ビームを使ったコミッショニング

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Cheng-Wei Shih (remote)

概要

目的

- FELIX のデータ読み出しタイミングを調整し、ビーム・ビーム衝突によるヒット検出に最適化すること

状況

- 2023/05/25 朝〜2023/05/26 未明
- 100 GeV 金・金衝突
  - 6 × 6 ビームバンチ（run7364-7350 (ID190-198), run8005-8059 ）
  - 56 × 56 ビームバンチ（run7374-8002）
- MBD トリガーを使ったデータ収集, トリガーレート 300 Hz

データ収集

- INTT システムを big partition に組み込み、ローカルモードで RCDAQ を使いデータ収集
- 生データ (calib_intt[0-7]-*.evt) を Buffer box に保存
- Joseph のプログラムで ROOT TTree 形式に変換し、ROOT ファイル (calib_intt[0-7]-*.root) に保存

ラン

- RCDAQ のモード：calib
- 基本的に Raul が FELIX/ROC/FPHX の初期化・設定、パラメータの設定、
  ランの開始・終了を行った
  - DAC0 を 23 に設定し、ノイズデータを減らした
- FPHX チップのパラメータは全チップで共通
- チャンネルマスク（キャリブレーションデータを使った Cheng-Wei によるもの）あり

- **生データ**
  - パス：/bbox/commissioning/INTT/calib/calib_intt[0-7]-0000????_0000.evt
  - INTT DAQ サーバー（EBDB?）intt[0-7] からアクセス可能
- **ROOT ファイル**
  - パス：/home/phnxrc/INTT/commissioning_5_23/hit_files/calib_intt[0-7]-0000????_0000.root
  - OPC0 からアクセス可能
  - inttdaq からもアクセス可能（/1008_home/phnxrc/…）

※ 特に序盤はラン番号の振り方がめちゃくちゃ（7364→7367→…）

FPHX チップのパラメータ

パラメータ名	値	パラメータ名	値
Vref	1	N1sel	6
DAC0	23	N2sel	4
DAC1	30	FB1sel	4
DAC2	60	Leaksel	0
DAC3	90	P3sel	0
DAC4	120	P2sel	4
DAC5	150	Gsel	2
DAC6	180	BWsel	8
DAC7	210	P1sel	5
		Injsel	0
		LVDS	63

```
Host intt0
     HostName 10.20.32.100
     User     phnxrc
     IdentityFile ~/.ssh/id_rsa
     ForwardX11 yes
     ProxyJump    OPC0
```

ランのまとめ（作成中）

The list of runs with remarks on the run number

ID	Run number	Remark
190 - 202		?
203-212	7369 - 7382	Scanning LV1 delay, open time = ?, n_collisions = ?
213	8000	Just before the beam dump, Try to get a beam signal with the largest windows.
214	8002	Just before the beam dump, Try to get a beam signal without trigger pre-scaling. LV1 delay was (thought to be) a good value.
215	8005	New beam. Attempted to reproduce the condition before (b/w run7364-7350)
216-227	8006 - 8017	Scanning LV1 delay, We were confused by ADC distributions at that time.
229 - 243	8020 - 8036	Scanning open time with fixed n_collision 127 and LV1 delay 20. A drop in event rate was found.
244 - 257	8037 - 8049	Scanning n_collision with fixed LV1 delay 25 and open time 25.
258 - 265	8050 - 8059	Scanning n_collision with fixed LV1 delay 25 and open time 30.

全ランのログ

データ

TTree

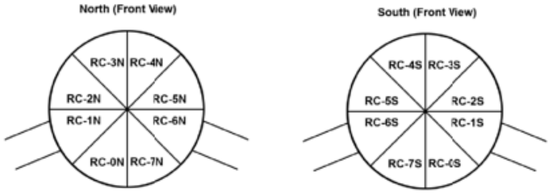
- ブランチは基本的に int 型
- FVTX テストベンチの構成を引き継ぎ、ブランチがいくつか追加されている
  - pid:パケット ID
  - adc
  - ampl
  - chip_id
  - module: FELIX readout ch
  - chan_id
  - bco
  - bco_full: Long64_t
  - event
  - roc
  - barrel
  - layer
  - ladder
  - arm: 0 (south), 1 (north)
  - full_fphx
  - full_roc

roc, barrel, layer, ladder, arm について

ROC の記述 (例 RC-2N) や

ラダーの記述 (例 B1 L0 14S) を再現できる変数

RC${roc}${arm}
B${barrel}L${layer}${ladder}${arm}



タイミング調整：4 つのパラメータを最適化する

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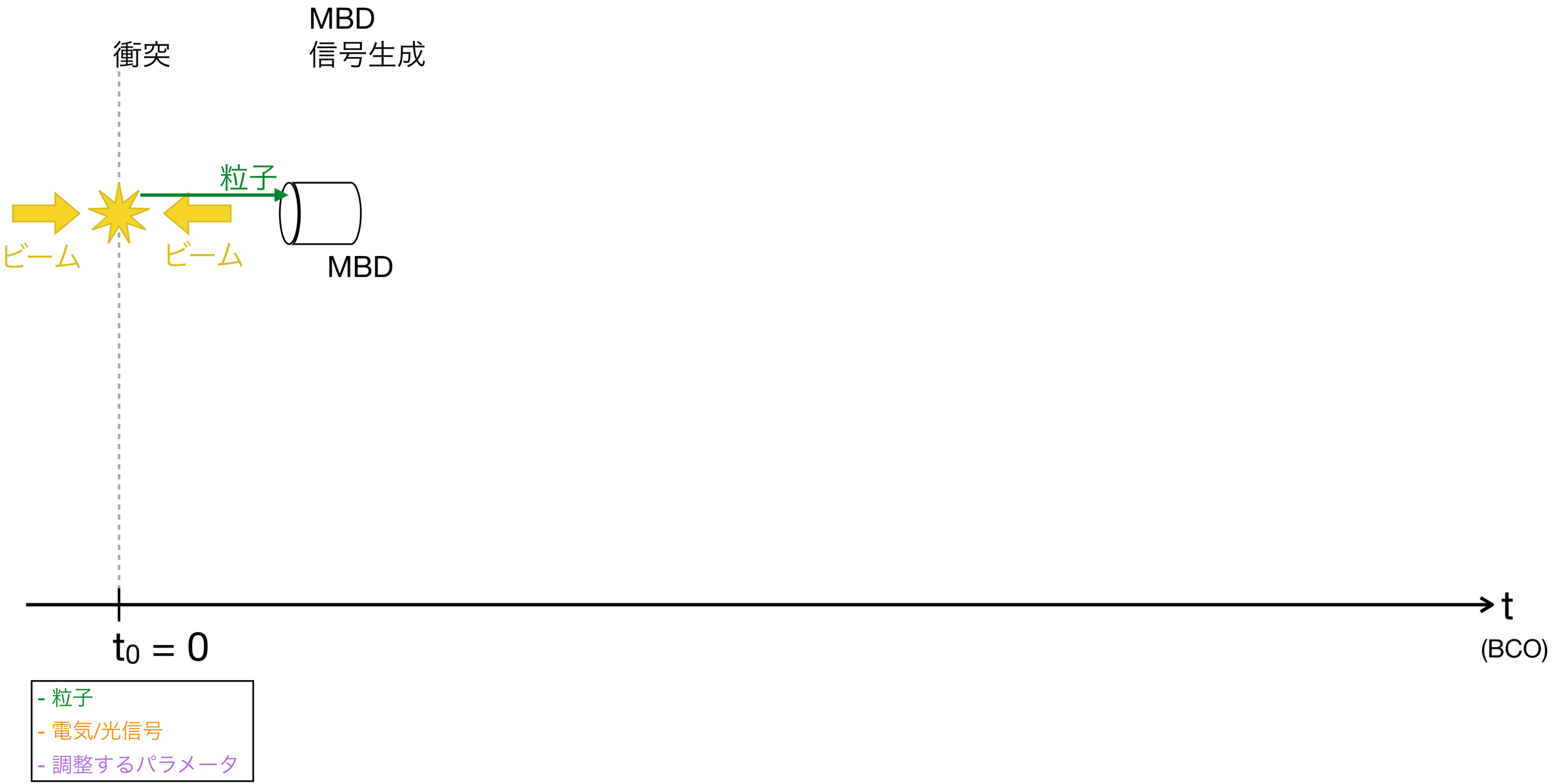
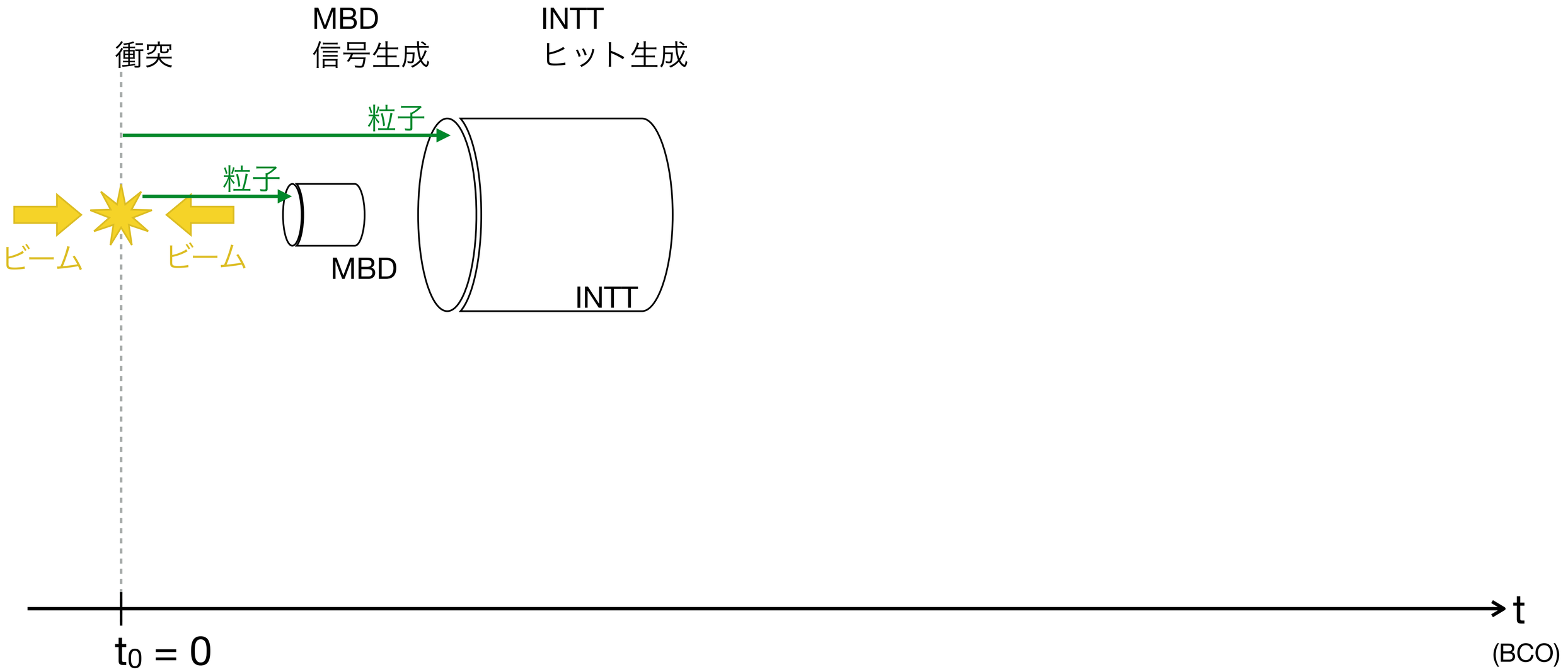
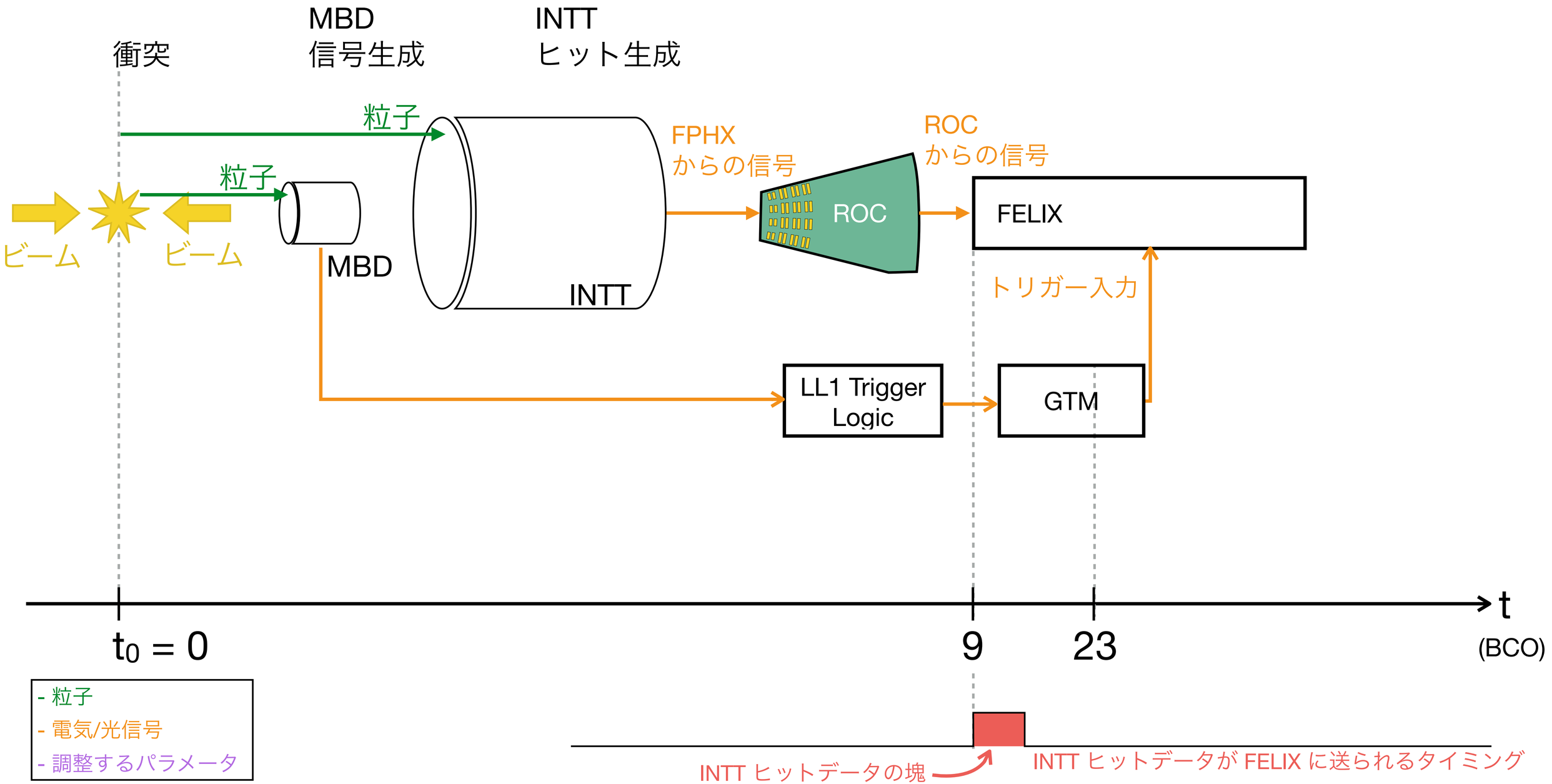


