Timing scan data analysis

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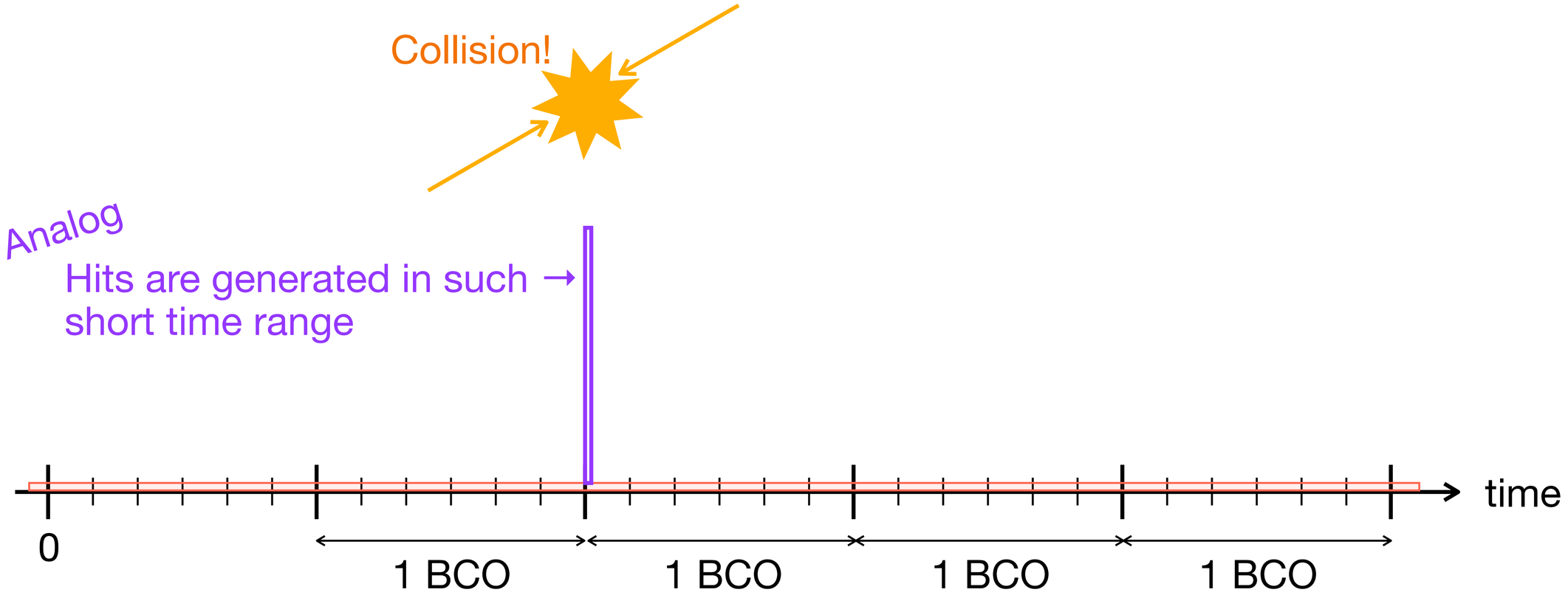
Timing scan

The identity of INTT is a tracker with a good timing resolution. Parameters related to timing have to be optimized, especially for p-p collisions.

The granularity of timing information of INTT hits is 1 BCO. We have to tag hits with the correct BCO value. A tag of BCO different by 1 from the correct BCO is not accepted basically, so we can identify hits with different BCO values (even by only 1) as hits generated by different collisions.

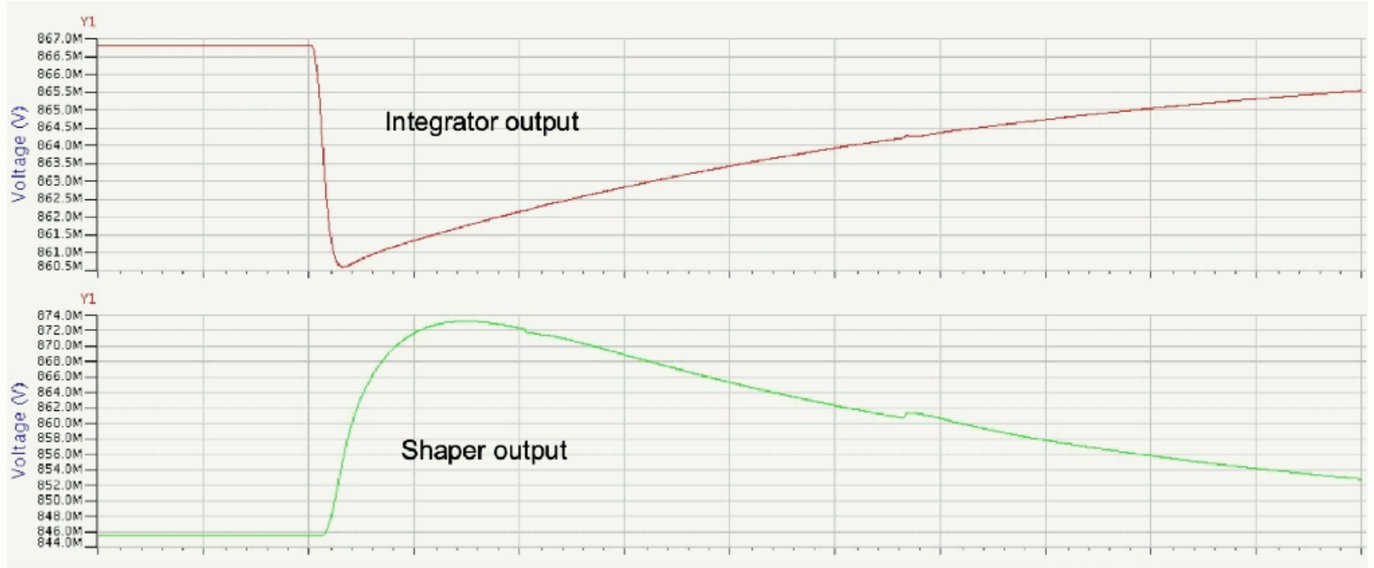
Timing scan: Simple case



- **Nominal output pulse peaking time:** 60 ns (programmable, set by the shaper)
- **Output pulse fall time:** programmable, set by the integrator fall time adjust

