

# Closing Remarks

R.Itoh, KEK



We are very sorry that we missed Iwasaki-san in this meeting.



Good News : We heard he left hospital!  
Hopefully we can meet him at KEK next week!

## Focus of this workshop

### 1. Cosmic ray run / Beam test

- The last DESY beam test for PXD+SVD was performed in February to March.
- The global cosmic run was started in July, and is now going on.
- We discussed various problems and improvements in these tests.

**We should congratulate the success of these test!!**

### 2. Preparation for Phase 2 run.

- Less than a half year before Phase 2 DAQ starts!
- We discussed the readiness, in particular, the high-rate tolerance.

### 3. Upgrade

- The readout upgrade is planned and the discussion on task sharing has been started in this meeting.

## One page summary of DAQ integration (with my prejudice)

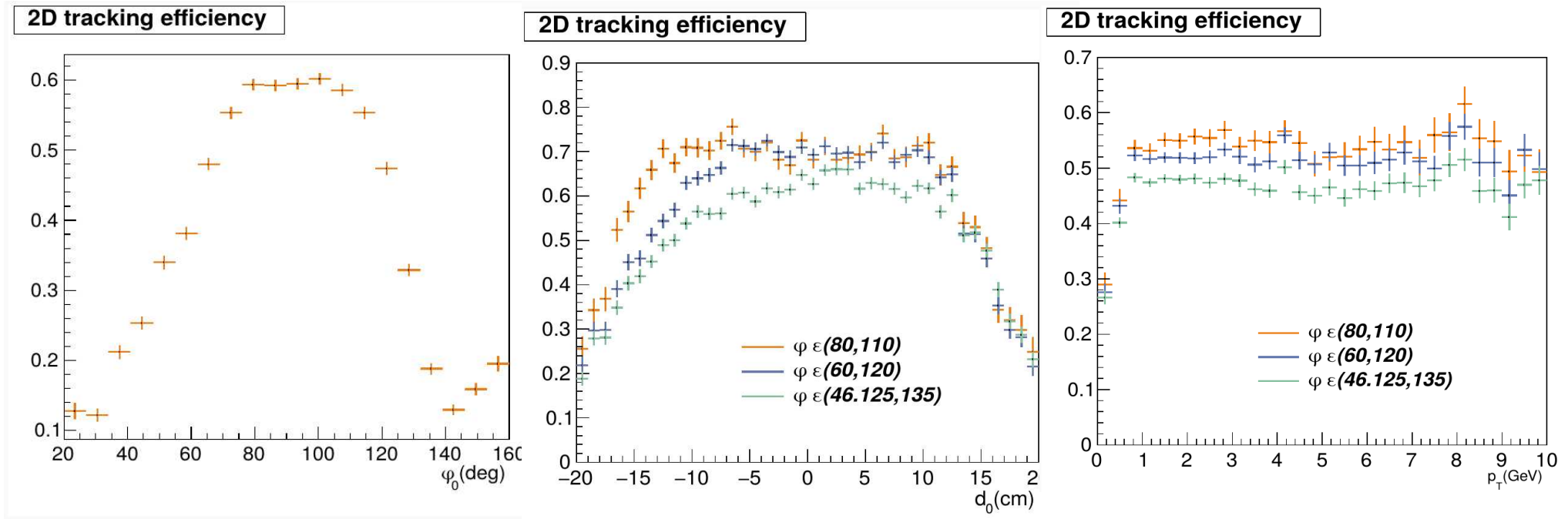
	Pocket DAQ	Back end	SLC	Cosmic	High-rate	Comment
PXD	○	△	△	×	×	Tested at DESY test beam a few kHz limit in DHH firmware
SVD	○	△	△	×	△	Tested at DESY test beam 30kHz operation confirmed in DESY
CDC	○	○	○	○	○	3 bad FEEs 60kHz confirmed.
TOP	○	○	○	○	×	Belle2link lost problem was fixed. FEE firm cannot handle high-rate.
ARICH	○	×	△	×	×	FEE firmware works at 20kHz Not yet integrated
ECL	○	○	○	○	○	BECL fully integrated. Stable in cosmic. Working at >30kHz.
KLM	○	○	○	△	×	FEE integration completed. FEE firm (scinti) cannot handle high-rate.
TRG	○	○	×	○	×	

○ : Good, △: Partially working, ×: Not yet working/implemented

\* Some detectors still have “tlost” problem.

