



# 2024 Pb run: BLM threshold proposal for TCTs and TCLDs

Anton Lechner, Belen Salvachua, Sara Vigo Morales, Volodymyr Rodin

Based on the input by Luisa Puddu, Federico Carra, Natalia Triantafyllou, Roderik Bruce

29/10/2024

# Recap: power deposition in TCT

Relative power deposition in TCT for the different scenarios (*per impacting ion*):

	Case 1a	Case 1b	Case 2
Impacted jaw	65%	44%	7%
Opposite jaw	7%	14%	4%
Tank	3%	6%	2%
<b>Total</b>	<b>75%</b>	<b>64%</b>	<b>13%</b>

Smaller impact parameter +  
larger half-gap

Much smaller impact  
parameter

Ion impact rate on TCT *for given power deposition in impacted jaw*:

Power in jaw	Case 1a	Case 1b	Case 2
2 kW	$3.43 \times 10^7$ Pb/s	$5.12 \times 10^7$ Pb/s	$31.3 \times 10^7$ Pb/s
0.4 kW	$0.68 \times 10^7$ Pb/s	$1.02 \times 10^7$ Pb/s	$6.25 \times 10^7$ Pb/s

TCT design spec: **2 kW deposited** up to 10 sec (RS08-10) and **400 W deposited** in RS12

# Estimated BLM response for actual TCT BLM positions

By interpolating between different BLM positions, can estimate BLM response based on actual position (as indicated in layout db):

	S-distance (m)	H-distance (m)	V-distance (m)	BLM orientation	Proton BLM Family	BLM response FLUKA (Case 1a)	BLM response FLUKA (Case 2)
<b>IR1</b>							
BLMTI.04L1.B1I10_TCTPH.4L1.B1	0.73	0.25	-0.2	V	THRI_TCT	<b>2.9x10<sup>-9</sup></b>	1.6x10 <sup>-9</sup>
BLMTI.04L1.B1I10_TCTPV.4L1.B1	1.32	0.25	-0.19	V	THRI_TCT	1.7x10 <sup>-9</sup>	1.4x10 <sup>-9</sup>
BLMTI.04R1.B2I10_TCTPV.4R1.B2	1.38	0.40	0	V	THRI_TCT	1.7x10 <sup>-9</sup>	1.3x10 <sup>-9</sup>
BLMTI.04R1.B2I10_TCTPH.4R1.B2	1.27	0.28	-0.14	V	THRI_TCT	1.9x10 <sup>-9</sup>	1.6x10 <sup>-9</sup>
<b>IR2</b>							
BLMTI.04L2.B1E10_TCTPH.4L2.B1	1.00	-0.33	-0.35	H	THRI_TCTVA	1.7x10 <sup>-9</sup>	0.6x10 <sup>-9</sup>
BLMTI.04L2.B1E10_TCTPV.4L2.B1	1.00	-0.45	0	H	THRI_TCTVA	2.4x10 <sup>-9</sup>	1.3x10 <sup>-9</sup>
BLMTI.04R2.B2E10_TCTPV.4R2.B2	1.48	-0.37	0	H	THRI_TCTVA	1.5x10 <sup>-9</sup>	1.4x10 <sup>-9</sup>
BLMTI.04R2.B2E10_TCTPH.4R2.B2	1.04	-0.45	0	H	THRI_TCTVA	2.3x10 <sup>-9</sup>	1.2x10 <sup>-9</sup>
<b>IR5</b>							
BLMTI.04L5.B1I10_TCTPH.4L5.B1	0.75	0.31	-0.31	V	THRI_TCT	2.1x10 <sup>-9</sup>	0.8x10 <sup>-9</sup>
BLMTI.04L5.B1I10_TCTPV.4L5.B1	1.25	0.31	-0.36	V	THRI_TCT	1.4x10 <sup>-9</sup>	0.6x10 <sup>-9</sup>
BLMTI.04R5.B2I10_TCTPV.4R5.B2	1.25	0.36	0	H	THRI_TCT	2.1x10 <sup>-9</sup>	<b>1.7x10<sup>-9</sup></b>
BLMTI.04R5.B2I10_TCTPH.4R5.B2	1.18	0.27	-0.39	V	THRI_TCT	1.5x10 <sup>-9</sup>	<b>0.5x10<sup>-9</sup></b>
<b>IR8</b>							
BLMTI.04L8.B1E10_TCTPH.4L8.B1	0.91	-0.48	0	H	THRI_TCT	2.4x10 <sup>-9</sup>	1.1x10 <sup>-9</sup>
BLMTI.04L8.B1E10_TCTPV.4L8.B1	1.74	-0.25	0	H	THRI_TCT	<b>1.0x10<sup>-9</sup></b>	1.9x10 <sup>-9</sup>
BLMTI.04R8.B2E10_TCTPV.4R8.B2	1.74	-0.27	0	H	THRI_TCTVB_OI_RC8	1.0x10 <sup>-9</sup>	1.8x10 <sup>-9</sup>
BLMTI.04L8.B1E10_TCTPH.4L8.B1	1.05	-0.51	0	H	THRI_TCT_RC	2.0x10 <sup>-9</sup>	0.8x10 <sup>-9</sup>

