LBNE FD Rawdata Event Display

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Outline

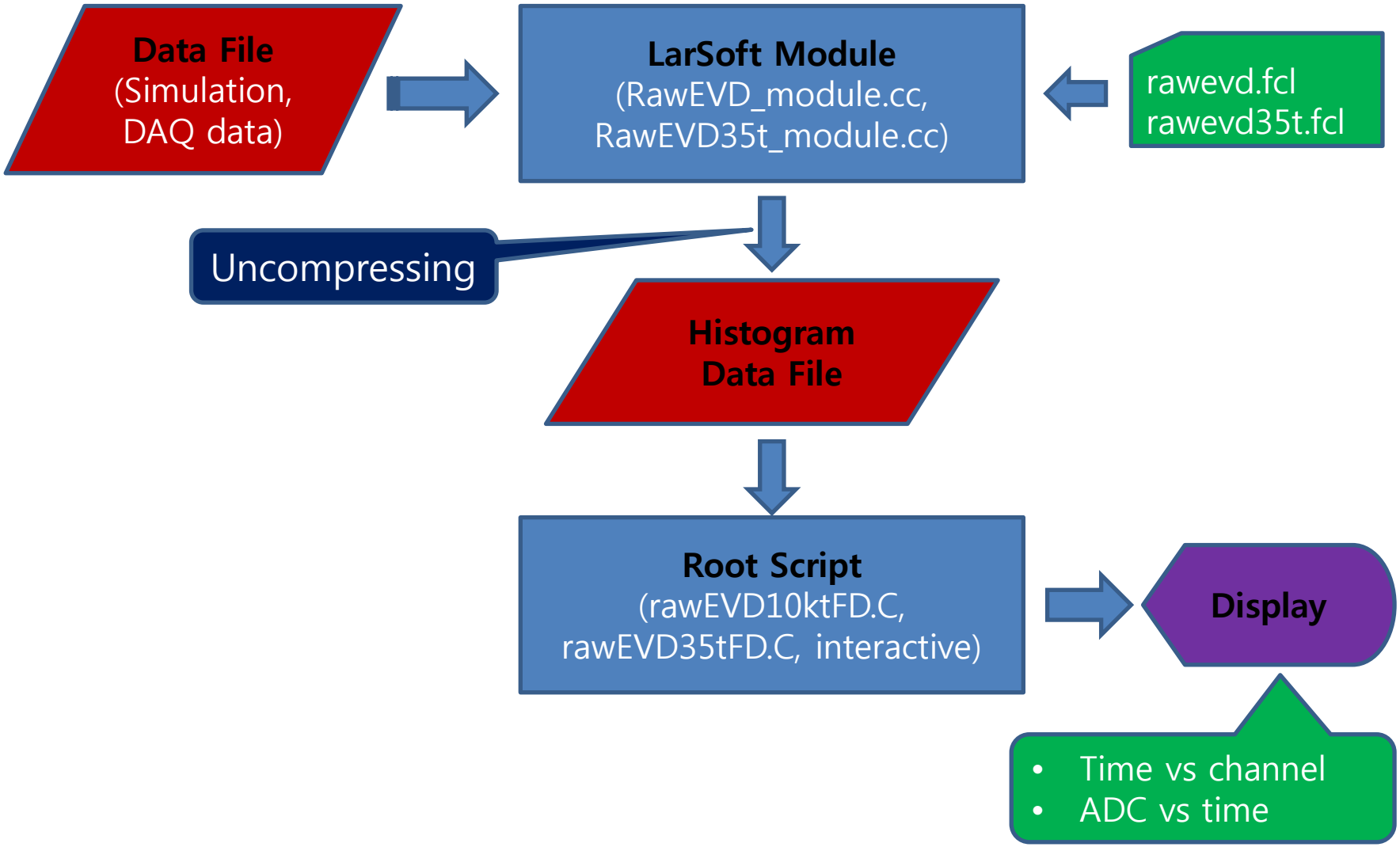
1. How rawdata event display works
2. 10kt FD event display
3. 35t event display
4. Examples of 35t rawdata display
5. Summary

Channel comparison between 10kt and 35t detectors

- **10kt Far detector (120 APA)**
  - ✓ Nchannels = 305,760 (=2548x120APA)
  - ✓ All APAs are identical:
  - ✓ Number of channels per APA = 2548
  - ✓ U channels per APA = 714
  - ✓ V channels per APA = 716
  - ✓ Z channels per APA side = 559
  - ✓ TPC: 0~119 in Cryostat 0
  - ✓ TPC: 120~239 in Cryostat 1

- **35t detector (4APA)**
  - ✓ Nchannels = 1992
  - ✓ U channels per APA = 138
  - ✓ V channels per APA = 138
  - ✓ Z channels per APA side = 111
  - ✓ One cryostat and different APA size

Procedure to view raw data



Histogram files

- **10kt FD**
  - ✓ 120 time(ticks) vs. channel histograms for U plane(APA)+120 Thumbnail histograms
  - ✓ 120 time(ticks) vs. channel histograms for V plane(APA))+120 Thumbnail histograms
  - ✓ 240 time(ticks) vs. channel histograms for Z plane(TPC))+240 Thumbnail histograms
  - ✓ 3 TH2D histogram of sum charge plot for U,V,Z planes
- **35t detector**
  - ✓ 4 time(ticks) vs. channel histograms for U plane(APA)+4 Thumbnail histograms
  - ✓ 4 time(ticks) vs. channel histograms for V plane(APA))+4 Thumbnail histograms
  - ✓ 8 time(ticks) vs. channel histograms for Z plane(TPC))+8 Thumbnail histograms
  - ✓ 3 TH2D histogram of sum charge plot for U,V,Z planes

- **Strategy for memory saving**
- ✓ Leaves all the histograms on the disk and only thumbnail histograms are loaded.
- ✓ Every time you click one of the thumbnails on the main display, automatically load the original version of the histograms into the memory and display on the event display window(time vs channel)
- ✓ When next click occurs, the previous histograms are removed from the memory and new histograms are loaded.

Samples and histogram generation time

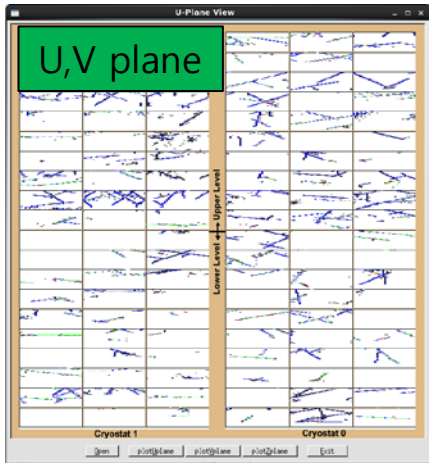
Particle	Generater (Detector)	Energy (MeV)	# of Events	Data file size	Histogram file size	Process Time
Electron	Babu Bhandari (35 t)	100	1000	640M	1.3M	7:00
Proton		30	1000	8.7M	0.1M	6:00
Muon		500	1000	471M	1.2M	8:00
Pion+		30	1000	47M	0.7M	6:10
Cosmic		-	1000	336M	8.4M	7:30
Genie-Cry	Tom Junk (10 kt)	-	1	259M	33M	3:30
Atmospheric Neutrinos		-	10(100)	150M	18M	9:00

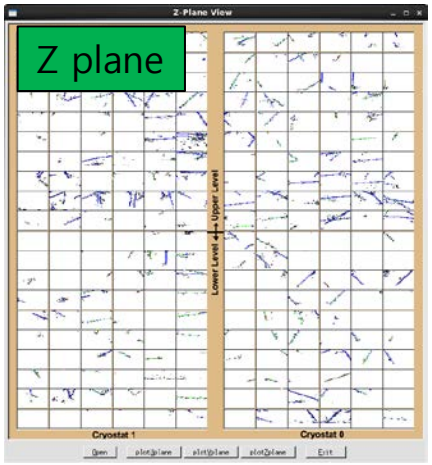
*No histograms from proton data?