タイミング調整：4 つのパラメータを最適化する

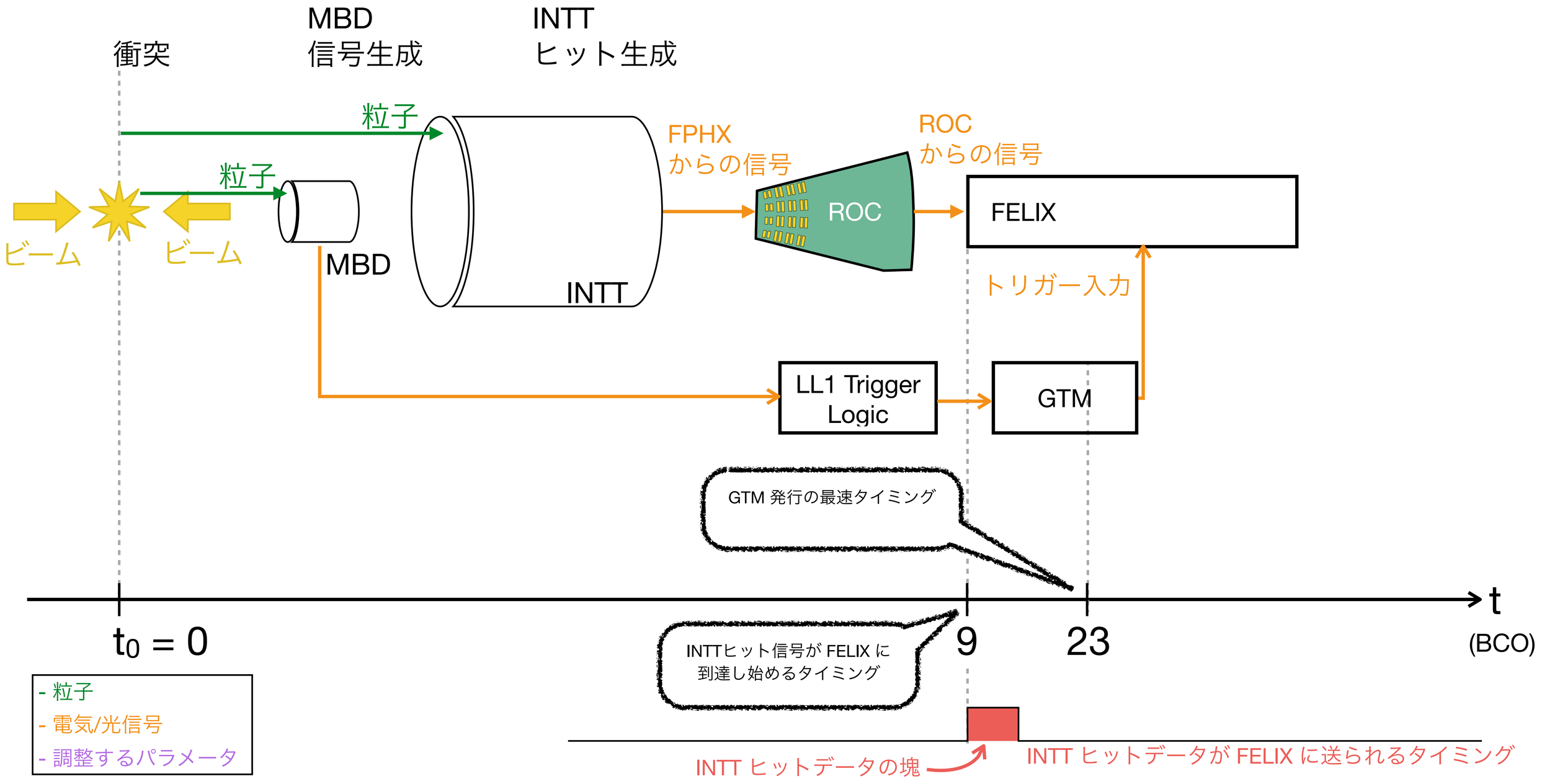


- 粒子
- 電気/光信号
- 調整するパラメータ

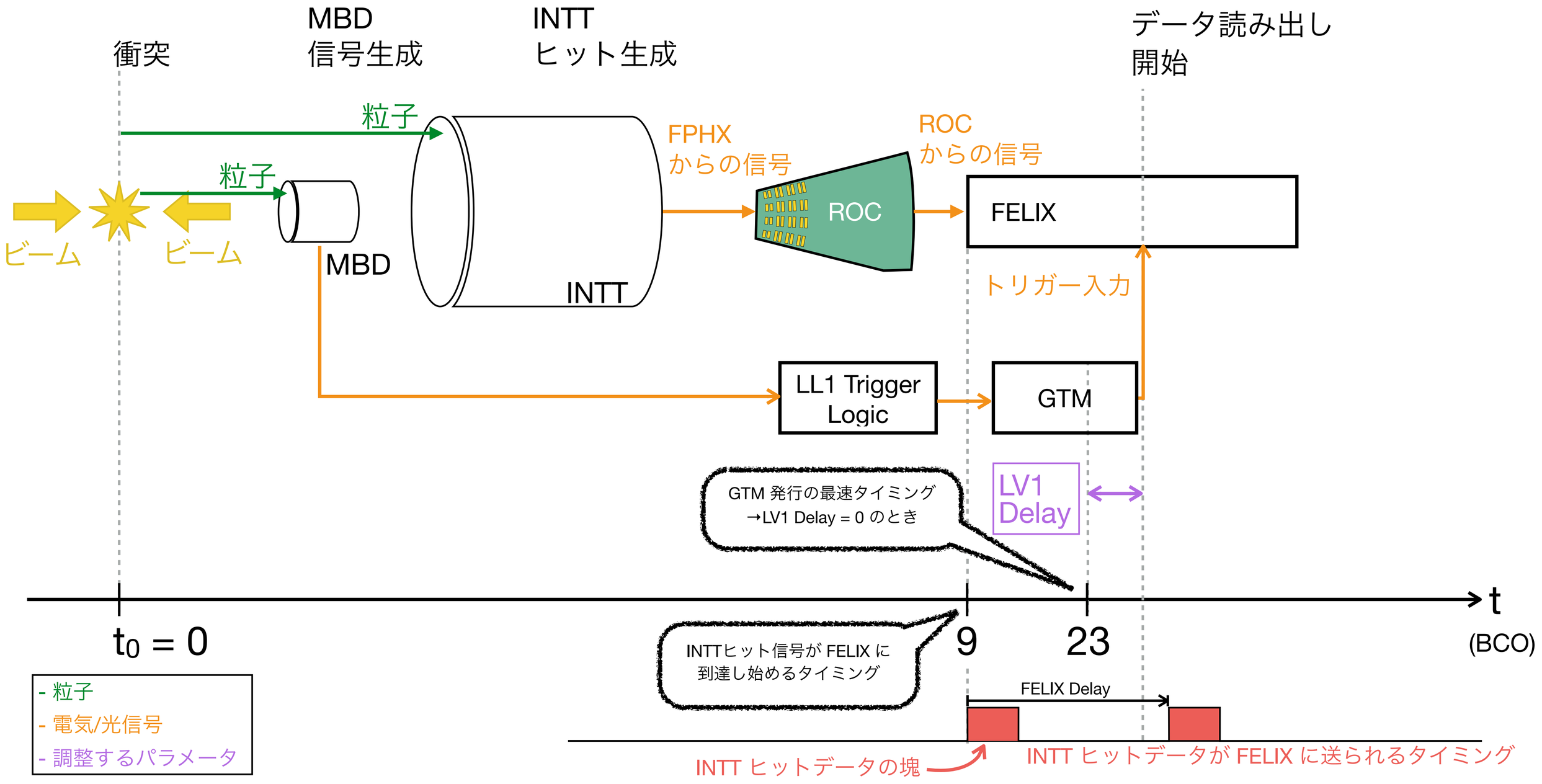
タイミング調整：4 つのパラメータを最適化する



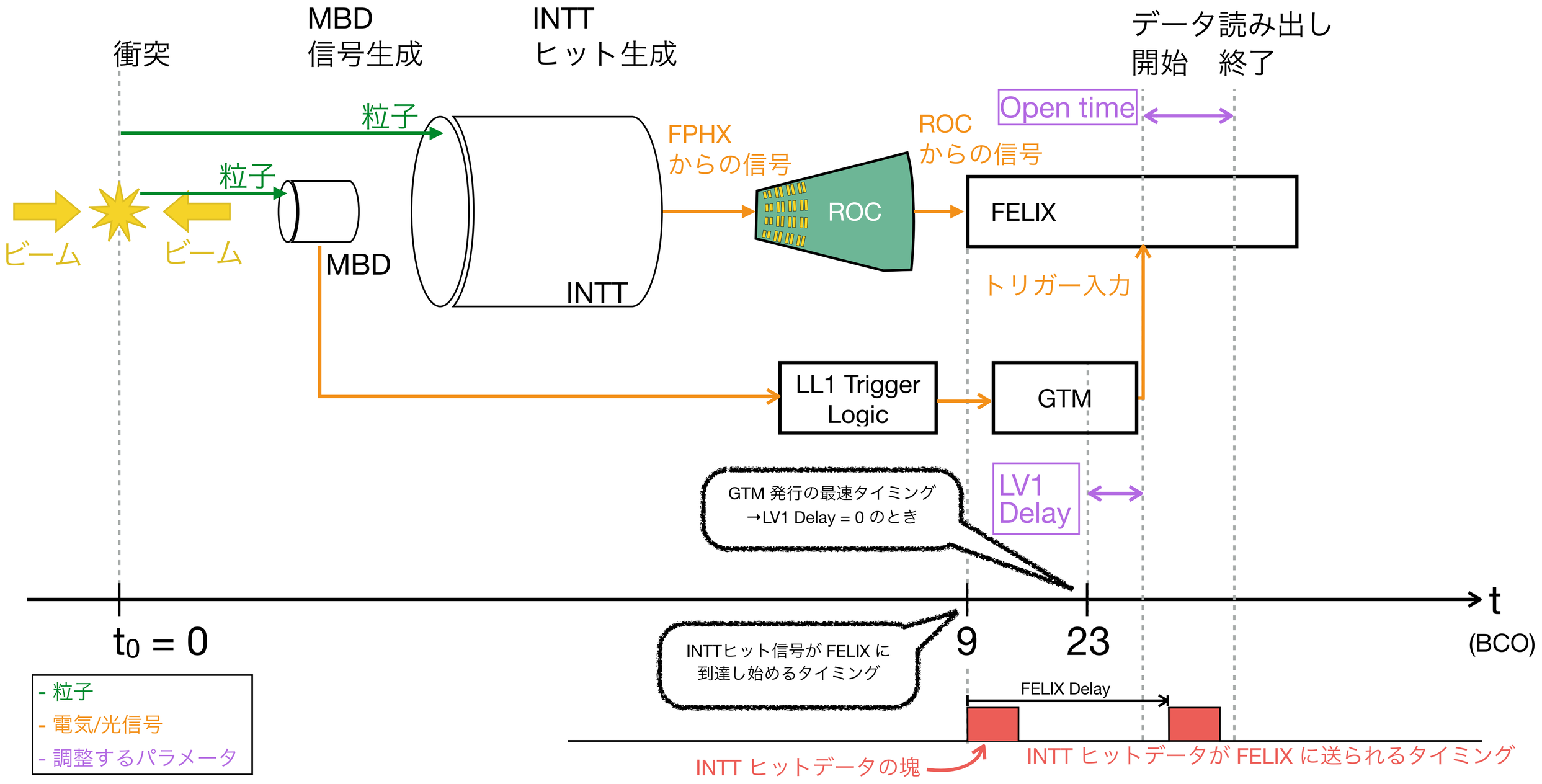
タイミング調整：4 つのパラメータを最適化する



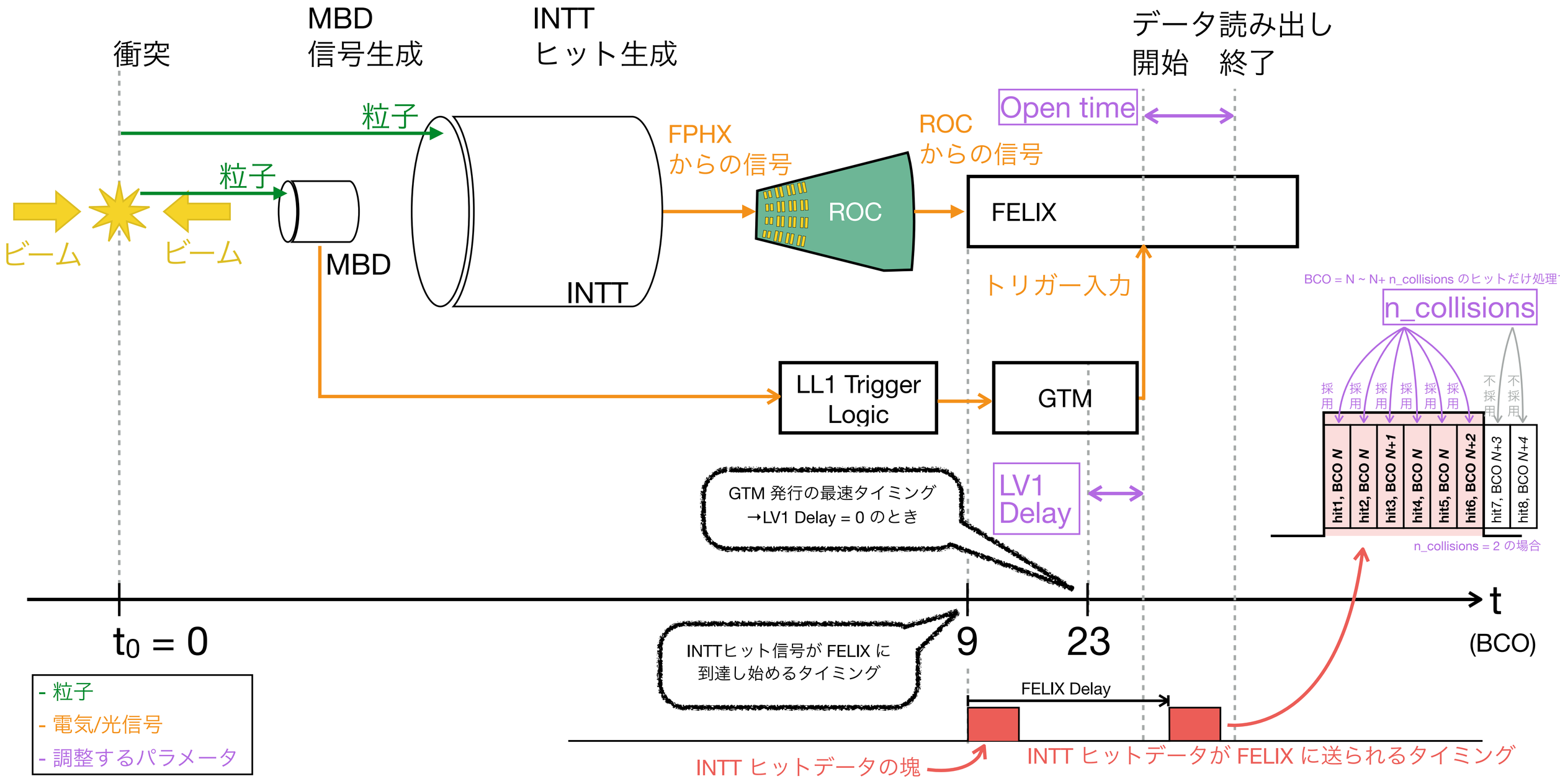
タイミング調整：4 つのパラメータを最適化する



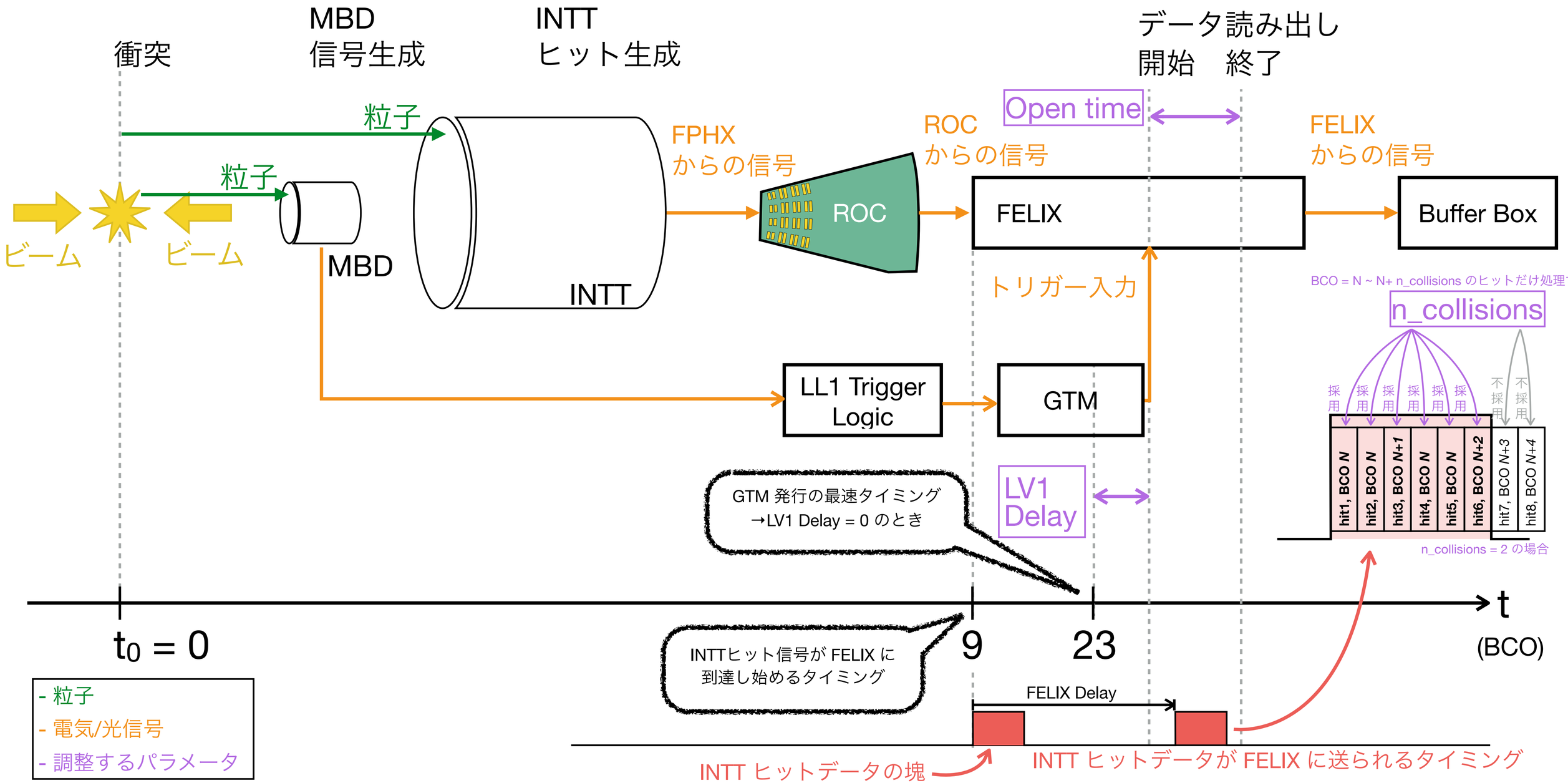
タイミング調整：4 つのパラメータを最適化する



タイミング調整：4 つのパラメータを最適化する



タイミング調整：4 つのパラメータを最適化する



タイミング調整：Open time

- Open time だけを変えながらデータ収集
  - LV1 Delay: 20（十分短いディレイ）
  - n_collisions: 127 （BCO 値の選択なし）
- Open time を十分長い値からはじめ、ヒットレートが極端に減少し始めたときの値が目安になる

Open time スキャンのラン一覧