# TCTs: possible threshold settings for 2024 Pb run

- Use again **THRI\_TCT\_ION** BLM threshold family, **but with a factor of 3 increase in RS06-12 in EL19-28**
- Like in 2023 run, all TCT BLMs without filters (14) should be assigned to this family (all TCTs except on R8)
- Contrary to 2023, we know that the MF can be increased to 1 if needed

Reference values:

	Case 1b	Case 2
Min BLM response per impacting Pb ion	1.0x10 <sup>-9</sup> Gy/Pb	0.5x10 <sup>-9</sup> Gy/Pb
Max BLM response per impacting Pb ion	2.9x10 <sup>-9</sup> Gy/Pb	1.7x10 <sup>-9</sup> Gy/Pb
Power deposition in impacting jaw	65%	7%

(6.8 TeV)	Present master threshold	Possible new master threshold	Power deposition in impacted jaw Case 1b	Power deposition in impacted jaw Case 2
RS06 (10 ms)	0.11431 Gy/s	0.34293 Gy/s	20 kW	4.3 kW
RS07 (82 ms)	0.02859 Gy/s	0.08577 Gy/s	5 kW	1.1 kW
RS08-12 (0.6s-82s)	0.01457 Gy/s	0.04371 Gy/s	2.5 kW	0.5 kW

# TCLDs: possible threshold settings for 2024 Pb run

- Derive new BLM threshold family **THRI\_TCLD\_W** from **THRI\_TCL\_W**, **increase RS06-12 according to the table below (for EL28 only)**
- Like in 2023 run, all TCT BLMs without filters (14) should be assigned to this family (all TCTs except on R8)
- Contrary to 2023, we know that the MF can be increased to 1 if needed

Reference values:

Min BLM response per impacting Pb ion	$0.6 \times 10^{-9}$ Gy/Pb
Max BLM response per impacting Pb ion	$1.2 \times 10^{-9}$ Gy/Pb
Power deposition in impacting jaw	50%

*Estimated from 2023 measurements*

*From simulations*

	Present master threshold		Possible new master threshold	Deposited power in impacted jaw at new master threshold
RS06 (10 ms)	0.06096 Gy/s	4x	0.24384 Gy/s	18 kW
RS07 (82 ms)	0.02935 Gy/s	2.5x	0.073375 Gy/s	5.5 kW
RS08-12 (0.6s-82s)	0.02935 Gy/s	1.5x	0.044025 Gy/s	3.3 kW

