Xilinx 9500/9500XL CPLD Testing CNGS 2009 Update 3.09

TE/MPE/MI Radiation Working Group 3rd September 2009

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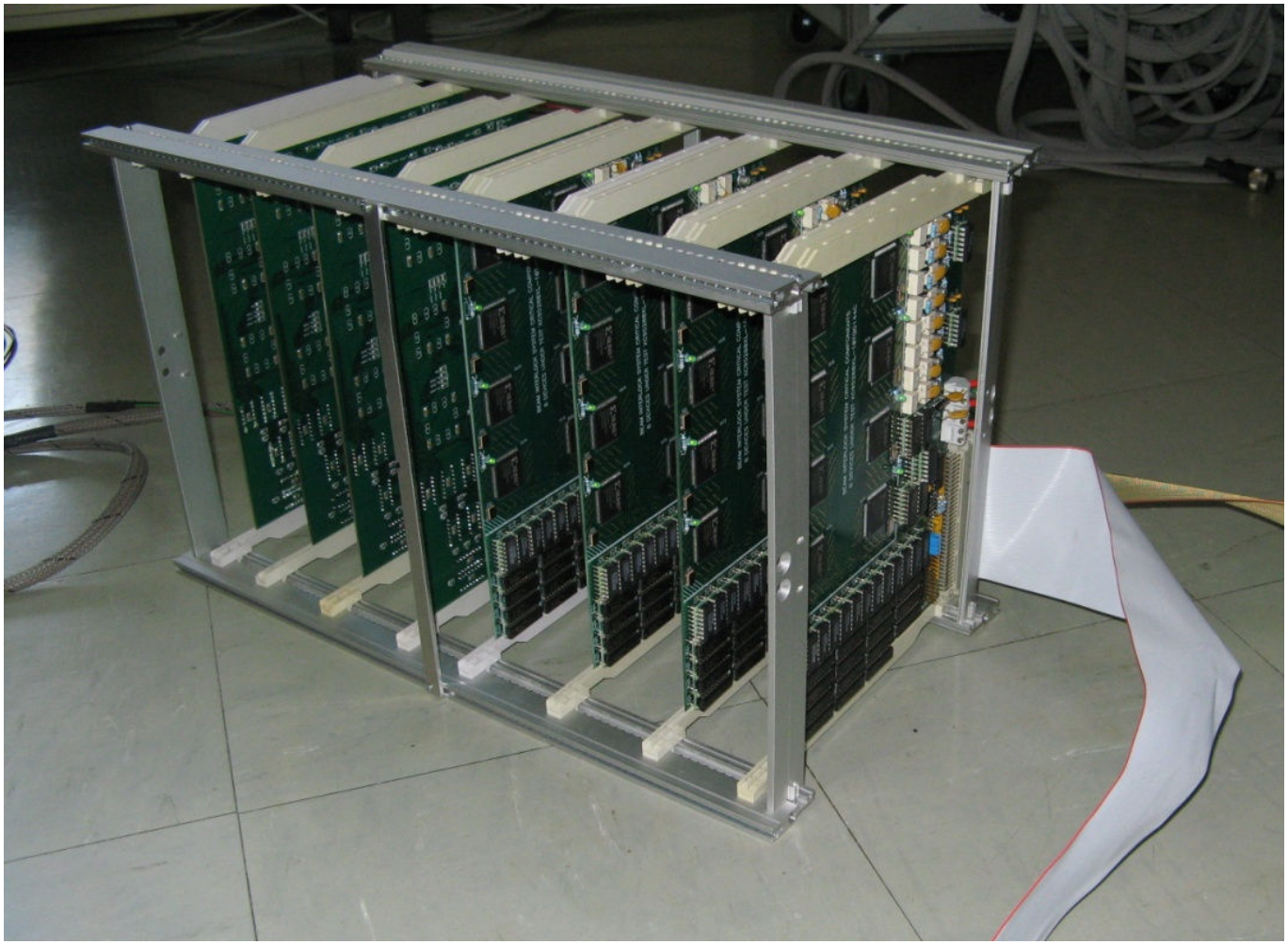
Introduction

MI has installed a Radiation Test Bench "CIRX" which is in CNGS

32 x XC9500 (5V)

32 x XC9500XL (3.3V)



PIC Conclusions so Far

32 x XC9500 (5V)

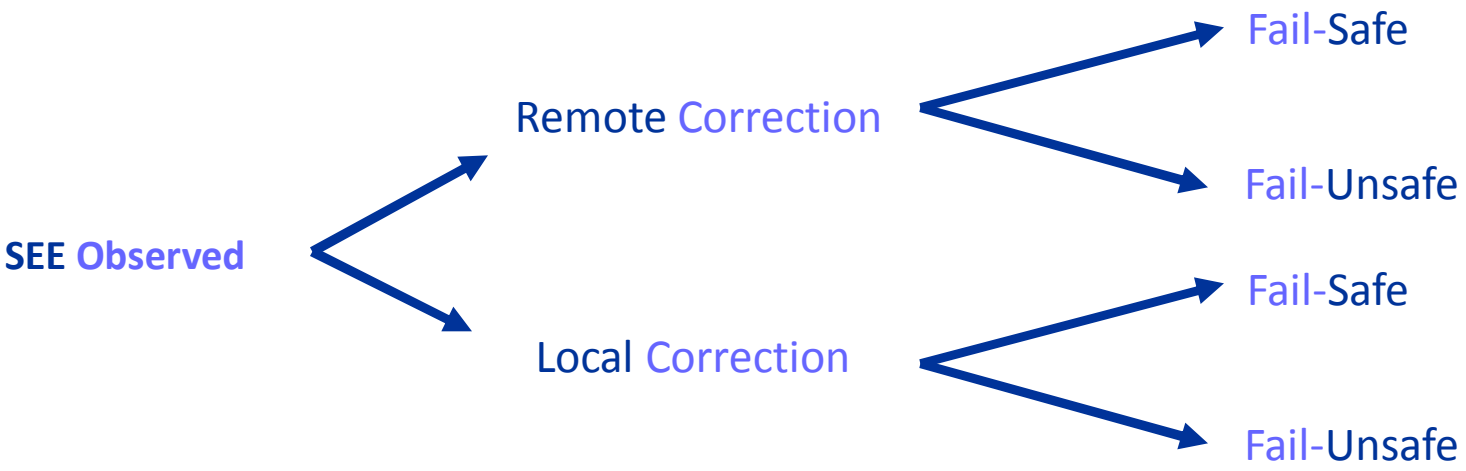
9 glitches

15/08/2009 03:12:08.0289 – Beam ON
16/08/2009 15:33:13.7339 – Beam ON
17/08/2009 18:35:46.0737 – Beam ON/OFF
20/08/2009 05:55:53.3168 – Beam ON
22/08/2009 00:40:03.1329 – Beam ON
23/08/2009 05:17:16.3159 – Beam ON
01/09/2009 08:11:19.3216 – Beam ON
01/09/2009 11:15:13.6641 – Beam ON
02/09/2009 08:27:47.7136 – Beam ON

one event doubtful there was beam – will have to look at logging shot-by-shot
Could be EMC…

BIS Conclusions so Far

32 x XC9500XL (3.3V)



BIS Conclusions so Far

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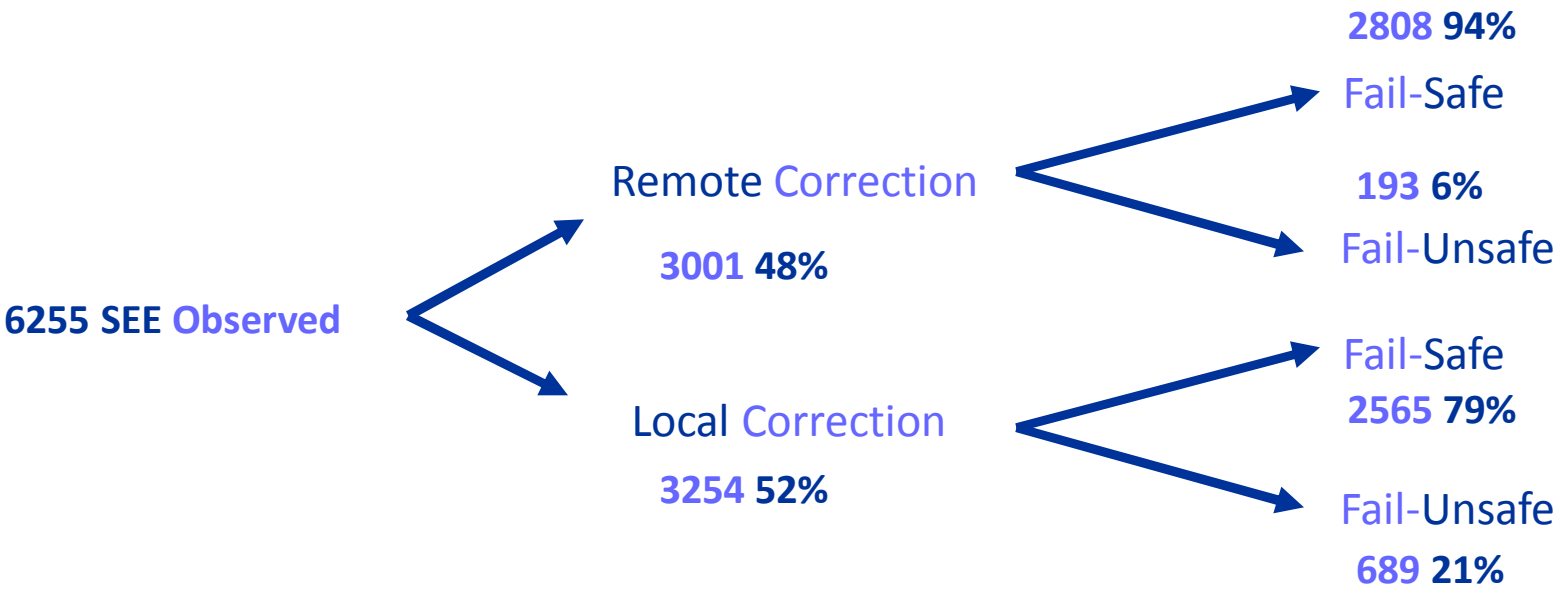

