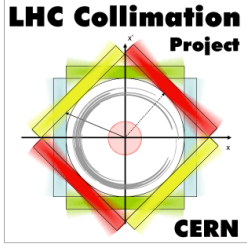

CERN

BLM Thresholds at Collimators Following Recent Observations

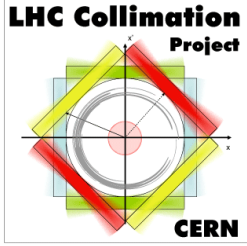
A. Mereghetti, on behalf of the LHC Collimation Team and the BLM Threshold Working Group



Update of BLM thresholds at collimators (mainly) due to:

- Collision debris;
  → experimental IRs, i.e. TCTs and TCLs;

- Betatron cleaning when beam life-time drops down;
  → IR7 collimators + equipment nearby + TCTs;



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- **Collision debris**;
  → **experimental IRs, i.e. TCTs and TCLs**;

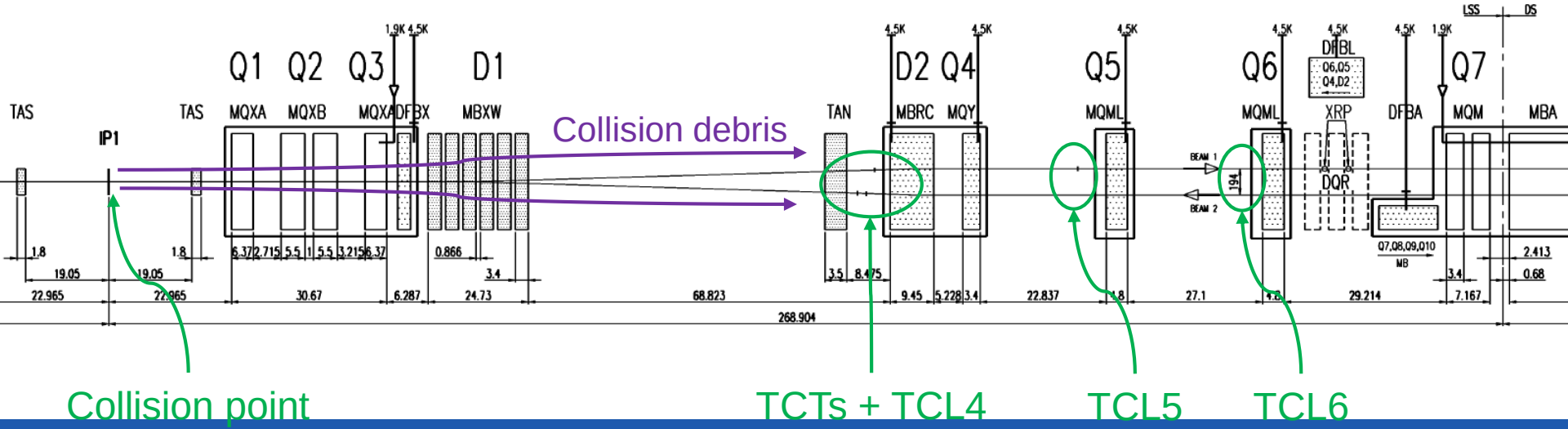
- Betatron cleaning when beam life-time drops down;
  → IR7 collimators + TCTs + equipment nearby;

Reasons for the Changes

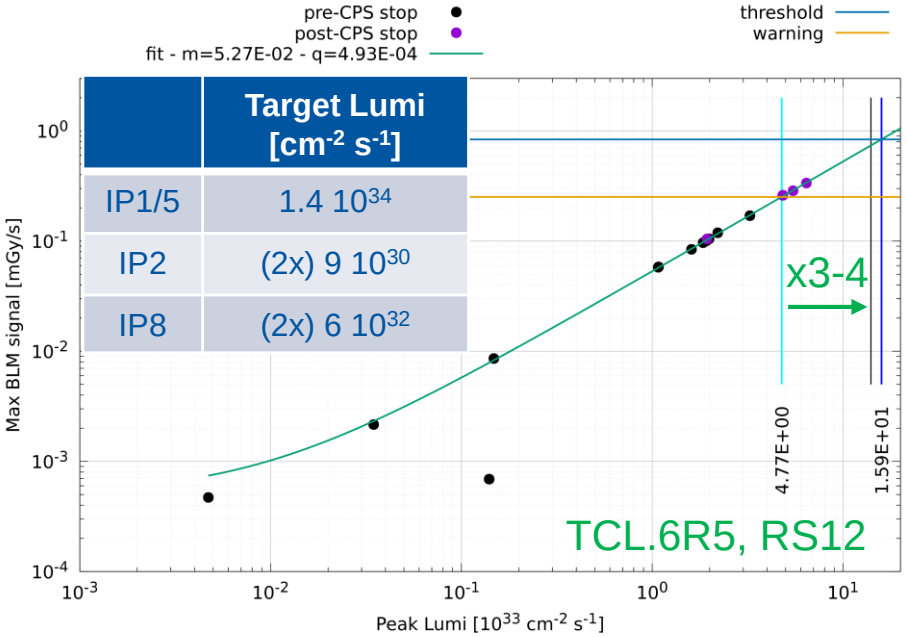
A fraction of the collision debris goes back to the machine and induces signals in BLMs nearby:

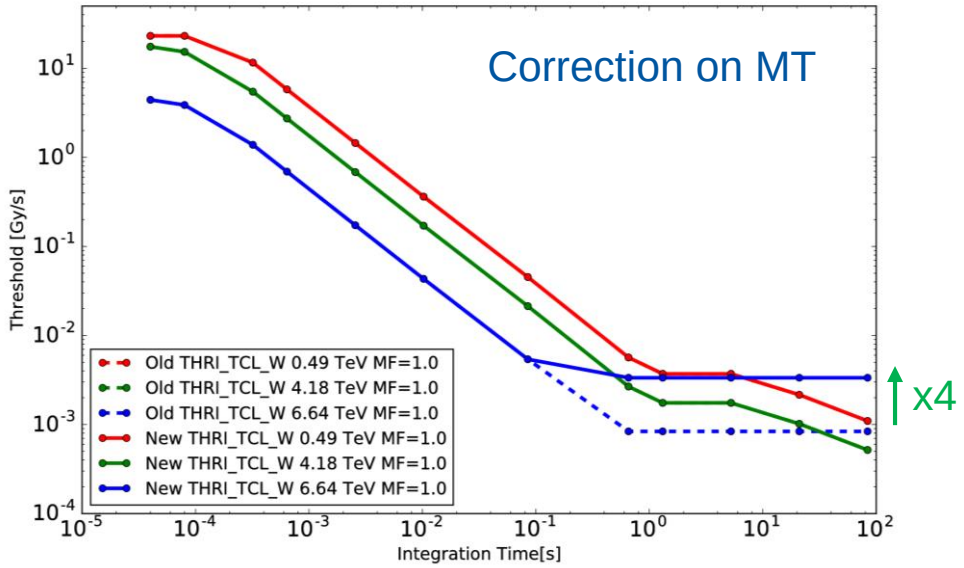
- Signals are proportional to instantaneous luminosity;
- The longest RSs (i.e. RS08-RS12) are mainly affected (pile up);
- Involved collimators: TCTs and TCLs;

This effect was already observed in 2015 and actions were taken accordingly;
→ Minor changes of crossing scheme + collimator settings (especially at TCTs: 13.7σ → 9σ) required a review:



The Changes





- For each BLM: build calibration curve, i.e. BLM signal vs peak lumi (for each RS, actually);
- For each BLM family:
  - take BLM with signals closest to dump threshold;
  - Set signal at target peak lumi as warning level;
- Flat Top correction of BLM thresholds, only for 'long' RSs (i.e. RS08-RS12);
- TCTs included in analysis, but changes dominated by next topic;

Family	BLMs	N	F
THRI_TCL	All at TCL.4 and TCL.5	8	4.0
THRI_TCL_W	All at TCL.6	4	4.0
THRI_TCT	All at TCTs in IR1/5 and Left of IR8	10	2.5

Update of BLM thresholds at collimators (mainly) due to:

- Collision debris;
  → experimental IRs, i.e. TCTs and TCLs;

- **Betatron cleaning when beam life-time drops down**;
  → **IR7 collimators + TCTs + equipment nearby**;

