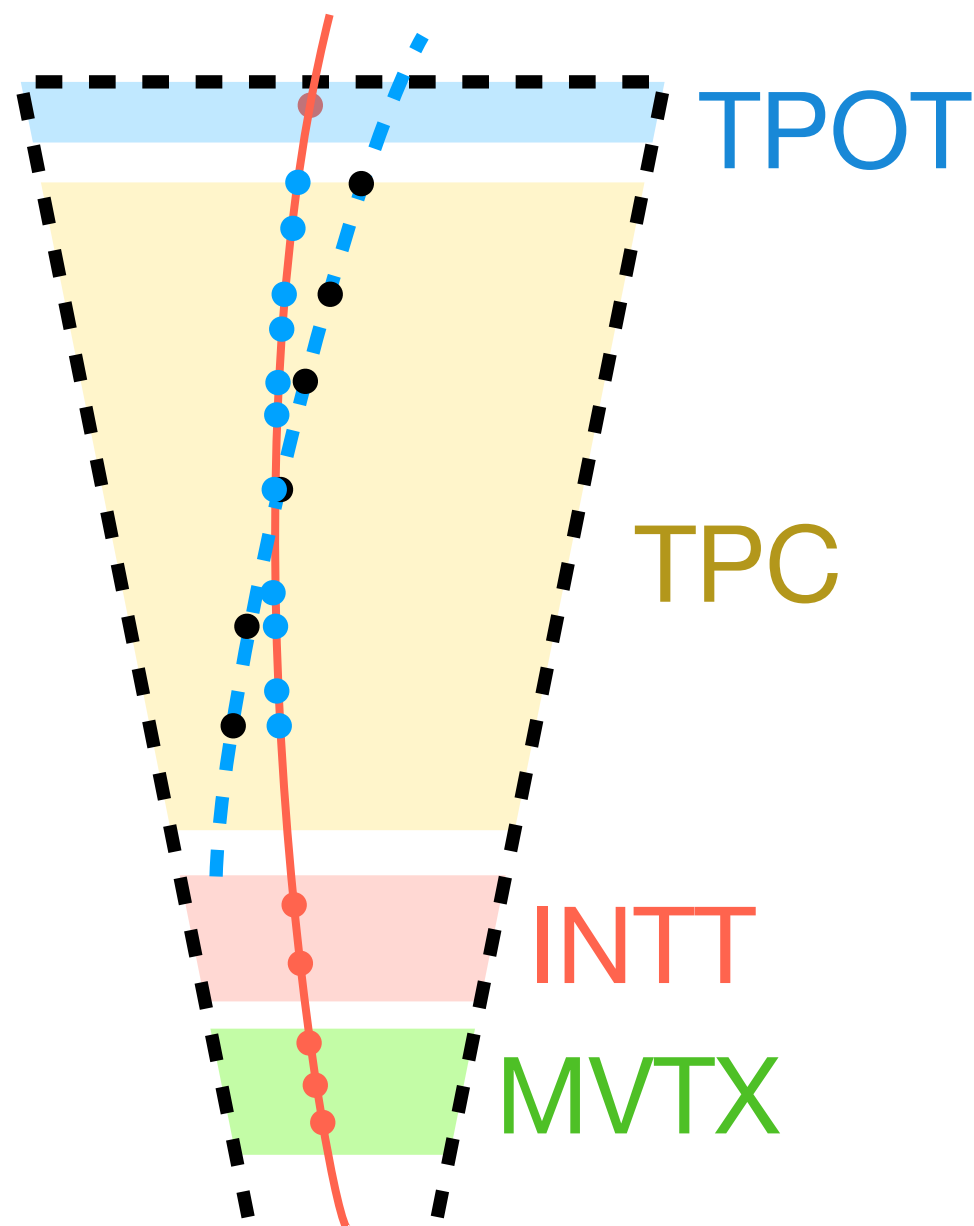
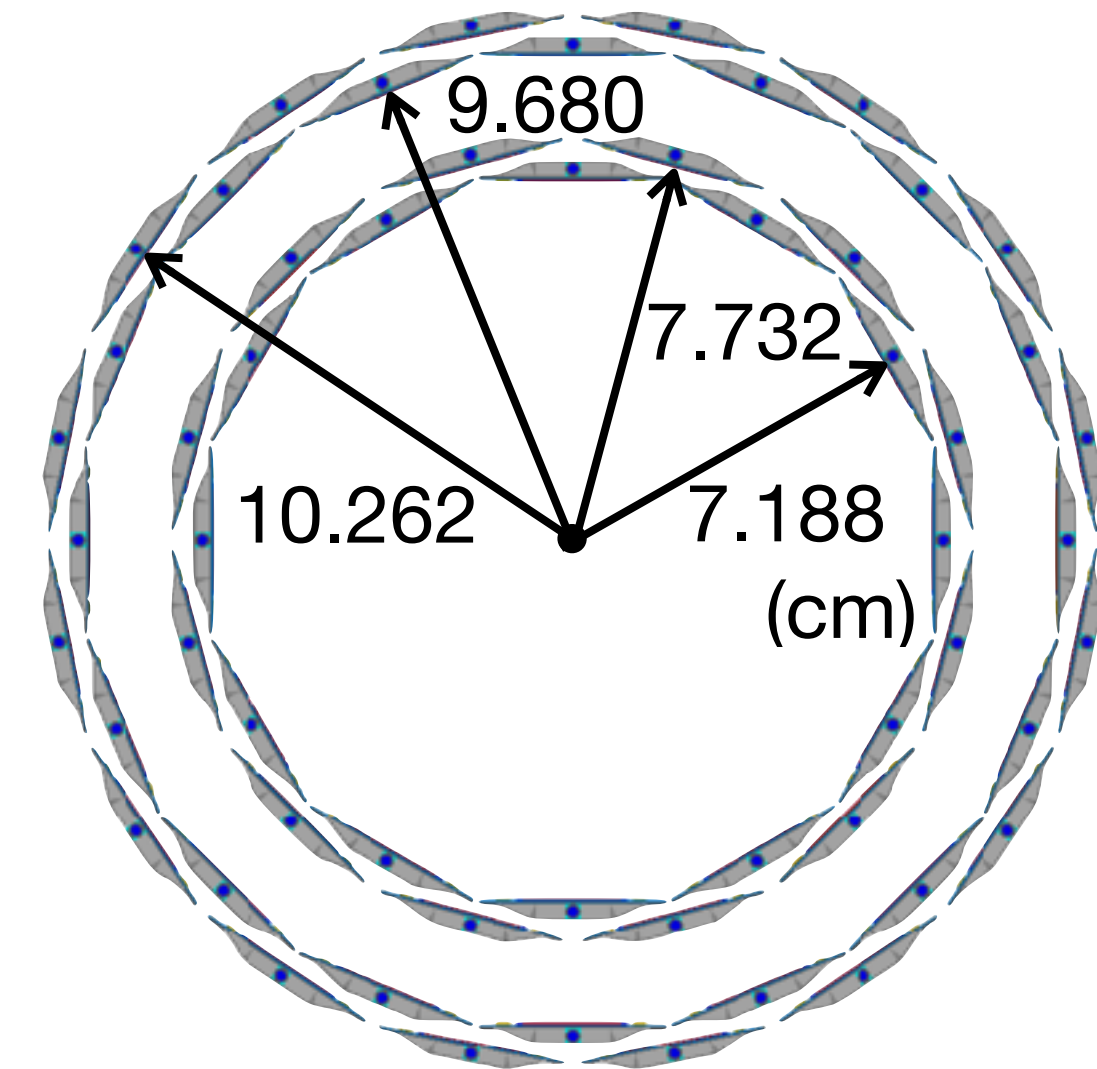
