BLM Threshold Changes for the 2012 run

E. Nebot del Busto for the BLM team

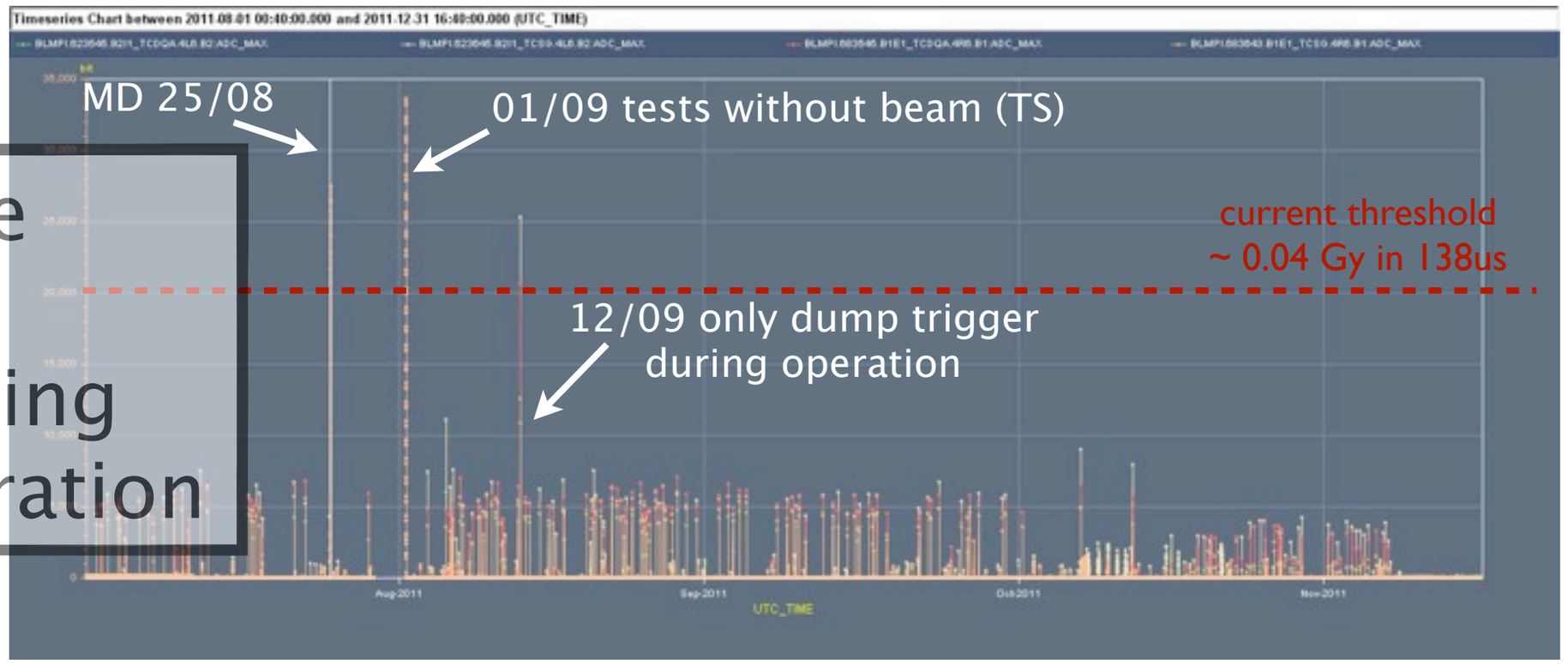
Outlook

- ✓Direct Dump BLMs
- ✓Injection region. LIC
- ✓UFO. Quench hunting in the ms scale
- ✓ Collimation:
  - Luminosity losses. TCTs
  - New layout in IP2

Direct Dump BLMs

Motivation

- ✓ Direct Dump connected to LBDS since 03/07/2011 (with maximum thresholds). Threshold current value set on 01/09/2011. Too conservative?

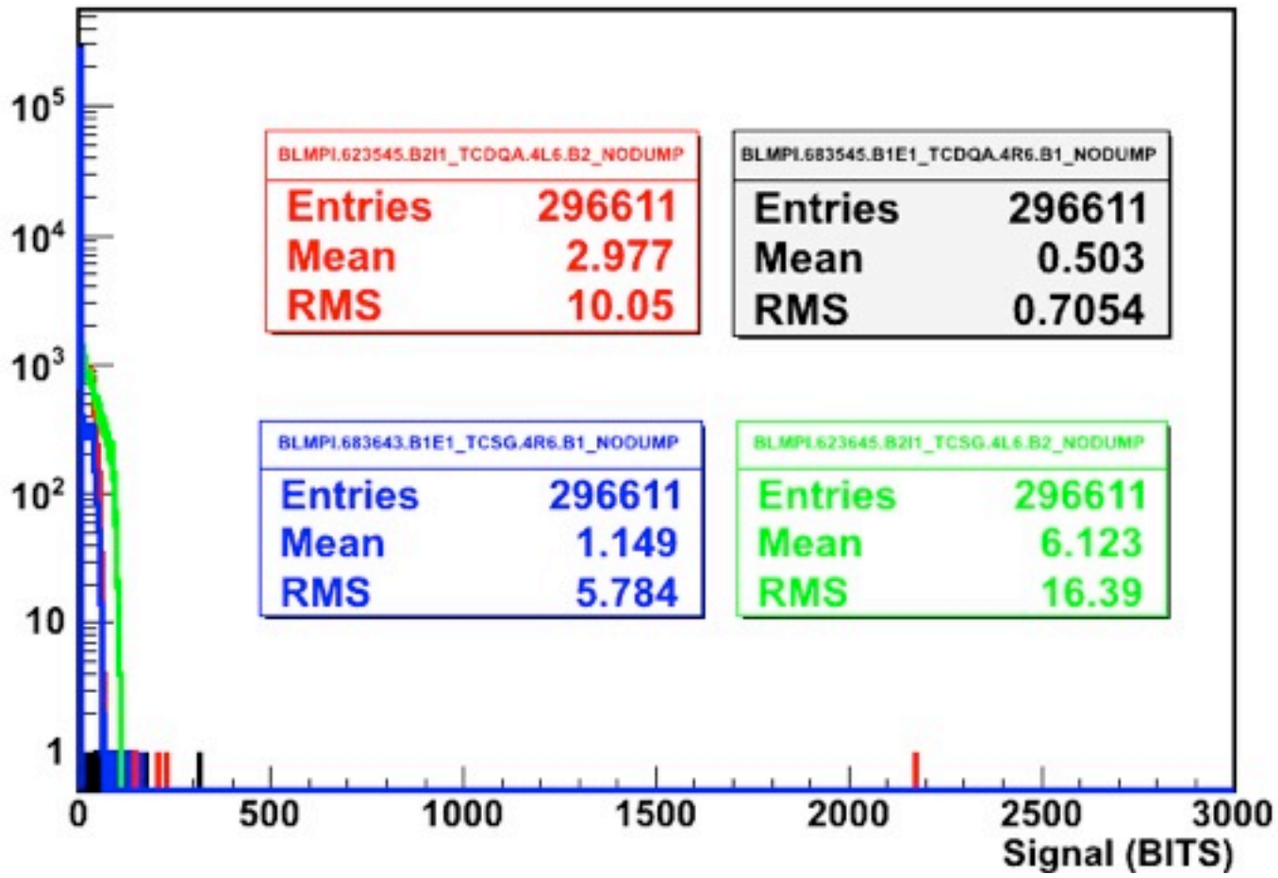


YES!. Only one signal reach threshold during standard operation

- ✓ Compromise for new dump thresholds:
  - Prevention from unnecessary beam dumps
  - Protection in case of BIS or BLM failure

Direct Dump Signal distribution

- ✓ Largest signals observed during beam dumps (requested by other system). Not a threat from the operational point of view
- ✓ Study of the signal distribution excluding dumps
- ✓ One single signals over 500 ADC counts
- ✓ MD 02/07/2011. Non linear chromaticity measurements