# Possible Monitor Factors

	2023 Pb run (final)	2024 Pb start (proposal)
TCTs (except R8)	Max 0.4	0.4*
TCLDs	Max 0.35	0.4**

**This would mean:**

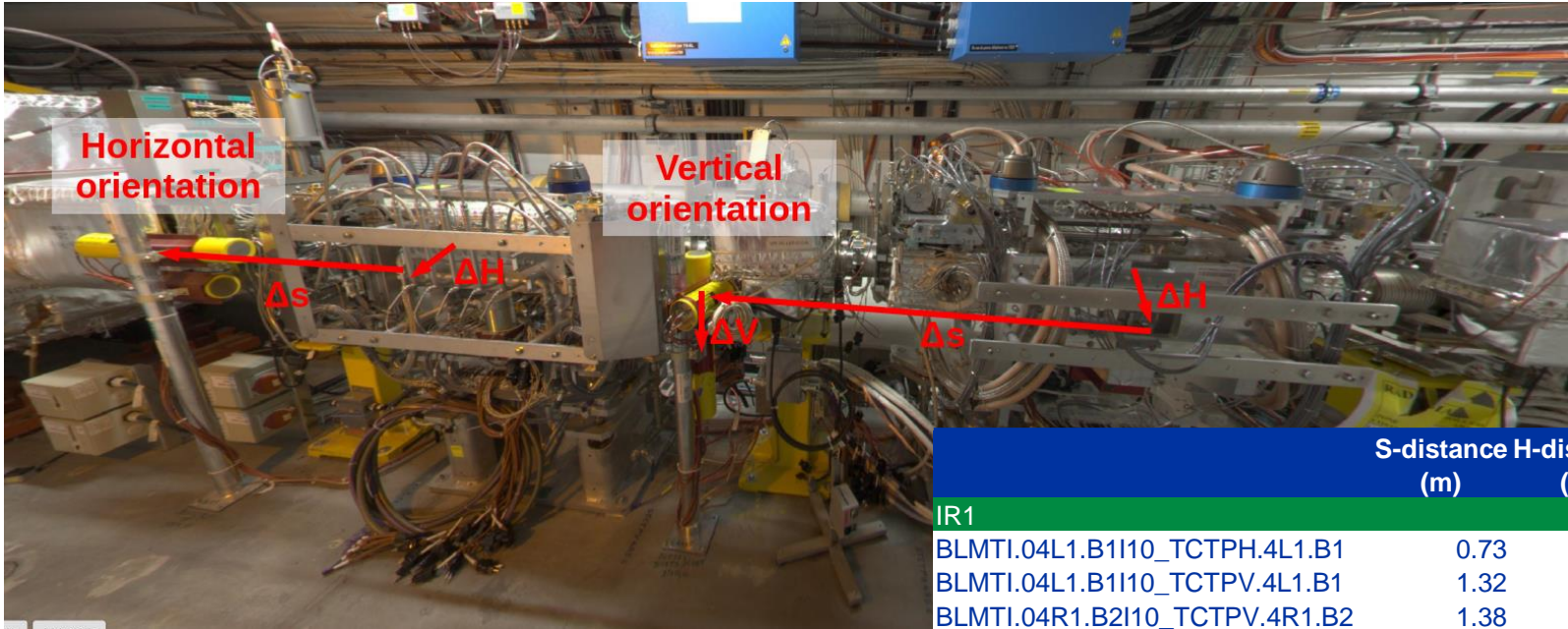
\*Start with 3x higher thresholds in RS06-12 (EL19-28) due to master threshold increase

\*\*Start with 1.5-4x higher thresholds in RS-12 (EL28) due to master threshold increase



[home.cern](http://home.cern)