- **35T 4APA sample**:
https://cdcvs.fnal.gov/redmine/projects/lbne-fd-sim/wiki/LBNE35T4APASamples
Particles injected at (100,50,0) cm along +z axis.

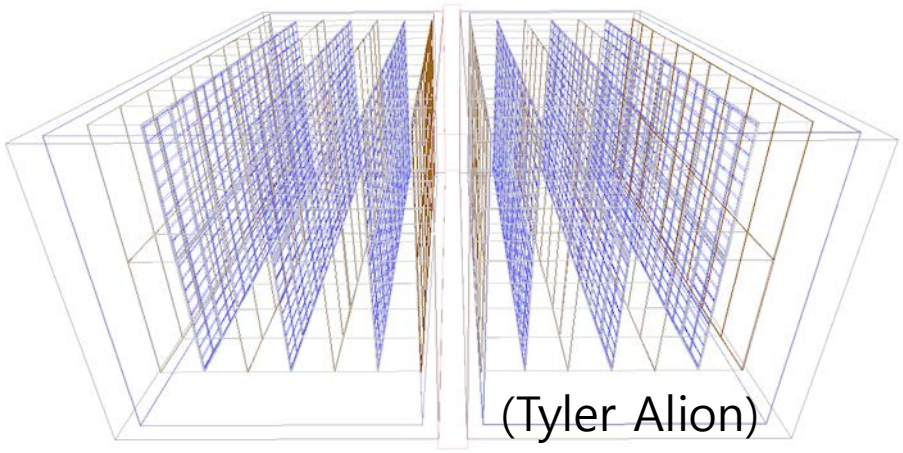
- **10kt Sample:**
https://cdcvs.fnal.gov/redmine/projects/lbne-fd-sim/wiki/LBNE10KTSamples

10kt FD APA(U,V planes) and TPC(Z-plane) locations





https://cdcvs.fnal.gov/redmine/projects/lbne-fd-sim/wiki/LBNE_Geometries



(Tyler Alion)

119	118	117	59	58	57
113	112	111	53	52	51
107	106	105	47	46	45
101	100	99	41	40	39
95	94	93	35	34	33
89	88	87	29	28	27
83	82	81	23	22	21
77	76	75	17	16	15
71	70	69	11	10	9
65	64	63	5	4	3
116	115	114	56	55	54
110	109	108	50	49	48
104	103	102	44	43	42
98	97	96	38	37	36
92	91	90	32	31	30
86	85	84	26	25	24
80	79	78	20	19	18
74	73	72	14	13	12
68	67	66	8	7	6
62	61	60	2	1	0
Cryo1			Cryo0		

