Using eLab Without a Detector

NATHAN UNTERMAN

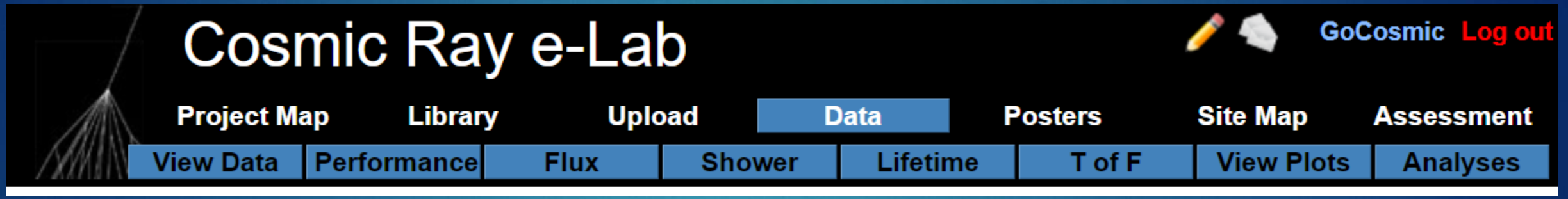
UNIVERSITY OF NEW MEXICO JULY 2022

UNM

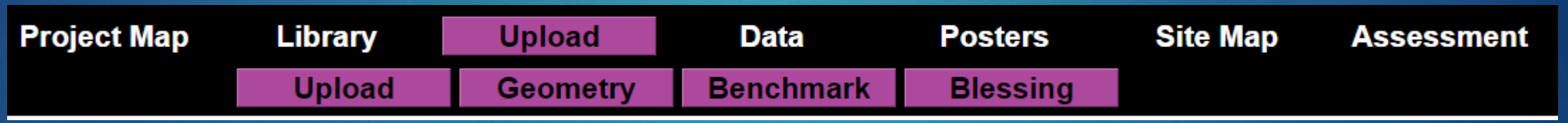
Golden Files

- How to find
  - Correct Tools
  - Geometry
  - Blessing Charts
- Classroom Strategies
- Differentiated learning

Tools



Geometry



Note: If you cannot directly get the geometry of a specific file, it can be seen from the Blessing Chart for that file.

New Detector 7026 Entry:

Date: July / 27 / 2022 @ 14 : 50 UTC *Detector Geometry*

If you are using EQUIP for data acquisition, you still need to enter geometry data on this page for use in the Cosmic Ray e-lab.

GPS is @ (0,0,0).
Each point (x,y,z) represents the center of a counter.
Confused? Seeing errors? Please consult the Geometry Tutorial.

	Active Channels:	1 ☑	2 ☑	3 ☑	4 ☑
	Cable Length (m)	Area(cm²)	x:E-W(m)	y:N-S(m)	z:Up-Dn(m)
 1	15.3	744.2	-0.50	0.80	-0.30
 2	15.3	744.2	-0.50	0.80	-0.50
 3	15.3	744.2	-0.50	0.80	-0.80
 4	15.3	744.2	-0.50	0.80	-0.83

 ◉ Stacked Orientation ○ Unstacked 

 Visualize geometry

GPS Coordinates

GPS Coordinates Tutorial Find GPS Coordinates

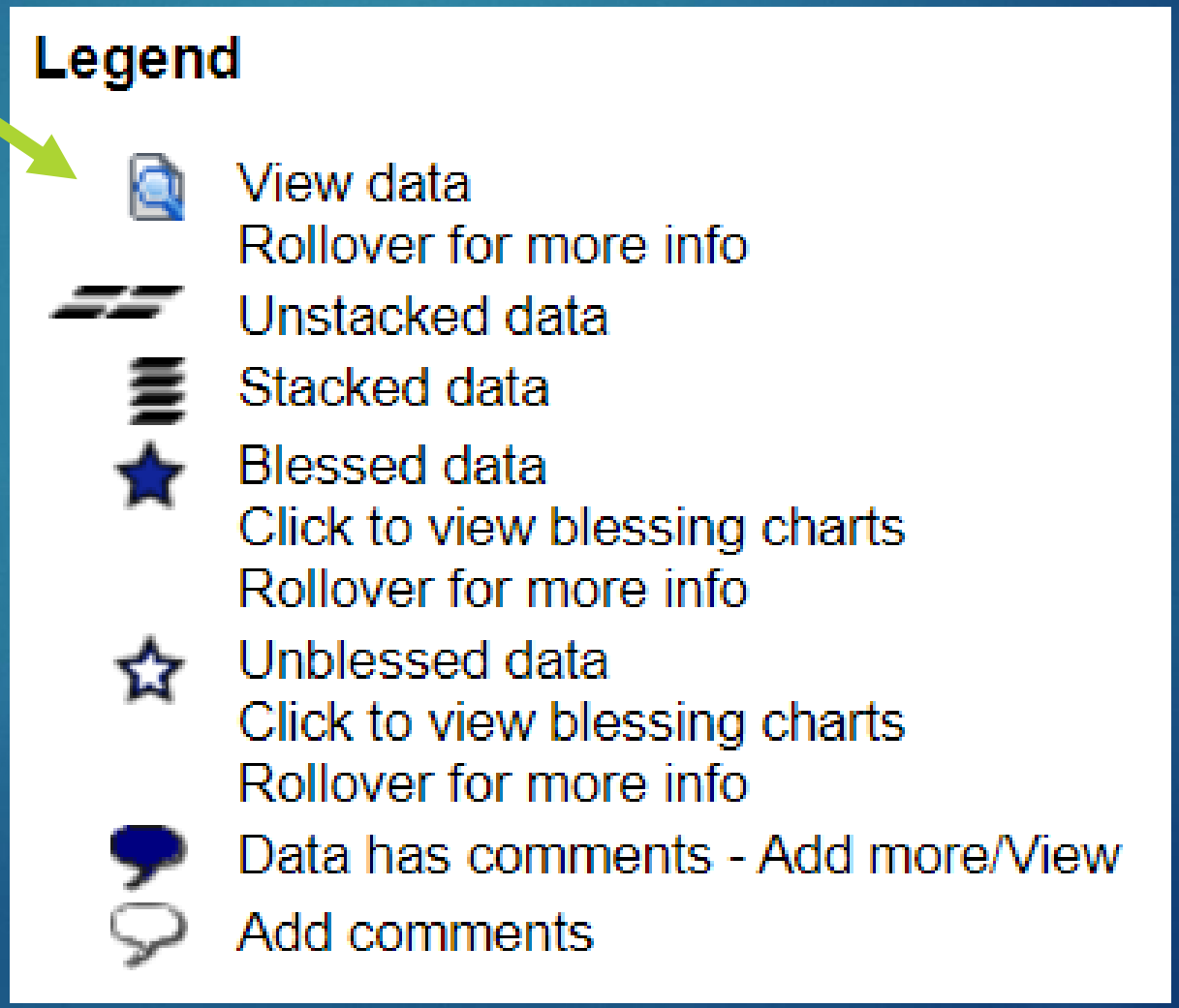
Latitude: 35:05.871445 N e.g., 47:39.234736 N
Longitude: 106:39.976060 W e.g., 122:18.68 W