Timing scan: Simple case

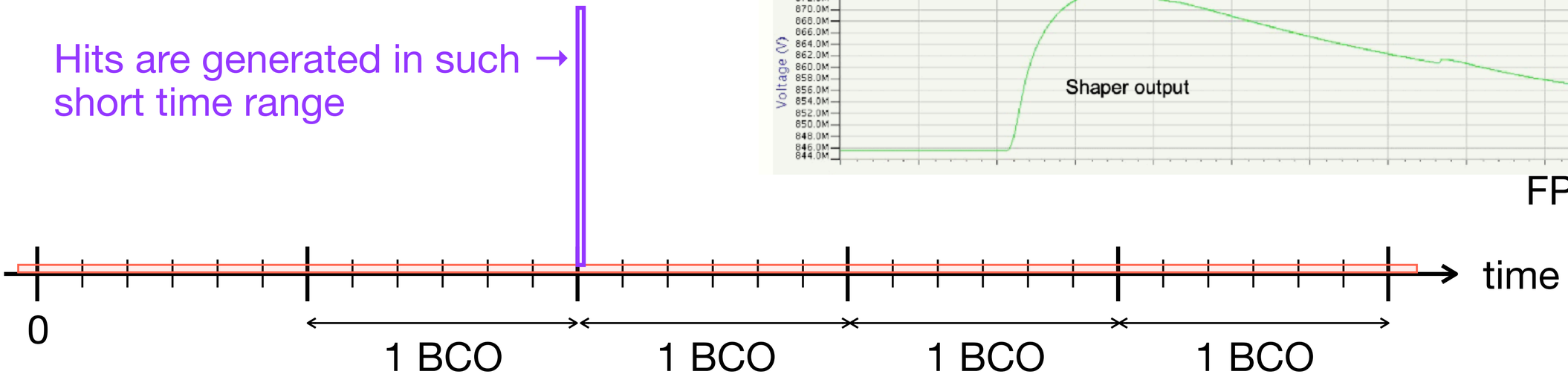
With default parameters (N2Sel = 0100, Fb1Sel = 0100, GSel = 010, BWSel = 00100). Cin = 2 pF, Qin = 2000e.



FPHX manual

Collision!

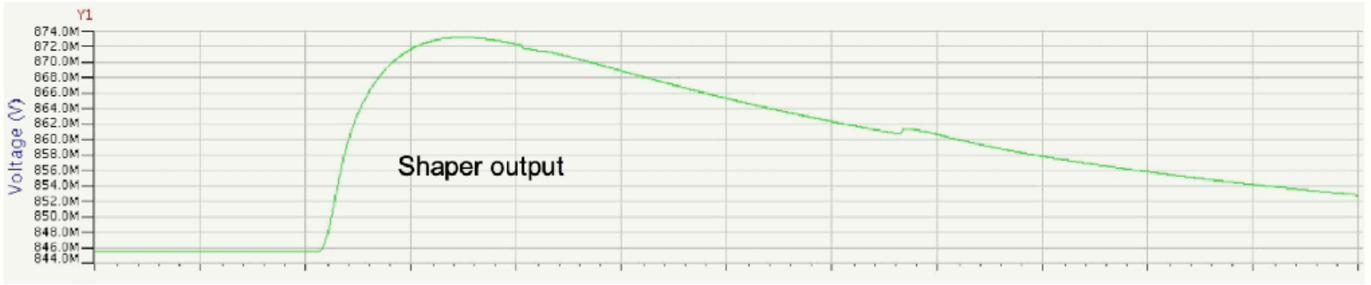
Hits are generated in such → short time range



- **Nominal output pulse peaking time:** 60 ns (programmable, set by the shaper)
- **Output pulse fall time:** programmable, set by the integrator fall time adjust

Timing scan: Simple case

- **Nominal output pulse peaking time:** 60 ns (programmable, set by the shaper)
- **Output pulse fall time:** programmable, set by the integrator fall time adjust

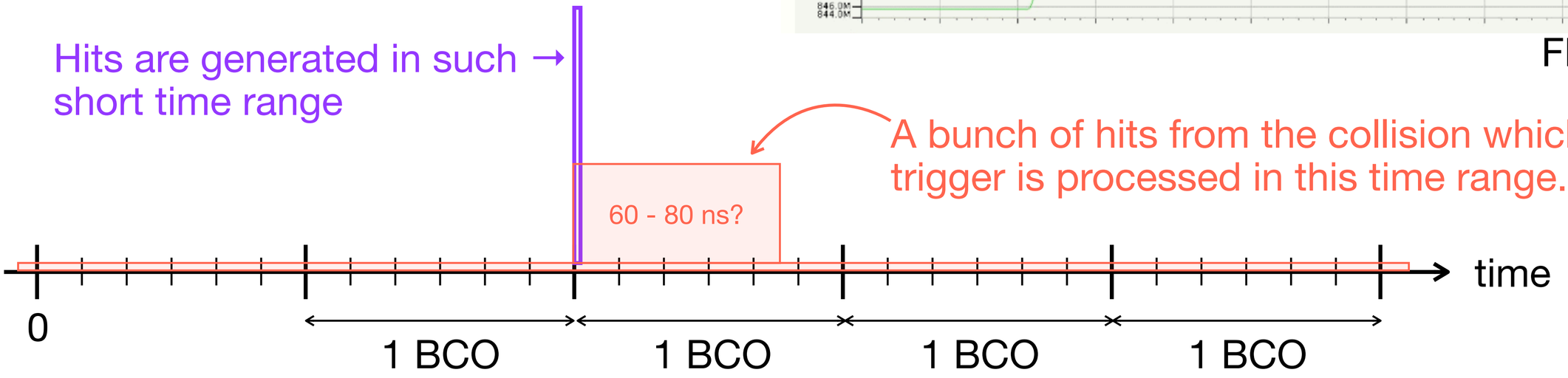


FPHX manual

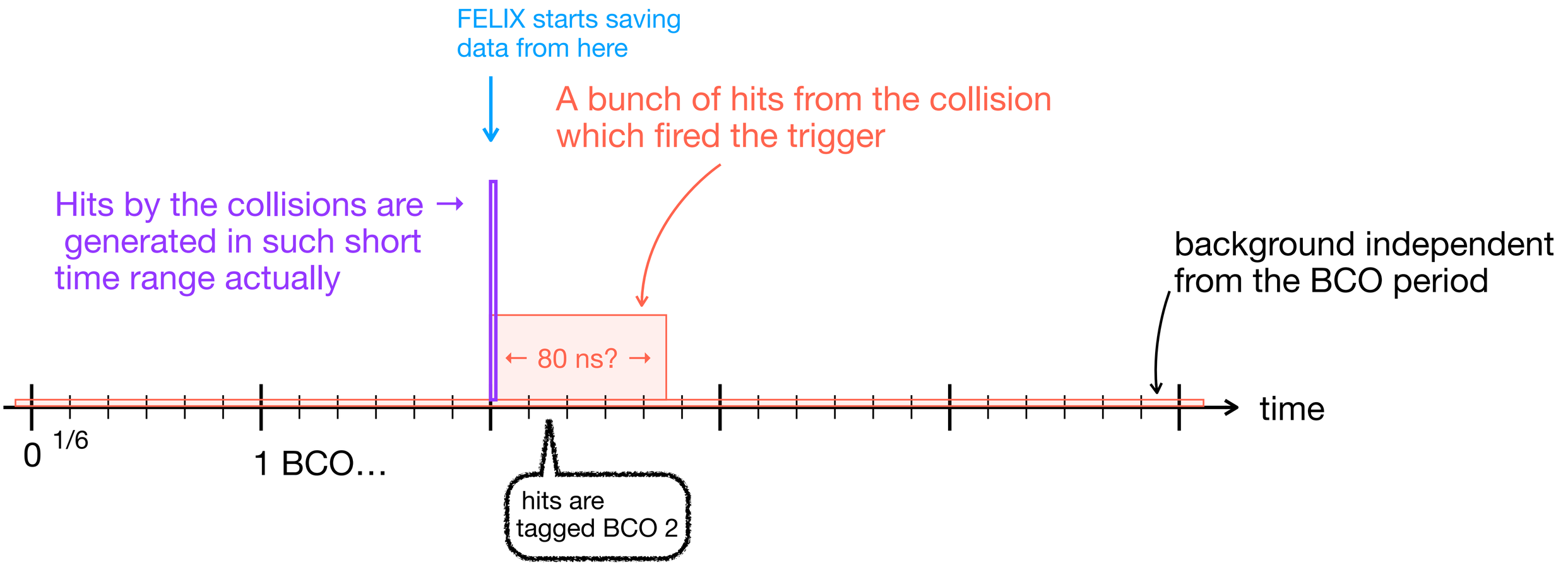
Collision!