# TCT BLM positions



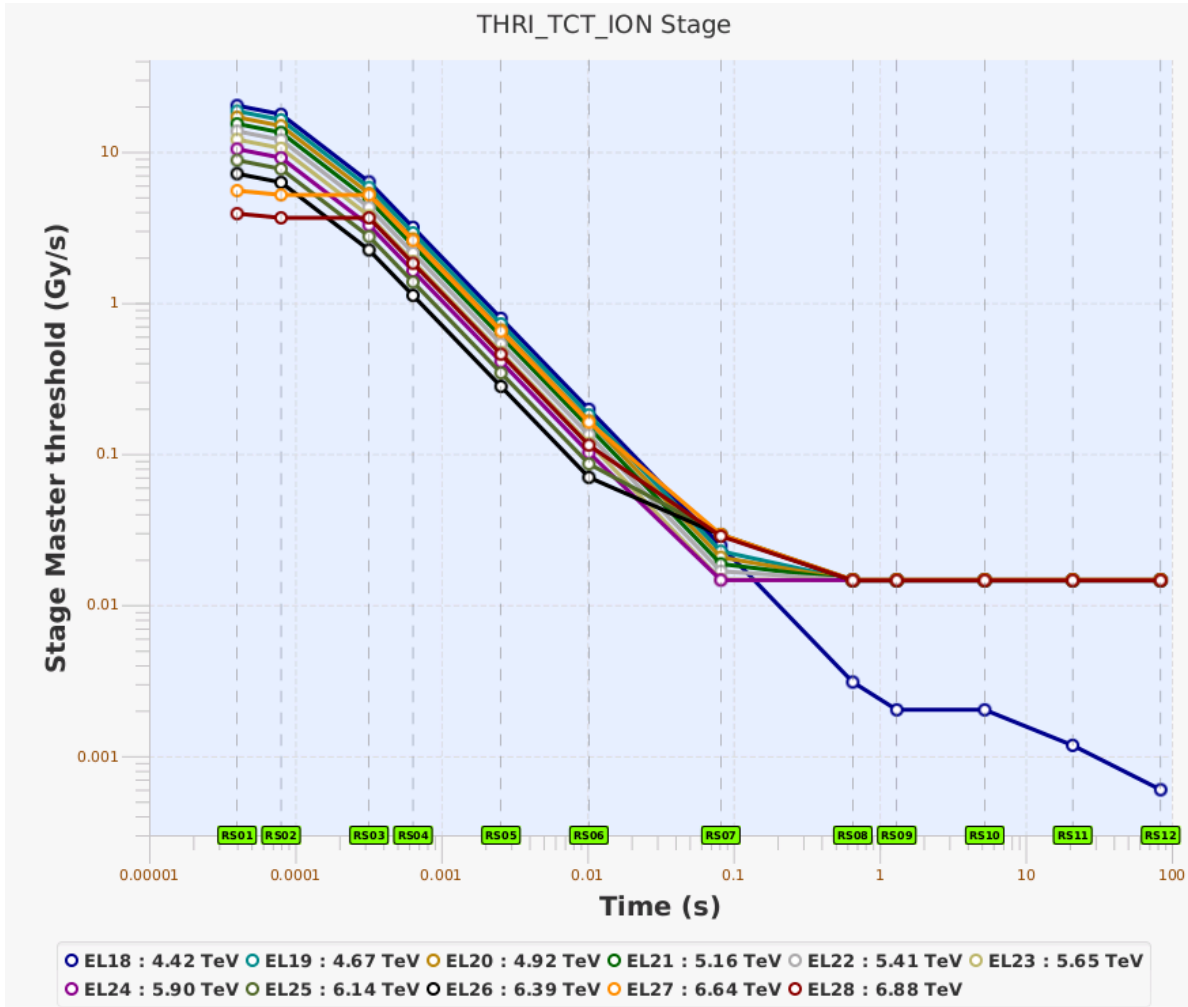
TCT BLM response depends on the BLM position with respect to the collimator

The table on the right shows the relative BLM position and orientation for the different TCTs

	S-distance (m)	H-distance (m)	V-distance (m)	BLM Orientation	Family	Filter
<b>IR1</b>						
BLMTI.04L1.B1I10_TCTPH.4L1.B1	0.73	0.25	-0.2	V	THRI_TCT	no
BLMTI.04L1.B1I10_TCTPV.4L1.B1	1.32	0.25	-0.19	V	THRI_TCT	no
BLMTI.04R1.B2I10_TCTPV.4R1.B2	1.38	0.40	0	V	THRI_TCT	no
BLMTI.04R1.B2I10_TCTPH.4R1.B2	1.27	0.28	-0.14	V	THRI_TCT	no
<b>IR2</b>						
BLMTI.04L2.B1E10_TCTPH.4L2.B1	1.00	-0.33	-0.35	H	THRI_TCTVA	no
BLMTI.04L2.B1E10_TCTPV.4L2.B1	1.00	-0.45	0	H	THRI_TCTVA	no
BLMTI.04R2.B2E10_TCTPV.4R2.B2	1.48	-0.37	0	H	THRI_TCTVA	no
BLMTI.04R2.B2E10_TCTPH.4R2.B2	1.04	-0.45	0	H	THRI_TCTVA	no
<b>IR5</b>						
BLMTI.04L5.B1I10_TCTPH.4L5.B1	0.75	0.31	-0.31	V	THRI_TCT	no
BLMTI.04L5.B1I10_TCTPV.4L5.B1	1.25	0.31	-0.36	V	THRI_TCT	no
BLMTI.04R5.B2I10_TCTPV.4R5.B2	1.25	0.36	0	H	THRI_TCT	no
BLMTI.04R5.B2I10_TCTPH.4R5.B2	1.18	0.27	-0.39	V	THRI_TCT	no
<b>IR8</b>						
BLMTI.04L8.B1E10_TCTPH.4L8.B1	0.91	-0.48	0	H	THRI_TCT	no
BLMTI.04L8.B1E10_TCTPV.4L8.B1	1.74	-0.25	0	H	THRI_TCT	no
BLMTI.04R8.B2E10_TCTPV.4R8.B2	1.74	-0.27	0	H	THRI_TCTVB_OI_RC8	small
BLMTI.04L8.B1E10_TCTPH.4L8.B1	1.05	-0.51	0	H	THRI_TCT_RC	small