Map GPS Coordinates

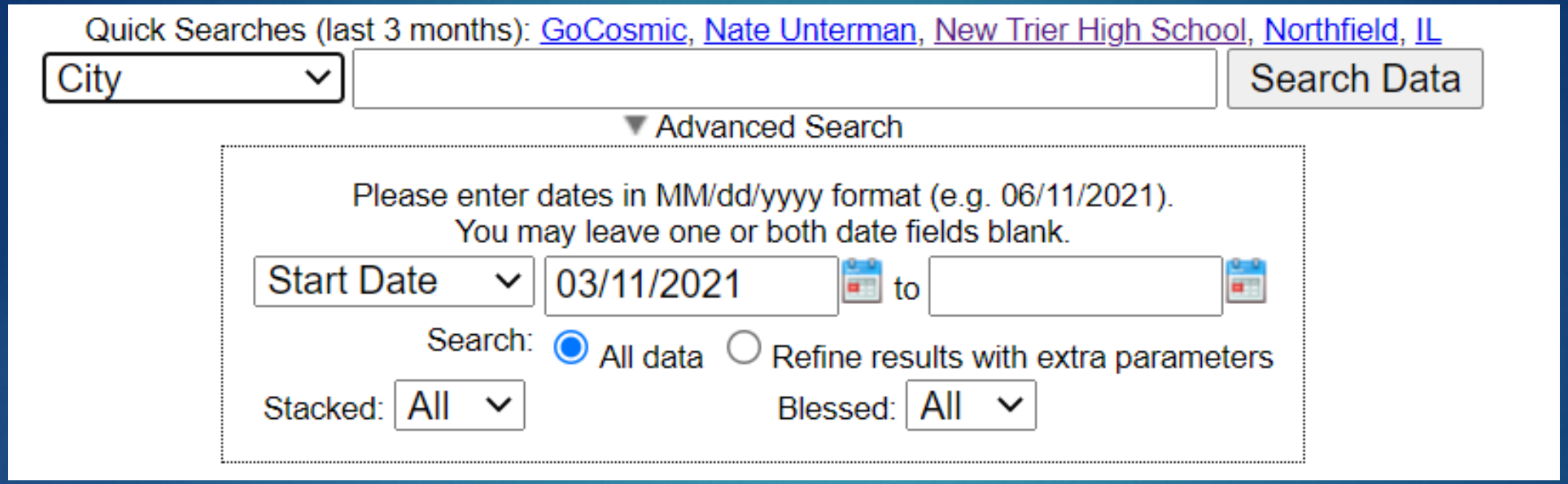
Altitude (m): 1525.50 GPS Cable Length (m): 35.48