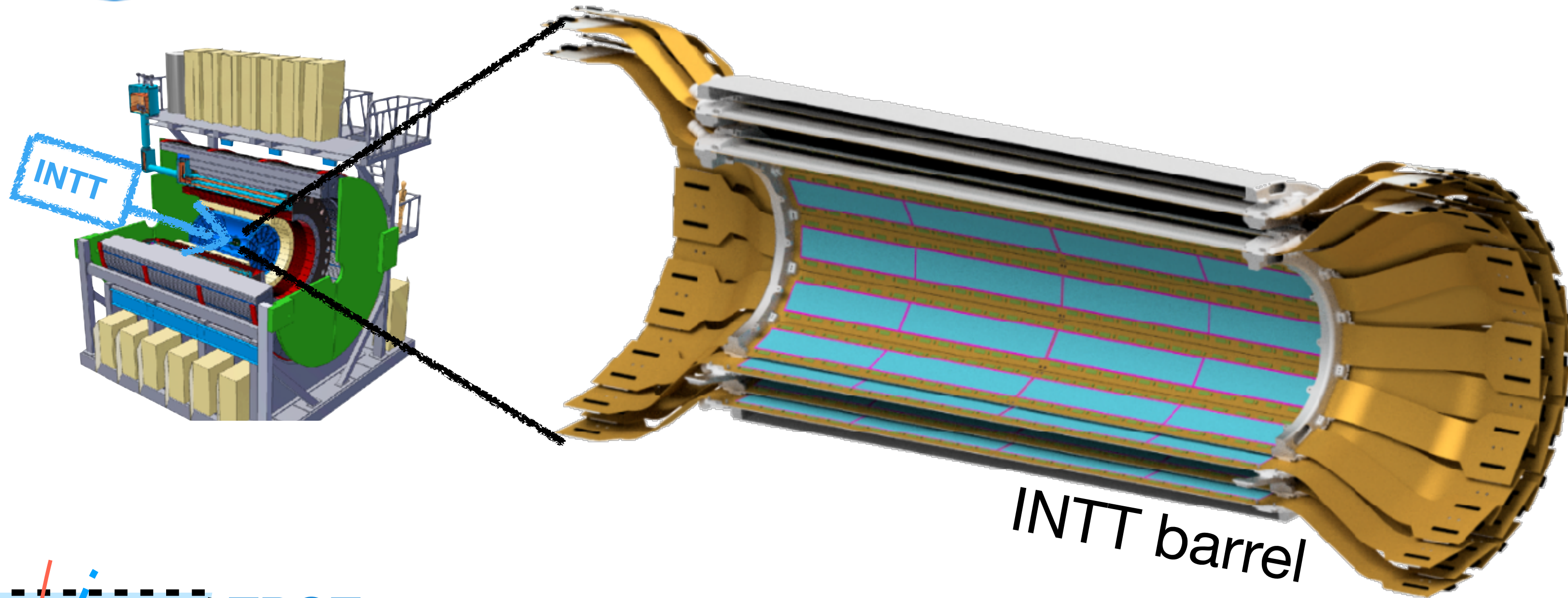


