



Cosmic ray run with PCIe40

S. Yamada (KEK)

Run summary of cosmic ray runs on June 9

datarun	Input TRG rate [Hz]	type	HLT script	Run time[s]	PCIe40 firmware	Run status	Used channels	
2021/6/9		~500	gdl	cosmic	1620	210407_eea4282f_48ch.sof	No error	rtop2: 20ch
2021/6/9	2176	~500	gdl	cosmic	2100	210407_eea4282f_48ch.sof	No error	rtop2: 32ch
2021/6/9	2177	~500	gdl	cosmic	435	210407_eea4282f_48ch.sof	Ff55 data-corruption ch28 of rtop1	rtop1 : 30ch rtop2 : 31ch
2021/6/9	2178	~500	gdl	cosmic	1155	210609_e2768c11d2_48ch.sof	No error	rtop1 : 30ch rtop2 : 31ch
2021/6/9	2179	~500	gdl	cosmic	809	210609_e2768c11d2_48ch.sof	No error	rtop1 : 30ch rtop2 : 31ch
2021/6/9	2180	~500	gdl	cosmic	31	belleII_v12.00_36ch.sof	Ff55 data-corruption ch28 of rtop1	rtop1 : 30ch rtop2 : 31ch
2021/6/9	2181	~500	gdl	cosmic	246	belleII_v12.00_36ch.sof	Ff55 data-corruption ch23 of rtop1	rtop1 : 30ch
2021/6/9	2182	~500	gdl	cosmic	745	belleII_v12.00_36ch.sof	Connected to KLM FTSW Ff55 data-corruption ch28 of rtop1	rtop1 : 30ch
2021/6/9	2183, 2184, 2185	500	gdl	cosmic	0	210609_32782d734b_36ch.sof	No event detection for some channels	rtop1 : 30ch rtop2 : 31ch
2021/6/9	2186	500	gdl	cosmic	1178	210609_e2768c11d2_48ch.sof	No error	rtop1 : 30ch rtop2 : 31ch
2021/6/9	2187	500	gdl	cosmic	1266	210609_e2768c11d2_48ch.sof	No error	rtop1 : 30ch rtop2 : 31ch

Commit ID	Committed date	Comment
e2768c11d20	Feb. 5, 2021	Master branch
eea4282fbe9	Apr. 7, 2021	My development branch (not yet merged)
32782d734b2	Just revert userlogic "ff55" formatting part to e2768c11d20 on Jun. 9	My development branch (not yet merged)
48628d84b94	Ver 12.0 : Jun. 4	Master branch

“FF55” DATA-CORRUPTION

- With a certain length and the starting position of an event-fragment, same 256bit data appears in merged data.

[FATAL] Bad ff55 143 pos 000007f0 ch 28

-> This message means we could not find “ff55” magic word for a trailer of an event-fragment from one link.

```
00dd0285 02db0209 32360846 fcf6be00 01d90000 007e00f4 00f100d4 2e3611c2
00000a70 4b434f16 ff552000 ffaa1c43 11ab3930 0401a026 0000000a 00ba2345
00000143 eef6bc00 014d0000 003b00c4 00d4009f 25352c14 00000a02 4b433c3c
00000143 eef6bc00 014d0000 003b00c4 00d4009f 25352c14 00000a02 4b433c3c
ffa54000 ffaa1d43 11ab39c0 0401a018 0000000a 00ba2345 00000143 36f7b200
```

Header

This 256bits is not necessary.

Trailer

- This error always happened with the length of 14words(=64bytes) and it started at the 4th word in 256bits.
- I tested with HSLB dummy data to reproduce this error at the B4 test bench but it did not happen. -> Long term test might be needed.
- Not sure if recorded data of the cosmic test contains the same pattern of an event without the error -> Need to check.

Persistent BUSY issue with Belle II TOP FEEs on May 12 (1)

- Events were not detected for some channels with recent PCIe40 firmware versions.