Commit Geometry

Blessing Files and Path to Geometry



File Search



The Drop Down menu has selections for DAQ and Date

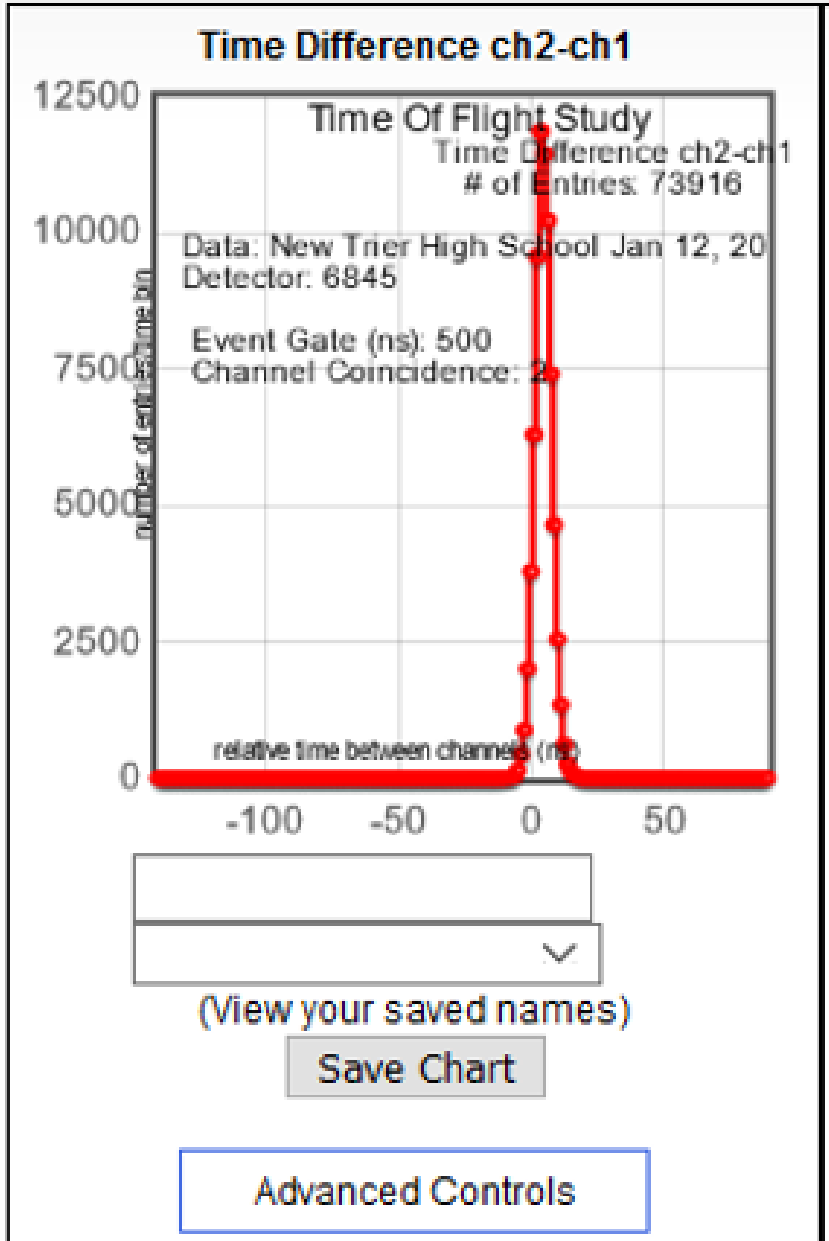
Available Files

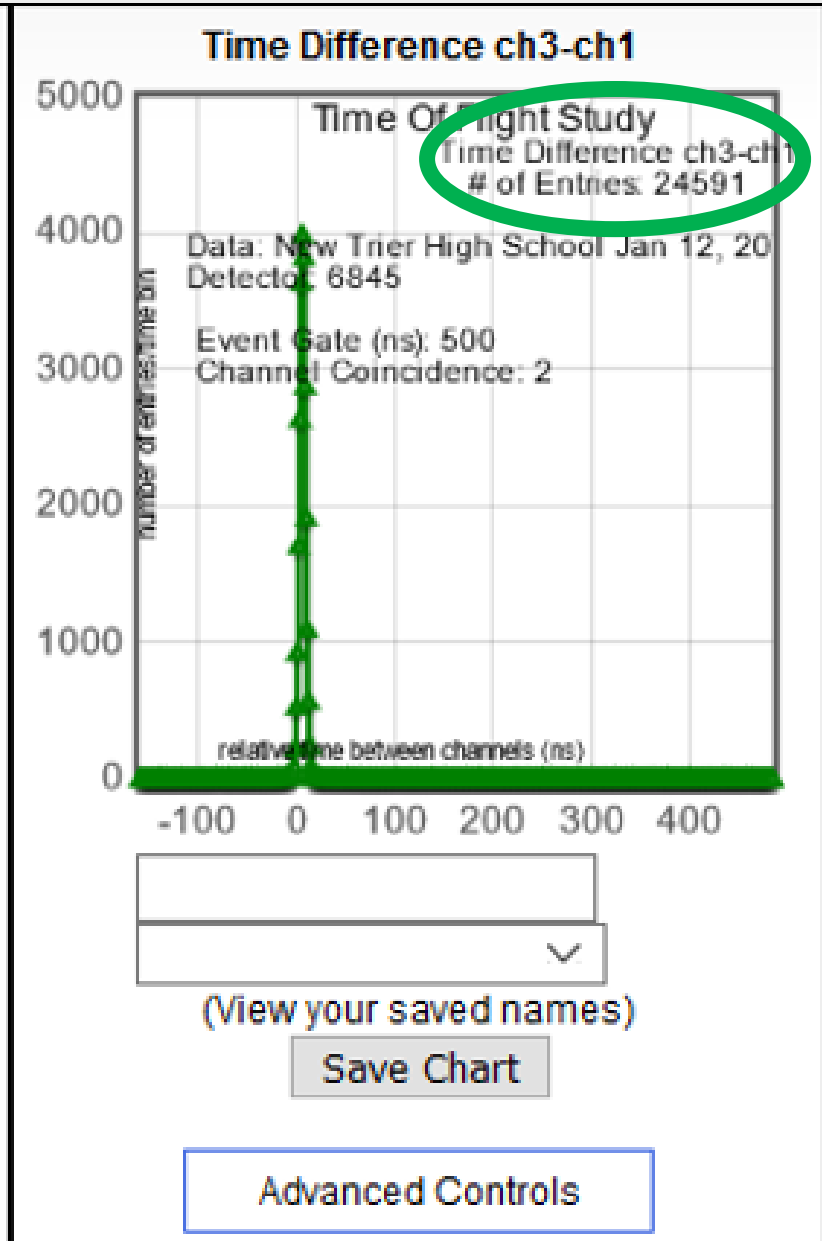
- Time of Flight
- Angle of Acceptance
- Shower Triangle Study
- Lifetime
- Shower Study 3.8 km Separation
- Speed of Muon
- Long Range Studies

