

# LHC BCT B for SBF issue

- Problem

- MTT Header was corrupted, to the point that even the source *identifier* was unrecognizable

- Cause

- During LS2, the (16 bit) BCTDCLHC2 FESA Class was heavily re-engineered
- BCT background reading drifts over time (change in temperature, humidity etc)
  - Calibration *offsets* are used to remove this background
    - current = equipment\_value – calib\_offset
  - Calibration code was *missing* in new FESA class allowing negative readings
    - When equipment\_value < calib\_offset
  - Negative reading corrupts the top 8 bits used to identify data

```
signed int current = ...  
frame = 0x00ffffff & current;  
frame |= getFrameHeader();
```

Safe Machine Parameters in CCC : Detailed Overview

Device Tree

- SMPC
  - SPS
    - RA
    - RB
    - GA
    - GB
    - A
  - LHC
    - RA
    - RB
    - GA
    - GB
    - A
    - C
  - CISV
  - BIC
  - CCR.CIB.1

Board Info

Board Name :

Variant Name :

Slot Number :

Monitor FPGA Info

Version :

Revision :

ISE Version :

Percent used :

UTC :

Control FPGA Info

Version :

ISE Version :

Percent used :

UTC :

Subscription State

UPDATE :

Reset Receiver Counters Panel

Reset All RX error counters

Reset All TX error counters

SOURCE 1 - LHC/BETS2 Reference/Operational

Value received : 0x920EA6D2 at time : 29-06-21 16:43:20

Polarity : INVERTED Ms received : FALSE

Source Alive : TRUE

Error received : 0x960EA679 at time : 29-06-21 16:43:14

Error Count : 6365313

Value transmitted : 0x3B000EA6 decoded : 450.00 GeV

Mon. Error transmitted : no error at time : never received

Ctrl. Error transmitted : no error

Error Count : 0

SOURCE 2 - LHC/BETS2 Interlock/Operational

Value received : 0x9A0EA683 at time : 29-06-21 16:43:20

Polarity : INVERTED Ms received : FALSE

Source Alive : TRUE

Error received : 0x9E0EA628 at time : 29-06-21 16:43:14

Error Count : 6365302

Value transmitted : 0x3D000EA6 decoded : 450.00 GeV

Mon. Error transmitted : no error at time : never received

Ctrl. Error transmitted : no error

Error Count : 0

SOURCE 3 - NOT RECOGNIZED

Value received : 0x1A05BE61 at time : 29-06-21 16:41:58

Polarity : NORMAL Ms received : TRUE

Source Alive : TRUE

Error received : 0xFFFFFFFF at time : 29-06-21 16:43:20

Error Count : 5407184

Value transmitted : 0x1B05BE61 decoded : 3.76417E13 [p]

Mon. Error transmitted : no error at time : never received

Ctrl. Error transmitted : no error

Error Count : 0

SOURCE 4 - NOT RECOGNIZED

Value received : 0x3A05BE63 at time : 29-06-21 16:41:58

Polarity : NORMAL Ms received : TRUE

Source Alive : TRUE

Error received : 0xFFFFFFFF at time : 29-06-21 16:43:20

Error Count : 5407179

Value transmitted : 0x2B05BE63 decoded : 3.75779E13 [p]

Mon. Error transmitted : no error at time : never received

Ctrl. Error transmitted : no error

Error Count : 0

# LHC BCT B for SBF issue

- Mitigation

- Clamp the current to  $\geq 0$  in FESA class

```
if (current < 0)
    current = 0;
```

- In fact the 24 bit BCT already has this logic in the code

```
if (iBeamInt1 < 0) iBeamInt1 = 0;
if (iBeamInt2 < 0) iBeamInt2 = 0;
```

- Re-implemented the calibration code in FESA and made a new sequencer task
  - Triggered before each fill

- Side-effects of mitigation

- The system effectively hides negative values from the BCT
  - If negative, clamp to zero
  - This is the same behaviour as run2
- Negative values should never be seen anyway if the sequencer executes before each fill
  - Sequencer issues a *calibration* request which effectively removes the background level when no beam in the machine