Received event information from PCIe40 via FTSW (PCIe40 fw v11.10)

```

9=26000 reg=0a000001 1080000c BUSY
ready tag=1 min=32
2=03040 20000000 [pcie40a]
0=03041 54000000 busy=none
0=03050 6a00017f ready tag=383
1=03051 6a000180 ready tag=384
2=03052 6a00017d ready tag=381
3=03053 6a00017f ready tag=383
4=03054 6a00017f ready tag=383
5=03055 6a00017f ready tag=383
6=03056 6a000180 ready tag=384
7=03057 6a00017f ready tag=383
8=03058 6a00017e ready tag=382
9=03059 6a000000 ready tag=0
10=0305a 6a00017e ready tag=382
11=0305b 6a00017e ready tag=382
12=0305c 6a00017a ready tag=378
13=0305d 6a00017e ready tag=382
14=0305e 6a000180 ready tag=384
15=0305f 6a00017f ready tag=383
1=03042 54000100 busy=none
0=03060 6a000179 ready tag=377
1=03061 6a00017d ready tag=381
2=03062 6a00017f ready tag=383
3=03063 6a00017a ready tag=378
4!03064 6a000000 ready tag=0
5=03065 6a000180 ready tag=384
6=03066 6a00017d ready tag=381
7=03067 6a00017a ready tag=378
8=03068 74000000 busy=none
9=03069 6a00017f ready tag=383
10=0306a 6a00017c ready tag=380
11=0306b 6a00017d ready tag=381
12=0306c 6a00017a ready tag=378
13=0306d 6a000180 ready tag=384
14=0306e 6a000180 ready tag=384
15=0306f 6a00017d ready tag=381
    
```

No events at ch9

Fw ver.	No-events channels
V11.10	ch9
V11.7	Ch14,23
V11.6	Ch28, 30
V11.5	Ch28, 30

- When we swapped fibers on either a patch panel or PCIe40 board itself, those channels were unchanged. So, it does not seem to be the issue of FEE or fibers.
- When we use v11.4 or v11.0, that issue did not occur. So, the update between v11.4 and v11.5 might affect the issue.

Improve timing constraints	NG	v11.5	04 Mar 2021
Increase version to 11.5			03 Mar 2021
Update LAL project file with latest changes	OK	v11.4	23 Feb 2021

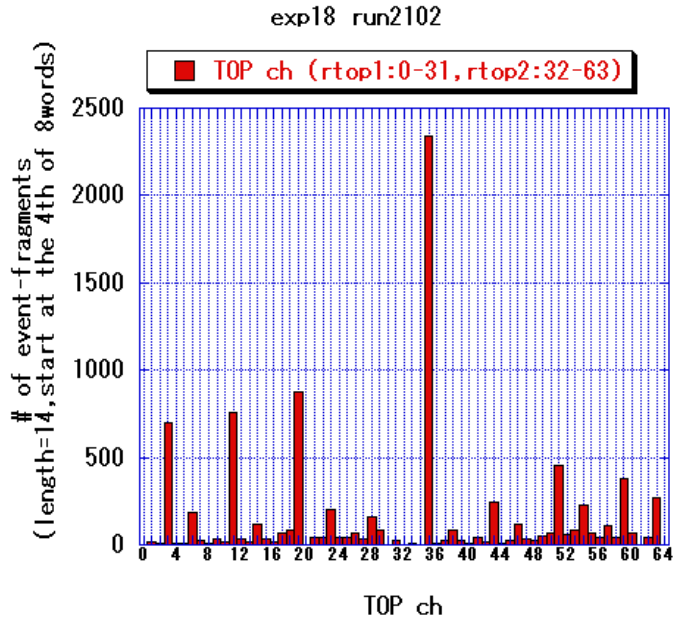
This issue can be reproduced at the test bench. After Patrick-san's work, with ver.12.0, this issue seems to be gone at the test bench. (but length FIFO busy happened and cannot take data with 48ch ver.)

- Not sure if recorded data of the cosmic test contains the same pattern of an event without the error -> Need to check.
 - I checked four runs but KLM data had no event-fragment with the patter.
 - TOP data had many even-fragments of this patter even before the error occurred.