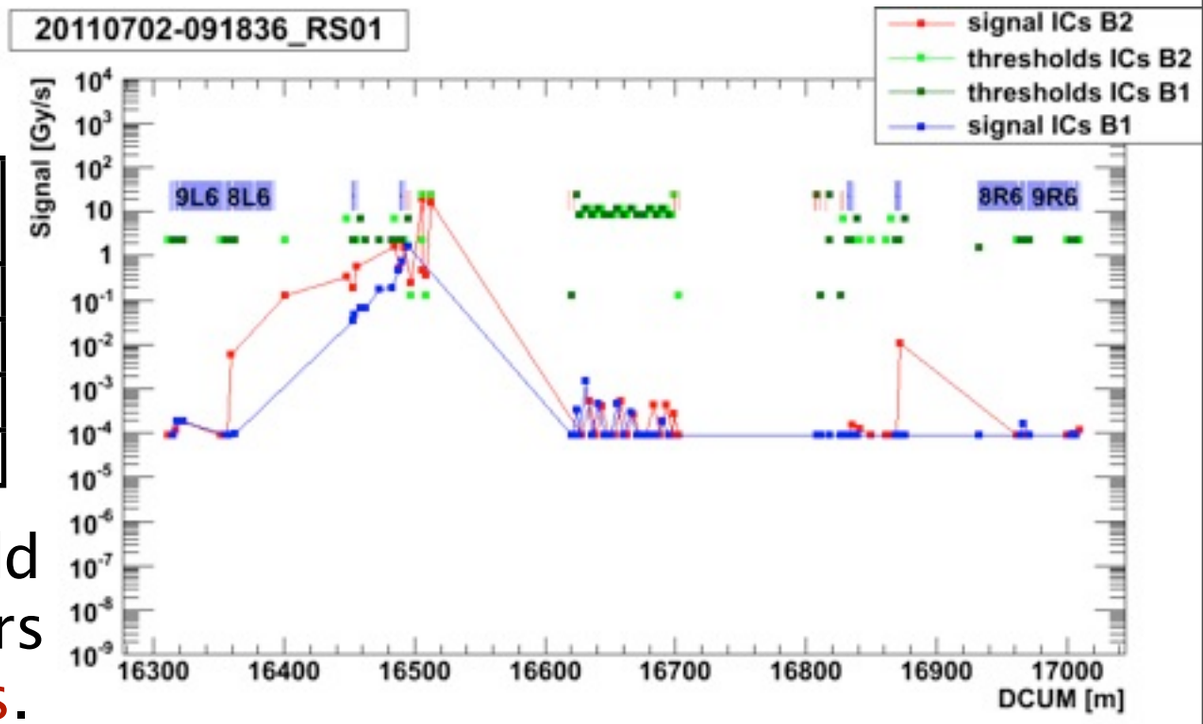


- ✓ Threshold estimated according to signals during this particular event

Threshold estimation

Monitors over threshold are maskable

Expert name	dcum (m)	S_RS01 (Gy/s)	T_RS01 (Gy/s)	S/T
BLMEI.04L6.B2I10_TCDQA.B4L6.B2	16508.9	0.362	0.127	2.84
BLMEI.04L6.B2I10_TCDQM.4L6.B2	16497.0	0.241	0.127	1.89
BLMEI.04L6.B2I10_TCSG.4L6.B2	16505.5	19.1	23.17	0.83
BLMEI.04L6.B2I10_TCDQA.A4L6.B2	16512.5	14.8	23.17	0.683



- Threshold estimation based on the threshold (23.17 Gy/s on RS01) of the standard monitors located at the same dcum as the DD monitors.

- Assumptions :
1) Due to the effect of the analog cable length, the charge collected by a BLM in the 40us integration window is about 40% of the total (modeled with a 120us RC filter).
2) The signal recorded in the DD BLM is a factor 2 lower than the one in the standard IC due to different position respect to the beam.

Tdd = (2 x (23.17 Gy/s x 40 us) / 0.40) / 2.0 uGy/BIT = 2317 BITS

Thr in Gy in RS01

Assumption 1

Assumption 2

Suggestion. Factor 3 safety => DUMP THRESHOLD ~ 3 x Tdd ~ 7500 BITS = 0.015 Gy

Injection/LIC

Motivation

- ✓ Reach factor 5 margin between dump threshold and losses at injection
- ✓ Little Ionization Chambers (LIC). LHC-IC type detectors with reduced active volume (~30) and filled with N2 at low pressure (0.4 bar)
- ✓ 7 Monitors in IP2/8 (in elements protected by other BLMs) identified to exercise LICs
- ✓ Sensitivity reduction by ~60
- ✓ Require noise estimation. Reduction in sensitivity may bring the noise level close to the dump threshold

Noise estimation

- ✓ Noise assumed to come from analog cables (not detector themselves). Estimated from previously located ICs

