

# BLM thresholds changes in the YETS 2015/2016

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# Introduction

- This presentation summarizes the proposed **BLM threshold changes in the YETS 2015/16**
- The proposed changes are the outcome of various discussions within the BLMTWG and with equipment experts
- Some aspects have already been presented in Evian 2015 and in Chamonix 2016 (B. Auchmann)
- To highlight the foreseen changes, I indicate each proposal with: **“Change (#xx)”**
- Outline:
  - ARC/DS: UFOs, ULO, BFPP ions
  - LSS (cold magnets): UFOs, symmetric quenches, pp debris
  - LSS (other equipment): BGI, AFP, TCL6

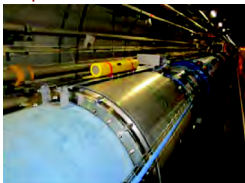
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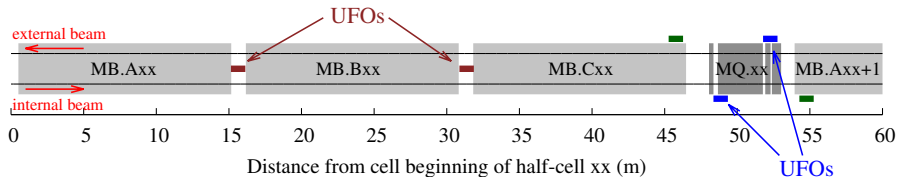
# Arc/DS: recap of BLM layout

Which BLMs are set for UFOs?

Top of MB-MB interconnects



Upstream end of MQ



- Depending on the UFO position in the MBs, BLM signals can vary by a factor 3–4
- Hence: protecting against UFO-induced quenches also means unnecessary dumps

# Arc/DS: UFO experience in 2015

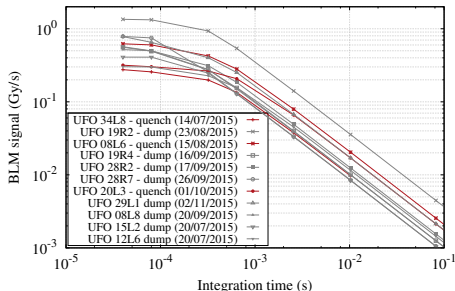
## UFOs in arc/DS at 6.5 TeV (w/o 15R8):

- 13 BLM dumps (2 quenches):
  - 1 potentially avoiding a quench
  - 2 too late to avoid a quench
  - 10 unnecessary dumps (9 did not even shorten UFO)
- 1 quench w/o BLM dump (91% of thresholds)

## Main conclusions from 2015:

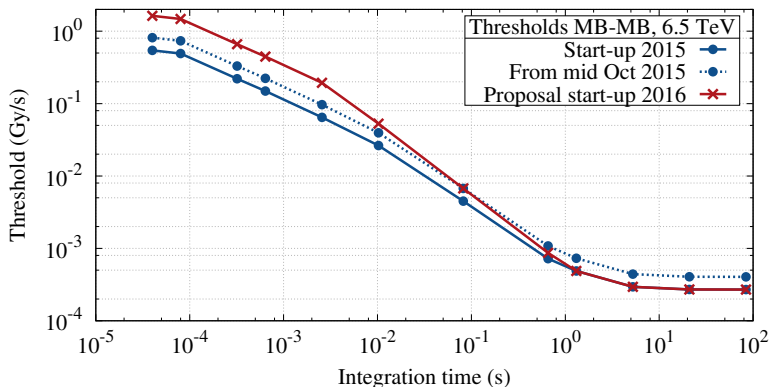
- If we want to avoid more<sup>†</sup> UFO-induced quenches, we would need to significantly lower the thresholds in short RSs, at the cost of many more unnecessary dumps
  - <sup>†</sup>some might be too fast → it takes 3 turns to dump
- In terms of availability, it seems more beneficial to avoid unnecessary dumps than to prevent all quenches
  - first step in this direction: MF was raised mid Oct from 0.333 to 0.499, but remaining time in 2015 was too short to appreciate impact on availability

