LHCb report on UFO induced dumps 2016

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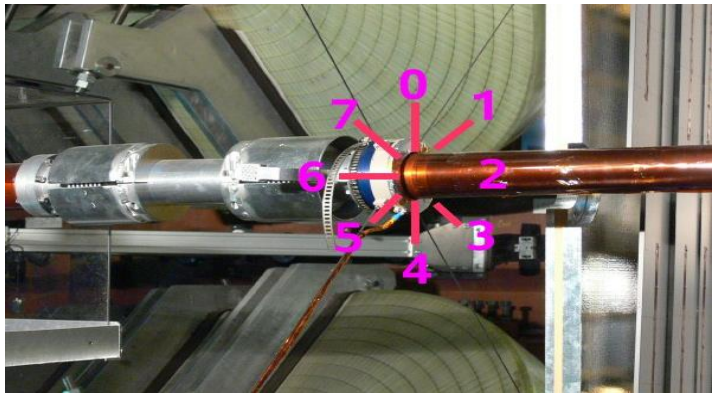
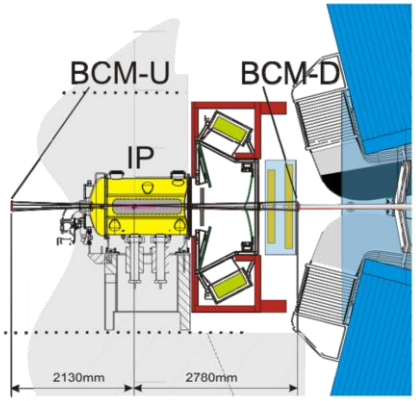
BLMTWG, 28-02-2017

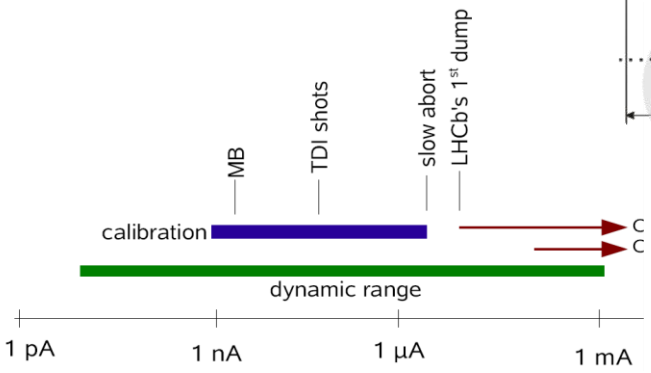
LHCb main dump system BCM

Beam Condition Monitor (BCM) – Main LHCb Life Guard

- 2 stations (Upstream/Downstream) of 8 diamonds (CVD) each 5/4cm from beam axis
  - z = - 2.131 m (U) and z = + 2.765 m (D)
- 40us integration.
  - Computed Running Sums: RS1 over 40 us and RS32 over 1280 us







- System has no dependence on control/software
  - Immediately operational on power-up
  - Reset after dump normally by software but may be done with hardware
- Beam permit (Injection Permit) is false for O(2-3 min) after PM

LHCb BCM dump logic and thresholds

- Dump logic:
  - 3 adjacent diamonds with RS1 above threshold for two frames (RS2)
    - Exclude triplet (6,7,0) as known to be noisy
    - Ignore RS2 when in injection
  - sum of all RS32 diamonds above threshold
    - Exclude lowest and two highest RS32

- Thresholds:
  - RS1
    - BCM-D: 500 (2600 nA, 2130)
      - » (500 x 5.2 nA) / (34 MIP x (36 pA/MIP)), 72k MIP*
    - BCM-U: 500 (10100 nA, 8274)
      - » (500 x 20.2 nA) / (34 MIP x (36 pA/MIP)), 72k MIP*
  - RS32
    - BCM-D: 100 (83200 nA, 68157)
      - » (100 x 5.2 nA x 32 x 5) / (34 MIP x (36 pA/MIP)), 2.3M MIP*
    - BCM-U: 100 (323200 nA, 264765)
      - » (100 x 20.2 nA x 32 x 5) / (34 MIP x (36 pA/MIP)), 2.3M MIP*

