γ beam test for new optical transceiver and CDCFE

2023/3/2

T.Koga

Motivation

-CDCFE and optical transceiver will be upgraded around LS2
  -bandwidth will increase from 2.5Gbps to 10Gbps per lane

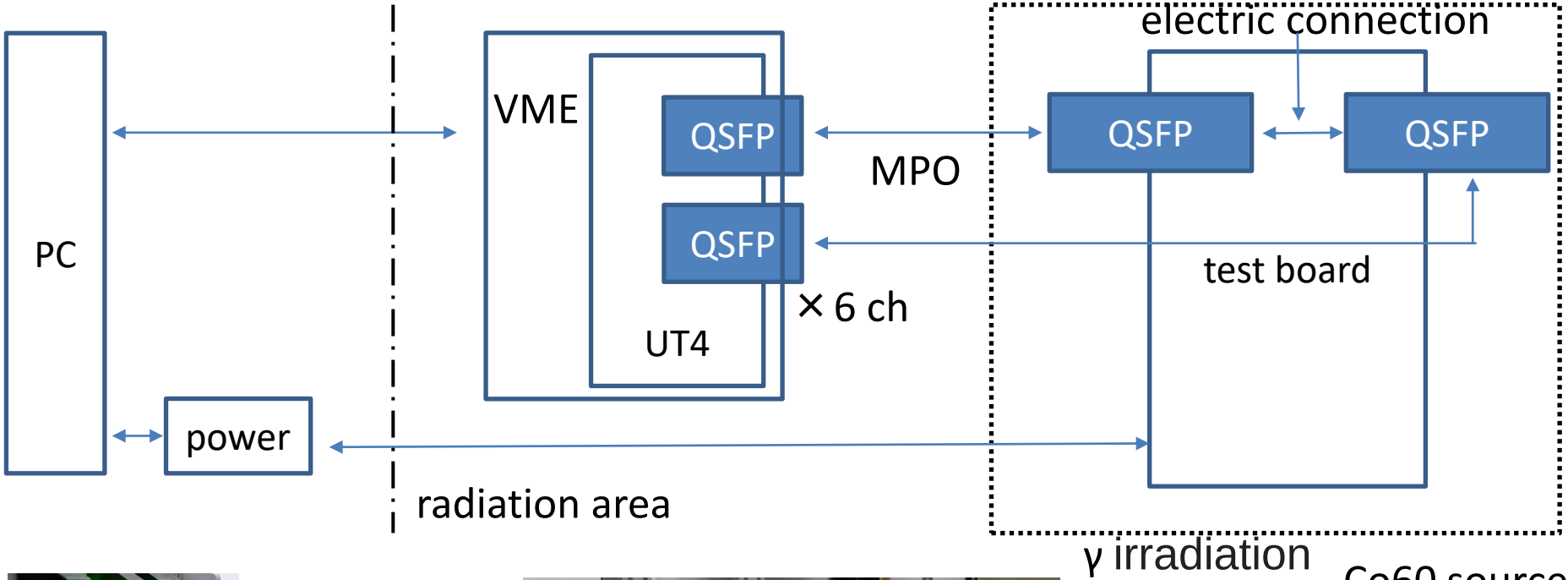
-beam test is schedule in February and March to check Radiation durability
  -gamma beam: optical transceiver, Feb.20-24th
  -neutron beam: entire CDCFE and transceiver, March 6-17th
  -lead by Yu Nakazawa-san from CDC group

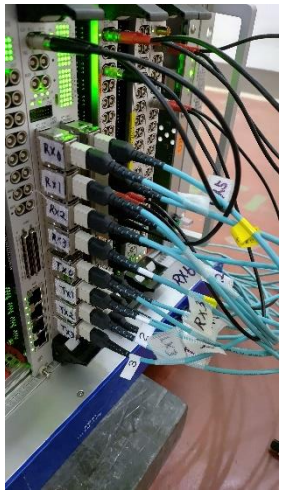
-share primary result of the gamma beam test

Setup

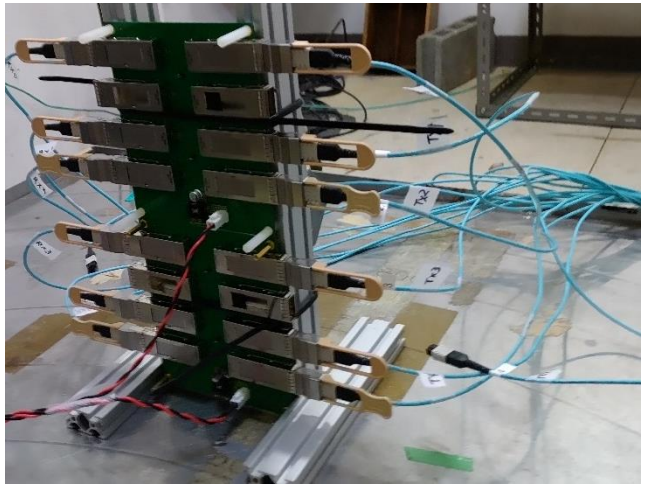
-γ (Co60,100Gy/hour) is injected to the QSFP with test board