# Some (random list of) findings in the reports in this WS

## 1. Low 2D TRG tracking efficiency



- What is the reason?
- Problem in TS finding???

\* 2D trigger is the basis of 3D/NN trigger and the reason should be investigated as early as possible.



## 2. High-rate tolerance of FEE firmware

- High rate operation is still not guaranteed for PXD, (SVD), TOP, (ARICH), and KLM.
- PXD : operated at a few kHz in DESY-TB inserting trigger hold-off with a few msec.
  - > Development of new DHH firmware is going on.  
**target: November**
- TOP : current firm can handle up to 750Hz with 1.5msec hold-off. in GCRT.
  - > Still need a lot of developments for 30kHz.  
**target: December**
- KLM : current firm requires 10msec hold-off -> 100Hz at max. O(100) improvement is necessary.
  - > Need a heavy effort  
**target: January, 2018**

**Are they really available on time for Phase 2????**

**-> will be discussed in TB on Aug.30.**

Plan for DHH firmware update by Igor

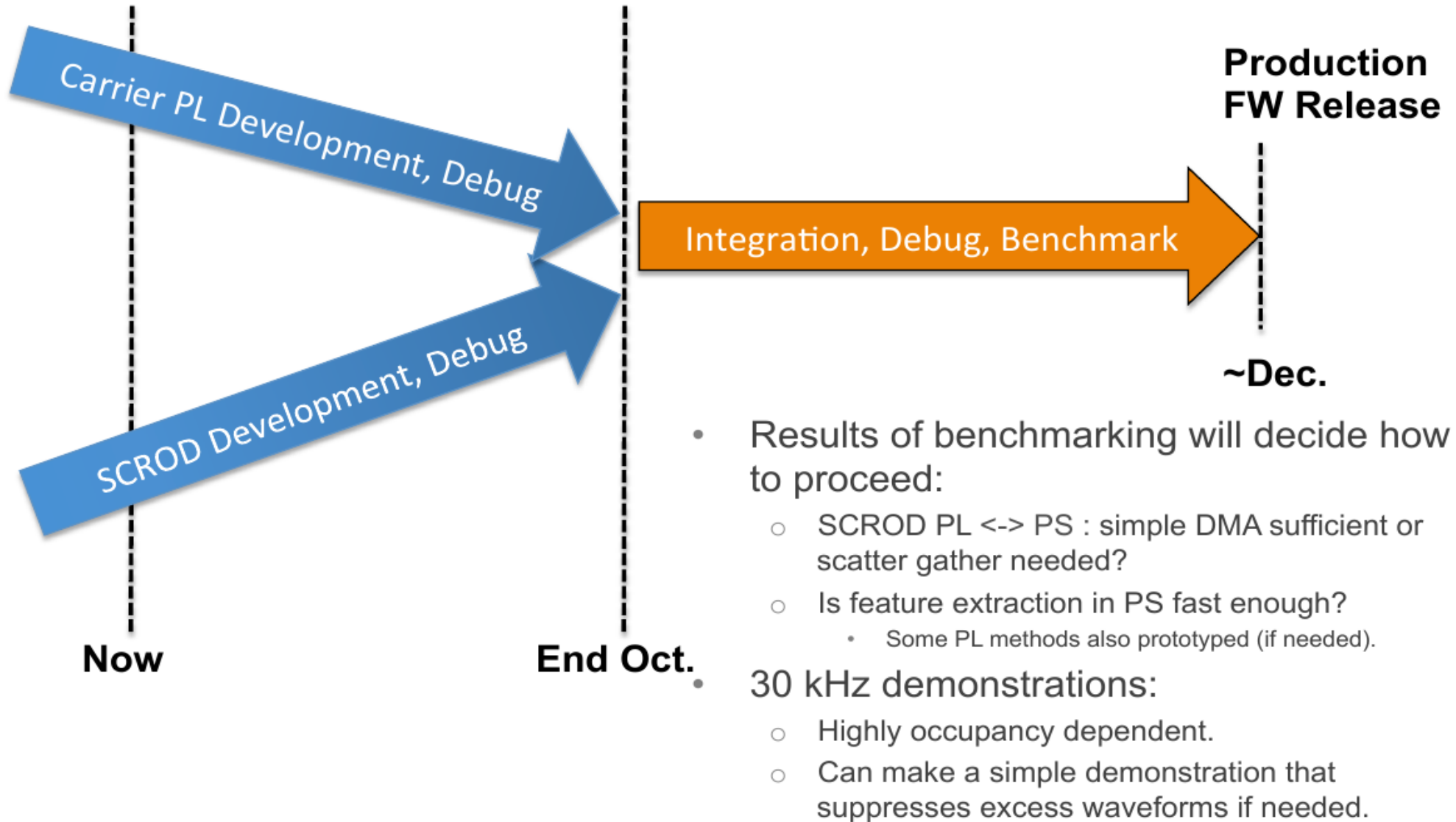


## Firmware Status for Phase 2

Current DHE firmware has limited trigger rate capability of about 5kHz

We plan to provide new firmware, which supports 30kHz trigger rate, in November

# Development Pathway (2)





Plan for KLM firmware update by Leo

## Moving Toward 30 kHz Readout

- ❖ **RPC readout is ready for 30 kHz readout today**, according to bench-test measurements at Indiana U