Hits are generated in such → short time range

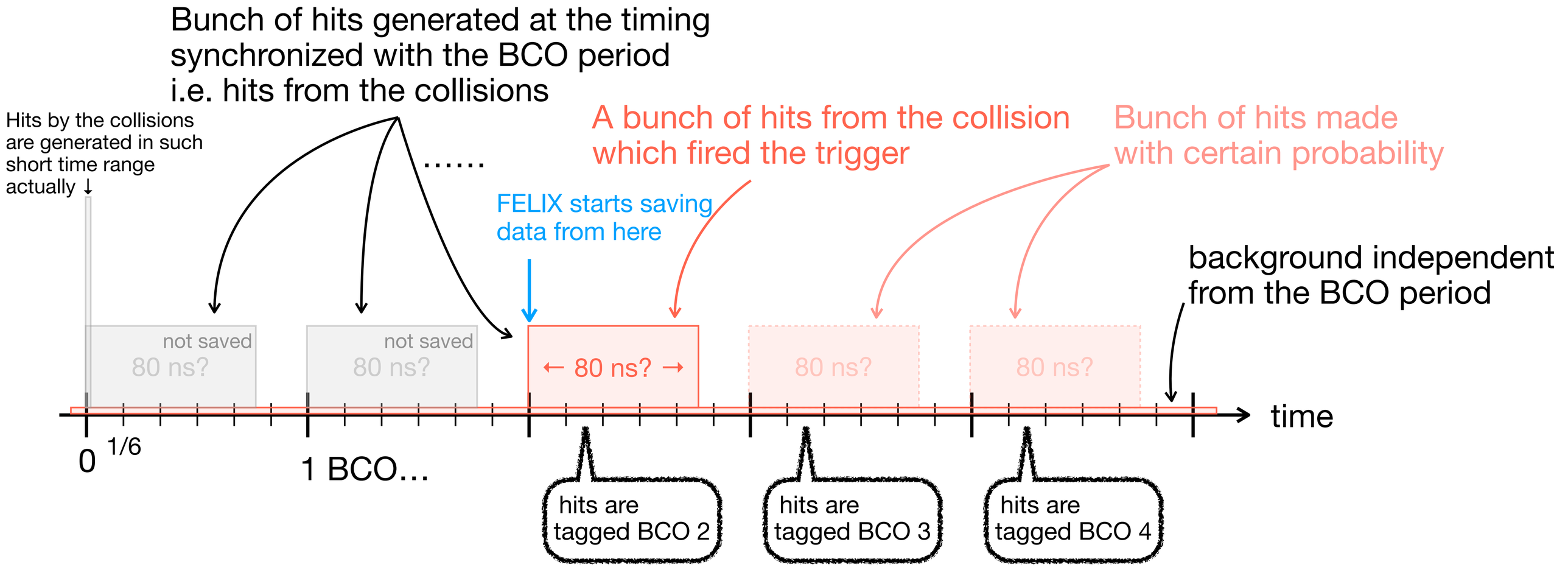
A bunch of hits from the collision which fired the trigger is processed in this time range.



Timing scan: Simple case

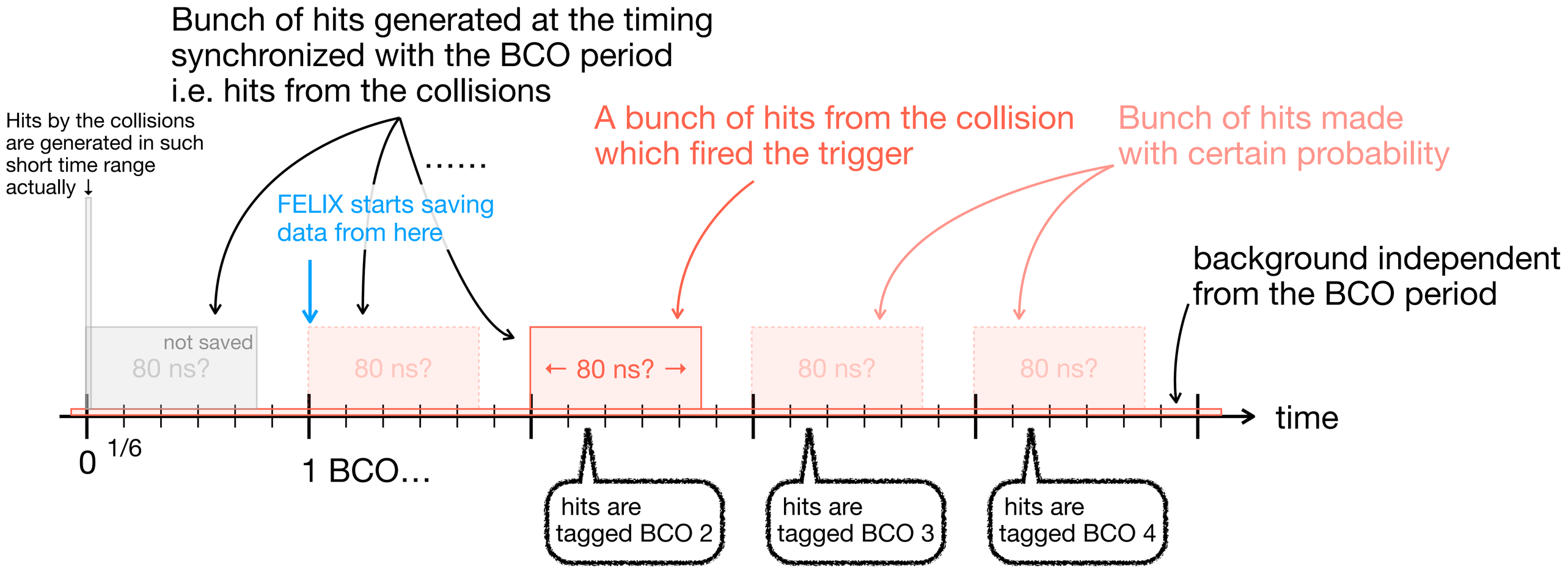


Timing scan


Bunch of hits generated at the timing
synchronized with the BCO period
i.e. hits from the collisions
Hits by the collisions
are generated in such
short time range
actually ↓
A bunch of hits from the collision
which fired the trigger
Bunch of hits made
with certain probability
FELIX starts saving
data from here
background independent
from the BCO period
not saved
80 ns?
not saved
80 ns?
← 80 ns? →
80 ns?
80 ns?
time
0
1/6
1 BCO…
hits are
tagged BCO 2
hits are
tagged BCO 3
hits are
tagged BCO 4