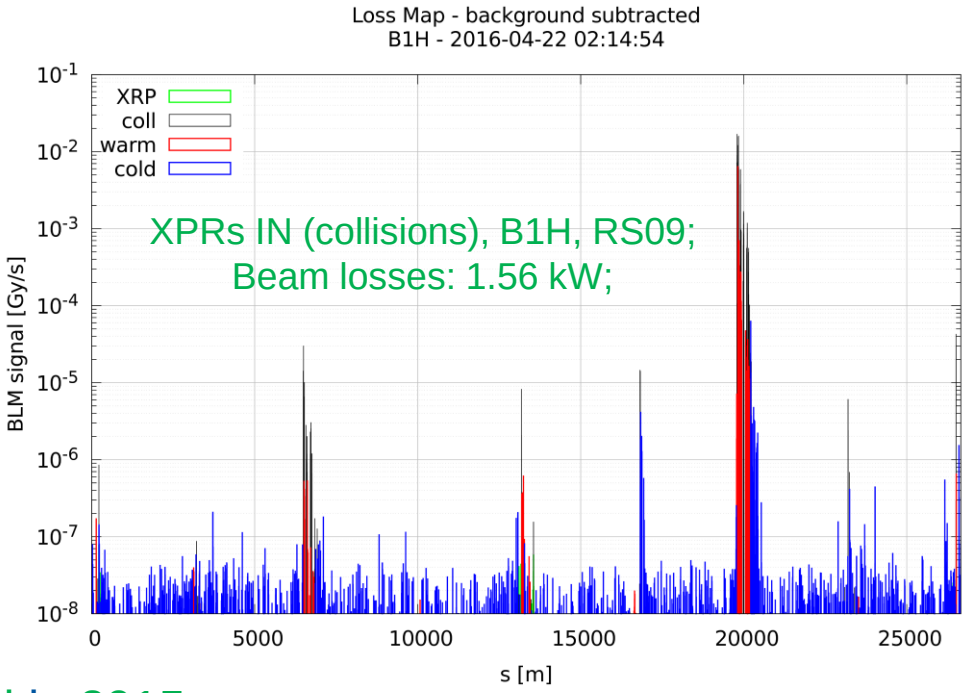
Reasons for the Changes

A drop down of beam life-time causes large losses on the collimation system:

- 200 kW / 500 kW (OP settings / design) beam losses in **1-10s**;
- 40 kW / 100 kW (OP settings / design) beam losses in **steady state**;

Operational tuning of BLM thresholds for collimation:

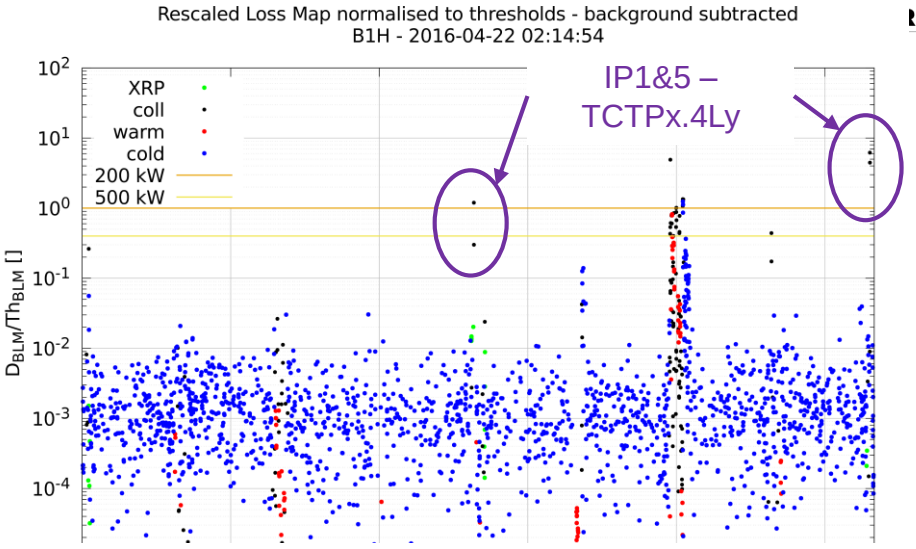
- Qualification loss maps: BLM pattern in case of losses on a given plane/beam;
- the power loss occurred to generate it allows to extrapolate the signals for a given power loss and check them against dump thresholds;