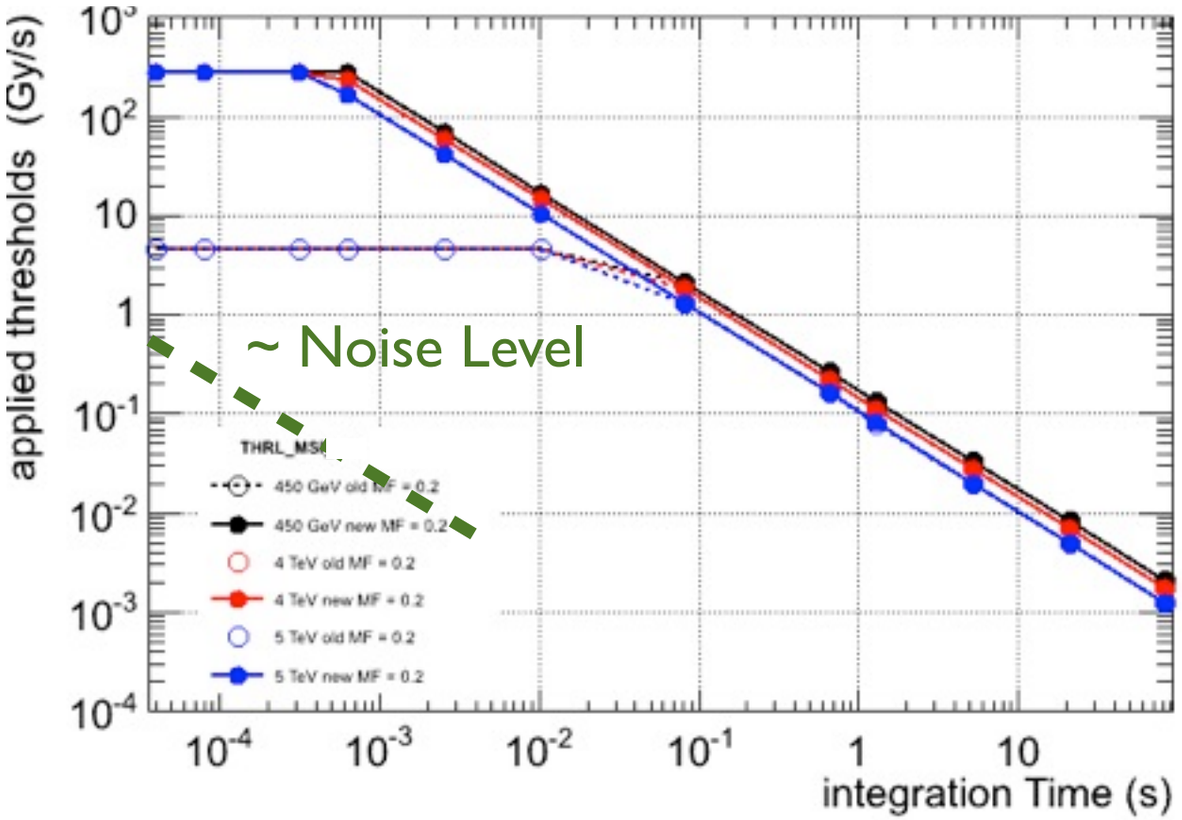
NOISE AND APPLIED THRESHOLD @ 5TeV

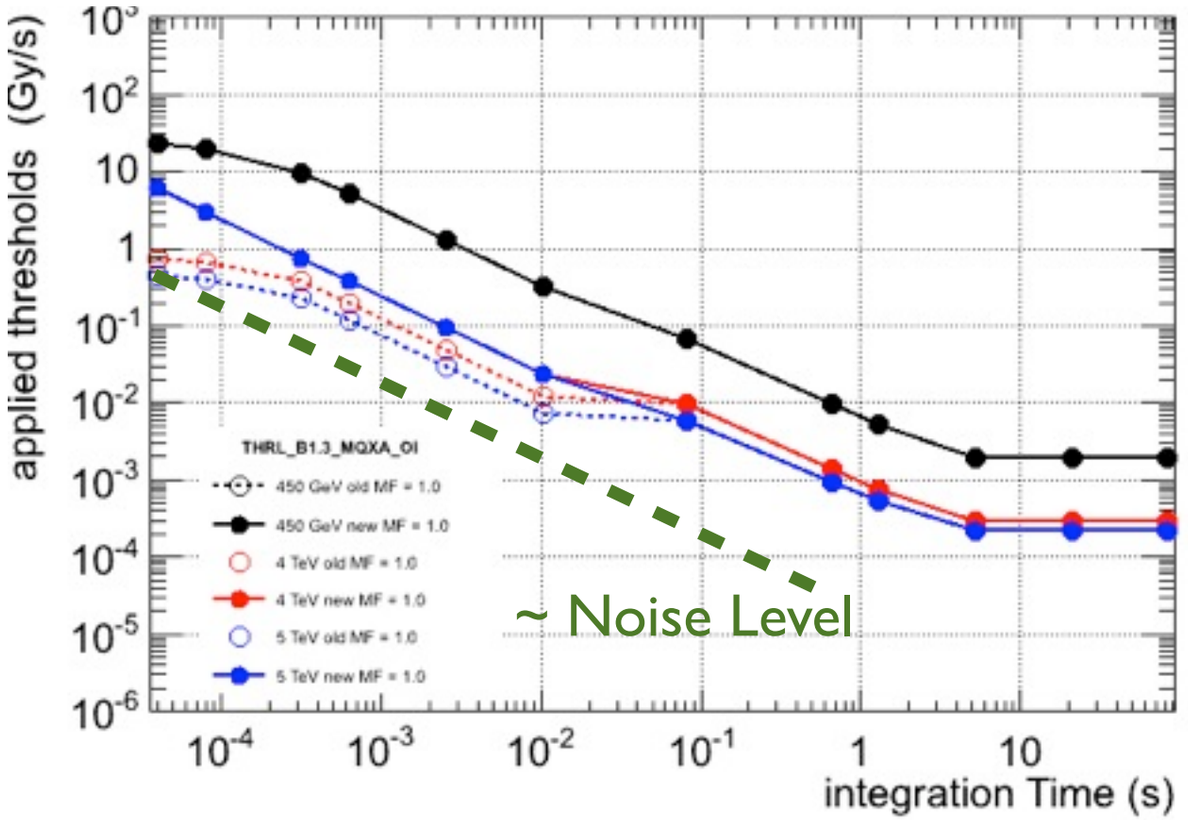
Monitor Name	Noise (Gy/s)	App T (Gy/s)	App T LIC (Gy/s)	Thr(LIC)/Noise
BLMQI.08L2.B2I10_MQML	1.00E-02	1.38	0.023	2.3
BLMEI.06L2.B1E0_MSIB	1.41E-02	4.74	0.079	5.6
BLMEI.04L2.B1E10_TDI.4L2.B1	2.19E-02	23.7	0.395	18.0
BLMQI.03R8.B1I30_MQXA	1.04E-02	0.44	0.007	0.7
BLMEI.04R8.B2E10_MBXB	2.72E-02	15.99	0.267	9.8
BLMEI.06R8.B2E0_MSIB	1.13E-02	4.74	0.079	7.0
BLMEI.04R8.B2E10_TDI.4L2.B1	1.81E-02	23.7	0.395	21.8

- ✓ Margin 5-10 between noise and dump threshold for comfortable operation.
- ✓ Thresholds increased to ~5xNoise level for critical monitors

LIC Thresholds

- ✓ The 7 selected monitors keep their old thresholds (adapted to detector sensitivity)
- ✓ Two exceptions:
  - Electronic saturation (gain up to a factor 60)
  - Threshold are pushed up to ~5xNoise level when necessary (2 cases)





UFO

Motivation

✓ Estimation of dumping UFOs (in the LHC Arcs) at higher energies
- Th(3.5TeV) ~ 5xTh(7TeV)
- Signal(7TeV) ~ 3xSignal(3.5TeV)
- UFO rate independent of energy

2 Dumps 3.5TeV (observed)
3 Dumps 4TeV (expected)
81 Dumps 7TeV (expected)

✓ Mitigation = Increase BLM thresholds. Probe quench level in the ms scale

- **Increase BLM thresholds for all arc BLMs in sectors 12, 34, 56, 67 by a factor 3.3.**
- If a quench occurs: **reduce BLM thresholds** according to observations.

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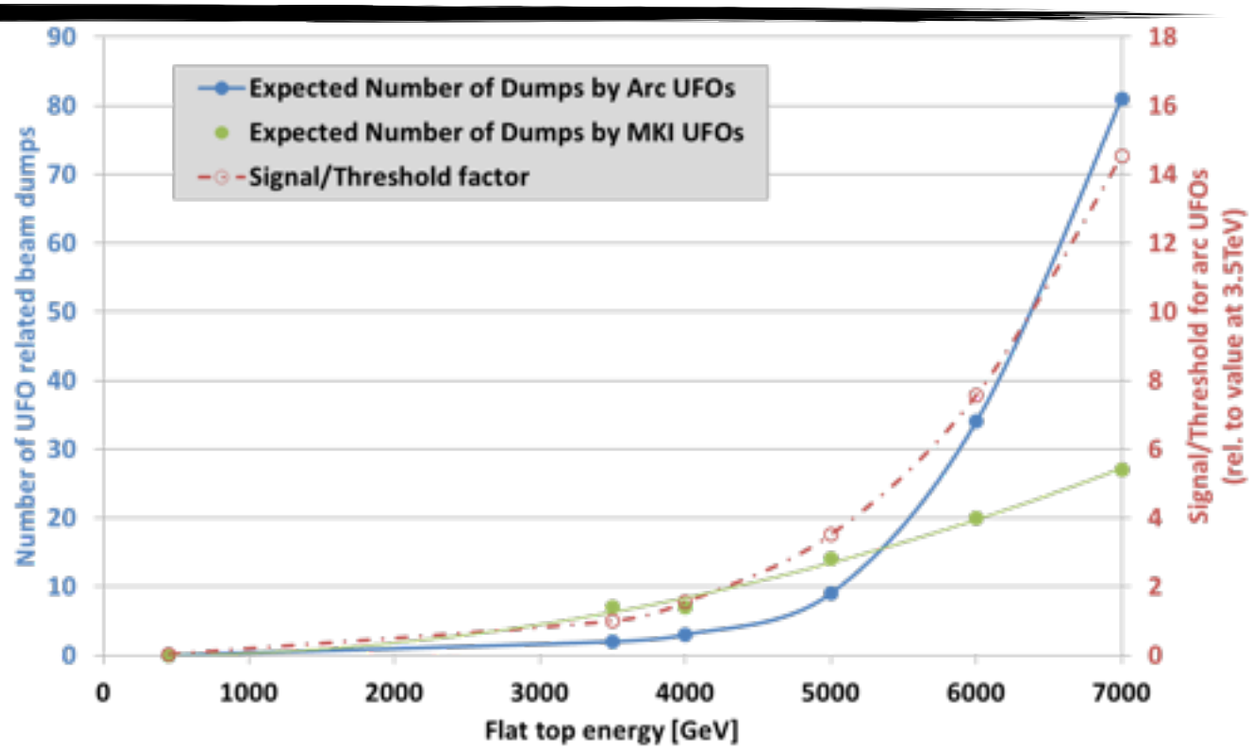