: a bunch of hits

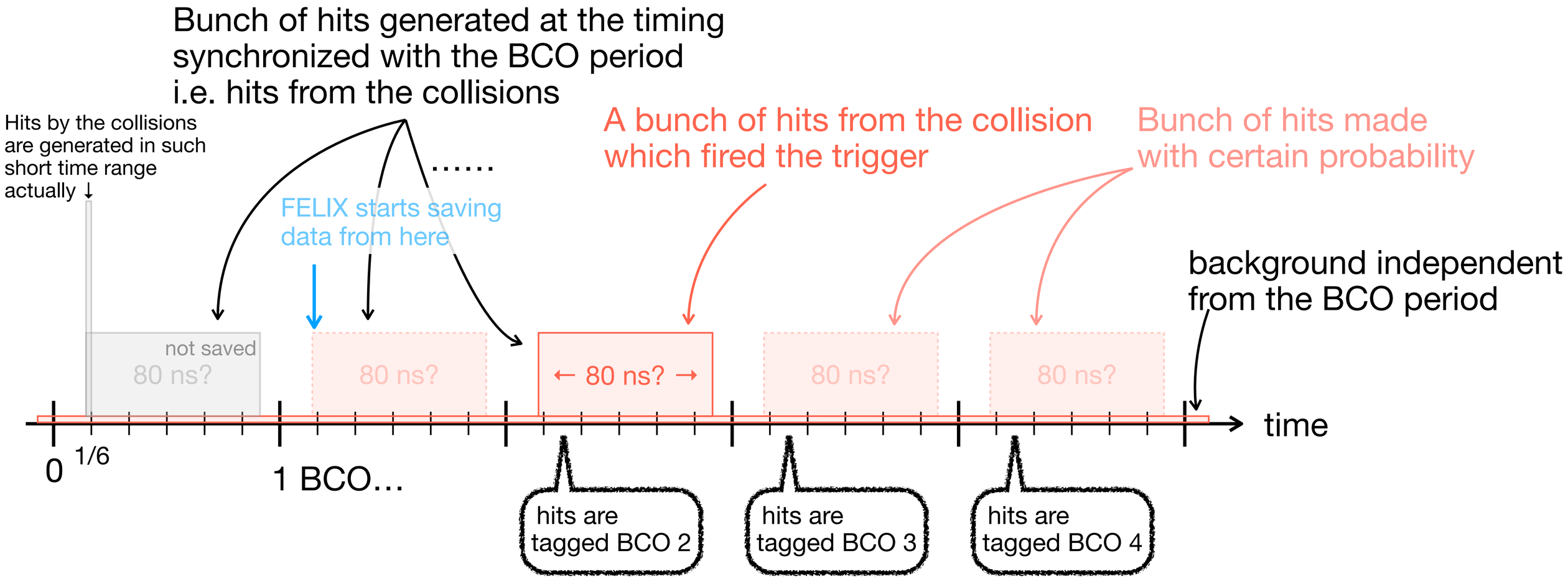
Timing scan



Mismatch of the timing of the beginning of data taking and arrival of the trigger event is possible. Not a big problem.

: a bunch of hits

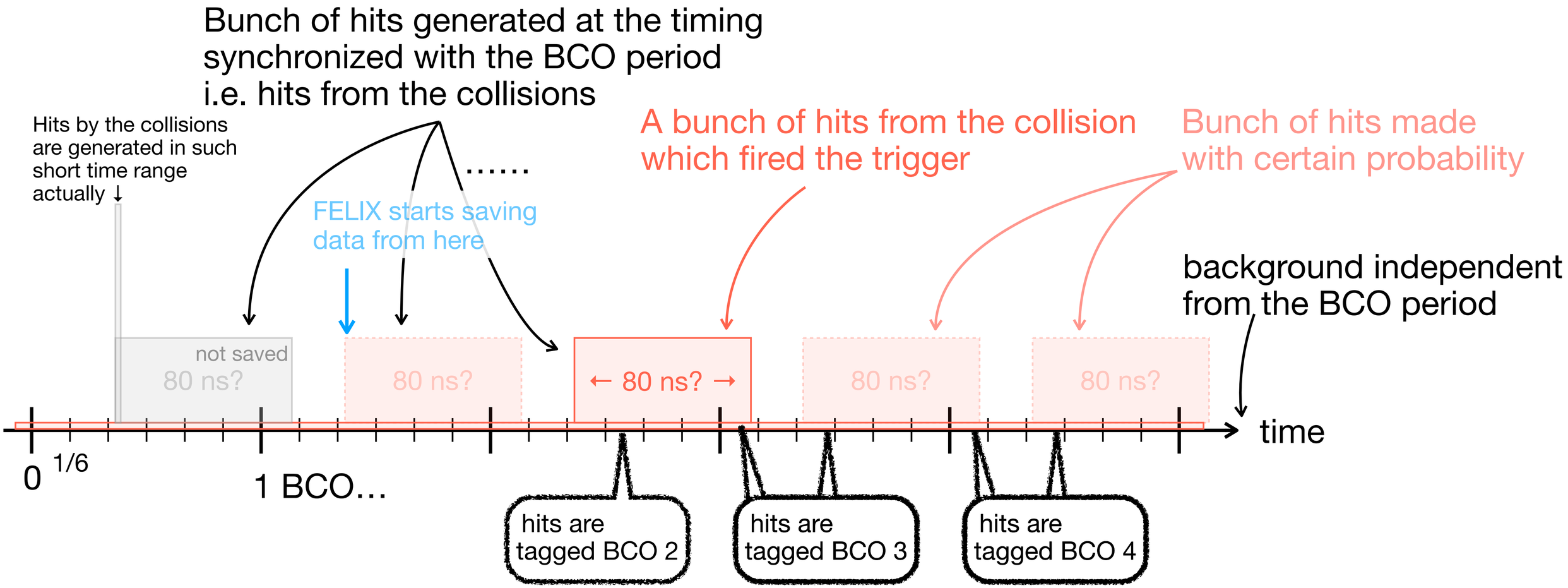
Timing scan



Shift of the arrival timing of bunch of hits from the beginning of BCO period (beginning of BCO phase 0) is possible. This case is acceptable.