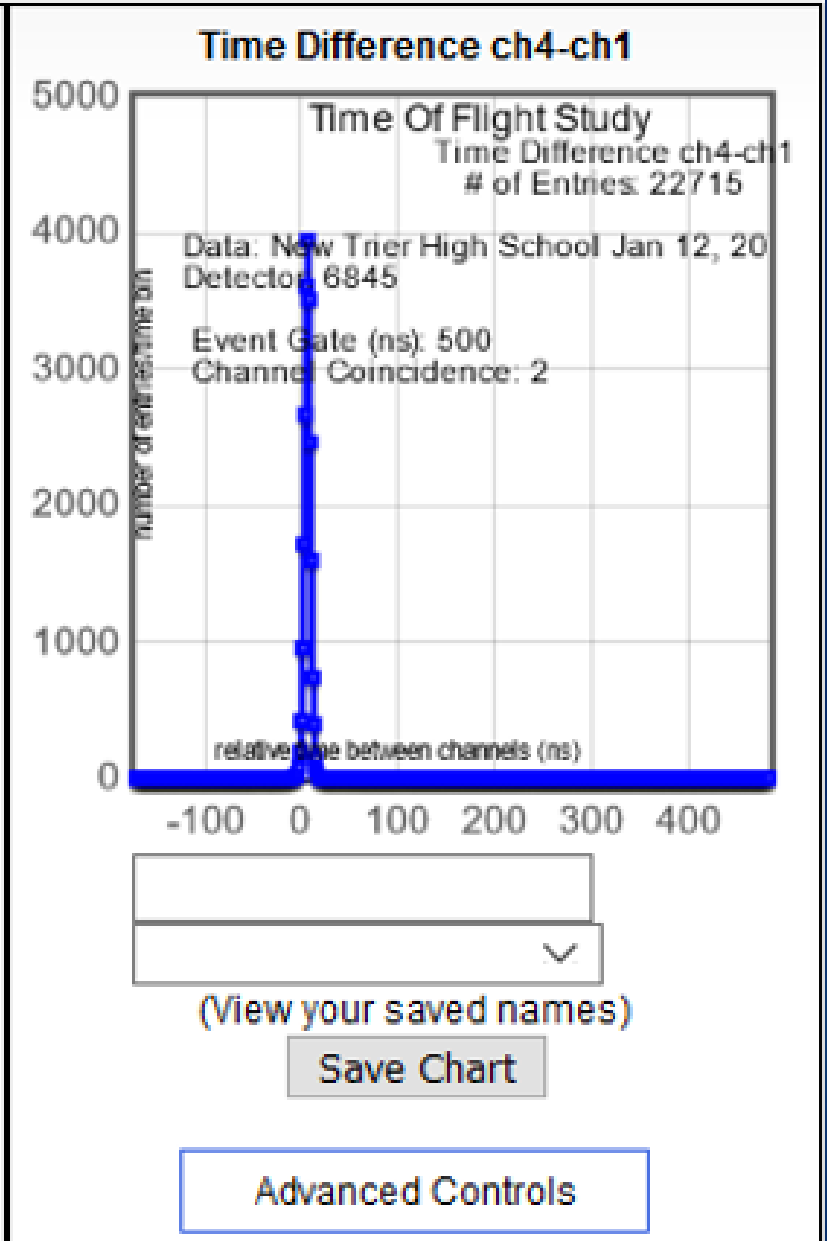
- Barometric Pressure Studies

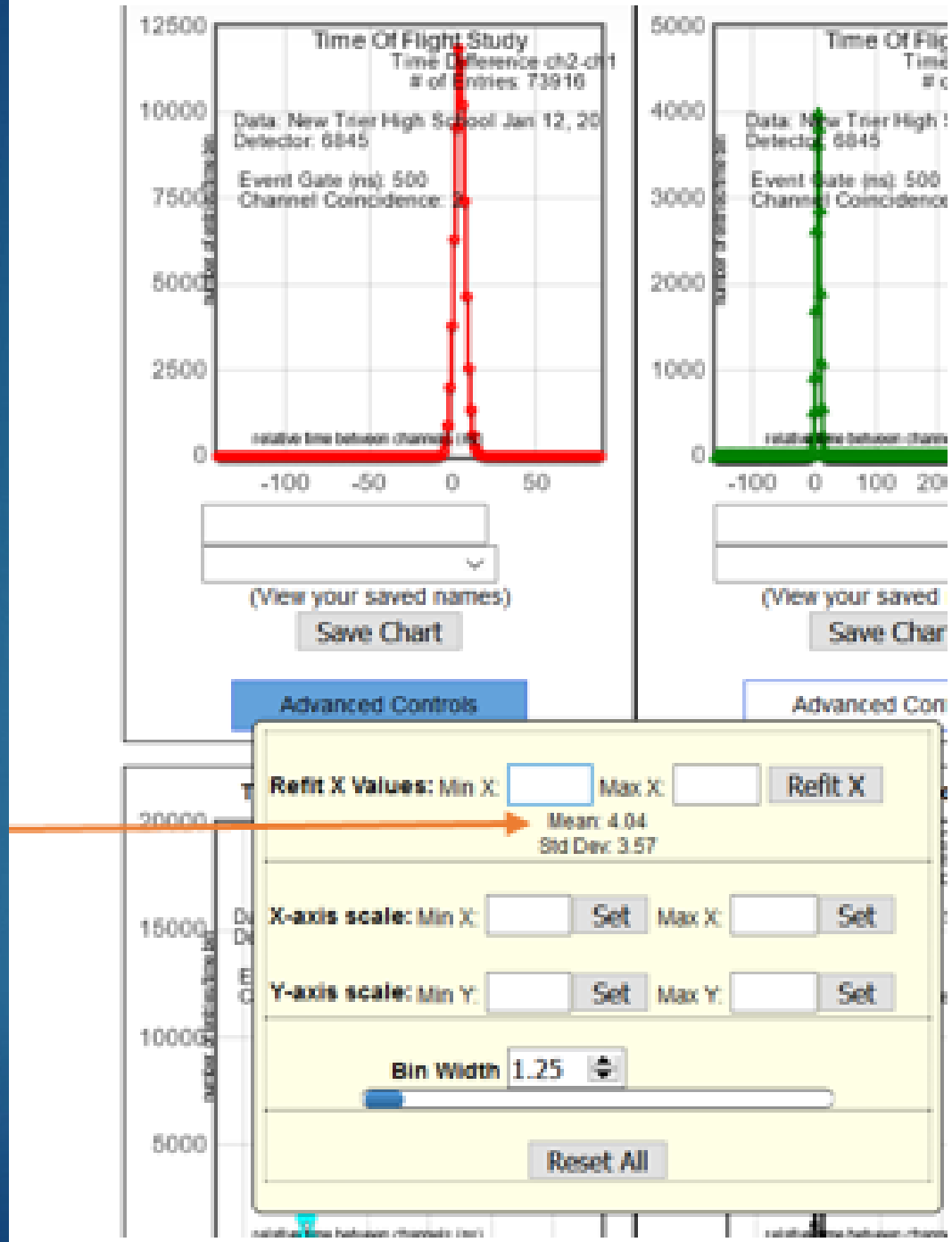
Time of Flight and Angle of Acceptance

Experiment	Experiment	DAQ	Date	Geometry	Position Channel 1 (m)	Position Channel 2 (m)	Position Channel 3 (m)	Position Channel 4 (m)	Coincidence	Gate (ns)	Pipeline (ns)	Comment
Time of Flight	Angle of Acceptance	6200	12.September.2019 -3	Stacked	0.04	-0.87	-1.64	-1.67	2	300	100	Barometer not reliable
Time of Flight	Angle of Acceptance	6200	13.September.2019	Stacked	0.04	-0.87	-1.64	-1.67	2	300	100	Barometer not reliable
Time of Flight	Angle of Acceptance	6200	14.September.2019	Stacked	0.04	-0.87	-1.64	-1.67	2	300	100	Barometer not reliable
Time of Flight	Angle of Acceptance	6200	15.September.2019	Stacked	0.04	-0.87	-1.64	-1.67	2	300	100	Barometer not reliable
Time of Flight	Angle of Acceptance	6200	16.September.2019 -0	Stacked	0.04	-0.87	-1.64	-1.67	2	300	100	Barometer not reliable
Time of Flight	Angle of Acceptance	6200	16.September.2019 -1	Stacked	0.04	-0.87	-1.64	-1.67	2	300	100	Barometer not reliable


Time Difference ch2-ch1
Time Of Flight Study
Time Difference ch2-ch1
# of Entries: 73916
Data: New Trier High School Jan 12, 20
Detector: 6845
Event Gate (ns): 500
Channel Coincidence: 2
number of entries/time bin
relative time between channels (ns)
12500
10000
7500
5000
2500
0
-100
-50
0
50
(View your saved names)
Save Chart
Advanced Controls


