Summary of activities

(mainly Compact Processing Module…)

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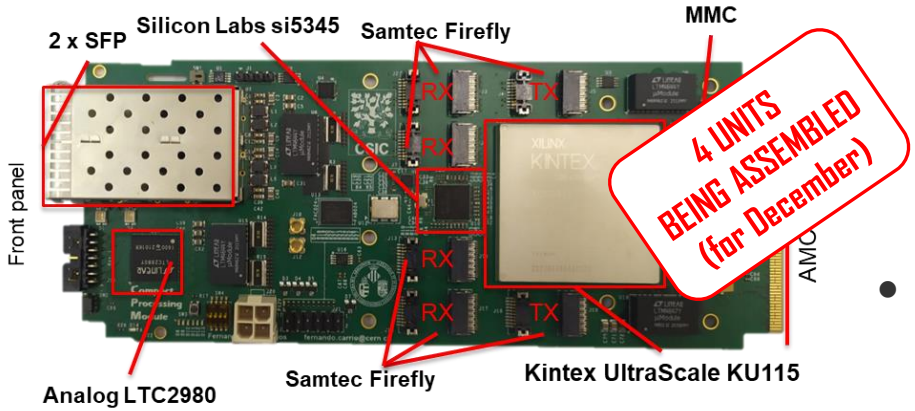
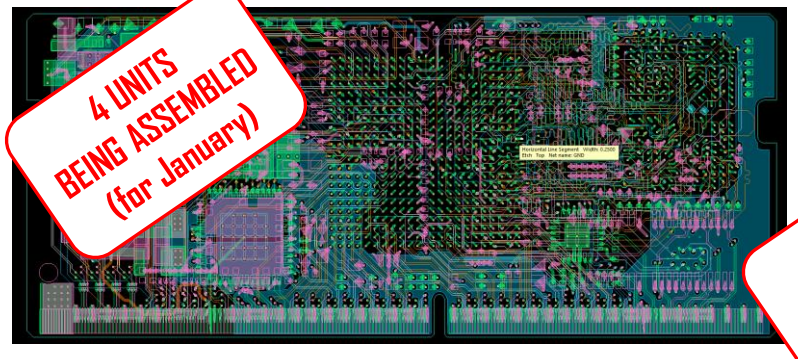
End-of-Year Tile meeting

HW: Hardware developments

- Revision 2.3 of the CPM
  - Single AMC board with full-size form factor
  - 6 x Samtec Firefly
  - XCKU115-2FLVA1517E

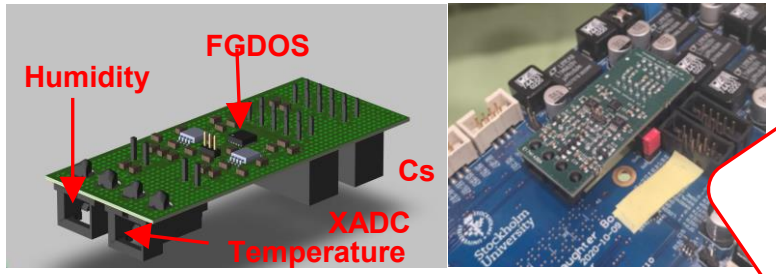


- Rev 1.3 of the TileCoM
  - SODIMM-240pin: 6.7 cm x 3 cm
  - 10 layers, 1 mm thickness, with 251 components



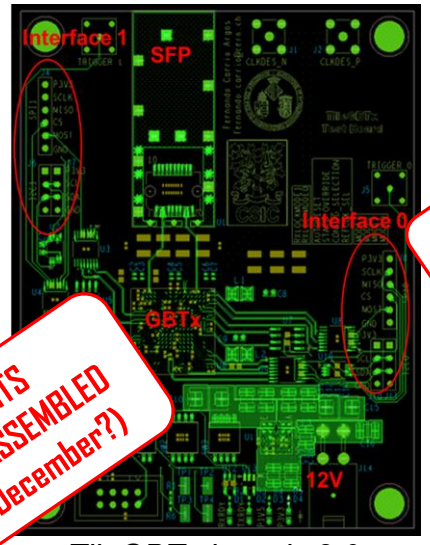
TileCoM v1.3

- Sensing environment conditions inside the TileCal modules
  - Analog signal conditioning for temperature (PT100) and humidity (polymer) using INA333 + Total Ionazing Dose (TID) sensor