-Loopback with UT4 to monitor optical link status, with 8Gbps/64b66b

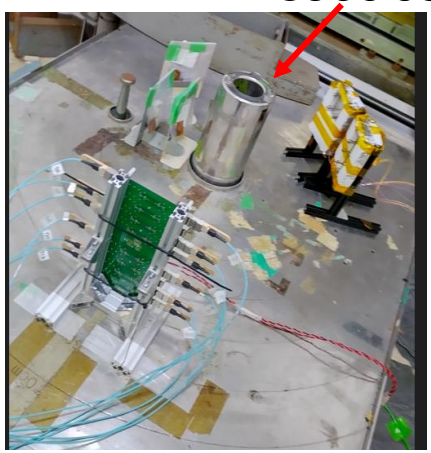




lead shield



Co60 source



Test menu

-Four kind of 40Gbps QSFP transceiver is tested
(selected from 8 candidates from the beam test at the last year)

company	type	#test sample
FiberJP	QSFP-40G-85-015	2
FiberJP	QSFP-40GSR4-8515	2
Startech.com	40G-QSFP-SR4-ST	2
fs.com	QSFP-SR4-40G	2
FORMERICAOE	TQS-Q1L59-881	4

-50Gy per hour.
~2000Gy total does for each transceiver (1000Gy is requirement for new CDCFE).

-power cycle at every ~100Gy

-log optical link status every 1 minute

Primary Result

-QSFP link stability is monitored
  -link get unstable -> totally dead
  -all modules satisfy the requirement of >~1000Gy
  -all modules dead >~1400Gy
  -FORMERICAOE TQS-Q1L59-881 shows the best radiation resistance

company	type	UT4 channel	total does, time @ link get unstable
FiberJP	QSFP-40G-85-015	4	~1000Gy, 21hour
FiberJP	QSFP-40GSR4-8515	1	~1000Gy, 21hour
Startech.com	40G-QSFP-SR4-ST	3	~1200Gy, 25hour
fs.com	QSFP-SR4-40G	2	~1200Gy, 25hour
FORMERICAOE	TQS-Q1L59-881 ①	5	~1200Gy, 25hour
FORMERICAOE	TQS-Q1L59-881 ②	6	~1400Gy, 29hour

-Detailed study is planned
  -kind of error, frequency, tendency

backup

Monitoring

-Following variables are monitored by UT4 with VME

#variable	variable
0	tx laneup
1	tx fifo full
2	tx rxvalid
3	tx rxctrl1
4	tx rxctrl3
5	tx txbufstatus
6	tx rxbufstatus

#variable	variable	
7	rx laneup	laneup
8	rx fifo full	FIFO full flag (outside GT IP)
9	rx fifo empty	FIFO empty flag (outside GT IP)
10	rx rxvalid	8b10b/64b66b decode failure
11	rx rxctrl1	8b10b bit flip
12	rx rxctrl3	8b10b decode failure
13	rx txbufstatus	tx buffer state (inside GT IP)
14	rx rxbufstatus	rx buffer state (inside GT IP)
15	clock counter check	check of data contents, clock counter
16	constant data check	check of data contents, fixed pattern

