

Changes to BLM system on 28. April 2010

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for the BLM team

LHC MPP
CERN, April 30, 2010

- Overinjection
- Injection of higher intensity
- TCLA IP7
- TCLA IP3
- Disconnected from BIS

LHC BLM Fixed Display

File Tools

Unit: Gray / s Scale: Log Integration Time: 40 us Display: Acquisition REF

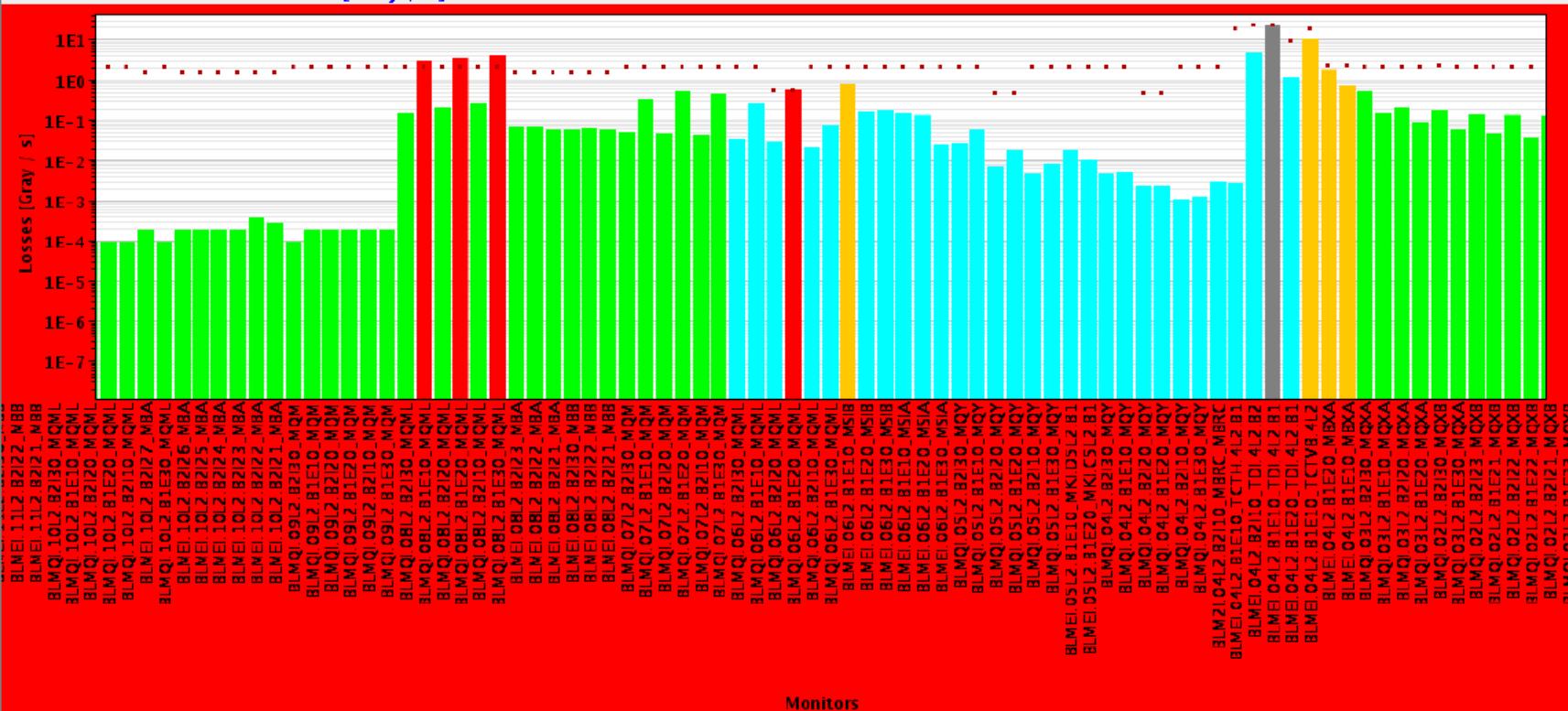
Sectors Filter Octant Filter Dump Filter List Filter Regex Filter

Filter (3545 / 3879)

Location	Type	Section	Sector	Beam	Transverse Position	Position on Element	Observed Element
<input checked="" type="checkbox"/> Quad	<input checked="" type="checkbox"/> IC	<input checked="" type="checkbox"/> LSS	<input checked="" type="checkbox"/> 1 - 2	<input checked="" type="checkbox"/> Beam 1	<input checked="" type="checkbox"/> External	<input checked="" type="checkbox"/> Entrance	%
<input checked="" type="checkbox"/> Other	<input type="checkbox"/> SEM	<input checked="" type="checkbox"/> DS	<input checked="" type="checkbox"/> 2 - 3	<input checked="" type="checkbox"/> Beam 2	<input checked="" type="checkbox"/> Internal	<input checked="" type="checkbox"/> Center	
<input checked="" type="checkbox"/> 2 Elements		<input checked="" type="checkbox"/> ARC	<input checked="" type="checkbox"/> 3 - 4		<input checked="" type="checkbox"/> Top	<input checked="" type="checkbox"/> Exit	
<input checked="" type="checkbox"/> Mobile			<input checked="" type="checkbox"/> 4 - 5		<input checked="" type="checkbox"/> Bottom		
			<input checked="" type="checkbox"/> 5 - 6				
			<input checked="" type="checkbox"/> 6 - 7				
			<input checked="" type="checkbox"/> 7 - 8				
			<input checked="" type="checkbox"/> 8 - 1				

Total Losses: 97.9859 [Gray / s]

15.04.2010 21:11:54



Show Labels Display Optics Elements Use DCUM

Start Stop Save Continuous Saving /user/slops/data/SPS_DATA/OP_DATA/LHCBLM

21:12:51 - Data received: 15.04.2010 21:12:51

Over-injection

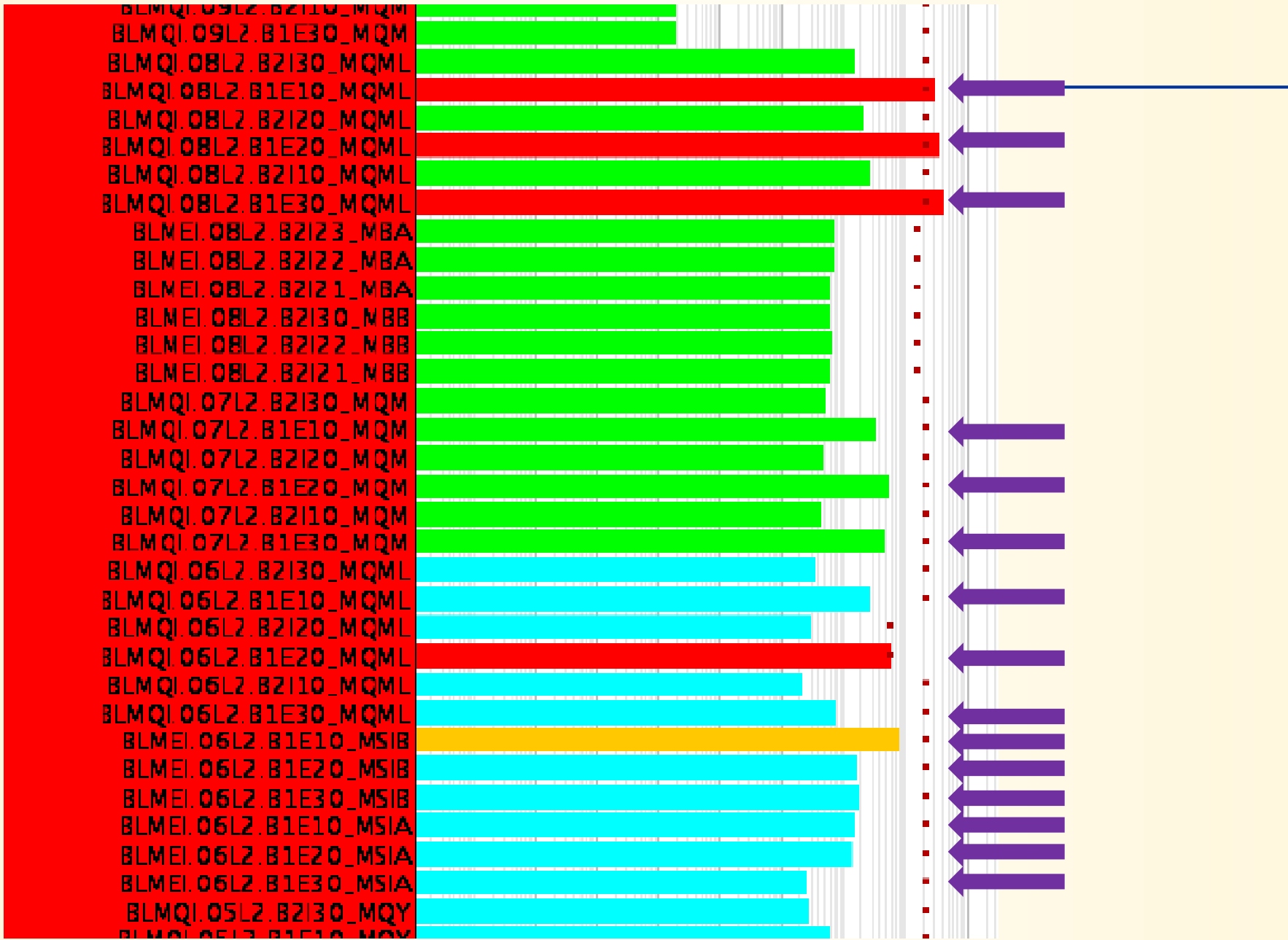
BLMZI.04L2.B2I10_MBRC_MBRC
BLMEI.04L2.B1E10_TCTH.4L2 B1
BLMEI.04L2.B2I10_TDI.4L2 B2
BLMEI.04L2.B1E10_TDI.4L2 B1
BLMEI.04L2.B1E20_TDI.4L2 B1
BLMEI.04L2.B1E10_TCTVB.4L2
BLMEI.04L2.B1E20_MBXA
BLMEI.04L2.B1E10_MBXA
BLMQI.03L2.B2I30_MQXA
BLMQI.03L2.B1E10_MQXA
BLMQI.03L2.B2I20_MQXA
BLMQI.03L2.B1E20_MQXA
BLMQI.02L2.B2I30_MQXB
BLMQI.03L2.B1E30_MQXA
BLMQI.02L2.B2I23_MQXB
BLMQI.02L2.B1E21_MQXB
BLMQI.02L2.B2I22_MQXB
BLMQI.02L2.B1E22_MQXB
BLMQI.02L2.B2I21_MQXB



