

15,9 mV/6360eV	Energy (eV)	Resolution	Resolution in mV	Resolution in ADC counts
Energy FE	6360	100,00%	15,9	460
FWHM (Shaping time 100ns)	71,6	1,13%	0,179	5,179
FWHM (Shaping time 250ns)	40,3	0,63%	0,101	2,915
FWHM (Shaping time 500ns)	33,6	0,53%	0,084	2,430
FWHM (Shaping time 1 us)	30,9	0,49%	0,077	2,235
FWHM (Shaping time 2 us)	27,9	0,44%	0,070	2,018
FWHM (Shaping time 4 us)	23,0	0,36%	0,058	1,664
FWHM (Shaping time = 7 us)	18,9	0,30%	0,047	1,367

5.4.1.4 SIS3316-125MHz -16bit Table: Measurements Channel 3 Input Range 5V

15,94 mV/6360eV	Energy (eV)	Resolution	Resolution in mV	Resolution in ADC counts
Energy FE	6360	100,00%	15,9	200
FWHM (Shaping time 100ns)	120,4	1,89%	0,301	3,786
FWHM (Shaping time 250ns)	61,2	0,96%	0,153	1,925
FWHM (Shaping time 500ns)	40,4	0,64%	0,101	1,270
FWHM (Shaping time 1 us)	28,9	0,45%	0,072	0,909
FWHM (Shaping time 2 us)	22,1	0,35%	0,055	0,695
FWHM (Shaping time 4 us)	18,3	0,29%	0,046	0,575
FWHM (Shaping time = 7 us)	16,9	0,27%	0,042	0,531

5.4.1.5 SIS3316-125MHz -16bit Table: Measurements Channel 9 Input Range 5V

15,94 mV/6360eV	Energy (eV)	Resolution	Resolution in mV	Resolution in ADC counts
Energy FE	6360	100,00%	15,9	200
FWHM (Shaping time 100ns)	123,2	1,94%	0,308	3,874
FWHM (Shaping time 250ns)	66,3	1,04%	0,166	2,085
FWHM (Shaping time 500ns)	52,0	0,82%	0,130	1,635
FWHM (Shaping time 1 us)	46,7	0,73%	0,117	1,469
FWHM (Shaping time 2 us)	41,0	0,64%	0,103	1,289
FWHM (Shaping time 4 us)	34,2	0,54%	0,086	1,075
FWHM (Shaping time = 7 us)	28,5	0,45%	0,071	0,896

5.4.2 SIS3316-250MHz -14bit

5.4.2.1 SIS3316-250MHz -14bit: Resolution Conclusion:

Shaping Amplifier Shaping time*	Shaping Amplifier Output Pulse width FWHM	SIS3316 Energy Filter P / G	Channel 3 FWHM (at 6360 eV)				Channel 9 FWHM (at 6360 eV)			
			Input Range 5V		Input Range 2V		Input Range 5V		Input Range 2V	
			in eV	%	in eV	%	in eV	%	in eV	%
100 ns	240 ns	28 / 32	173,9	2,73%	85,1	1,34%	180,3	2,83%	87,6	1,38%
250 ns	590 ns	108 / 32	97,0	1,53%	45,9	0,72%	101,2	1,59%	49,7	0,78%
500 ns	1.2 us	268 / 32	69,4	1,09%	32,1	0,50%	77,8	1,22%	40,3	0,63%
1 us	2.4 us	568 / 32	54,4	0,86%	24,8	0,39%	67,8	1,07%	36,0	0,57%
2 us	4.8 us	1168 / 32	45,0	0,71%	19,8	0,31%	59,5	0,94%	32,4	0,51%
3,46 us	8.3 us	2044 / 32	39,7	0,62%	17,2	0,27%	52,9	0,83%	28,1	0,44%

5.4.2.2 SIS3316-250MHz -14bit Table: Measurements Channel 3 Input Range 2V

15,9 mV/6360eV	Energy (eV)	Resolution	Resolution in mV	Resolution in ADC counts
Energy FE	6360	100,00%	15,9	124
FWHM (Shaping time 100ns)	85,1	1,34%	0,213	1,659
FWHM (Shaping time 250ns)	45,9	0,72%	0,115	0,895
FWHM (Shaping time 500ns)	32,1	0,50%	0,080	0,626
FWHM (Shaping time 1 us)	24,8	0,39%	0,062	0,484
FWHM (Shaping time 2 us)	19,8	0,31%	0,050	0,386
FWHM (Shaping time 3,46 us)	17,2	0,27%	0,043	0,335

