New BCT5 Connection to the SPS-SMP and Implications for the YETS 2023-24

240th Machine Protection Panel Meeting

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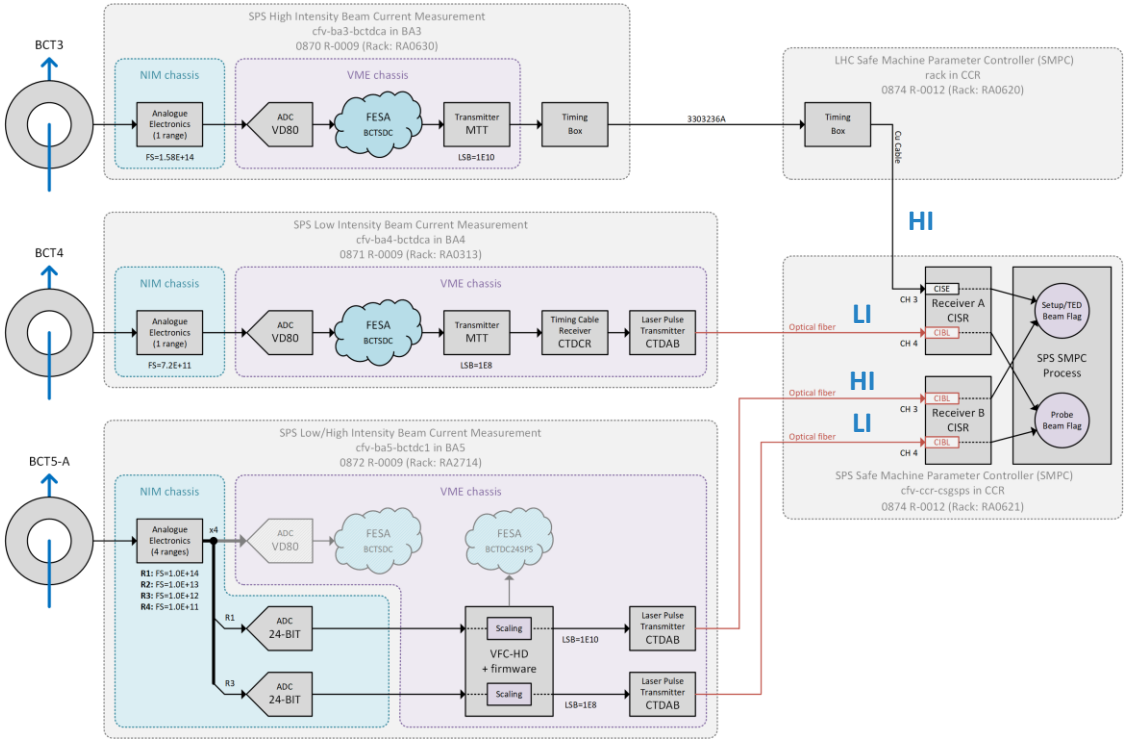
on behalf of SY-BI-IQ & TE-MPE-MI

17th November 2023

BCT Sources connections to SPS-SMP - I



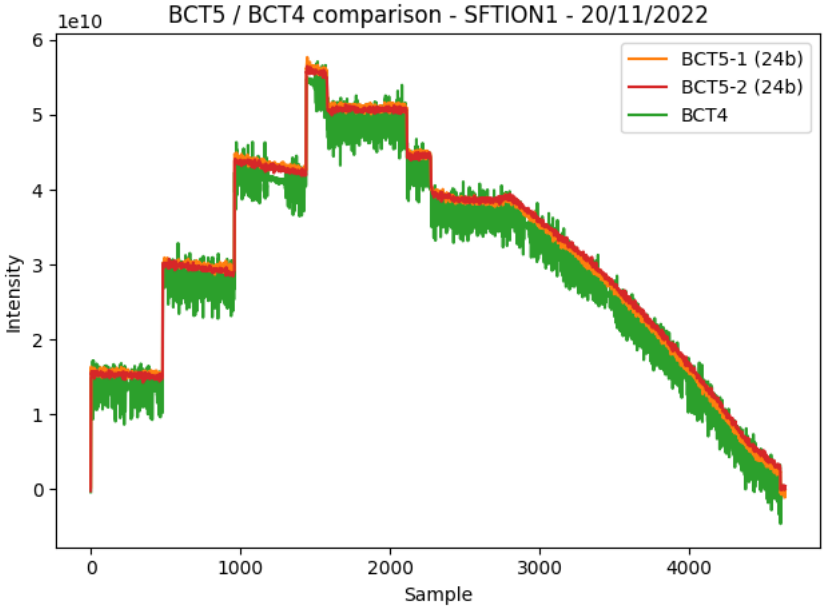
- Since 2023 (see **231st MPP**) the SPS SMP is connected to 4 intensity sources:
  - BCT3 (High Intensity) → SMP-A
  - BCT4 (Low Intensity) → SMP-A
  - BCT5-A (High Intensity) → SMP-B
  - BCT5-A (Low Intensity) → SMP-B
- **Reminder:** before 2023 no redundance of Low Intensity measurements – only BCT4 as source!