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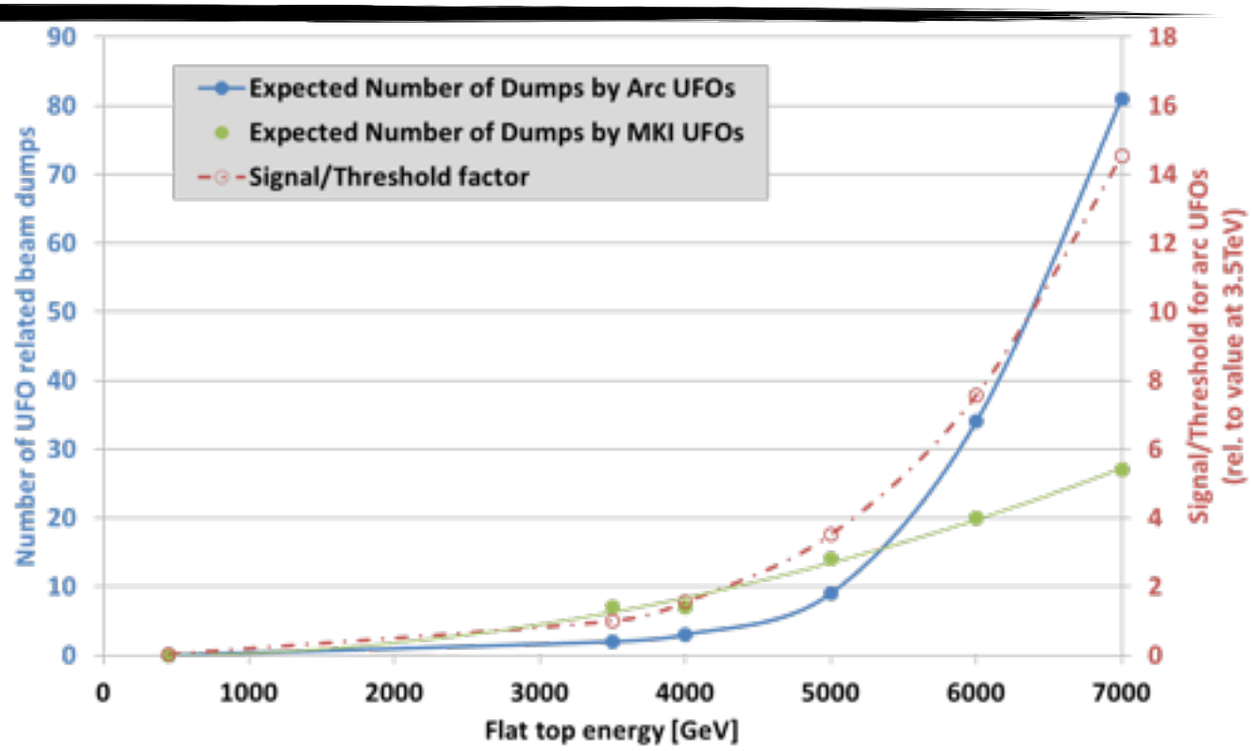

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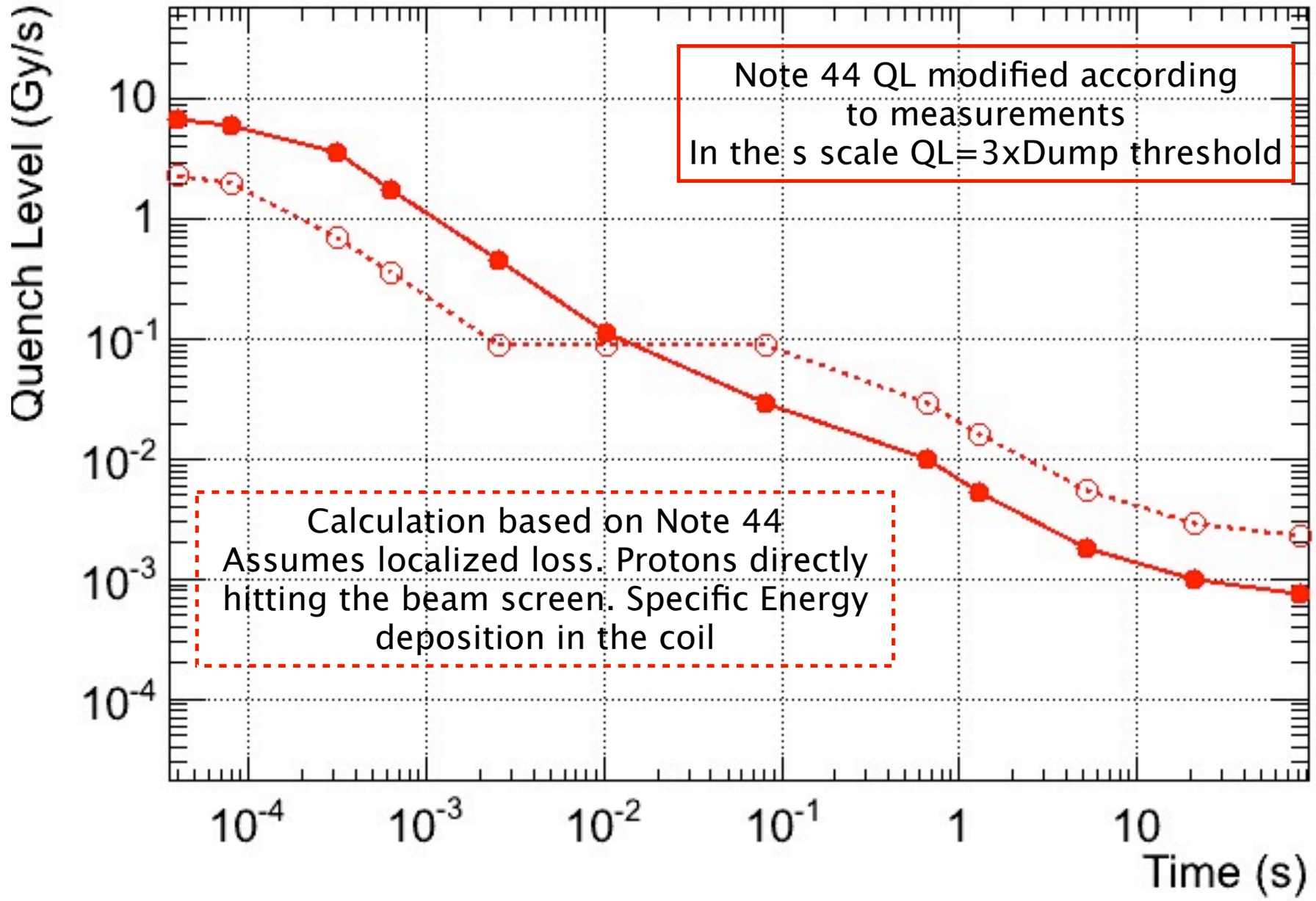
	Sector	Measured at 1A at:	Largest R_excess measured (uOhm at warm)	Approximate Emax (5 magnet quenches)
✓	**12**	warm	39±9	**4.5TeV**
	23	cold	80±40	-
✓	**34**	warm	36±8	**4.8TeV**
	45	warm	53±15	**3.6TeV**
✓	**56**	warm	20±7	5.8TeV
✓	**67**	warm	31±9	**4.8TeV**
	78	cold	90±30	-
	81	cold	120±40	-

A. Siemko, Chamonix Workshop 2012.

- **Increase BLM thresholds for all arc BLMs in sectors 12, 34, 56, 67 by a factor 3.3.**
- If a quench occurs: **reduce BLM thresholds** according to observations.