ID	Run	LV1 Delay	Open time	n_collisions
229	8020	0	120	127
230	8021	20	80	127
231	8023	20	75	127
232	8024	20	70	127
233	8025	20	65	127
234	8026	20	60	127
235	8027	20	50	127
236	8028	20	40	127
237	8030	20	30	127
238	8031	20	20	127
239	8032	20	10	127
240	8033	20	15	127
241	8034	20	17	127
242	8035	20	19	127
243	8036	20	12	127

タイミング調整：Open time

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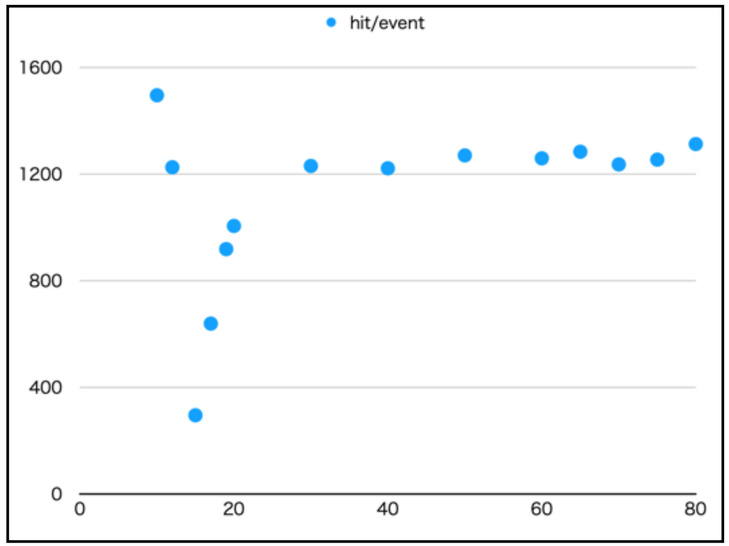
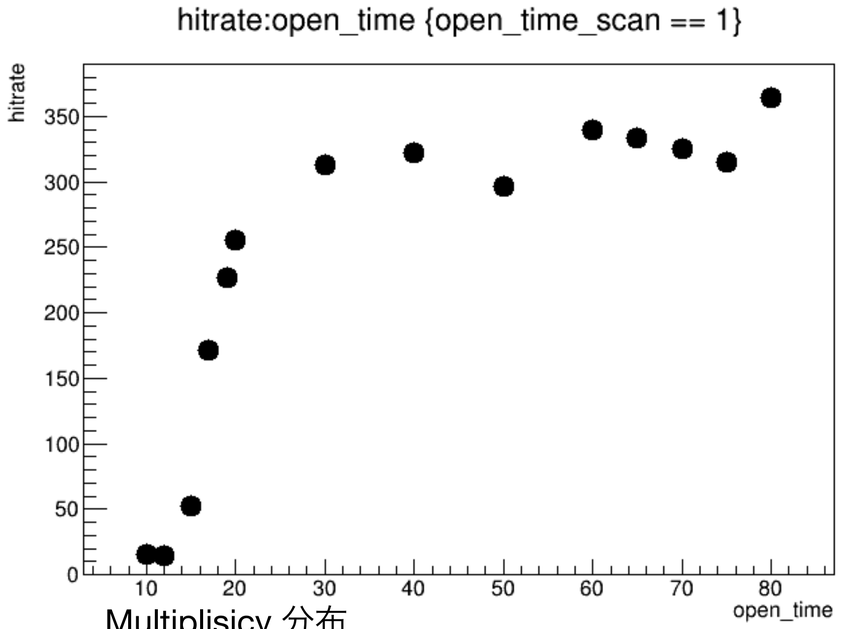
- Open time を十分長い値からはじめ、ヒットレートが極端に減少し始めたときの値が目安になる



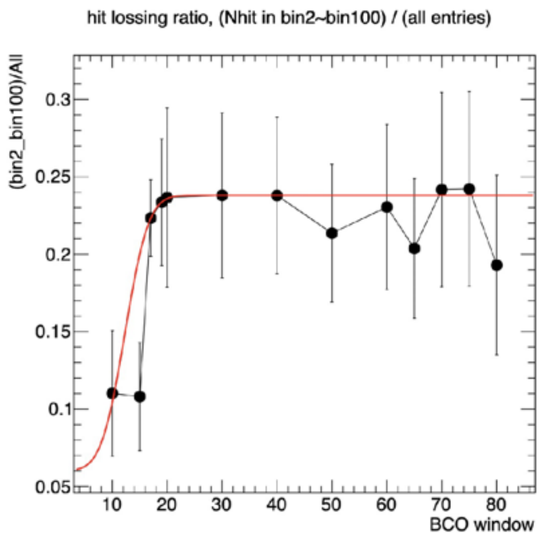
B1L101S, Chip14 のランあたりのヒット数
イベント数による規格化あり
オンライン解析
藤原