UFO events 2015, THRI.ARDS\_MBMB family, 6.5 TeV



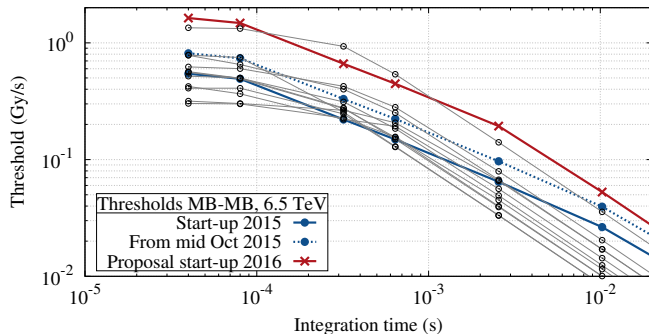
# Arc/DS: strategy for UFO-induced losses in 2016

- **Change (#1):** for all arc/DS UFO families, we propose
  - to further increase the applied thresholds in short RSs (1-5) by a factor 2 as compared to the end of 2015 (via AdHoc correction of a factor 3)
  - to revert the MF back to 0.333 and hence bring the longest RSs back to the same thresholds as at start-up in 2015



# Arc/DS: strategy for UFO-induced losses in 2016

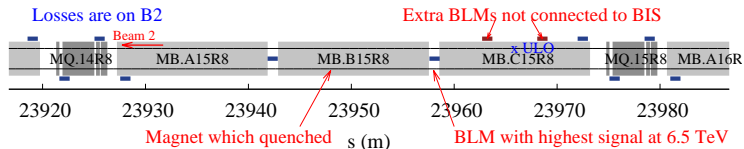
- with the proposed settings, only one of the UFO events from 2015 would have caused a dump, possibly would have had a fourth quench in addition



- we do **not have enough statistics** to provide a meaningful extrapolation of the **expected number of quenches and dumps for 2016** (remember, we only had one quench in the last two months of p operation)
- we will follow closely during operation and **re-evaluate the thresholds** if we have indications that the settings are not aiding in availability

# Arc/DS: other changes (ULO, BFPP ions)

- **Change (#2):** we propose to assign the monitors downstream of the ULO to a dedicated family, with the same applied thresholds as in 2015 ( $MF=0.15$ )



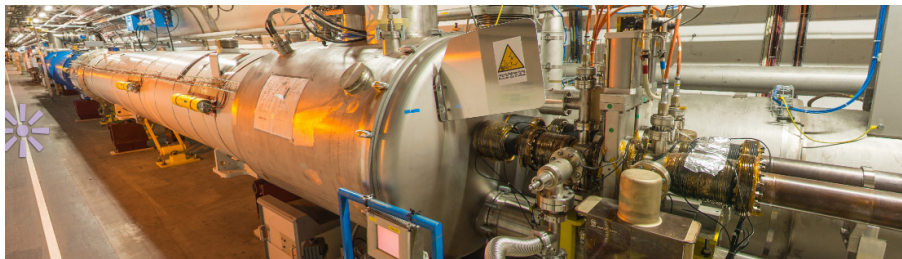
- **Change (#3):** we propose to reduce the steady-state thresholds of BFPP BLMs according to the findings of the BFPP Quench Test (i.e. we set them to the signal at which we quenched)
  - need more studies before modifying monitor families for proton operation
- **Change (#4):** some monitors not protecting against BFPP losses were in warning during the 2015 ion run; we propose to assign these monitors to a separate family:
  - $MF$  shall be increased in future ion runs ( $MF=1.0$ )
  - BLMs retain their original settings during proton operation (UFOs)



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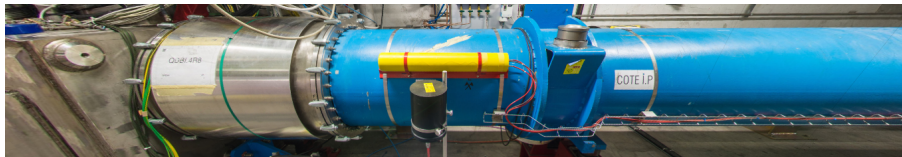
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# IPQs, IPDs (all IRs): strategy for UFOs