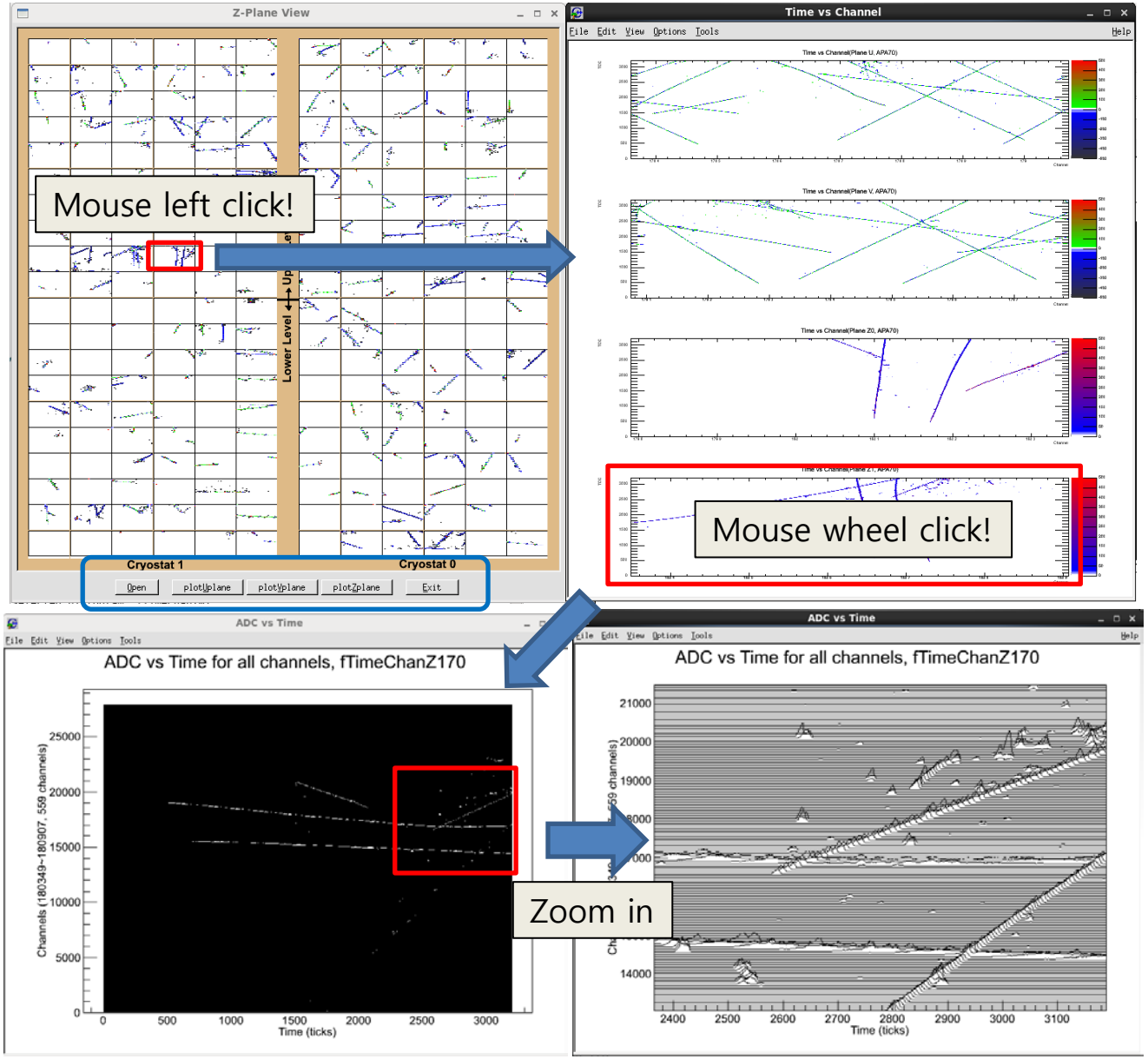
APA numbers and locations

239	238	237	236	235	234	119	118	117	116	115	114
227	226	225	224	223	222	107	106	105	104	103	102
215	214	213	212	211	210	95	94	93	92	91	90
203	202	201	200	199	198	83	82	81	80	79	78
191	190	189	188	187	186	71	70	69	68	67	66
179	178	177	176	175	174	59	58	57	56	55	54
167	166	165	164	163	162	47	46	45	44	43	42
155	154	153	152	151	150	35	34	33	32	31	30
143	142	141	140	139	138	23	22	21	20	19	18
131	130	129	128	127	126	11	10	9	8	7	6
233	232	231	230	229	228	113	112	111	110	109	108
221	220	219	218	217	216	101	100	99	98	97	96
209	208	207	206	205	204	89	88	87	86	85	84
197	196	195	194	193	192	77	76	75	74	73	72
185	184	183	182	181	180	65	64	63	62	61	60
173	172	171	170	169	168	53	52	51	50	49	48
161	160	159	158	157	156	41	40	39	38	37	36
149	148	147	146	145	144	29	28	27	26	25	24
137	136	135	134	133	132	17	16	15	14	13	12
125	124	123	122	121	120	5	4	3	2	1	0
Cryo1						Cryo0					

