

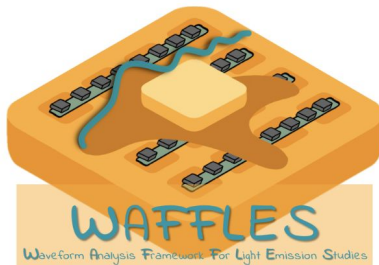
SPE template Studies for ProtoDUNE-HD

Maritza Delgado

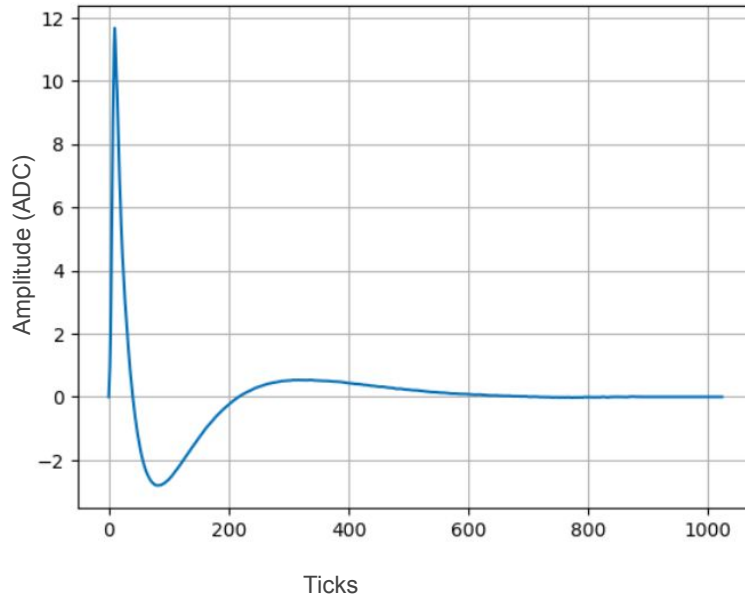
ProtoDUNE PDS Sim/Reco meeting
December 09,2024

MOTIVATION

- Generate the SPE templates per channel for the deconvolution module in LArSoft using PDS data (NP04 runs).
- DUNE X-ARAPUCA signals **have undershoot** .
- To better **estimate the total charge and time** of each pulse, a deconvolution needs to be implemented.
- SPE template was obtained using my modified version of the script written by Renan in Waffles.
- Waffles is the NP04/NP02 PDS analysis framework Written in python, initially developed by Julio Ureña with contributions with other ~10 person.