: a bunch of hits

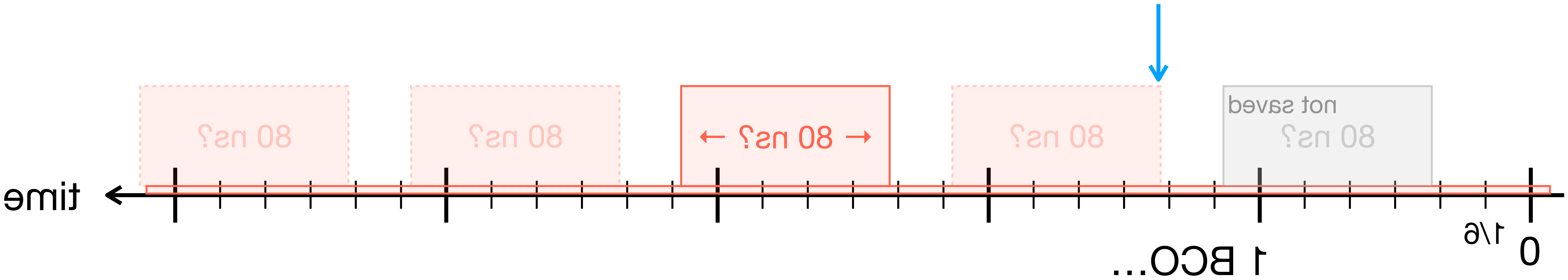
Timing scan



Shift of the arrival timing of bunch of hits from the beginning of BCO period (beginning of BCO phase 0) is possible. This case is NOT acceptable because hits are tagged different BCO in a group.