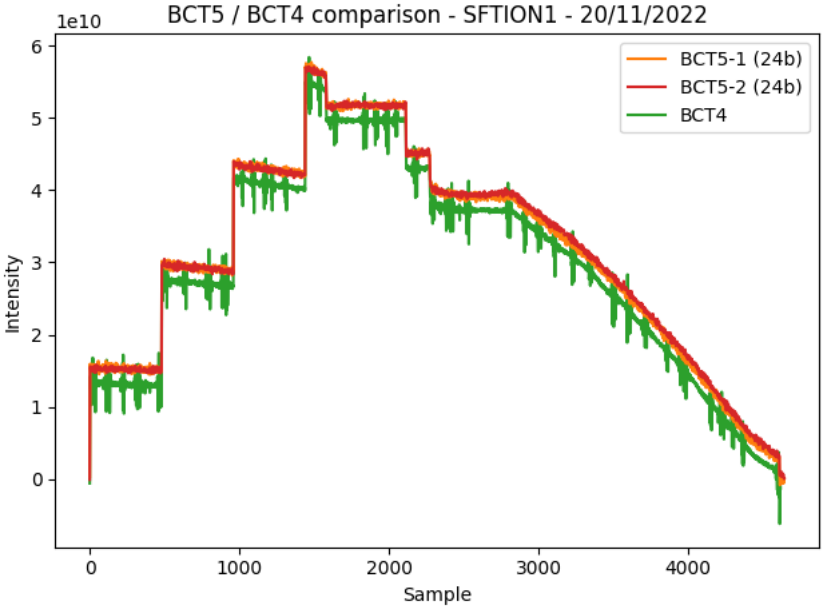
- BCT3/BCT4 are commercial devices (black boxes) dating from the '90s. Electronics is reaching end of life.

- BCT5-A/B are a redundant identical pair of BCTs, built at CERN, and installed in 2012. Same technology as all other accelerators.

“Recent” issues with BCT4 – I

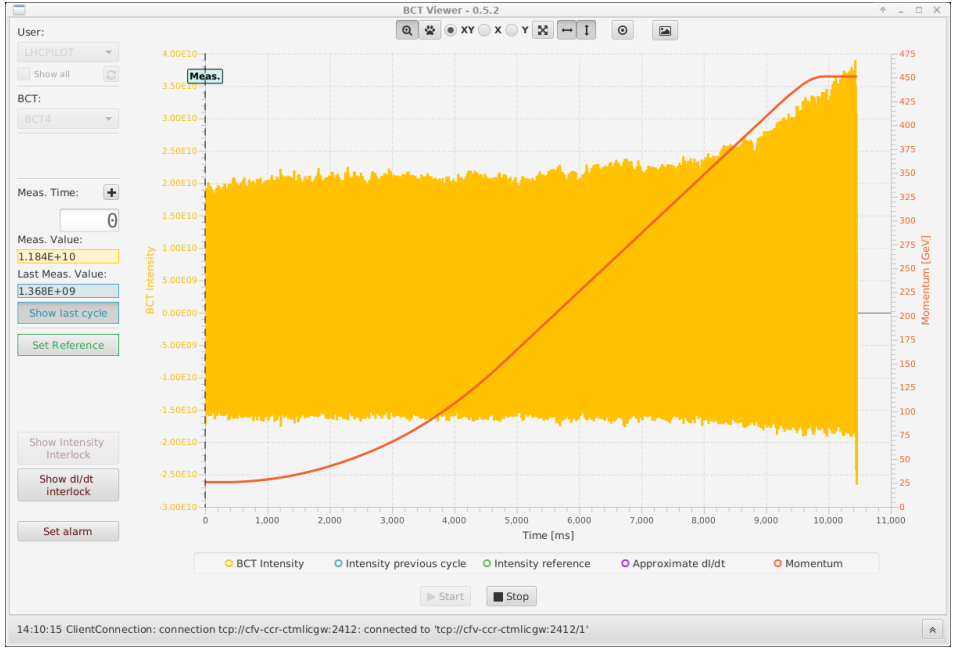
- Noise reported by OP on BCT4 (both OASIS & FESA) on (Sunday) 20/11/2022 (BIIQ-458)
- Disappeared by itself before we could investigate…