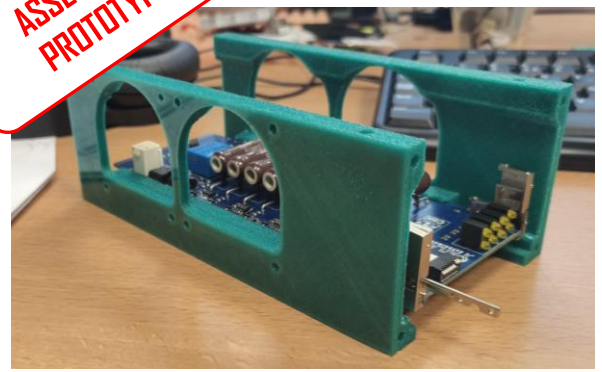
TileSensor board v1.0

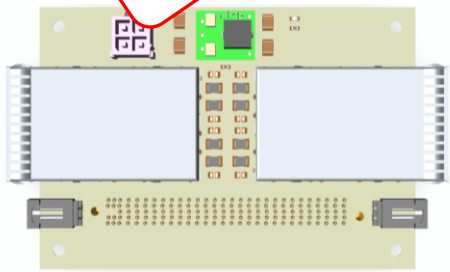
- Optical GBT-GPIO expander
  - Remote control of the HV and LED drivers from CPM



TileGBTx board v2.0

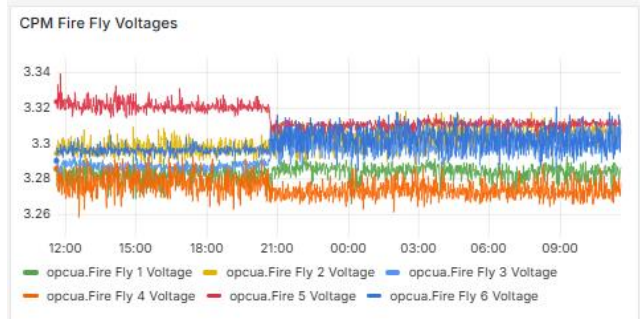
- Plastic support for on-table test benches + Ethernet backplane
  - Support with built-in guidelines
  - Four 60 mm x 60 mm fans
  - Backplane with 4 SFP and power distribution