5.4.2.3 SIS3316-250MHz -14bit Table: Measurements Channel 9 Input Range 2V

15,9 mV/6360eV	Energy (eV)	Resolution	Resolution in mV	Resolution in ADC counts
Energy FE	6360	100,00%	15,9	124
FWHM (Shaping time 100ns)	87,6	1,38%	0,219	1,708
FWHM (Shaping time 250ns)	49,7	0,78%	0,124	0,969
FWHM (Shaping time 500ns)	40,3	0,63%	0,101	0,786
FWHM (Shaping time 1 us)	36,0	0,57%	0,090	0,702
FWHM (Shaping time 2 us)	32,4	0,51%	0,081	0,632
FWHM (Shaping time 3,46 us)	28,1	0,44%	0,070	0,548

5.4.2.4 SIS3316-250MHz -14bit Table: Measurements Channel 3 Input Range 5V

15,9 mV/6360eV	Energy (eV)	Resolution	Resolution in mV	Resolution in ADC counts
Energy FE	6360	100,00%	15,9	50
FWHM (Shaping time 100ns)	173,9	2,73%	0,435	1,367
FWHM (Shaping time 250ns)	97,0	1,53%	0,243	0,763
FWHM (Shaping time 500ns)	69,4	1,09%	0,174	0,546
FWHM (Shaping time 1 us)	54,4	0,86%	0,136	0,428
FWHM (Shaping time 2 us)	45,0	0,71%	0,113	0,354
FWHM (Shaping time 3,46 us)	39,7	0,62%	0,099	0,312

5.4.2.5 SIS3316-250MHz -14bit Table: Measurements Channel 9 Input Range 5V

15,9 mV/6360eV	Energy (eV)	Resolution	Resolution in mV	Resolution in ADC counts
Energy FE	6360	100,00%	15,9	50
FWHM (Shaping time 100ns)	180,3	2,83%	0,451	1,417
FWHM (Shaping time 250ns)	101,2	1,59%	0,253	0,796
FWHM (Shaping time 500ns)	77,8	1,22%	0,195	0,612
FWHM (Shaping time 1 us)	67,8	1,07%	0,170	0,533
FWHM (Shaping time 2 us)	59,5	0,94%	0,149	0,468
FWHM (Shaping time 3,46 us)	52,9	0,83%	0,132	0,416

6 FIR Filter Resolution Measurements with multiple amplitudes

6.1 SIS3316 Energy Resolution Measurement Setup

SIS3316-125-16bit Input Configuration

Input Range: ~2.25V (2V setting) (~34,3 μ V/count)

Input Range: ~5.2V (5V setting) (~79,3 μ V/count)

Impedance: 50 Ω

SIS3316-250-14bit Input Configuration

Input Range: ~2.1V (2V setting) (~128,2 μ V/count)

Input Range: ~5.2V (5V setting) (~317,4 μ V/count)