15.04.2010 21:11:54

Over-injection

- Thresholds 4 MBX monitors now allow for over-injection onto a 'fat' pilot. Requested: Brennan
 - 40us to 10ms (RS1 to RS6) changed for injection energy
 - BLMEI.04R8.B2E10_MBXB and BLMEI.04L2.B1E10_MBXA
 - Up to 'pilot' of $\sim 8e9$
 - At the next possibility: increase margin to $1.2e10$ (same as MQXA)
 - Thresholds to be recalculated (unnecessarily low for higher energies)
 - BLMEI.04R8.B2E20_MBXB and BLMEI.04L2.B1E20_MBXA
 - To be verified and possibly changed
- Threshold on TCT not increased (requested: Ralph) → next in the line to trigger
- Two additional corrections:
 - Swap names: BLMEI.04L2.B1E10_MBXA and BLMEI.04L2.B1E20_MBXA
 - Past logging data reassigned accordingly – should be transparent
 - Corrected threshold settings (3 MBX monitors were in wrong family)
- ECR to be done once all changes finalized



Injection of higher intensity

- RC filter for the monitors requested by the injection team factor 25 (all are external monitors;)
- Maximum current will be reduced by a factor of 8.3 by RC filter and additional factor of 3 with (future) thresholds
- Factor of ~10 between signal on external and internal monitors
- For moment the threshold values not changed!
- → For all other energies the thresholds are now too high
 - A quench could occur
 - New thresholds to be calculated asap
- All these monitors set to maskable
- Estimate: Quench of magnet by outside shower if injection intensity $2e13$

TCLA thresholds - Constraints

Requested by Ralph:

- a) All signal divided by thresholds values should be smaller than 0.01 taking the resonance crossing data from UTC: 15:35:00 28.03.2010, 15:28:38 28.03.2010, 15:25:48 28.03.2010 and 15:32:16 28.03.2010
- b) The original number of protons allowed to hit the TCLA directly, should not increase by more than a factor of 4 (potential damage)

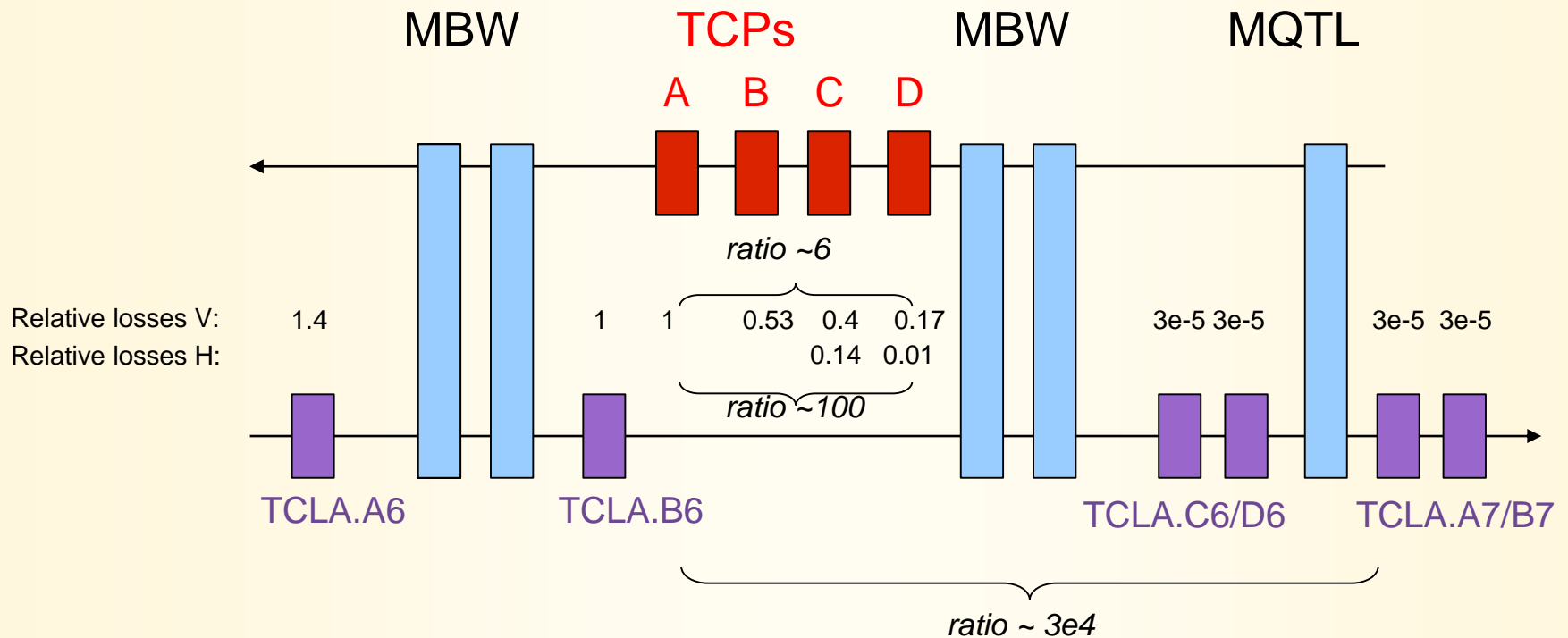
Here are the original numbers for p/s (or p) allowed on the TCLAs:

$t > 10s$	$1s < t < 10s$	$t < 1s$
p/s	p/s	p
6.00E+08	3.00E+09	3.00E+09
4.00E+07	2.00E+08	2.00E+08

- These two constraints seem to exclude each other.

Constraint (a)