BIS Conclusions so Far

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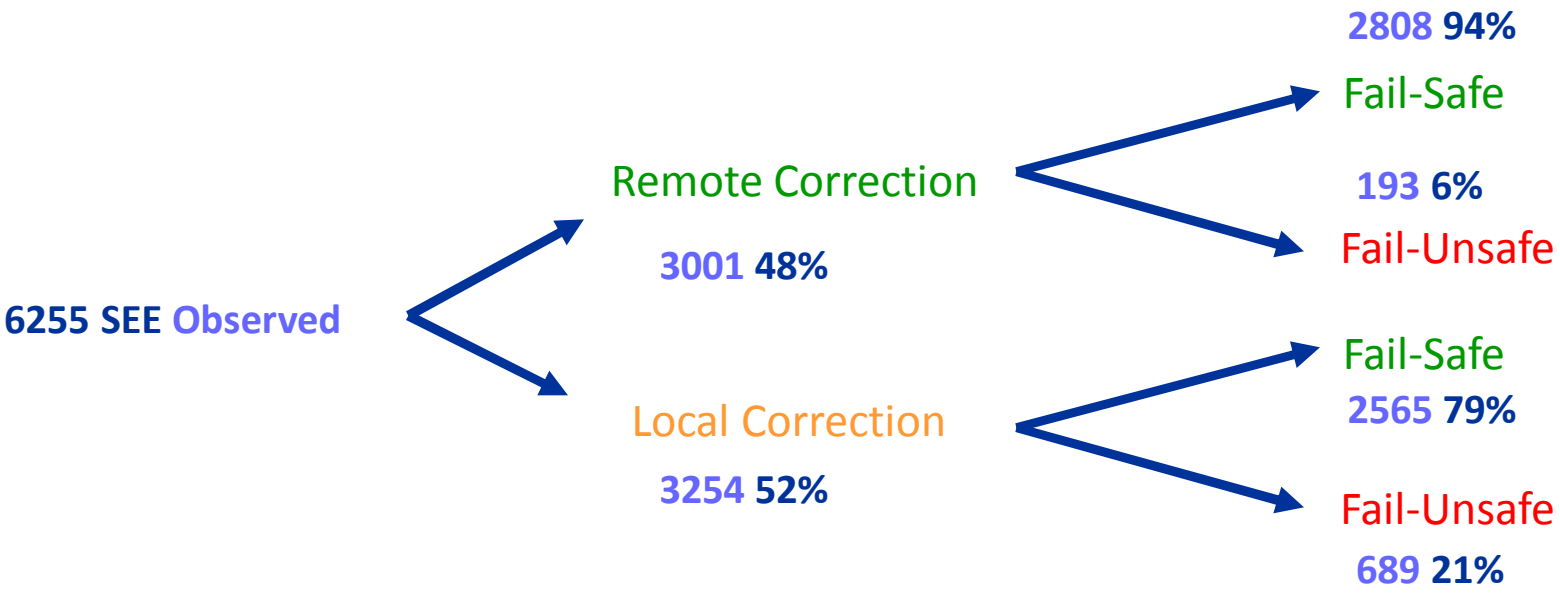

BIS Conclusions so Far

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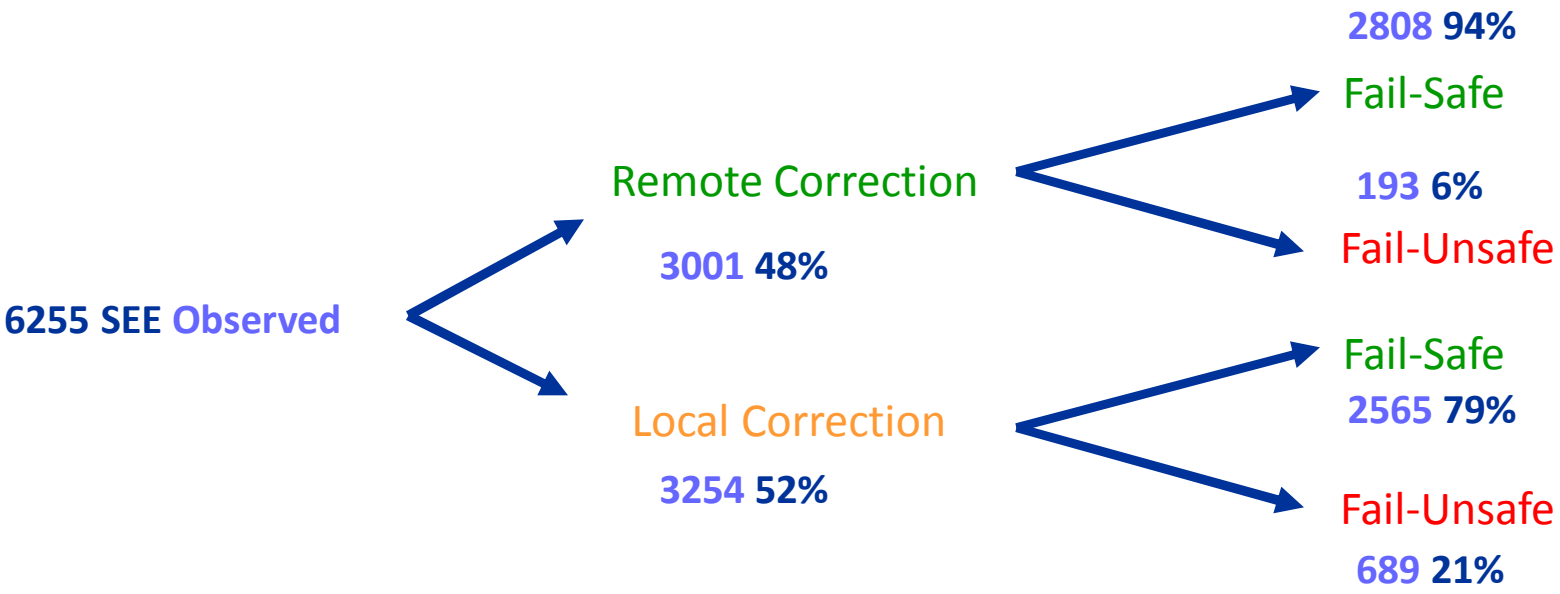


47 (Gy) Total Dose

1.13e12 1MeV equivalent Hadrons

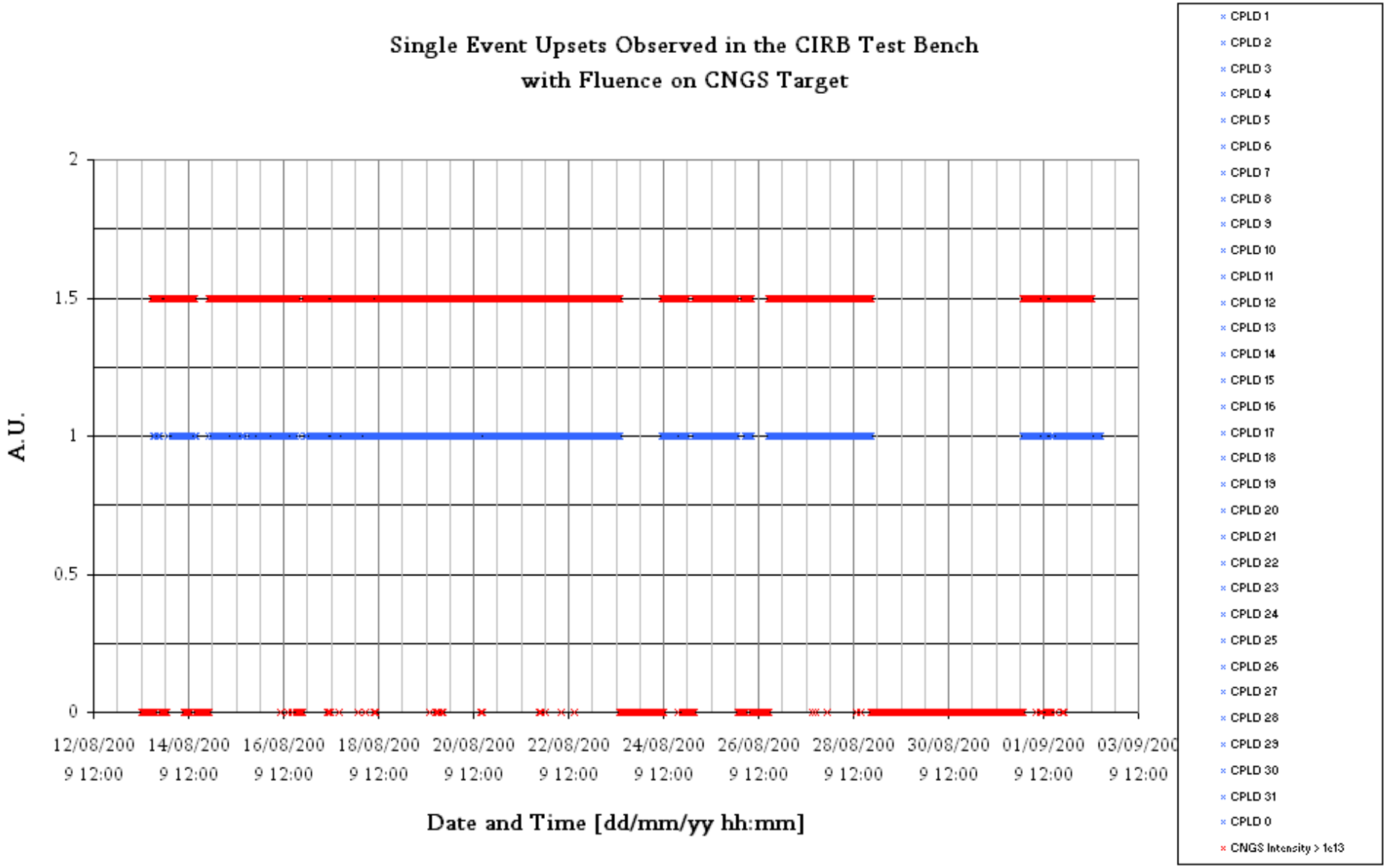
7.8e11 >20MeV Neutrons

No failed devices yet.