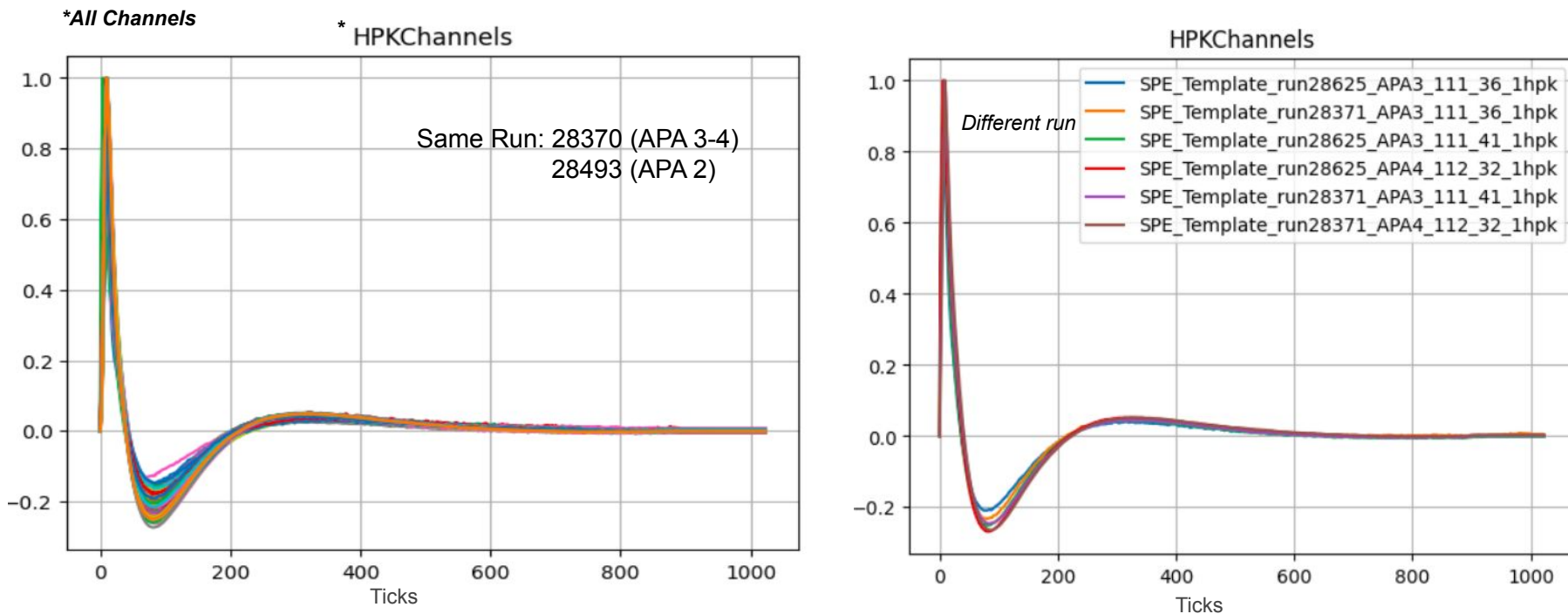


SPE template requirements in LarSoft



- 62.5 MHz sampling time (Digitizer and deconvolution module).
- 1024 ticks (ProtoDUNE data).
- Smooth.
- Without pretrigger. (Avoid time delay between true photons and signal peak).
- Template by manufacturer and by Channel (fbk and HPK).

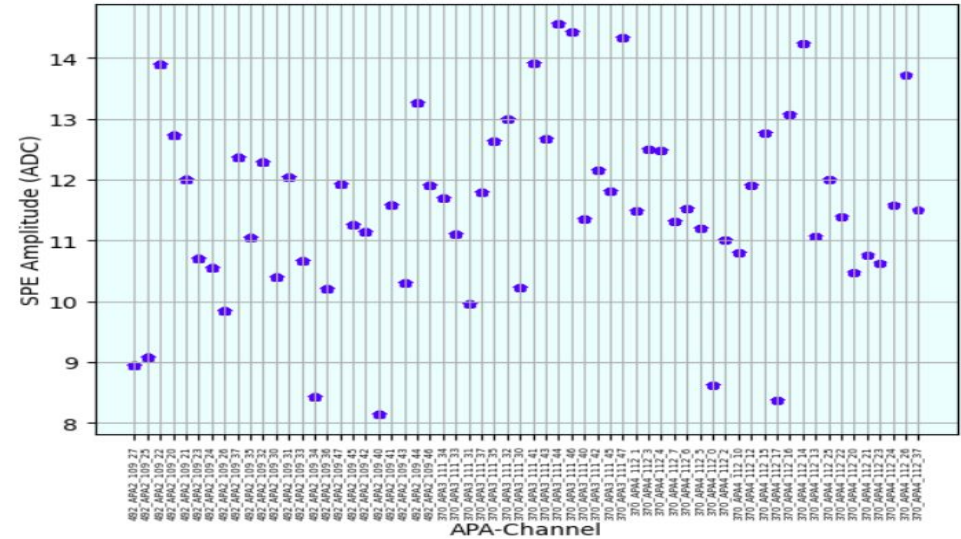
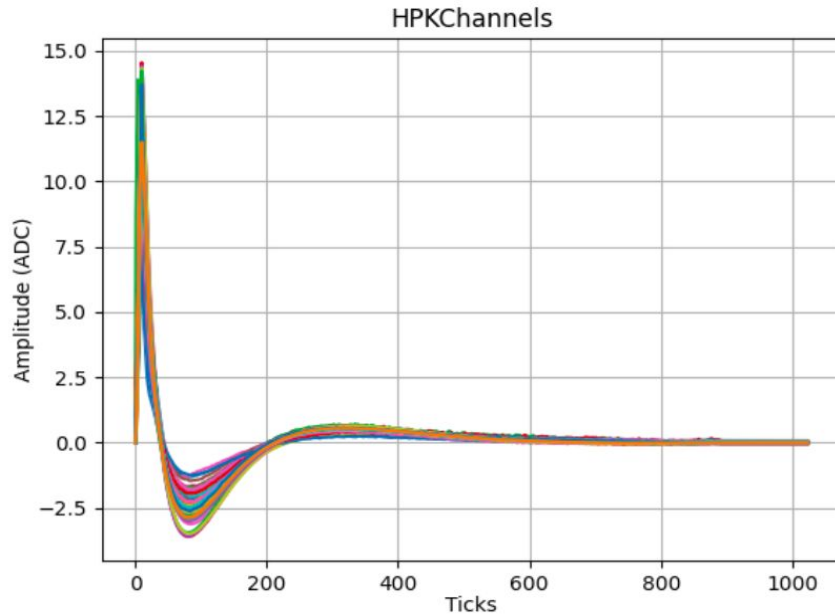
Analysis of the shape of the SPE in HPK channels