TPC(or Z0(even), Z1(odd) plane) numbers and locations

Snap shot of 10kt FD event display

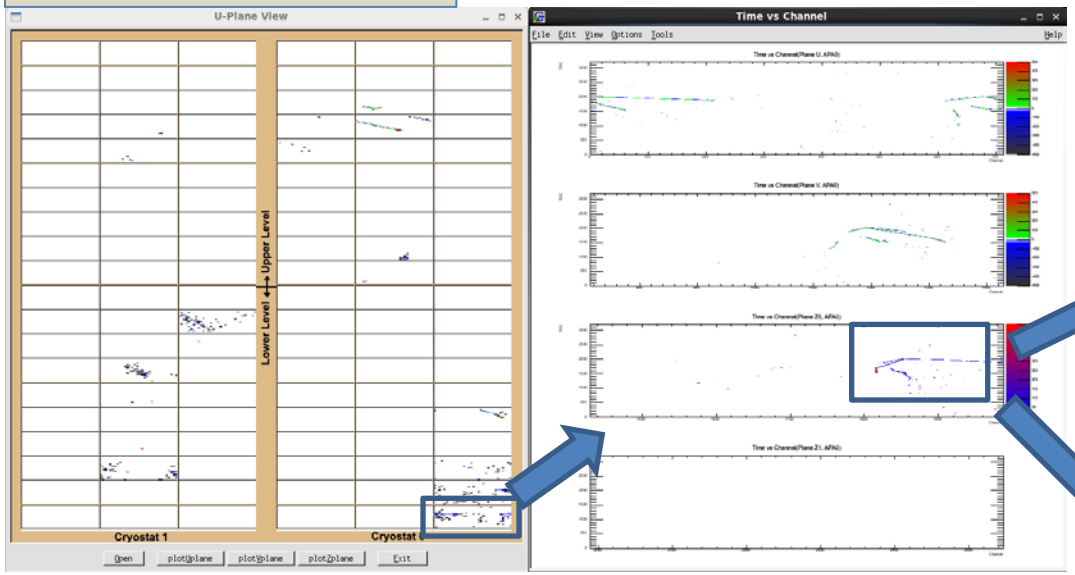
Z-plane view: 240 TPCs

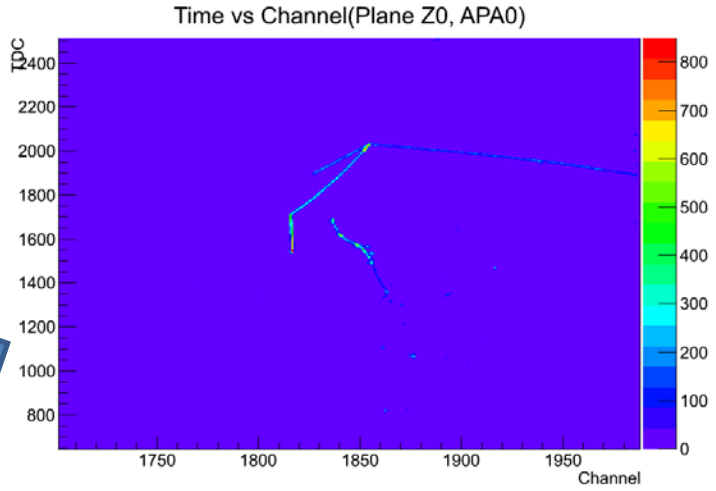


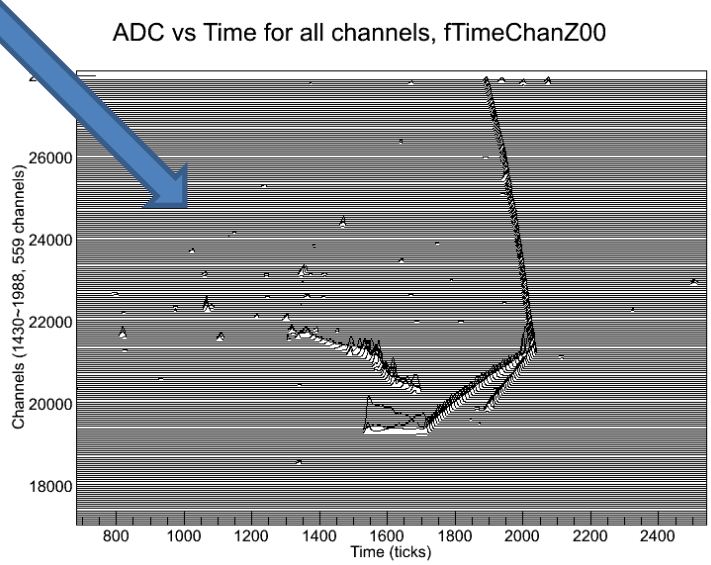
GENIE + CRY samples: 10 kT CDR geometry

Atmospheric Neutrinos

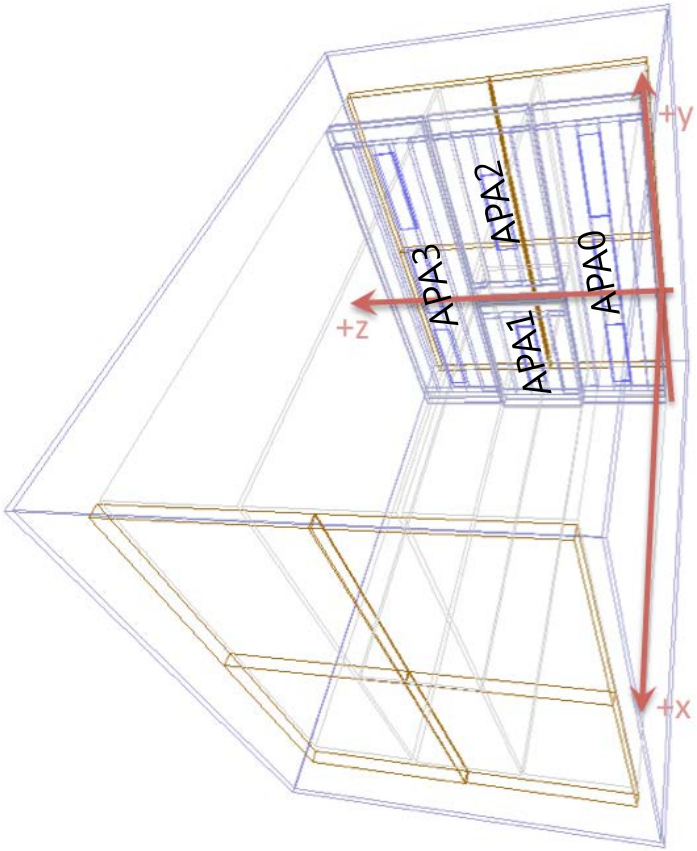
10 neutrino events







- primary vertex X is uniform from -1722 cm to +1722 cm, except for -150 cm to +150 cm which is skipped (the septum).
- primary vertex Y is uniform from -879 cm to +879 cm. Z is uniform from 0 cm to 3016 cm
- noise simulation is off
- zero suppression is on

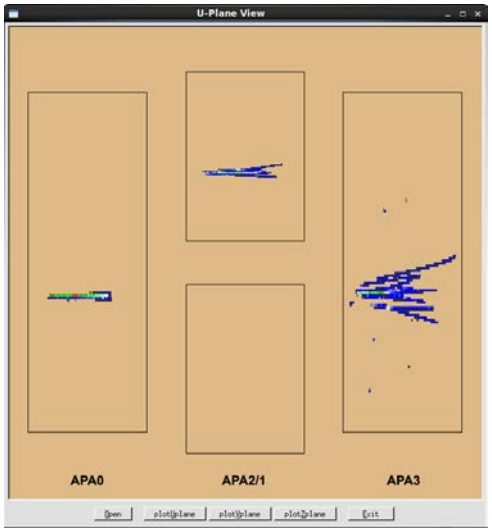


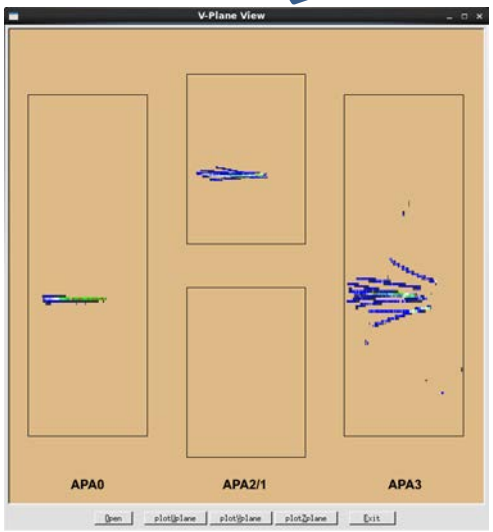
35t detector geometry and main view of event display

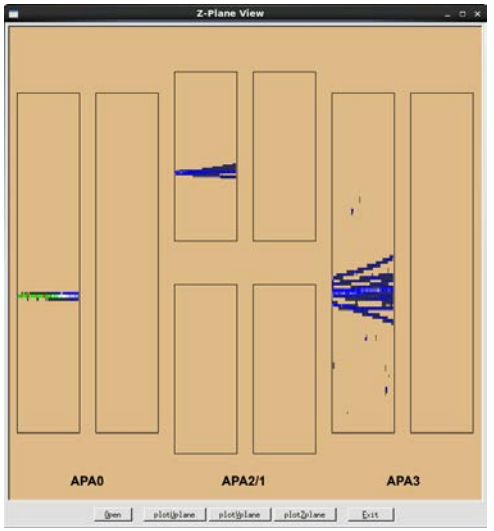
35t detector

- 4 APAs, 8 TPCs
- Number of channels = 1992
- U channels per APA = 138
- V channels per APA = 138
- Z channels per APA = 111
- Time ticks: 3200

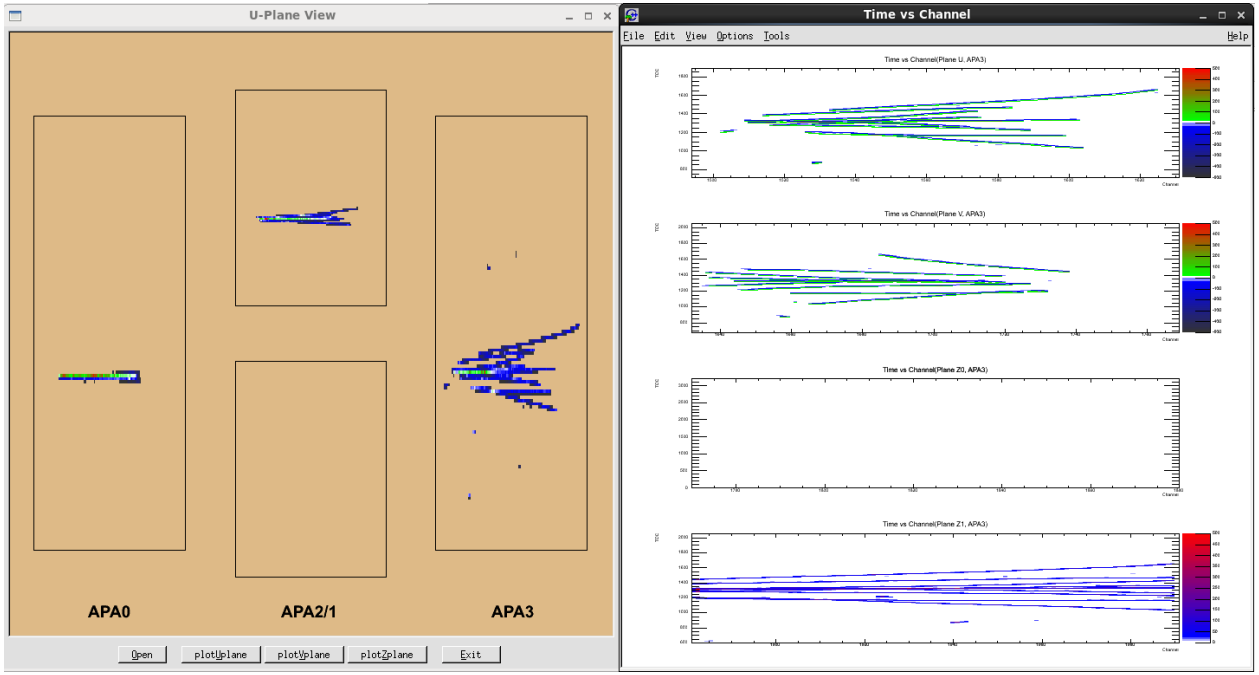
V-plane wire ordering reversed?