*inferred, documentation missing

LHCb dumps in 2016

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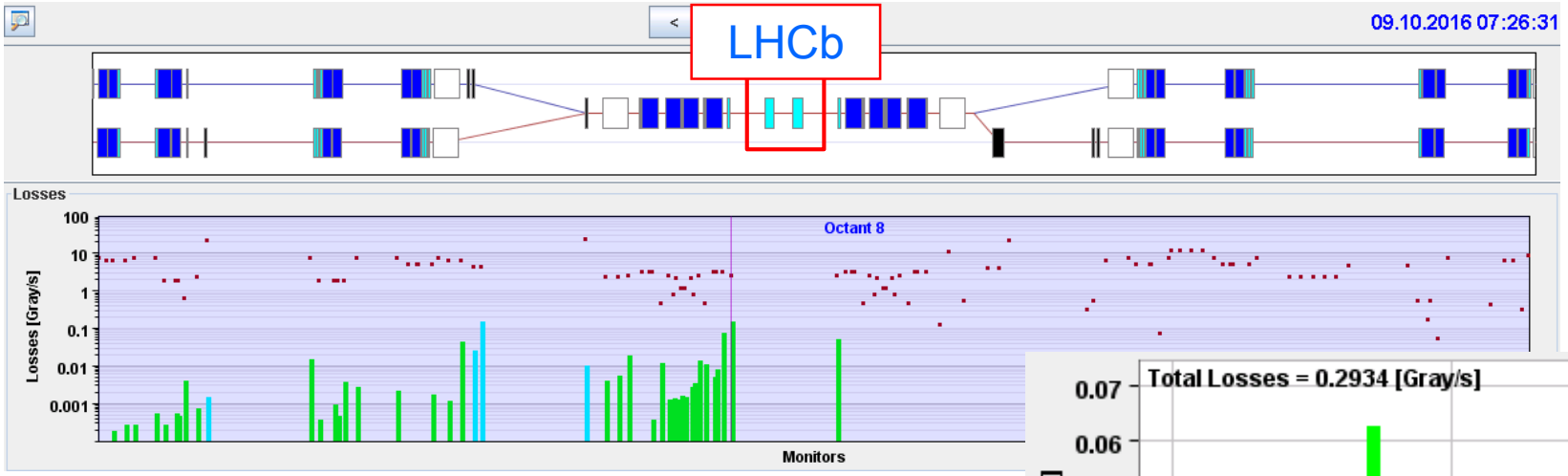

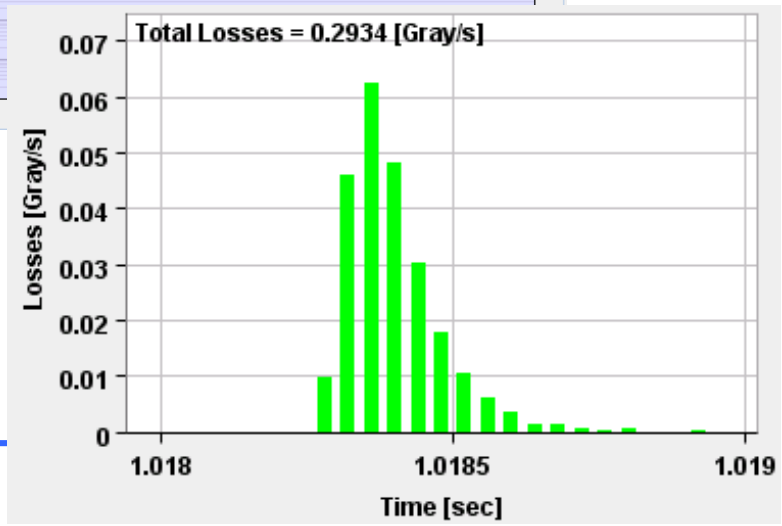

BLM pictures provided by Anton Lechner

At Flat Top, in an intensity ramp-up between 600 and 2200 bunches.