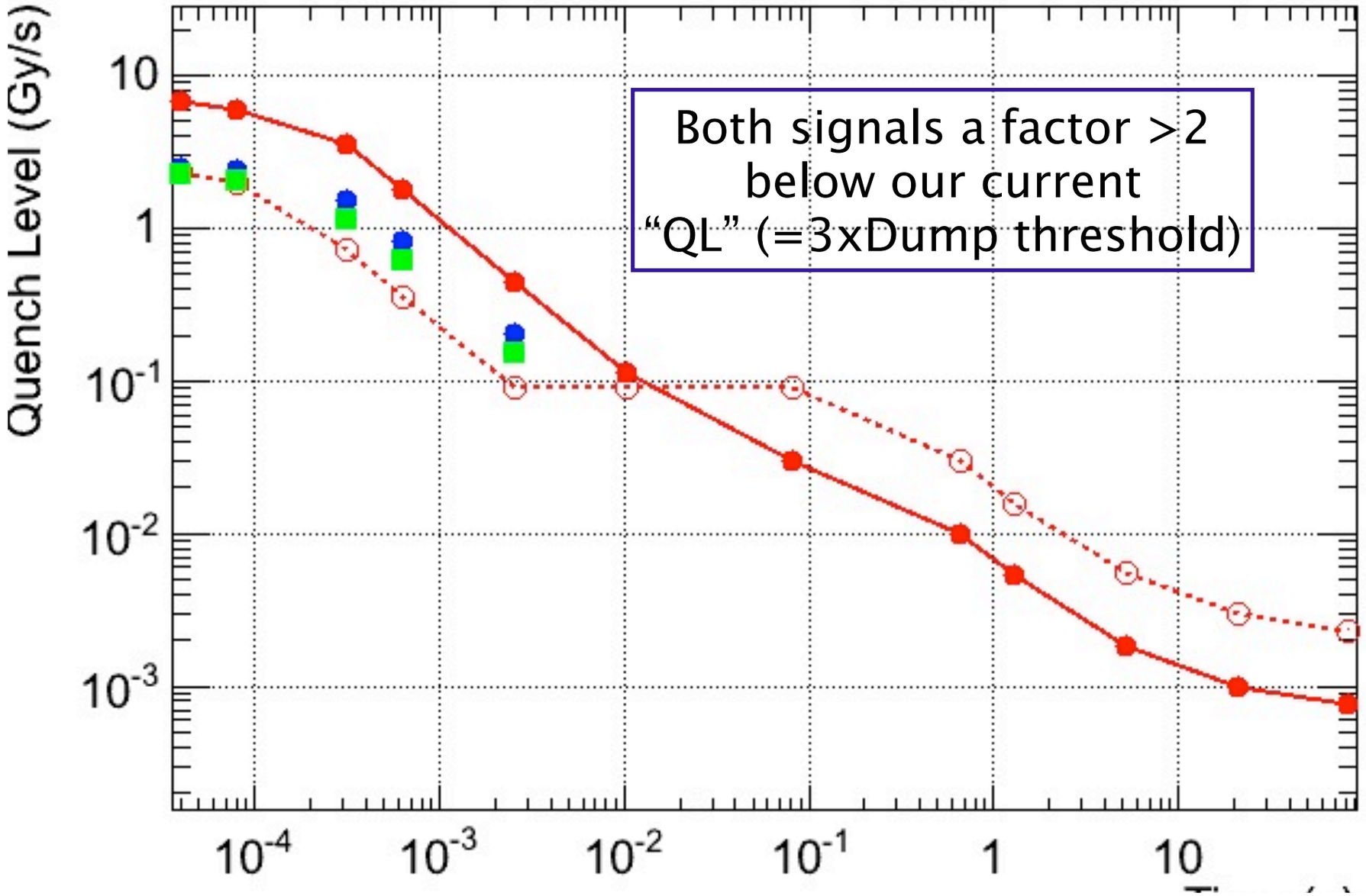
Quench levels

- ✓ Quench level for MQ @ 3.5 TeV



How far are we from Quench level?

✓ Two ARC dumps during 2011.



✓ Easiest. Bring thresholds to QL by increasing them by 3.3 via the monitor factor.

Collimator thresholds

Threshold at TCTs

- ✓ Increase of luminosity induced losses by a factor ~2 may require threshold increase.
- ✓ Due to increase in energy it is recommended to keep current thresholds and modify them according to observation. Factor 10/5/2 increase available via MF.

Chart | Table

BLM	Threshold Factors	
BLMEI.04R1.B2I10_TCTVA.4R1.B2		0.100000
BLMEI.04R1.B2I10_TCTH.4R1.B2		0.100000
BLMEI.04L2.B1E10_TCTH.4L2.B1	9.6.2011	0.500000
BLMEI.04L2.B1E10_TCTVB.4L2		1.000000
BLMEI.04R2.B2E10_TCTVB.4R2		0.100000
BLMEI.04R2.B2E10_TCTH.4R2.B2		0.100000
BLMEI.04L5.B1I10_TCTH.4L5.B1		0.100000
BLMEI.04L5.B1I10_TCTVA.4L5.B1		0.100000
BLMEI.04R5.B2I10_TCTVA.4R5.B2		0.100000
BLMEI.04R5.B2I10_TCTH.4R5.B2		0.100000
BLMEI.04L8.B1E10_TCTH.4L8.B1	21.4.2011	0.200000
BLMEI.04L8.B1E10_TCTVB.4L8	24.7.2011	0.200000
BLMEI.04R8.B2E10_TCTVB.4R8		1.000000
BLMEI.04R8.B2E10_TCTH.4R8.B2	9.6.2011	0.500000
BLMEI.04L1.B1I10_TCTH.4L1.B1		0.100000
BLMEI.04L1.B1I10_TCTVA.4L1.B1		0.100000

Injection losses + delay filter 14.10.2010

UFOs at MKI

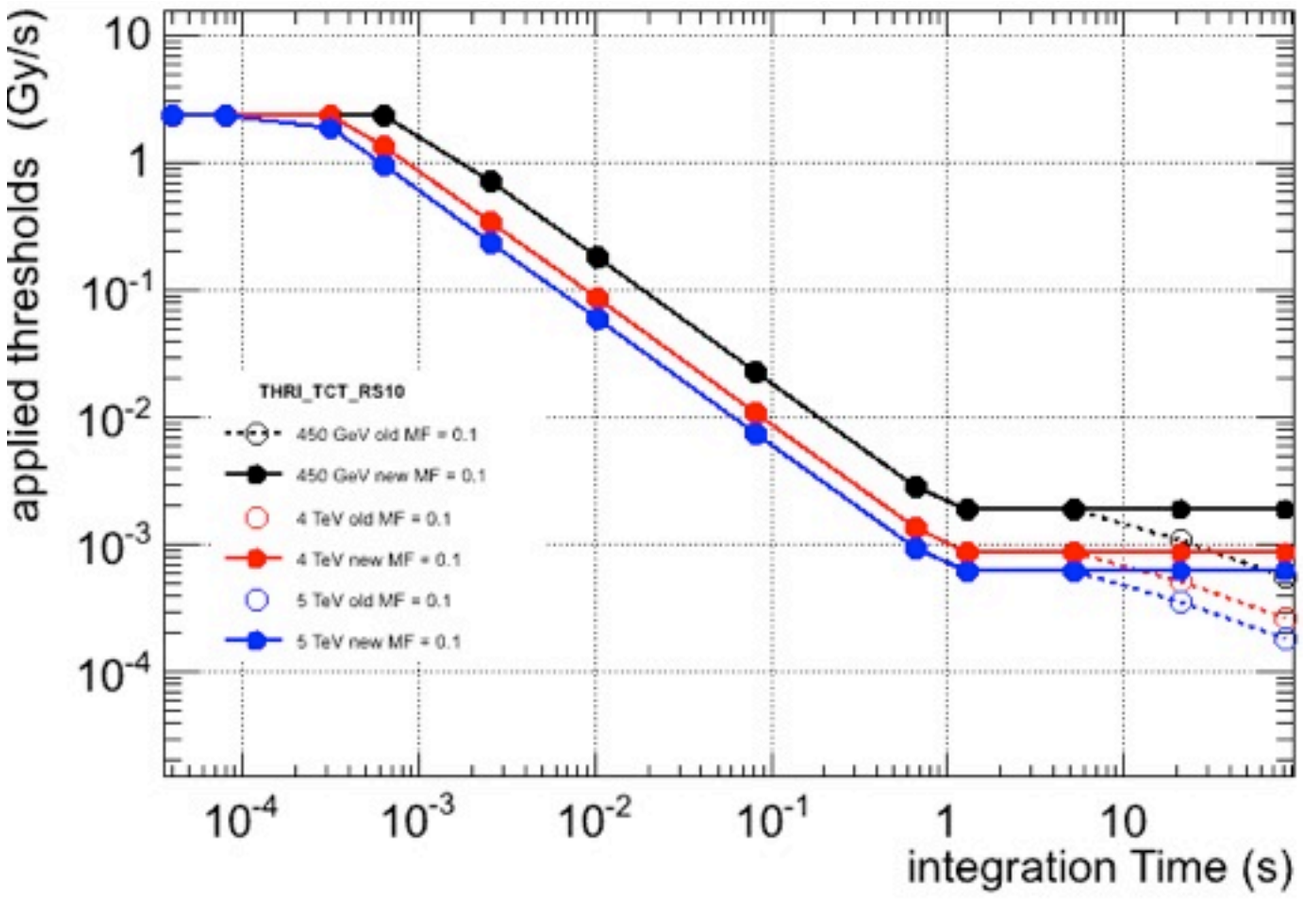
Most critical monitor. S/T ~0.2 in the 83s RS.

'LHCb lumi debris' Vacuum activity

UFOs at MKI

Threshold at TCTs

- ✓ Specific Luminosity loss correction may be applied to keep the MF functionality free.
- ✓ Allow constant loss rate after a certain RS (typically RS10).



Factor of threshold increase in RS11 and RS12.

Energy	RS11	RS12
450 GeV	1.72	3.34
4.TeV	1.74	3.38

New layout in IP2

- ✓ Three new monitors installed due to change on layout (new TCTVA, removal of TCTVB and shift on TCTs).
- ✓ Thresholds account for damage levels of protected element (not showers coming from elsewhere).