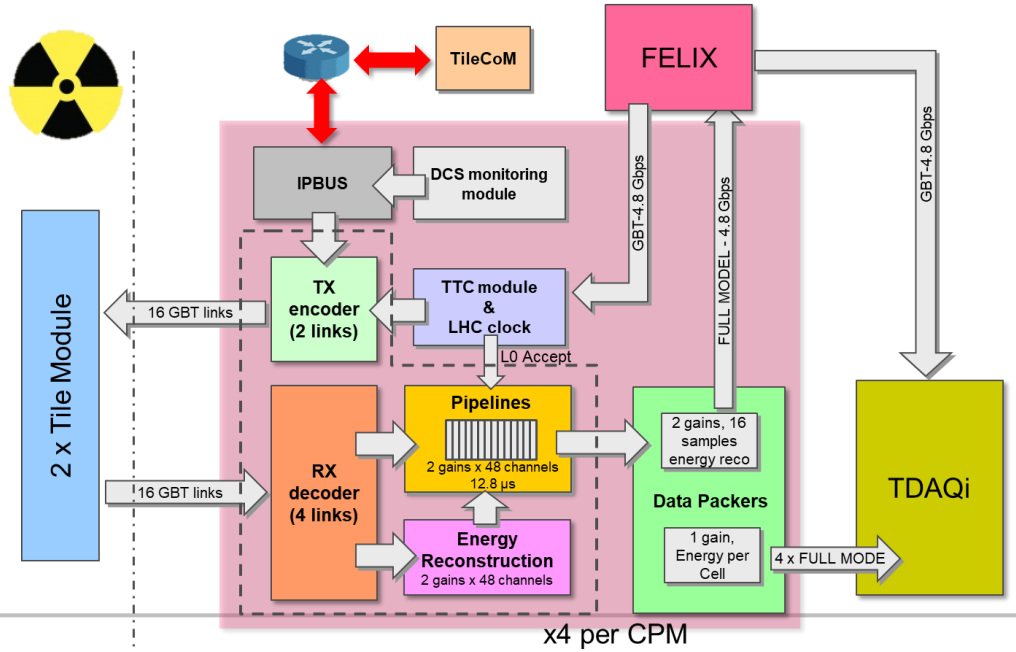


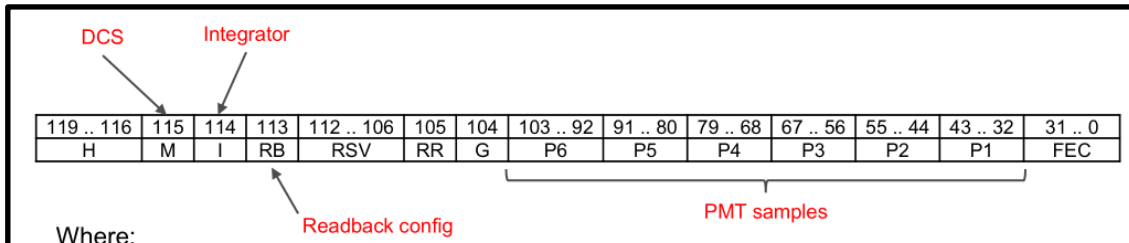
FW: Compact Processing Module

- Most functionalities in place and validated during test beams, VST and Demonstrator
  - 2 link @ 4.8 Gbps to FELIX: TTC and Readout + 1 GbE for IPbus communication
    - LTI - FULL MODE (9.6 Gbps) implemented
  - 28 x links to DaughterBoards (4.8/9.6Gbps): **GBT with FEC and new data format**
  - 4 x links @ 9.6 Gbps to TDAQi: FULL mode
  - Remote programming via IPbus for both CPM and DaughterBoards
  - Block to detect corruption in the data samples to be added (stuck bits, spikes, etc)
  - Firmware updates for the DCS readings → Brenton as part of his Master thesis
    - Deployment in P1 in January: Ipbus → IS → pBeast
  - Several firmware updates to extend debugging capabilities



DCS readings via IPbus





Where:

- H: GBT header.
- M: DCS & monitoring data.
- I: Integrator data.
- RB. Read back commands.
- RSV: Reserved bits.
- RR: Reset Request from the Daughterboard.
- G: FEB gain. 0 is low gain and 1 high gain.
- Px: PMT samples.
- FEC: Forward Error Correction.

BW assigned	Assigned bits	Description/ max requirement
80 Mbps	4	GBT header → Used as returned BCR
80 Mbps	1	DCS monitoring data. It includes a maximum of 100 sensors * 10 Hz * 32-bit words for monitoring of temperature sensors, voltages and currents.
80 Mbps	1	Integrator data. It includes a maximum of 6 PMTs * 200 Hz * 32-bit words
80 Mbps	1	Read back of MB and DB registers
80 Mbps	1	Reset Request from the DB
80 Mbps	1	High and Low gain identifier
5.760 Gbps	72	PMT readout data
2.56 Gbps	32	Forward Error Correction

SW: Compact Processing Module

- Python libraries using official uHAL with high-level functions are completed
- TROOPER libraries: https://gitlab.cern.ch/fcarrio/tropper-libraries/-/tree/master
  - C++ libraries + using pybind11 → allows consistent usage of libs when using Python
  - Very simple structure:
    - Core: very low-level functions (write, reads, helper functions)
    - Drivers: low-level functions to control specific registers: TTC, FELIX config, pipelines
    - Applications: high-level applications, e.g. link monitoring