# **Status of INTT**

Genki Nukazuka (RIKEN)

# Intermediate Silicon Tracker (INTT)



## 2 layers of barrel detector with silicon strip sensors

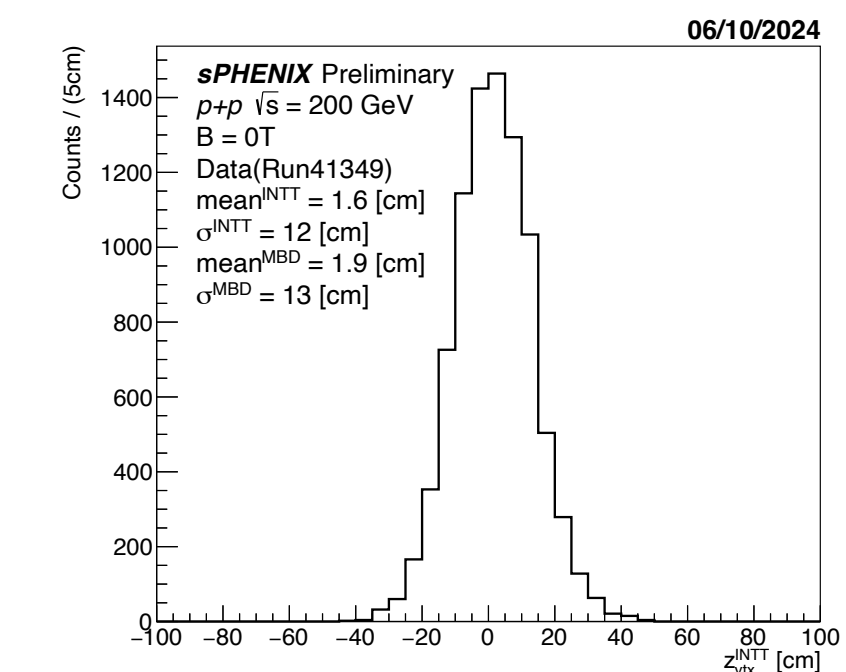
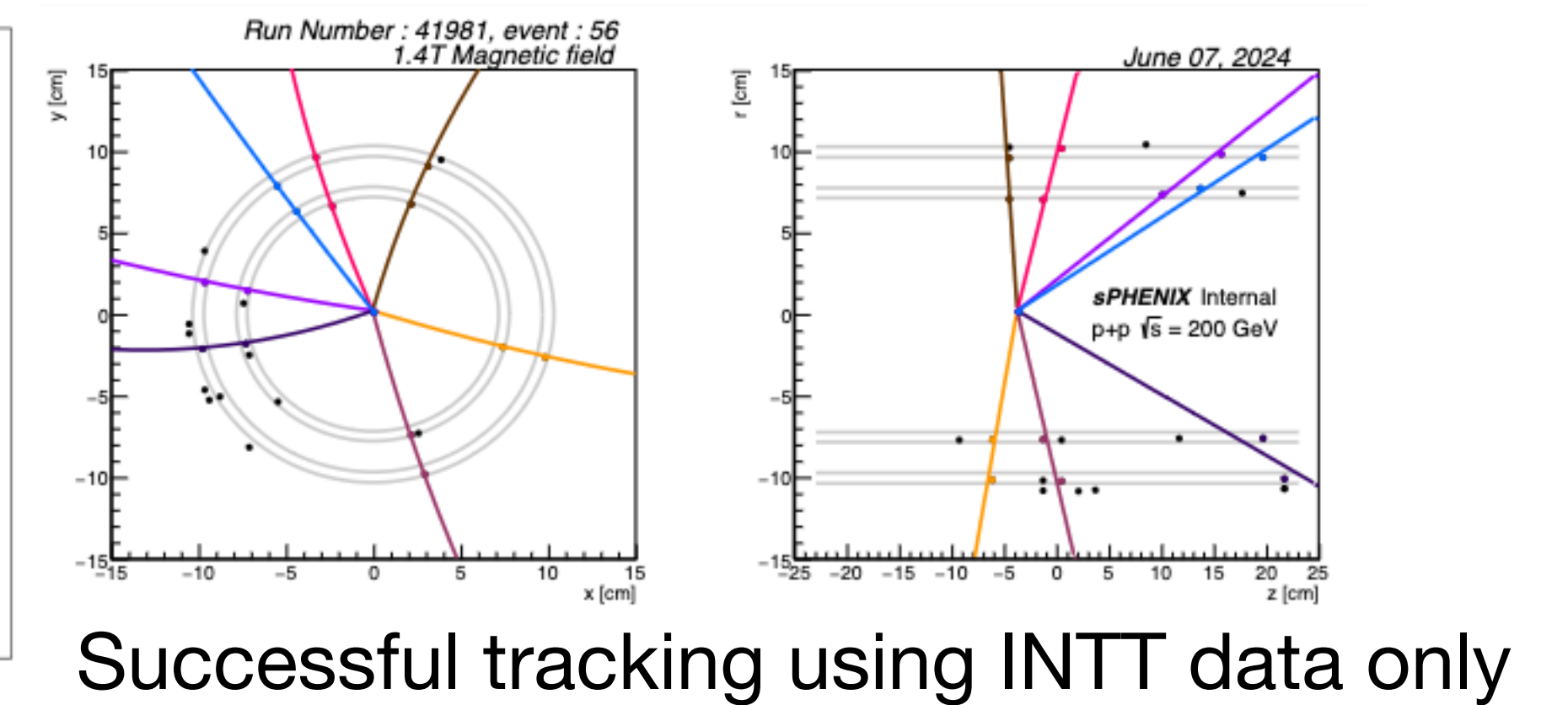
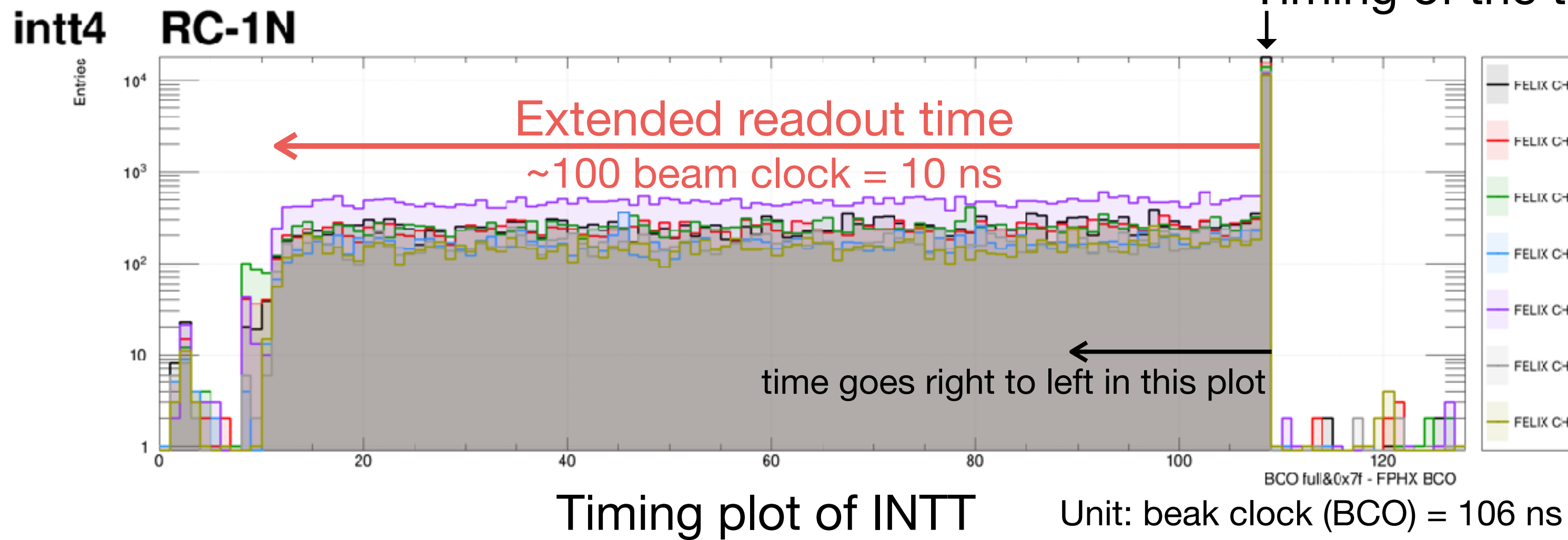
- Full azimuthal angle coverage in the midrapidity region  $|\eta| < 1.1$
- Low radiation length  $X/X_0 < \sim 1.1\%$  / ladder
- 360k channels in total