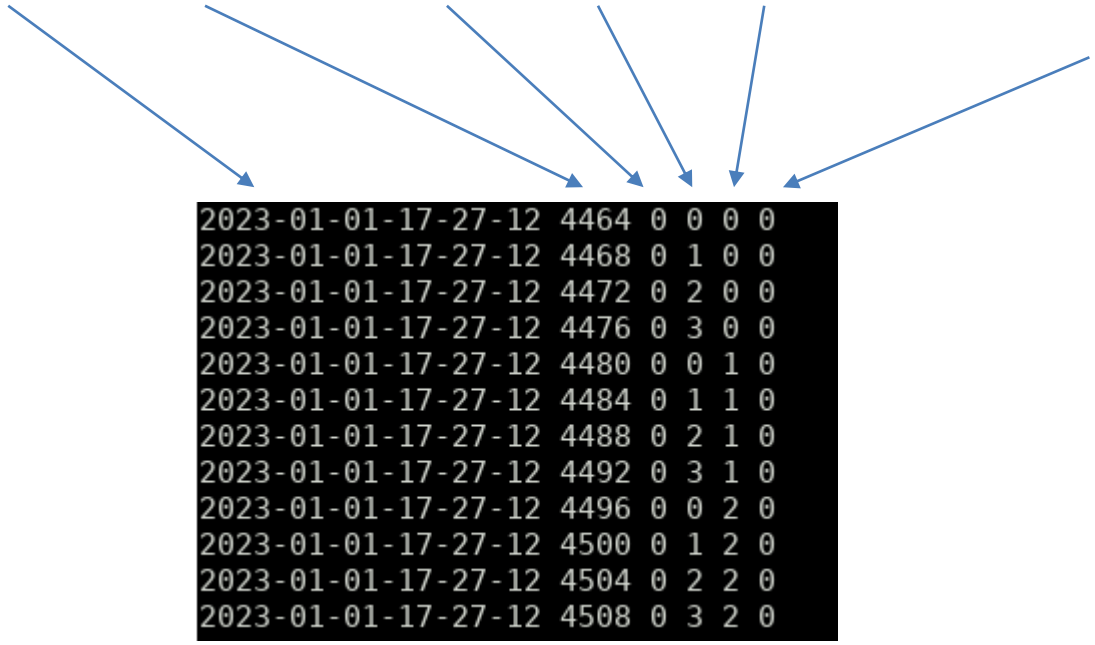
rxctrl1,3 for 8b10b

laneup=rxvalid & txdone & rxdone & txactive & rxactive & rxctrl1 & rxctrl3 &
rx_cdr_stable & user_initdone

Monitoring

-command for logging
  -ssh trgadmin@btrgpc00
  -ssh vmetrg12
  -./test.sh

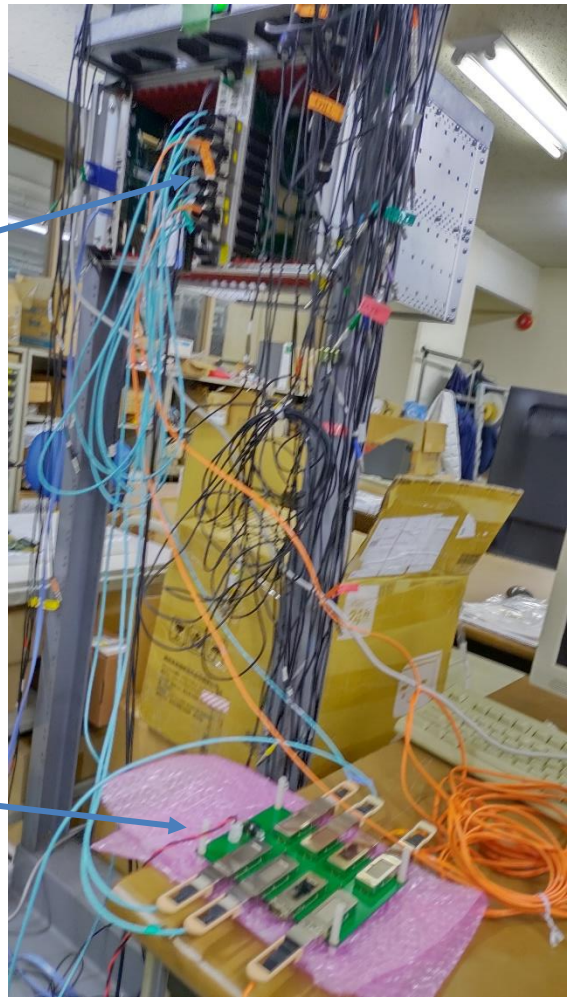
-dump the counter of variables to test.txt every 1minutes
  -If variables goes to fail state, corresponding counter is incremented
  -data format: date, vme address, #variable, #lane, #TX/RX, counter of variable (falling edge)



-Stability checked in test bench at B2: no error for 12hours

Stability test before gamma test

-Stability of optical link is checked in test bench at B2.
No error for 12hours.



QSFP

-2023/2/20-22

UT4 Channel	QSFP Board Channel	VME register Channel	QSFP type	S/N
GTH0	--	RX0	loopback	--
GTH1	0-2	RX1	fiber QSFP-40GSR4-8515	221205CI0009
GTH2	0-3	RX2	FS QSFP-SR4-40G	G2230442772
GTH3	1-0	RX3	fiber QSFP-40G-85-015	221205AV0003
GTH4	--	TX0	loopback	--
GTH5	0-2	TX1	fiber QSFP-40GSR4-8515	221205CI0010
GTH6	0-3	TX2	FS QSFP-SR4-40G	G2230442773
GTH7	1-0	TX3	fiber QSFP-40G-85-015	221205AV0004
GTY0	0-0	RX4	fiber QSFP-40G-85-015	221205AV0001
GTY1	1-2	RX5	fiber QSFP-40GSR4-8515	G2230442798
GTY2	1-3	RX6	FS QSFP-SR4-40G	221205CI0011
GTY3	--	RX7	loopback	--
GTY4	0-0	TX4	fiber QSFP-40G-85-015	221205AV0002
GTY5	1-2	TX5	fiber QSFP-40GSR4-8515	221205CI0012
GTY6	1-3	TX6	FS QSFP-SR4-40G	G2230442780
GTY7	--	TX7	loopback	--