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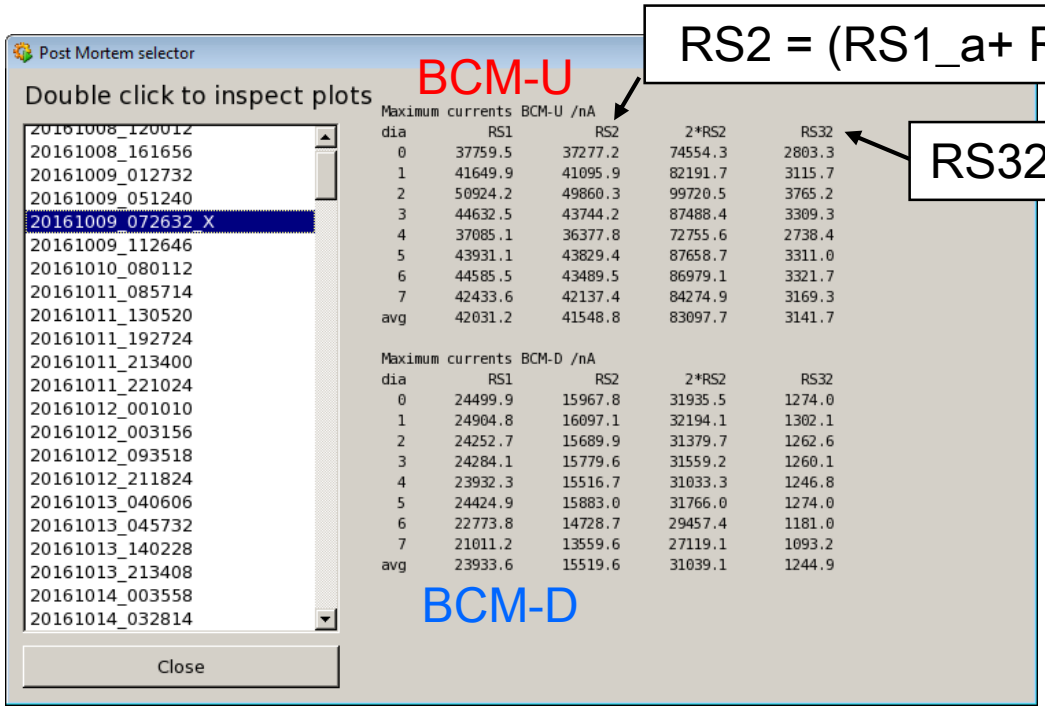

All sensors above threshold in RS2

BCM-U RS2 x 4.1 above threshold → 41548 nA (avg) vs 10100nA (thresh)

BCM-D RS2 x 6.0 above threshold → 15520 (avg) vs 2130 (thresh)

RS32 far from thresholds

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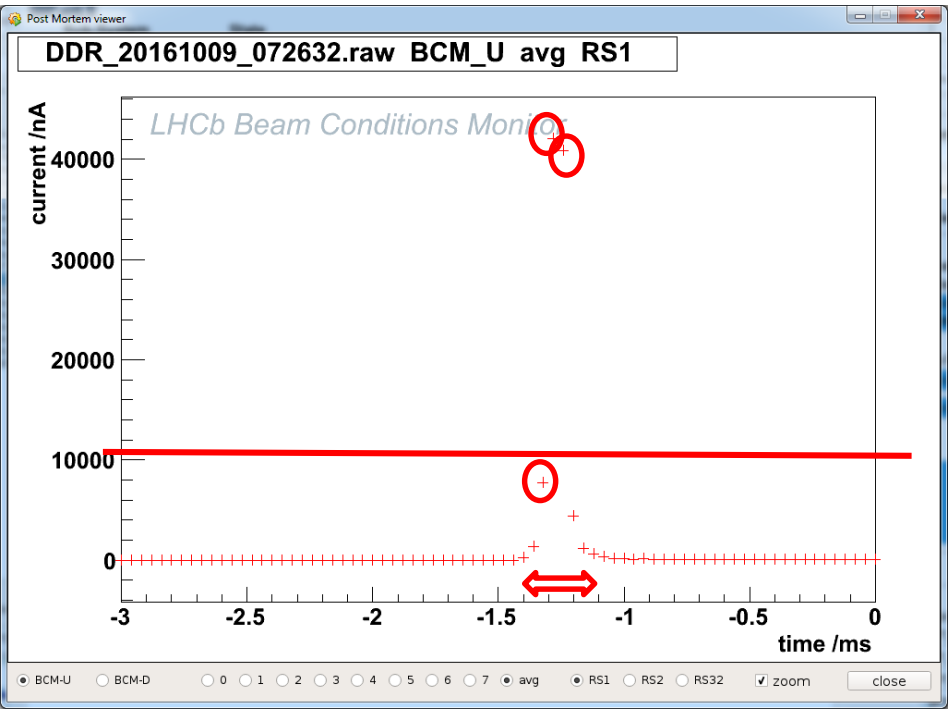