- ❖ Scintillator-readout firmware overhaul:
  - **Step 1: 100 Hz → 1 kHz: (Oct 2017)**
    - ✓ Increase internal FPGA clock from 64 to 127 MHz
    - ✓ Implement clock enables
    - ✓ Speed up digitization process in TARGETX readout sub-FW
  - **Step 2: 1 kHz → 10 kHz: (Dec 2017)**
    - ✓ Expand ROI readout to only channels of interest
    - ✓ Aggressive pedestal caching
  - **Step 3: 10 kHz → 30 kHz: (Jan 2018)**
    - ✓ Optimize readout process
    - ✓ Optimize/reduce readout window size/length

# Phase-2 VXD commissioning plan

- **Sep 19-23: VXD DAQ integration test w/o detector**
  - DHH will be located beside B4 clean room (TBC)
  - FADC will be located on the top of the Belle
  - Complete system test with limited data rate (SVD will try 30kHz trigger here.)
- **Oct 19 – Nov 1: Phase-2 VXD test before installation**
  - Phase-2 VXD is in B4 clean room
  - DHH + FADC will be located beside the clean room
- **Nov 28 – Dec 11: Phase-2 VXD test after installation**
  - Phase-2 VXD is inside the Belle II detector
  - DHH + FADC will be located on the top of the Belle
  - Complete system test with full data rate at KEK w/ detectors
- **Dec – Feb: Commissioning with cosmic ray data**
- **DAQ for above commissioning**
  - PXD/SVD standalone DAQ (PocketDAQ?) + global DAQ