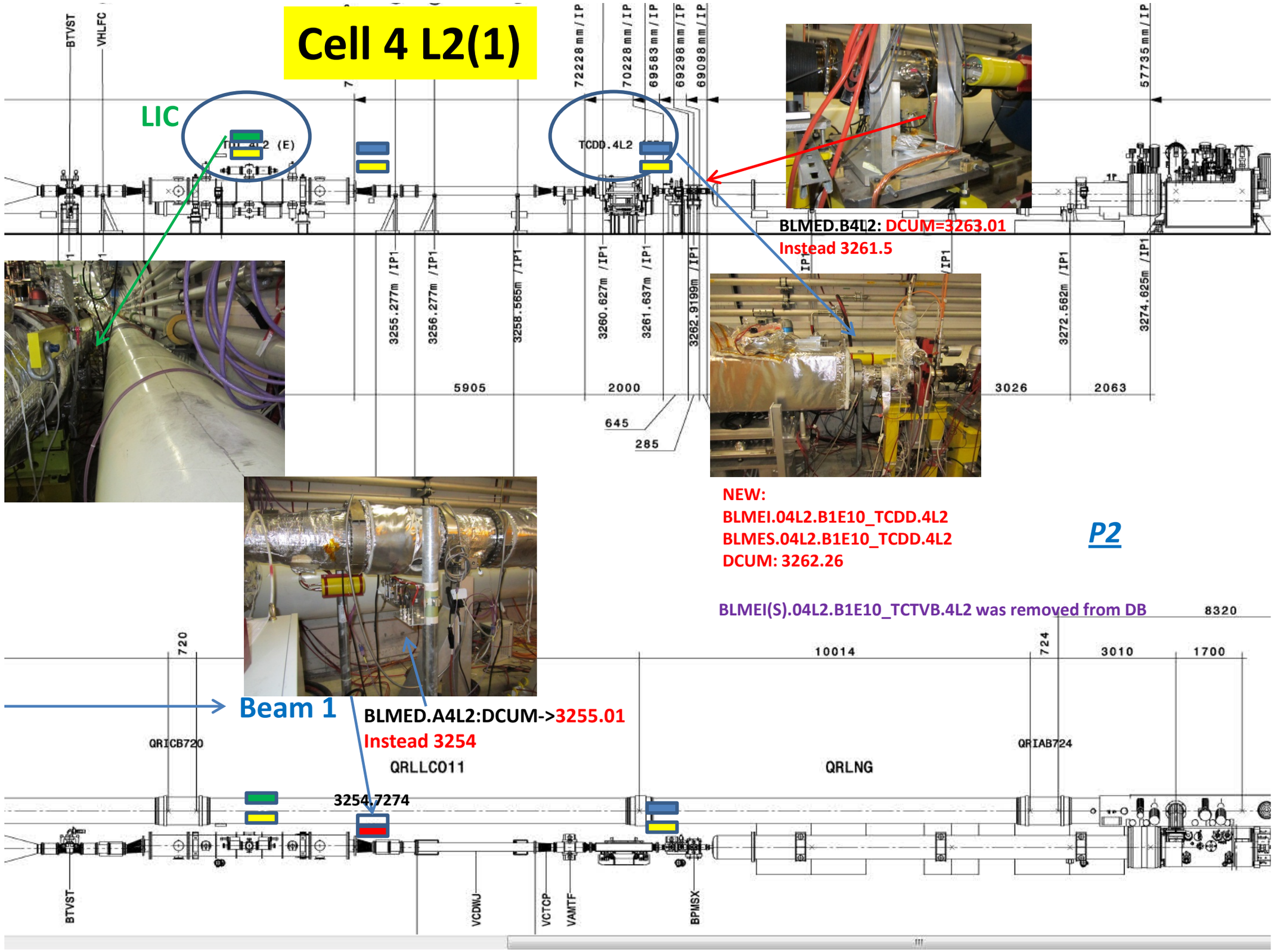
NEW	SHIFTED	DECOUPLED
BLMEI.04L2.B1E10_TCTVA.4L2.B1 BLMEI.04R2.B2E10_TCTVA.4R2.B2	TAKE TCTVB THRESHOLDS	
BLMEI.04L2.B1E10_TCDD.4L2	MAXIMUM THRESHOLDS (NOT CONNECTED TO BIS)	
BLMEI.04L2.B1E10_TCTH.4L2.B1 BLMEI.04L2.B1E10_TCTH.4L2.B1_T BLMEI.04R2.B2E10_TCTH.4R2.B2 BLMEI.04R2.B1I10_TCLIA.4R2	KEEP OLD THRESHOLDS (relative distance to TCT ~ same)	
BLMEI.04R2.B1I10_MBRC BLMEI.04R2.B1I20_MBRC	KEEP OLD THRESHOLDS	
BLMEI.04R2.B2E10_drift (previously BLMEI.04R2.B2E10_TCTVB.4R2)	MAXIMUM THRESHOLDS (NOT CONNECTED TO BIS)	

Conclusions

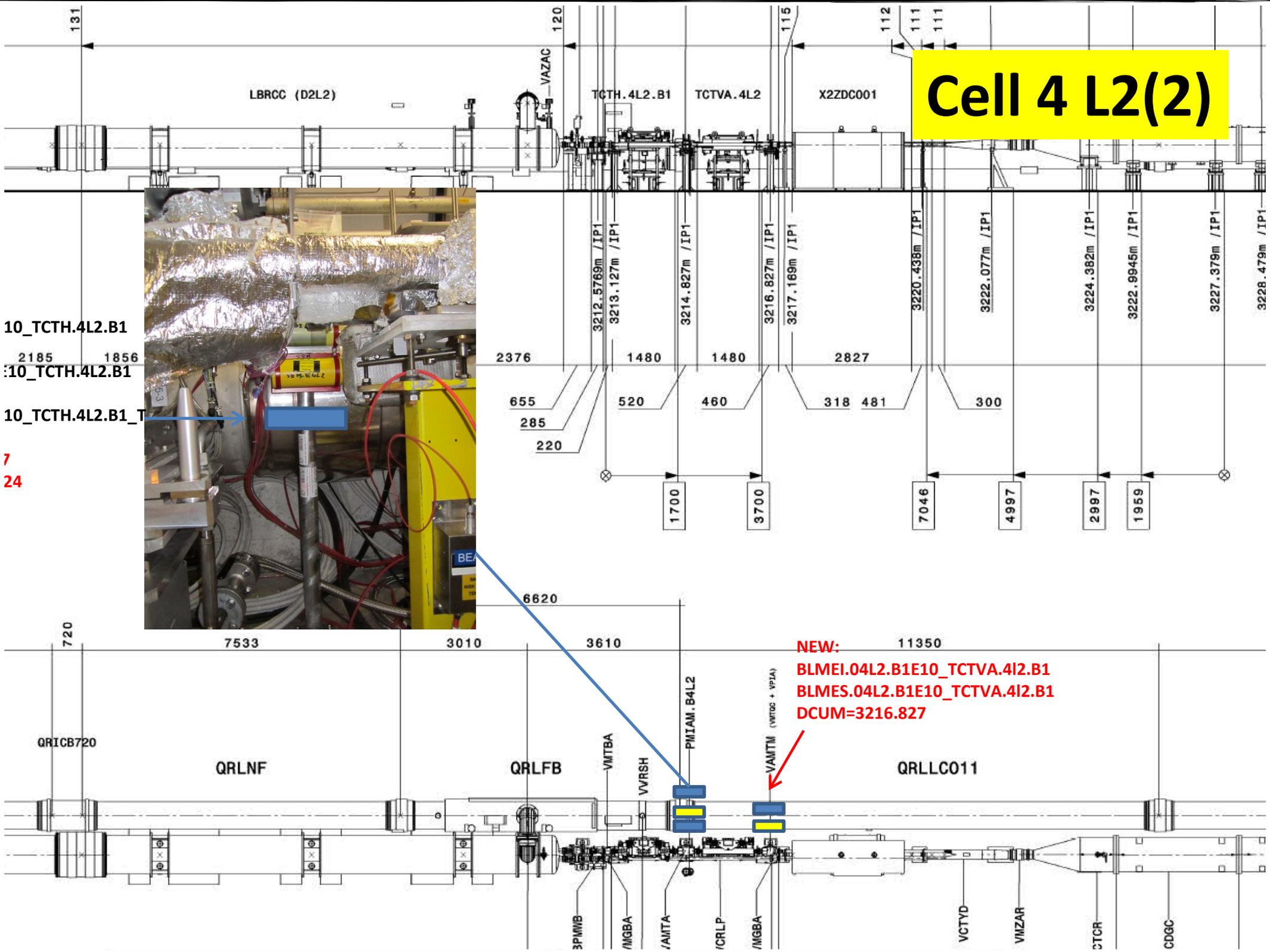
- ✓ Conservative reduction of Direct Dump thresholds to provide some protection
- ✓Thresholds for LIC adapted to sensitivity of detectors. Gain up to 60 margin. Thresholds enforced to be over ~5x Noise level
- ✓UFO. Increase of thresholds by a factor 3.3 to push them to the “Quench limit”
- ✓ Collimation. No threshold changes

