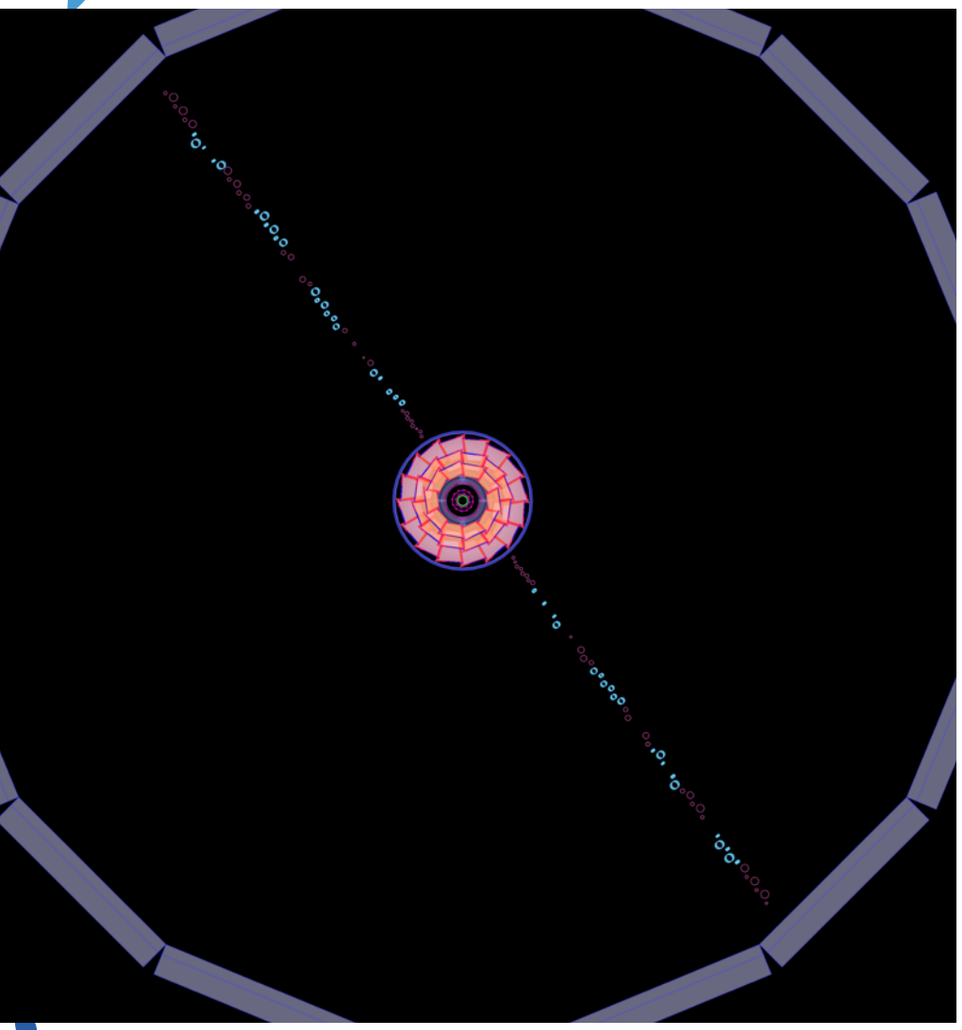
CDC

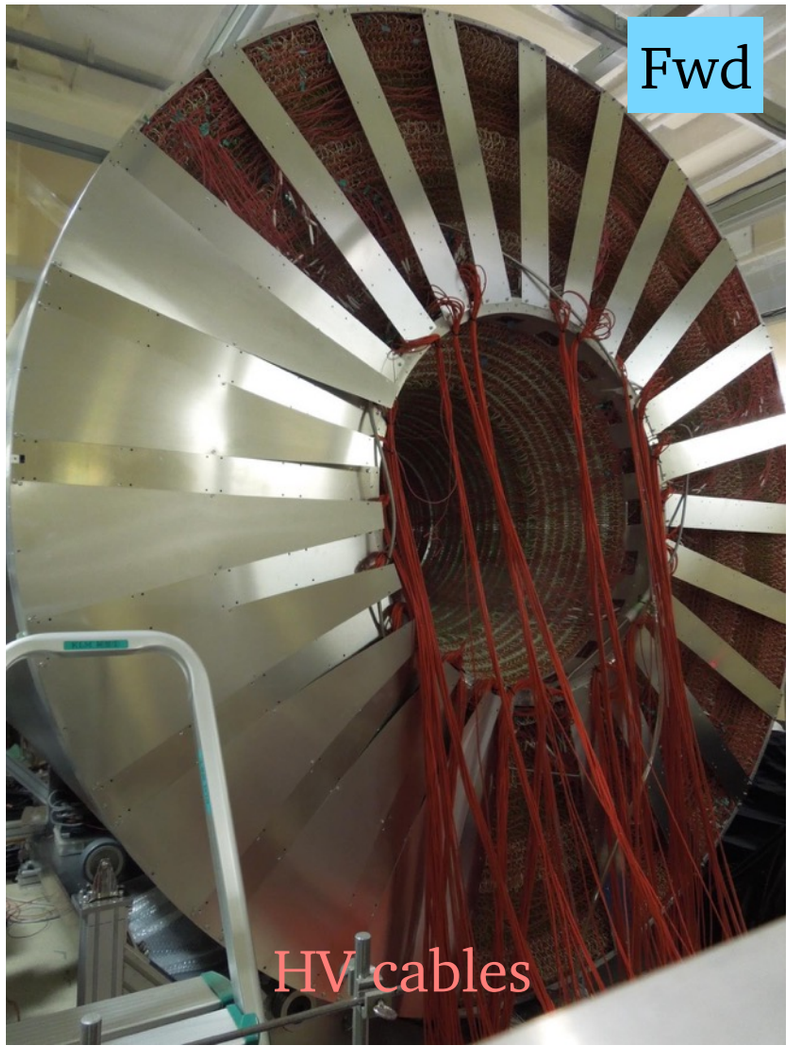
Nanae Taniguchi (KEK)