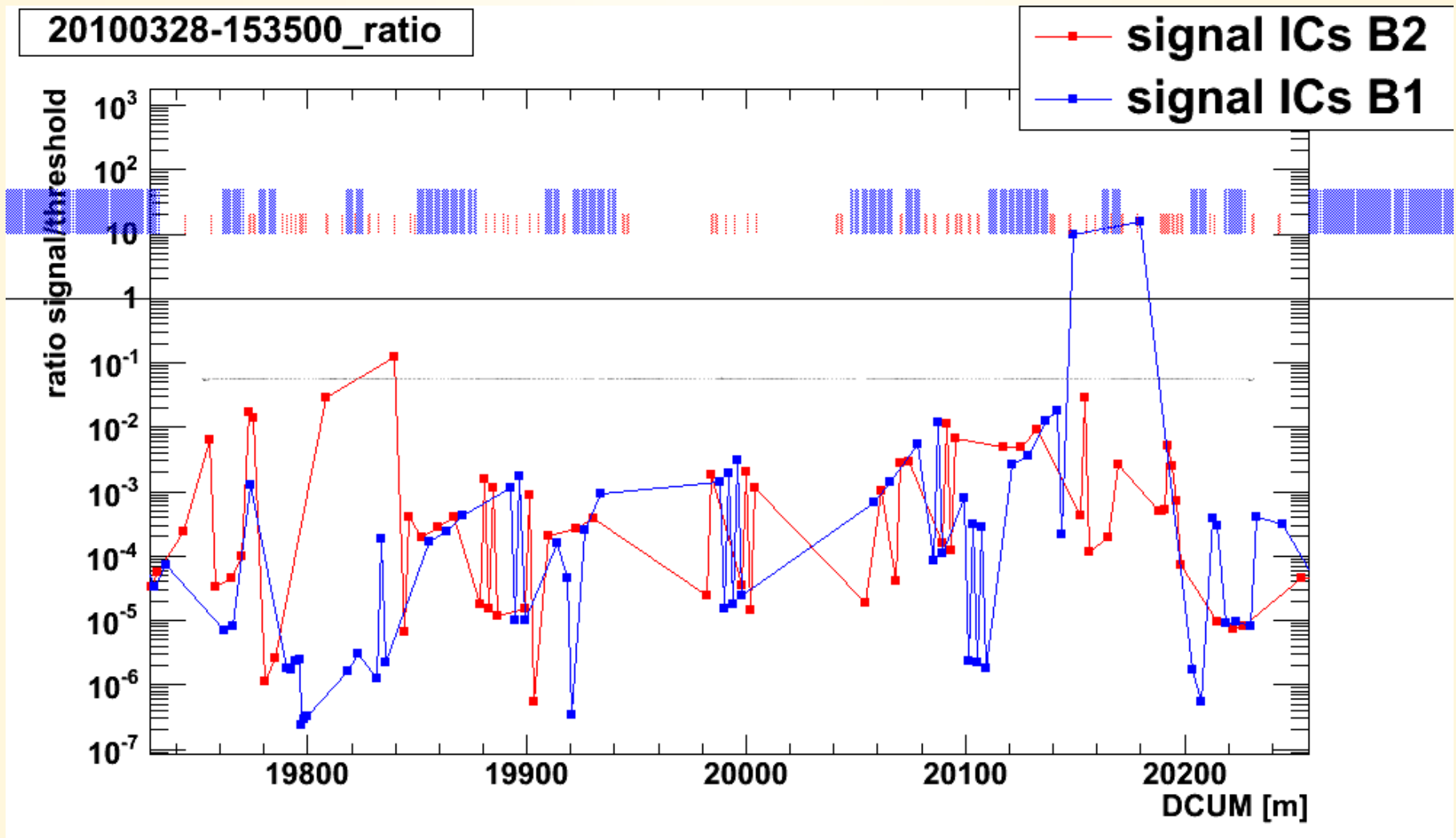
Excitation of beam 2 and relative losses



Constraint (a)

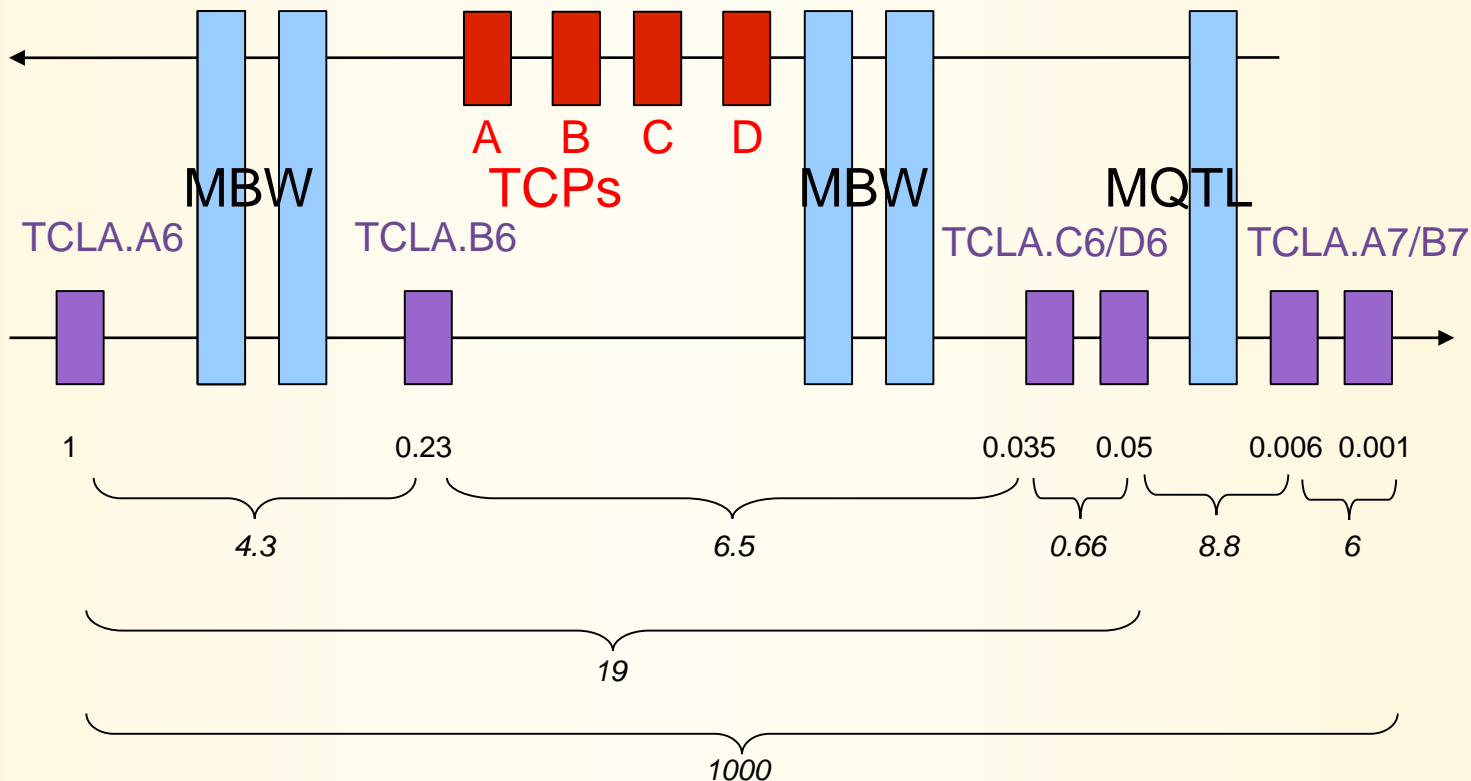
Resonance Crossing Beam 2 Horizontal

RATIO B2H



Constraint (b)

Moving TCLA.A6 into circulating beam 1 and relative losses



Scraping with TCLA

(First TCLA collimator TCLA.A6R7.B1 for beam1 moved into the beam. Recorded loss maps will allow to adjust TCLA thresholds more accurately. Beam dump triggered by BLM RS 655ms TCT collimator (TCTH.4L1) in IR1.