Back up slides

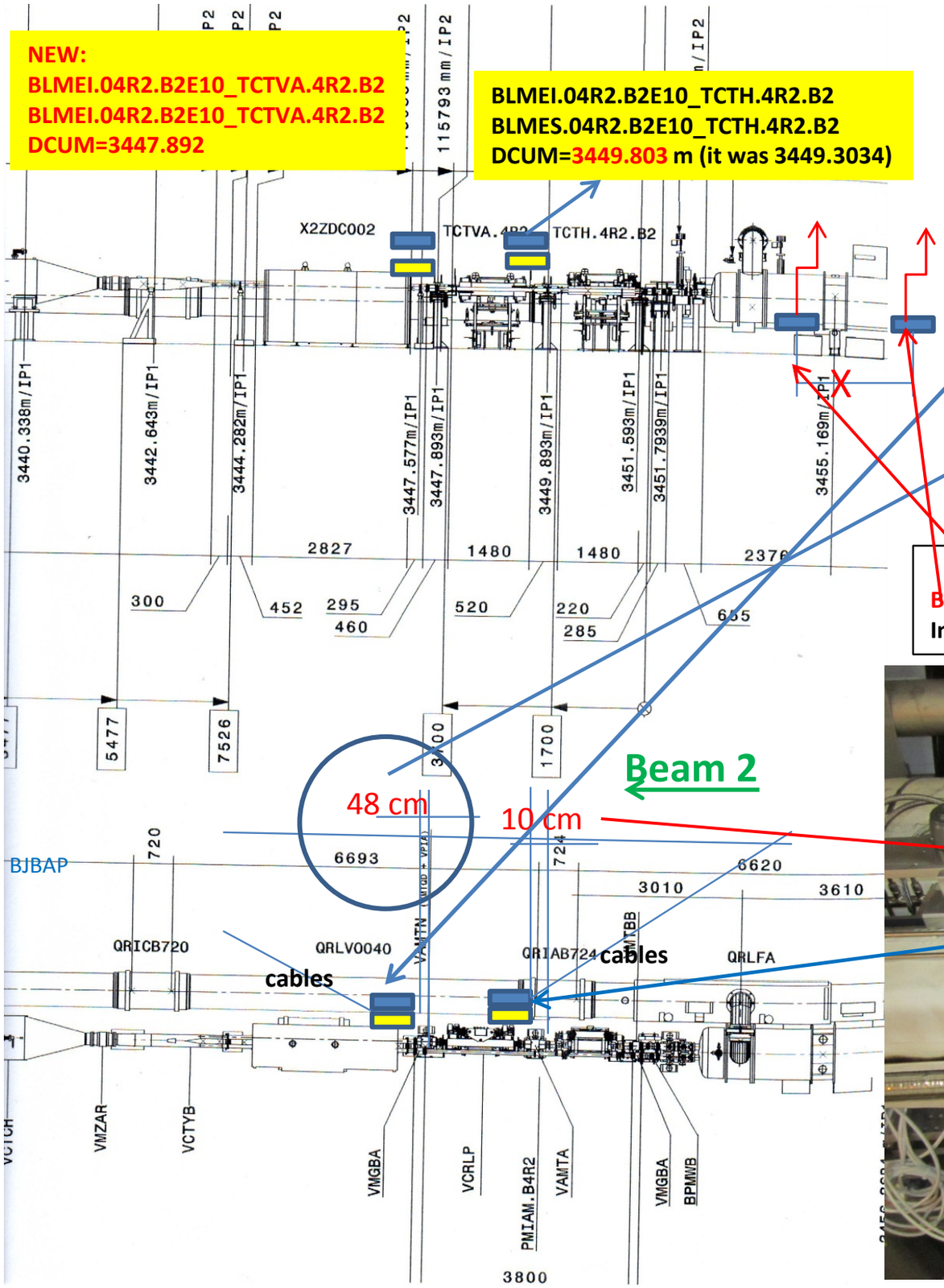
Layout in IP2 (left)

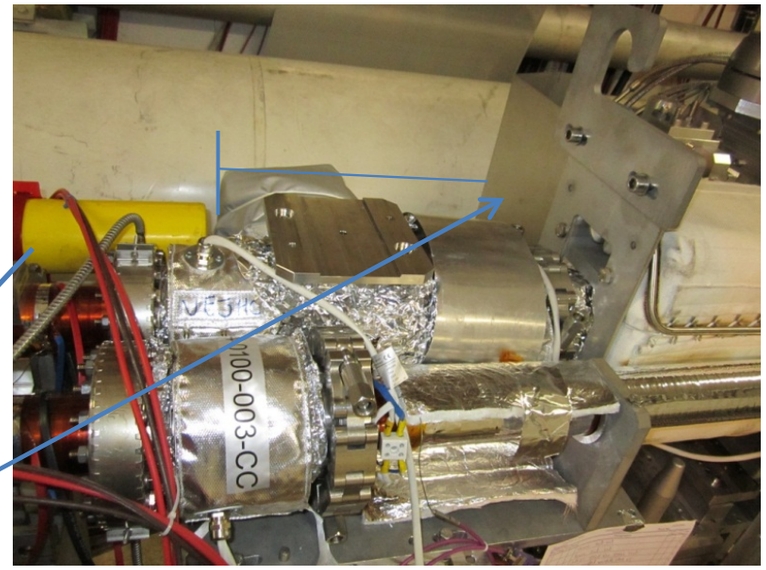


Layout in IP2 (left)

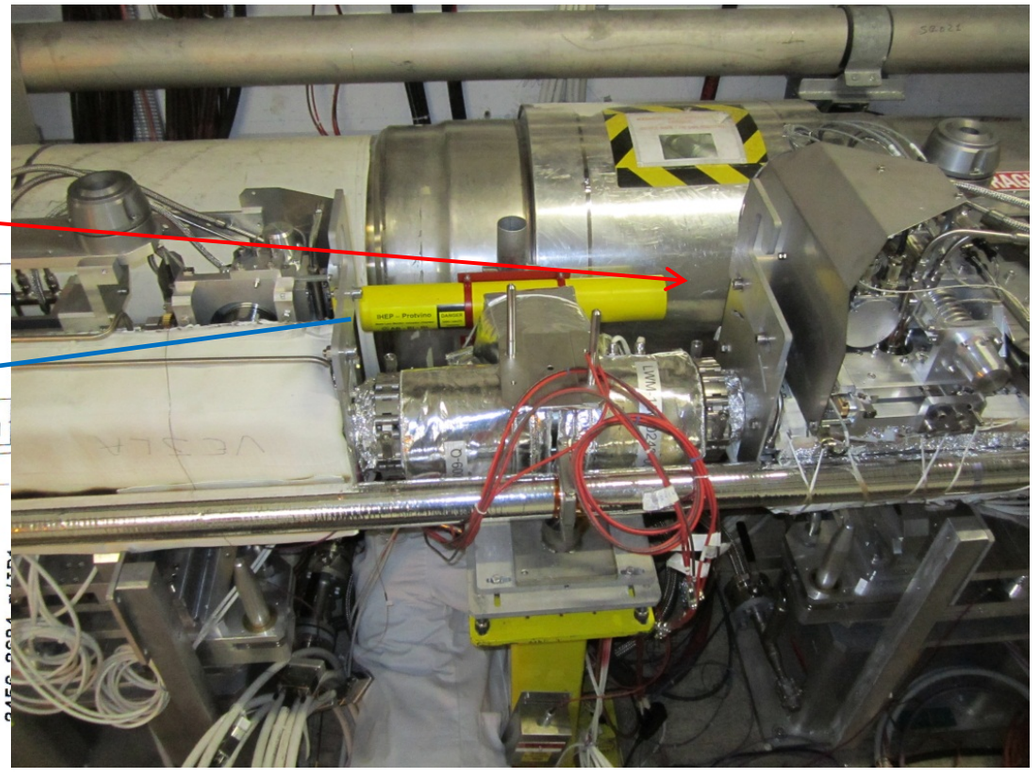


Layout in IP2 (right)