Impedance: 50 Ω

Waveform Generator: Agilent 33522A

Waveform: Square

Rising edge: 120 ns

1. Amplitude: 15.9 mV

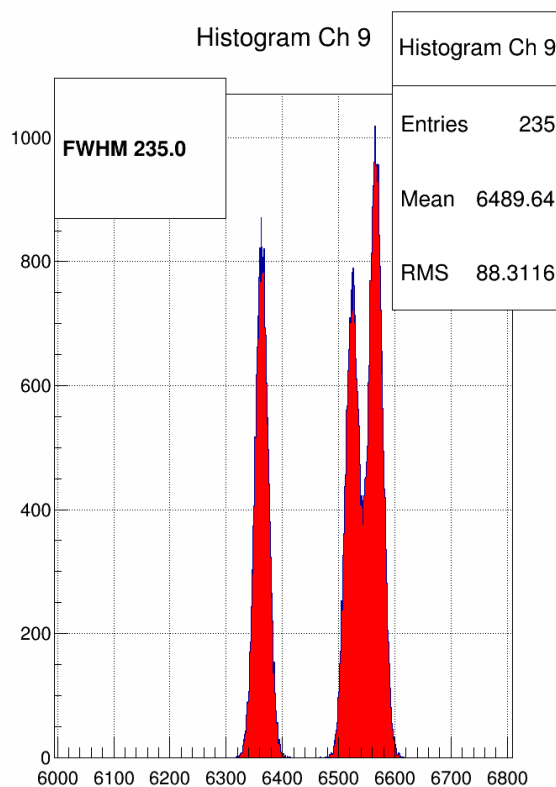
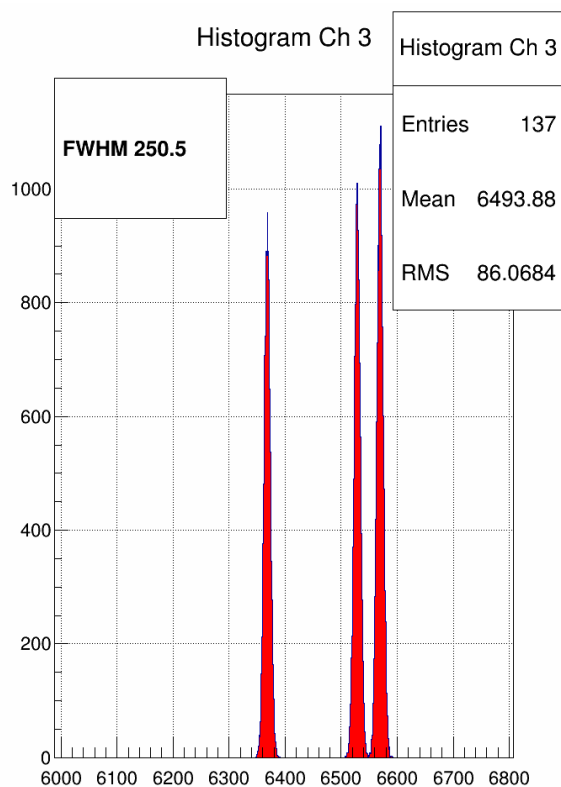
2. Amplitude: 16.3 mV (15.9 mV + 400 μ V)

3. Amplitude: 16.4 mV (15.9 mV + 400 μ V + 100 μ V)

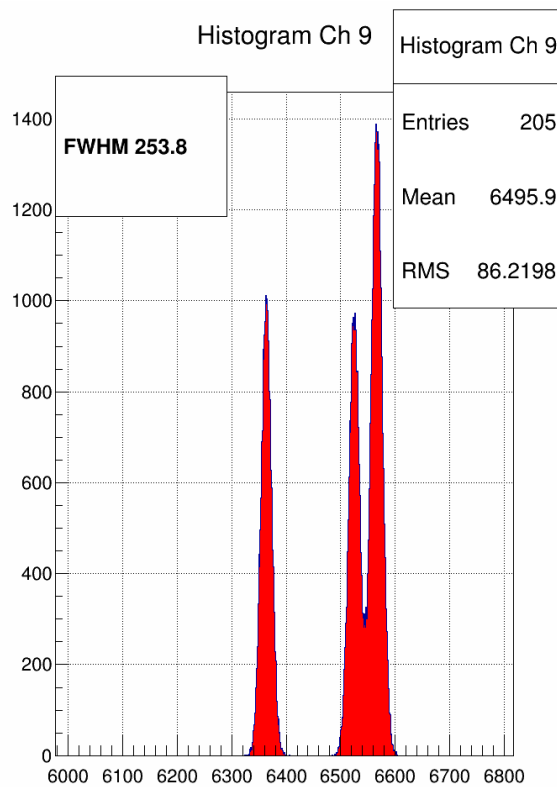
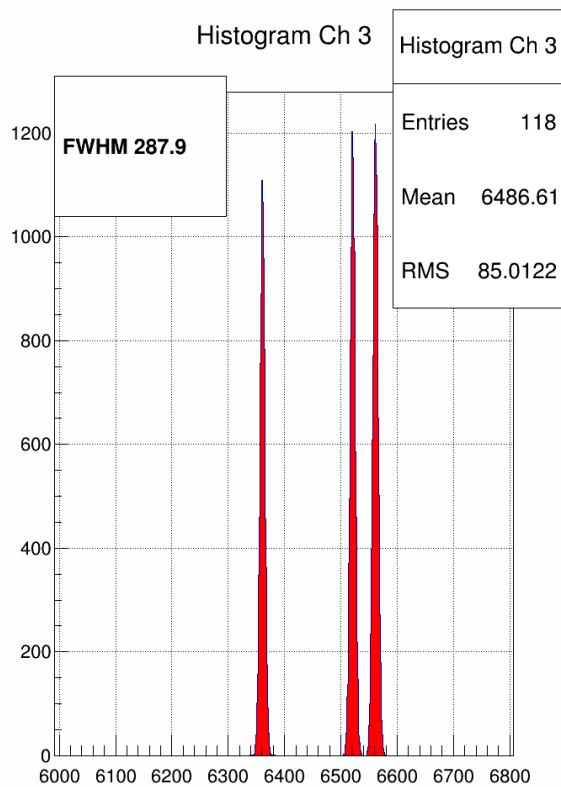
6.2 SIS3316-125MHz -16bit Measurements