Single photoelectron normalized to 1

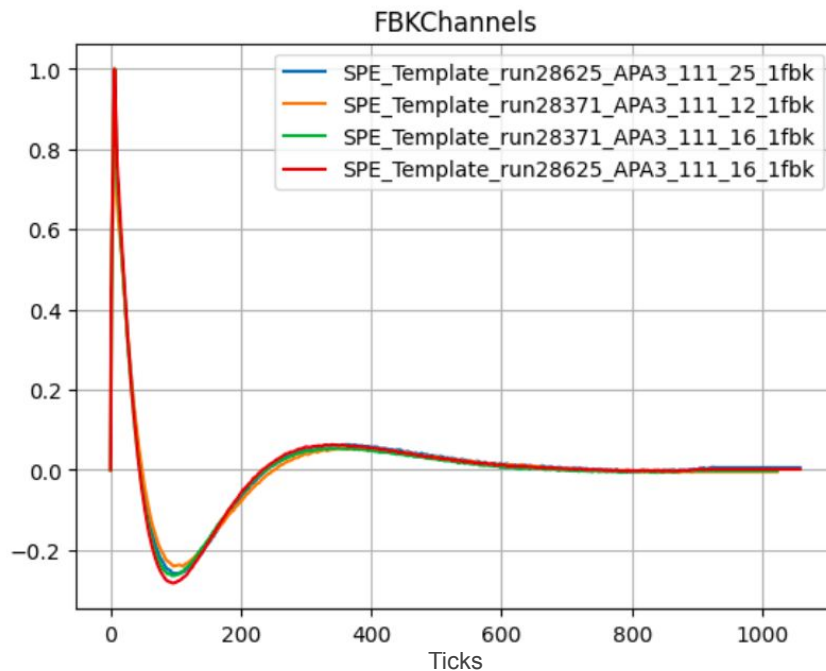
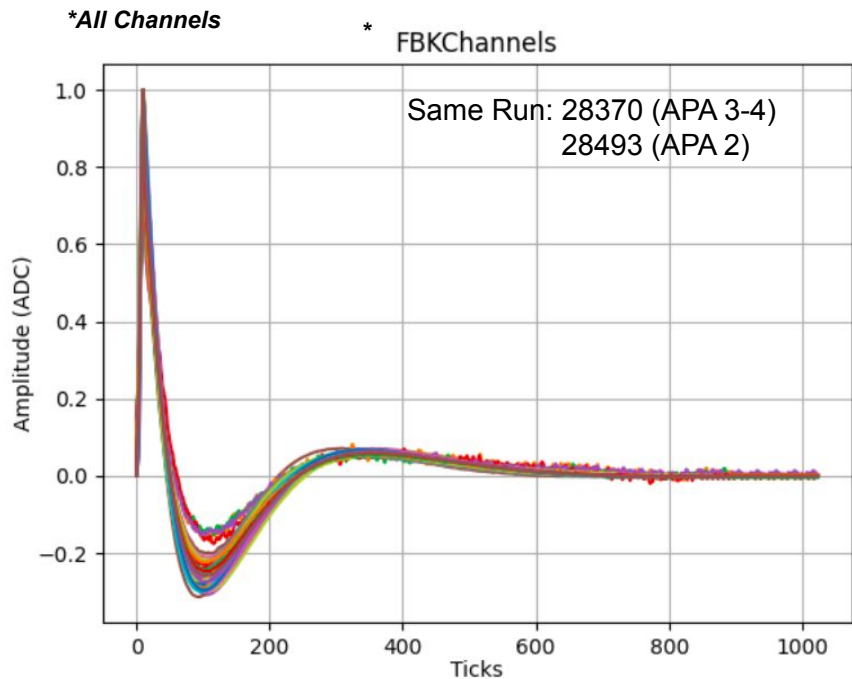
SPE amplitudes in all HPK channels