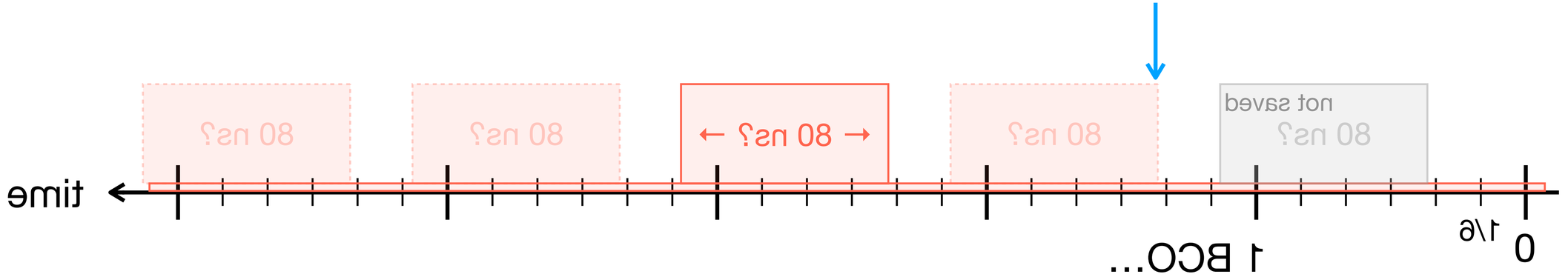
: a bunch of hits

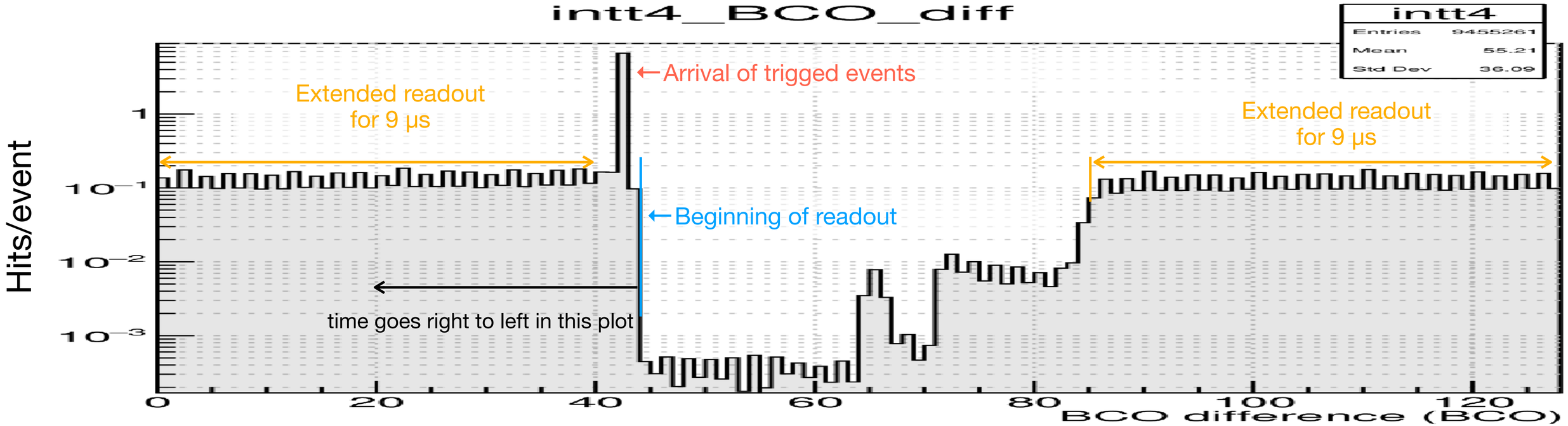
Timing scan



Reverse this figure → Reverse this figure
because …

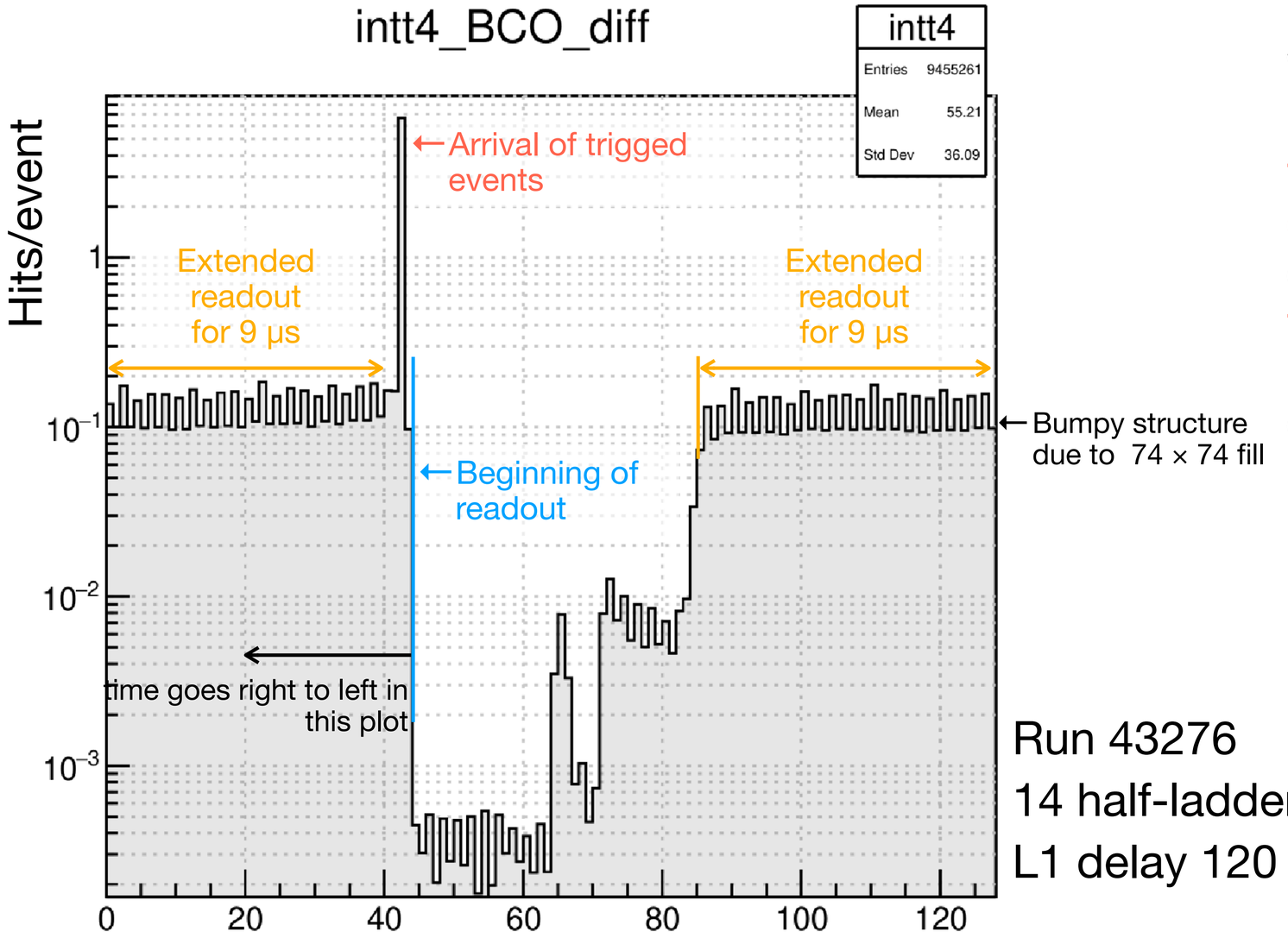
Timing scan





Lower 7 bits of GTM BCO - FPHX BCO (BCO = 106 ns)

Timing scan



We need to find the best timing parameters. “Best” means the condition that the most hits from the trigger collision are in the same peak bin. In other words, a configuration that makes the peak bin the tallest is the best. A numerical discussion is needed to evaluate how much good is also needed.

Run 43276

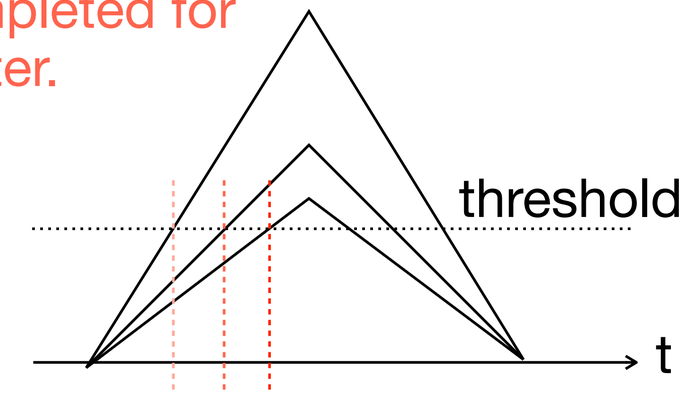
14 half-ladders of intt4 shown

L1 delay 120 (BCO/6)

Steps

1. Making a list of runs ✓
2. Processing those runs ✓
    i. Decoding ✓
    ii. Hot channel analysis ✓
    iii. Hot channel removal ✓
3. Run-by-run analysis (InttRawHit without hot channel removal is OK)
    i. Peak finding, plateau finding
    ii. Peak position comparison over all FPHX chips
    iii. Peak height estimation
4. Analysis using runs
    i. Comparison of peak position alignment over runs
    ii. Comparison of peak height over runs
5. Repeating steps 3 and 4 with hot channel removal
6. Repeating step 6 with more sophisticated hit selection
    1. ADC cut
    2. MIP selection using INTT tracking
7. and…?

Those should be completed for JPS and HP talk/poster.



Timing of exceeding threshold depends on signal size

Plan towards the goal

Day	July	August	September
1			Circulate poster in INTT
2			
3			
4			
5			
6			
7		INTT meeting	
8			Circulate poster in INTT (final)
9			Move to Japan
10	today		
11			INTT meeting
12			
13			sPHENIX General meeting/Poster printing
14		INTT meeting	
15			
16		sPHENIX General meeting	
17	INTT meeting		JPS meeting Talk
18			
19	Move to NY		
20			
21		INTT meeting	
22		Start writing analysis note	
23	Deadline of JPS talk abstract		
24	INTT meeting		HP 2024 Poster
25			
26		Start making poster	
27			
28		INTT meeting	
29			
30		sPHENIX General meeting	
31	INTT meeting		

Poster review

Approval session (backup)