Time Difference ch3-ch1
Time Of Flight Study
Time Difference ch3-ch1
# of Entries: 24591
Data: New Trier High School Jan 12, 20
Detector: 6845
Event Gate (ns): 500
Channel Coincidence: 2
number of entries/time bin
relative time between channels (ns)
5000
4000
3000
2000
1000
0
-100
0
100
200
300
400
(View your saved names)
Save Chart
Advanced Controls


Time Difference ch4-ch1
Time Of Flight Study
Time Difference ch4-ch1
# of Entries: 22715
Data: New Trier High School Jan 12, 20
Detector: 6845
Event Gate (ns): 500
Channel Coincidence: 2
number of entries/time bin
relative time between channels (ns)
5000
4000
3000
2000
1000
0
-100
0
100
200
300
400
(View your saved names)
Save Chart
Advanced Controls

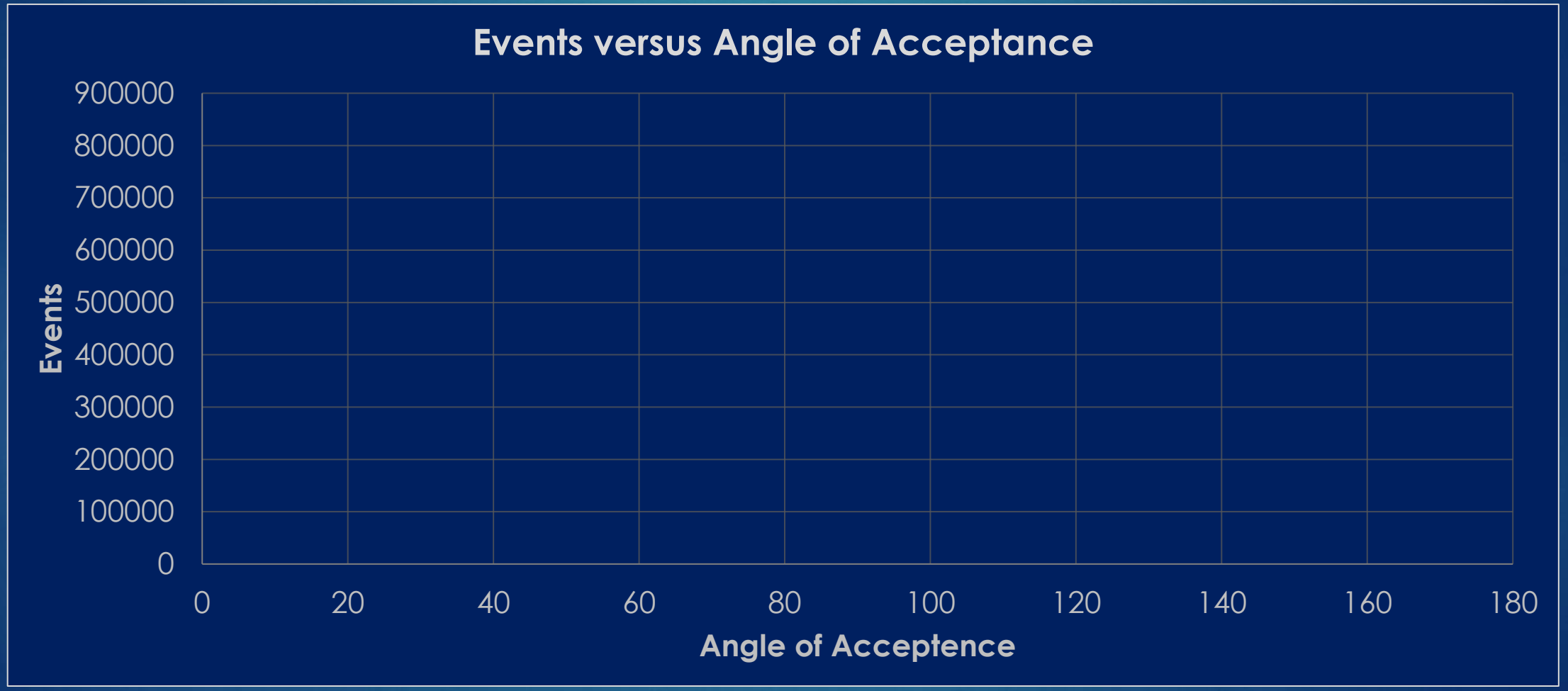

Time Of Flight Study
Time Difference ch2-ch1
# of Entries: 73916
Data: New Trier High School Jan 12, 20
Detector: 6845
Event Gate (ns): 500
Channel Coincidence:
relative time between channels (ns)
12500
10000
7500
5000
2500
0
-100
-50
0
50
(View your saved names)
Save Chart
Advanced Controls
Refit X Values: Min X: Max X: Refit X
Mean: 4.04
Std Dev: 3.57
X-axis scale: Min X: Set Max X: Set
Y-axis scale: Min Y: Set Max Y: Set
Bin Width 1.25
Reset All
5000
4000
3000
2000
1000
0
-100
0
100
(View your saved
Save Char
Advanced Con

Angle of Acceptance Analysis

24-hour files only		angle acceptance = $\tan^{-1}((side/2)/(channel\ separation/2))*2$						
NOT corrected for pressure		angle acceptance = $\tan^{-1}((0.26/2)/(channel\ separation/2))*2$						
	Channel pair	1-2	1-3	1-4	2-3	2-4	3-4	1-2-3-4
	Separation (meters)	0.824	1.68	1.71	0.856	0.859	0.03	1.71