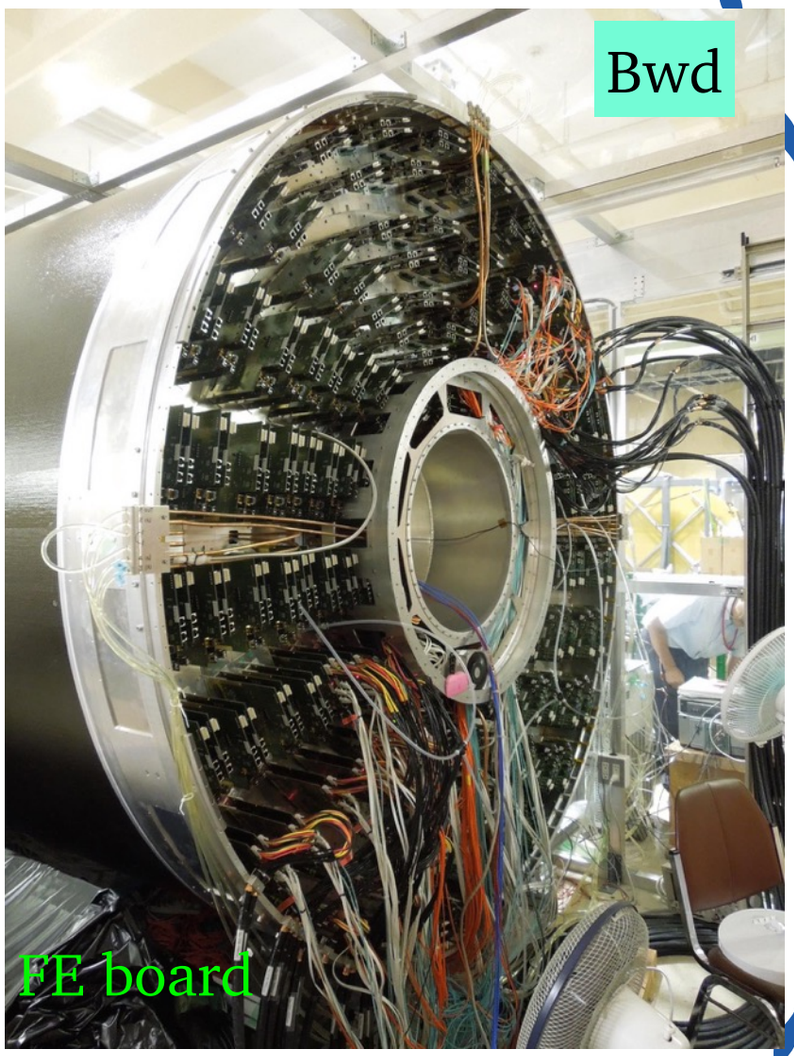
Trigger DAQ workshop 2016
BINP

detector status

Tsukuba B4

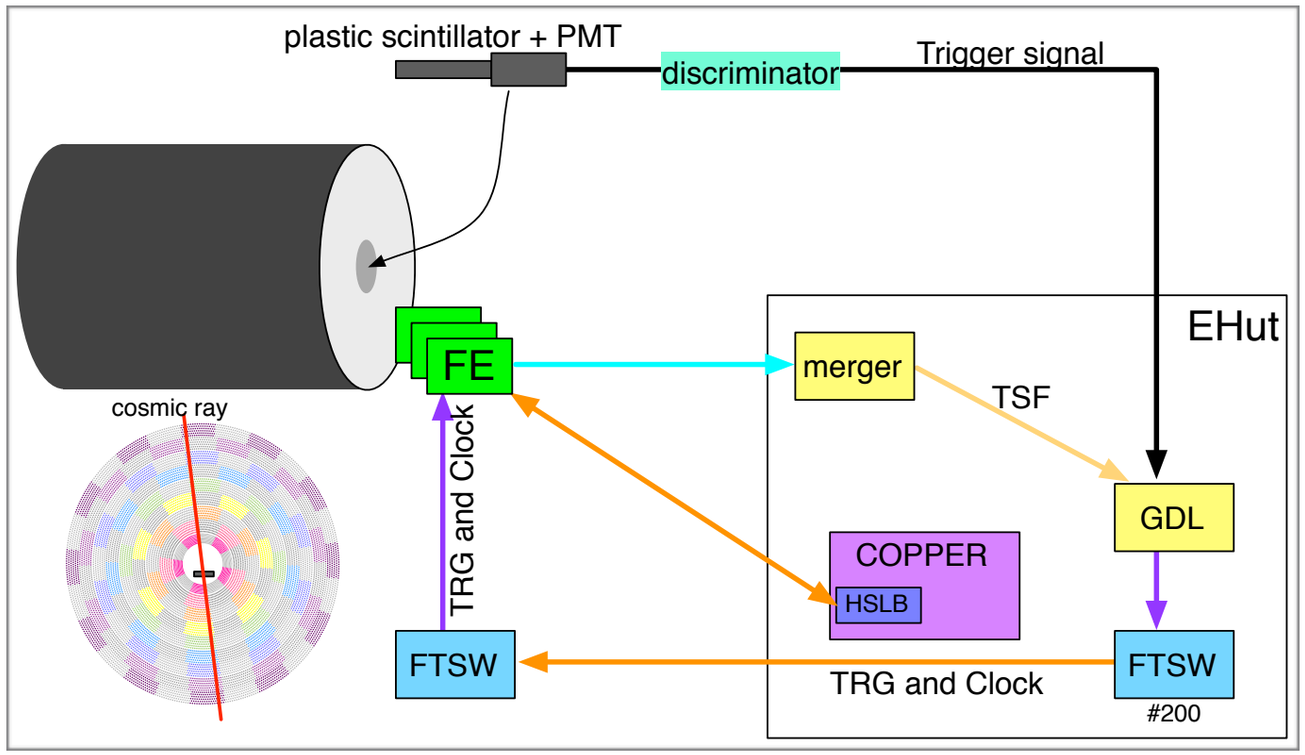






- All FE boards (299) are installed
- All signal wires are checked with cosmic ray
- cosmic ray test will be continued until installation