5e-9 Events per Particle

8e-9 Events per Particle

BIS Conclusions so Far



CPLD research

A look in our stock showed:

Device:	Package:	has Pb:	Circuit Revision:	Wafer Fabrication Location:	Geometry:	Year:	Week:	Assembly:	Full Lot Number:	Speed Grade:	Temperature:
XC95288	HQ208	Yes	A	E	M	05	13	A	1352012A	-10	Commercial
XC95288	HQ208	Yes	A	M	M	06	49	A	1433121A	-10	Commercial
XC95144	PQ100	Yes	A	M	M	03	45	F	1287020A	-15	Commercial
XC95144	PQ100	No	A	M	M	06	09	F	3018364A	-10	Commercial
XC95144	PQ100	No	A	M	M	06	45	F	3052264A	-10	Commercial
XC95144	PQ100	No	A	M	M	06	45	F	3031762A	-10	Commercial
XC95144	PQ100	No	A	M	M	07	09	F	3065279A	-10	Commercial
XC95288XL	TQ144	No	A	W	N	09	05	D	3631628A	-6	Commercial

Wafer Fabrication Location Codes:

E = UMC, 8"
F = UMC, 8"
G = UMC, 12"
K = Seiko
M = UMC, 8"
N = Toshiba
P = Philips, MOSIV
R = ST Micro
W = He-Jian, China

Geometry Codes

H = 1.00um
J = 0.60um (3-layer CMOS)
K = 0.85um
M = 0.50um (3-layer CMOS)
N = 0.35 (4 metal)
P = 0.35-0.25 Hybrid
S = 0.18-0.22 Hybrid
T = 0.18-0.15 Hybrid

Assembly Codes:

A = AMKOR Korea
B = IBM, Canada
D = SPIL, Taiwan
F = AMKOR Philippines
S = STATS ChipPAC

Sylvie (EPC) will arrange to have the plastic taken off, so we can inspect

Conclusions

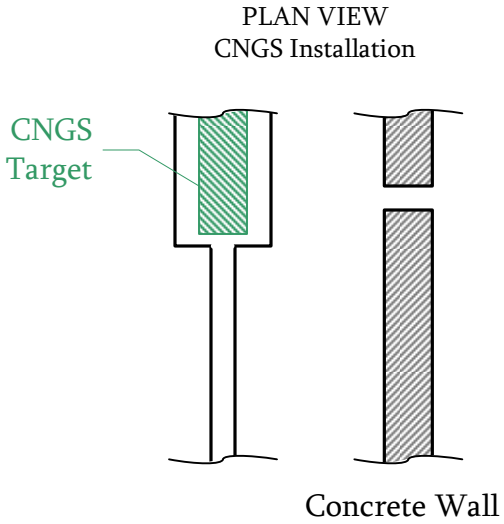
Next steps:

1 . Keep going
Want to get figures for Total Dose too

2. Contingency preparation for moving the BIC away from radiation
UA63/67

FIN

Principle for Test-bench “CIRX”



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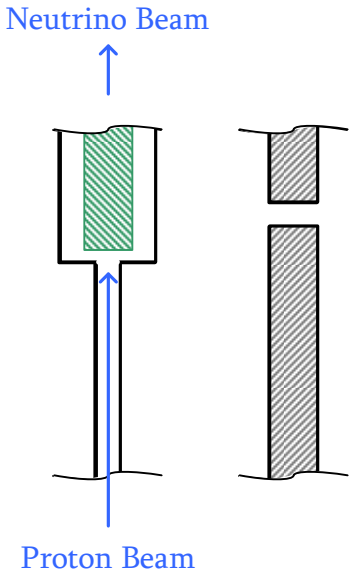

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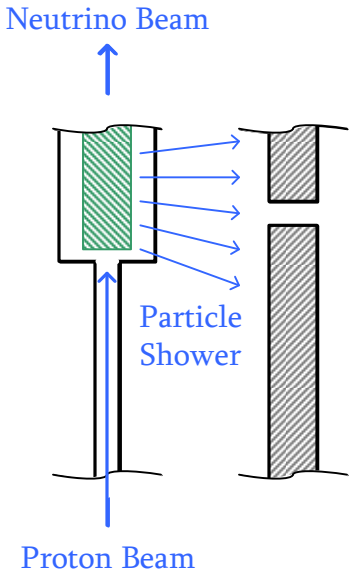

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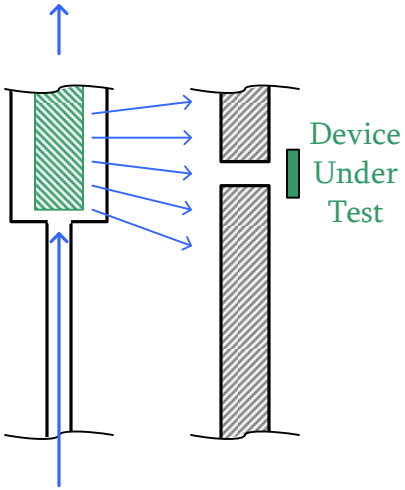

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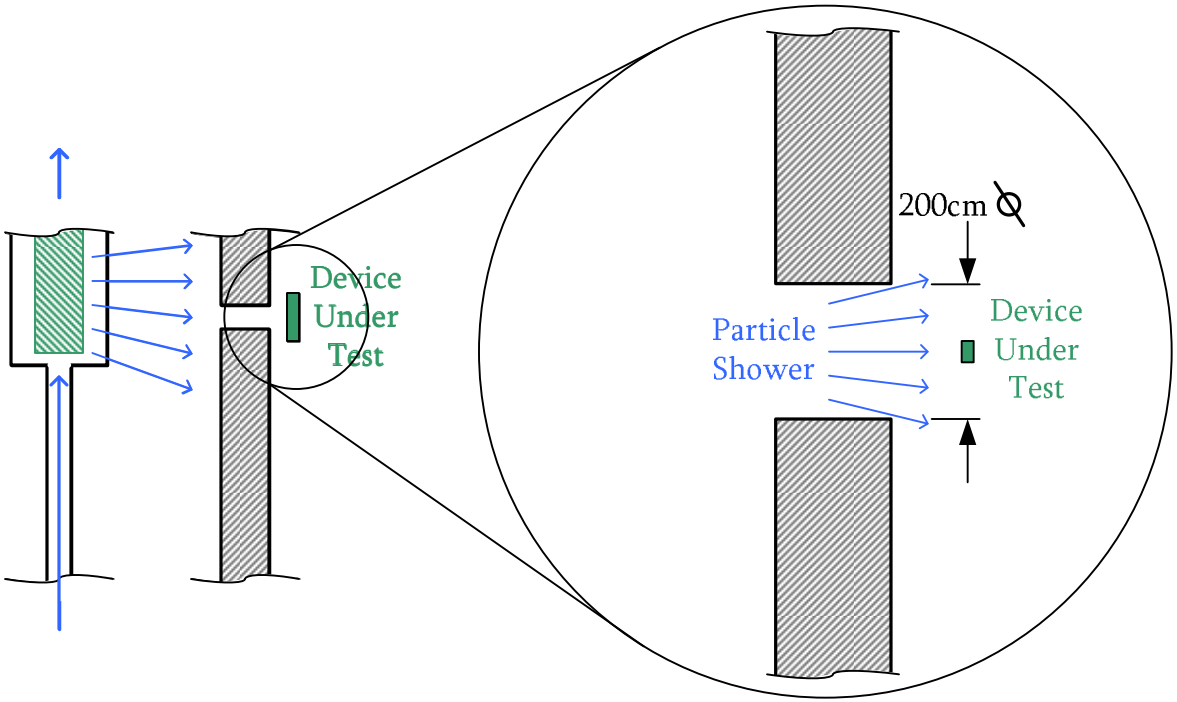

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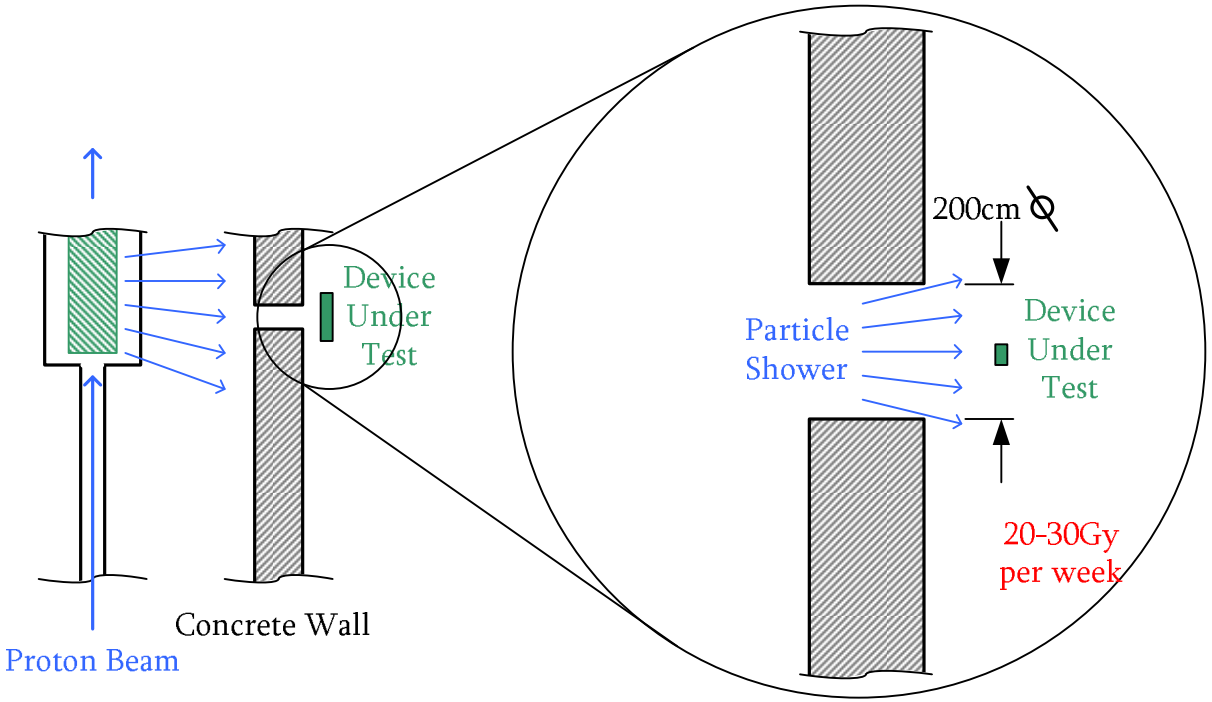