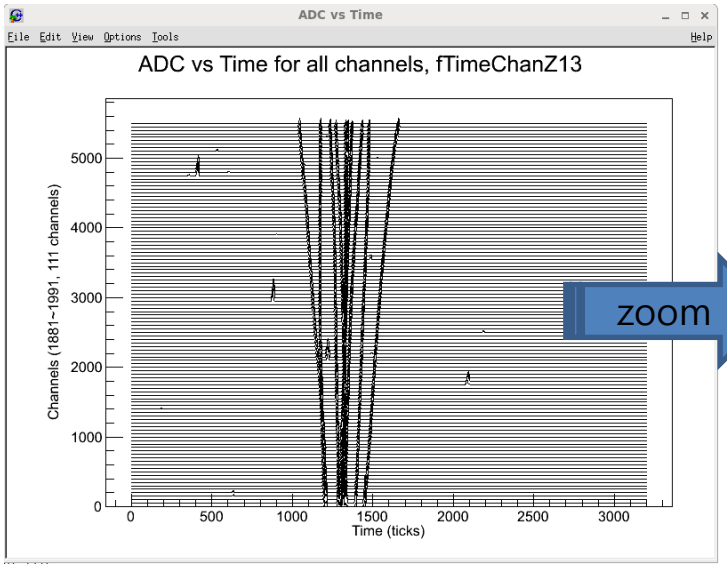


Snap shot of 35t detector event display

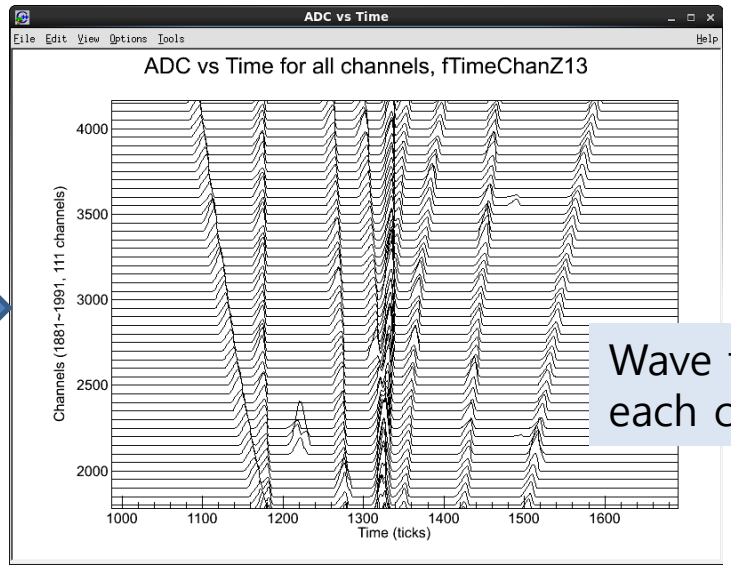


Example of 10 μ (500 MeV) events

- Particles are generated at the position (100,50,0)cm and beam is along the z axis.
- Particles with momentum of 0.5 GeV.
- Noise simulation is off.
- Zero suppression is on.