Almost final results for the approval session

Final results for the approval session

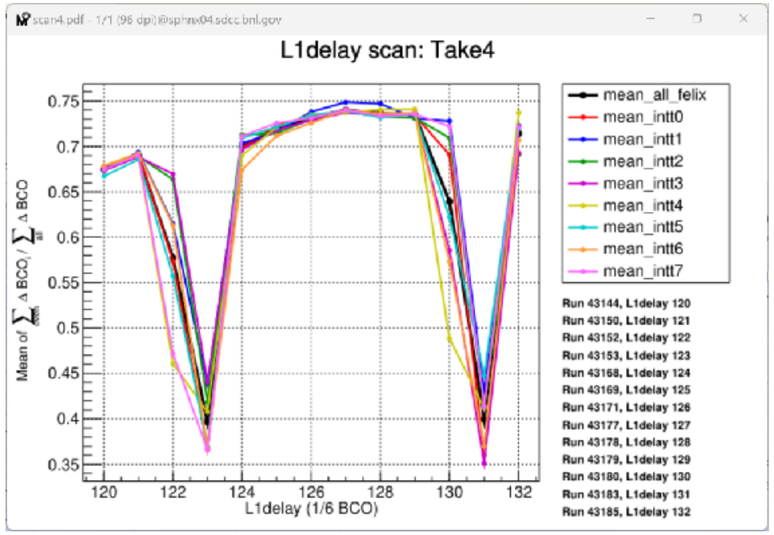
Approval session

List of runs

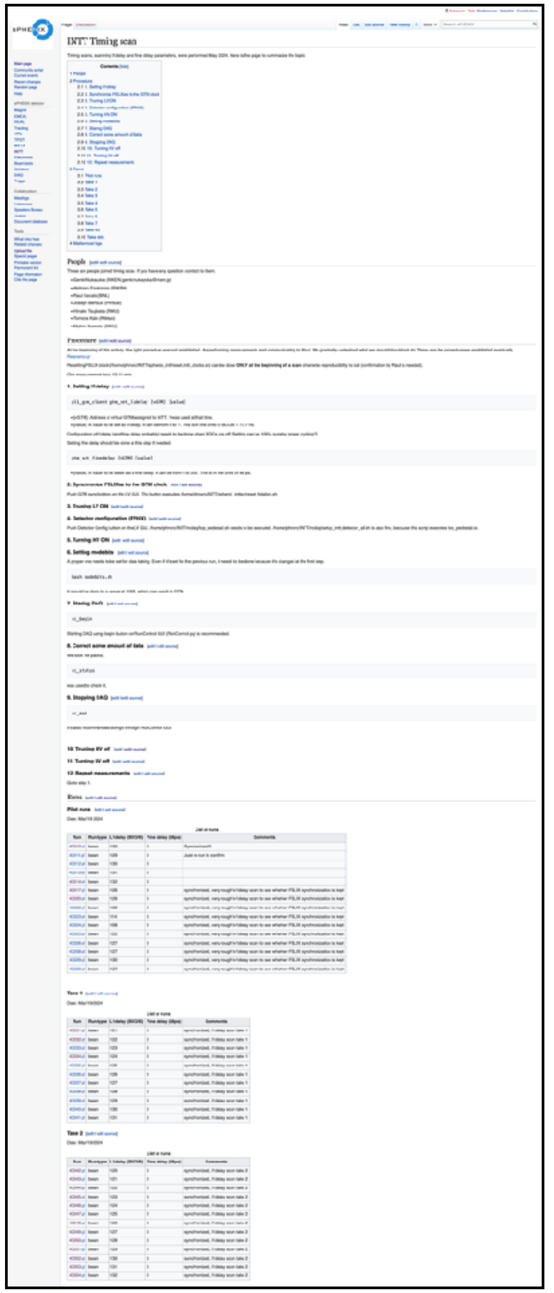
Information is summarized in the wiki.

We scanned L1delay parameters 8 times:

- Pilot runs: taken by Genki. It's junk due to wrong parameter configuration procedures
- take1, 2, 3: It's junk due to wrong parameter configuration procedures
- take4—: Good for analysis since we changed the configuration procedures



Semi-online analysis of the scan take 4. Thanks to the correct procedures, we could see the reasonable periodical structure.



List of runs

Take 4

Run	Run type	L1delay (BCO/6)	Fine delay (88ps)	Comments
43069	beam	132	0	We checked whether intt0 has data or not. But all felix servers have no data.
43070	beam	132	0	After chip reconfiguration. Not synchronized.
43071	beam	132	0	After execution reset_fidalign.sh. No data.
43131	beam	120	0	Synchronized.
43135	beam	120	0	l1delay scan with repower sycling.L1delay scan started with power cycling.
43137	beam	121	0	l1delay scan with repower sycling. No data.
43139	beam	121	0	Test measurement to see whether all FELIXes take data or not.All FELIXes took data successfully!
43141	beam	120	0	start to take l1delay scan4. Not synchronized
43144	beam	120	0	L1delay scan take 4. Synchronized! Scan data. Trigger : MBD N&S >= 1
43150	beam	121	0	L1delay scan take 4.changed l1delay value befor turning on. Synchronized! Scan data
43152	beam	122	0	L1delay scan take 4. synchronized. scan data.
43153	beam	123	0	L1delay scan take 4. synchronized. scan data.
43160	beam	124	0	changed the server from intt0 to intt1. No trriger.
43162	beam	120	0	Rebooted from DAQ. Synchronized.
43165	beam	124	0	L1delay scan take 4. Synchronized,Intt0 has a super noisy chip(Felix CH6 chip7)
43168	beam	124	0	L1delay scan take 4. Synchronized
43169	beam	125	0	L1delay scan take 4. Synchronized ,intt6 has a super noisy laddr(FELIX CH10)(SNL),Intt0 has a super noisy chip(Felix CH6 chip7),INTT5
43171	beam	126	0	L1delay scan take 4. Synchronized,intt6 has a super noisy ladder(FELIX CH10)(SNL)
43172	beam	127	0	L1delay scan take 4. Synchronized. It's stopped before getting enough statisitics because there was long break without trigger.
43177	beam	127	0	
43178	beam	128	0	L1delay scan take 4
43179	beam	129	0	L1delay scan take 4
43180	beam	130	0	L1delay scan take 4
43183	beam	131	0	L1delay scan take 4. Intt0 has a super noisy chip(Felix CH6 chip7) and Intt6 has a super noisy ladder(Felix CH10).
43185	beam	132	0	L1delay scan take 4

Take 5

Run	Run type	L1delay (BCO/6)	Fine delay (88ps)	Comments
43215	beam	123	40	
43216	beam	123	80	
43217	beam	126	0	Test of fine delay parameter. These measurements covers L1delay 126 - 128(BCO/6). LV/HV power cycling is done between runs.https://sphenix-intra.sdcc.bnl.gov/WWW/subsystem/intt/
43218	beam	126	100	
43219	beam	127	0	No trigger.
43221	beam	127	0	
43222	beam	127	100	
43223	beam	128	0	No trigger.
43224	beam	128	0	
43225	beam	128	0	Test measurement to see the shape of bco difference distribution is corresponding to the beam fill.
43227	beam	128	100	open time and n_collisions are long.
43228	beam	129	0	open time and n_collisions are long.
43229	beam	128	100	Delay scan take 5. This is the compensation run for 43227.
43230	beam	129	0	Delay scan take 5. This is the compensation run for 43228.