QSFP

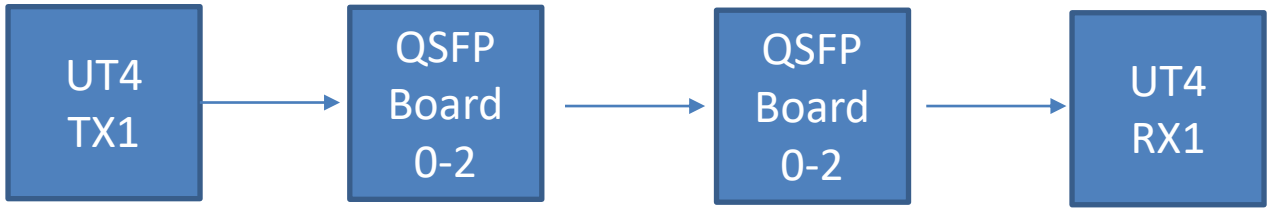
-2023/2/22-24

UT4 Channel	QSFP Board Channel	VME register Channel	QSFP type	S/N
GTH0	--	RX0	loopback	--
GTH1	0-2	RX1	fiber QSFP-40GSR4-8515	221205CI0015
GTH2	0-3	RX2	FS QSFP-SR4-40G	G2230442768
GTH3	1-0	RX3	Startech 40G-QSFP-SR4-ST	19706215946
GTH4	--	TX0	loopback	--
GTH5	0-2	TX1	fiber QSFP-40GSR4-8515	221205CI0016
GTH6	0-3	TX2	FS QSFP-SR4-40G	G2230442786
GTH7	1-0	TX3	Startech 40G-QSFP-SR4-ST	19706215950
GTY0	0-0	RX4	fiber QSFP-40G-85-015	221205AV0009
GTY1	1-2	RX5	FORMERICA TQS-Q1L59-881	T2151B0453
GTY2	1-3	RX6	FORMERICA TQS-Q1L59-881	T2151B0449
GTY3	--	RX7	loopback	--
GTY4	0-0	TX4	fiber QSFP-40G-85-015	221205AV0007
GTY5	1-2	TX5	FORMERICA TQS-Q1L59-881	T2151B0450
GTY6	1-3	TX6	FORMERICA TQS-Q1L59-881	T2151B0452
GTY7	--	TX7	loopback	--

UT4 channel mapping

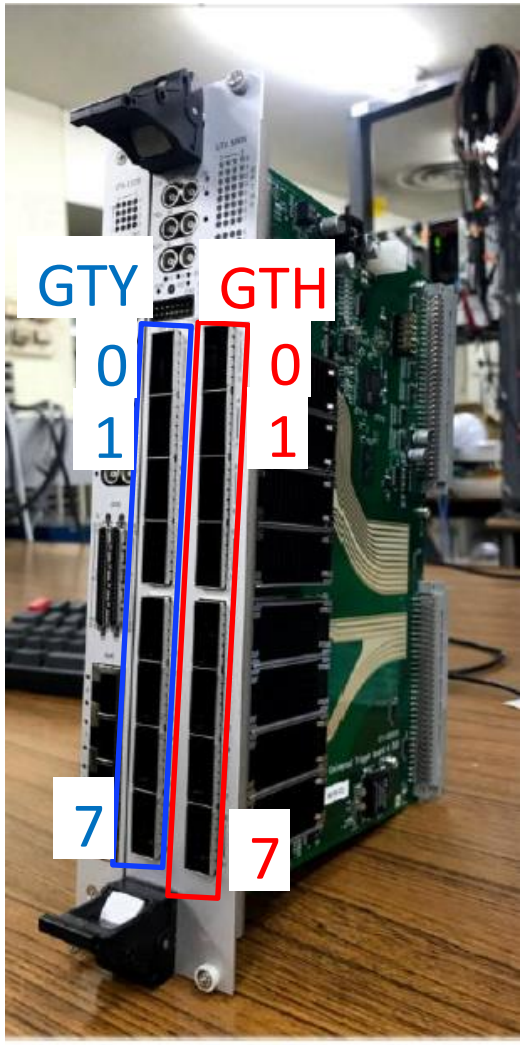
-Firmware is prepared (svn: UT4/FPGA/TSF/unified/test_opt_gamma)

-8Gbps with 64b66b



GTY Channel	TX/RX
0	RX4
1	RX5
2	RX6
3	RX7
4	TX4
5	TX5
6	TX6
7	TX7

GTH Channel	TX/RX
0 unstable	RX0
1	RX1
2	RX2
3	RX3
4	TX0
5	TX1
6	TX2
7	TX3



QSFP board channel mapping