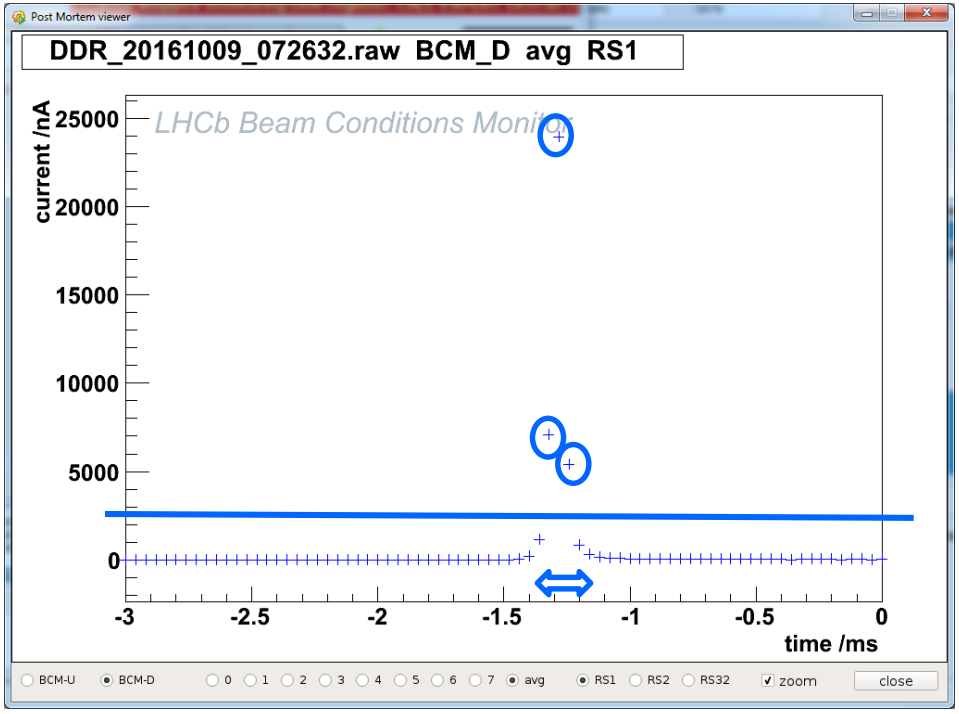

Width is ~320 us → 8x 40 us

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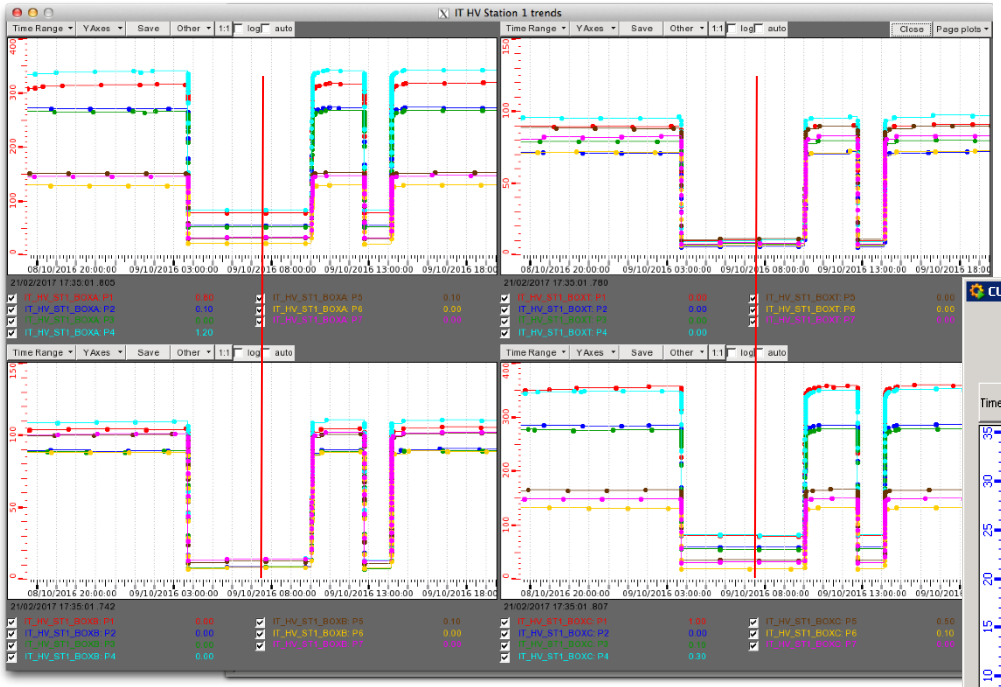
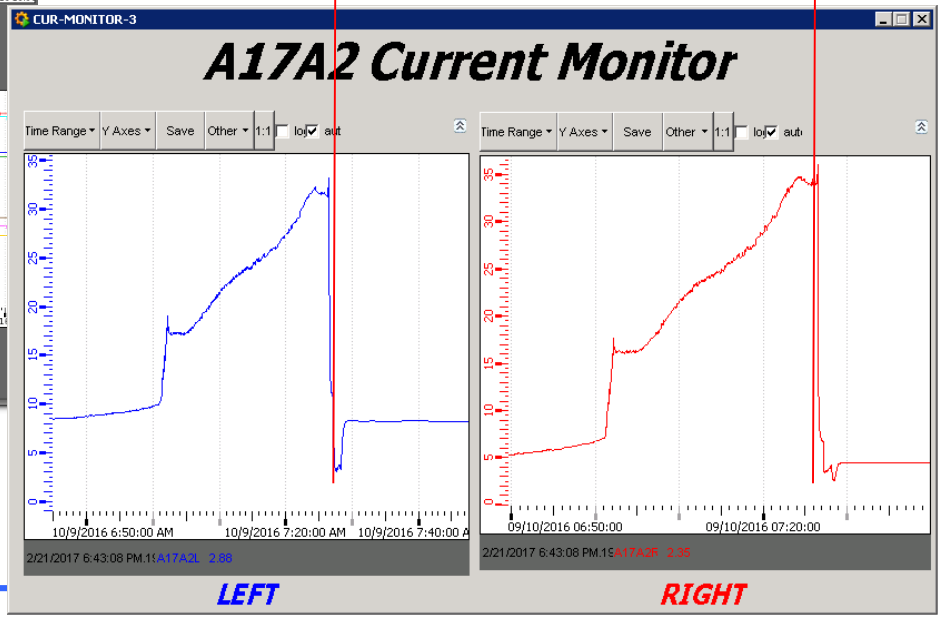