## Roll of INTT

- Taking hits b/w MVTX and TPC for better tracking performance.
- Rejection of pileup background using good timing resolution of  $< 1$  bunch-crossing. (MVTX and TPC work at the order of  $\mu\text{s} - 10 \mu\text{s}$ )

# The trigger mode to the streaming readout mode

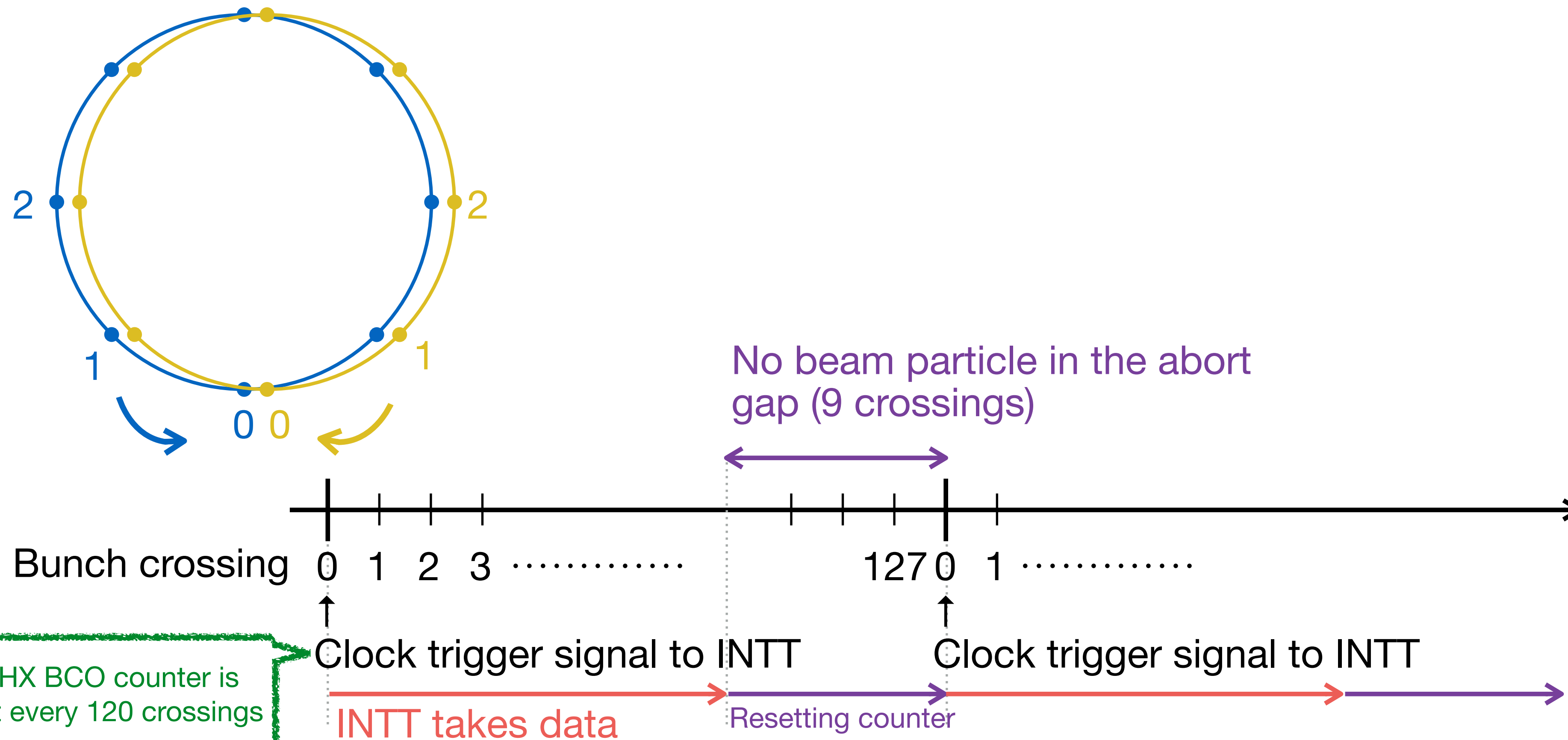
- INTT is working well in the trigger mode + 7  $\mu\text{s}$  extended readout.
- The next step is the migration to the streaming readout mode, which covers 100% in time.



$z_{vtx}$  determination  
using INTT data only

# The streaming readout mode

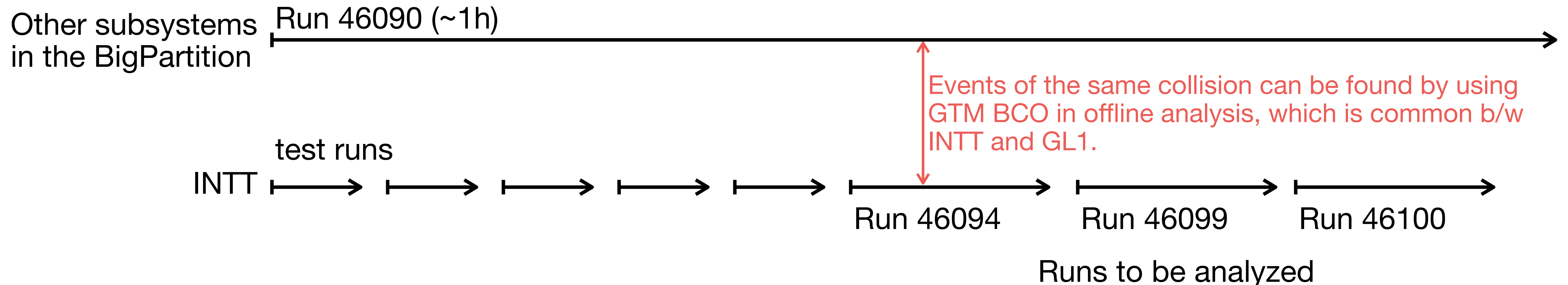
- INTT is operated independently from the trigger.
- Clock signals are fed to INTT at 75 kHz as trigger signals.
- When INTT gets a clock trigger signal, data is read out for 120 BCO. At the beginning of data taking, the FPHX BCO counter is reset so that the counter works as a bunch number counter.