6.2.1 Input Range 2V setting

6.2.1.1 SIS3316-125MHz -16bit 2V: Shaping Time 2 us

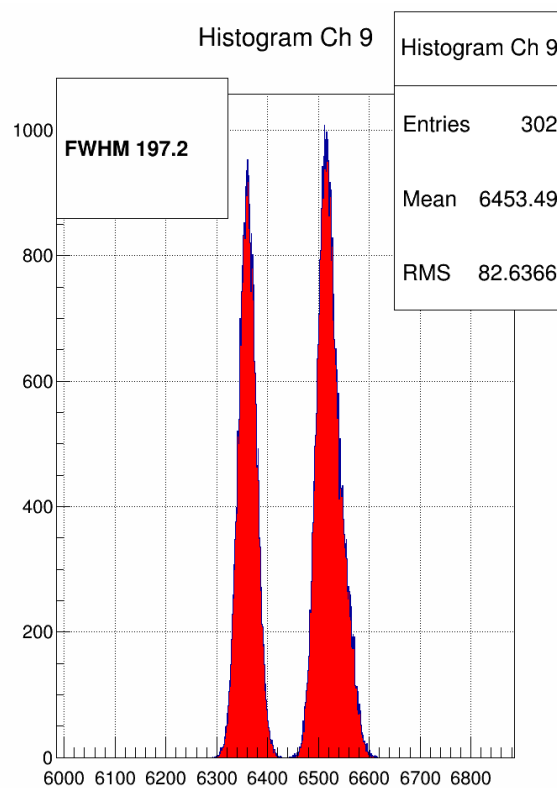
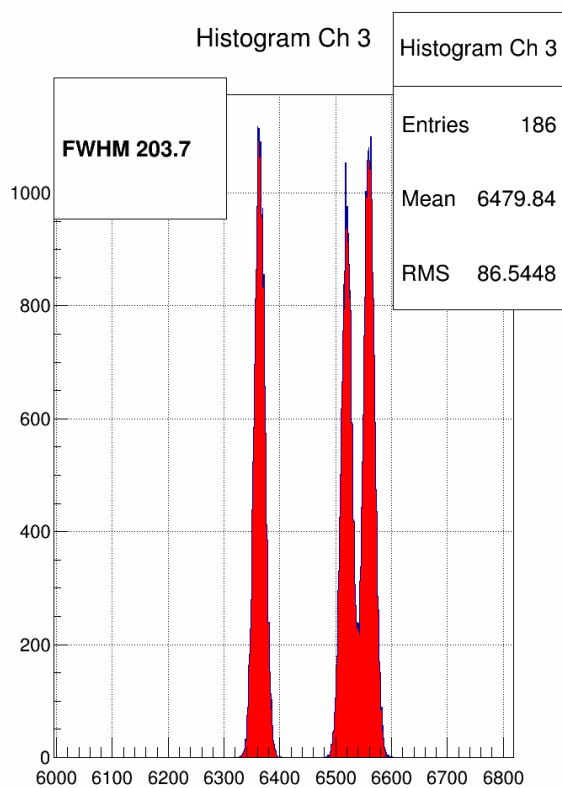