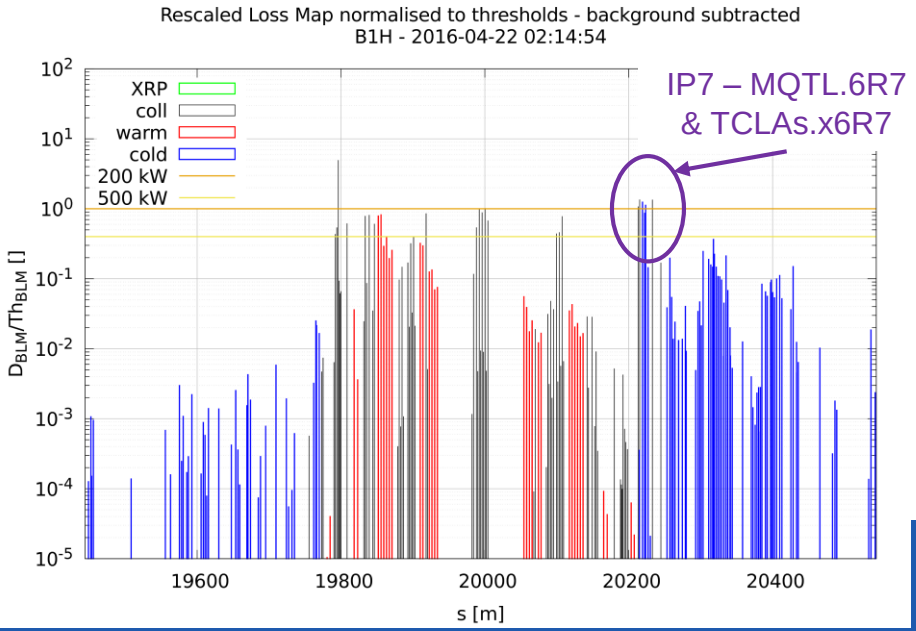


This tuning was already implemented in 2015;
→ changes in collimator settings (TCSGs, TCLAs and TCTs) required a review;

The Changes

BLM triggering the Change	Family	F
BLMQI.06R7.B1E10_MQTL	THRI.IP7.P1_MQTL_FT	1.25
BLMTI.06R7.B2I10_TCSG.A6R7.B2	THRI_7_TCSG_F5	1.35
BLMTI.06R7.B1E10_TCLA.D6R7.B1	THRI.06_7_CD_TCLA	1.35
BLMTI.07R7.B1E10_TCLA.A7R7.B1	THRI.07_7_AB_TCLA	1.35
BLMTI.04L1.B1I10_TCTPH.4L1.B1	THRI_TCT	6.20





Two (avoidable?) beam dumps so far:

- Fill 4914 (600b) - Wed 11th May 2016, 19:00:37 – 4min after start of squeeze:
  - Trigger: TCLA.D6R7.B1 (RS08);
  - B1H transverse instability;
  - Beam losses at ~170 kW;
- Fill 4975 (1854b) - Tue 1st June 2016, 01:48:30 – 4min after start of Totem BP:
  - Trigger: TCTPH.4L1.B1 (RS08);
  - Blown up beam in B1H + CO changes during Totem BP → losses in IR7;
  - Beam losses at ~30 kW;

Conclusions

Changes to BLM thresholds at collimators are necessary to avoid premature beam dumps from collimation:

- Changes involve master table mainly:
  - flat top corrections, i.e. only for 6.5TeV energy levels and above;
  - On ‘long‘ RSs (RS08-RS12);
- BLMs at TCTs and TCLs in experimental IRs suffer from collision debris inducing spurious signals;
  → Changes aimed not only at avoiding dumps before reaching target peak luminosities, but also at staying out of warning region;
- BLMs in IR7 + at TCTs require correction to allow for a temporary drop down of beam lifetime, leading to 200 kW beam losses;

Family	BLMs	N	F
THRI_TCL	All at TCL.4 and TCL.5	8	4.0
THRI_TCL_W	All at TCL.6	4	4.0

Family	BLMs	N	F
THRI.IP7.P1_MQTL_FT	IR7 Q6, P1	4	1.25
THRI_7_TCSG_F5	Most of IR7 TCSGs (cell 5/6)	10	1.35
THRI.06_7_CD_TCLA	1st set of IR7 TCLAs	4	1.35
THRI.07_7_AB_TCLA	2nd set or IR7 TCLAs	8	1.35
THRI_TCT	TCTs in IR1/5 + TCTs left of IR8	10	6.20