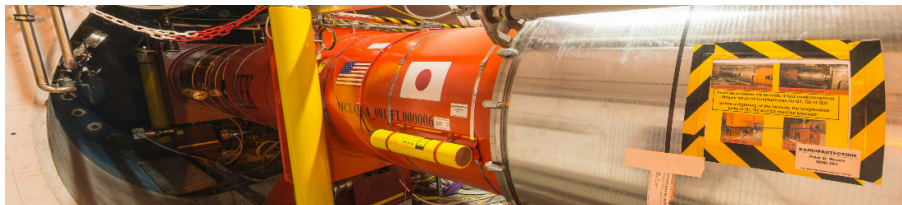
- **IPQ and IPD BLM settings in 2015:**
  - Policy was to start in 2015 with a lower MF (**0.1**) than in the arcs (**0.333**)
  - Only had two UFO-induced dumps on IPQ and IPD BLMs in 2015
  - Like in the arcs, MF was increased mid Oct for most of IPQs and IPDs to avoid further UFO-induced dumps (from **0.1** to **0.333**)
- **Proposal for 2016:** *keep MF for IPQ and IPD BLMs at **0.333**, i.e. at the same value as for arc/DS magnets (with some exceptions → see next page); yet we do not foresee an AdHoc increase like in the arcs since UFOs were less limiting in the LSS*

# IPQs, IPDs (IR5/8): avoiding symmetric quenches



- **Issue:** for some magnets, symmetric quenches would not, or only with some delay, be detected by the QPS; these magnets should therefore have lower BLM thresholds
- **Concerned IPQs:**
  - MQYs: MP3 recommended to lower the QPS threshold for MQYs, however, some noise on the QPS signal prevents this action for the **Q4.L5/R5**
  - MQMs: still under study by MP3
- **Concerned IPDs:**
  - MBX: exhibit in principle a good thermal stability, but the **D1.R8** has some issues with the quench heaters
- **Change (#5):** *we propose to create special families for these magnets and apply a MF of 0.1 (as compared to the 0.333 proposed on the previous page)*

# Triplet (IR1/5): adjusting FT correction for collision debris



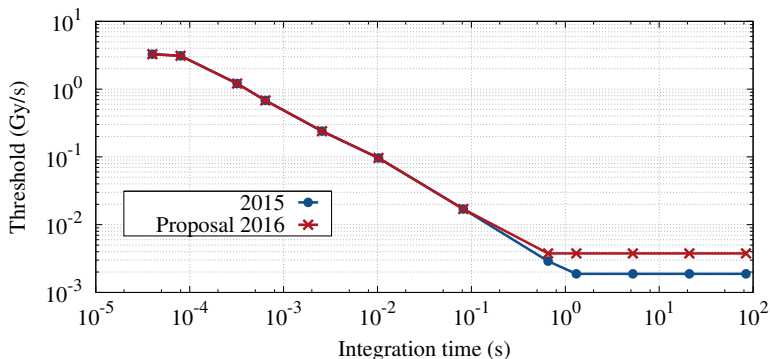
- **Triplet BLM families IR1/5:** thresholds set for local beam losses inside the quads, however FT correction is required for lumi production (signal from pp debris)
- **Settings in 2015:**
  - FT correction set such that warning level (30% of thresholds) would be reached for a lumi of  $1 \times 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$
  - accordingly, max signal/threshold ratio measured in long RSs in 2015 was 12.5% in IR1 and 13.5% in IR5 (for  $\sim 0.5 \times 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$ )
- **Change (#6:)** *we propose to proactively increase the FT correction of all IR1/5 triplet families by a factor two in order to avoid reaching warning levels once the lumi increases in 2016 and 2017/18; MF would remain 0.166 as in 2015*