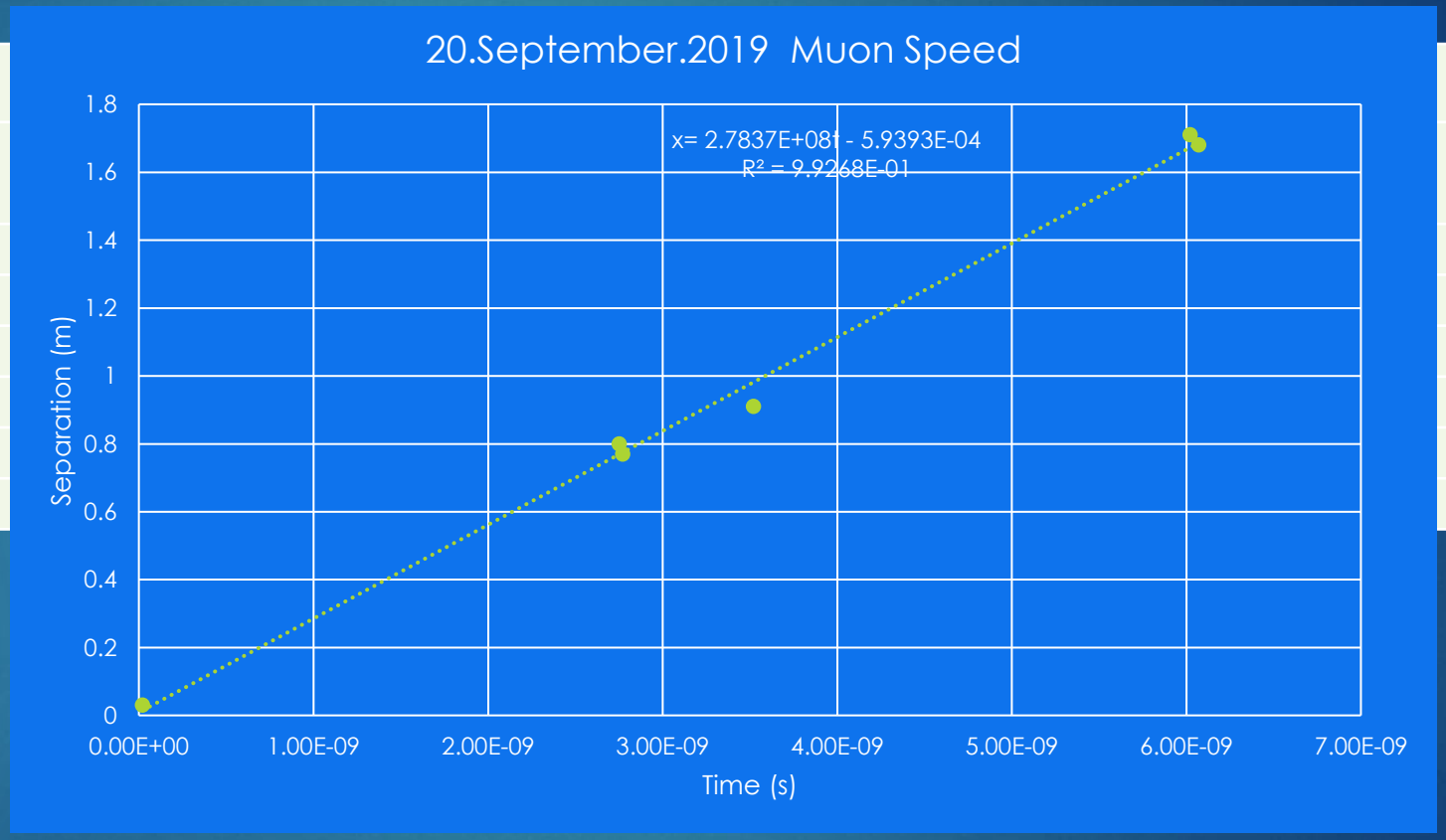
		Number of Events for (Counter Pair) Angle of Acceptance								
Date	DAQ	(1-2) 35.0º	(1-3) 17.6º	(1-4) 17.3º	(2-3) 33.8º	(2-4) 33.7º	(3-4) 166.8º	17.3º		Column E - I
13.Sept.2019	6200	58231	19049	17552	80896	71747	835224	15189		2363
14.Sept.2019	6200	57692	19070	17526	80208	71162	834085	15246		2280
15.Sept.2020	6200	58237	19271	17744	81205	71745	837186	15451		2293
17.Sept.2019	6200	57898	19144	17575	80434	71168	834965	15298		2277
18.Sept.2019	6200	57688	19077	17561	81210	71542	834466	15201		2360
20.Sept.2019	6200	55889	18888	17360	80395	71322	835586	15123		2237
21.Sept.2019	6200	55655	18701	17276	80445	71582	835501	15059		2217