# The streaming readout mode: tests

- Operation of INTT with clock signals at various frequencies: completed in 2023.
- Resetting BCO counter during abort gap
- Validation check of data
- Firmware implementation of FELIX for some features is needed.

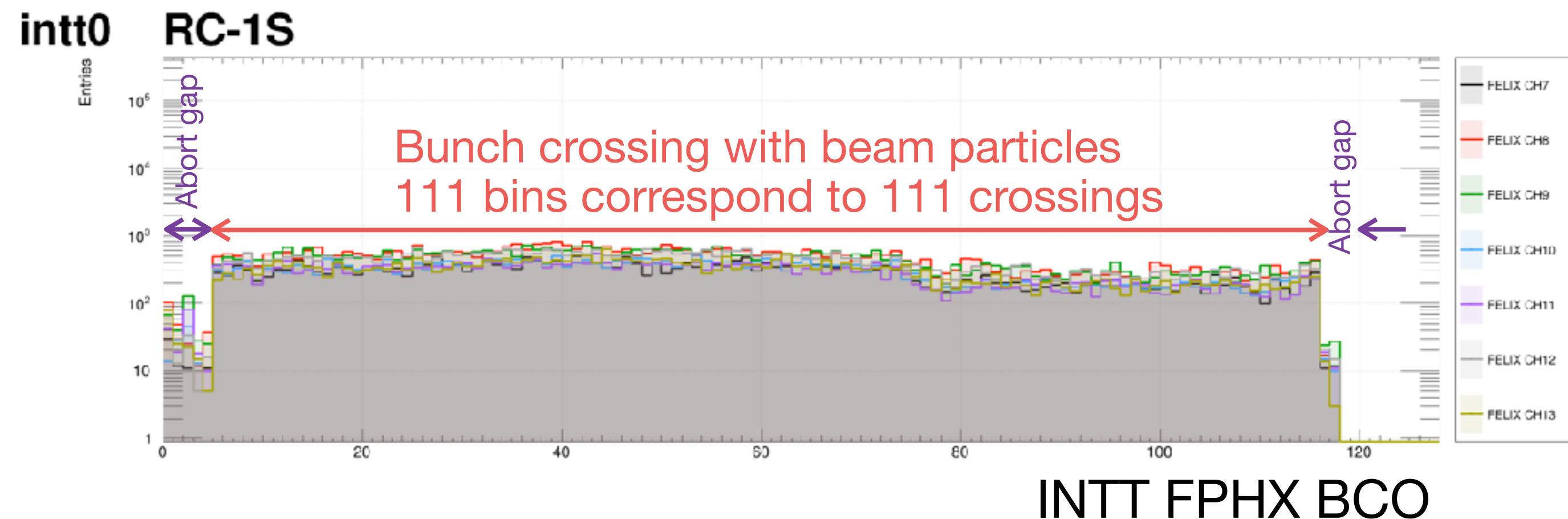
**Test run:** Standalone operation of INTT in streaming readout mode. Other subsystems, including the trigger, were operated independently but at the same time. If it's successful, INTT should take events that fired the trigger.