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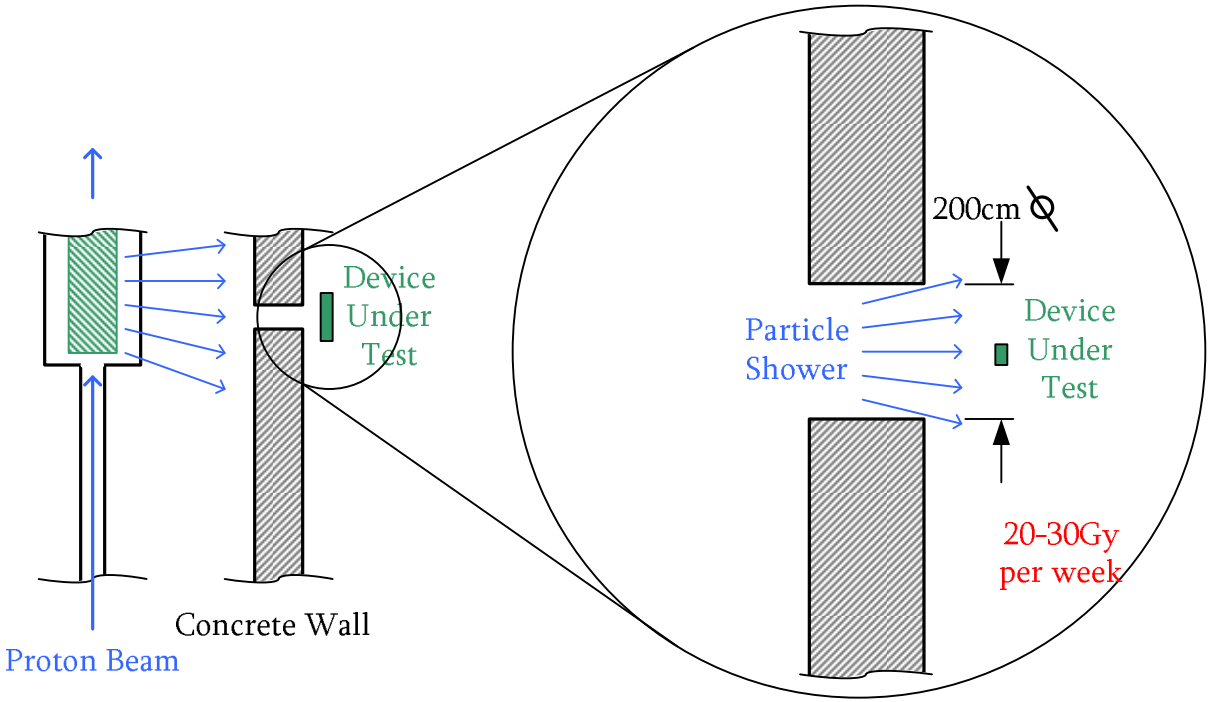
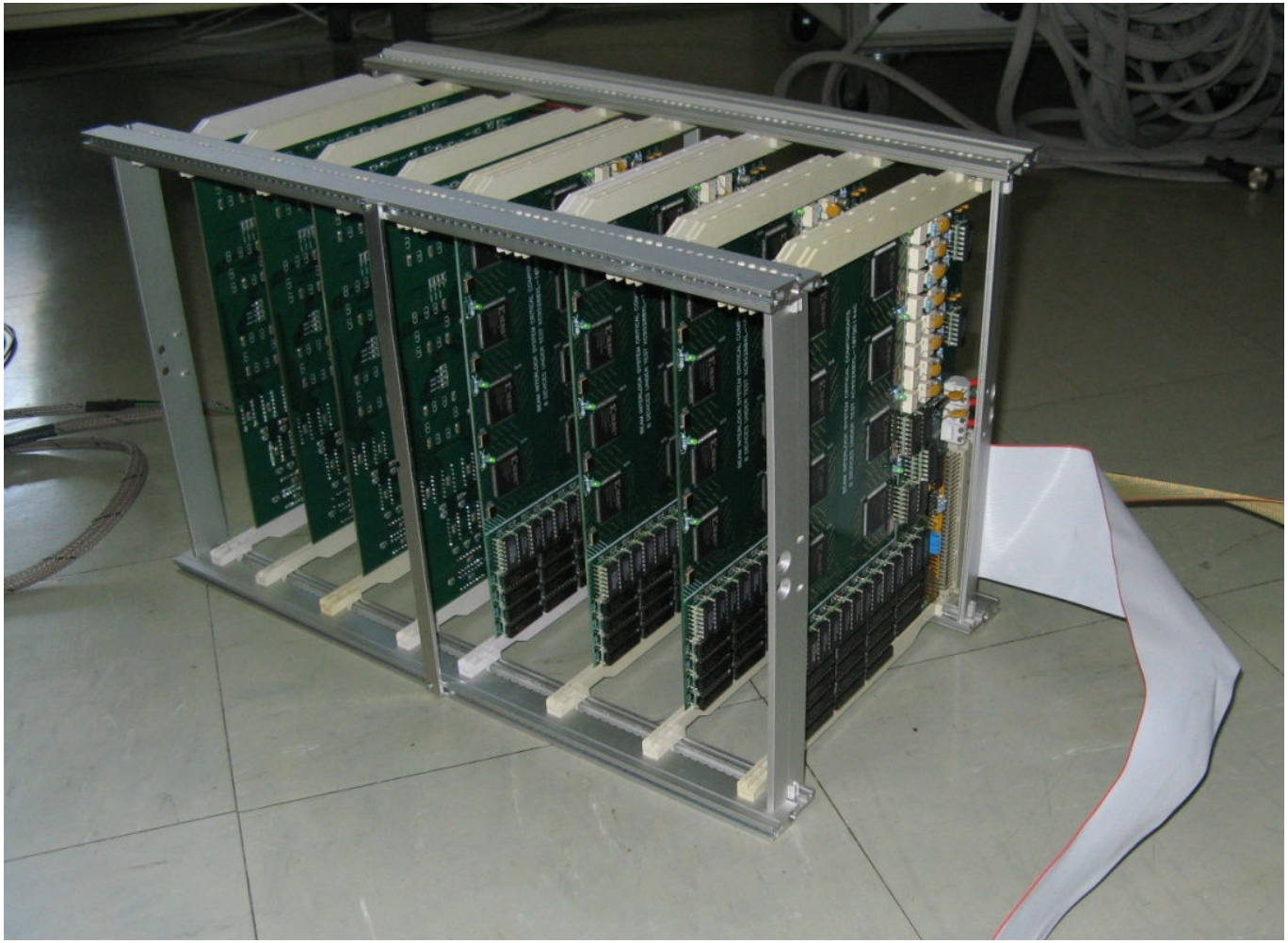
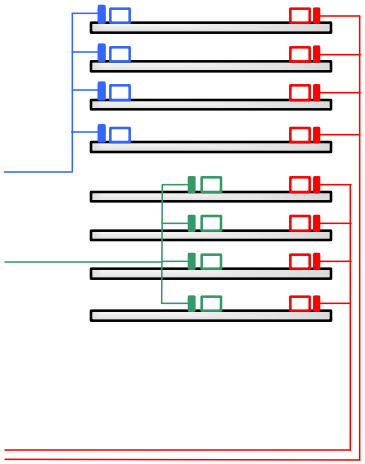


XC95144 x 32
XC95288XL x 32

Testbench Electronic Functionality





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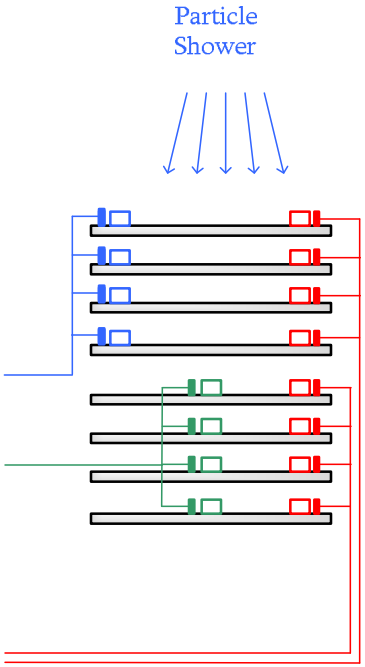

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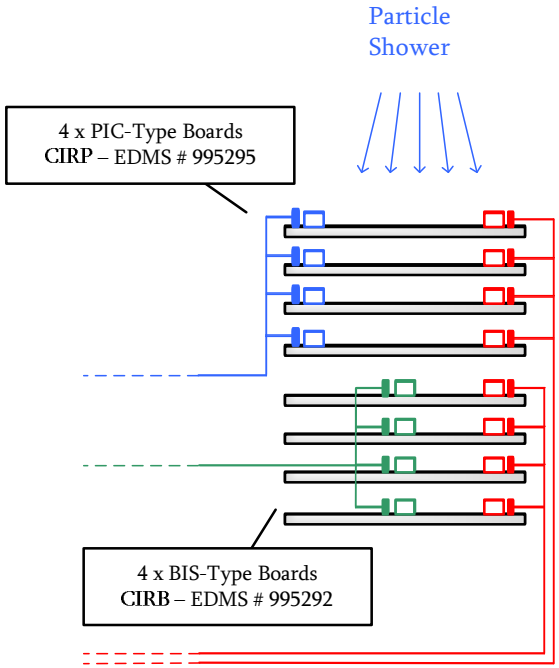