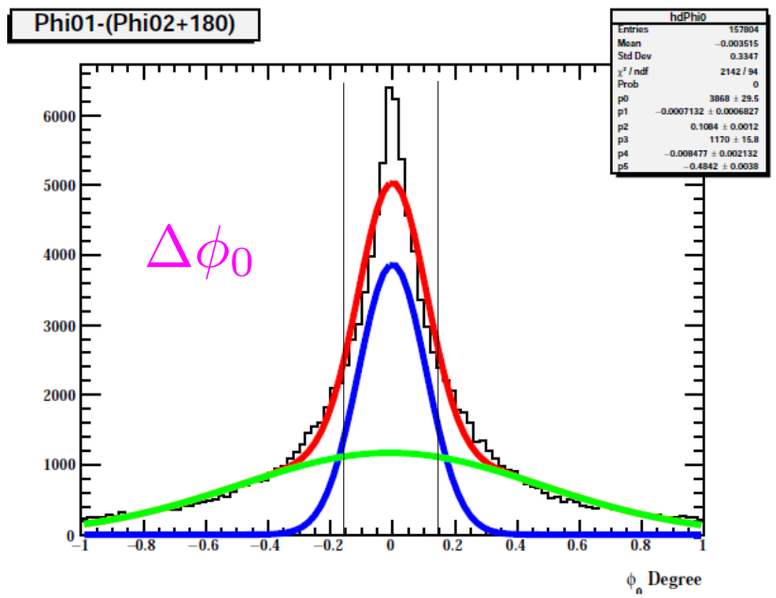
cosmic ray test

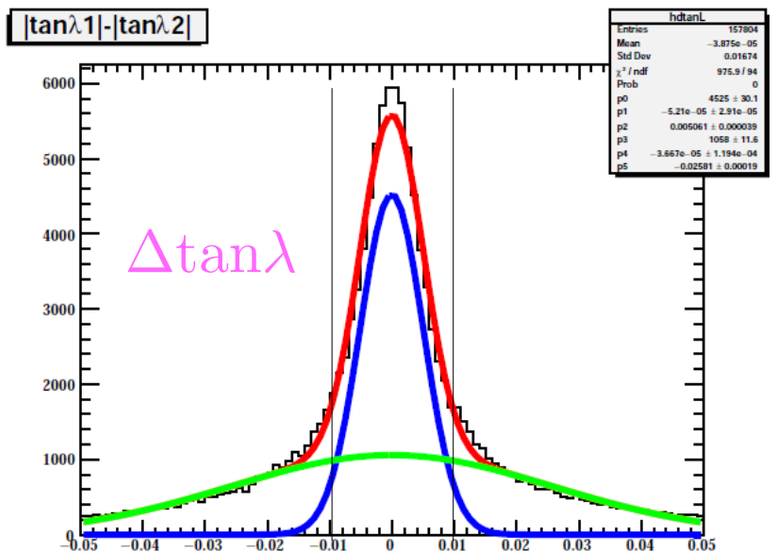


belle2link 0.16, b2tt 0.46, hslb 0.54, ft2u 0.72, tt4r/tt5r 0.40

- partial readout (60 FEs)
  - limited by # of cables
- minor firmware update
  - latest CDC core : 5th July, 2016
- Global DAQ system
  - pocket DAQ also
- CDCTRG provide TSF
  - TSF : track segment finder
  - TRG delay ~ 4.0usec
  - trigger rate = 0.1 - 2 Hz

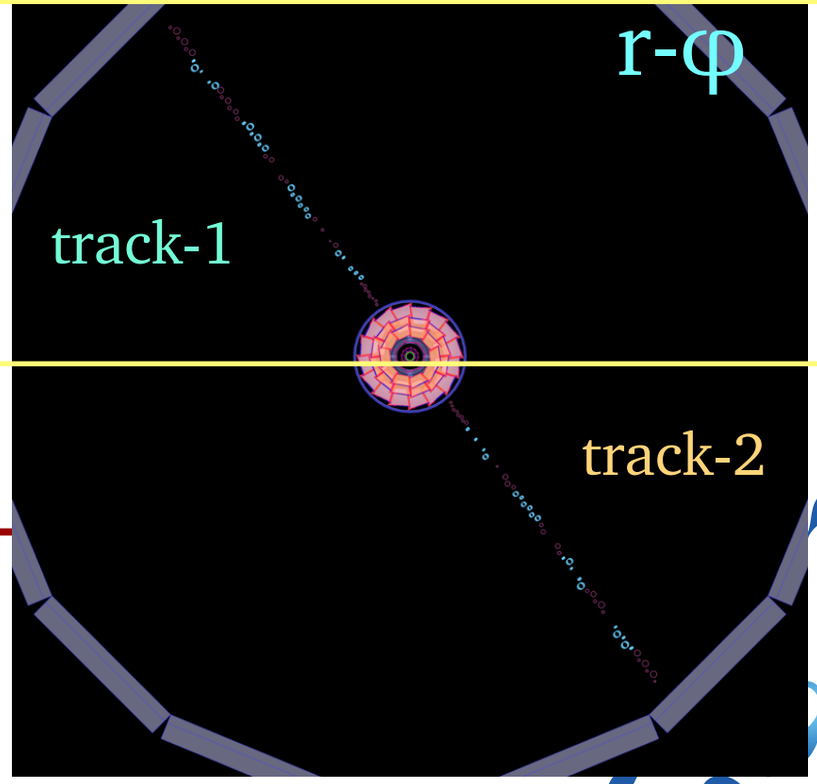
The difference of Δφ and Δtanλ





- $\sigma_{\Delta\Phi 0} = 0.1080 \pm 0.001$(Deg)
- $\sigma_{\Delta\tan\lambda} = 0.0051 \pm 0.0001$

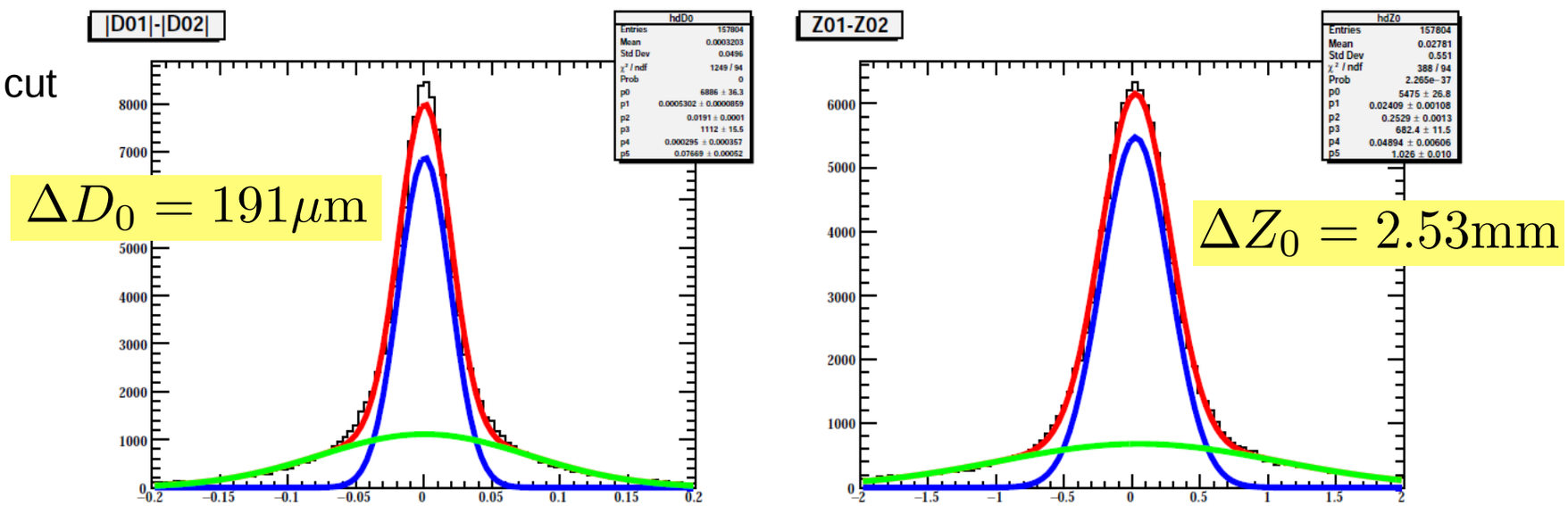
1 cosmic ray track is treated as 2 tracks