*All Channels



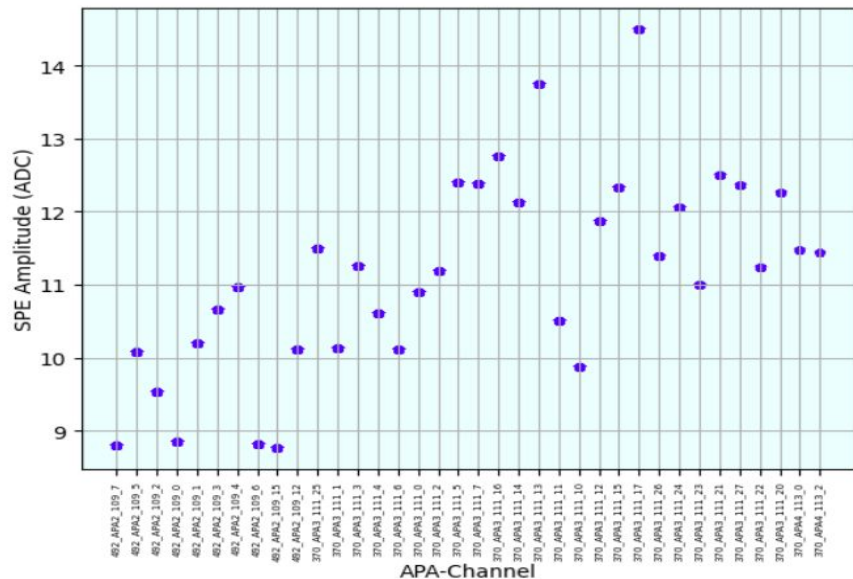
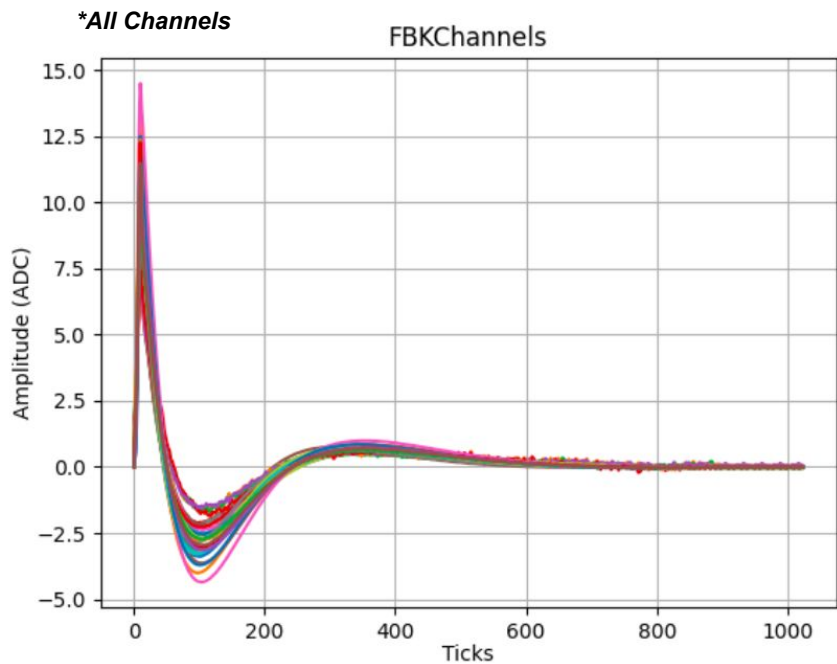
Before VGain Tuning (See [Federico's presentation](#) Collaboration Meeting - Santa Fe)