NO signs of trips or dramatic increase in currents in Silicon detectors and inner GEMs (MUON)



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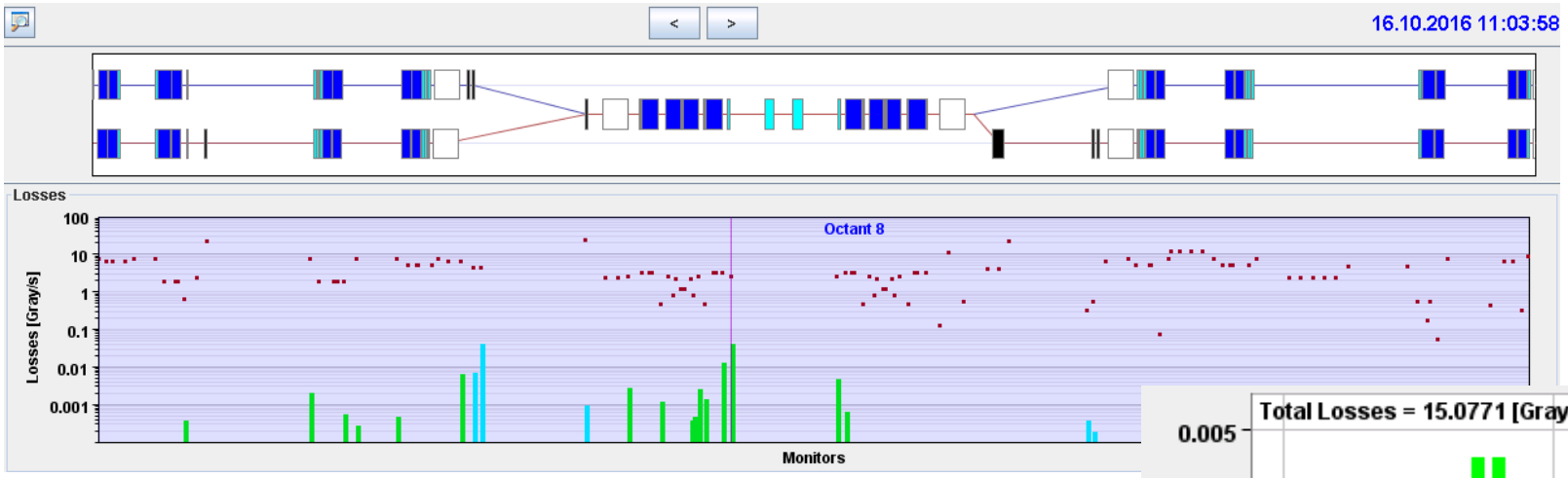