The difference of D0 and Z0

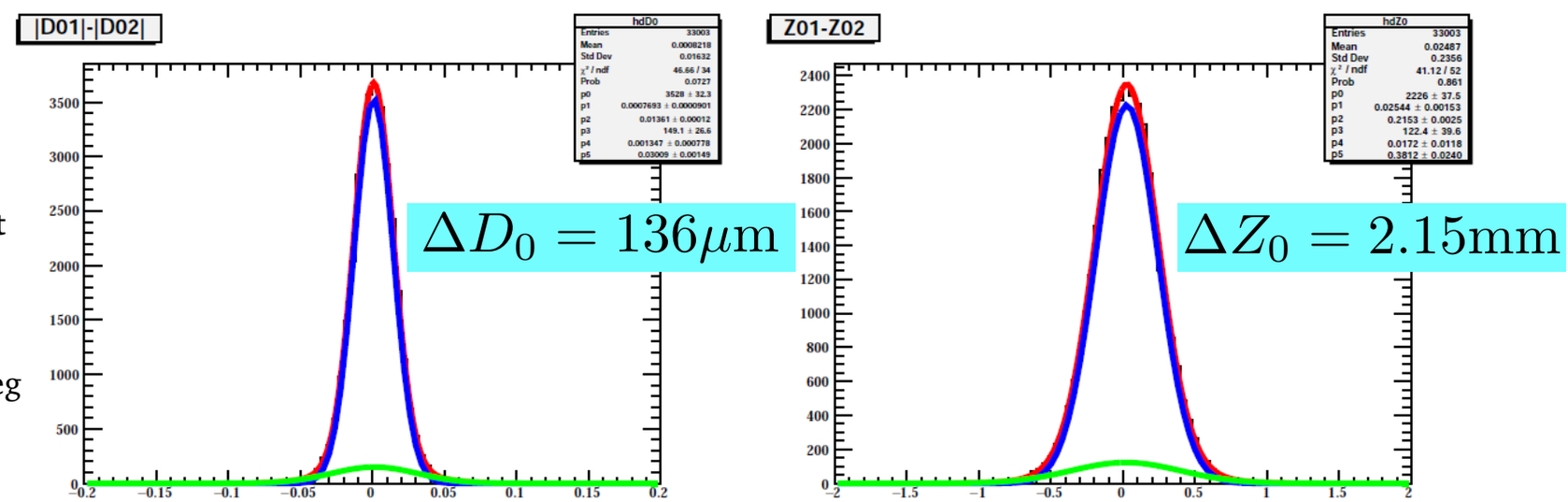
transverse/longitudinal impact parameter (dD_0/dZ_0)

Without cut



Cut:to reject short track and larger scatter trajectory.

- NDF>25
- $|\Delta\Phi_0|$<0.15 Deg
- $|\Delta\tan\lambda|$<0.01



FE data format

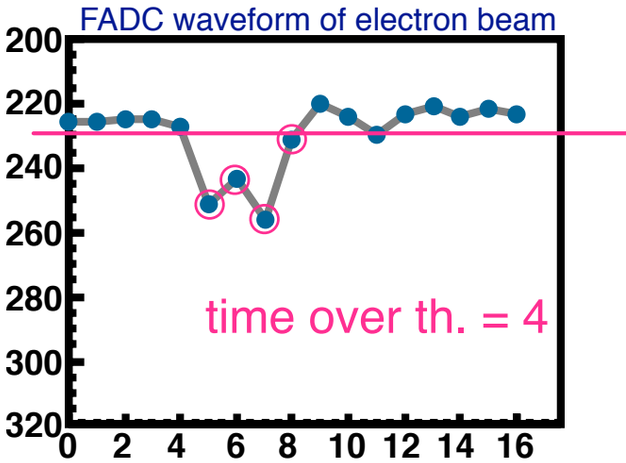
Physics run (suppressed data)

data mode | board ID | data length of the event

2000 0018 43f7 0024 0000 0001

always 00 | trigger received time | Trigger count

12 byte (FE header)



ch# | ch data length | time over th. (waveform) | summed ADC | 1st TDC

2508 0003 0048 0f6c

8 byte/(1ch data size per hit)

1e0a 0003 001b 0f28 0ead

10 byte/(1ch data size per hit)