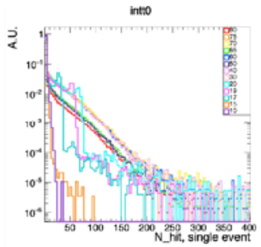


Multiplisicy 分布
RC-4S, 7 ラダーの平均
オンライン解析
Joseph

Open time スキャンのラン一覧

ID	Run	LV1 Delay	Open time	n_collisions
229	8020	0	120	127
230	8021	20	80	127
231	8023	20	75	127
232	8024	20	70	127
233	8025	20	65	127
234	8026	20	60	127
235	8027	20	50	127
236	8028	20	40	127
237	8030	20	30	127
238	8031	20	20	127
239	8032	20	10	127
240	8033	20	15	127
241	8034	20	17	127
242	8035	20	19	127
243	8036	20	12	127



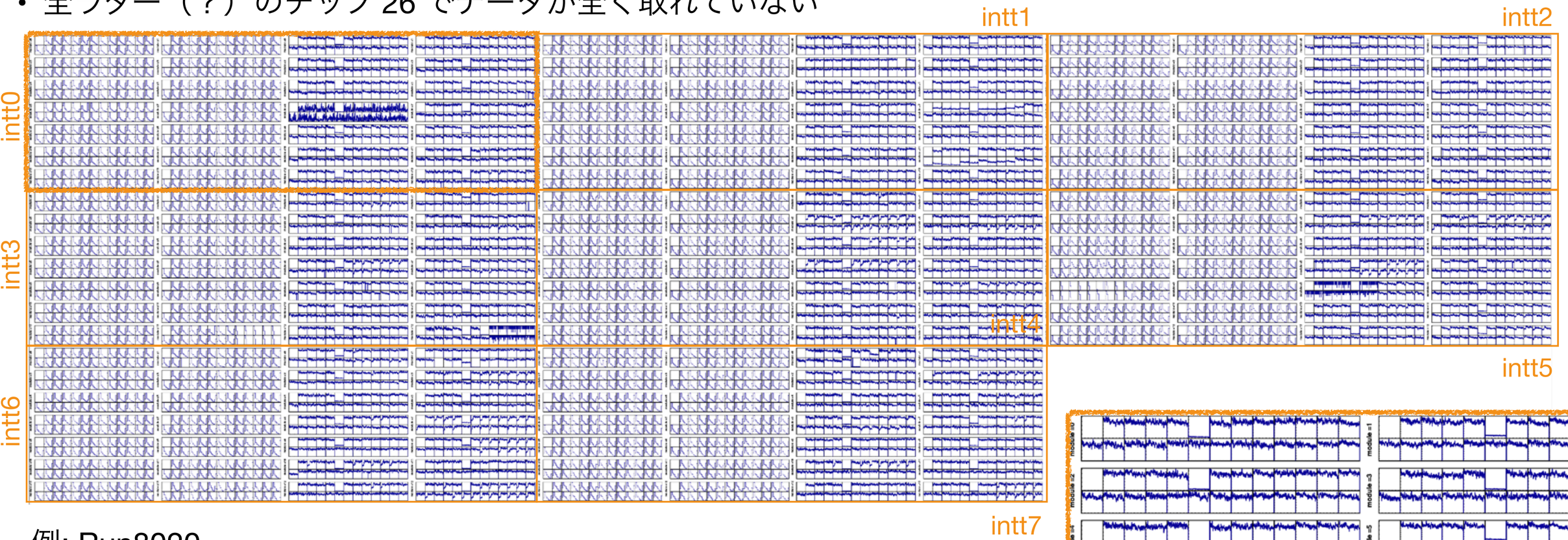


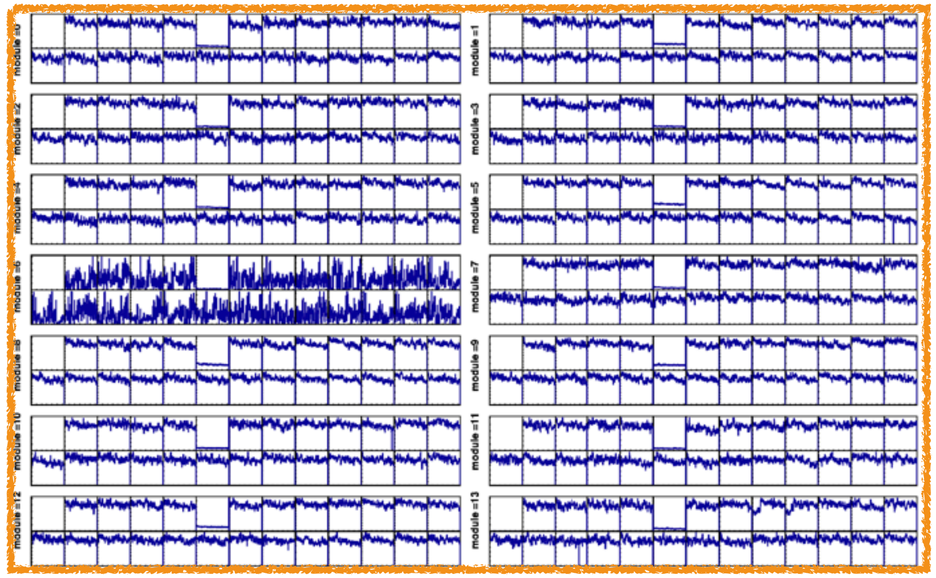
Multiplicity,
Cheng-Wei

Hit lossing ratio
Cheng-Wei

興味深い点

- 全ラダー（？）のチップ 26 でデータが全く取れていない





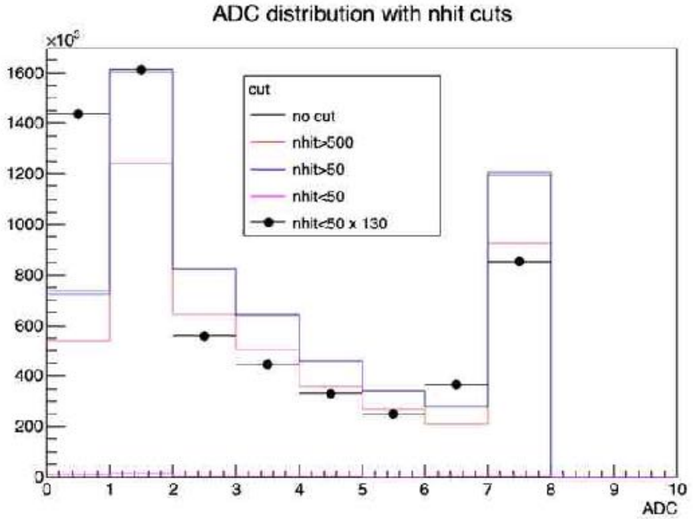
例: Run8020

Run 番号 8000 以上のデータで chip_id==26 のヒット

はーつも見つからなかった

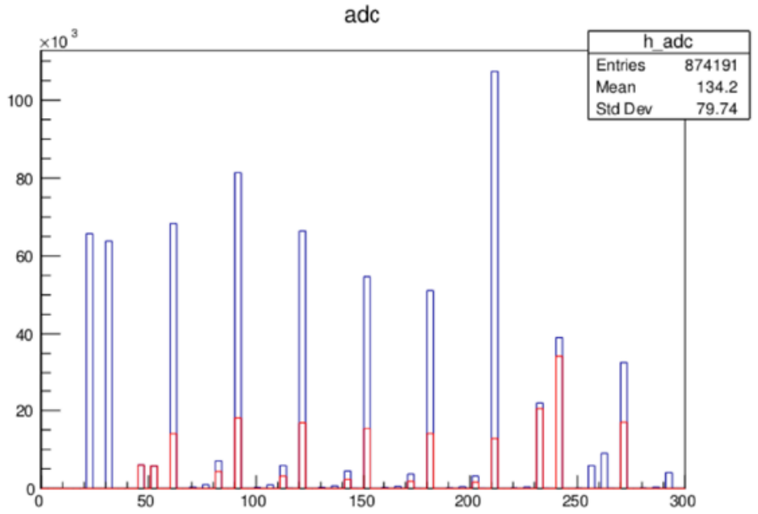
興味深い点

- 全ラダー（？）のチップ 26 でデータが全く取れていない
- ADC 分布に明確な MIP ピークが見えない
- ヒットのクローンがあるかもしれない



Multiplicity ごとに分割した ADC 分布

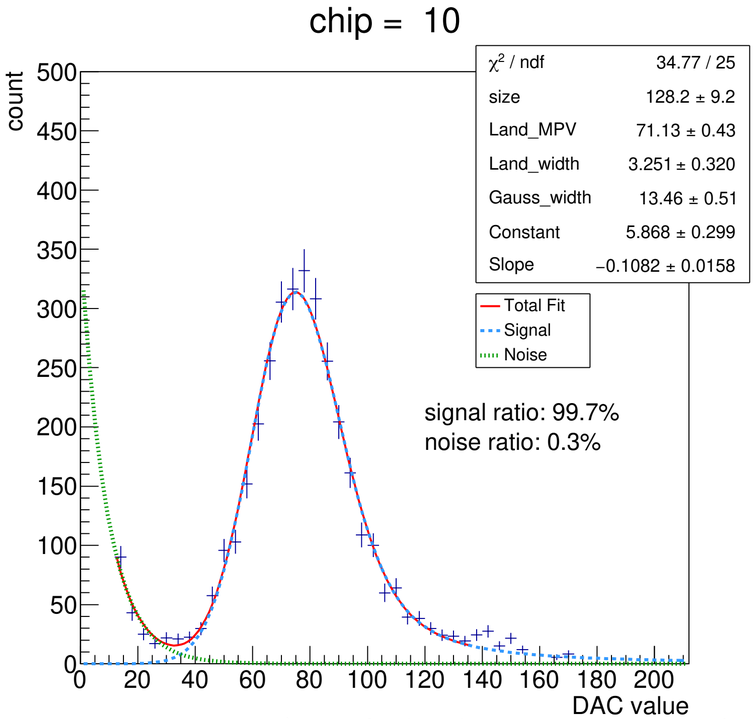
下村



クラスタリング後の DAC 分布

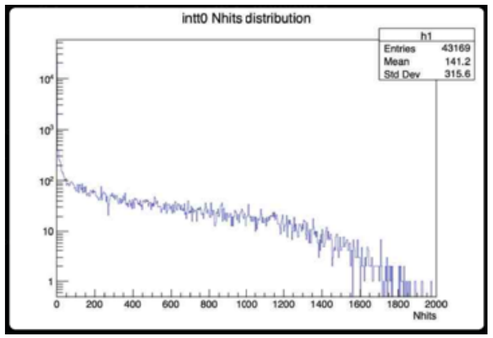
蜂谷

パラメータ名	値	パラメータ名	値
DAC0	23	DAC4	120
DAC1	30	DAC5	150
DAC2	60	DAC6	180
DAC3	90	DAC7	210