- Prometeo-like debugging tools, ASCII mode for Demo
  CIS linear, CIS pulse, ADC linear, Pedestals, etc
  - Generation of a json file with the raw data and analysis results
    - Prometeo team using these tools to develop software

```
(venv) [fcarrio@lxplus939]/eos/home-f/fcarrio/TestBeam/prometeo% python Main.py --debug --mode ADClinear
Using connection file from argument: addresses/connections.xml
Reusing existing ipbus instance for device: cpm175
Reusing existing ipbus instance for device: cpm175
CH00:   225   502   785  1068  1352  1631  1914  2197  2480  2761  3043  3324  3605  3887  4095  4095
CH01:   249   523   801  1080  1359  1634  1914  2194  2473  2750  3027  3304  3583  3860  4095  4095
CH02:   243   519   800  1082  1364  1640  1923  2205  2487  2767  3048  3326  3607  3887  4095  4095
CH03:   254   528   808  1088  1368  1644  1924  2204  2484  2763  3040  3318  3597  3876  4095  4095
CH04:   243   519   799  1080  1359  1638  1919  2199  2481  2760  3037  3317  3598  3878  4095  4095
CH05:   249   525   805  1085  1365  1641  1921  2202  2482  2761  3038  3316  3596  3875  4095  4095
CH06:   255   532   813  1095  1377  1656  1938  2220  2502  2782  3061  3341  3623  3903  4095  4095
CH07:   244   520   799  1082  1363  1641  1922  2203  2485  2765  3044  3323  3603  3883  4095  4095
CH08:   231   510   793  1078  1363  1643  1928  2212  2497  2779  3061  3343  3627  3910  4095  4095
CH09:   256   533   814  1095  1376  1652  1934  2215  2497  2775  3055  3333  3614  3893  4095  4095
CH10:   251   528   807  1088  1368  1644  1925  2206  2486  2764  3042  3321  3601  3881  4095  4095
CH11:   230   509   791  1074  1357  1635  1918  2201  2484  2765  3046  3325  3609  3891  4095  4095