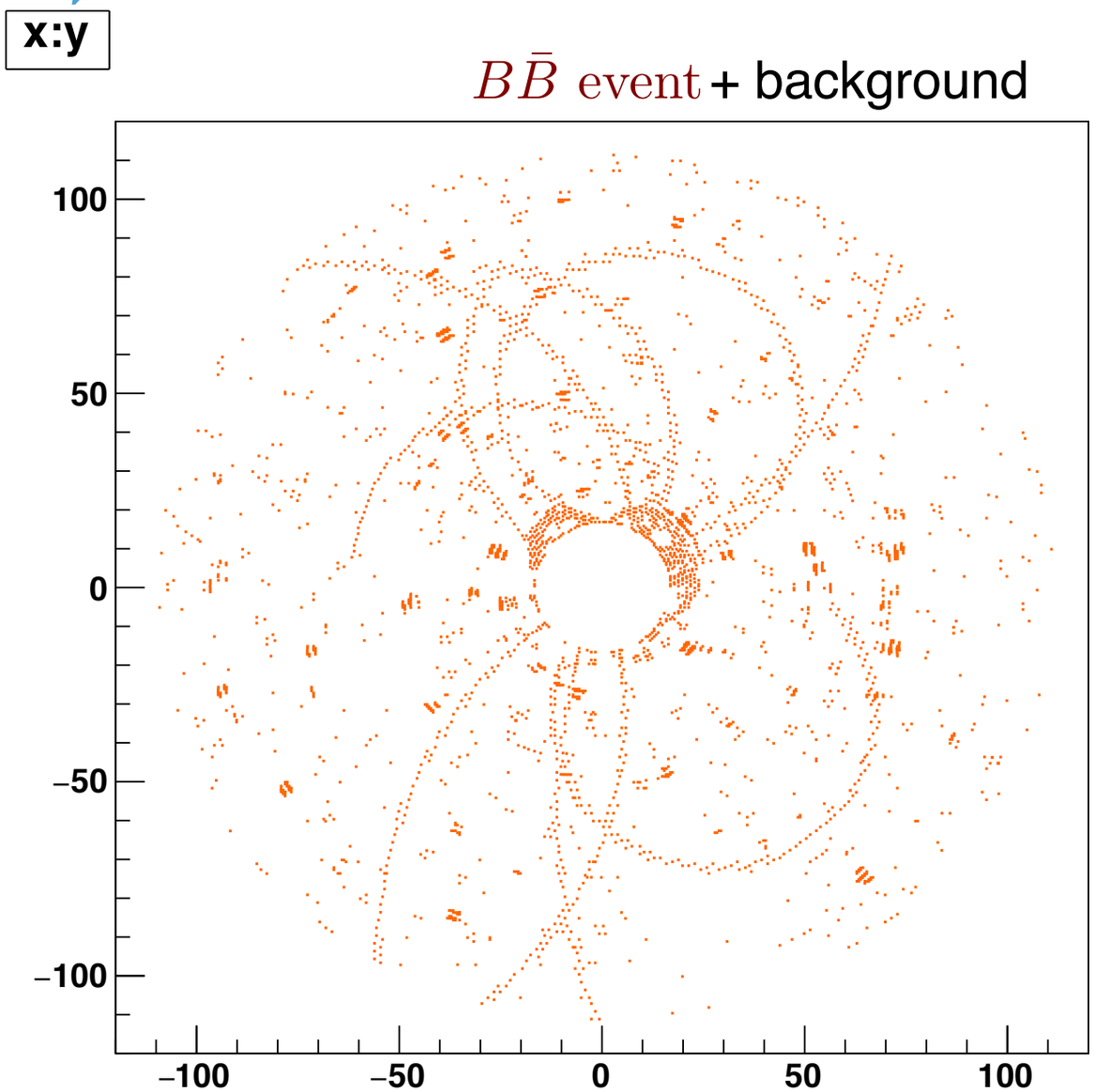
2nd TDC (if exist)

[time over th.] is newly added in FE data
(Before 2013 beam test)

[2nd TDC] is not considered in the previous calculation of data size

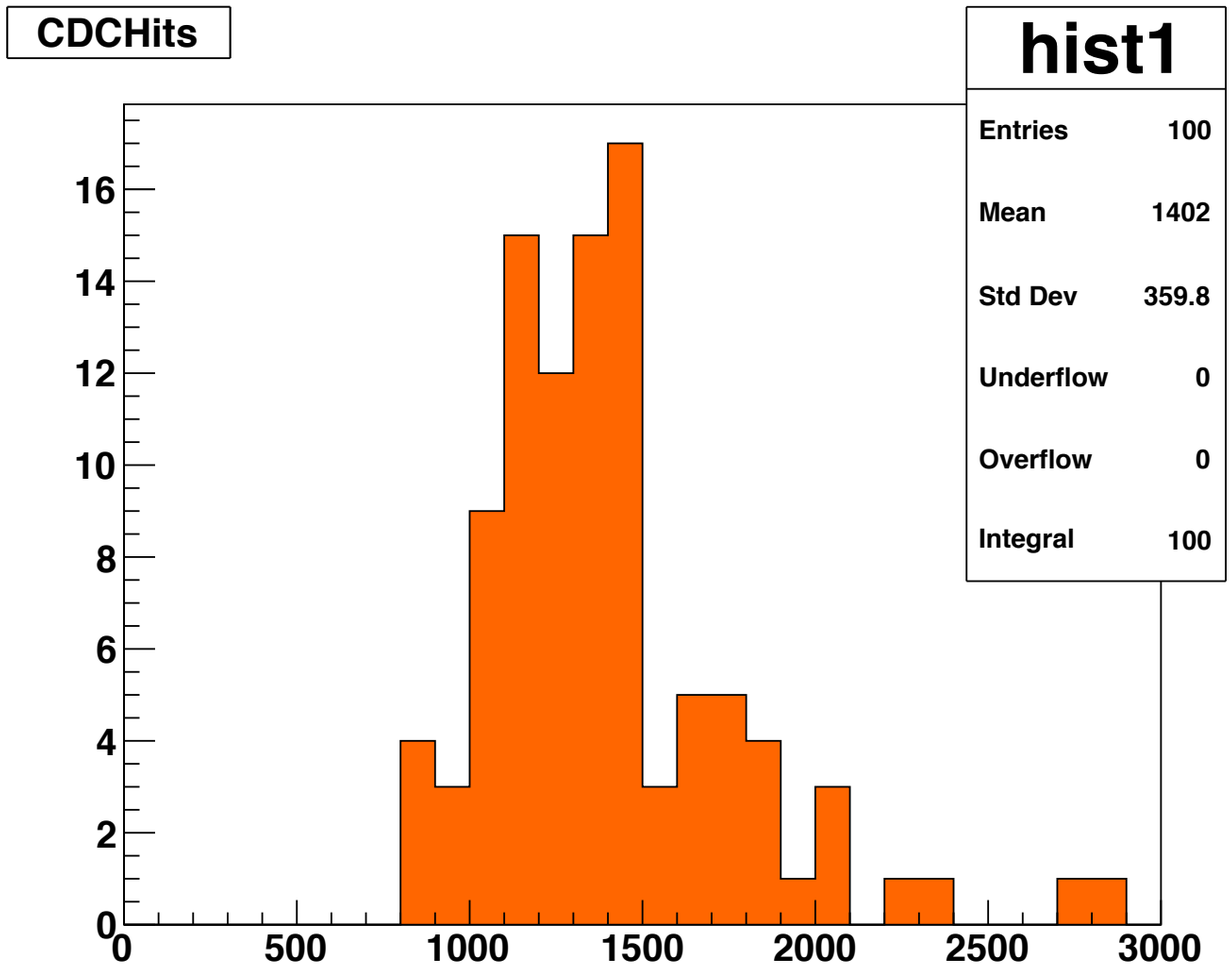
https://confluence.desy.de/download/attachments/34029240/Packet_format_of_RECBE.pdf?version=1&modificationDate=1467374565066&api=v2