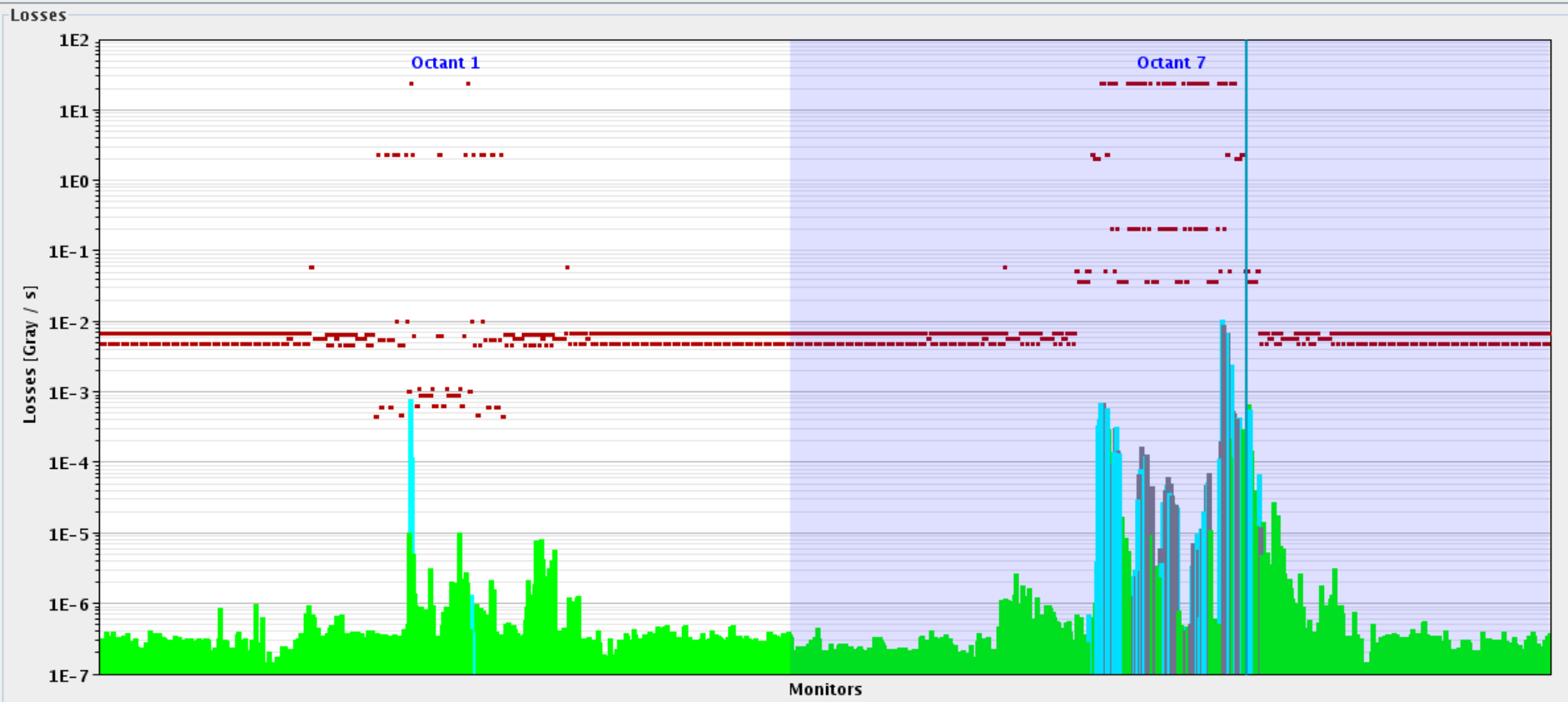
BLM/BLMLHC

Unit: Gray / s Scale: Log Integration Time: 1.3 s Start: 0 End: 511 Losses: Max Display: Acquisition

Filter (957 / 3879)

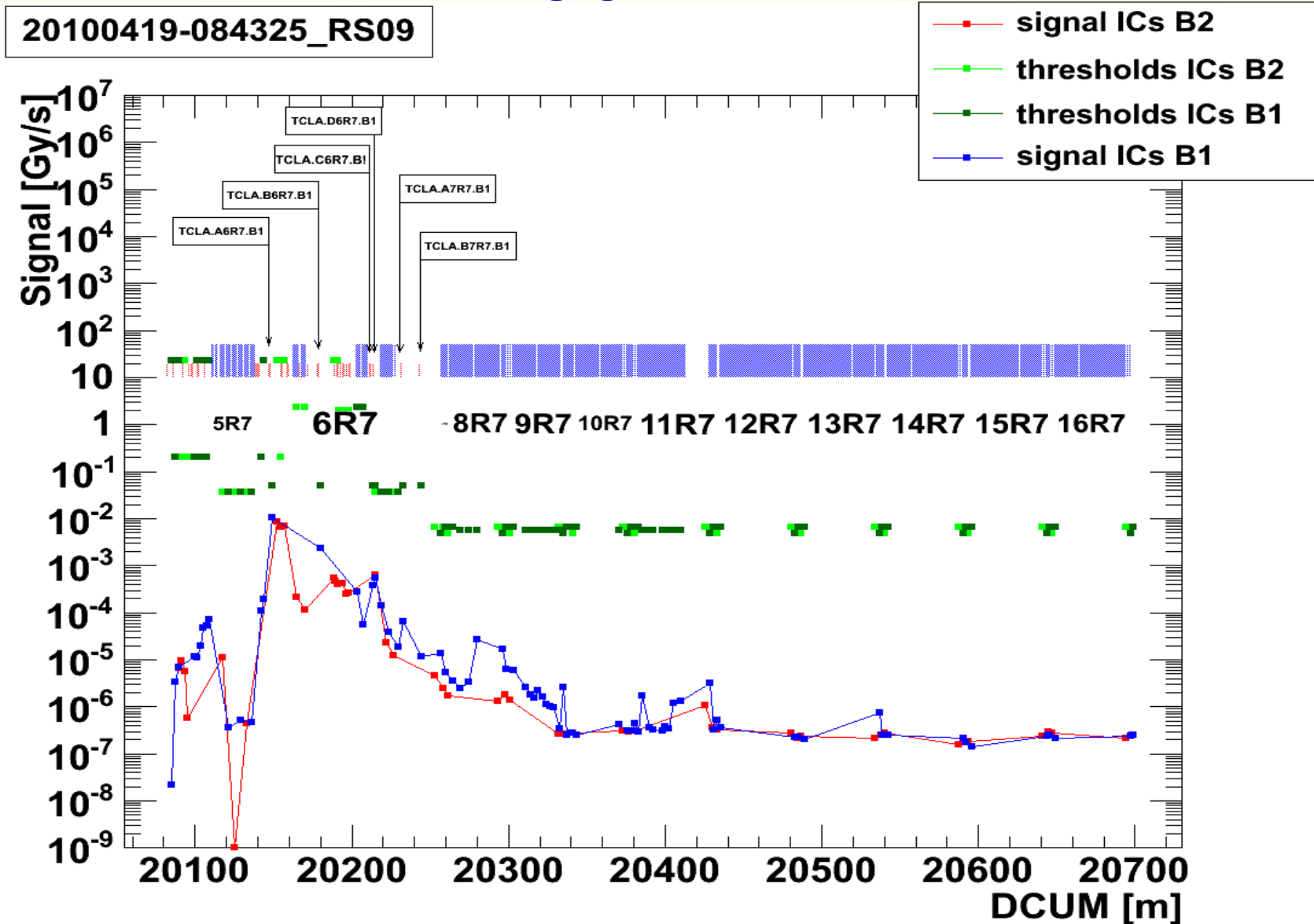
Location	Type	Section	Left Right	Octant	Beam	Transverse Position	Position on Element	Observed Element
<input checked="" type="checkbox"/> Quad	<input checked="" type="checkbox"/> IC	<input checked="" type="checkbox"/> LSS	<input checked="" type="checkbox"/> Left	<input checked="" type="checkbox"/> 1 <input type="checkbox"/> 5	<input checked="" type="checkbox"/> Beam 1	<input checked="" type="checkbox"/> External	<input checked="" type="checkbox"/> Entrance	%
<input checked="" type="checkbox"/> Other	<input type="checkbox"/> SEM	<input checked="" type="checkbox"/> DS	<input type="checkbox"/> Right	<input type="checkbox"/> 2 <input type="checkbox"/> 6	<input type="checkbox"/> Beam 2	<input checked="" type="checkbox"/> Internal	<input checked="" type="checkbox"/> Center	
<input checked="" type="checkbox"/> 2 Elements		<input checked="" type="checkbox"/> ARC		<input type="checkbox"/> 3 <input checked="" type="checkbox"/> 7		<input checked="" type="checkbox"/> Top	<input checked="" type="checkbox"/> Exit	
<input checked="" type="checkbox"/> Mobile				<input type="checkbox"/> 4 <input type="checkbox"/> 8		<input checked="" type="checkbox"/> Bottom		