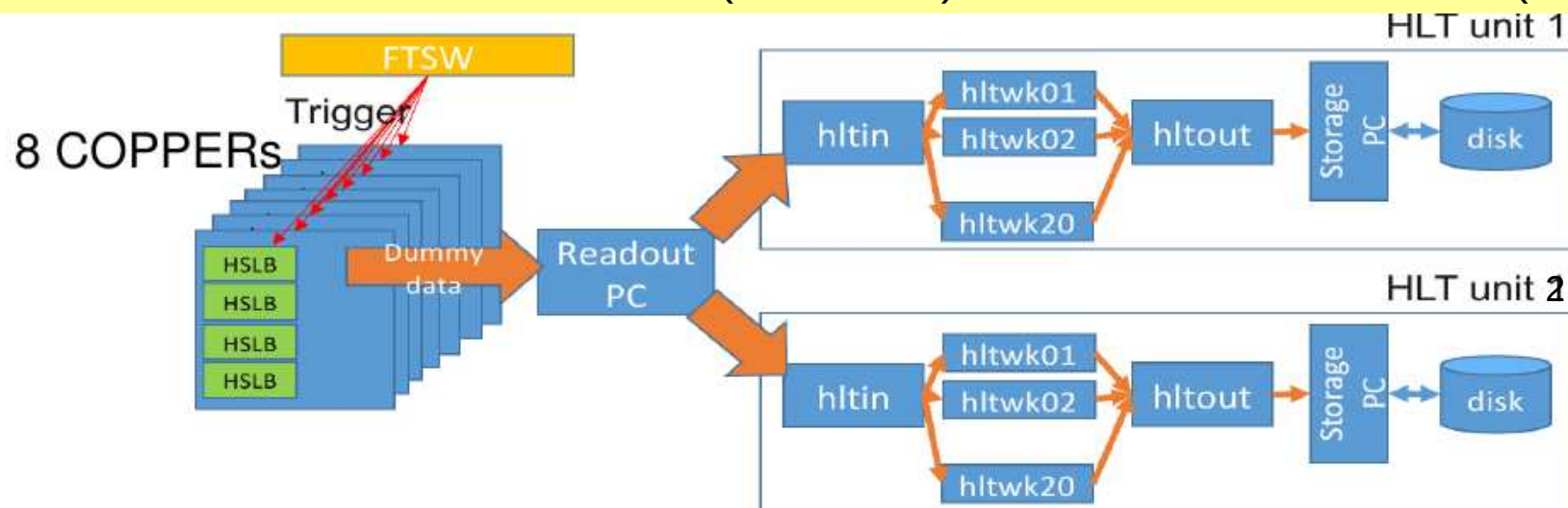
### 3. High-rate “system test”

- We need to perform a high-rate “system test” from detector FEE to Storage well before next B2GM in Oct.
- We can start the test with CDC+ECL and 5 units of HLT/Storage.
- Will be started from next week.

# Previous high rate system test

- The performance of HLT framework was tested in the real DAQ.
- The dummy data are generated on 8 COPPERs and sent to 2 HLT units through event builder 1.

Note: The software version is old (last winter), and the data size is small (~1kB/ev).



- Dummy data are generated on Belle2link receiver cards (HSLB) whenever a trigger is recovered from FTSW.

Input rate(kHz)	Event size /HSLB(bytes)	Output rate(kHz)
30	44	30
40	44	38
30	88	30

\* Event size(44Bytes/HSLB) is the estimated typical size.

Realistic test using simulated raw data + full recon is performed soon.

## 4. NSM crash

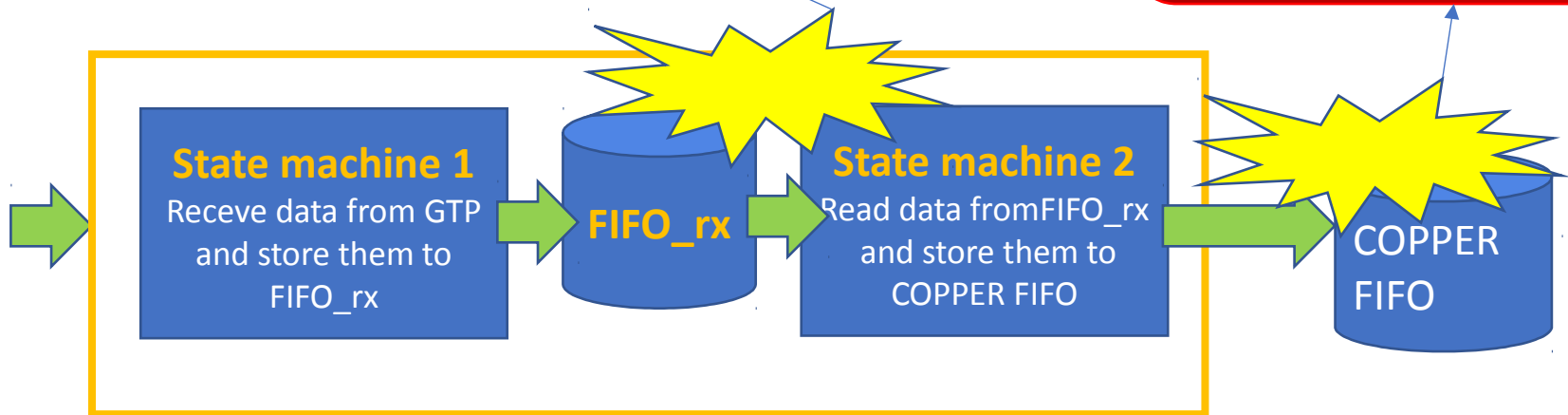
- In the on-going GCRT, the whole nsm2 network crashes once per every two days or so.
- It takes ~one hour to recover from this trouble.
- The investigation is in progress, but the fix may require to go into deep inside of NSM.
  - > One more task for Nakao-san.... (sorry)