# Triplet (IR1/5): adjusting FT correction for collision debris

- **Expectation from Change #6:** will allow to remain below warning level for expected peak lumis in Run 2, i.e. would reach a max. signal/threshold ratio of
  - 16% for  $1.1 \times 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$  (2016<sup>†</sup>)
  - 23% for  $1.6 \times 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$  (2017/18 with BCMS beams<sup>†</sup>)

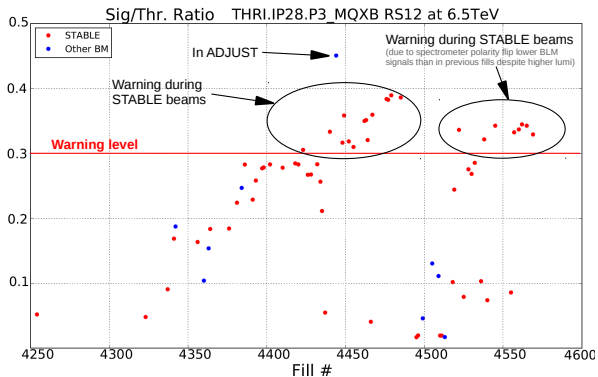
<sup>†</sup> Peak lumi estimates from M. Lamont, Chamonix 2016

Thresholds THRI.IP15.P1\_MQXA\_FT family, 6.4 TeV



# Triplet (IR8): introducing FT correction for collision debris

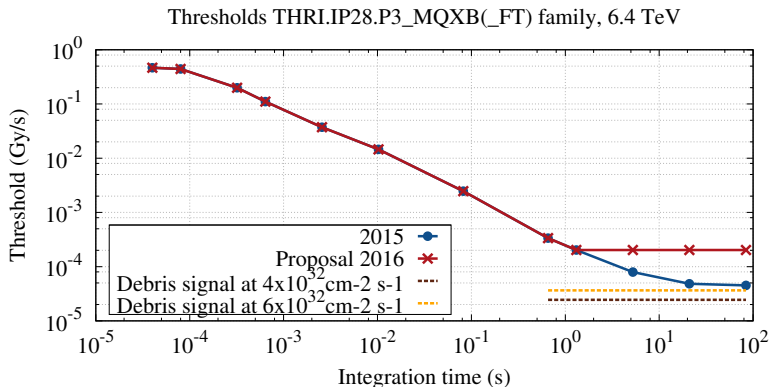
- **Triplet in IR8:** BLMs of one triplet family (Q2) in IR8 regularly reached warning levels in the long RSs in 2015 – up to **40%** in stable beams (due to error in assumed debris signal no FT correction has been thought to be necessary)



- **Change (#7):** we propose to introduce a FT correction for the concerned IR8 triplet family in order to avoid reaching warning levels during lumi production in LHCb; MF would remain **0.166** as in 2015

# Triplet (IR8): introducing FT correction for collision debris

- Expectation from Change #7:** for a levelled lumi of  $4(6) \times 10^{32} \text{ cm}^{-2} \text{ s}^{-1}$ , can expect to remain below 13(19)% of threshold in stable beams (can be somewhat higher in other beam modes)



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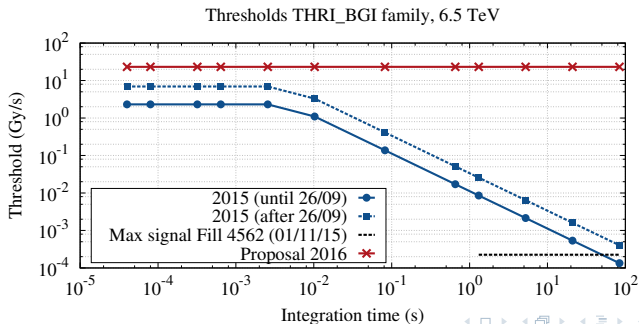
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# BGI (IR4): beam-gas collisions