ELPH テストビーム実験で得られた DAC 分布

杉山

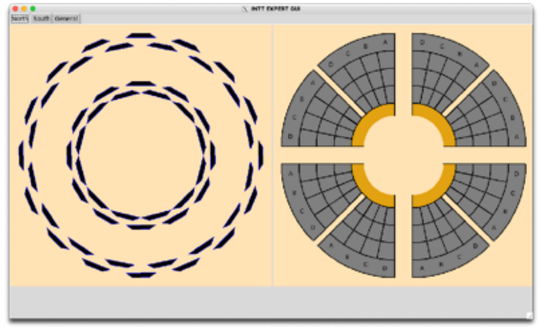


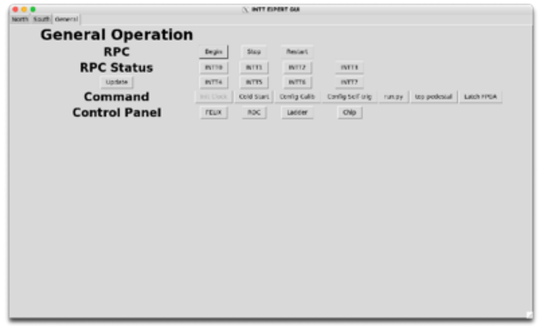
Multiplicity 分布

下村

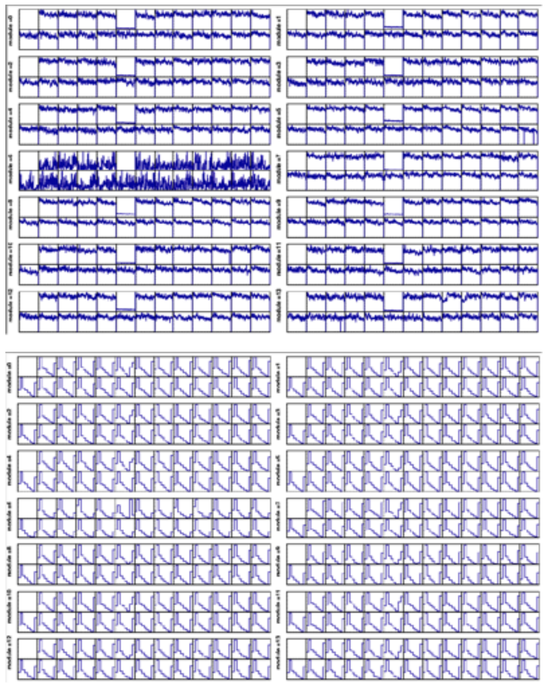
その他

- Slow control は Expert GUI で行った。主に全 FELIX への一斉操作を行い、サーバー 1 台を除きRPC は安定稼働した。
  cold start の結果を一覧するのに図が役立った。
- ランごとに波多さんの FELIX Quick Viewer (1 FELIX version) で結果をすぐに確認した。データ処理スピートは問題なかった（ 1 ファイル平均 20 MB）。
- 加納さんがランの記録を詳細に残した。Raul の手伝いでも活躍した。