6360 keV -> 15,9 mV + 400 uV + 100 uV

6.2.1.2 SIS3316-125MHz -16bit 2V: Shaping Time 4 us

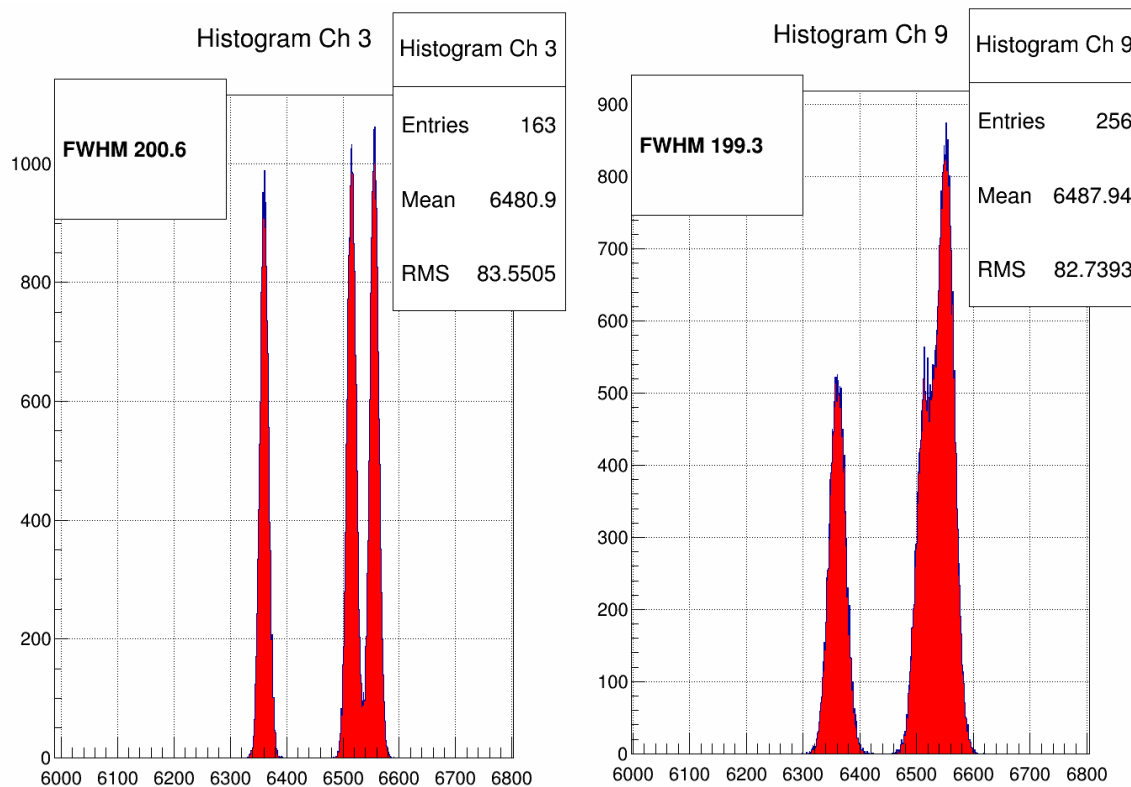
6360 keV -> 15,9 mV + 400 uV + 100 uV

6.2.1.3 SIS3316-125MHz -16bit 5V: Shaping Time 2 us