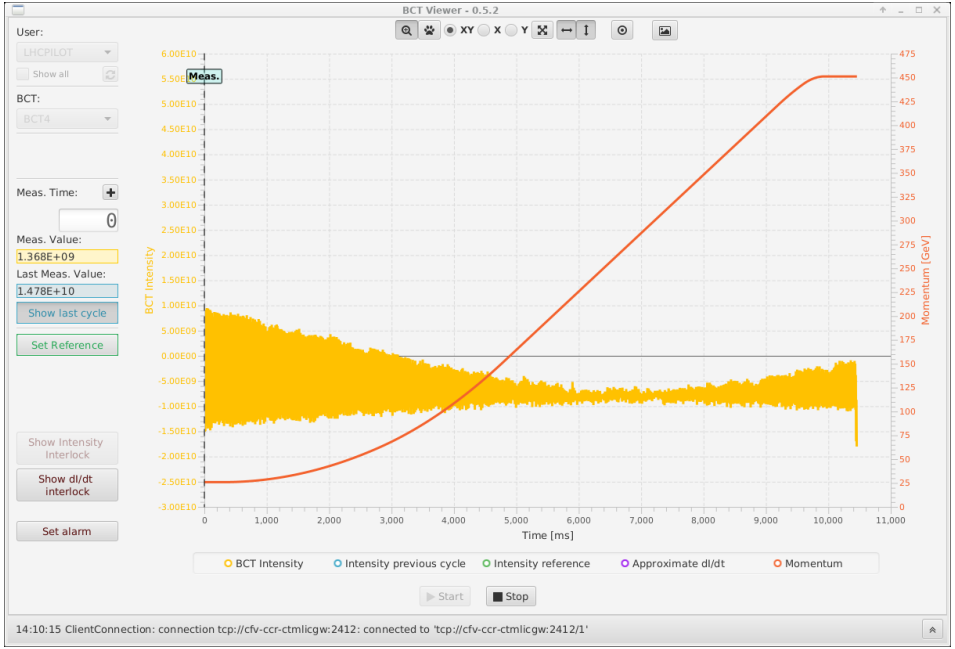




Recent issues with BCT4 – II

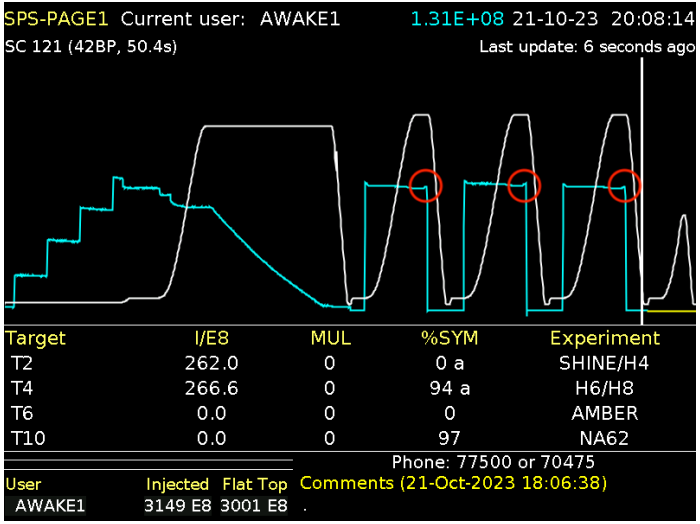
- Again, noise reported by OP on BCT4 on **02/09/2023** (BIIQ-663)
- Level above PBF and blocking extraction to LHC via SMP – **OP disable BCT4 and operate only with BCT5**
- Back-end electronics exchanged by the spare. OK after **but we have no more spares!**

