Status of FLUKA Simulations for Collimation BLM Thresholds

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Sixtrack input provided from the Collimation team

Overview

- Ideal strategy
- Present request
- Concerns
- Available results
- BLM matrices
- Disclaimer

Ideal Strategy

- Collimator (Type, material, BLM position etc…)
  Parameters (Collimator orientation, opening etc…)
  Scenario (Accident, Nominal cleaning etc…)

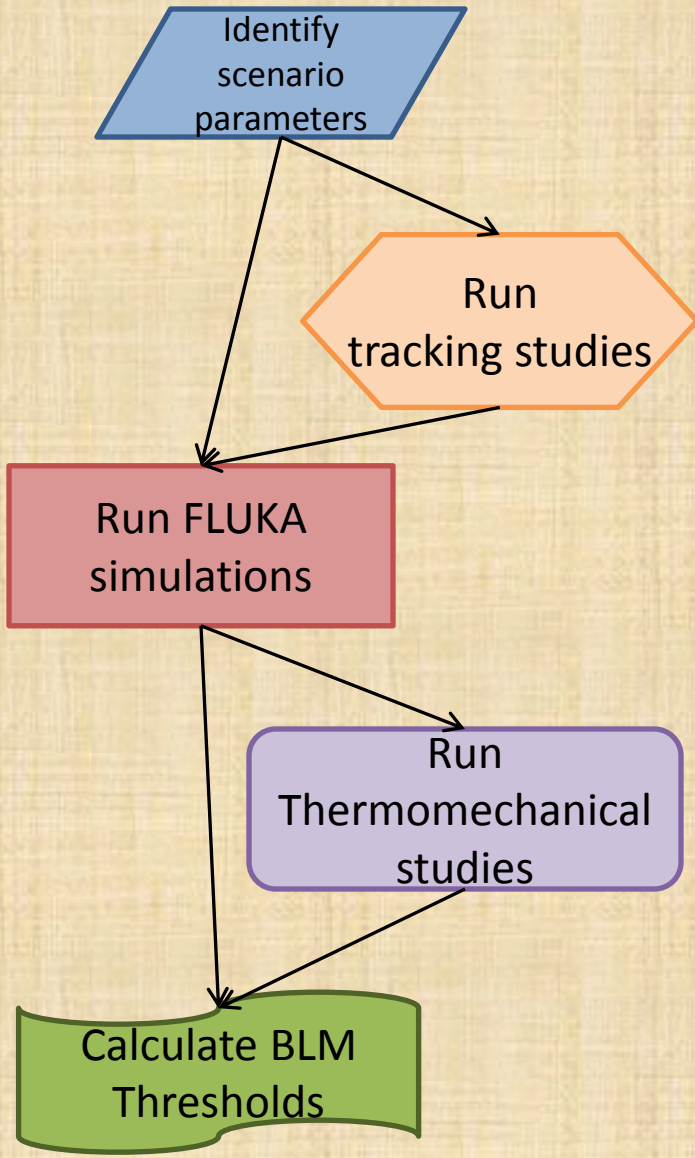
- Run tracking (SixTrack) studies to provide FLUKA with the *distribution of protons (ions) impacting the collimator*.

- Run shower simulations and provide: *energy deposition distribution* and *BLM signal per incident proton*

Attention: The relevant energy deposition and BLM signal could very well be at a collimator **other** than the one considered in the scenario

- Run thermomechanical studies to identify the *intensity rate limit*

- Calculate BLM Thresholds: translate the above limit into BLM signal using the FLUKA ratio



Present request

- BLM signal per proton lost (BLM Matrices)

for 4 families:

- TCP (carbon)
- TCSG (carbon)
- TCLA (Inermet)
- TCT (Inermet)

for 2 orientations:

- Horizontal
- Vertical

for 3 energies:

- 450 GeV
- 3.5 TeV
- 7 TeV

- Use primary collimator lossmap for all cases (scenario: considered collimator acting as primary).