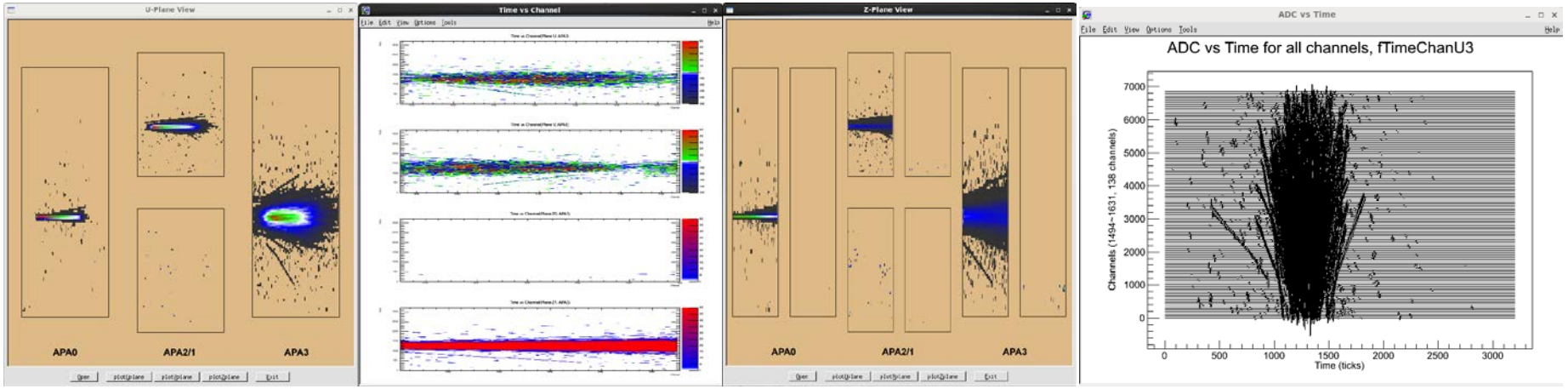


zoom

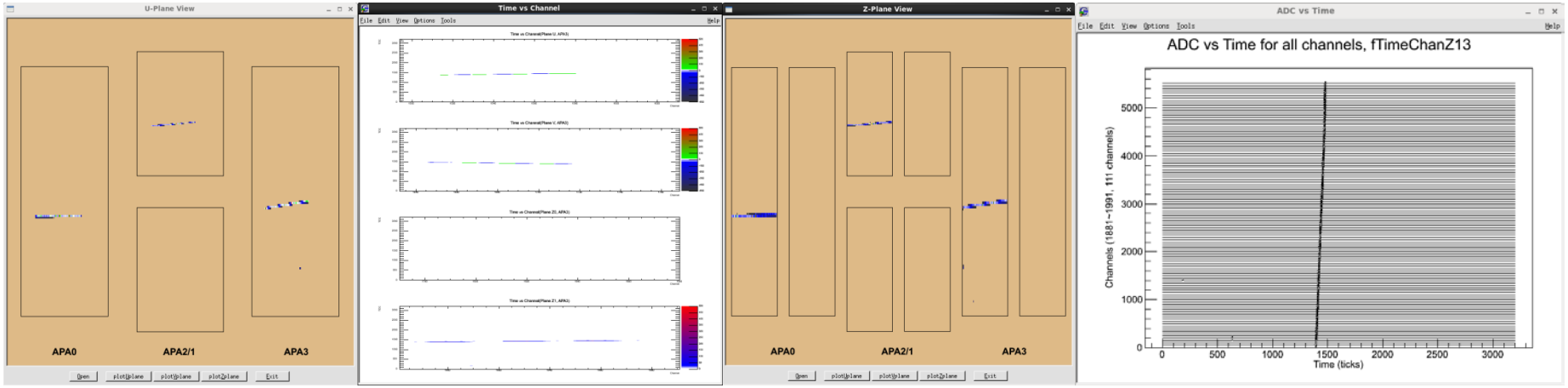


Wave forms on each channel

35t μ^- events

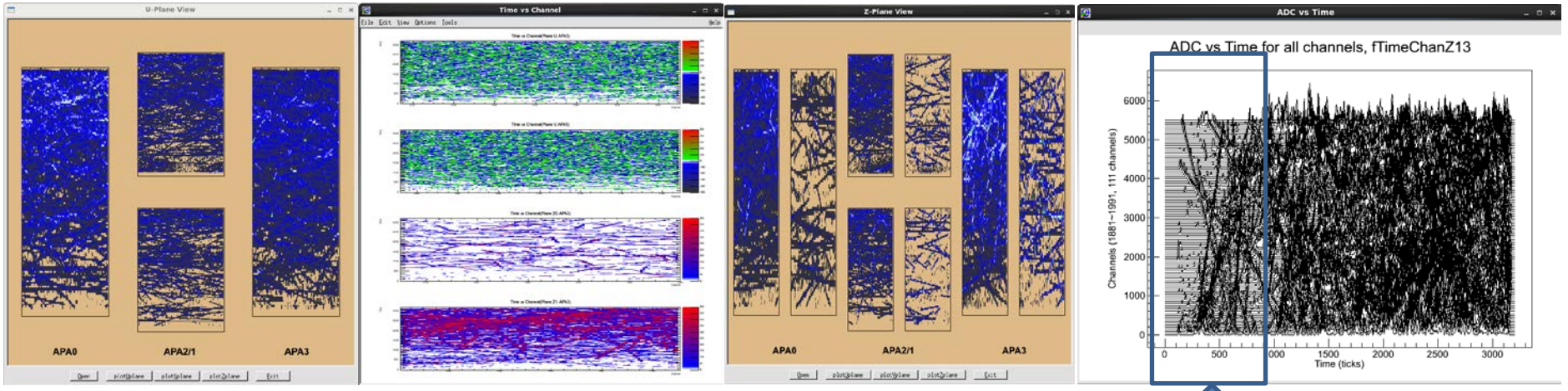


1000 events overlapped



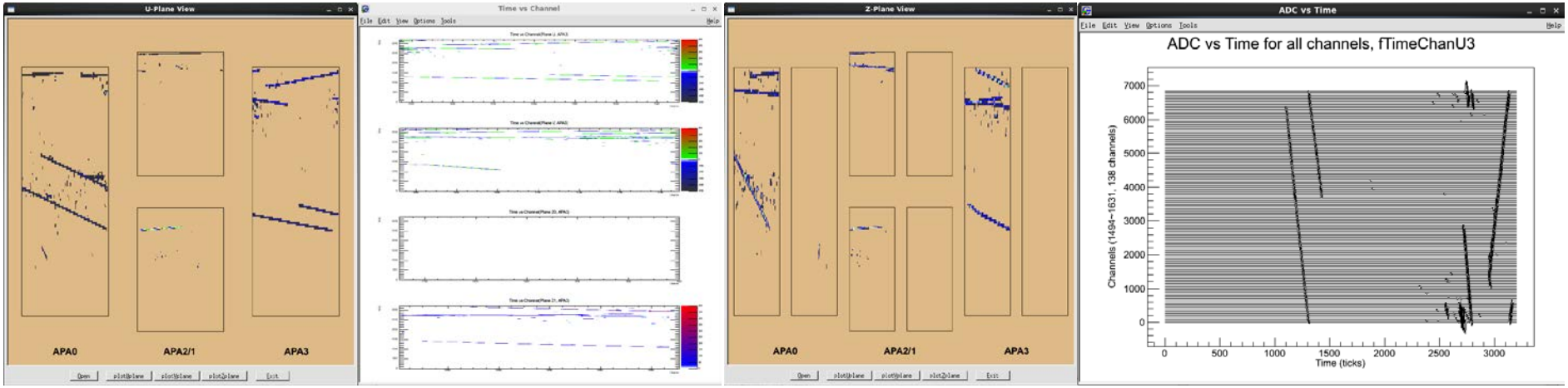
First event

35t cosmic events



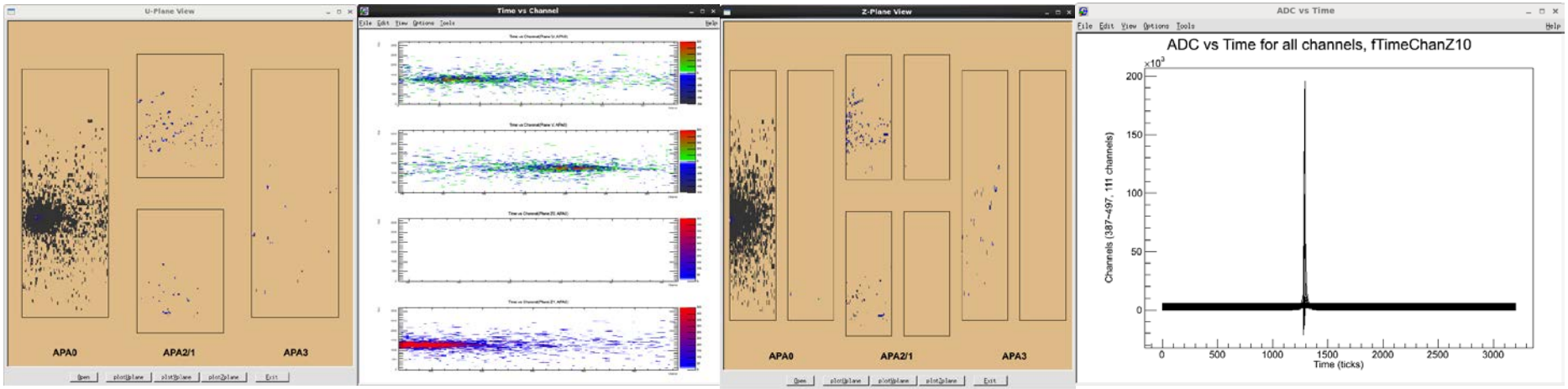
1000 events overlapped

Early time zone=near APA plane
Why low rate in this area?