Event size



$B\bar{B}$ event + background

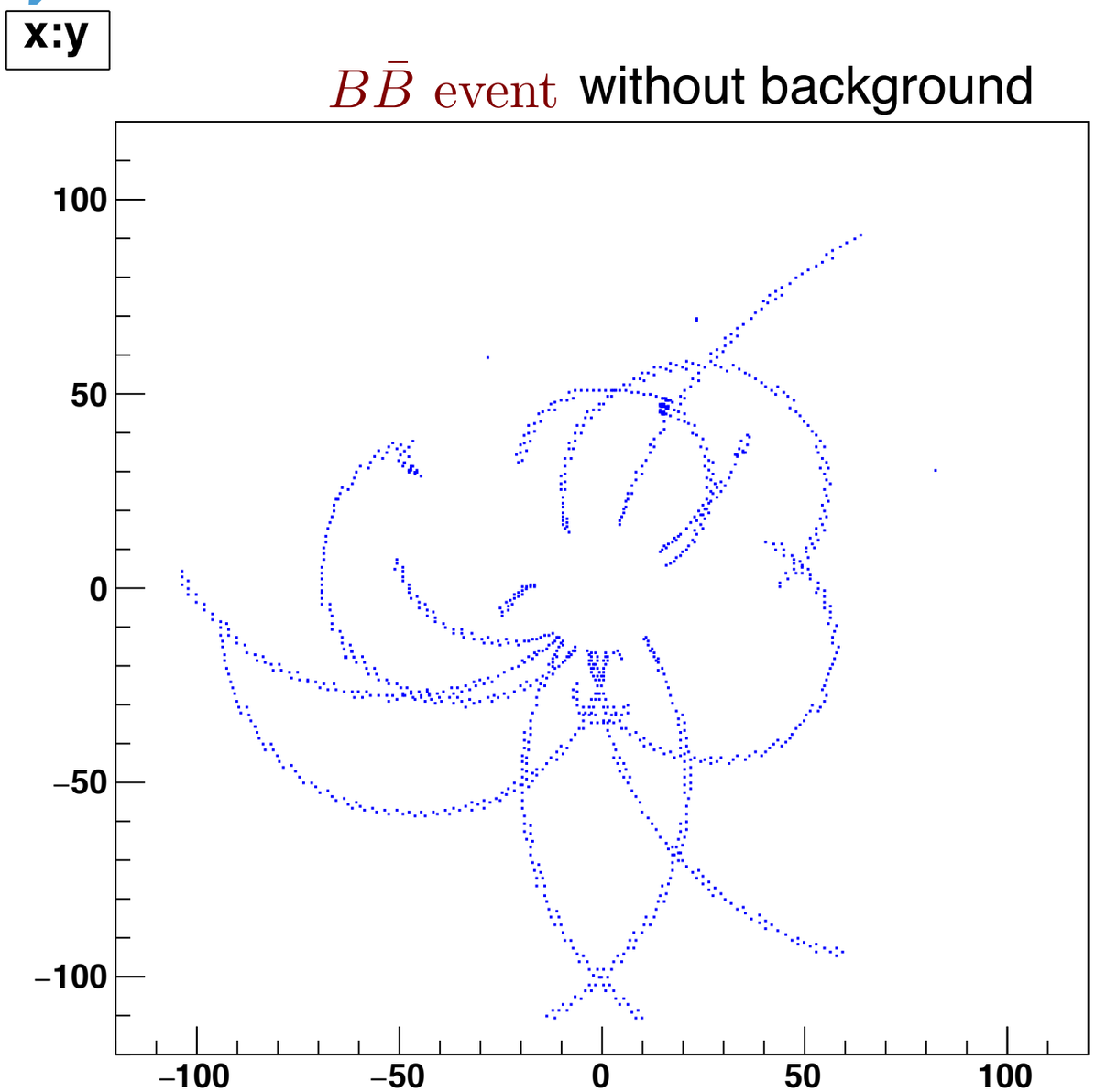
Number of hit channels / event



Occupancy = 1402/14336 ~10%

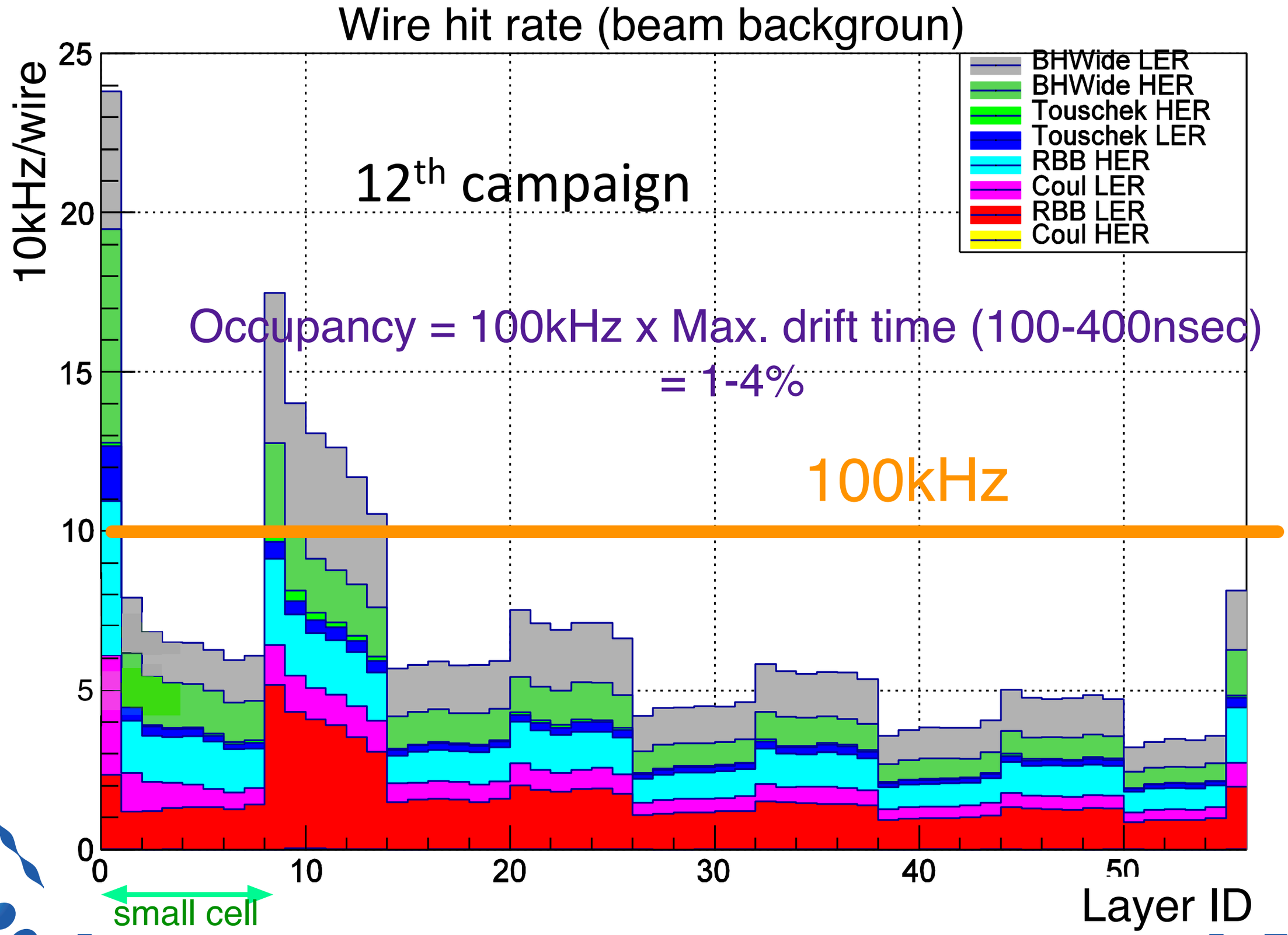
script provided by T. Kuhr

event size



Occupancy(BB)
= (~10 tracks x 56 layers)/14336
= 560 ch/14336 ~ 4%

Event size


Wire hit rate (beam backgroun)
10kHz/wire
12th campaign
BHWide LER
BHWide HER
Touschek HER
Touschek LER
RBB HER
Coul LER
RBB LER
Coul HER
Occupancy = 100kHz x Max. drift time (100-400nsec)
= 1-4%
100kHz
small cell
Layer ID
0
5
10
15
20
25
0
10
20
30
40
50

Event size

12 byte x 300FE = 3600 byte = 3.6kB (FE header/event)

10 byte x 14336ch x 0.1 = 14336 byte = 14.4kB (data/event)

ev sz = 3.6+14.4=18kB

18kB x 30kHz = 520MB/s

- we can arrange layout of connection between FE and HSLB considering event size/COPPER

Belle II Data Acquisition System Data Rates