6360 keV -> 15,9 mV + 400 uV + 100 uV

6.2.1.4 SIS3316-125MHz -16bit 5V: Shaping Time 4 us

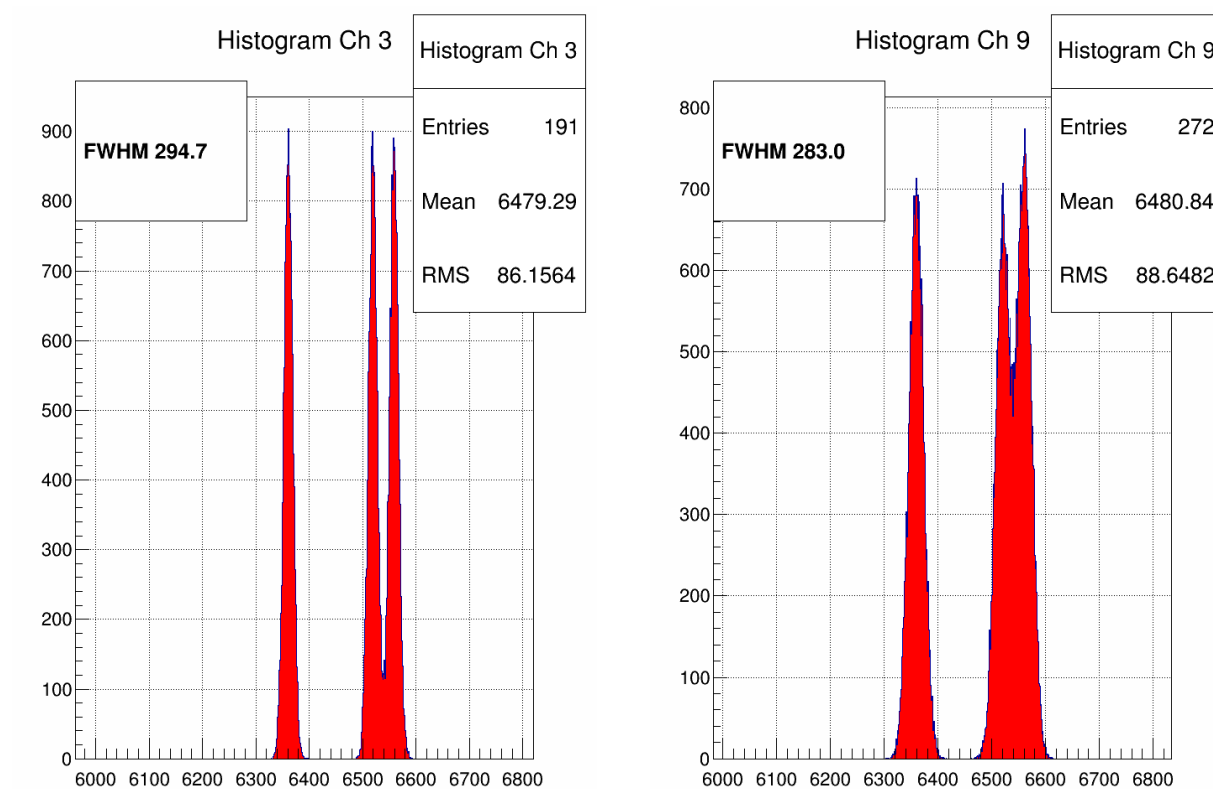


6360 keV -> 15,9 mV + 400 uV + 100 uV

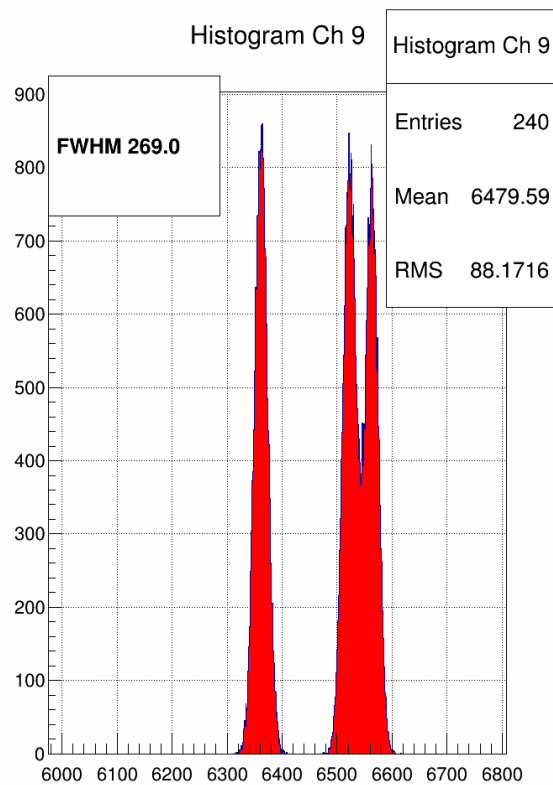