# 5. Good thing : Error rate reduction in COPPER

Inside hslb\_receiver.vhd

ff00ff00 error -> avoided this error by workaround ??

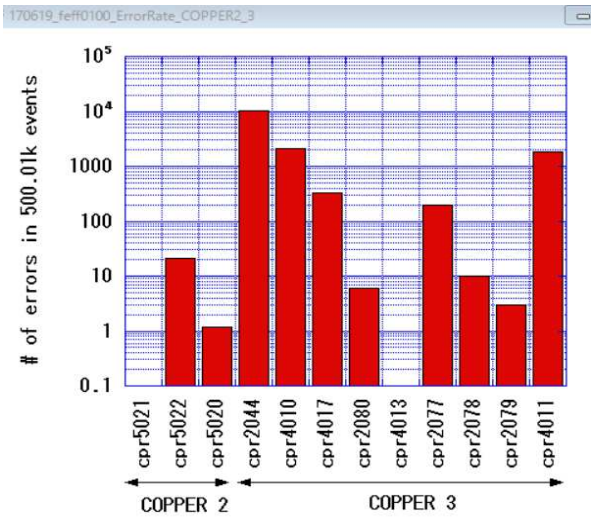
SSO(simultaneous switching output) Error  
1bit is lost ->  
Feffffff 01000000  
->feffffff 00000000 (corrupted)



## D. The error rate differs in COPPERs

# of CRC errors in TOP calib. Test (Feb.10-Apr.26)

	slot A	slot B	slot C	slot D
cpr3001	0	0	0	2
cpr3002	0	0	0	0
cpr3003	63	6	15	1015
cpr3004	1	12	4	524
cpr3005	18	13	19	71
cpr3006	176	20	73	2190
cpr3007	2	0	3	23
cpr3008	50	37	269	1419
cpr3009	4	3	5	207
cpr3010	0	0	0	1
cpr3011	120	10	15	142
cpr3012	35	2	8	32
cpr3013	7	0	1	0
cpr3014	2	1	4	79
cpr3015	210	15	143	1702
cpr3016	10	1	2	33



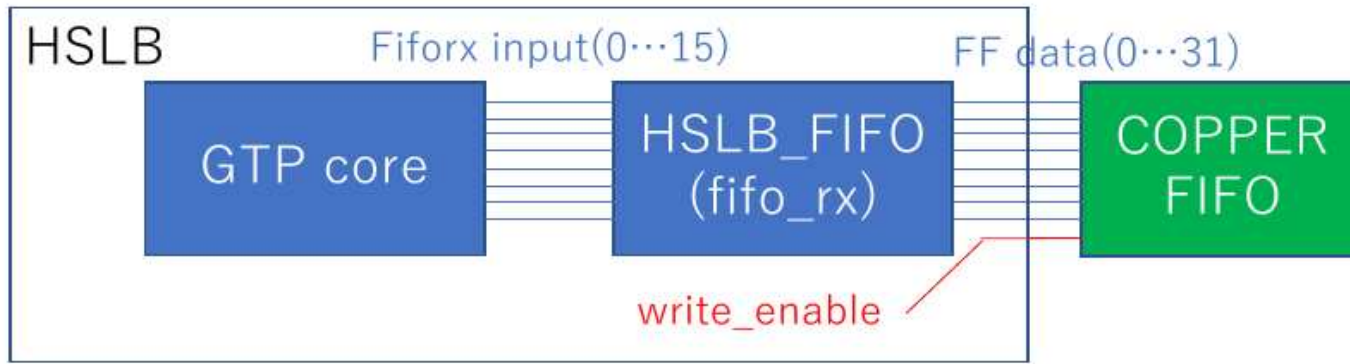
# of errors in 50M events (error rate ~0.02% in the most problematic COPPER)

- \* The problem occurs inside COPPER.
- \* Various fixes were tried and the error rate was reduced.
- \* More effort is required to understand the symptom.