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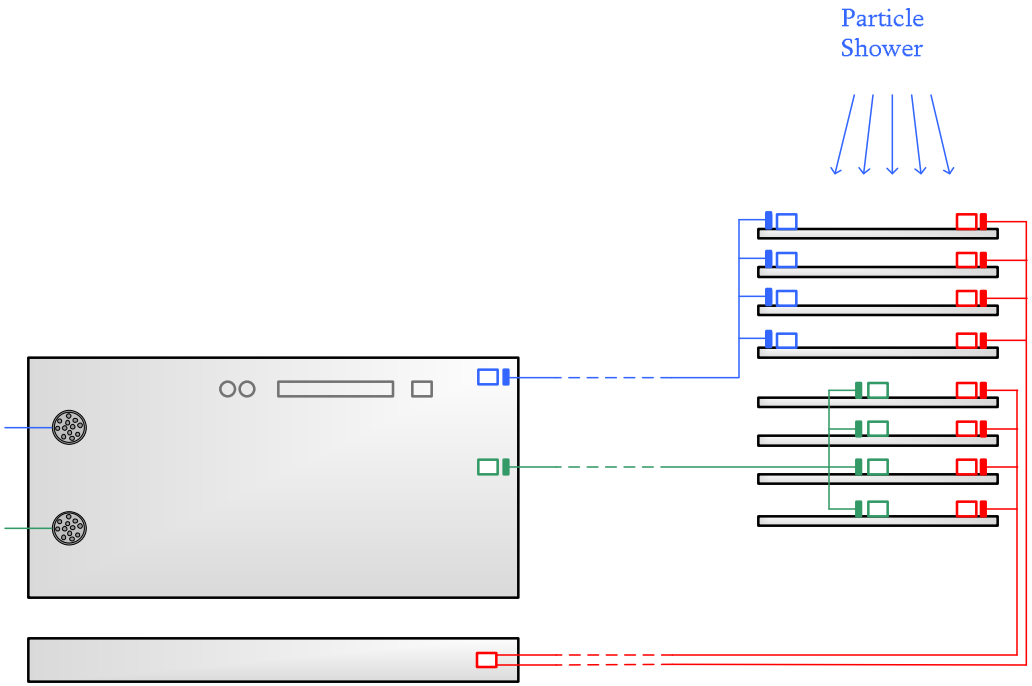

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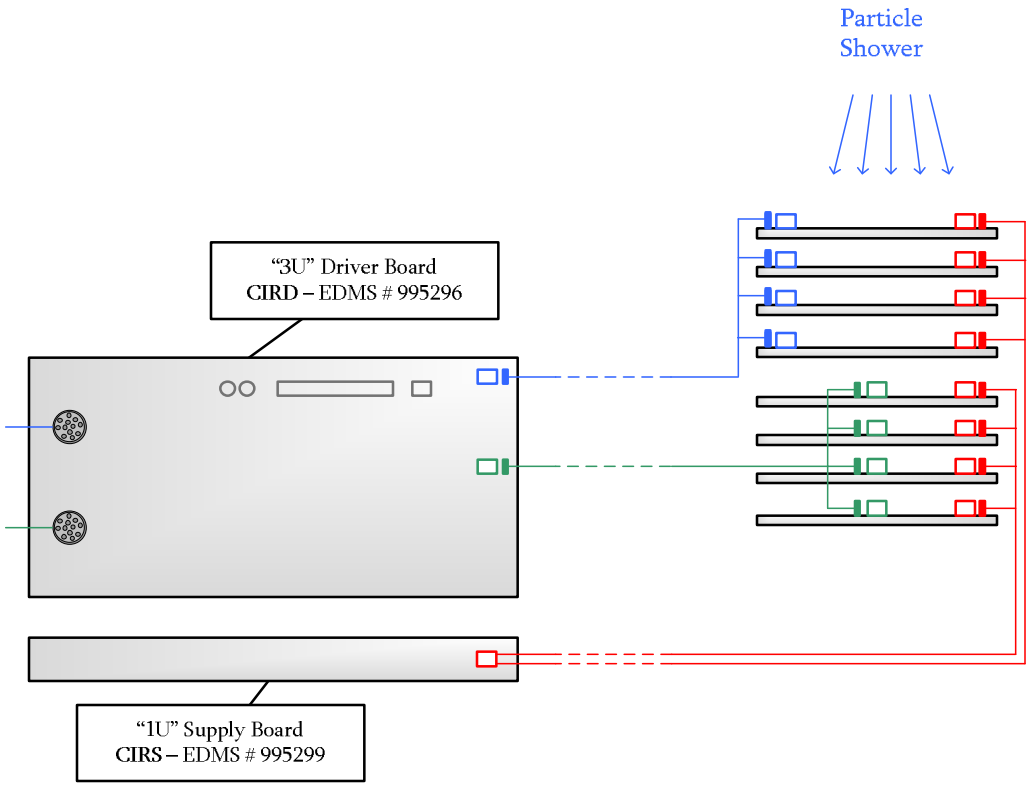

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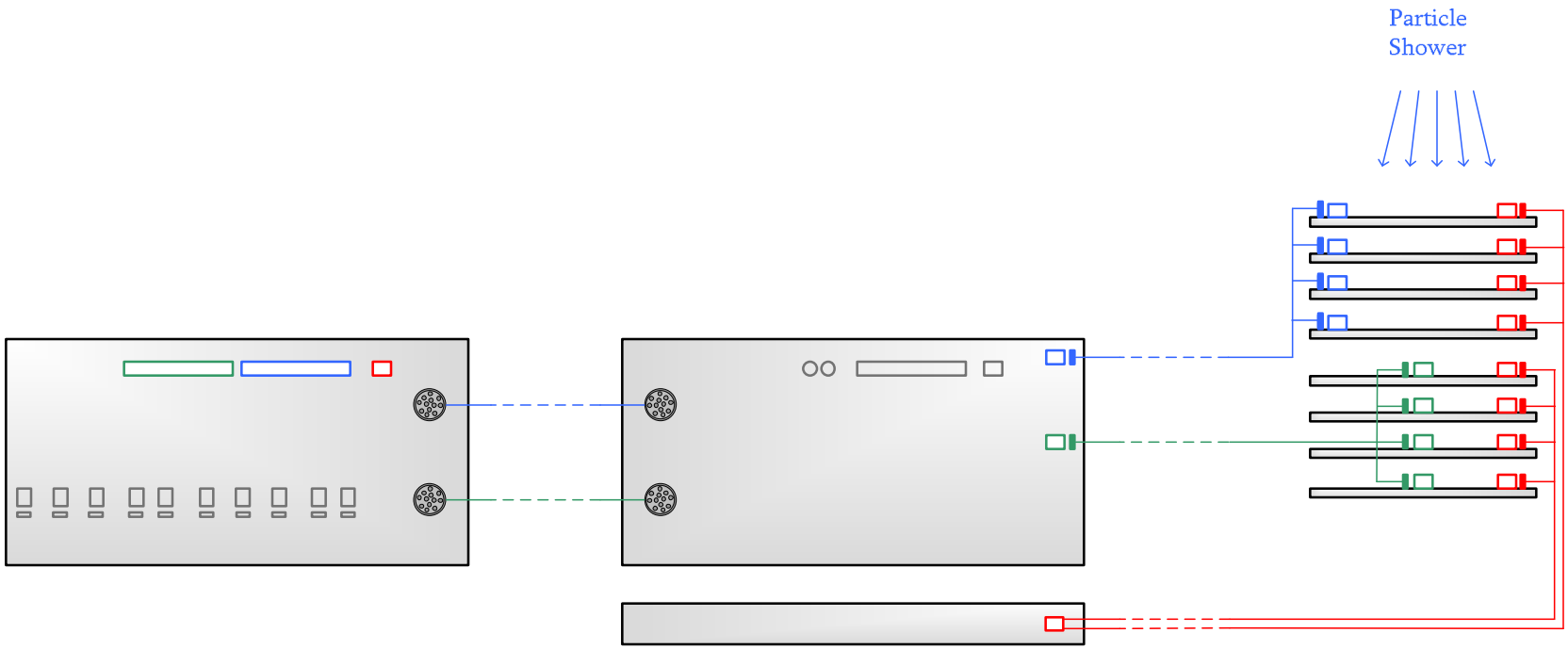

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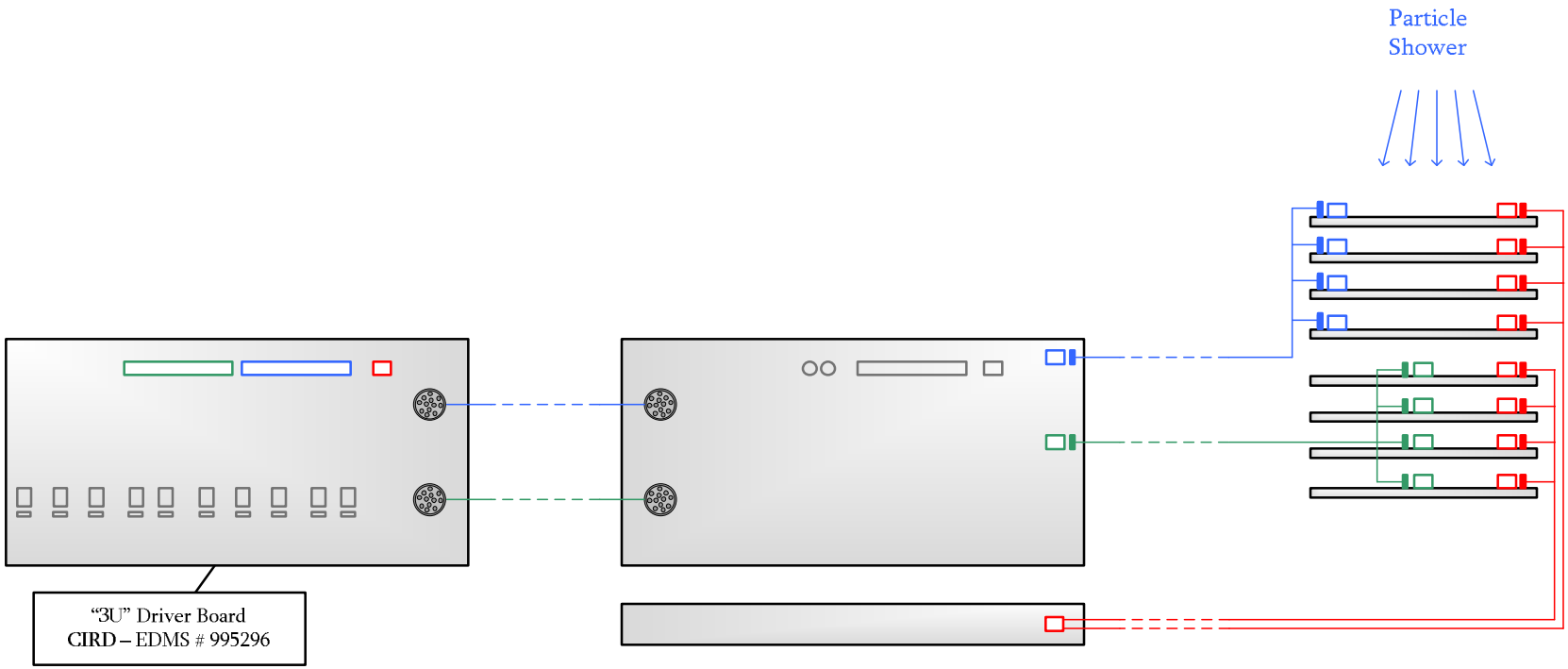