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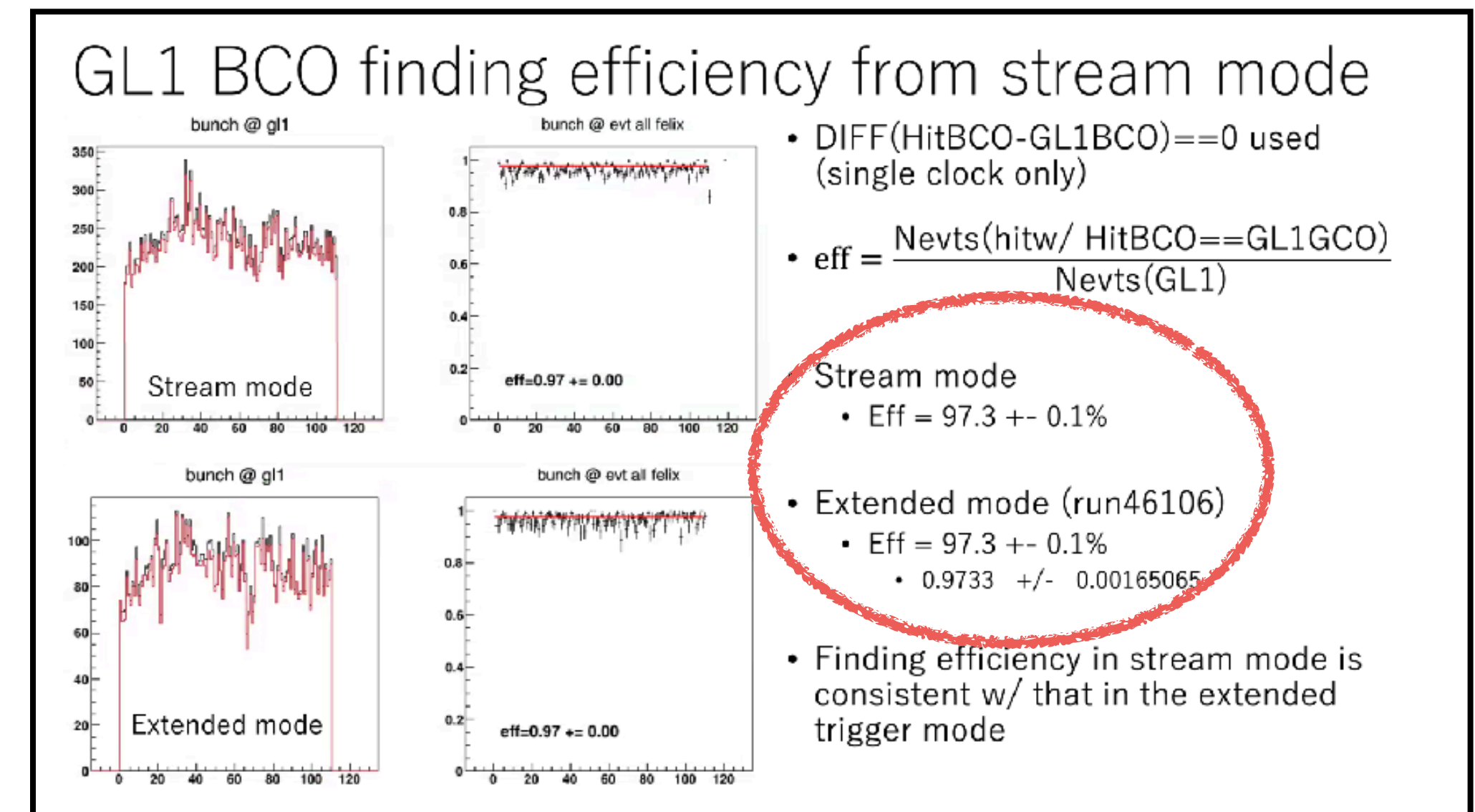
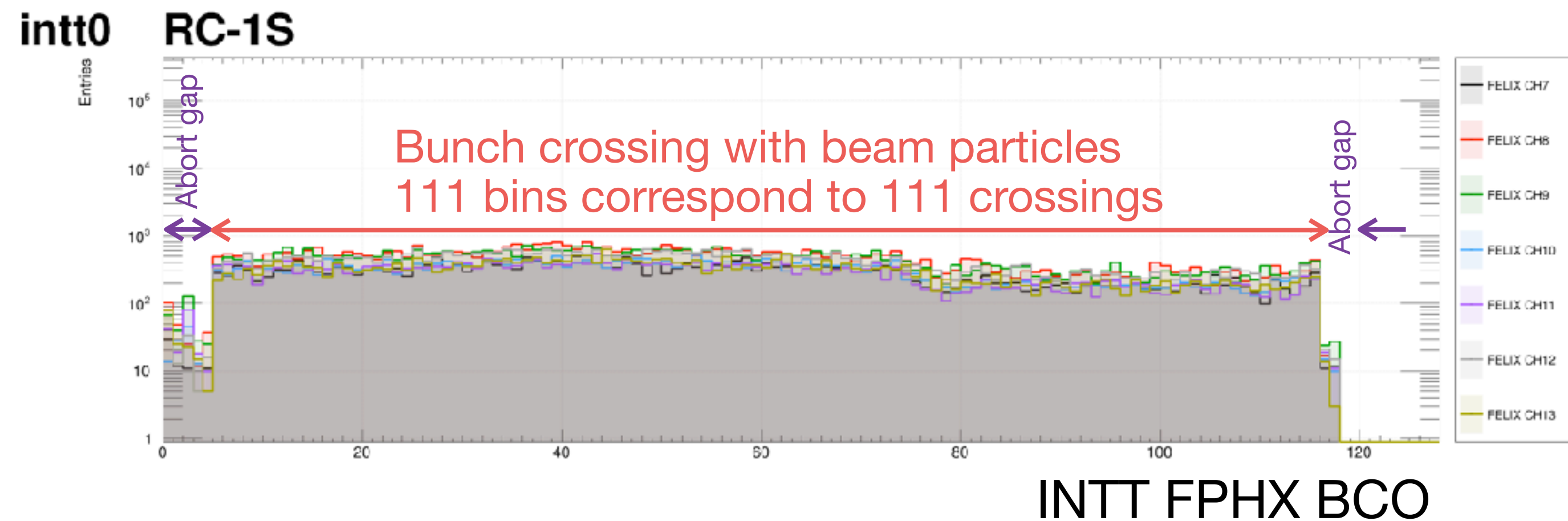
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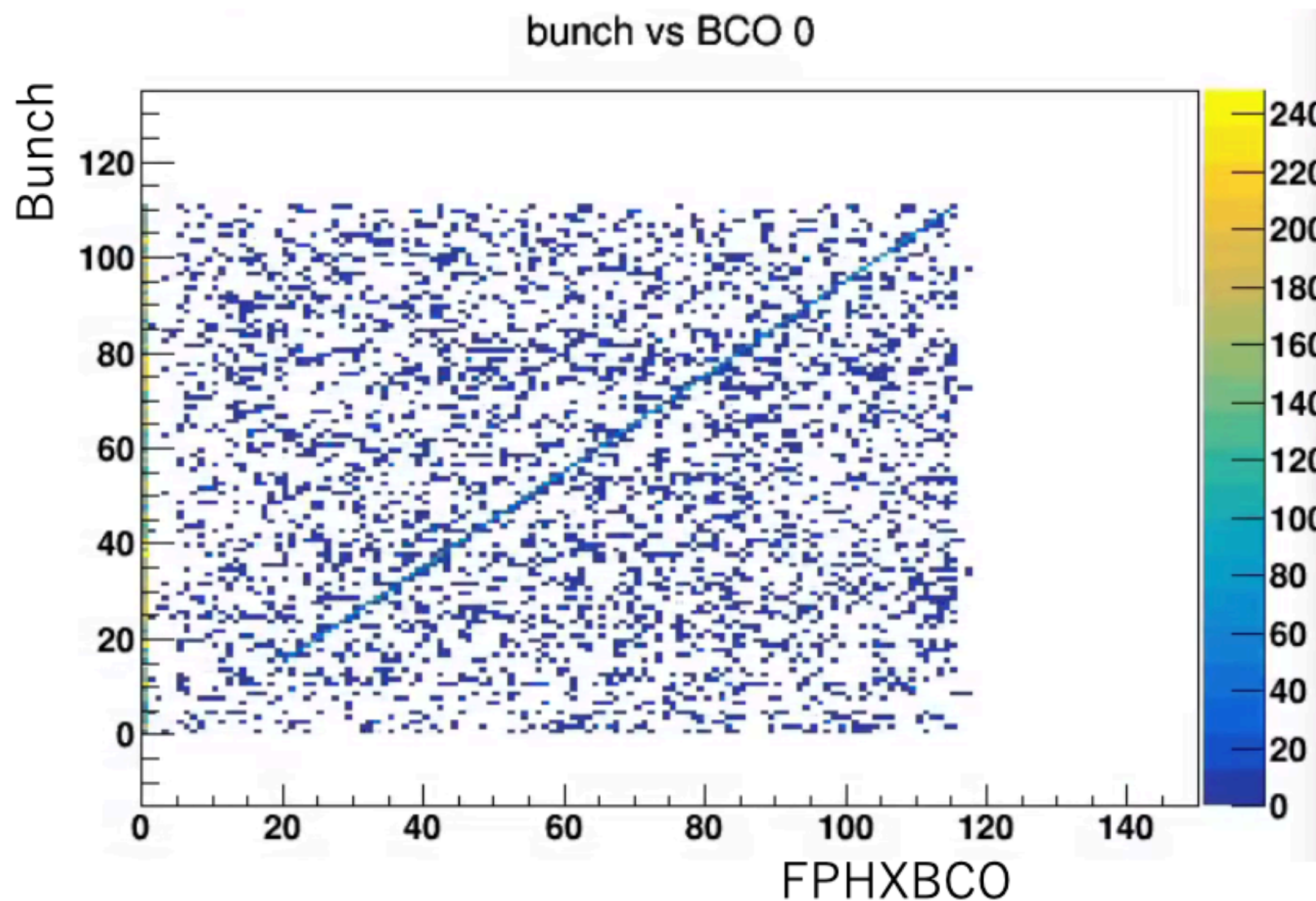
T. Hachiya (NWU)'s analysis for data validation check