List of runs

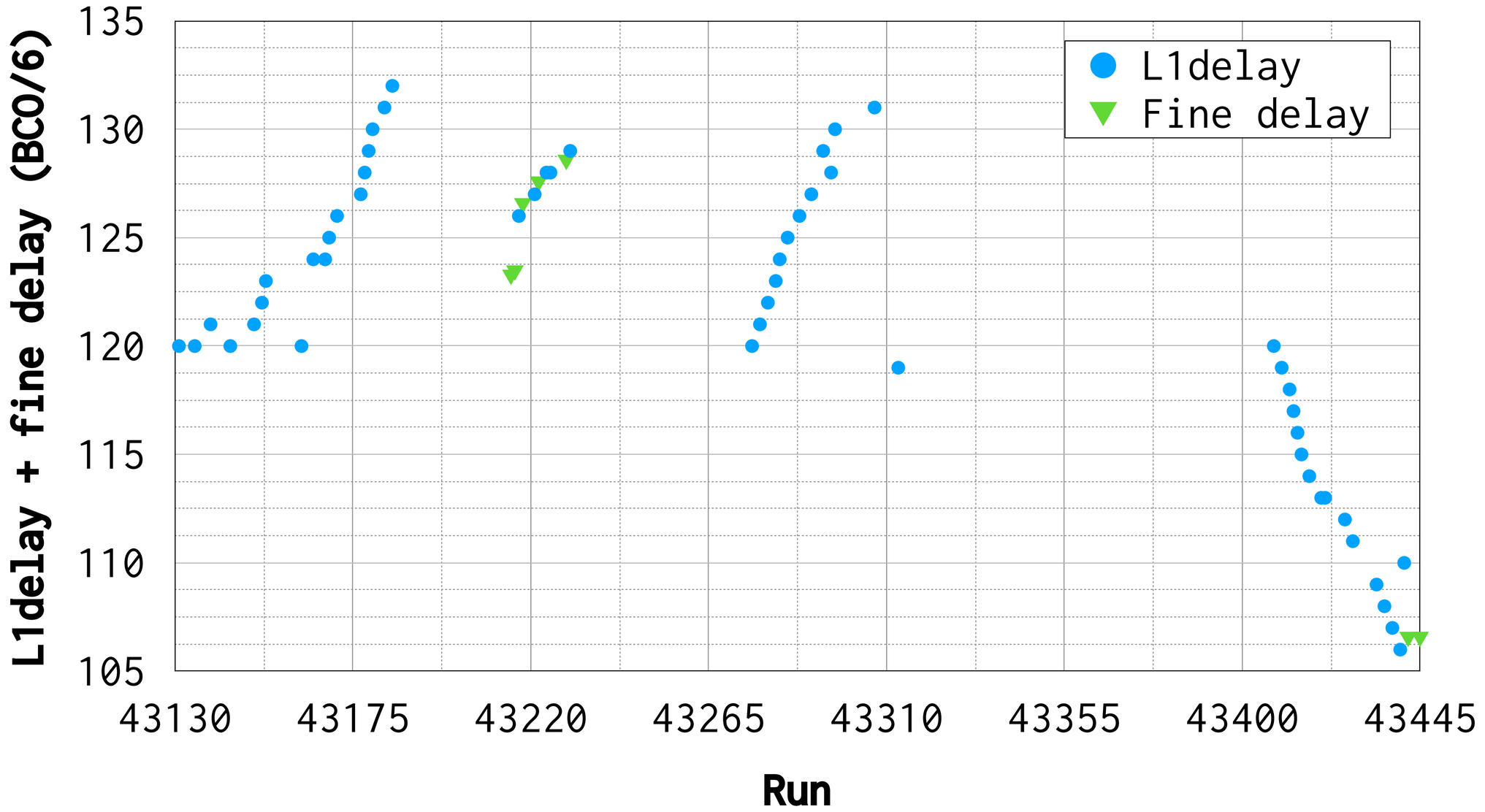
Take 6

Run	Run type	L1delay (BCO/6)	Fine delay (88ps)	Comments
43276	beam	120	0	Raul fixed the python script in the rest_intt_clocks.sh about between run , trigger is MBD N&S>=1, Syncronized ,Intt0 has a super noisy chip(SNC)
43278	beam	121	0	syncronized
43280	beam	122	0	syncronized,
43282	beam	123	0	syncronized
43283	beam	124	0	syncronized
43285	beam	125	0	syncronized
43288	beam	126	0	syncronized
43291	beam	127	0	syncronized
43293	beam	128	0	syncronized (peak jump)
43294	beam	129	0	syncronized (peak is stayed atl jumped pojition)
43296	beam	128	0	syncronized
43297	beam	130	0	syncronized
43307	beam	131	0	
43310	beam	132	0	Synchronized(Peak is at jumped position). intt0 has less data than others.
43313	beam	119	0	Delay scan take 6. Synchronized. Trigger was lost during the run and came back.

Take 7

Run	Run type	L1delay (BCO/6)	Fine delay (88ps)	Comments
43408	physics	120	0	Delay scan take 7, MDB N&S trigger. FELIXes synchronized.
43410	beam	119	0	Delay scan take 7, MDB N&S trigger. FELIXes synchronized.
43412	beam	118	0	Delay scan take 7, MDB N&S trigger. FELIXes synchronized.
43413	beam	117	0	Delay scan take 7, MDB N&S trigger. FELIXes synchronized.
43414	beam	116	0	Delay scan take 7, MDB N&S trigger. FELIXes synchronized.
43415	beam	115	0	Delay scan take 7, MDB N&S trigger. FELIXes synchronized.
43417	beam	114	0	Delay scan take 7, MDB N&S trigger. FELIXes synchronized.
43421	beam	113	0	Delay scan take 7, MDB N&S trigger. FELIXes synchronized.
43426	beam	112	0	Delay scan take 7, MDB N&S trigger. FELIXes synchronized.
43428	beam	111	0	Delay scan take 7, MDB N&S trigger. FELIXes synchronized.
43431	beam	110	0	2 peaks
43434	beam	109	0	Delay scan take 7, MDB N&S trigger. FELIXes synchronized.
43436	beam	108	0	Delay scan take 7, MDB N&S trigger. FELIXes synchronized.
43438	beam	107	0	Delay scan take 7, MDB N&S trigger. FELIXes synchronized.
43440	beam	106	0	Delay scan take 7, MDB N&S trigger. FELIXes synchronized.
43442	beam	106	100	fine delay : 110 The shape of the timing distribution looks weird.
43445	beam	106	100	The shape of the timing distribution looks weird.
43446	beam	120	100	The shape of the timing distribution looks weird.
43447	beam	119	100	The shape of the timing distribution looks weird.
43448	beam	119	100	Took data with L1delay : 119 again. The shape of the timing distribution looks weird.
43450	beam	118	100	The shape of the timing distribution looks weird.
43454	beam	118	100	Took data with L1delay : 118 again. The data taken is five times more than before. The shape of the timing distribution looks weird.
43455	beam	117	100	The shape of the timing distribution looks weird.
43456	beam	117	100	fine delay was set to 100 agein. The shape of the timing distribution looks weird.
43458	beam	116	100	The shape of the timing distribution looks weird. After this measurment, gtm command did not work.
43420	beam	113	0	Delay scan take 7, MDB N&S trigger. FELIXes synchronized. evt files are not found. Maybe junk run.
43441	beam	110	0	Took data with L1delay : 110 again because the previous data has two peaks.

List of runs: Scanned range



Mattermost logs

- May/18/2024: Take1, 2, and 3
- May/19/2024: Take4
- May/19/2024: Take5
- May/21/2024: Take7