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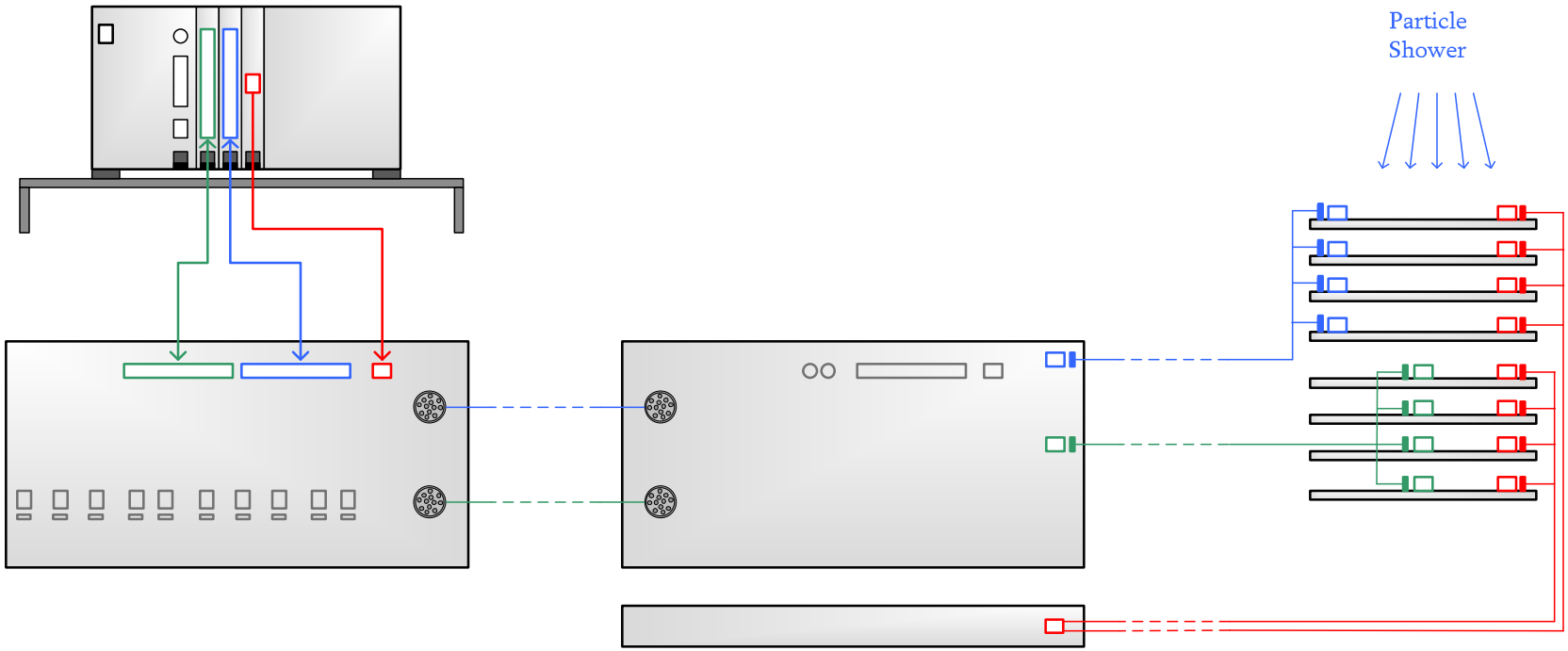

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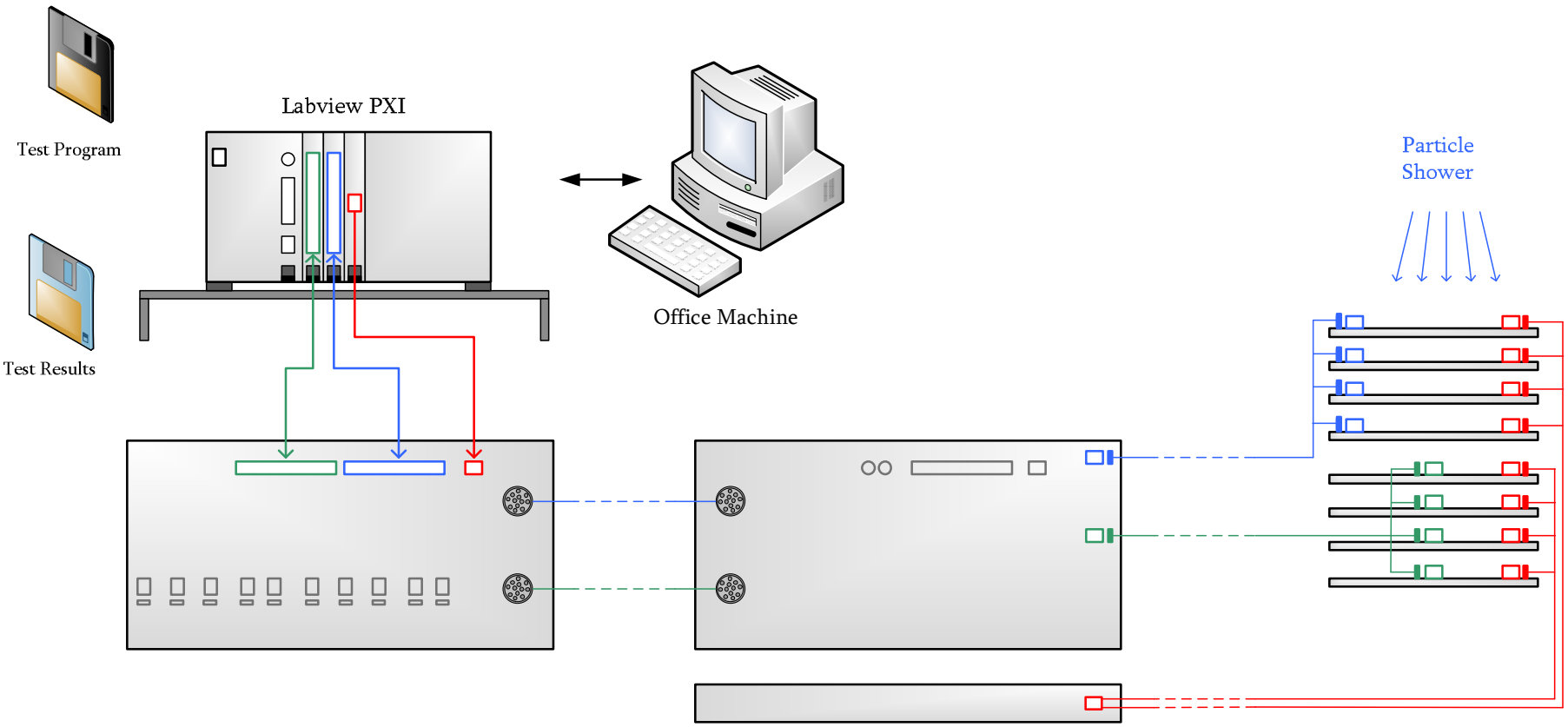