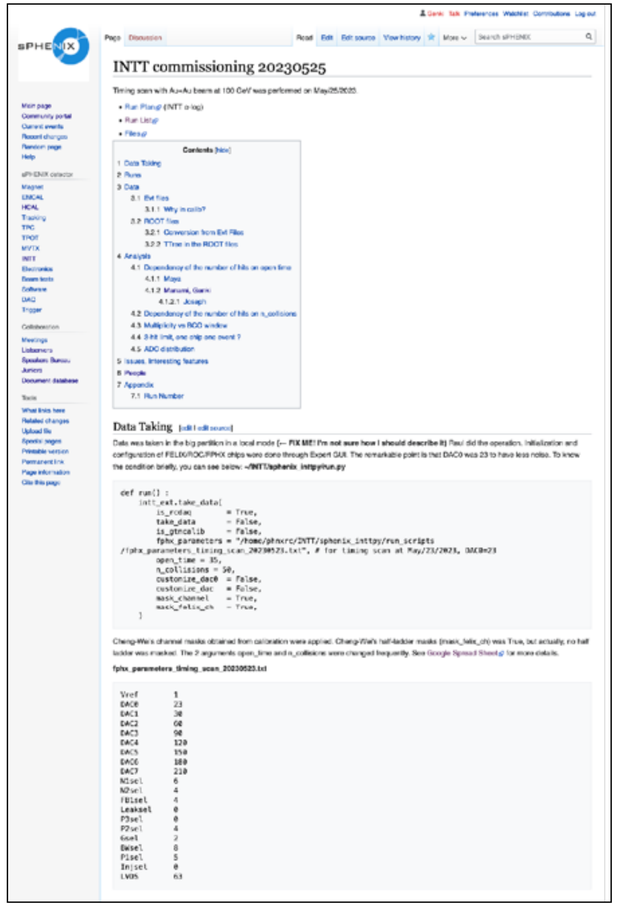


	A	B	C	D	E	F	G	H	I	J	K	L
1		date	run #	Filename	ROC	Run Type calib/ped/ beam/cali bration	Duration [min.]	DAC(	Purpose	Purpose		
198	190	2023/5/25	7364	/home/phnxrc/INTT/commissioning_5_23/hit_files/calib_intt0-00007364-0000.root	intt0 - 7	calib	5	23	semi-stream readout to see	n_collision=127, Felix delay=62, BCO, time window=80, 56x56 bunch store		
199		2023/5/25	7367	/home/phnxrc/INTT/commissioning_5_23/hit_files/calib_intt0-00007367-0000.root	intt0 - 7	calib	6 - 10	23	semi-stream readout to see	n_collision=127, Felix delay=62, BCO, time window=80		
200	191	2023/5/25	7351	/home/phnxrc/INTT/commissioning_5_23/hit_files/calib_intt0-00007351-0000.root	intt0 - 7	calib	10	23	L1Delay Scan for time-in	17:26:53		
201	192	2023/5/25	7354	/home/phnxrc/INTT/commissioning_5_23/hit_files/calib_intt0-00007354-0000.root	intt0 - 7	calib	10	23	L1Delay Scan for time-in	L1Delay=50		
202	193	2023/5/25	7356	/home/phnxrc/INTT/commissioning_5_23/hit_files/calib_intt0-00007356-0000.root	intt0 - 7	calib	10	23	L1Delay Scan for time-in	L1Delay=46		
203	194	2023/5/25	7358	/home/phnxrc/INTT/commissioning_5_23/hit_files/calib_intt0-00007358-0000.root	intt0 - 7	calib	10	23	L1Delay Scan for time-in	L1Delay=52		
204	195	2023/5/25	7363	/home/phnxrc/INTT/commissioning_5_23/hit_files/calib_intt0-00007363-0000.root	intt0 - 7	calib	10	23	L1Delay Scan for time-in	L1Delay=44		
205	196	2023/5/25	7365	/home/phnxrc/INTT/commissioning_5_23/hit_files/calib_intt0-00007365-0000.root	intt0 - 7	calib	6	23	L1Delay Scan for time-in	L1Delay=54		
206	197	2023/5/25	7366	/home/phnxrc/INTT/commissioning_5_23/hit_files/calib_intt0-00007366-0000.root	intt0 - 7	calib	6	23	L1Delay Scan for time-in	L1Delay=42 MBD time in finished. From here on possible timing change and rate changed in the middle		
207	198	2023/5/25	7350	junk						L1Delay=56 almost no event		
208	199	2023/5/25	7374	/home/phnxrc/INTT/commissioning_5_23/hit_files/calib_intt0-00007374-0000.root	intt0 - 7	calib	5	23	L1Delay Scan for time-in	L1Delay=54, trigger rate ~ 3kHz, Fat ADC distribution for all intt servers, 56x56 bunch store		
209	200		7375	/home/phnxrc/INTT/commissioning_5_23/hit_files/calib_intt0-00007375-0000.root	intt0 - 7	calib	5	23	L1Delay Scan for time-in	L1Delay=52, trigger rate ~ 3kHz sharp drop ADC distribution for all			
210	201		7376	/home/phnxrc/INTT/commissioning_5_23/hit_files/calib_intt0-00007376-0000.root	intt0 - 7	calib	5	23	L1Delay Scan for time-in	L1Delay=56, trigger rate ~ 3kHz, Fat ADC distribution for all intt servers			
211	202		7368	/home/phnxrc/INTT/commissioning_5_23/hit_files/calib_intt0-00007368-0000.root	intt0 - 7	calib	5	23	L1Delay Scan for time-in	L1Delay=54, trigger rate ~ 300Hz sharp drop ADC distribution for all			
212	203		7369	/home/phnxrc/INTT/commissioning_5_23/hit_files/calib_intt0-00007369-0000.root	intt0 - 7	calib	5	23	L1Delay Scan for time-in	L1Delay=52			
213	204		7370	/home/phnxrc/INTT/commissioning_5_23/hit_files/calib_intt0-00007370-0000.root	intt0 - 7	calib	5	23	L1Delay Scan for time-in	L1Delay=56			
214	205		7371	/home/phnxrc/INTT/commissioning_5_23/hit_files/calib_intt0-00007371-0000.root	intt0 - 7	calib	5	23	L1Delay Scan for time-in	L1Delay=50			
215	206		7372	/home/phnxrc/INTT/commissioning_5_23/hit_files/calib_intt0-00007372-0000.root	intt0 - 7	calib	5	23	L1Delay Scan for time-in	L1Delay=58			
216	207		7377	/home/phnxrc/INTT/commissioning_5_23/hit_files/calib_intt0-00007377-0000.root	intt0 - 7	calib	5	23	L1Delay Scan for time-in	L1Delay=48			
217	208		7378	/home/phnxrc/INTT/commissioning_5_23/hit_files/calib_intt0-00007378-0000.root	intt0 - 7	calib	5	23	L1Delay Scan for time-in	L1Delay=60			
218	209		7379	/home/phnxrc/INTT/commissioning_5_23/hit_files/calib_intt0-00007379-0000.root	intt0 - 7	calib	5	23	L1Delay Scan for time-in	L1Delay=46			
219	210		7380	/home/phnxrc/INTT/commissioning_5_23/hit_files/calib_intt0-00007380-0000.root	intt0 - 7	calib	5	23	L1Delay Scan for time-in	L1Delay=62			
220	211		7381	/home/phnxrc/INTT/commissioning_5_23/hit_files/calib_intt0-00007381-0000.root	intt0 - 7	calib	5	23	L1Delay Scan for time-in	L1Delay=44			
221	212		7382	/home/phnxrc/INTT/commissioning_5_23/hit_files/calib_intt0-00007382-0000.root	intt0 - 7	calib	5	23	L1Delay Scan for time-in	L1Delay=64			
222	213		8000	/home/phnxrc/INTT/commissioning_5_23/hit_files/calib_intt0-00008000-0000.root	intt0 - 7	calib	5	23	L1Delay Scan for time-in	L1Delay=0, n_collision=127 sanitary check run, prescale=100			
223	214		8002	/home/phnxrc/INTT/commissioning_5_23/hit_files/calib_intt0-00008002-0000.root	intt0 - 7	calib	5	23	L1Delay Scan for time-in	L1Delay=54, n_collision=127			
224	215		8005	/home/phnxrc/INTT/commissioning_5_23/hit_files/calib_intt0-00008005-0000.root	intt0 - 7	calib	5	23	L1Delay Scan for time-in	L1Delay=20,n_collision=127			
225	216		8006	/home/phnxrc/INTT/commissioning_5_23/hit_files/calib_intt0-00008006-0000.root	intt0 - 7	calib	5	23	L1Delay Scan for time-in	L1Delay=54,n_collision=2			