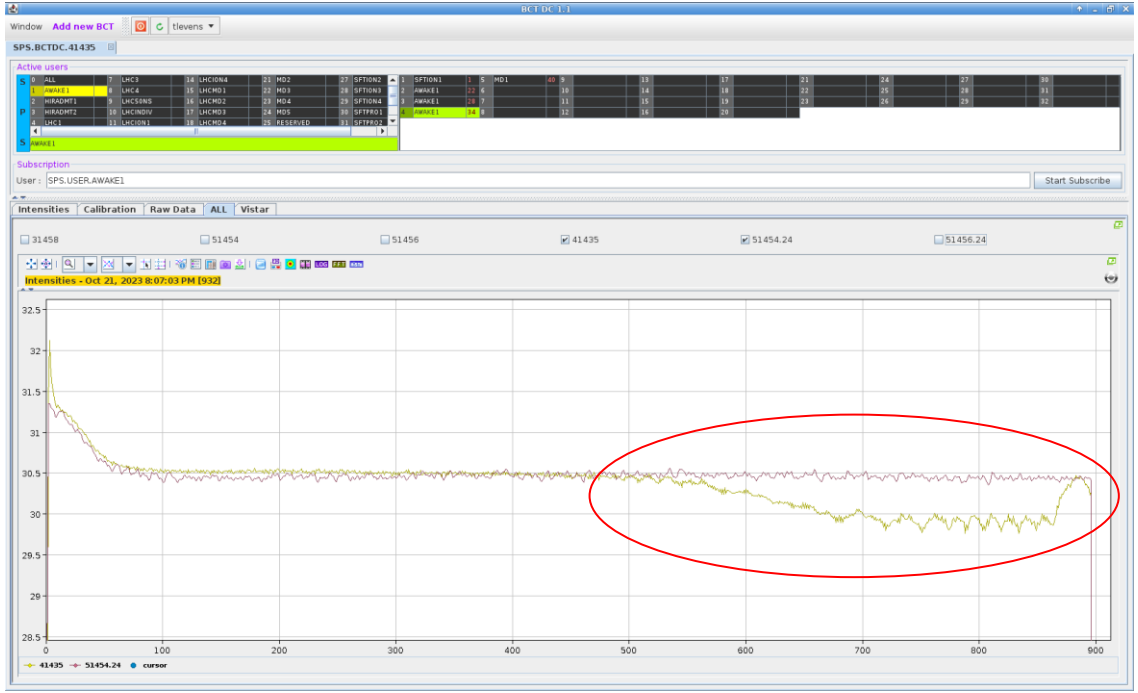




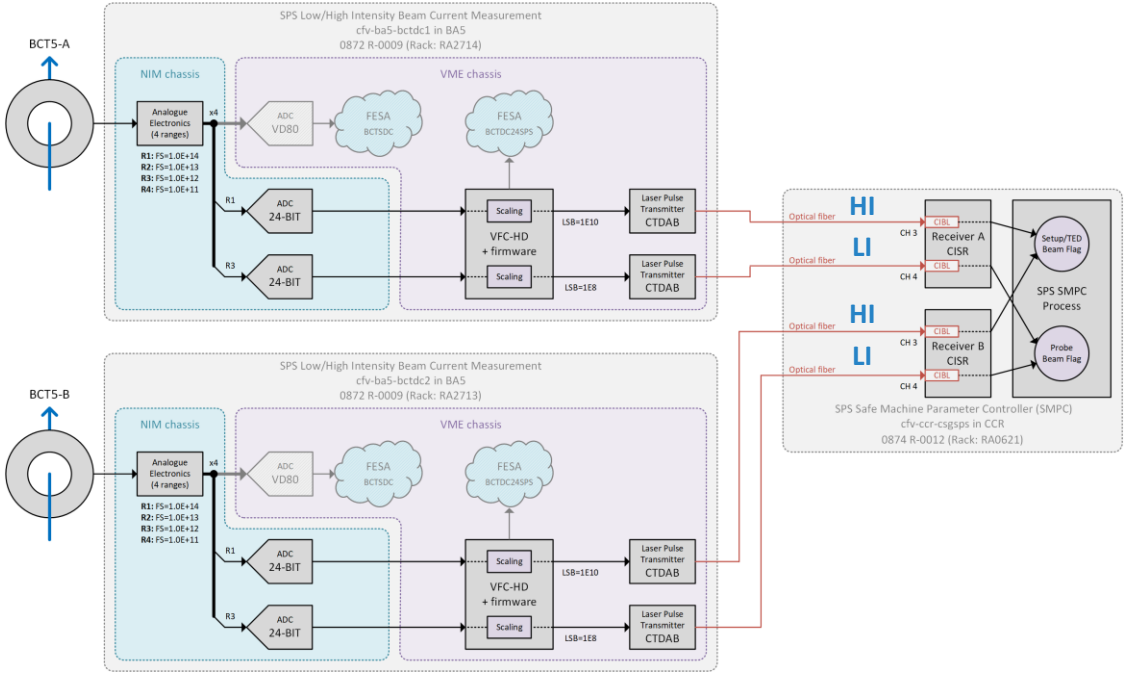
Recent issues with BCT4 – III

- Strange behaviour at flat top with AWAKE cycle reported on 21/10/2023 with 3e11 ppb (BIIQ-679)
- So far not explained…