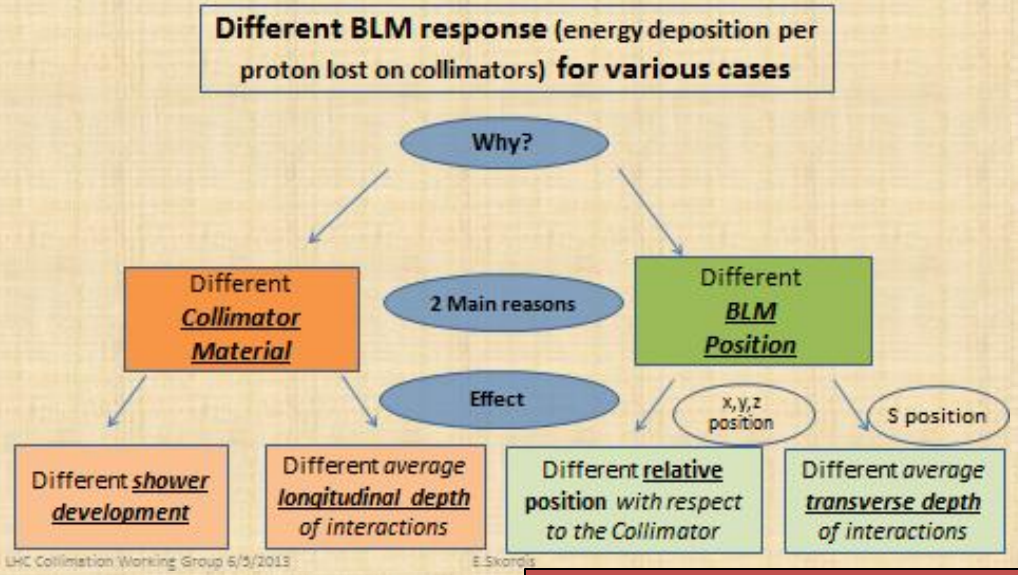
❖ Pre-defined intensity rate limits to be translated into <initial> BLM thresholds by the above matrices

Concerns

- How was the max number of protons into the collimators estimated?
- What is the uncertainty of that calculation?
- What level of accuracy are we looking for in the present study?
- No 450 GeV primary collimator lossmap available in order to provide results for that energy

Concerns

Motivation for FLUKA simulations

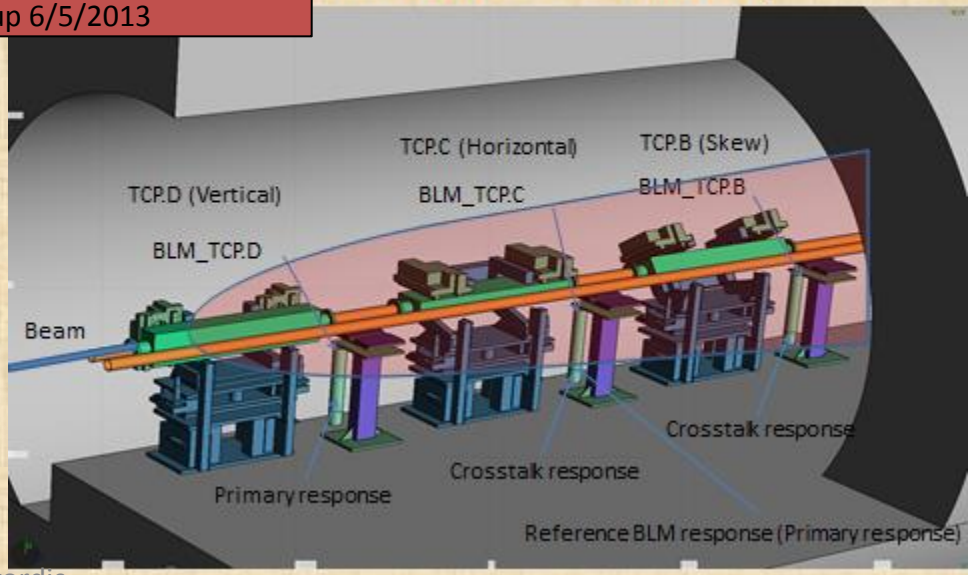


Depending on the level of accuracy required each case can be **unique**

The complexity is increased by the BLM signal **Crosstalk** which plays a major role