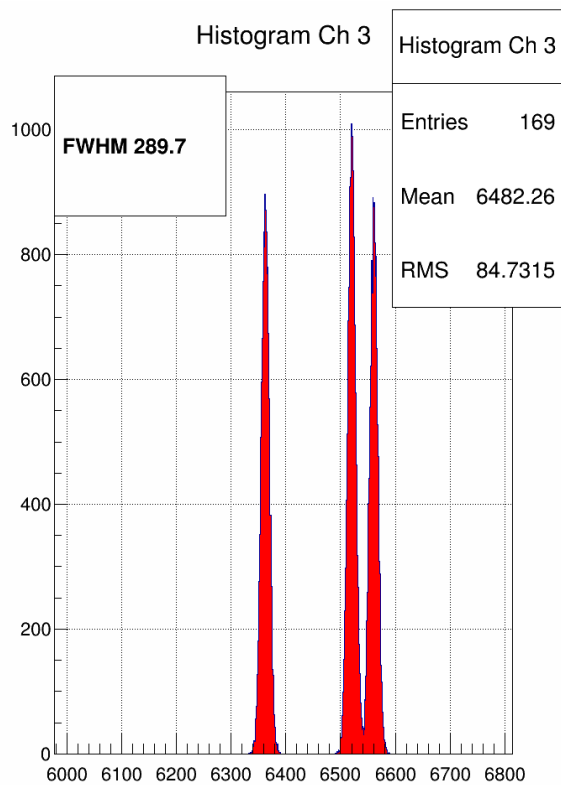
6.3 SIS3316-250MHz -14bit Measurements

6.3.1 Input Range 2V setting

6.3.1.1 SIS3316-250MHz -14bit 2V: Shaping Time 2 us

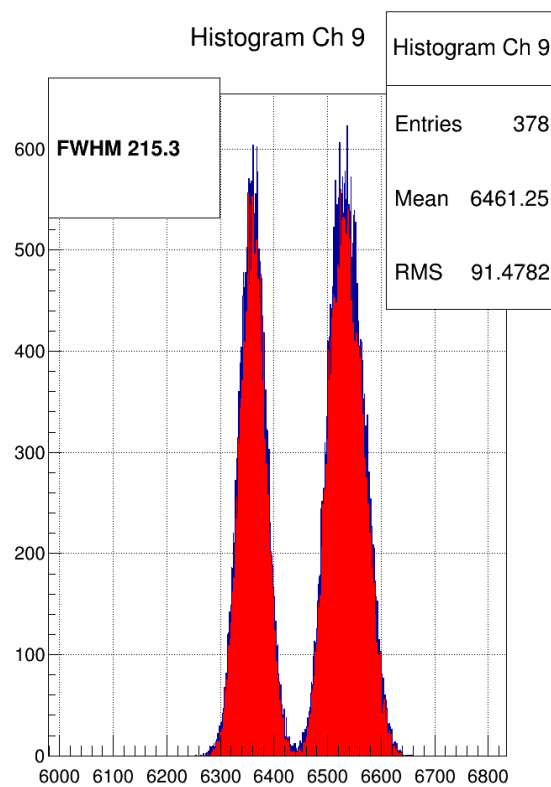
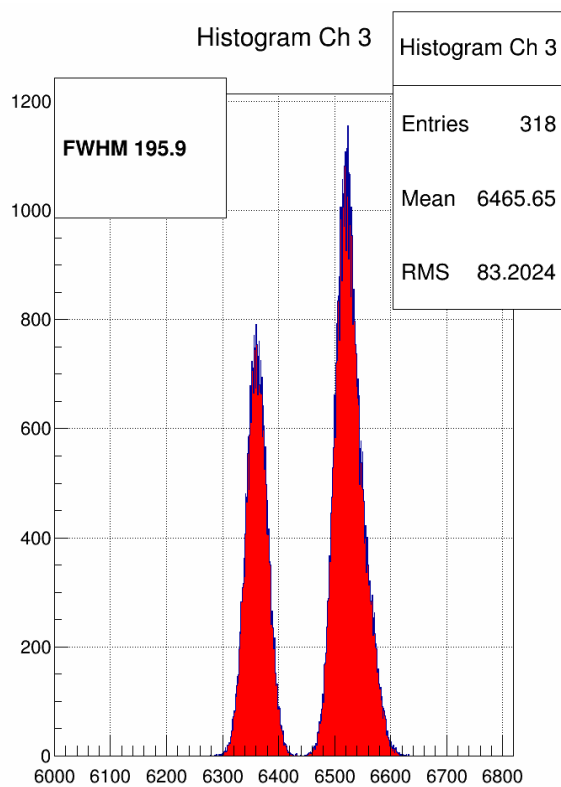