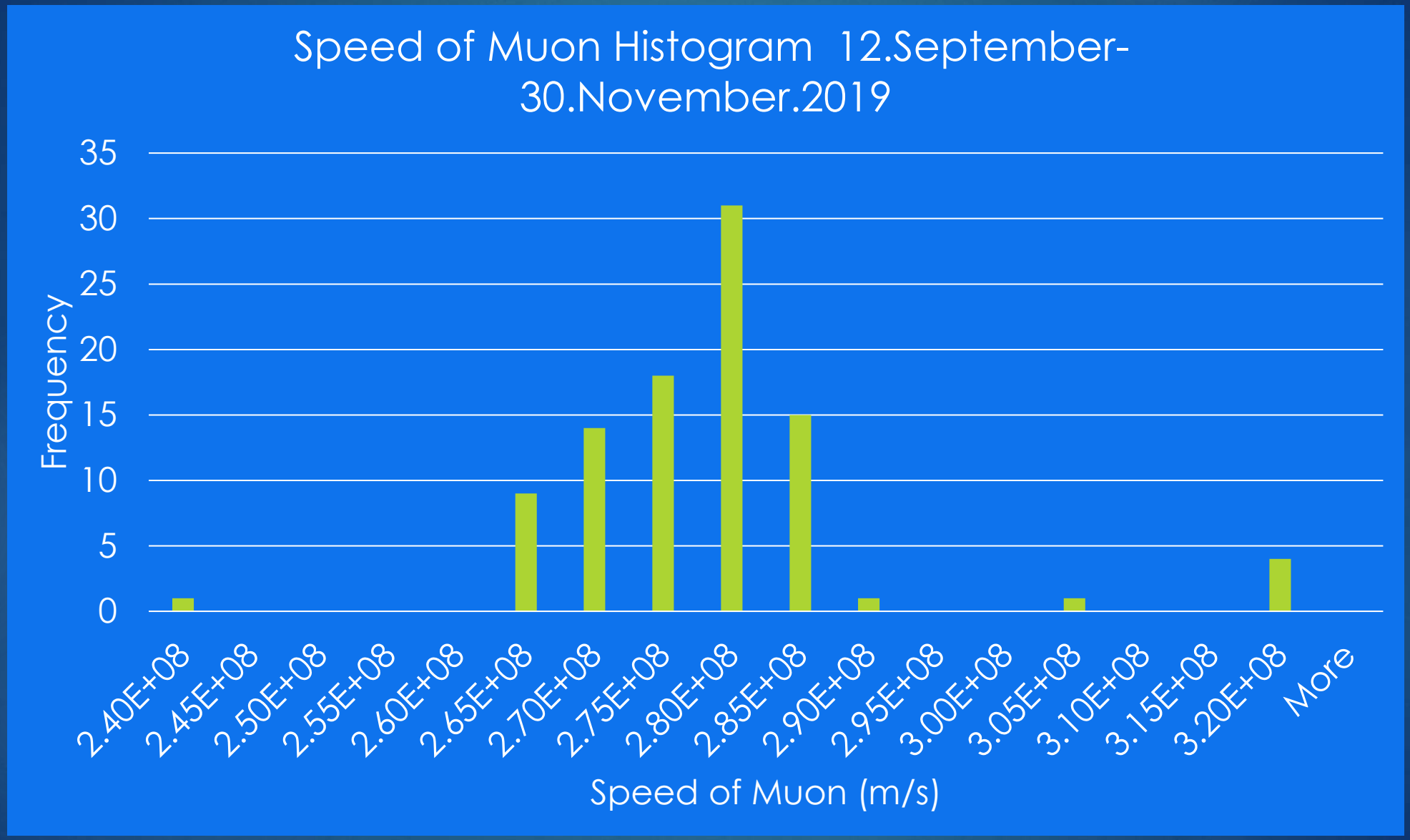
Angle of Acceptance



Speed of Muon

20.Sept.2019		DAQ 6200		
Counter Pair	Time (s)	Spacing (m)		
1 – 2	3.52E-09	0.91	v	2.78E+08
1 - 3	6.07E-09	1.68		
1 - 4	6.02E-09	1.71		
2 - 3	2.77E-09	0.77		
2 - 4	2.75E-09	0.8		
3 - 4	2.00E-11	0.03		



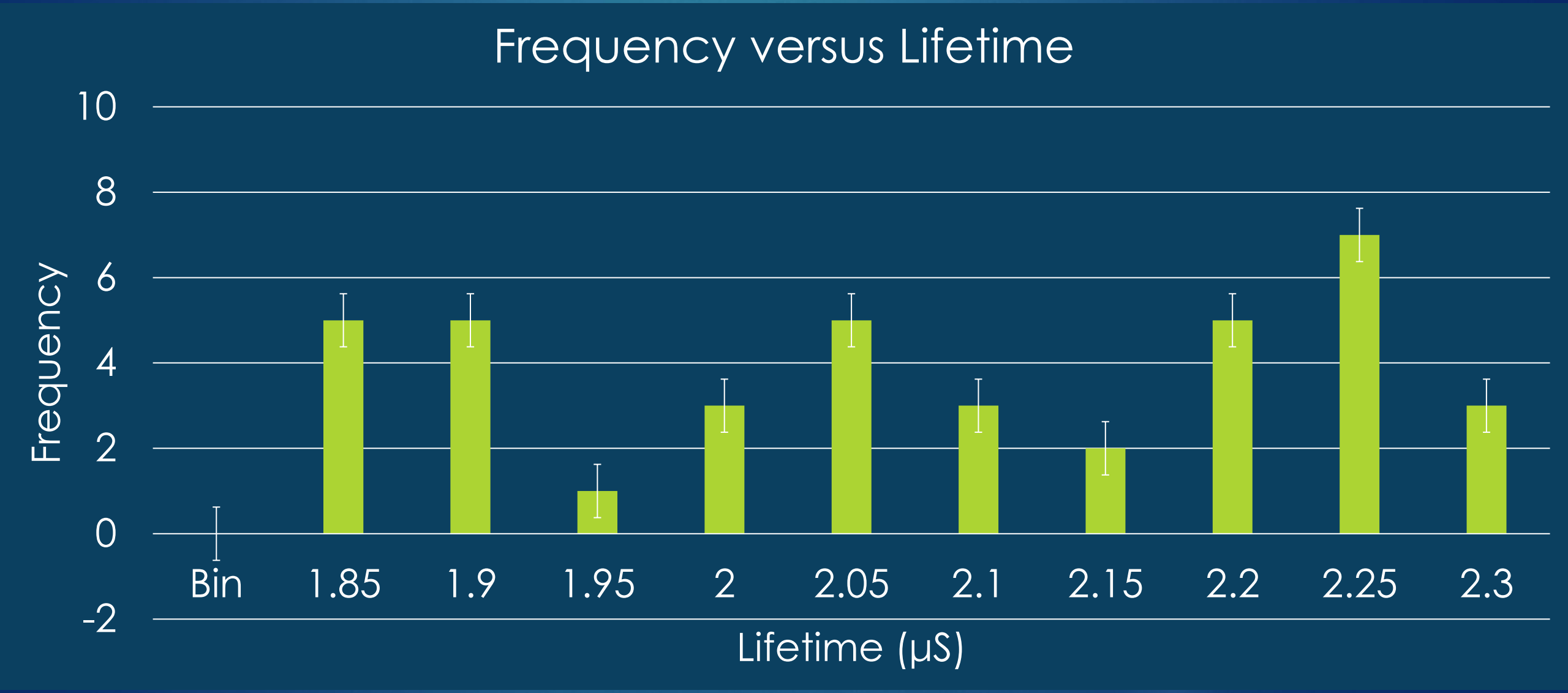

Speed of Muon Histogram 12.September-30.November.2019
Frequency
35
30
25
20
15
10
5
0
2.40E+08
2.45E+08
2.50E+08
2.55E+08
2.60E+08
2.65E+08
2.70E+08
2.75E+08
2.80E+08
2.85E+08
2.90E+08
2.95E+08
3.00E+08
3.05E+08
3.10E+08
3.15E+08
3.20E+08
More
Speed of Muon (m/s)

Shower Triangle Study

Indoor Study								All need to normalize by duration
Experiment	DAQ	Date	Time Duration	Geometry	Side Length (m)	Events	Coincidence	Comment
Shower Triangle	6690	06.September.2015	14:34	Stack	0.00	38988	3	
Shower Triangle	6690	04.November.2015	0:56	Array	0.50	442	3	
Shower Triangle	6690	04.November.2015	12:58	Array	1.00	108	3	
Shower Triangle	6690	04.November.2015	17:00	Array	1.50	99	3	
Shower Triangle	6690	04.November.2015 - 05.November.2015	22:29	Array	2.00	37+ 274	3	Crosses midnight UTC