19.04.2010 10:43:24



Moving TCLA.A6 into circulating beam 1

SIGNAL



TCLA thresholds now in IP7

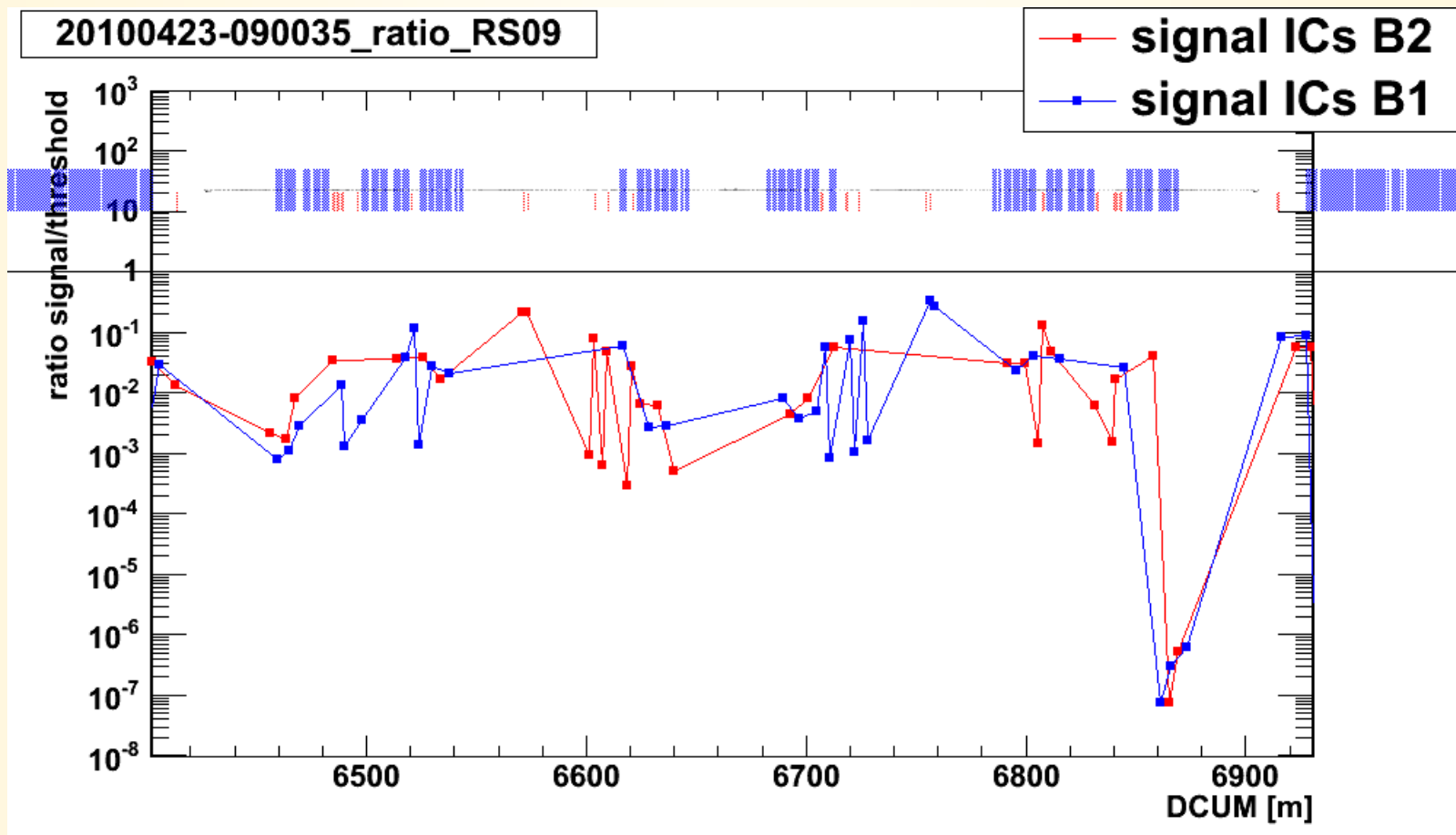
- The TCLA A & B in cell 6 (which sit in the shower of the TCP of the opposite beam) thresholds increased by **2500** with respect to the original values, to satisfy condition (a). (1600 would be enough)
- The TCLA C & D in cell 6 and TCLA A & B in cell 7 (which do not sit in the shower of the TCP) thresholds increased by a factor of 2 with respect to the original values, in order to satisfy condition (a). Condition (b) is satisfied as well.
- **Protection** of TCLA A & B in cell 6 against potentially dangerous **direct proton impact**:
 - Only the thresholds of TCLA C and D in cell 6 can protect. But a factor of **40** (20×2) more protons can directly hit TCLA A & B, than originally specified.
 - **Constraint (b) not satisfied**

-
- Should be ok for the moment:
 - If all our arguments are true, it is not more dangerous than what we have had in the machine since 16. April 2010 (all TCLA thresholds increased by factor 50 above the original value)
 - It cannot be assured that any kind of potential damage is excluded.
 - Estimation of damage needed

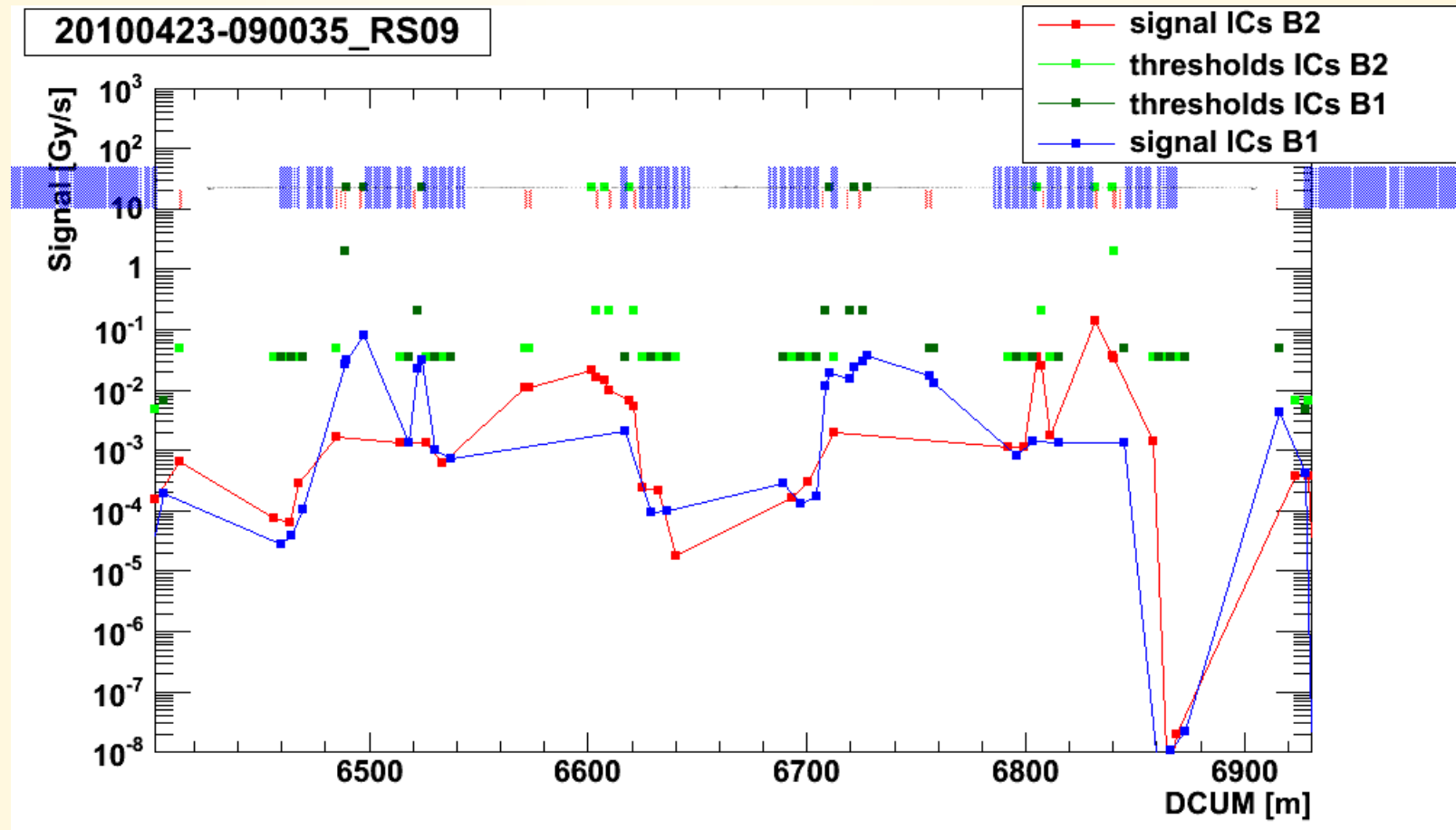
TCLA thresholds now in IP3 (last changed 16.4.2010)

- 50 times higher than the original values from Ralph
- Constraint (b) not necessarily satisfied for all TCLAs (not proven to be satisfied)
- Not changed this week:
 - For momentum cleaning on 23.4.2010, the signal to threshold values for the TCLA are not significantly higher than for other elements.
 - In fact the TCLAs do not seem to sit in the shower of the TCPs.
 - The TCTs in IP2 had the highest signal to threshold ratio. They went over threshold while the TCLAs did not.
 - We don't have data of direct proton losses on the TCLAs yet. So we cannot determine the protection level be distant monitors.