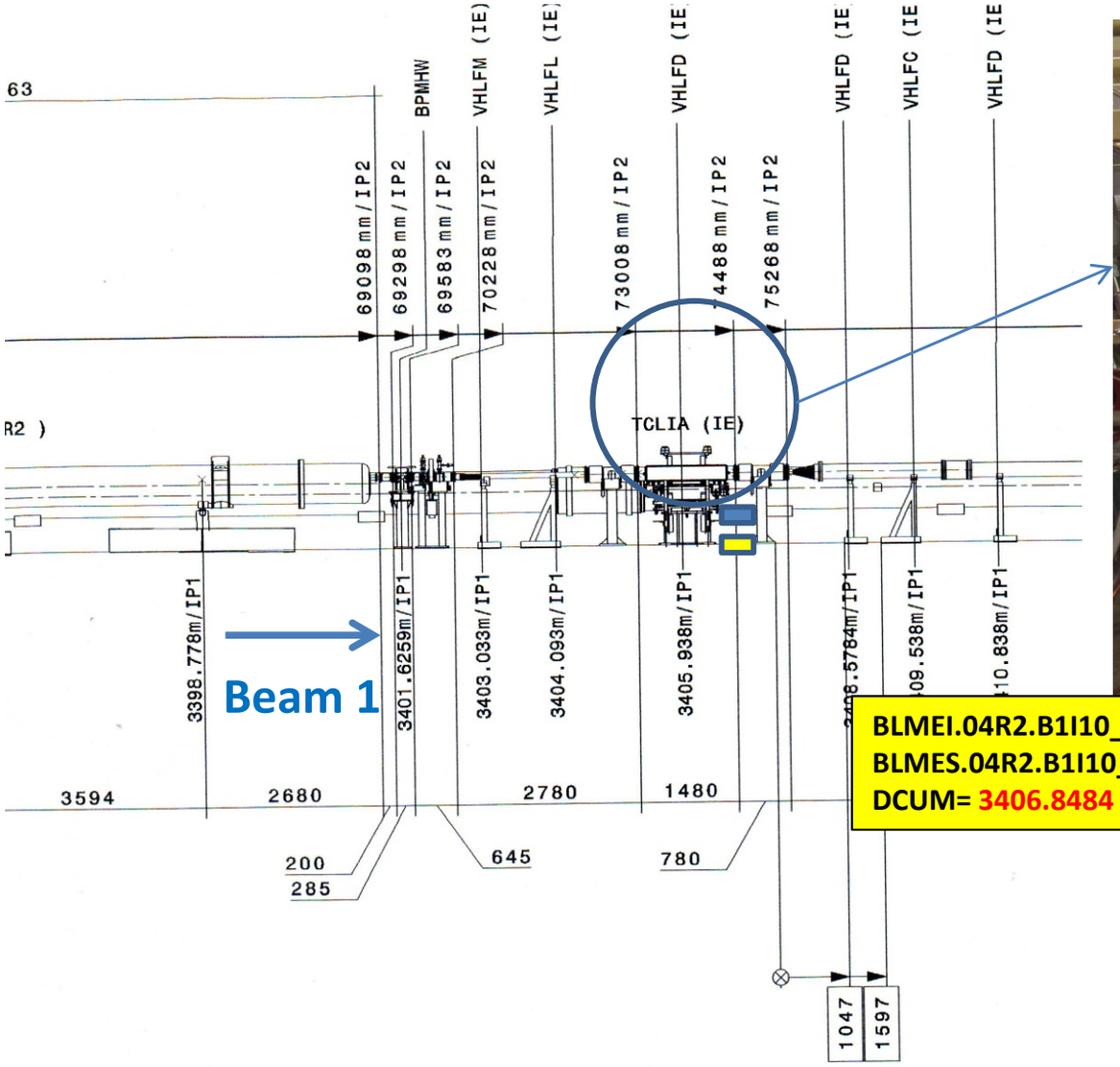


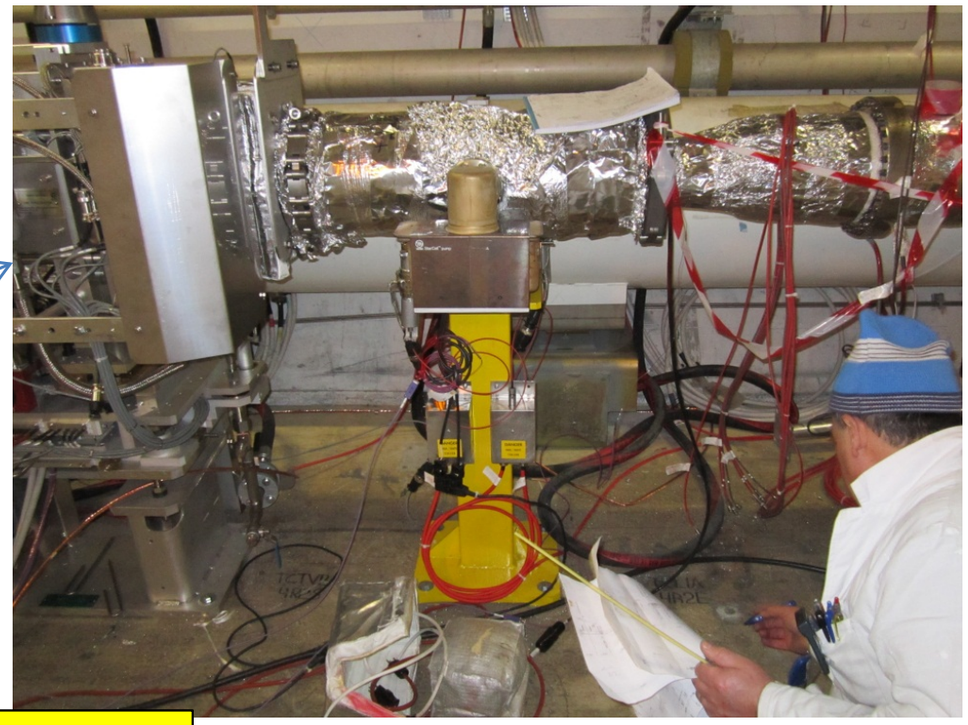


BLMEI.04R2.B1I10_MBRC, DCUM=3454.3444
BLMEI.04R2.B1I20_MBRC, DCUM=3459.4144
Instead BLM2I

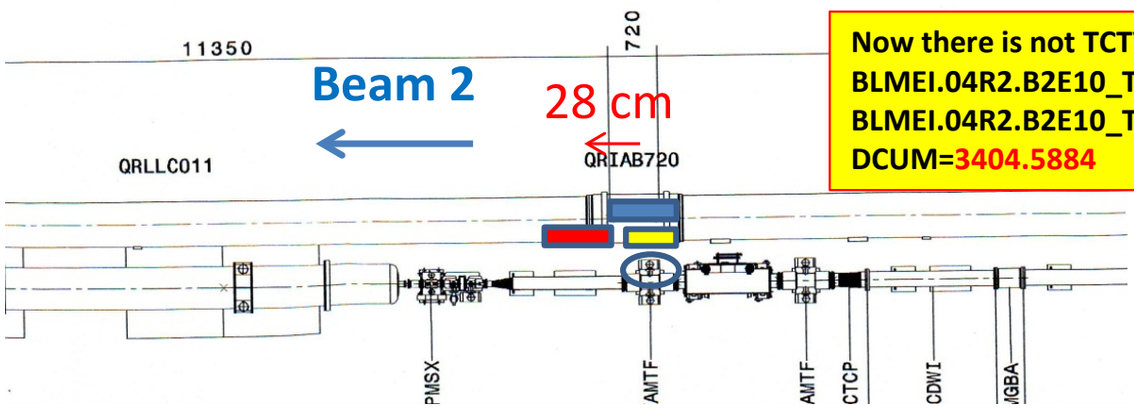


Layout in IP2 (right)





BLMEI.04R2.B1I10_TCLIA.4R2
BLMES.04R2.B1I10_TCLIA.4R2
DCUM= 3406.8484



Now there is not TCTVB, but we leaved
BLMEI.04R2.B2E10_TCTVB.4R2
BLMEI.04R2.B2E10_TCTVB.4R2
DCUM=3404.5884

Quench levels