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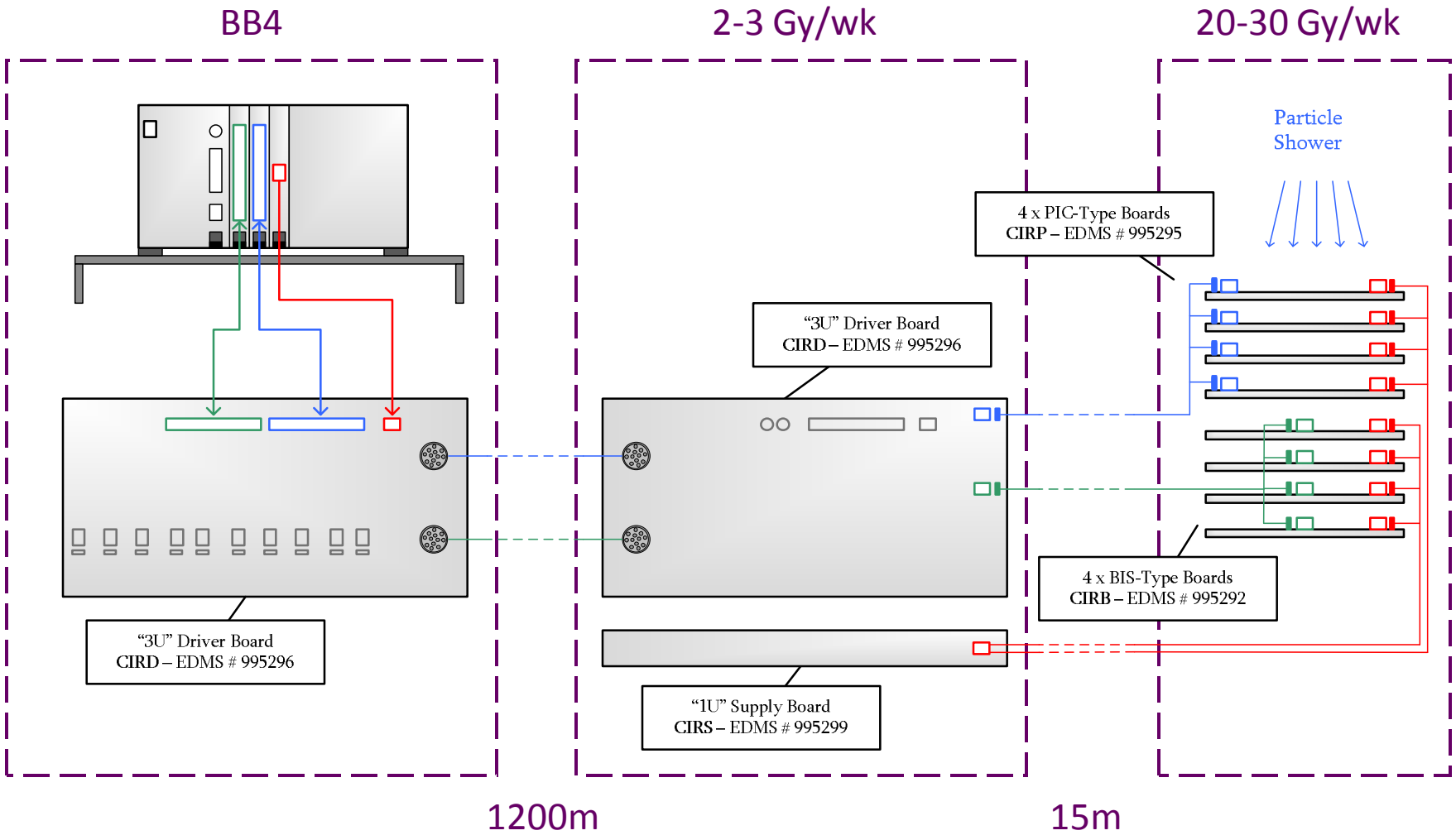
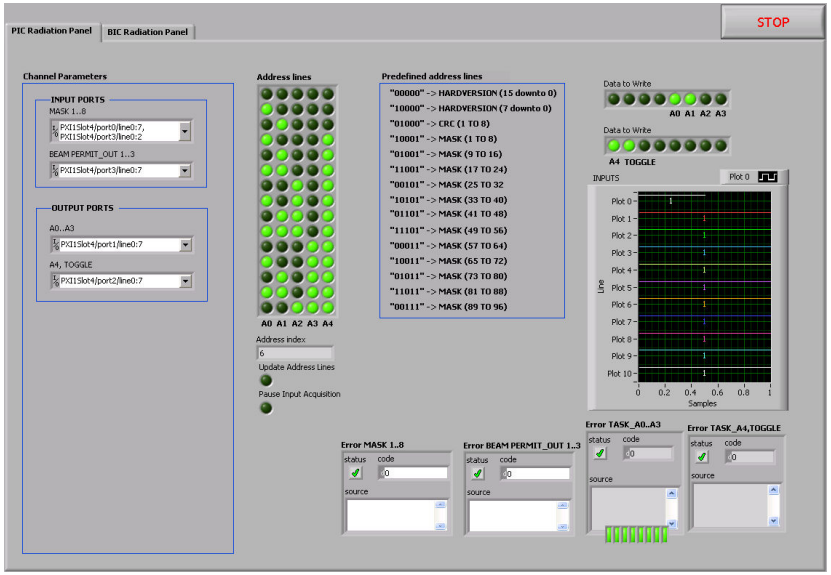
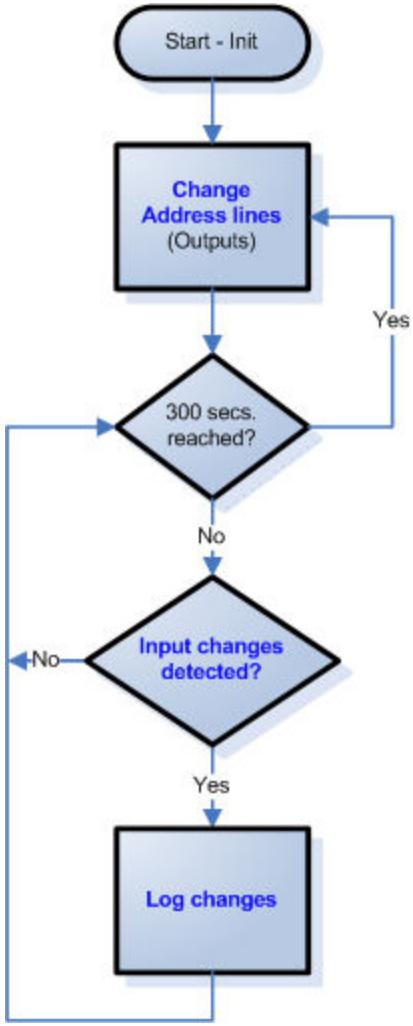


- 96-Channel Digital I/O Board used for detecting changes on:
  - Critical Path (3 Beam Permit signals)
  - Monitoring Part (CRCs, Glitch Counters, Versions….)
- Change detection on Inputs detected with events (no polling is used = less processor usage)
- Address lines (Outputs) change every 300 seconds
- Log-file written in case of inconsistency in the outputs of CPLD (XNORs)

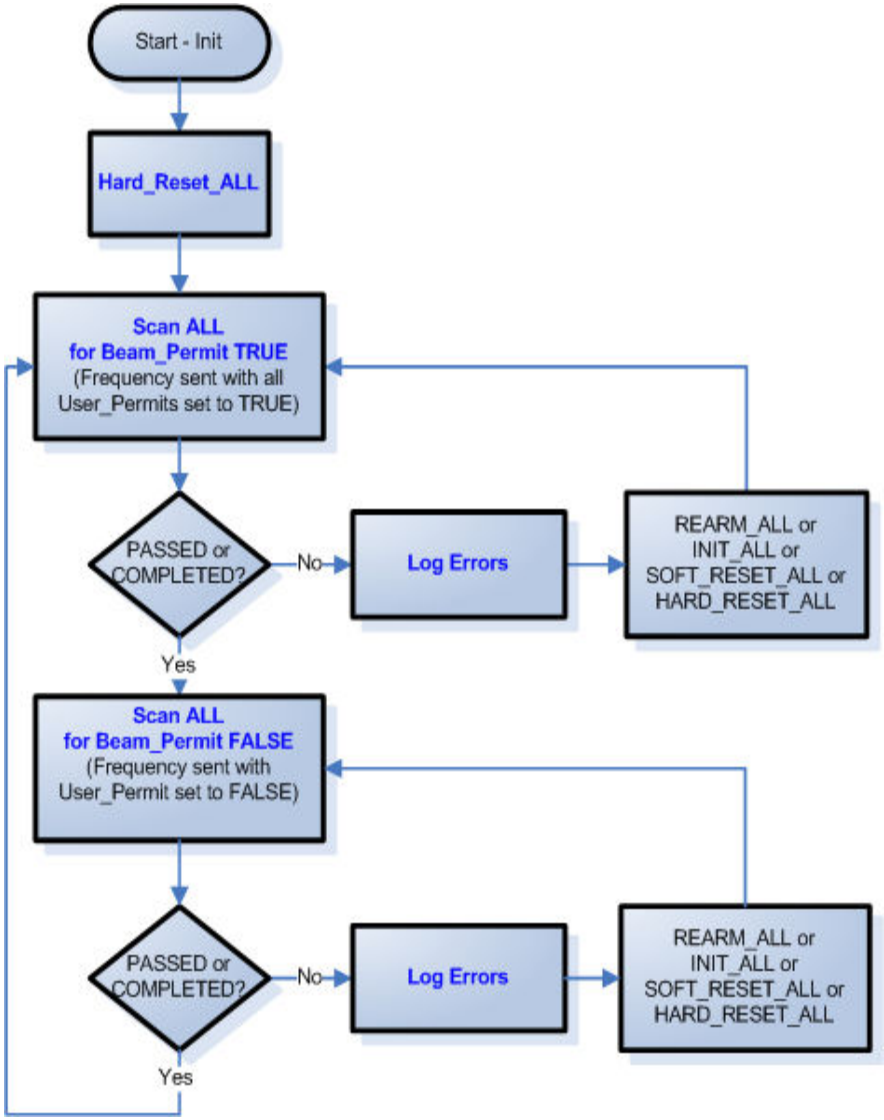




BIC LabVIEW

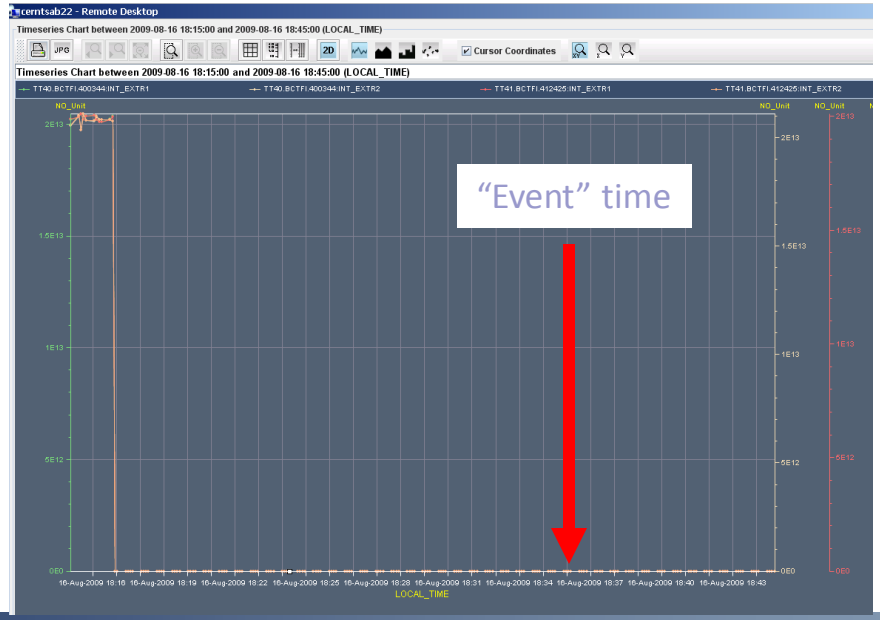
- 96-Channel Digital I/O Board used for :
  - Scanning all 32 CPLS for frequency detection when all User_Permits are TRUE