Muon Lifetime

DAQ	Date	Configuration	Position Channel 1 (m)	Position Channel 2 (m)	Position Channel 3 (m)	Position Channel 4 (m)	Coincidence	Gate Width (seconds)	Bins	Lifetime (μS)	Comments
6234	21.December.2017	Stacked	0.12	0.1	x	0	1	1.00E-05	40	2.1	Run under OLD program
6234	22.December.2017	Stacked	0.12	0.1	x	0	1	1.00E-05	40	2.25	Run under OLD program
6234	23.December.2017	Stacked	0.12	0.1	x	0	1	1.00E-05	40	2.24	Run under OLD program
6234	24.December.2017	Stacked	0.12	0.1	x	0	1	1.00E-05	40	1.99	Run under OLD program
6234	25.December.2017	Stacked	0.12	0.1	x	0	1	1.00E-05	40	2.36	Run under OLD program
6234	26.December.2017	Stacked	0.12	0.1	x	0	1	1.00E-05	40	2.06	Run under OLD program
6234	27.December.2017	Stacked	0.12	0.1	x	0	1	1.00E-05	40	2.29	Run under OLD program


Frequency versus Lifetime
10
8
6
4
2
0
-2
Frequency
Bin
1.85
1.9
1.95
2
2.05
2.1
2.15
2.2
2.25
2.3
Lifetime (µS)

Shower Study 3.8 km Separation

DAQ	Date	Configuration	DAQ	Date	Configuration
6200	07.February.2020	Stacked	6845	07.February.2020	Stacked
6200	08.February.2020	Stacked	6845	08.February.2020	Stacked
6200	09.February.2020	Stacked	6845	09.February.2020	Stacked
6200	10.February.2020 -0	Stacked	6845	10.February.2020 -0	Stacked
6200	10.February.2020 -1	Stacked	6845	10.February.2020 -1	Stacked
6200	11.February.2020	Stacked	6845	11.February.2020	Stacked

Barometric Studies

- Any stacked file lends itself to barometric studies
- Days may be concatenated together under Flux study. Barometer tool will show concatenated Blessing Charts.

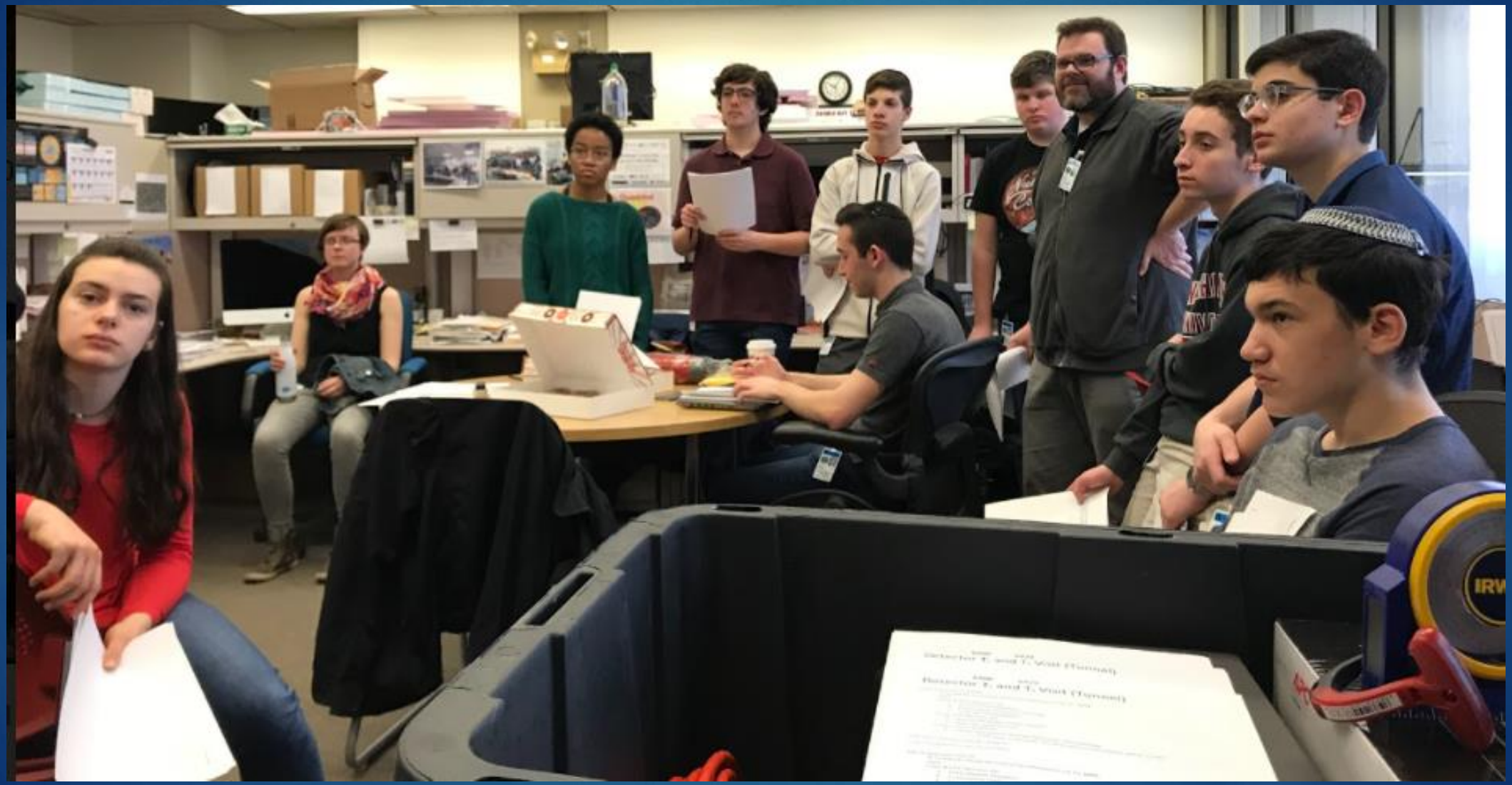
Classroom Strategies

- In most studies, enough files for individualized assignment
- Simple studies, such as speed of muons, taking averages
  - More complex with histograms
  - Outlier error analysis
  - Differentiated Instruction possibilities
- Multiple sections of course can build analysis cooperatively
- Poster writing
- Reflection and metacognition of process
- More difficult problems, such as shower study at 3.8 km available for enrichment
- What else can be asked of the data set?

Other Studies

- Might Lunar Shadow be buried within the data set?
- Severe weather
- . . . Only limited by imagination

Questions?



Contact

- Nathan Unterman
- nunterman@gmail.com
- 773 758-0464