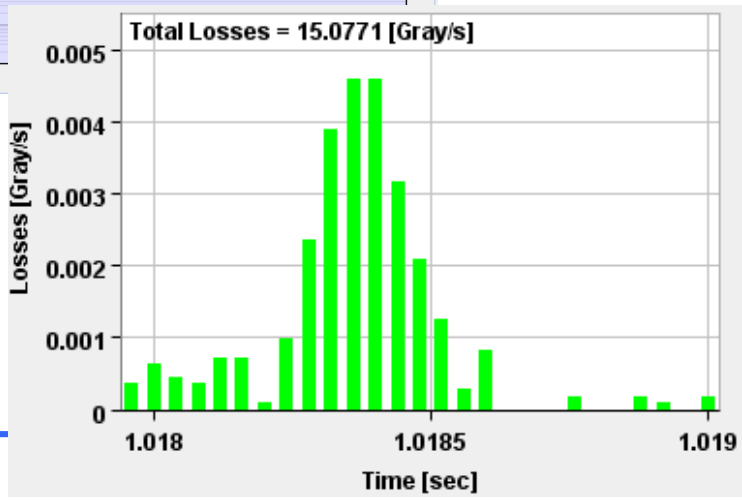

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In Stable Beams, B2 had one train less due to MKI heating

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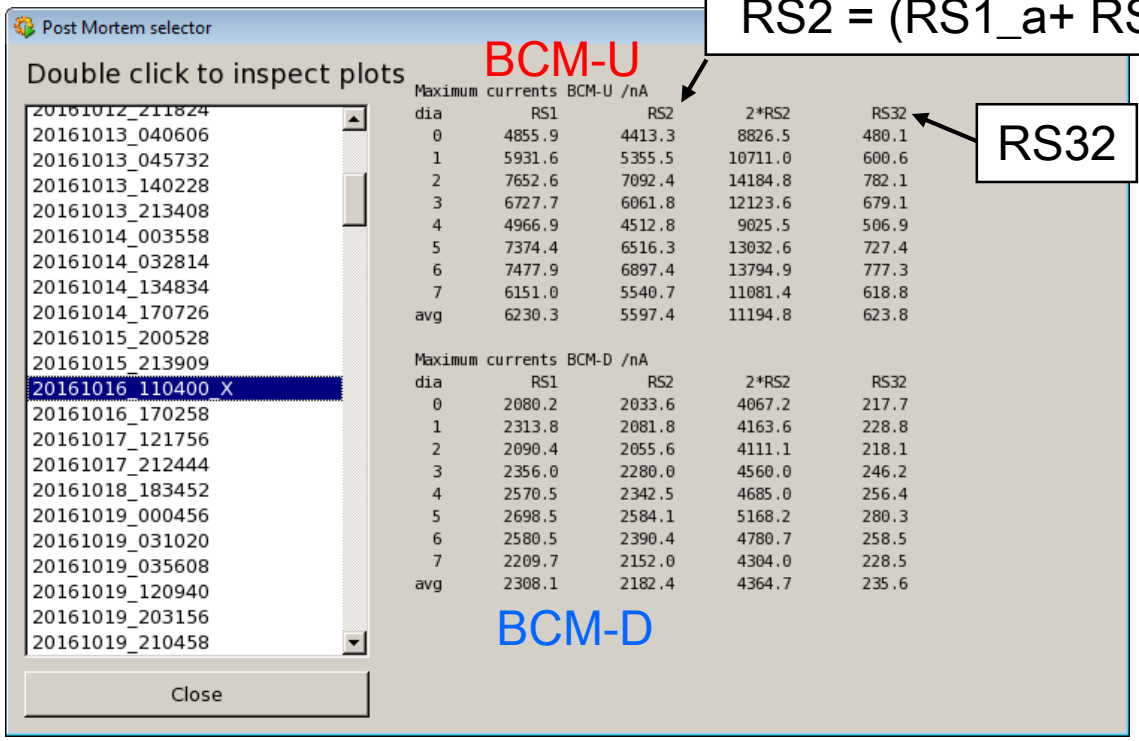

RS2 = (RS1_a+ RS1_b) /2

RS32

None in BCM-U above threshold
→ 4413 nA (min) – 7092 nA (max) vs 10100 nA (thresh)

3 sensors in BCM-D close to threshold, but not above
→ 2584 nA (max) vs 2600 nA (thresh)
→ Tracked to be due to software conversion, to be fixed