226	217		8007	/home/phnxrc/INTT/commissioning_5_23/hit_files/calib_intt0-00008007-0000.root	intt0 - 7	calib	5	23	L1Delay Scan for time-in	L1Delay=52, n_collision=2, ADC distribution narrower			
227	218		8008	/home/phnxrc/INTT/commissioning_5_23/hit_files/calib_intt0-00008008-0000.root	intt0 - 7	calib	5	23	L1Delay Scan for time-in	L1Delay=56, n_collision=2, ADC distribution narrower			
228	219		8009	/home/phnxrc/INTT/commissioning_5_23/hit_files/calib_intt0-00008009-0000.root	intt0 - 7	calib	5	23	L1Delay Scan for time-in	L1Delay=50			
229	220		8010	/home/phnxrc/INTT/commissioning_5_23/hit_files/calib_intt0-00008010-0000.root	intt0 - 7	calib	5	23	L1Delay Scan for time-in	L1Delay=58, n_collision=2, ADC distribution narrower			
230	221		8011	/home/phnxrc/INTT/commissioning_5_23/hit_files/calib_intt0-00008011-0000.root	intt0 - 7	calib	5	23	L1Delay Scan for time-in	L1Delay=48			
231	222		8012	/home/phnxrc/INTT/commissioning_5_23/hit_files/calib_intt0-00008012-0000.root	intt0 - 7	calib	5	23	L1Delay Scan for time-in	L1Delay=60, n_collision			
232	223		8013	/home/phnxrc/INTT/commissioning_5_23/hit_files/calib_intt0-00008013-0000.root	intt0 - 7	calib	5	23	L1Delay Scan for time-in	L1Delay=46			
233	224		8014	/home/phnxrc/INTT/commissioning_5_23/hit_files/calib_intt0-00008014-0000.root	intt0 - 7	calib	5	23	L1Delay Scan for time-in	L1Delay=62			
234	225		8015	/home/phnxrc/INTT/commissioning_5_23/hit_files/calib_intt0-00008015-0000.root	intt0 - 7	calib	5	23	L1Delay Scan for time-in	L1Delay=44			
235	226		8016	/home/phnxrc/INTT/commissioning_5_23/hit_files/calib_intt0-00008016-0000.root	intt0 - 7	calib	5	23	L1Delay Scan for time-in	L1Delay=64			
236	227		8017	/home/phnxrc/INTT/commissioning_5_23/hit_files/calib_intt0-00008017-0000.root	intt0 - 7	calib	5	23	L1Delay Scan for time-in	L1Delay=100			
237	228		8018	/home/phnxrc/INTT/commissioning_5_23/hit_files/calib_intt0-00008018-0000.root	intt0 - 7	calib				L1Delay=46			
238	229		8020	/home/phnxrc/INTT/commissioning_5_23/hit_files/calib_intt0-00008020-0000.root	intt0 - 7	calib	5			L1Delay=0,n_collision=127, open time=120			
239	230		8021	/home/phnxrc/INTT/commissioning_5_23/hit_files/calib_intt0-00008021-0000.root	intt0 - 7	calib	5			L1Day=20, n_collision=127, open time=80			
240	231		8023	/home/phnxrc/INTT/commissioning_5_23/hit_files/calib_intt0-00008023-0000.root	intt0 - 7	calib	5			L1Day=20,n_collision=127,open time=75			
241	232		8024	/home/phnxrc/INTT/commissioning_5_23/hit_files/calib_intt0-00008024-0000.root	intt0 - 7	calib	5			L1Delay=20,n_collision=127,open time=70			
242	233		8025	/home/phnxrc/INTT/commissioning_5_23/hit_files/calib_intt0-00008025-0000.root	intt0 - 7	calib	5			L1Delay=20,n_collision=127,open time=65			
243	234		8026	/home/phnxrc/INTT/commissioning_5_23/hit_files/calib_intt0-00008026-0000.root	intt0 - 7	calib	5			L1Delay=20,n_collision=127,open time=60			
244	235		8027	/home/phnxrc/INTT/commissioning_5_23/hit_files/calib_intt0-00008027-0000.root	intt0 - 7	calib	5			L1Delay=20,n_collision=127,open time=50			



sPHENIX Wiki

- リンク
- 書けることをとりあえず全て書いています。
- 解析の経過報告などもここに集約できるといいと思います。
- 足りない情報、わかりにくい記述などがあれば教えてください。



INTT commissioning 20230525

Timing scan with Au+Au beams at 100 GeV was performed on May25/2023.

- Run Plan@ (INTT e-log)
- Run List@
- Files@

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7.1 Run Number

Data Taking [edit | edit source]

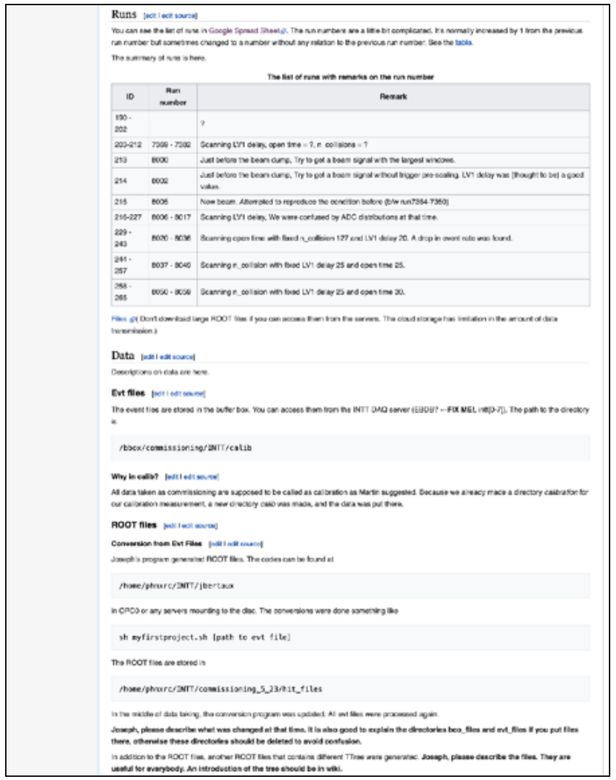
Data was taken in the big partition in a local mode (<-- FIX ME! I'm not sure how I should describe it) Ravi did the operation. Initialization and configuration of FELIX/ROC/PHX chips were done through Expert GUI. The remarkable point is that DAC0 was 23 to have less noise. To knew the condition briefly, you can see below: ~/INTT/sphenix_inttgyrun.py

```
def run() :
    intt_ext.take_data(
        is_rcdaq        = True,
        take_data       = False,
        is_gtmcalib     = False,
        fphx_parameters = "/home/phnxrc/INTT/sphenix_inttgy/run_scripts
/fphx_parameters_timing_scan_20230523.txt", # for timing scan at May/23/2023, DAC0=23
        open_time = 85,
        n_collisions = 50,
        customize_dac0  = False,
        customize_dac   = False,
        mask_channel    = True,
        mask_felix_ch   = True,
    )
```

Cheng-Wei's channel masks obtained from calibration were applied. Cheng-Wei's half-ladder masks (mask_felix_ch) was True, but actually, no half ladder was masked. The 2 arguments open_time and n_collisions were changed frequently. See Google Spread Sheet@ for more details.

fphx_parameters_timing_scan_20230525.txt

```
Vref      1
DAC0      23
DAC1      30
DAC2      60
DAC3      90
DAC4      120
DAC5      150
DAC6      180
DAC7      210
NOsel     6
N2sel     4
FBisel    4
Leakgsel  0
P3sel     0
P2sel     4
Gsel      2
Bwisel    0
Pisel     5
Injsel    0
LVDS      63
```



Runs [edit | edit source]

You can see the list of runs in Google Spread Sheet@. The run numbers are a little bit complicated. It's normally increased by 1 from the previous run number but sometimes changed to a number without any relation to the previous run number. See the table.

The summary of runs is here.