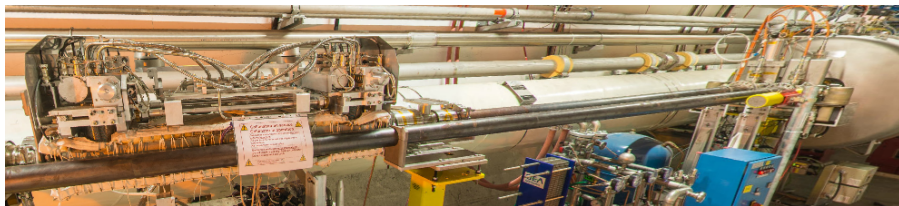
- **BGI BLMs in 2015:** in the second half of Sept, BLM of BGI R4 started to reach warning levels in long RSs (up to  $\sim 60\%$  in Fill #4420); temporary mitigation by raising MF from 0.1 to 0.3 but warning resurfaced end of Oct
- **Change (#8):** we propose to set thresholds of BGI family to max (with MF=1.0) as these BLMs have no protection functionality for the BGI; present thresholds are old obsolete thresholds for warm magnets



# AFP (right side of IR1)

- **AFP (ATLAS Forward Proton) experiment:**
  - Two Roman Pot (RP) stations in cell 6R1 (at 205.2 and 217.3 m from IP), operational for the first time in 2016 → each station equipped with a BLM
  - For BLM thresholds we can exploit similarities to TOTEM:
    - almost comparable RP locations
    - similar material budget as the cylindrical TOTEM RP (=XRP.E6R5: gave highest BLM signal of all TOTEM pots in 2015)
    - yet some differences (e.g. crossing scheme IR1/5, small differences in relative BLM-pot position can give different signal)
- **Change (#9):** *for the start-up in 2016, we propose to apply the same thresholds as for TOTEM, but within a separate BLM family for AFP*
- **Expectations for 2016:**
  - BLM of cylindrical TOTEM pot estimated to remain below **10%** of thresholds for  $1 \times 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$ , despite the plan of having the pots closer to the beam than in 2015 (M. Deile, Coll WG Meeting #200)
  - Signals of AFP BLMs will depend on running scenario and RP/collimator settings, thresholds might need to be adjusted after first experience with beam

# TCL6: separate family



- TCL family in 2015 (from July):** all TCL BLMs were contained in one family, however with different MFs to reflect the different material robustness of the TCL4/5 (Cu, MF=1.0) and the TCL6 (W, MF=0.1), see [A. Mereghetti, MPP #112](#)
- Adjustments in 2015:** the MF of the two TCL6 BLMs in IR5 were increased on the 23/10 to 0.2 to give more margin for Roman Pot runs - discussed by [A. Mereghetti in MPP #118](#) (09/10)
- Change (#10):** *we propose to derive a separate family for TCL6 BLMs, with a scaling correction of 0.2 but keeping the same applied thresholds as in 2015 (i.e. with MF=0.5 in IR1 and MF=1.0 in IR5); this allows to enforce the policy that significant threshold increases can only be done via master threshold changes.*

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# All changes at a glance

- **Change #1:** improve availability for UFOs in the arcs/DS (increase in short RSs)
- **Change #2:** move ULO BLMs to separate family (no change of applied thresholds)
- **Change #3:** adapt BFPP BLMs to quench test observations (decrease in long RSs)
- **Change #4:** create separate family for BLMs in warning during ion run (no change of applied thresholds)
- **Change #5:** create separate family for IPQs/IPDs where symmetric quenches should be avoided (decrease in all RSs)
- **Change #6:** avoid reaching warning levels on IR1/5 triplet BLMs due to pp debris (increase in long RSs)
- **Change #7:** avoid reaching warning levels on IR8 triplet BLMs due to pp debris (increase in long RSs for one family)
- **Change #8:** removing obsolete BGI thresholds, avoid warnings (set to max)
- **Change #9:** apply same thresholds for AFP as for TOTEM (new)
- **Change #10:** separate TCL6 family to account for different absorber material (no change of applied thresholds)