Analysis of the shape of the SPE in FBK channels



Single photoelectron normalized to 1

SPE amplitudes in all FBK channels



Before VGain Tuning (See [Federico's presentation](#) Collaboration Meeting - Santa Fe)

Channel Map

APA1

104-7	104-5	104-2	104-0
150	140	130	120
104-1	104-3	104-4	104-6
151	141	131	121
104-17	104-15	104-12	104-10
152	142	132	122
104-11	104-13	104-14	104-16
153	143	133	123
105-7	105-5	105-2	105-0
154	144	134	124
105-1	105-3	105-4	105-6
155	145	135	125
105-26	105-24	105-23	105-21
156	146	136	126
105-10	105-12	105-15	105-17
157	147	137	127
107-17	107-15	107-12	107-10
158	148	138	128
107-0	107-2	107-5	107-7
159	149	139	129

APA2

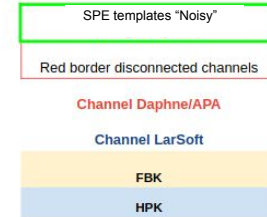
109-27	109-25	109-22	109-20
110	100	90	80
109-21	109-23	109-24	109-26
111	101	91	81
109-37	109-35	109-32	109-30
112	102	92	82
109-31	109-33	109-34	109-36
113	103	93	83
109-7	109-5	109-2	109-0
114	104	94	84
109-1	109-3	109-4	109-6
115	105	95	85
109-17	109-15	109-12	109-10
116	106	96	86
109-11	109-13	109-14	109-16
117	107	97	87
109-47	109-45	109-42	109-40
118	108	98	88
109-41	109-43	109-44	109-46
119	109	99	89

APA3

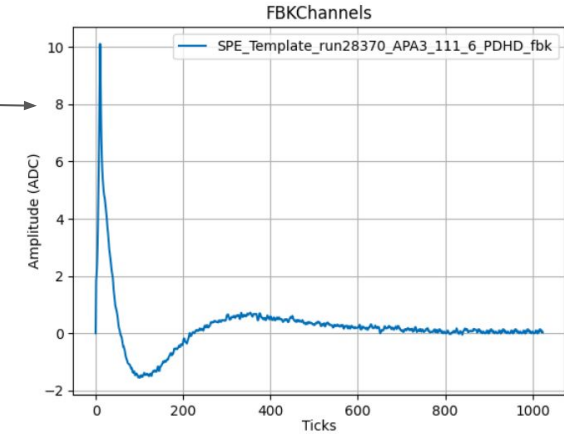
111-1	111-3	111-4	111-6
70	60	50	40
111-36	111-34	111-33	111-31
71	61	51	41
111-0	111-2	111-5	111-7
72	62	52	42
111-37	111-35	111-32	111-30
73	63	53	43
111-41	111-43	111-44	111-46
74	64	54	44
111-16	111-14	111-13	111-11
75	65	55	45
111-10	111-12	111-15	111-17
76	66	56	46
111-26	111-24	111-23	111-21
77	67	57	47
111-40	111-42	111-45	111-47
78	68	58	48
111-27	111-25	111-22	111-20
79	69	59	49

APA4

112-0	112-2	112-5	112-7
30	20	10	0
112-6	112-4	112-3	112-1
31	21	11	1
112-10	112-12	112-15	112-17
32	22	12	2
112-16	112-14	112-13	112-11
33	23	13	3
113-0	113-2	113-5	113-7
34	24	14	4
112-27	112-25	112-22	112-20
35	25	15	5
112-21	112-23	112-24	112-26
36	26	16	6
112-37	112-35	112-32	112-30
37	27	17	7
112-31	112-33	112-34	112-36
38	28	18	8
112-47	112-45	112-42	112-40
39	29	19	9



SPE templates "Noisy"



NEXT STEPS

- The SPE and Noisy templates were stored in */pnfs/dune/persistent/stash/ProtoDUNE/HD/*
Thanks to Jose Soto and Ken Herner!!
- Verify that the deconvolution module works with the new SPE templates, especially the noisy ones.
- Analyze and Include some noise and SPE templates from the latest PDS runs

Thank you!!

Amplitude changes, same channel, different run.