We confirmed that the streaming readout data is at the same quality as the trigger + extended readout data in terms of correspondence of trigger.

# The streaming readout mode: tests

- Operation of INTT with clock signals at various frequencies: completed in 2023.
- Resetting BCO counter during abort gap
- Validation check of data
- Firmware implementation of FELIX for some features is needed.

Bunch number from GL1, which was running independently from INTT



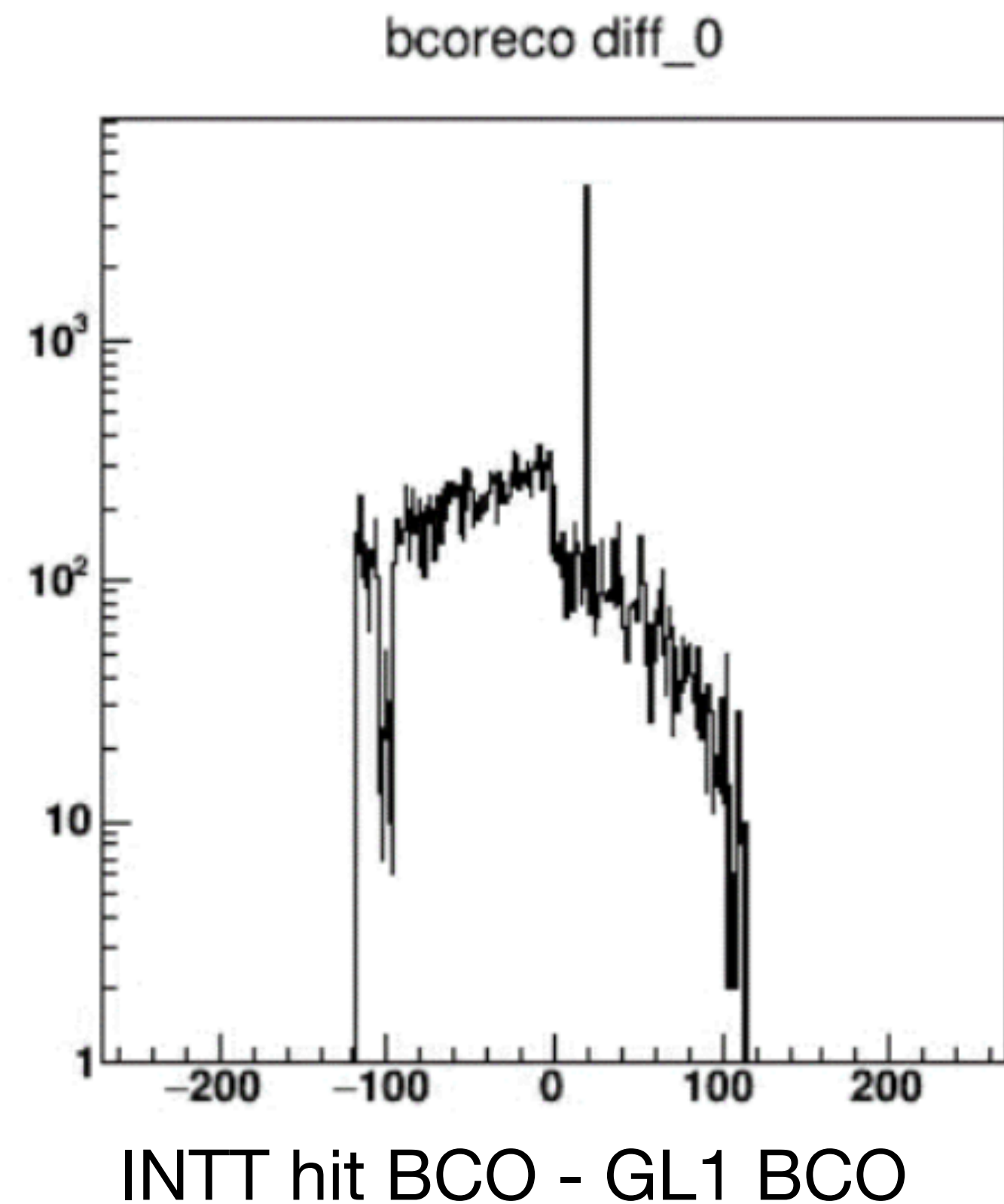
FPHX BCO of INTT,  
that should work as a bunch counter

A clear correlation between the FPHX BCO of INTT and the bunch number of GL1 can be seen.



# The streaming readout mode: tests

- Operation of INTT with clock signals at various frequencies: completed in 2023.
- Resetting BCO counter during abort gap
- Validation check of data
- Firmware implementation of FELIX for some features is needed.



- GL1 BCO: 40 bits, provided to subsystems and works as sPHENIX clock
- INTT BCO: not simple
  - FELIX takes GL1 BCO. It's assigned to each event but insensitive to the timing of hit creation.
  - FPHX BCO: 7 bits, a local BCO counter at the level of readout from the silicon sensor.
  - ➔ The combination of GL1 BCO and FPHX BCO is the real timing of hit creation.