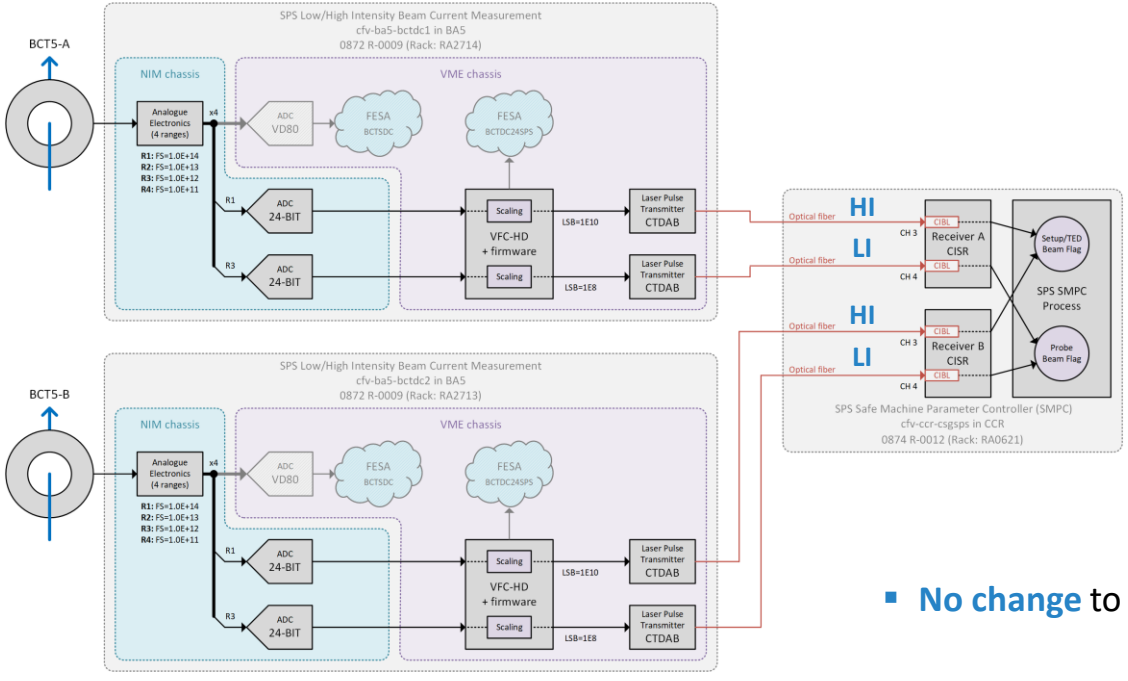


BCT Sources connections to SPS-SMP - II



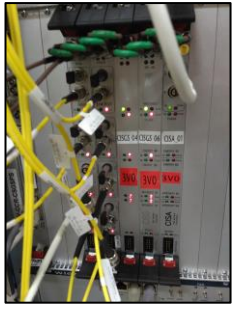
- Proposal for 2024:
  - **BCT3** and **BCT4** connections removed
  - Replaced by **BCT5-B** for both low & high intensity
- Use 2x spare **fiber optics** connections from BA5 to CCR
- Keep **High-Intensity/Low-Intensity** logic unchanged
- **BCT connection to SMP is now entirely implemented in firmware → no more software processing**

BCT Sources connections to SPS-SMP - III



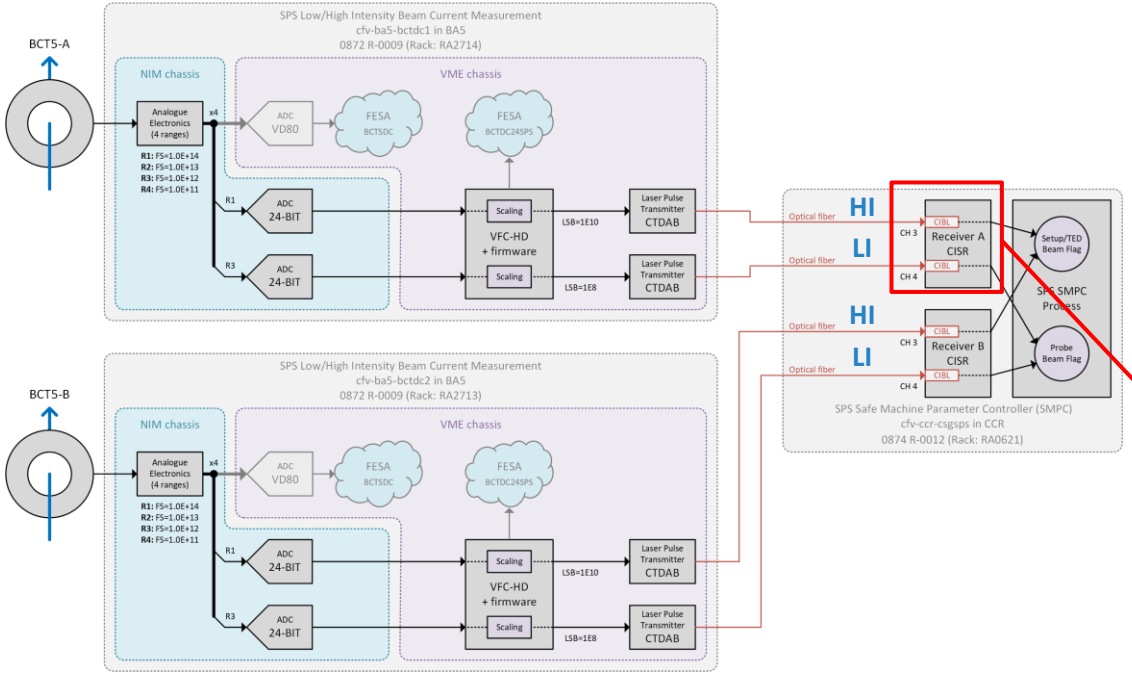
- **No change** to Data transmission format
- **No change** to **frame headers** identifying the source
  - **BCT5-A** HI: 0x4B (as BCT3)
  - **BCT5-A** LI: 0x0C (as BCT4)
  - BCT5-B HI: 0x4D
  - BCT5-B LI: 0x0D