ipbus instance for device destroyed.
(venv) [fcarrio@lxplus939]/eos/home-f/fcarrio/TestBeam/prometeo%
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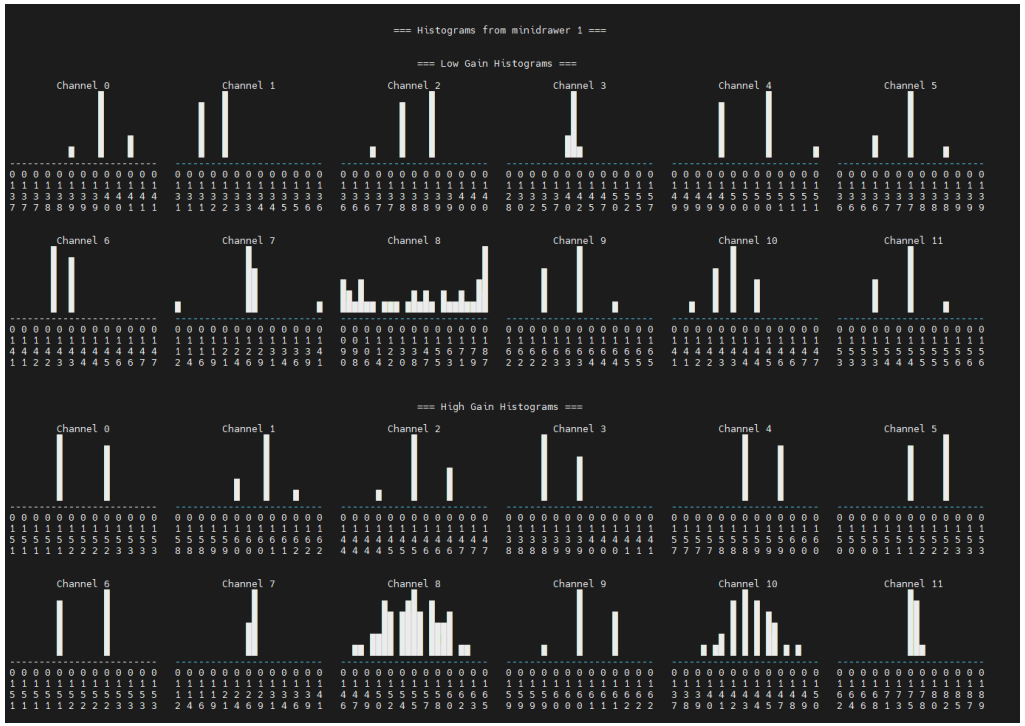
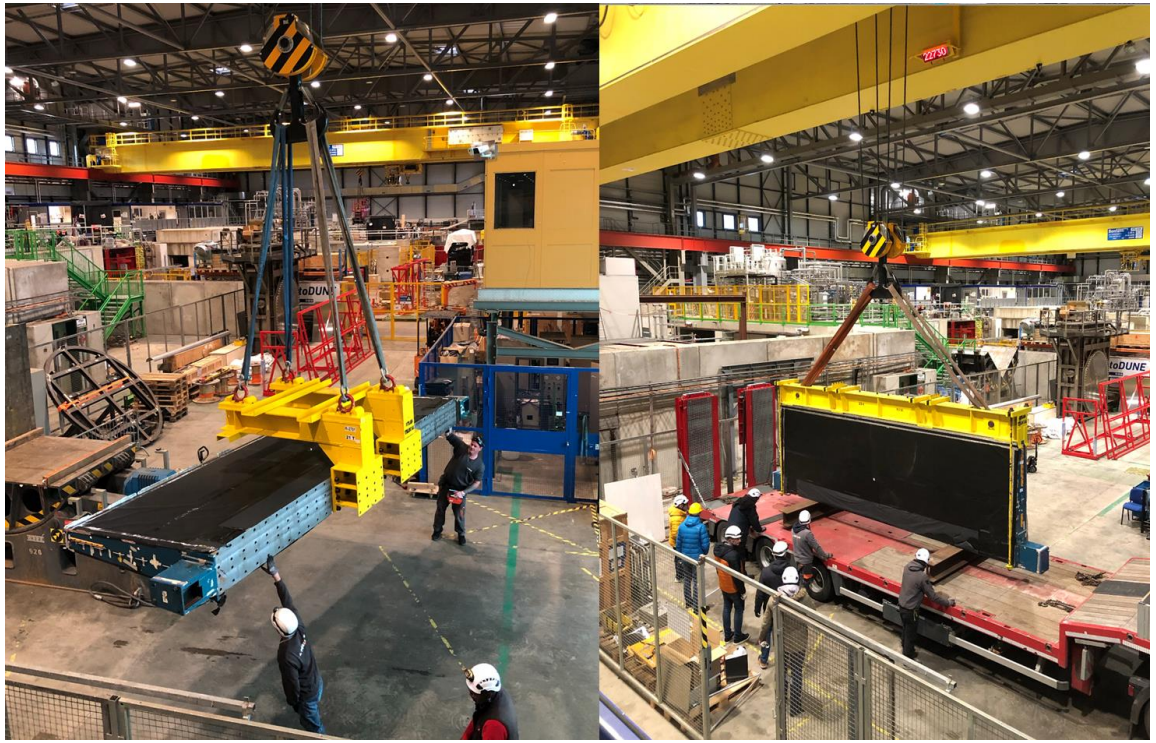


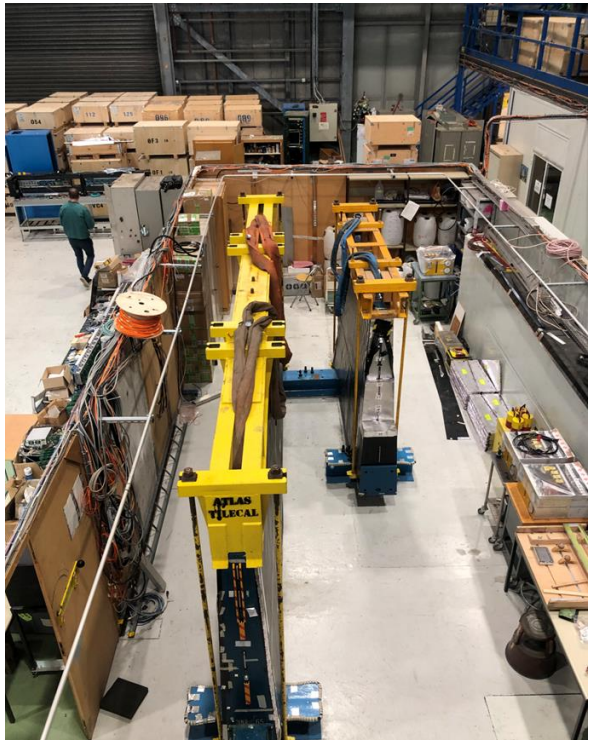
Prometeo version with pyTROOPER libraries

Test: Integration tests - Vertical Slice Test

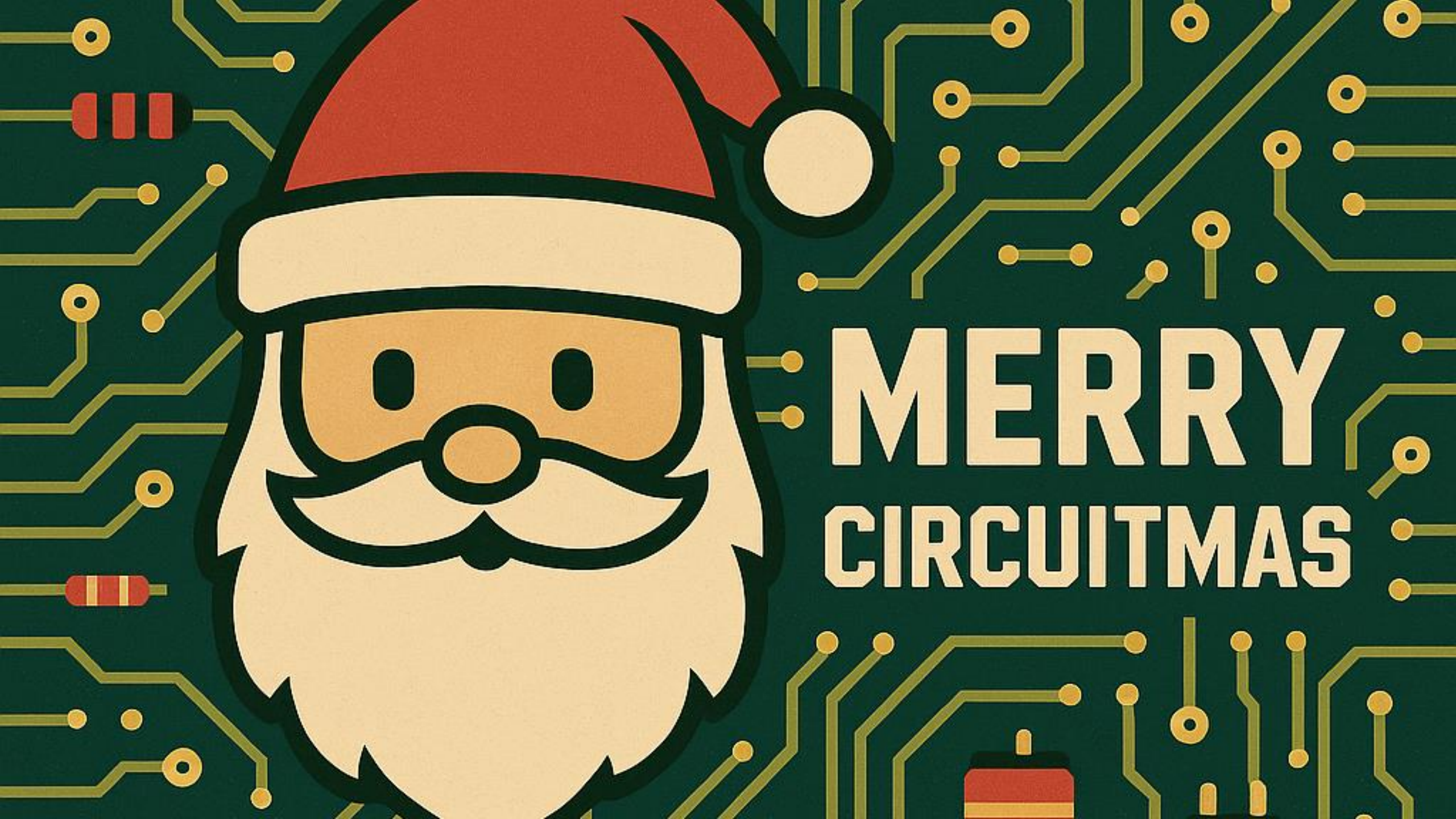
- Vertical Slice Test setup just moved to bld 175
  - After serving during more than 10 test beam campaigns between 2015 and 2025 in SPS NA
- 2 TileCal modules equipped with the lastest upgrade electronics
- DB6.4/6.5, CPM+Carrier and TDAQi fully integrated and controlled from TDAQ
- Active test bench with continous integration activities ongoing such as Expert and Integration weeks



SPS North Area



Building 175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CIRCUITMAS