6360 keV -> 15,9 mV + 400 uV + 100 uV

6.3.1.2 SIS3316-250MHz -14bit 2V: Shaping Time 3,46 us

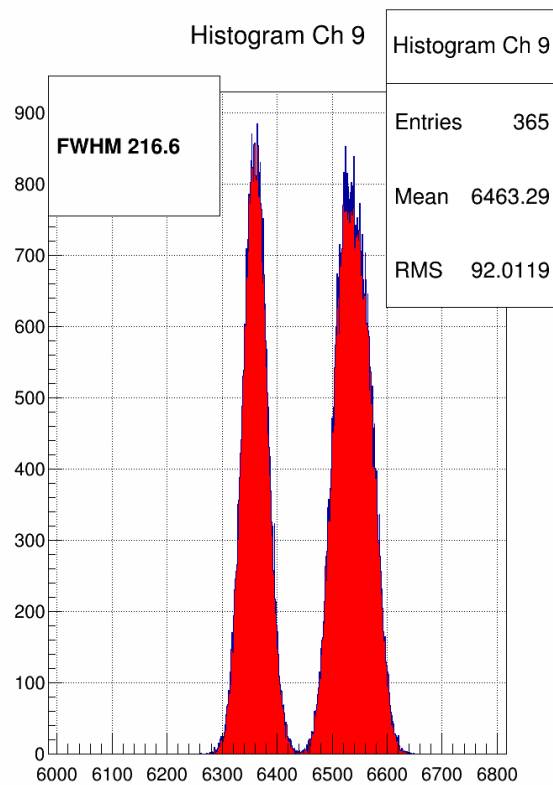
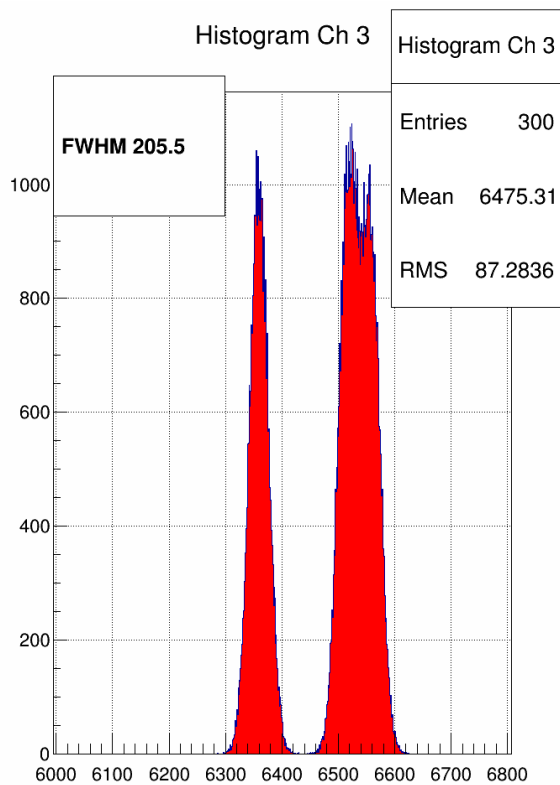
6360 keV -> 15,9 mV + 400 uV + 100 uV

6.3.1.3 SIS3316-250MHz -14bit 5V: Shaping Time 2 us



6360 keV -> 15,9 mV + 400 uV + 100 uV

6.3.1.4 SIS3316-250MHz -14bit 5V: Shaping Time 3,46 us



6360 keV -> 15,9 mV + 400 uV + 100 uV

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