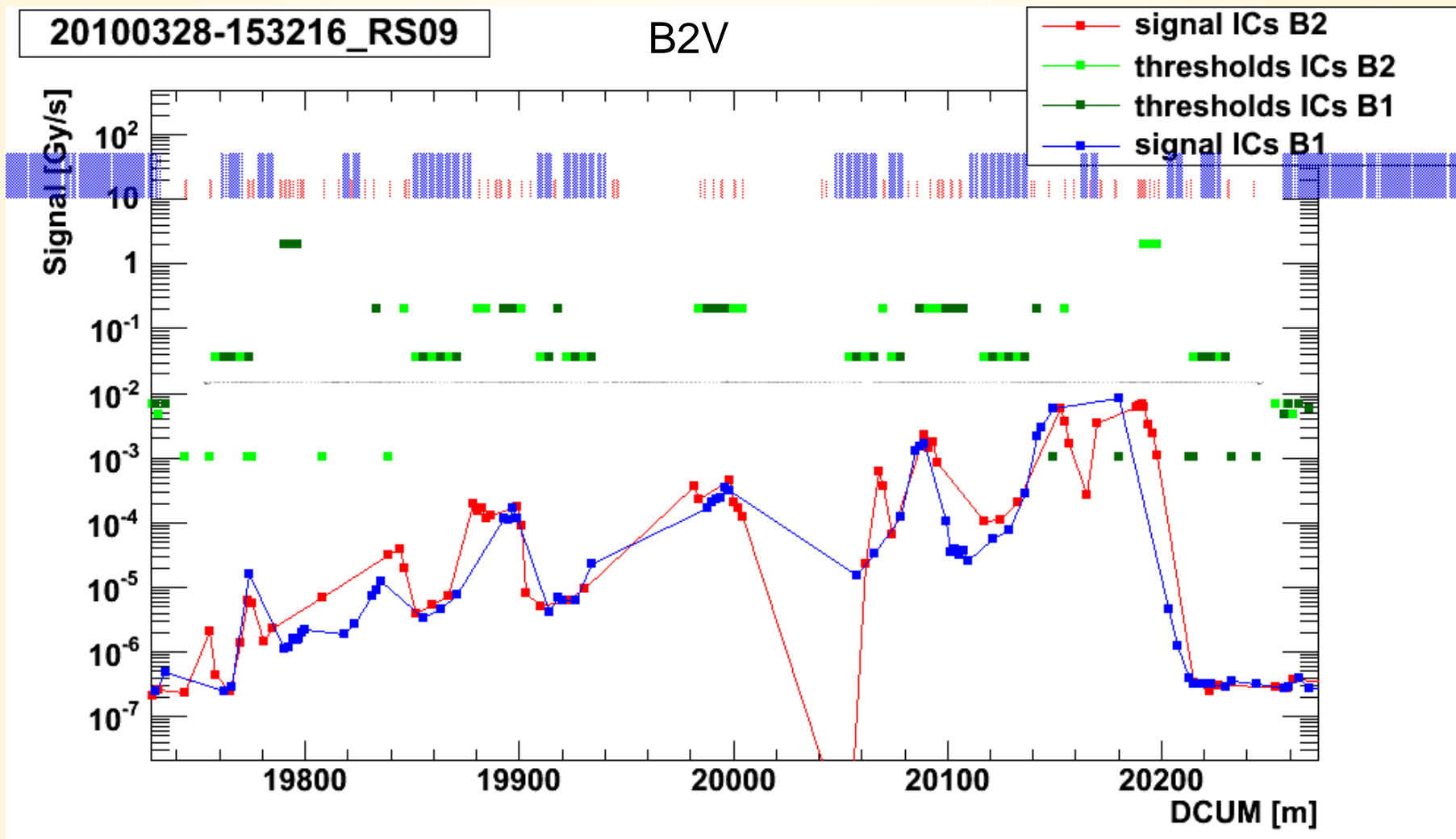
Momentum cleaning IP3 Ratio



Momentum cleaning IP3



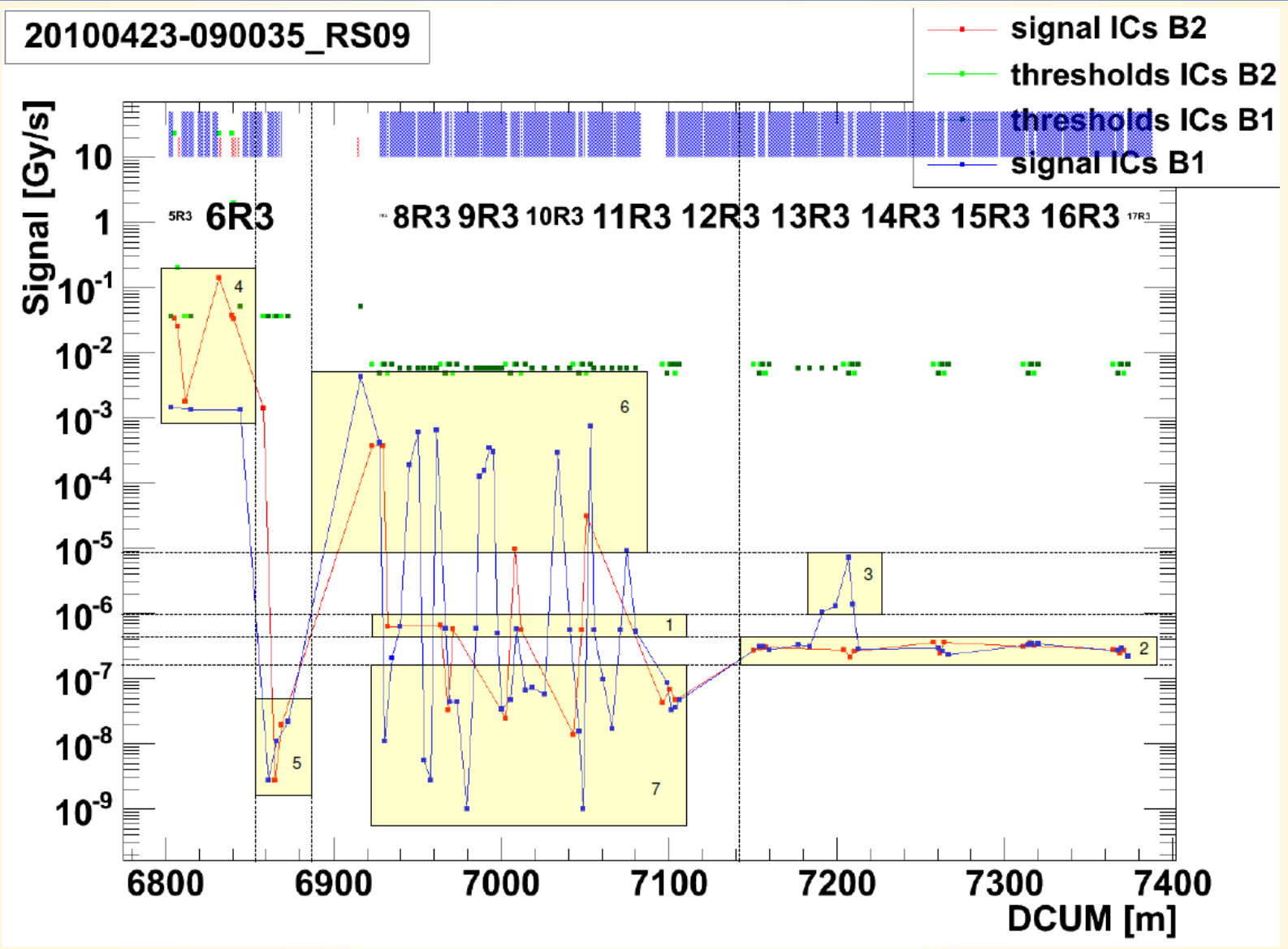
Compare to 'shower' case in IP7



Further Changes – disconnected from BIS

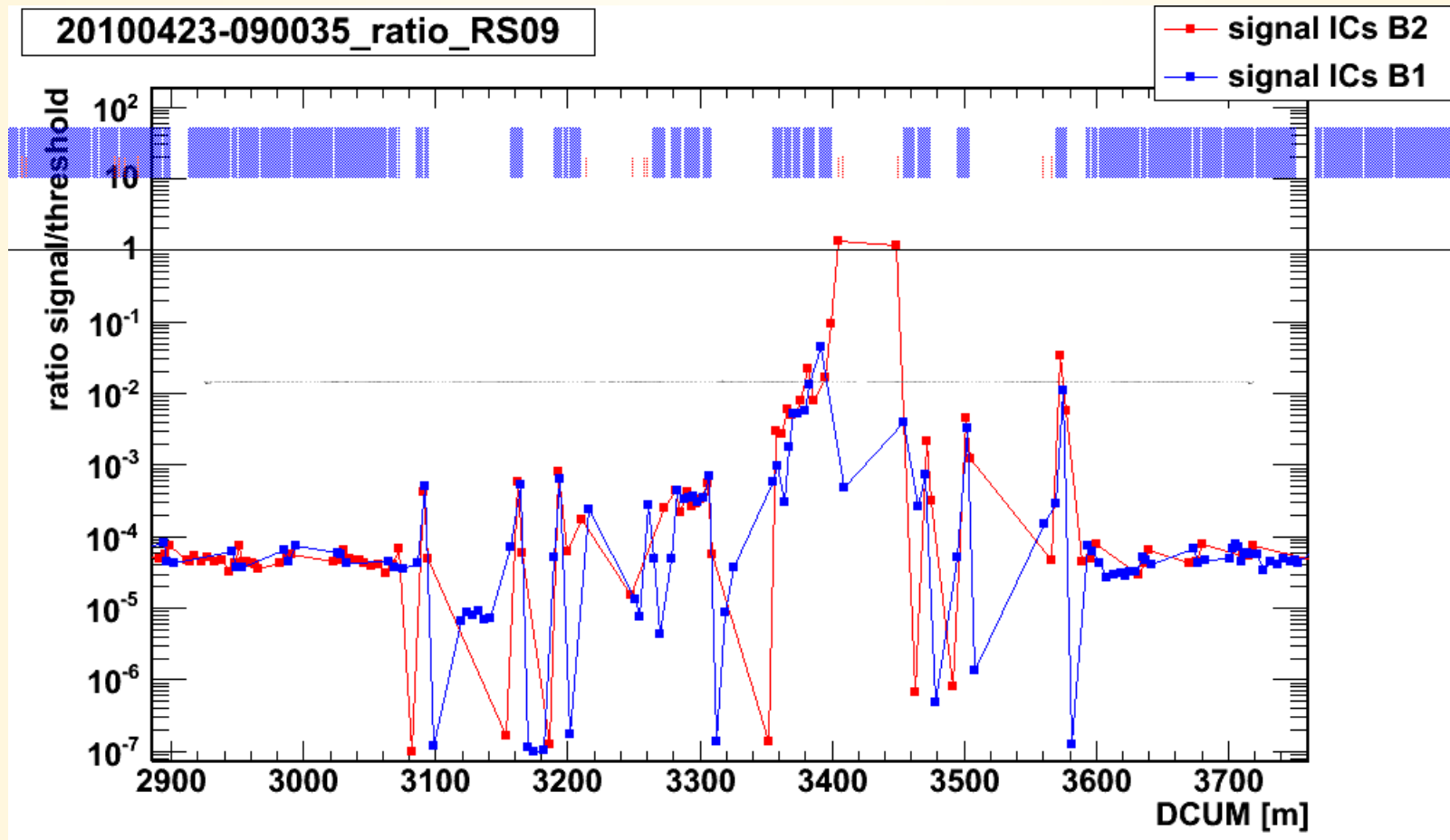
- Disable (disconnect from BIS) all monitors which have no element installed to be protected
- List had been taken from Collimator webpage on 12. February 2010 and confirmed by Stefano
 - 8 (all) TCHS (since 2009)
 - 36 (all) TCSM (since 2009)
 - 2 TCLA (since 16.4.2010)
 - 2 TCP
 - 1 TCSG
 - 4 TCL
- Additionally the 2 TCAPA are disconnected from BIS (always have been)