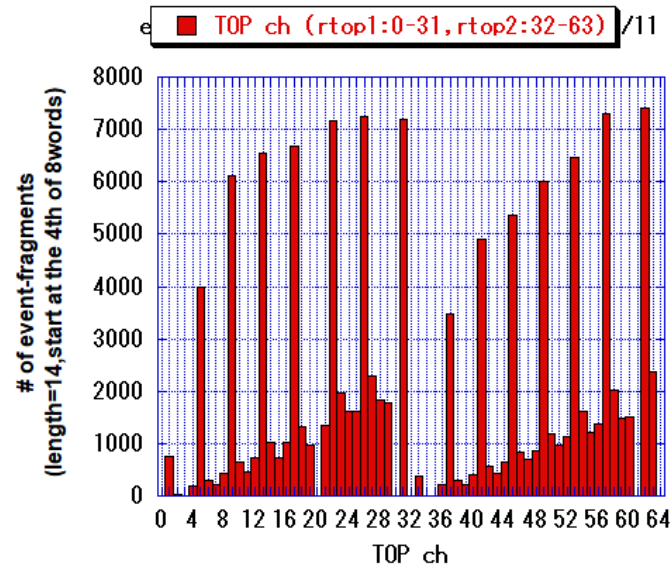
```

00dd0285 02db0209 32360846 fcf6be00 01d90000 007e00f4 00f100d4 2e3611c2
00000a70 4b434f16 ff552000 ffaa1c43 11ab3930 0401a026 0000000a 00ba2345
00000143 eef6bc00 014d0000 003b00c4 00d4009f 25352c14 00000a02 4b433c3c
00000143 eef6bc00 014d0000 003b00c4 00d4009f 25352c14 00000a02 4b433c3c
ff554000 ffaa1d43 11ab39c0 0401a018 0000000a 00ba2345 00000143 36f7b200
  
```

With ver.11.4 (Feb.23) : ff55 error



E2768c11d20 (Feb.7) : no erro



Many events without reduction of header and trailer are observed with Feb.7 version.

FEATURE/BII-7732 UNPACKER UPDATE FOR PCIe40 READOUT

<https://stash.desy.de/projects/B2/repos/software/pull-requests/7822/overview>

Release note:

The current COPPER-board-based readout system will be replaced with a PCIe40-board-based system. Since TOP and KLM readout system will be replaced first, rawdata, top, klm packages are updated to unpack PCIe40 data properly.

(<https://confluence.desy.de/display/BI/Upgrade+of+the+Belle+II+Readout+Subsystem>)