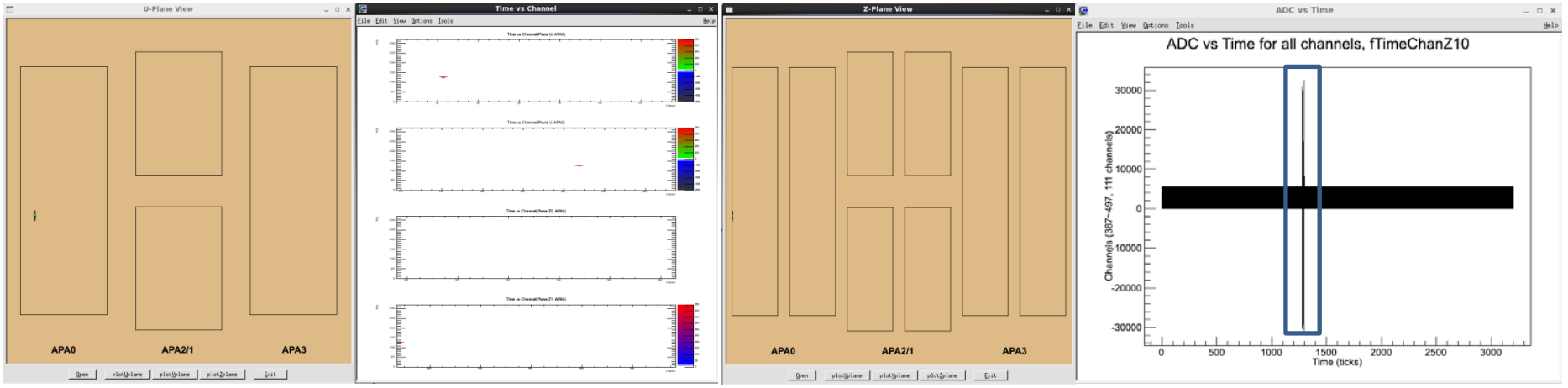


First 10 events overlapped

35t π^+ (30 MeV)events



1000 events overlapped

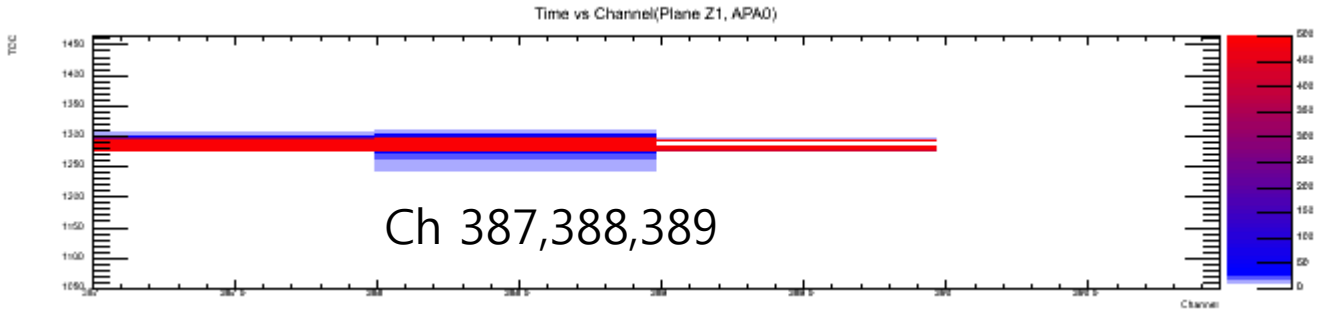


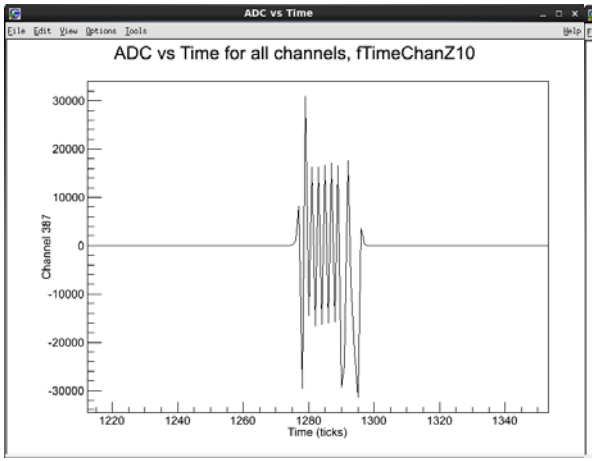
First event

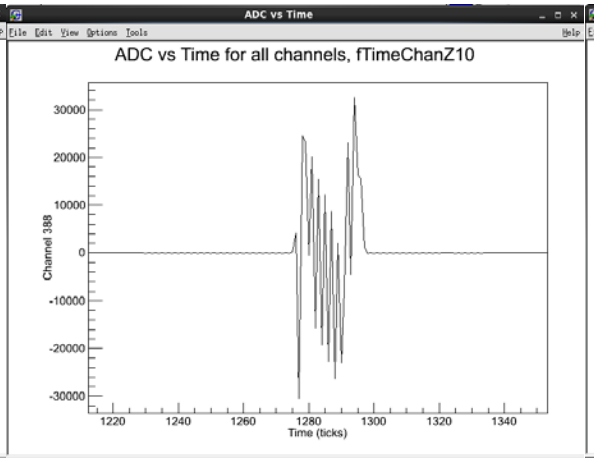
Why bipolar signals on collection channels?

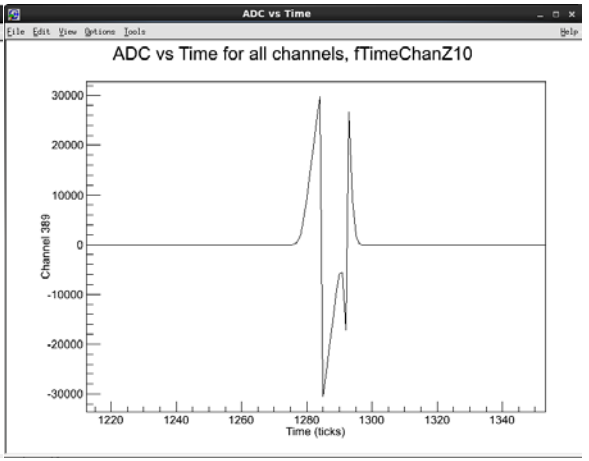
Bad signals?

The first three collection channels show peculiar waveforms.
This is observed only in the Pion+ data.