TCP simulated Geometry

LHC Collimation Working Group 6/5/2013



Available Results

DIFFERENT SENSITIVITY [I]

normalized to 4.58 10^{-12} Gy/p i.e. the BLM_TCP.C response to a 3.5 TeV proton caught in the TCP.C

PRIMARY COLLIMATORS (IR7, B1) 3.5 TeV					6.5 TeV
halo plane	BLM response / proton catcher	BLM_TCP.D	BLM_TCP.C	BLM_TCP.B	BLM_TCP.C
horizontal	TCP.C	0.01	1	2.53	1.38
vertical	TCP.D	0.58	1.80	2.13	

dependence on jaw orientation

dominant cross talk

energy dependence

DIFFERENT SENSITIVITY [II]

normalized to 4.58 10^{-12} Gy/p i.e. the BLM_TCP.C response to a 3.5 TeV proton caught in the TCP.C

TERTIARY COLLIMATORS (IR5, B1) 3.5 TeV				7 TeV	
halo plane	BLM response / proton catcher	BLM_TCTH	BLM_TCTV	BLM_TCTH	BLM_TCTV
horizontal	TCTH	6.27	1.21	18.1	4.68
horizontal	TCTV	0.43	3.23	0.71	13.9

dependence on jaw material

dependence on jaw orientation

cross talk, even backwards

energy dependence

VARIATION OF THE TCT BLM RESPONSE [I]

normalized to 4.58 10^{-12} Gy/p i.e. the BLM_TCP.C response to a 3.5 TeV proton caught in the TCP.C

TERTIARY COLLIMATORS (IR5, B1) 3.5 TeV				7 TeV	
halo plane	BLM response / proton catcher	BLM_TCTH	BLM_TCTV	BLM_TCTH	BLM_TCTV
vertical	TCTH	6.73	1.47	19.1	6.10
vertical	TCTV	0.53	3.08	0.60	15.3

- Various unpresented studies with artificial sources on different collimators e.g.:
  - Tertiary collimators with a BLM at the TCLA position.
  - Tertiary collimators with x, x', y, y' coordinates of TCP losses

BLM matrices

- Available extrapolations

for 2 families:

- Carbon
- Inermet

for 2 orientations:

- Horizontal
- Vertical

for 2 energies:

- 3.5 TeV
- 7 TeV

- Use primary collimator lossmap for all cases (scenario: considered collimator acting as primary).
- The **minimum** computed BLM signal is given for each case based on multiple simulations

- A possible underestimation (overprotection) factor is given for each BLM signal
  (maximum expected BLM signal = min BLM signal * factor)
- Results are normalised to the horizontal TCP primary response (4.58 10^{-12} Gy/p taken as 1)

BLM Responses matrices

(Values are normalised to the **BLM_TCP.C** response for horizontal losses at 3.5 TeV which corresponds to 4.58 10^{-12} Gy/p)

scenario: considered <u>collimator acting as primary</u>

3.5 TeV

Orientation / Collimator material	Horizontal		Vertical	
	Minimum BLM signal	Possible overprotection factor	Minimum BLM signal	Possible overprotection factor
Carbon	**0.9**	3	**0.5**	3
Inermet 180	2	3	1	3

7 TeV

Orientation / Collimator material	Horizontal		Vertical	
	Minimum BLM signal	Possible overprotection factor	Minimum BLM signal	Possible overprotection factor
Carbon	**1.2**	3	0.6	3
Inermet 180	**6**	3	3	5

This defines a variation interval from 0.5 up to ~20, reduced inside a specific family (C vs W)

Disclaimer

- The BLM signals presented in this study are a guess for the “worst” possible case, meaning the lowest possible signal per case – just considering the impacted collimator and its BLM -
- Cross-talk totally neglected!
- For a more meaningful evaluation, we propose the strategy suggested in slide 3