VALIDATION PLOTS

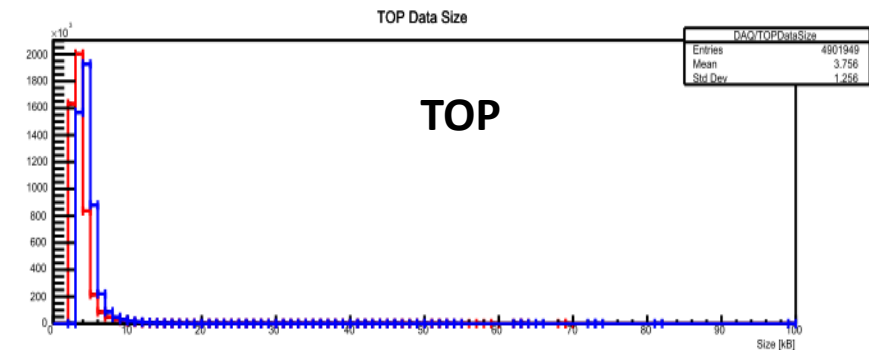
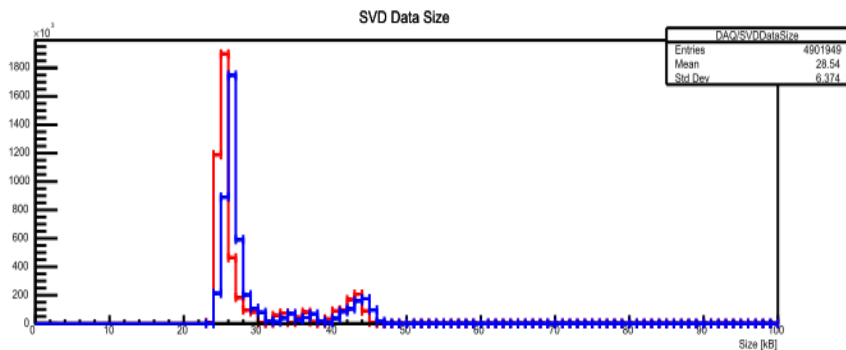
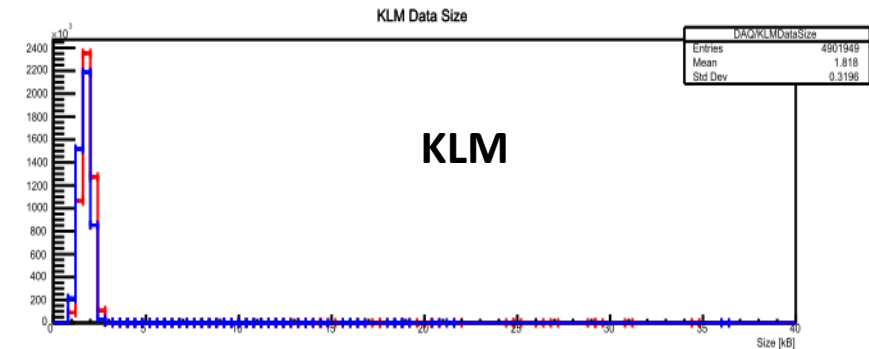
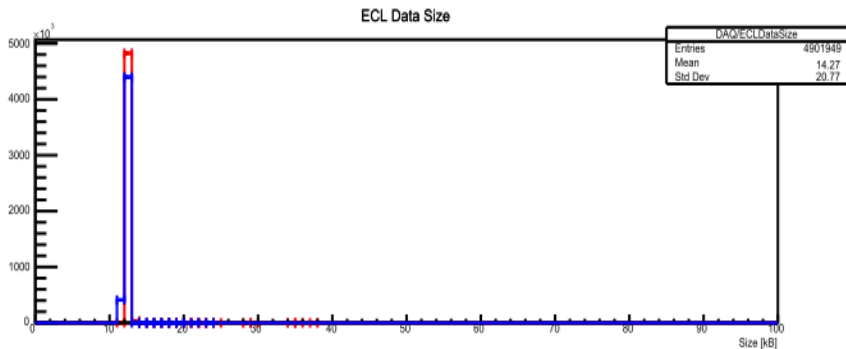
During maintenance days or non-beam time, we performed cosmic ray tests and compared DQM plots made by HLT.

		Basf2 ver. on HLT	PCIe40 board or COPPER board	
2021-05-28 12:33	Exp18 run 1734	Release05-02-10	COPPERs: All	} Comparison 1
2021-05-28 11:54	Exp18 run 1733	BII-7732	COPPERs: All	
2021-06-08 11:18	Exp18 run 2114	Release05-02-10	COPPERs: All	} Comparison 2
2021-06-08 08:04	Exp18 run 2103	BII-7732	PCIe40 : TOP+KLM COPPERs : others	

Please check more details at

<https://indico.belle2.org/event/4062/>

Red : run2114 : 05-02-10 (All : COPPER)
Blue : run2103 : BII-7732 (TOP+KLM :PCle40)



- Event size is different for SVD, KLM and TOP
- I was asked to unpack a same run with different basf2 version and see if the output is different.

backup

Since it could happen with cosmic data from the Belle II TOP, it is difficult to test updated version of firmware.

- Next maintenance day : June 23.

- Check the recorded data in the cosmic ray test.
 - Does KLM have the same kind of data-pattern ?
 - Does recorded TOP data have the same kind of data-pattern but no error ?

- Reduce possible noise in the E-hut setup
 - Use different CAT-7 cables between FTSW and PCIe40

- Try to reproduce the troubles at a test bench.
 - We should try to move the setup in E-hut and see if the errors happen.

- Currently, [210609_e2768c11d2_36/48ch.sof](#) (produced on Feb. 7) seems stable with cosmic data.
 - We should consider go back to this version.
 - Which part is missing ?