RS32 far from thresholds

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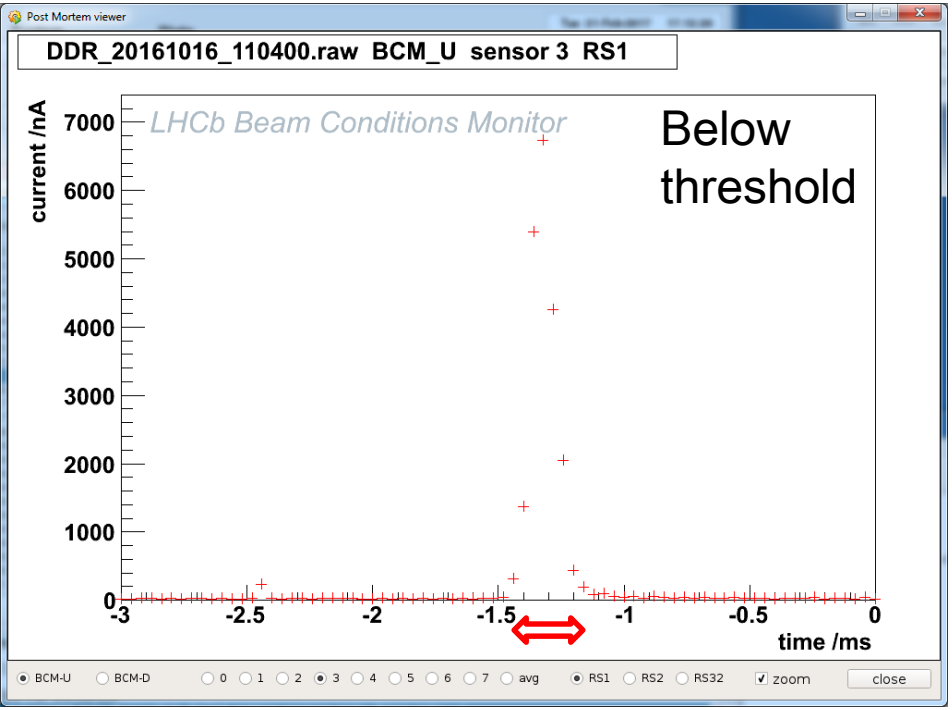