version 20140414a

	#ch	occ [%]	#link	/link [MB/s]	#CPR	ev sz [kB]	total [MB/s]	/CPR [MB/s]
PXD	8	2	40	455	—	800	1820	—
SVD	223744	1.7(5.5)	48	8.9(33.8)	48	14.9	428	8.9(33.8)
CDC	14336	10	302	0.6	76	6	175	2.3
BPID	8192	2.5	64	1.5	16	3.2	96	8
EPID	65664	1.5	90	1.1	23	2.8	84	4.2
ECL	8736	33	52	7.7	26	12	360	15
BKLM	19008	1	24	9.7	6	2	60	10
EKLM	16800	2	16	35.8	9	1.4	42	4.7
TRG			19		10			

updated (20160905)

CDC	14336	10	299	1.74M/s	75	18kB	520MB/s	6.9MB/s

= 520MB/s/299

= 520MB/s/75

CDC packer

	Prev. estimation (DAQ Twiki)	Thomas-san's script (EventGen)	Thomas-san's script (BHWide)
FEE data size [kB/ev]	6.0 +3.6	15.3	9.3
FEE overhead [kB/ev]		3.6	3.6
Hit size[byte/hit]	4	8 ☹	8
Occupancy[%]	10	10.2	5.0
DAQ overhead[kB/ev]	7.8 ☹	7.8	7.8
Total data flow[MB/s]	522	693	512

updated (20160905)

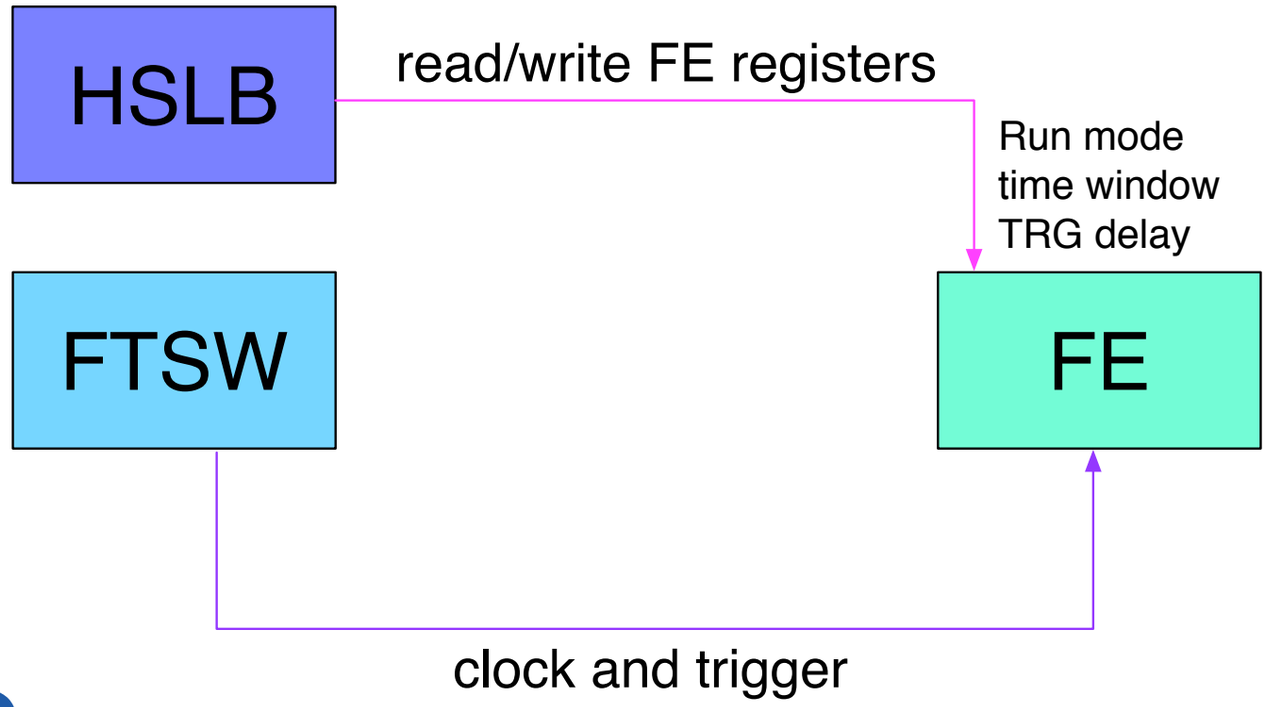
CDC	14336	10	299	1.74M/s	75	18kB	520MB/s	6.9MB/s