Run summary of cosmic ray runs on June 7 and 8

data	run	Input TRG rate [Hz]	TRG type	HLT script	Run time[s]	PCIe40 firmware	Run status	Used channels
2021/6/7	2081	~500	gdl	cosmic	47	210407_eea4282f_48ch.sof	Ff55 data-corruption	rtop : 61chrklm1 : 32ch
2021/6/7	2082	~500	gdl	cosmic	78	210407_eea4282f_48ch.sof	Ff55 data-corruption	rtop : 61chrklm1 : 32ch
2021/6/7	2083	~500	gdl	cosmic	118	210407_eea4282f_48ch.sof	Ff55 data-corruption	rtop : 61chrklm1 : 32ch
2021/6/7	2084	~500	gdl	cosmic	194	210407_eea4282f_48ch.sof	Ff55 data-corruption	rtop : 61chrklm1 : 32ch
2021/6/7	2085	~500	gdl	cosmic	279	210407_eea4282f_48ch.sof	Ff55 data-corruption	rtop : 61chrklm1 : 32ch
2021/6/7	2086	~500	gdl	cosmic	1050	210407_eea4282f_48ch.sof	Ff55 data-corruption	rtop : 61chrklm1 : 32ch
2021/6/7	2087	~500	gdl	cosmic	42	210407_eea4282f_48ch.sof	Ff55 data-corruption	rtop : 61chrklm1 : 32ch
2021/6/7	2088	~500	gdl	cosmic	498	210407_eea4282f_48ch.sof	Ff55 data-corruption	rtop : 61chrklm1 : 32ch
2021/6/8	2097	~500	gdl	cosmic	1620	210407_eea4282f_48ch.sof	Download fw again Ff55 data-corruption	rtop : 61chrklm1 : 32ch
2021/6/8	2099	~500	gdl	cosmic	720	210407_eea4282f_48ch.sof	Ff55 data-corruption	rtop : 61chrklm1 : 32ch
2021/6/8	2100	~500	gdl	cosmic	0	Rtop: belleII_v12.00_48ch.sof Rklm: 210407_eea4282f_48ch.sof	Stopped due to anyerr from PCIe40 (at 1023 events)	rtop : 61chrklm1 : 32ch
2021/6/8	2101	~500	gdl	cosmic	0	Rtop: belleII_v12.00_48ch.sof Rklm: 210407_eea4282f_48ch.sof	Stopped due to anyerr from PCIe40 (at 1023 events)	rtop : 61chrklm1 : 32ch
2021/6/8	2102	~500	gdl	cosmic	520	Rtop: belleII_v12.00_36ch.sof Rklm: 210407_eea4282f_48ch.sof	Ff55 data-corruption	rtop : 61chrklm1 : 32ch
2021/6/8	2103	~500	gdl	cosmic	4205	210207_e2768c11d209_36ch.sof	No error	rtop : 61chrklm1 : 32ch

Commit ID	Committed date	Comment
e2768c11d20	Feb. 5, 2021	Master branch
65cfa16f6de	Ver 11.4 ; 23 Feb 2021	
eea4282fbe9	Apr. 7, 2021	My development branch (not yet merged)
48628d84b94	Ver 12.0 : Jun. 4	Master branch

From this test on June 7-9,
The error happened in specific channels.

June 7

4 times : rtop2 ch17
2 times : rtop1 ch12
2 times : rtop2 ch22
Once : rtop1 ch23
Once : rtop2 ch7

June 9

3 times : rtop1 ch28
once : rtop1 ch23

- Effect of max # of input channels in firmware.
 - 36ch -> 48ch : [e2768c11d20](#) (Feb.5) -> No change (still no error)
 - 48ch -> 36ch : [eea4282fbe9](#) (Apr.7) -> No change (still have the error)
 - 48ch -> 36ch : [48628d84b94](#) (v12.0)
 - Another error that we cannot take any data was gone with 36ch ver.
 - Ff55-data corruption occurred even with 36ch.

- TOP FTSW is very noisy ?
 - With KLM FTSW connected with rtop1, we still had the error (run2182)

- Change the format of ff55 part.
 - Some signals are connected to the ff55 trailer, which might cause severe timing situation.
 - Reverted to [e2768c11d20](#) for that formatting part.
 - No-event detection error and cannot take any data. (run2183-2185)