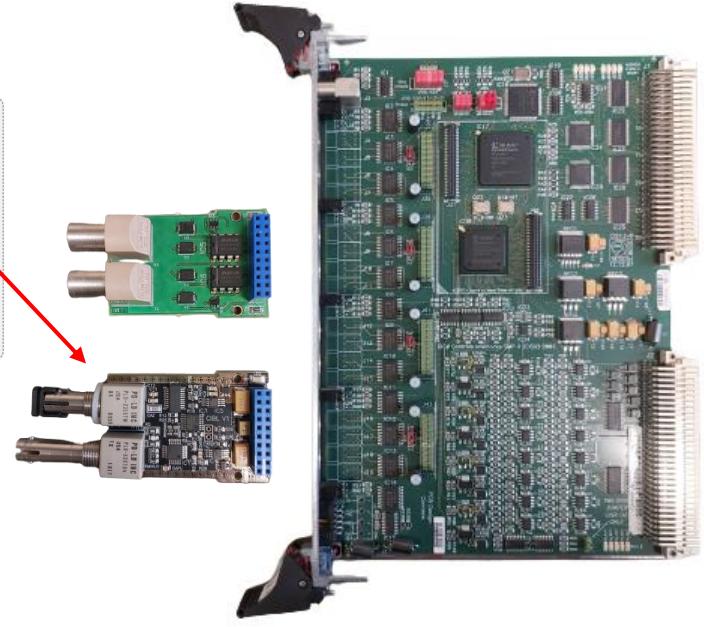
- **No change** to SMP main firmwares



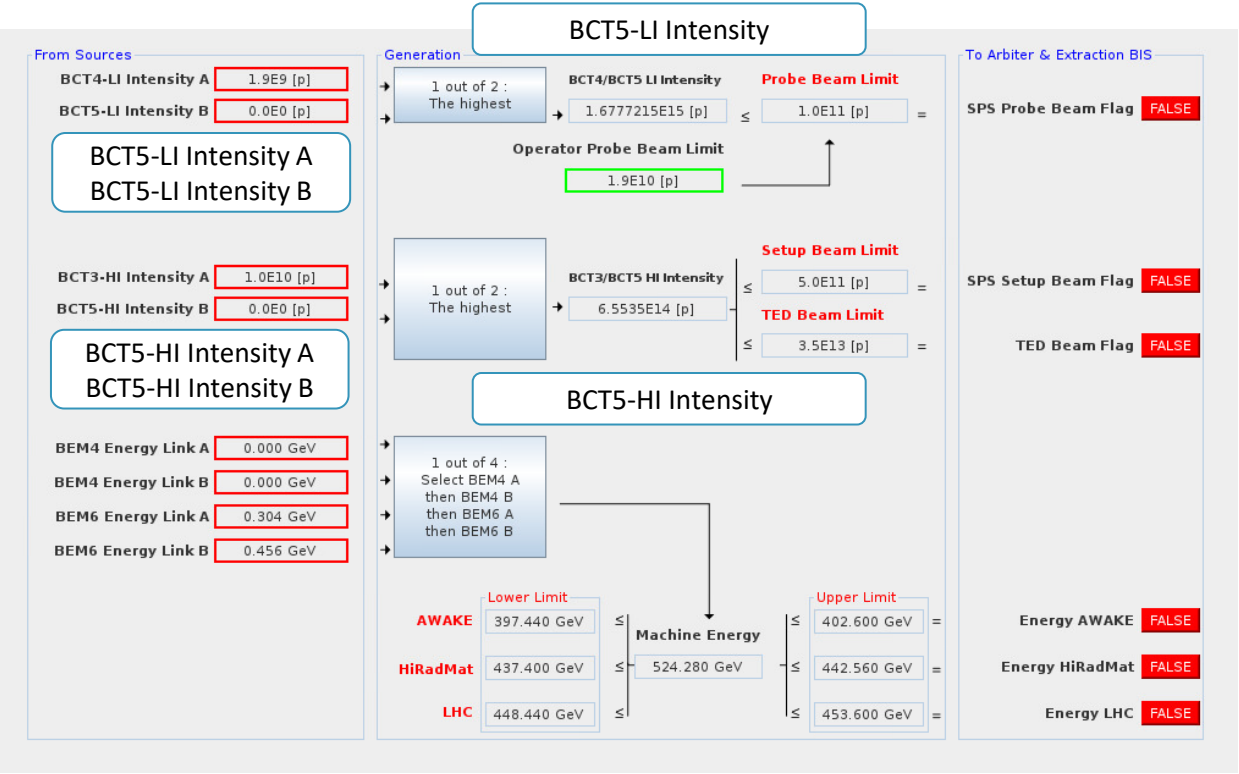
BCT Sources connections to SPS SMP - IV

- **Replace** RS485 **differential** mezzanine (CISE) with **optical** transceiver mezzanine (CIBL)