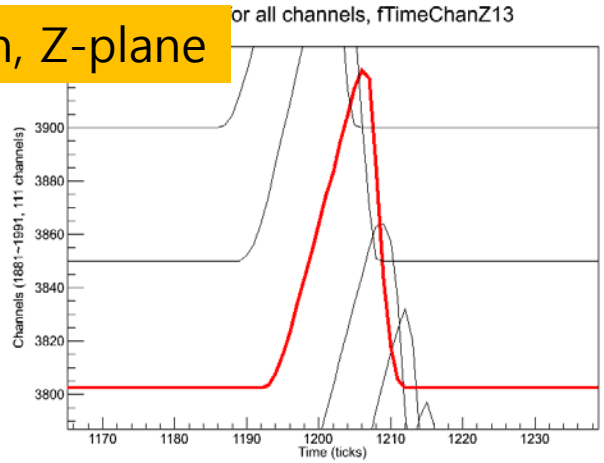




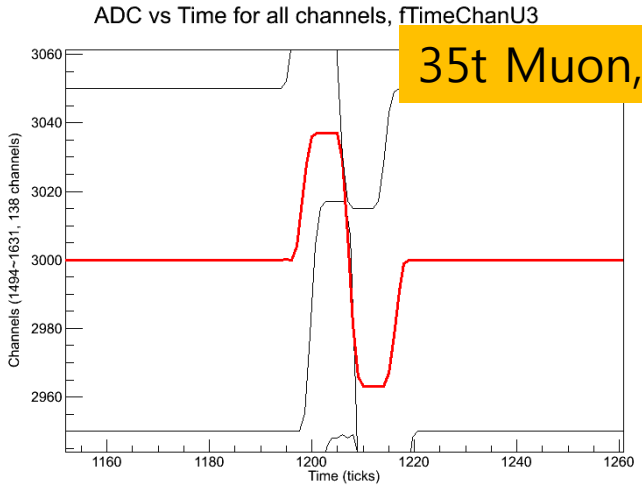


Typical wave forms on wire

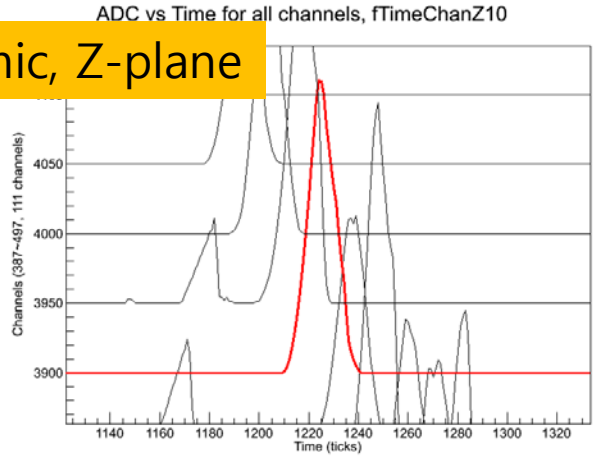
35t Muon, Z-plane



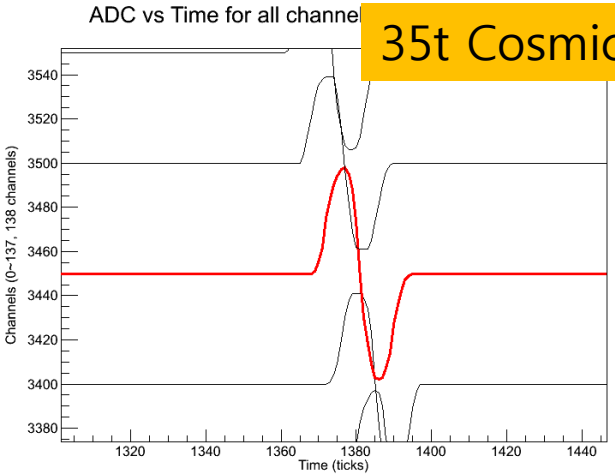
35t Muon, U-plane



35t Cosmic, Z-plane

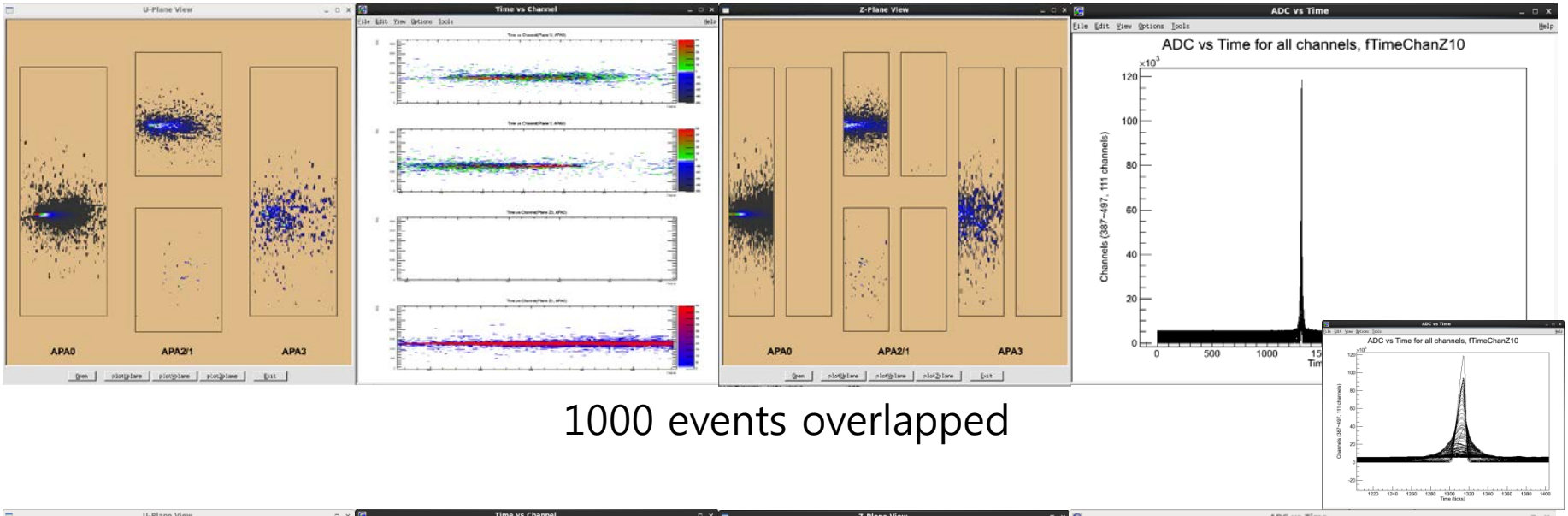


35t Cosmic, Z-plane

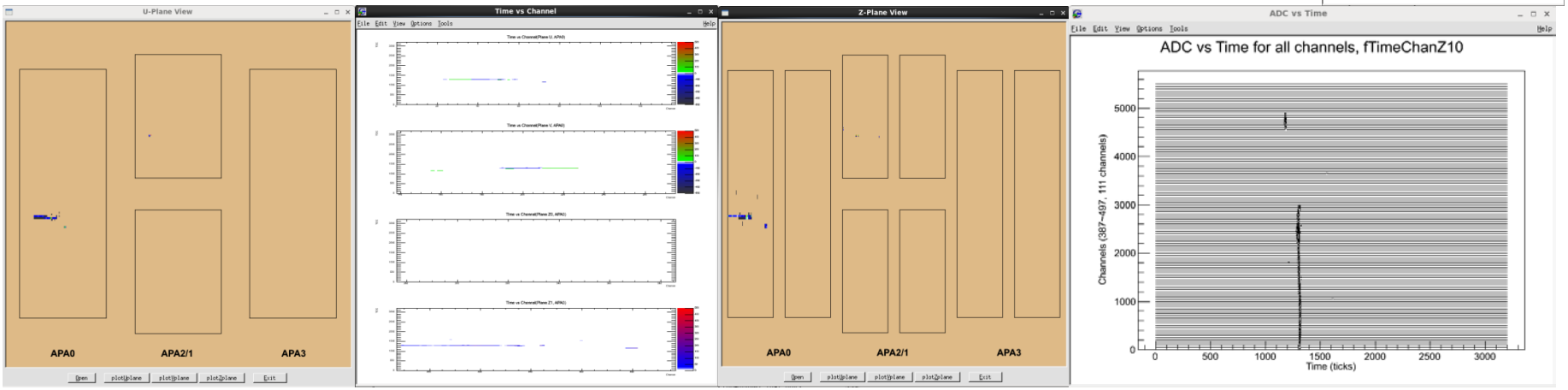


Waveform shapes are not always the same.

35t e^- (100 MeV) events



1000 events overlapped



First event

Summary

- The main purpose of this work was to get a fast, light, portable event display which is independent of LarSoft.
- This raw data event display is composed of two programs, A LarSoft module for histogram generation and a ROOT script for data display.
- Two separate programs for 10kt FD and 35t detector, respectively
- These modules and ROOT scripts are checked in to the new lbnecode repository (git/mrb/usb). The package name is 'RawdataDisplay'. Feel free to use them.