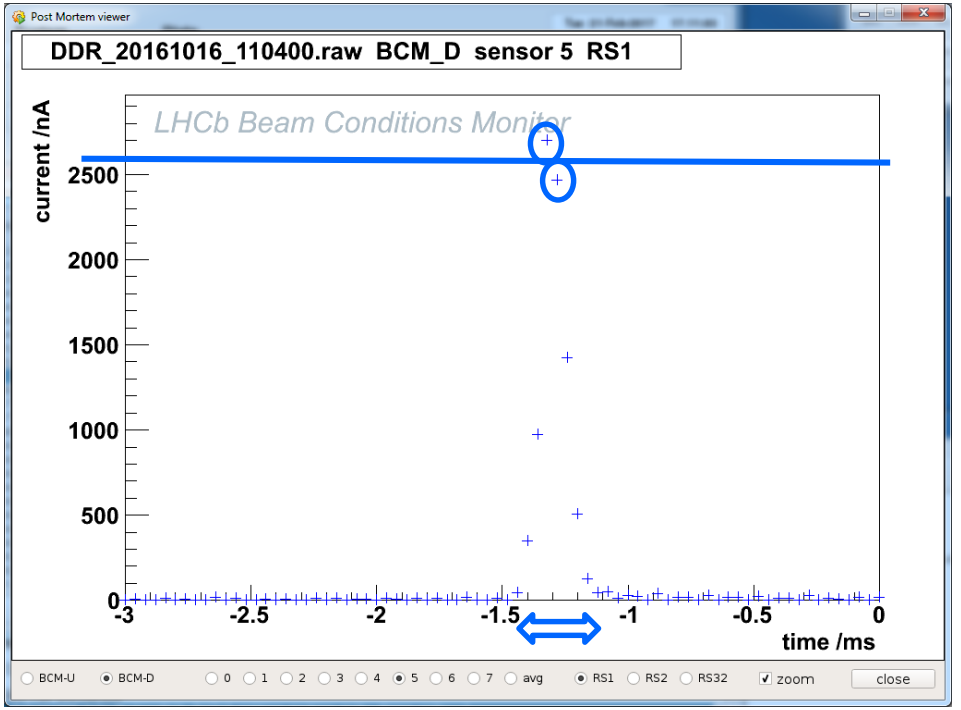

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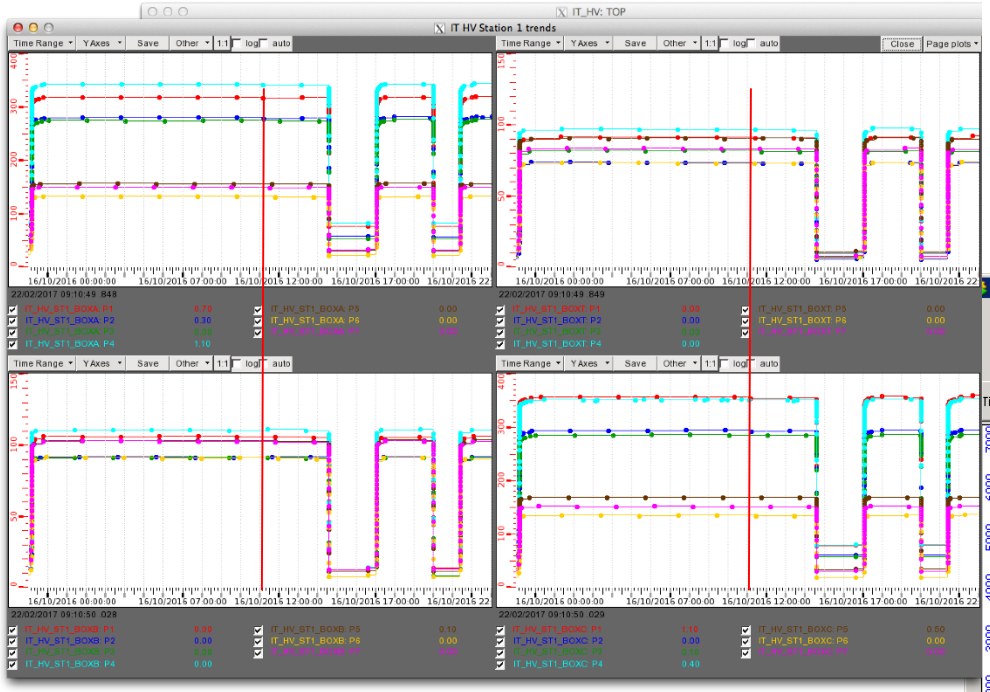

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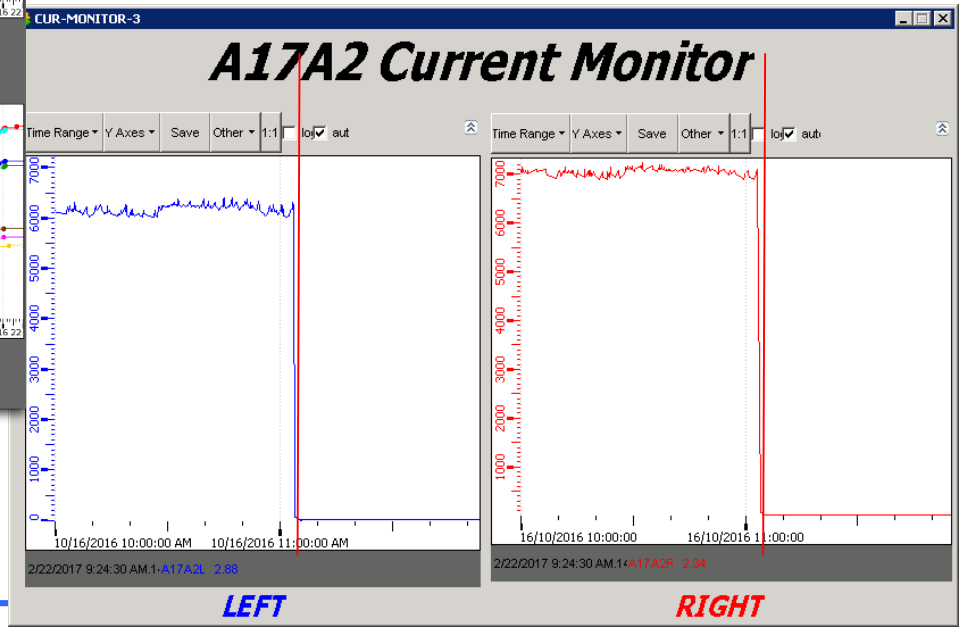

LHCb BCM threshold changes

- Thresholds are encoded in the BCM readout board firmware
  - Firmware needs to be recompiled
  - Developers not around anymore, need time to dig everything out
    - Some documentation is missing or details not well explained (will review this)

- Two options:
  - Leave it as is (☺), knowing that we'll dump once or twice over the year
  - Bite the bullet and change thresholds
    1. adapting them to the worst case scenario
    2. or higher? If so, by how much?

  - We may also investigate the possibility of masking the dump during special injection tests
    - But in that case, will request rigorous usage of accelerator/beam modes