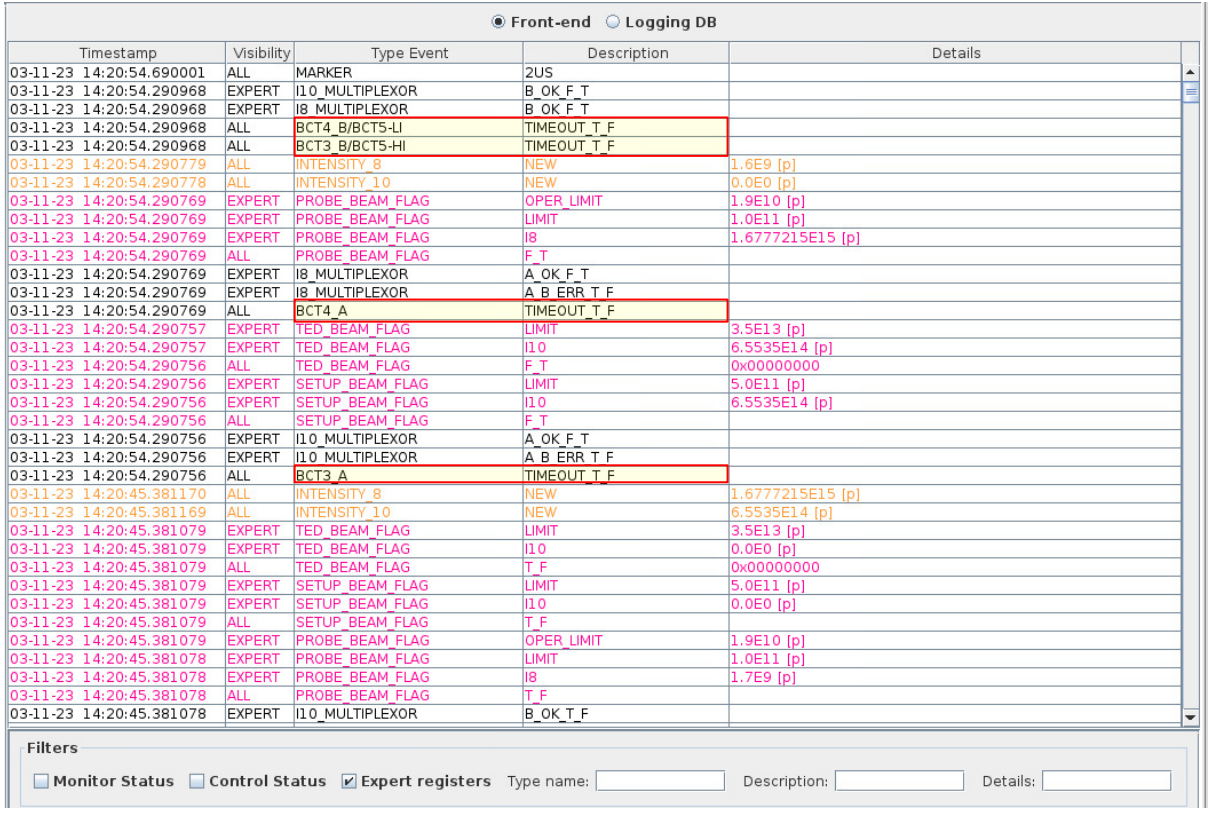




Changes to the SMP GUI – Flag Generation



Changes to diagnostics – History Buffer



◉ Front-end ○ Logging DB

Timestamp	Visibility	Type Event	Description	Details
03-11-23 14:20:54.690001	ALL	MARKER	2US	
03-11-23 14:20:54.290968	EXPERT	I10_MULTIPLEXOR	B_OK_F_T	
03-11-23 14:20:54.290968	EXPERT	I8_MULTIPLEXOR	B_OK_F_T	
03-11-23 14:20:54.290968	ALL	BCT4_B/BCT5-LI	TIMEOUT_T_F	
03-11-23 14:20:54.290968	ALL	BCT3_B/BCT5-HI	TIMEOUT_T_F	
03-11-23 14:20:54.290779	ALL	INTENSITY_8	NEW	1.6E9 [p]
03-11-23 14:20:54.290778	ALL	INTENSITY_10	NEW	0.0E0 [p]
03-11-23 14:20:54.290769	EXPERT	PROBE_BEAM_FLAG	OPER_LIMIT	1.9E10 [p]
03-11-23 14:20:54.290769	EXPERT	PROBE_BEAM_FLAG	LIMIT	1.0E11 [p]
03-11-23 14:20:54.290769	EXPERT	PROBE_BEAM_FLAG	I8	1.6777215E15 [p]
03-11-23 14:20:54.290769	ALL	PROBE_BEAM_FLAG	F_T	
03-11-23 14:20:54.290769	EXPERT	I8_MULTIPLEXOR	A_OK_F_T	
03-11-23 14:20:54.290769	EXPERT	I8_MULTIPLEXOR	A_B_ERR_T_F	
03-11-23 14:20:54.290769	ALL	BCT4_A	TIMEOUT_T_F	
03-11-23 14:20:54.290757	EXPERT	TED_BEAM_FLAG	LIMIT	3.5E13 [p]
03-11-23 14:20:54.290757	EXPERT	TED_BEAM_FLAG	I10	6.5535E14 [p]
03-11-23 14:20:54.290756	ALL	TED_BEAM_FLAG	F_T	0x00000000
03-11-23 14:20:54.290756	EXPERT	SETUP_BEAM_FLAG	LIMIT	5.0E11 [p]