- Log-file is written in case of inconsistency in Beam_Permit frecuency



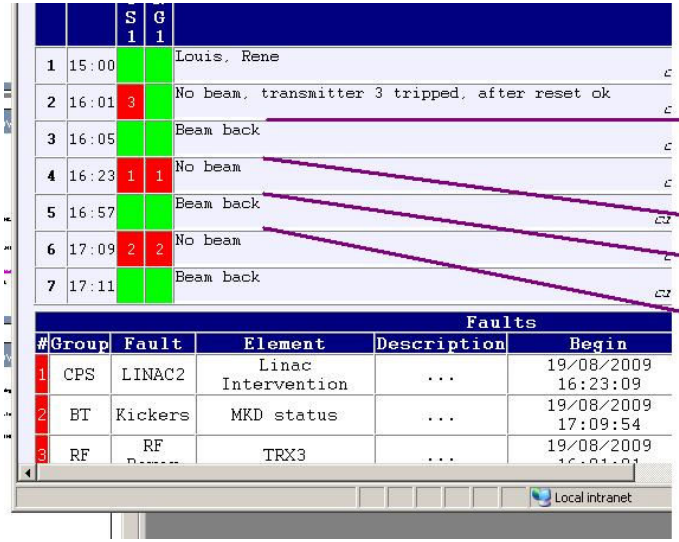
PIC Conclusions so Far

- 3 ‘events’ in MONITORING PART have been observed since re-start of CNGS with beam, NONE in the safety critical part
  - 15.August 2009 (03:12:08.0289) - According to Logbook & TIMBER with beam in CNGS (2E13)
  - 16.August 2009 (15:33:13.7339) - According to Logbook & TIMBER with beam in CNGS (2E13)
  - 16.August 2009 (18:35:46.0737) - According to Logbook WITHOUT beam in CNGS (since 20 minutes)
- Events seen more likely to be due to EMC problems (longer cables, especially the 5m flat cable in CNGS using TTL, shielding issues of NE48 as observed by PO)?
- Will continue to improve SW and exclude problem sources to have clarity (maybe small intervention in tunnel during next shut-down)



BIS Conclusions so Far

- Have seen constant events in the log-file since 15:00 on day of installation
- False Beam Dumps
- Missed Beam Dumps
- Periods without beam in SPS = no errors…

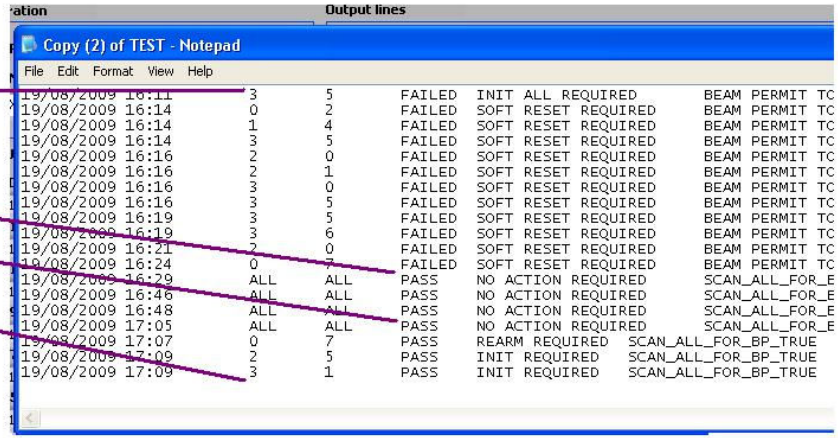


		S 1	G 1	
1	15:00			Louis, Rene
2	16:01	3		No beam, transmitter 3 tripped, after reset ok
3	16:05			Beam back
4	16:23	1	1	No beam
5	16:57			Beam back
6	17:09	2	2	No beam
7	17:11			Beam back

Faults

#	Group	Fault	Element	Description	Begin
1	CPS	LINAC2	Linac Intervention	...	19/08/2009 16:23:09
2	BT	Kickers	MKD status	...	19/08/2009 17:09:54
3	RF	RF	TRX3	...	19/08/2009

Local intranet



Output lines

Copy (2) of TEST - Notepad

File Edit Format View Help

19/08/2009 16:11	3	5	FAILED	INIT ALL REQUIRED BEAM PERMIT TC
19/08/2009 16:14	0	2	FAILED	SOFT RESET REQUIRED BEAM PERMIT TC
19/08/2009 16:14	1	4	FAILED	SOFT RESET REQUIRED BEAM PERMIT TC
19/08/2009 16:14	3	5	FAILED	SOFT RESET REQUIRED BEAM PERMIT TC
19/08/2009 16:16	2	0	FAILED	SOFT RESET REQUIRED BEAM PERMIT TC
19/08/2009 16:16	2	1	FAILED	SOFT RESET REQUIRED BEAM PERMIT TC
19/08/2009 16:16	3	0	FAILED	SOFT RESET REQUIRED BEAM PERMIT TC
19/08/2009 16:16	3	5	FAILED	SOFT RESET REQUIRED BEAM PERMIT TC
19/08/2009 16:19	3	5	FAILED	SOFT RESET REQUIRED BEAM PERMIT TC
19/08/2009 16:19	3	6	FAILED	SOFT RESET REQUIRED BEAM PERMIT TC
19/08/2009 16:21	2	0	FAILED	SOFT RESET REQUIRED BEAM PERMIT TC
19/08/2009 16:24	0	7	FAILED	SOFT RESET REQUIRED BEAM PERMIT TC
19/08/2009 16:29	ALL	ALL	PASS	NO ACTION REQUIRED SCAN_ALL_FOR_E
19/08/2009 16:46	ALL	ALL	PASS	NO ACTION REQUIRED SCAN_ALL_FOR_E
19/08/2009 16:48	ALL	ALL	PASS	NO ACTION REQUIRED SCAN_ALL_FOR_E
19/08/2009 17:05	ALL	ALL	PASS	NO ACTION REQUIRED SCAN_ALL_FOR_E
19/08/2009 17:07	0	7	PASS	REARM REQUIRED SCAN_ALL_FOR_BP_TRUE
19/08/2009 17:09	2	5	PASS	INIT REQUIRED SCAN_ALL_FOR_BP_TRUE
19/08/2009 17:09	3	1	PASS	INIT REQUIRED SCAN_ALL_FOR_BP_TRUE

- Software will be further optimised to get rates/ratios

Conclusions

TE/MPE/MI take the radiation issue seriously

Dedicated testbench designed

Considerable effort

1. We need some time in the next access window to check our equipment

2. XC9500XL = one event every 3 minutes
(this is in a BIC VME Chassis)

3. XC9500 = one event every 2 days
(this is in a PIC and User Interface Chassis)

4. Enhance software

5. Establish rates and ratios

CIBU : User Interface Locations

IR1	IR2	IR3	IR4	IR5	IR6	IR7	IR8	other
SR1	SR2	SR3	SR4	SR5	SR6	SR7	UA83	CCR
US151	UA23	UJ33	UA43	UJ56	UA63	UJ76	UA87	
USA151	UA27		UA47	USC55	UA67	TZ76	UX85	
USA152			SX4	RR53	US65	RR73	US851	
RR13			CR4	RR57	US651	RR77		
RR17			US451					
UJ14								
UJ16								

“critical areas”

BIC : **B**eam **I**nterlock **C**ontroller Locations

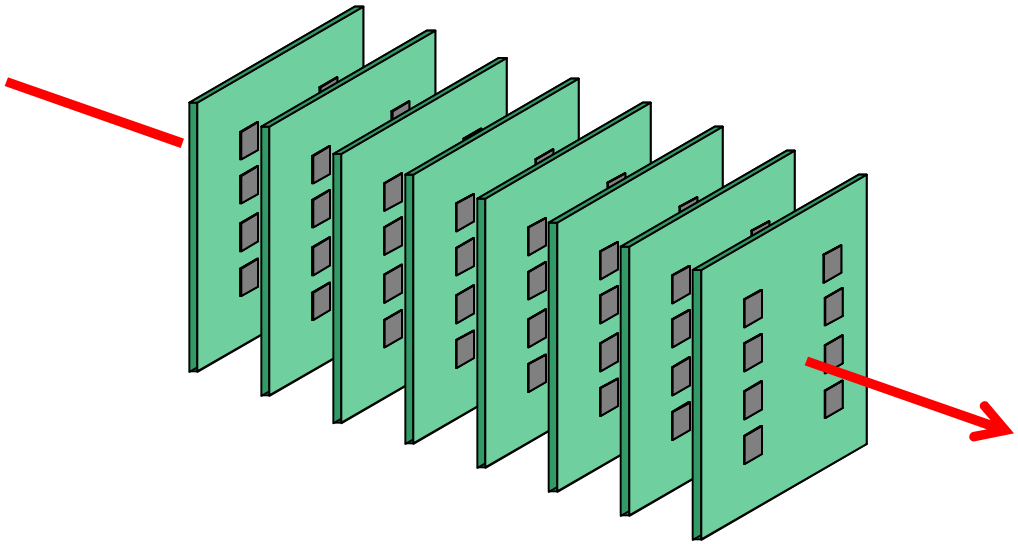
IR1	IR2	IR3	IR4	IR5	IR6	IR7	IR8	other
US15	SR2	SR3	UA43	UJ56	UA63	SR7	SR8	CCC
	UA23	UJ33	UA47	UCS55	UA67	TZ76	UA83	
	UA27						UA87	

FIN

PIC Function

- 4x8 = 32 CPLDs on dedicated CIRP boards installed
- Identical SW as used in the LHC devices, with dedicated remote monitoring/readout facility (RS485 line drivers and PXI chassis in control room)
- LabView program will change every 300s address lines and input states of the CPLD (throughout all possibilities as used in LHC)
- Setup is constantly comparing against each other the outputs of all 32 CPLDs and will detect and log any output change (along with the current input settings)
- Readout of critical path (Beam Permits) separated from Monitoring part

First Observations



particles pass through consecutive boards

K. Rooed simulations show 20-30% error in fluence due to this