Start to study noise right of IP3

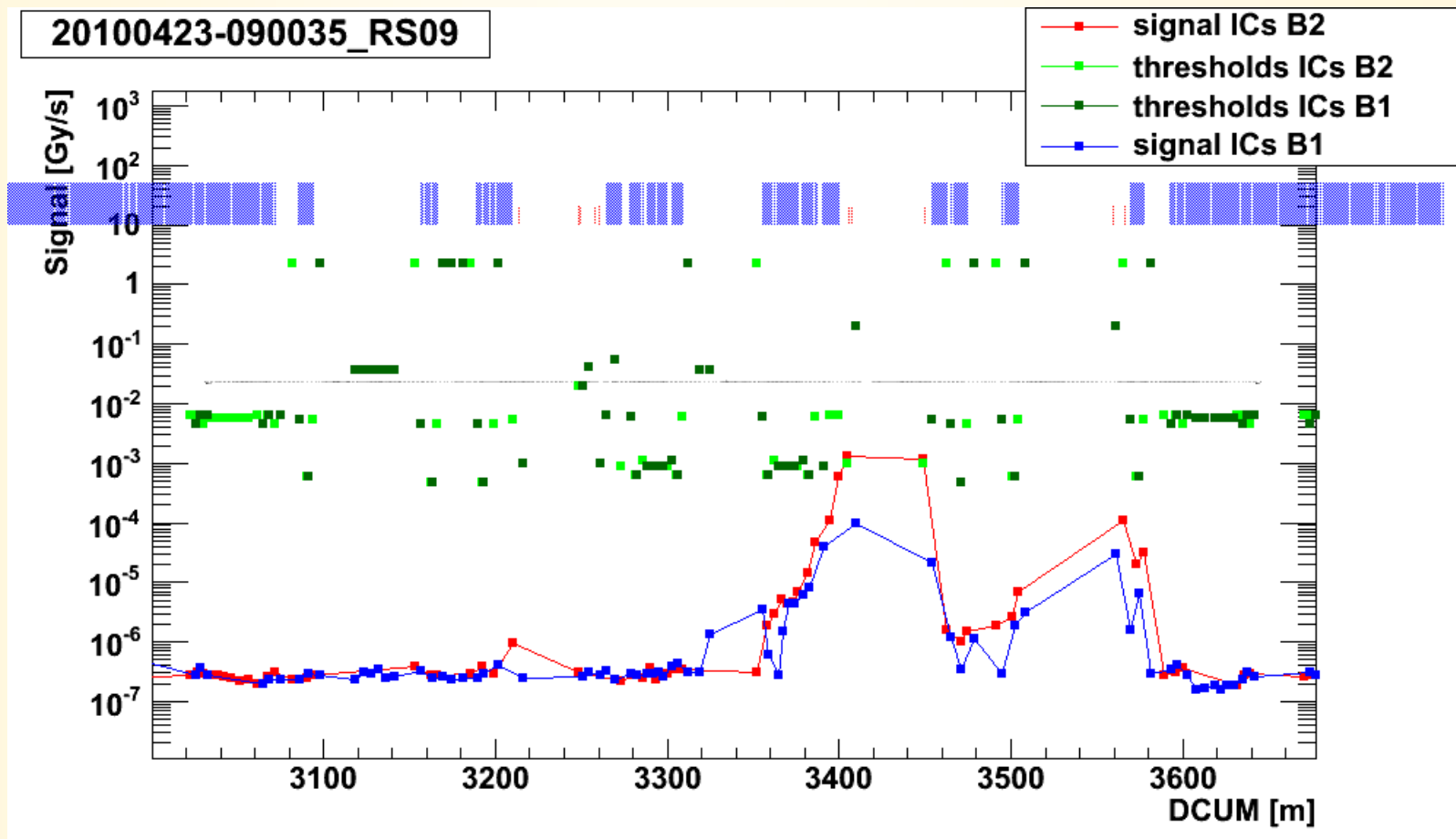


Some more slides

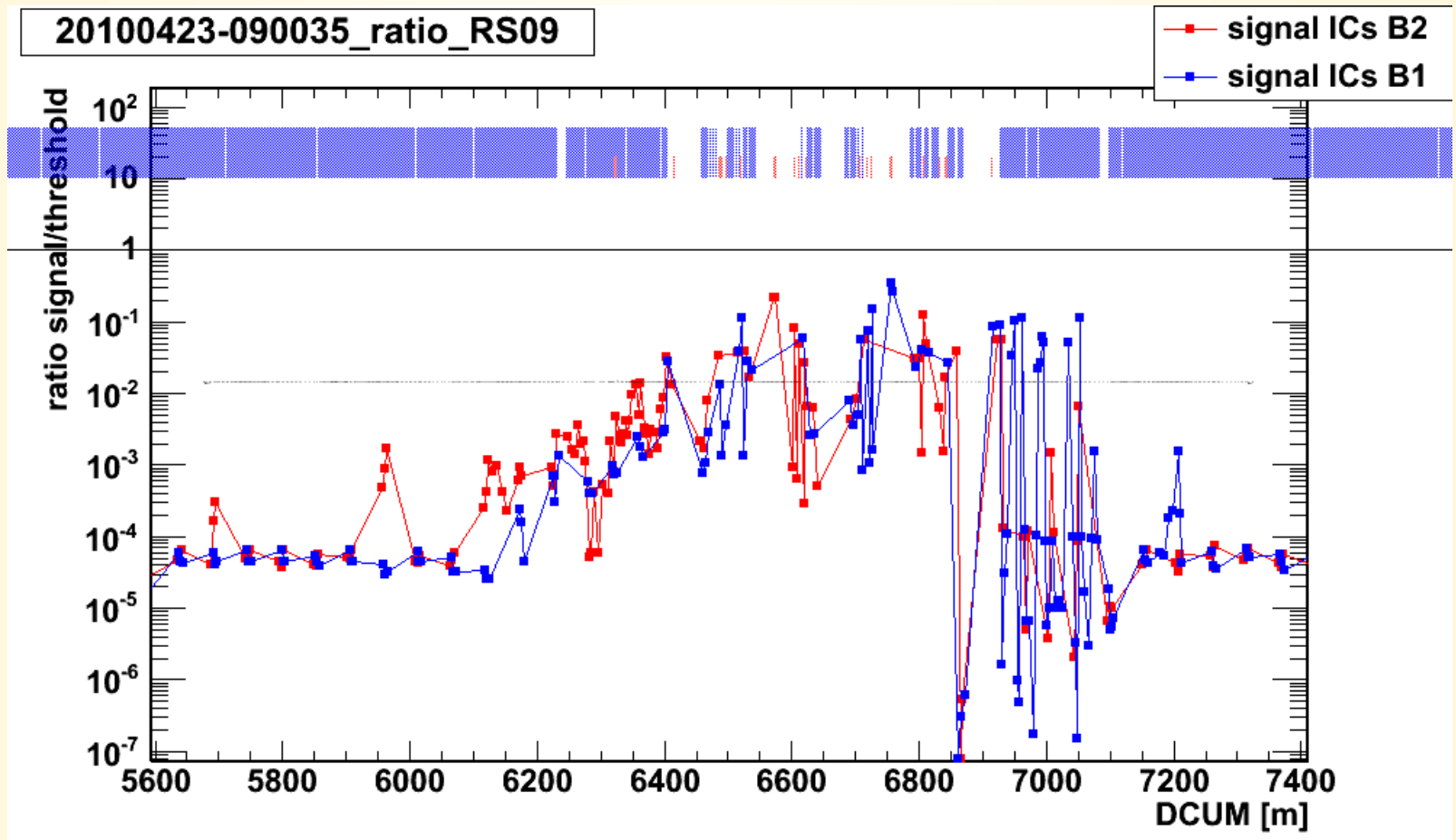
Momentum cleaning IP2 TCT over threshold