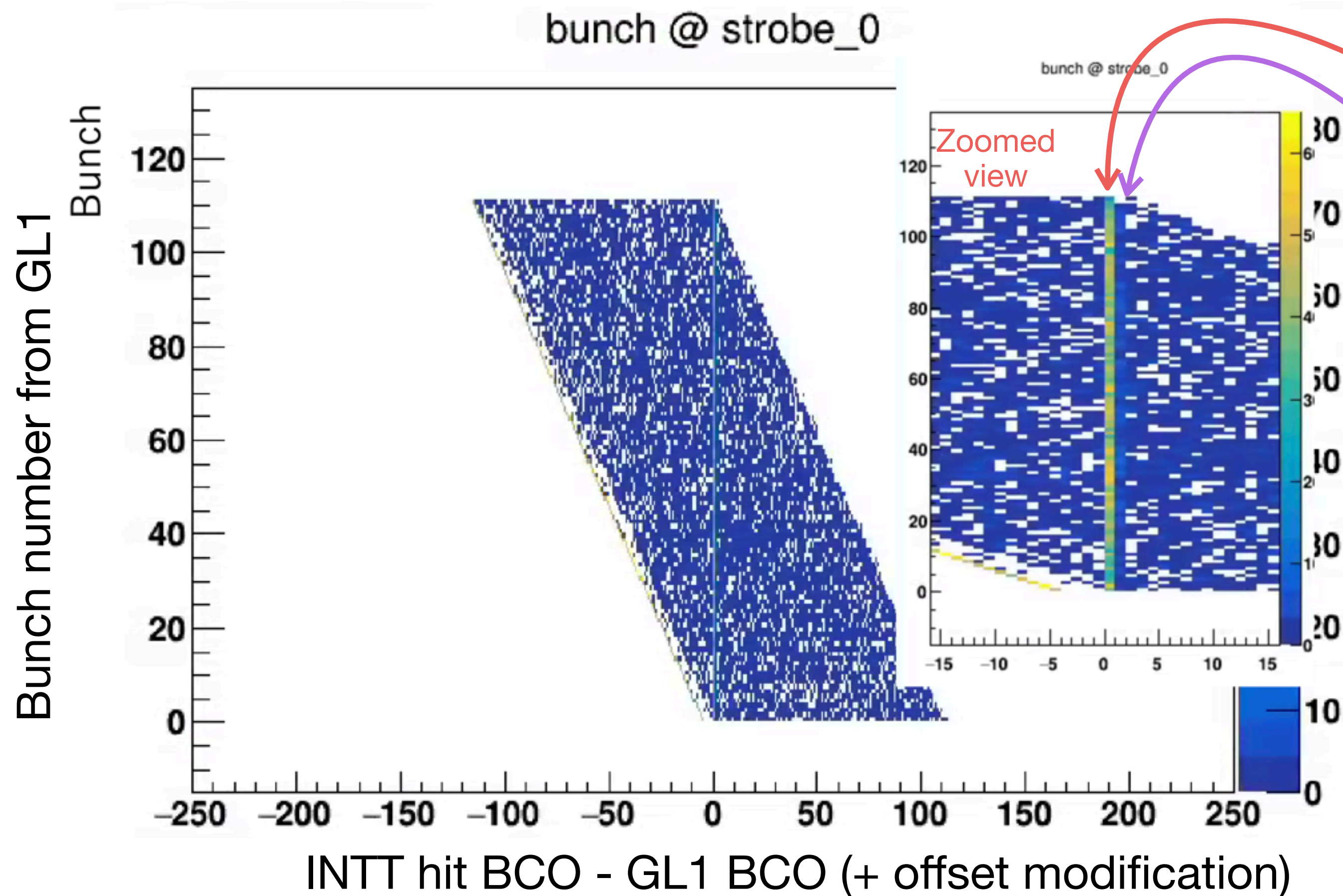
	40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1								
GL1	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█				
FPHX																																																
GL1 & FPHX	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█

The difference between INTT hit BCO (GL1 BCO & FPHX BCO) and GL1 BCO should be well correlated.

The correlation can be found. An offset is also seen.

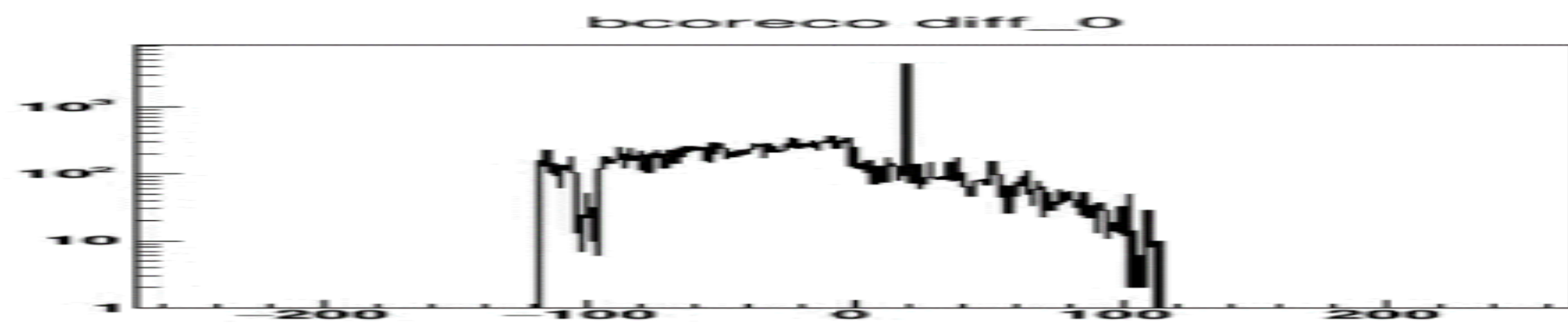
→ **The hit timing was reconstructed successfully.**

# The streaming readout mode: tests



A clear correlation can be seen at the difference = 0. That's good.

There is another correlation line at the difference = 1. Hits are leaked to the next BCO tag. This may be due to the signal charge being dependent on the timing (slewing). It was seen in triggered data as well.



# The streaming readout mode: Current status

- ✓ Operation of INTT with clock signals at various frequencies: completed in 2023.
- ✓ Resetting BCO counter during abort gap
- ✓ Validation check of data
- Firmware implementation of FELIX for some features is needed.
  - ← Almost done

INTT will switch to the streaming readout for physics data taking soon.