# Reduction of the corruption rate (1)

## Data flow from HSLB to COPPER FIFO



## FF data output and write enable

		FF data				
		...	}			
Readout clock from fifo_rx ↓	0	5402	00bc	1	ff5508e7	
	0	5402	95fb	1	ff5508e7	
	0	5402	7933	1	ff5508e7	
			...	}		
	0	5402	00c6	1	ff5508e7	
	0	5402	a906	1	ff5508e7	
	0	5402	fe00	1	ff5508e7	
	0	5402	95fd	1	ff5508e7	
	0	5402	448d	1	ff5508e7	
	0	5402	7e1f	1	ff5508e7	
	0	5402	00bc	1	ff5508e7	
	0	5402	00bc	1	ff5508e7	
	0	5402	00bc	1	ff5508e7	
	0	5402	00bc	2	ffaa00c6	
	0	5897	00bc	2	ffaa00c6	
0	0000	95fb	2	54025897		
0	00c6	ff00	2	54025897		

write\_en = false

write\_en = true

0 0000 00bc 9 00000000

charisK status    FIFO\_rx output    FIFO\_rx input    FIFO\_rx status    Combine FIFO outputs (COPPER FIFO input)

- So far, even when write\_en = false, the output from HSLB (FF data) has some value.
- I changed the firmware to keep FF\_data zero while write\_en = false.

## Reduction of the corruption rate (2)

### B3 test bench (cpr2044)

- Dummy data (feffffff 01000000) production firmware (dummy data -> HSLB fifo -> COPPER FIFO)
- Download firmware to all four HSLBs on a COPPER
- Normal firmware :
  - Error rate :  $0.0056 \text{ error/event}$  ( = 7779error/ (156sec\*8.93kHz) )
- FF\_data is zero when write\_enable is false
  - Error rate :  $< 1.6e-9 \text{ error/event}$  (No error in ( 178353 sec \* 8.94kHz ) events )

### CDC FEEs

- Use almost all CDC FEEs.
  - Dummy trigger input 100kHz :
  - Suppress mode in CDC data format
- Normal firmware
  - Output event rate : 53kHz (run 20170712\_1314)
  - Error rate :  $5.6e-6 \text{ error/event}$  ( =1822 error/(6093sec\*53kHz) )
- FF\_data is zero when write\_enable is false (run 20170817\_2343)
  - Output event rate : 66.6kHz
  - Error rate :  $< 2.1e-9 \text{ error/event}$  (No error in 40506 sec.\*66.6kHz )



Improved. We'd like to test this firmware in TOP.

# Next Workshop. Where and When?

- TRG/DAQ workshop series has been started from 1997 and workshops were annually held until 2006 at various places **in Japan**. After 3-year intermission, the WS series was restarted from 2010.
- History:
  - 2010 : Seoul (Korea Univ. hosted by E.Won)
  - 2011 : Beijing (Peking Univ. hosted by Z.-A.Liu)
  - 2012 : Hawaii (U. of Hawaii hosted by G.Varner)
  - 2013 : Seoul (Hanyang Univ. hosted by B.G.Cheon)
  - 2014 : Taipei (NTU hosted by J.G Shiu)
  - 2015 : Osaka (OCU hosted by E.Nakano)
  - 2016 : Novosibirsk (BINP hosted by A.Kuzmin)
  - 2017 : Taipei (NTU hosted by J.G.Shiu)**
- When? -> Could be summer-fall in 2018 after Phase II
- Where? -> Maybe in Korea considering the “turn”, but the political situation concerning North Korea.....  
Other good place if we succeed to get funding.

Let's thank Shiu-san and his colleagues  
for organizing this great workshop!

Excellent coordination and Excellent foods....!!!!



and many others!