03-11-23 14:20:54.290756	EXPERT	SETUP_BEAM_FLAG	I10	6.5535E14 [p]
03-11-23 14:20:54.290756	ALL	SETUP_BEAM_FLAG	F_T	
03-11-23 14:20:54.290756	EXPERT	I10_MULTIPLEXOR	A_OK_F_T	
03-11-23 14:20:54.290756	EXPERT	I10_MULTIPLEXOR	A_B_ERR_T_F	
03-11-23 14:20:54.290756	ALL	BCT3_A	TIMEOUT_T_F	
03-11-23 14:20:45.381170	ALL	INTENSITY_8	NEW	1.6777215E15 [p]
03-11-23 14:20:45.381169	ALL	INTENSITY_10	NEW	6.5535E14 [p]
03-11-23 14:20:45.381079	EXPERT	TED_BEAM_FLAG	LIMIT	3.5E13 [p]
03-11-23 14:20:45.381079	EXPERT	TED_BEAM_FLAG	I10	0.0E0 [p]
03-11-23 14:20:45.381079	ALL	TED_BEAM_FLAG	T_F	0x00000000
03-11-23 14:20:45.381079	EXPERT	SETUP_BEAM_FLAG	LIMIT	5.0E11 [p]
03-11-23 14:20:45.381079	EXPERT	SETUP_BEAM_FLAG	I10	0.0E0 [p]
03-11-23 14:20:45.381079	ALL	SETUP_BEAM_FLAG	T_F	
03-11-23 14:20:45.381079	EXPERT	PROBE_BEAM_FLAG	OPER_LIMIT	1.9E10 [p]
03-11-23 14:20:45.381078	EXPERT	PROBE_BEAM_FLAG	LIMIT	1.0E11 [p]
03-11-23 14:20:45.381078	EXPERT	PROBE_BEAM_FLAG	I8	1.7E9 [p]
03-11-23 14:20:45.381078	ALL	PROBE_BEAM_FLAG	T_F	
03-11-23 14:20:45.381078	EXPERT	I10_MULTIPLEXOR	B_OK_T_F	

Filters

☐ Monitor Status ☐ Control Status ☑ Expert registers Type name: Description: Details: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