The list of runs with remarks on the run number

ID	Run number	Remark
190 - 202		?
203-212	7099 - 7102	Scanning LV1 delay, open time = ?, n_collisions = ?
213	8000	Just before the beam dump, Try to get a beam signal with the largest windows.
214	8002	Just before the beam dump, Try to get a beam signal without trigger pre-scaling. LV1 delay was [thought to be] a good value.
215	8006	Now beam. Attempted to reproduce the condition before (b/w run7354-7360)
216-227	8006 - 8017	Scanning LV1 delay, We were confused by ADC distributions at that time.
229 - 243	8020 - 8036	Scanning open time with fixed n_collision 127 and LV1 delay 20. A drop in event rate was found.
244 - 257	8037 - 8049	Scanning n_collision with fixed LV1 delay 25 and open time 25.
258 - 265	8050 - 8058	Scanning n_collision with fixed LV1 delay 25 and open time 30.

Files@ (Don't download large ROOT files if you can access them from the servers. The cloud storage has limitation in the amount of data transmission.)

Data [edit | edit source]

Descriptions on data are here.

Evt files [edit | edit source]

The event files are stored in the buffer box. You can access them from the INTT DAQ server (EBDC7 -- FIX ME!, intt[0-7]). The path to the directory is

```
/bbox/commissioning/INTT/calib
```

Why in calib? [edit | edit source]

All data taken as commissioning are supposed to be called as calibration as Martin suggested. Because we already made a directory calibration for our calibration measurement, a new directory calib was made, and the data was put there.

ROOT files [edit | edit source]

Conversion from Evt Files [edit | edit source]

Joseph's program generated ROOT files. The codes can be found at

```
/home/phnxrc/INTT/jbertaux
```

In CPC3 or any servers mounting to the disc. The conversions were done something like

```
sh myfirstproject.sh [path to evt file]
```

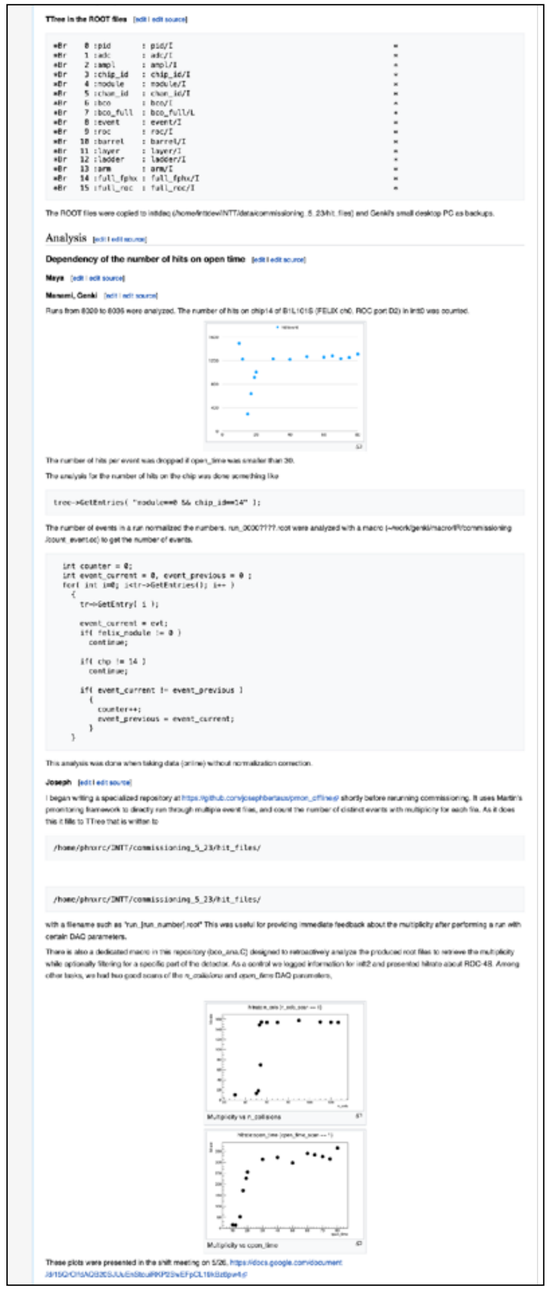
The ROOT files are stored in

```
/home/phnxrc/INTT/commissioning_5_23/Rit_files
```

In the middle of data taking, the conversion program was updated. All evt files were processed again.

Joseph, please describe what was changed at that time. It is also good to explain the directories bco_files and evt_files if you put files there, otherwise these directories should be deleted to avoid confusion.

In addition to the ROOT files, another ROOT files that contains different TTree were generated. **Joseph, please describe the files. They are useful for everybody. An introduction of the tree should be in wiki.**



TTree in the ROOT files [edit | edit source]

```
*Br    0 :pid       : pid/I                                  *
*Br    1 :adc       : adc/I                                  *
*Br    2 :amp       : amp/I                                  *
*Br    3 :chip_id   : chip_id/I                              *
*Br    4 :module    : module/I                               *
*Br    5 :chan_id   : chan_id/I                              *
*Br    6 :bco       : bco/I                                  *
*Br    7 :bco_full  : bco_full/L                             *
*Br    8 :event     : event/I                                *
*Br    9 :roc       : roc/I                                  *
*Br   10 :barrel    : barrel/I                               *
*Br   11 :layer     : layer/I                                *
*Br   12 :ladder    : ladder/I                               *
*Br   13 :arm       : arm/I                                  *
*Br   14 :full_fphx : full_fphx/I                            *
*Br   15 :full_roc  : full_roc/I                             *
```

The ROOT files were copied to intdaq (/home/eritbew/INTT/data/commissioning, 5_23/Hit_files) and Genki's small desktop PC as backups.

Analysis [edit | edit source]

Dependency of the number of hits on open time [edit | edit source]

Maya [edit | edit source]

Manami, Genki [edit | edit source]

Runs from 8009 to 8036 were analyzed. The number of hits on chip14 of B1L1O1S (FELIX ch0, ROC port B2) in Intt0 was counted.

The number of hits per event was dropped if open_time was smaller than 30.

The analysis for the number of hits on the chip was done something like

```
tree->GetEntries( "module==0 && chip_id==14" );
```

The number of events in a run normalized the numbers. run_00007777.root were analyzed with a macro (~/work/genki/macro/ll/commissioning /count_event.cc) to get the number of events.

```
int counter = 0;
int event_current = 0, event_previous = 0 ;
for( int i=0; i<tr->GetEntries(); i++ )
  {
    tr->GetEntry( i );

    event_current = evt;
    if( felix_module != 0 )
      continue;

    if( chip != 14 )
      continue;

    if( event_current != event_previous )
      {
        counter++;
        event_previous = event_current;
      }
  }
```

This analysis was done when taking data (online) without normalization correction.

Joseph [edit | edit source]

I began writing a specialized repository at https://github.com/josephbertaux/pmon_offline@ shortly before resuming commissioning. It uses Martin's prominlong framework to directly run through multiple event files, and count the number of distinct events with multiplicity for each file. As it does this it fills to TTree that is written to

```
/home/phnxrc/INTT/commissioning_5_23/Rit_files/
```

```
/home/phnxrc/INTT/commissioning_5_23/Rit_files/
```

with a filename such as 'run_[run_number].root' This was useful for providing immediate feedback about the multiplicity after performing a run with certain DAQ parameters.

There is also a dedicated macro in this repository (bco_ana.C) designed to retroactively analyze the produced root files to retrieve the multiplicity while optionally filtering for a specific part of the detector. As a control we logged information for intt2 and presented results about ROC 48. Among other tasks, we had two good scans of the n_collisions and open_time DAQ parameters.

Multiplicity vs n_collisions

Multiplicity vs open_time

These plots were presented in the shift meeting on 5/26, https://docs.google.com/document/d/1SQrOYsNQ92ESJUcEn5tbcaRKP23vEFpCL1thSzSpvr4/

Dependency of the number of hits on n_collisions [edit | edit source]

Multiplicity vs BCO window [edit | edit source]

- May 28 2023 updated by Cheng-Wei
  - Used data : run 229 ~ 242 (or run 8035 ~ run 8093). First trail, no cut basically.
  - Range of BCO window : 100 to 140
  - The intt1 is not included (no data taken with the intt1, I don't know the reason)
  - The definition of multiplicity :
    - With the cut (chip_id > 0 && chip_id < 27 && chan_id > -1 && chan_id < 128 && module > -1 && module < 14)
    - Number of hits in one server (14 half-ladders) in one bco and bco_full (same bco and bco_full).
  - Plots can be found in "/home/eritbew/data/IR_DAQ_server/INTT_study_run/BCO_window" of intt.dag or google drive@
  - For the movie, please check : movies_file.gif
- Conclusion
  - The multiplicity distribution is stable from 120 to around 40. Starting from 40, the distribution start to shrink, drastically in the range of 30 to 20.
  - The summary plot can be seen here : plots!
    - This plot is based on the multiplicity distribution of each server of each BCO_window setting.
    - The Y-axis : the average of " the number of entries from 2nd bin to the last bin divided by total entries " of all servers.
    - The Y-axis error bar : is given by the standard deviation among the servers in each set.
    - The fitting function : error function, Fit range : BCO_window 16 to BCO_window 46

3-hit limit, one chip one event ? [edit | edit source]

Based on the plot@, The N_hit in one event in one chip can be more than 3.

Another plot@, checked file : calib_intt0-00035021-0000.root

ADC distribution [edit | edit source]

Issues, Interesting features [edit | edit source]

- Chip 26 of all ladders got no data
- intt1 sometimes gave a huge evt file (up to 14 GB)
- Shape of ADC distribution has to be understood

People [edit | edit source]

- Itaru Nakagawa
- Rachid Nouicer
- Maya Shimomura
- Genki Nukazuka
- Ravi Cacala
- Joseph Bertaux
- Mai Kano
- Manami Fujiwara
- Cheng-Wei Shih (remote)

Appendix [edit | edit source]

Run Number [edit | edit source]

The list of runs with remarks on the run number

ID	Run number	Remark
190	7094	
null	7357	changed differently
191	7351	changed differently
192	7354	changed differently
193	7356	changed differently
194	7358	changed differently
195	7363	changed differently
196	7365	changed differently
197	7368	
198	7360	changed differently
199	7374	changed differently
200	7375	
201	7376	
202	7368	changed differently
203	7369	
204-206		omitted
207	7377	changed differently
208-212		omitted
213	8000	changed differently
214	8002	changed differently