# Final TCT master thresholds from 2023 Pb run



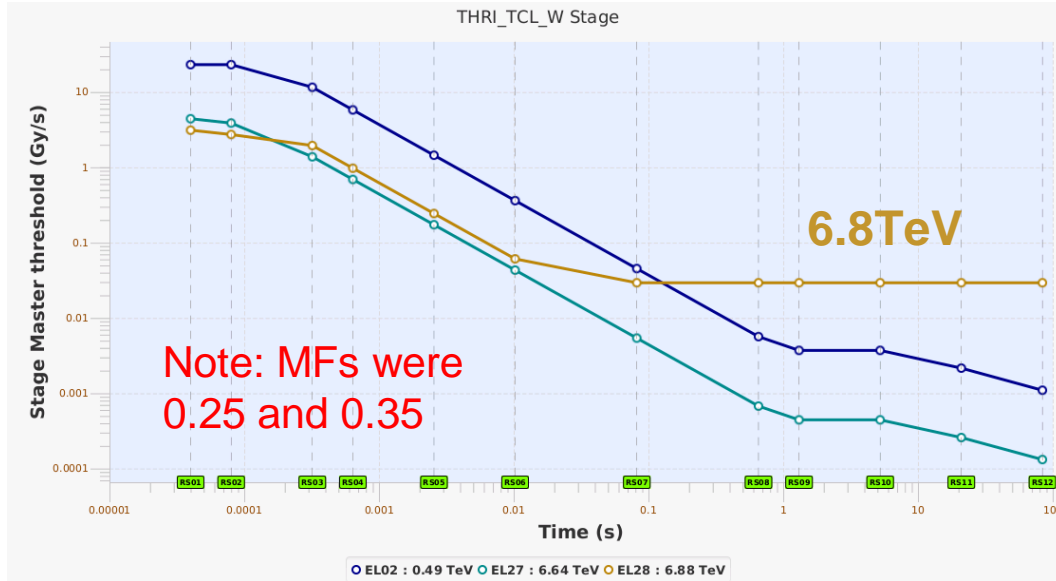
- Dedicated **THRI\_TCT\_ION** BLM threshold family was created, based on the THRI\_TCT proton family
- In 2023 Pb run, all TCT BLMs without filters (14) were assigned to this family (all TCTs except those on the right of IP8 which stayed in their proton family)

(at 6.8 TeV)	Master threshold	Deposited power in jaw* at present master threshold
RS06 (10 ms)	0.11431 Gy/s	2.3-6.6kW
RS07 (82 ms)	0.02859 Gy/s	0.6-1.7 kW
RS08-12 (0.6s-82s)	0.01457 Gy/s	0.3-0.9 kW

\*Assuming **Case 1a**:

- min/max BLM response (real BLM pos):  $1-2.9 \times 10^{-9}$  Gy/Pb
- 65% of power deposited in impacted jaw

# TCLD master thresholds from 2023 Pb run



- Were added in the **TCL\_W** BLM thr. family, i.e. in the same BLM family as W TCLs in IR1/5

## TCLD BLM response:

- Can reconstruct BLM response from known BFPP power ( $150 \text{ W}$  for  $L=6 \times 10^{27} \text{ cm}^{-2} \text{ s}^{-1}$ )
- Few caveats: depends on TCLD gap (shower leakage); in addition, contribution from EMD not well known (only partially lost on TCLD)
- Found  **$0.6-1.2 \times 10^{-9} \text{ Gy/Pb}$**  → matches very well what we get in TCT! BLM response simulations

	Master thr.	Deposited power in impacted jaw* at master threshold	Integrated energy deposition in jaw* at master threshold
RS06 (10 ms)	0.06096 Gy/s	2.3-4.5 kW	23-45 J (within 10 ms)
RS07 (82 ms)	0.02935 Gy/s	1.1-2.2 kW	90-180 J (within 82 ms)

\*If one assumes same BLM response as for BFPP ( $0.6-1.2 \times 10^{-9} \text{ Gy/Pb}$ ) and assuming that the deposited power in impacted jaw = half of impacting power