= 520MB/s/299

= 520MB/s/75

calibration run

- ee → μμ (not so frequency)
  - calibration of drift chamber
- test pulse data (daily)
  - record waveform for each channel
  - pulse shape of test pulse
  - pedestal



Run mode

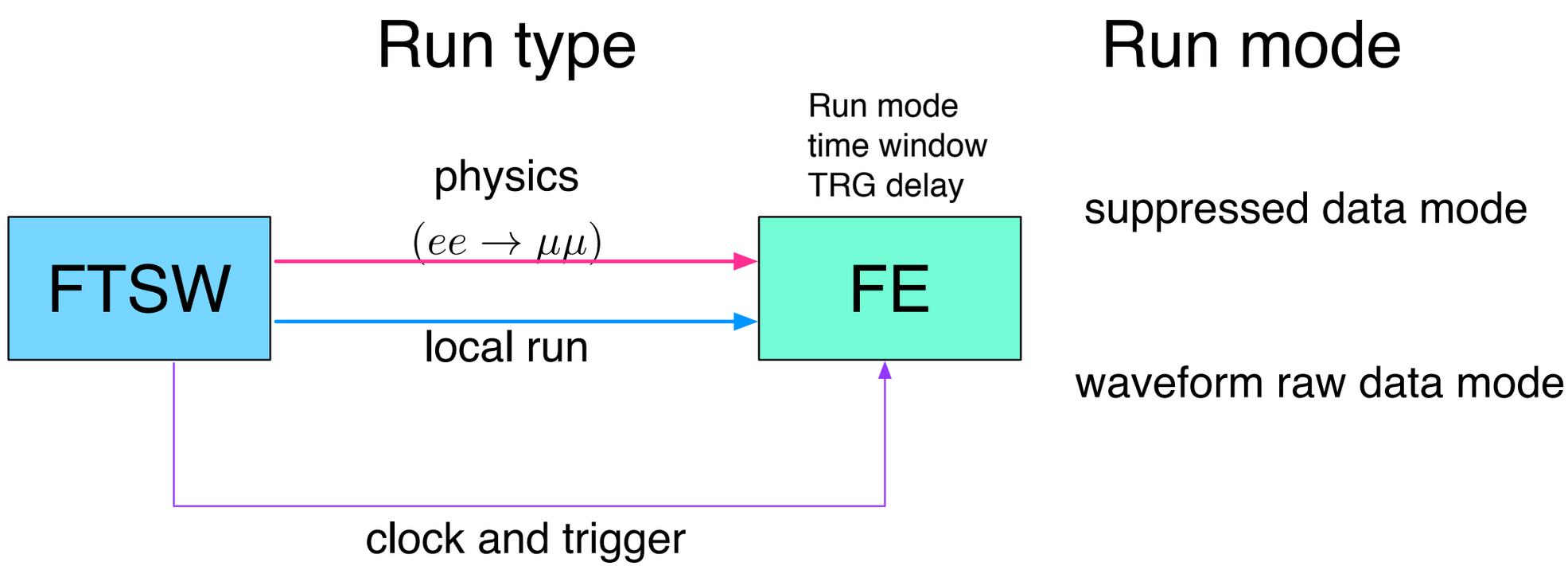
suppressed data mode

waveform raw data mode

test pulse is generated FPGA
Internal clock is used

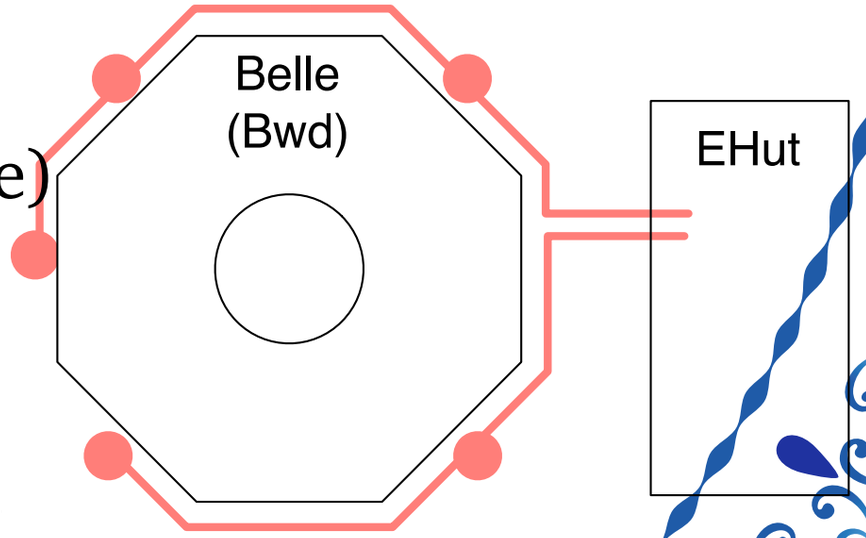
calibration run

- ee → μμ (not so frequency)
  - calibration of drift chamber
- test pulse data (daily)
  - record waveform for each channel
  - pulse shape of test pulse
  - pedestal



schedule

- Cosmic ray test at Tsukuba B4 : until the end of Sep.
  - remove all cables
- CDC installation : 1 week
  - start from 10th Oct.
  - setting jig (2d) + installation (1d) + alignment and survey (2d)
- Cabling and piping : 2 weeks
  - 600 optical fibers (DAQ and TRG) : 50% done
  - 600 cat.7 cables
  - 230 HV cables
  - 150 LV cables (from EHut to side : 5/6 done)
  - monitor cables
- Several test : 1 month
  - HV check, noise level and cosmic ray signal



Nanae Taniguchi (160903)

schedule