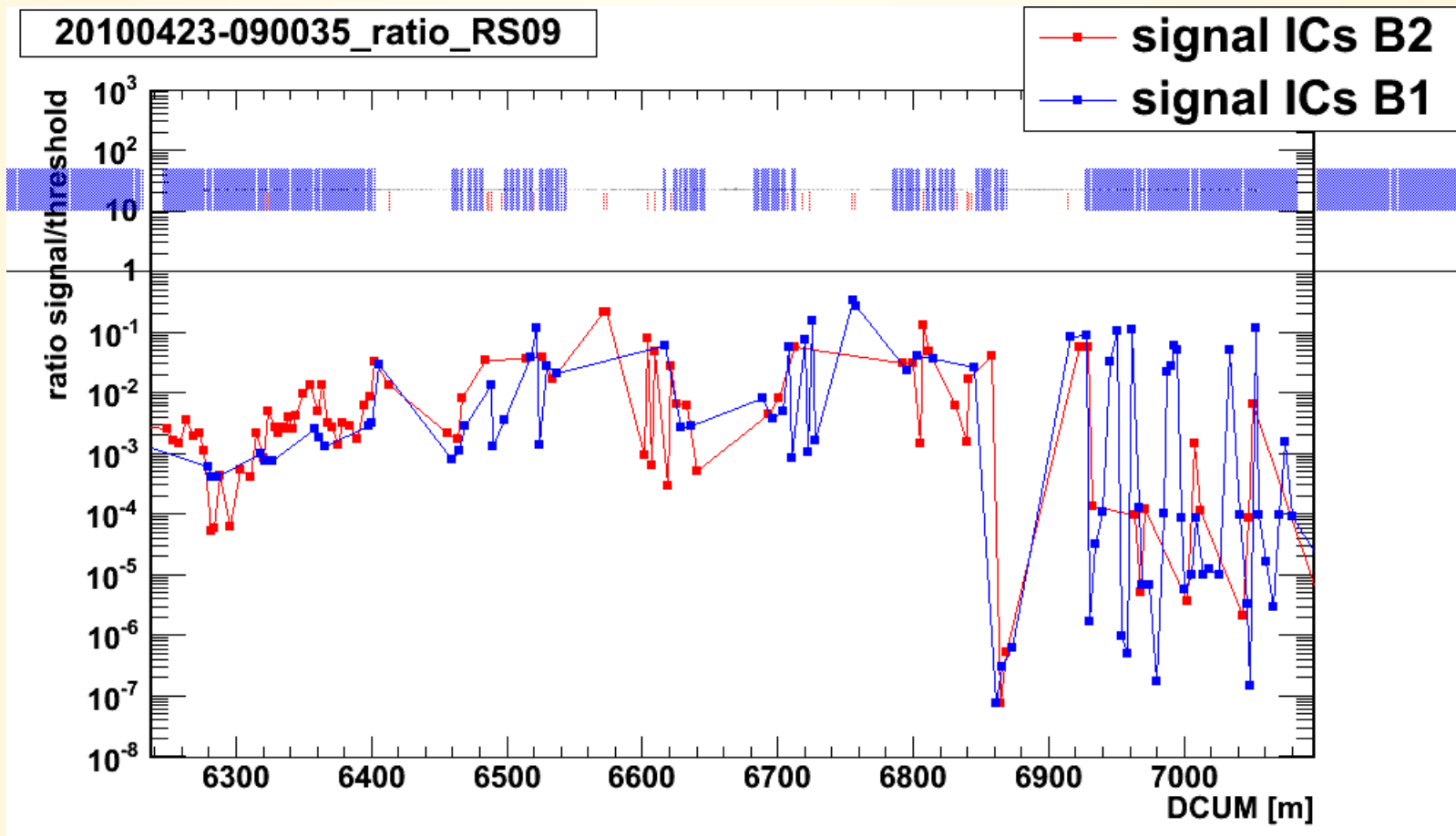
Momentum cleaning IP2 TCT over threshold



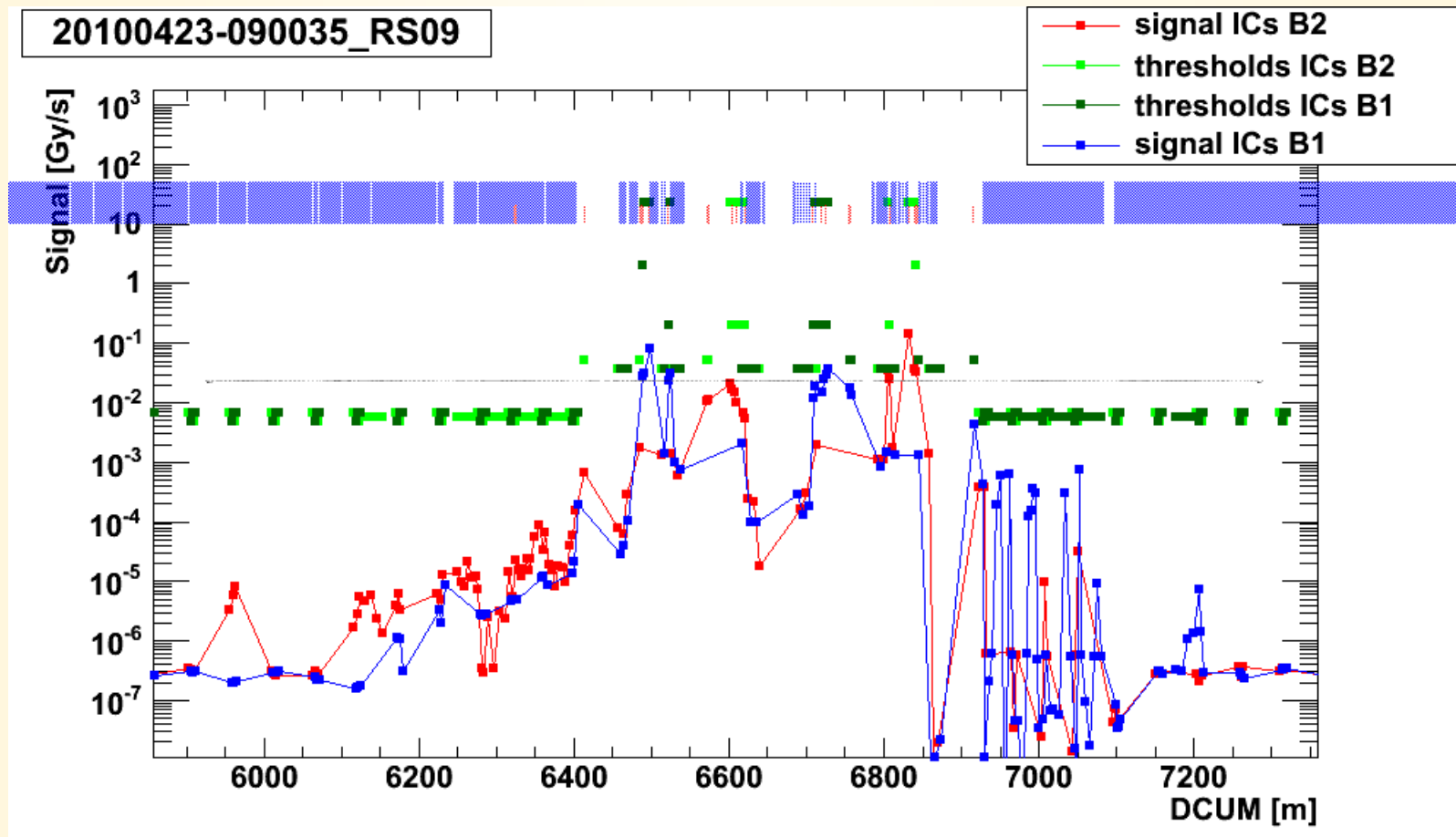
Momentum cleaning IP3 Ratio



Momentum cleaning IP3 Ratio



Momentum cleaning IP3



Momentum cleaning IP3

