Sensitivity, response and thresholds; first experience during scrubbing and intensity ramp up

17/04/2024

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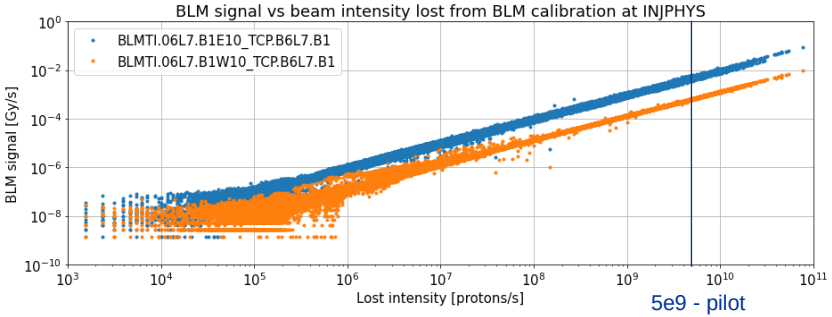
Joint MPP, LHC Collimation WG and BLMTWG

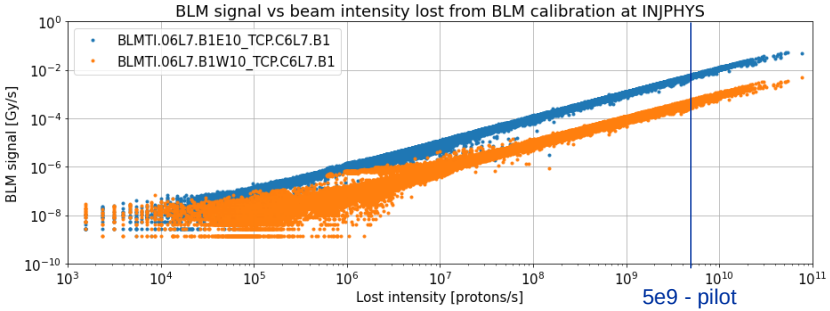
Outline

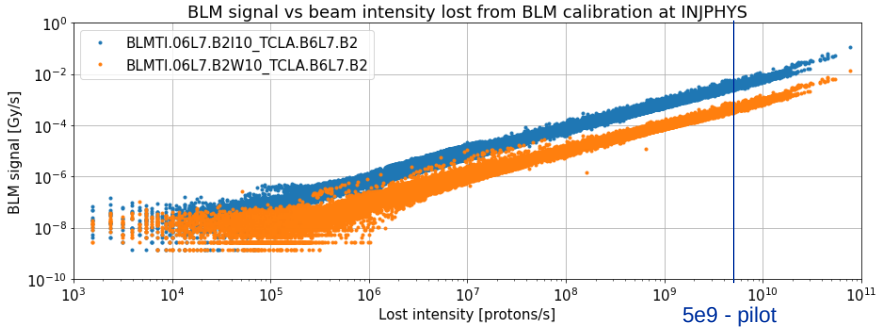
- Sensitivity of new detectors in the wall (RS09)
  - Top energy
  - Injection energy/scrubbing
- Losses during injection (RS01 and RS09)
- New response factors from betatron lossmaps (RS09)
- New BLM thresholds families

Sensitivity of new detectors on the wall

- Comparison of signal of “wall” and “old” BLM vs lost intensity from BLM calibration
- INJPHYS beam modes a minimum of 1e12 protons per beam in the machine (scrubbing included)



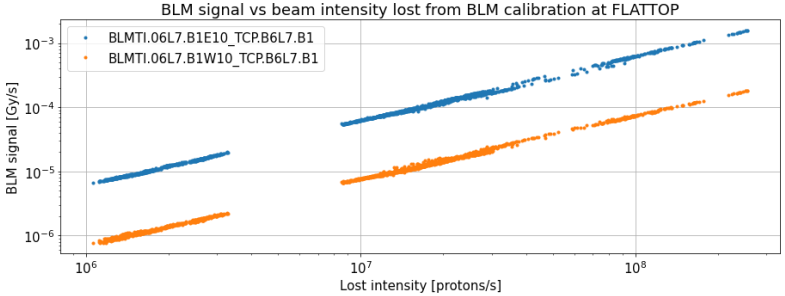


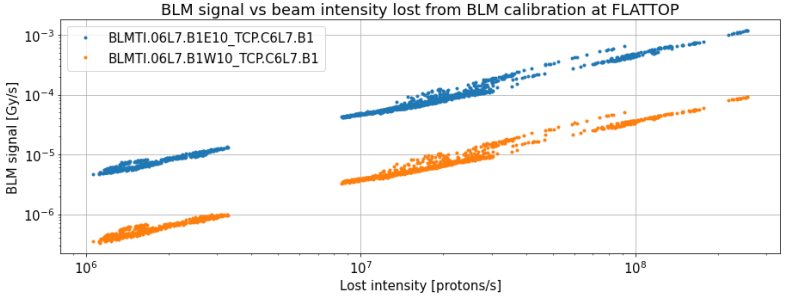


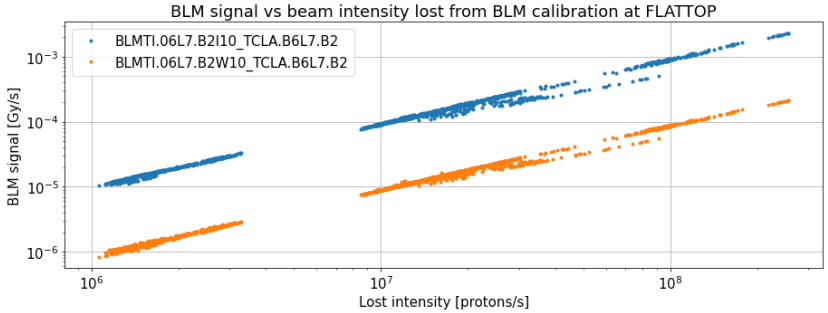
In all cases signal in new BLMs visible from at least losses around 1e6 protons/s

Sensitivity of new detectors on the wall

- Comparison of signal of “wall” and ”old” BLM vs lost intensity from BLM calibration
- FLATTOP beam modes with a minimum of 1e12 protons per beam in the machine (intensity ramp-up from 12 bunches included)



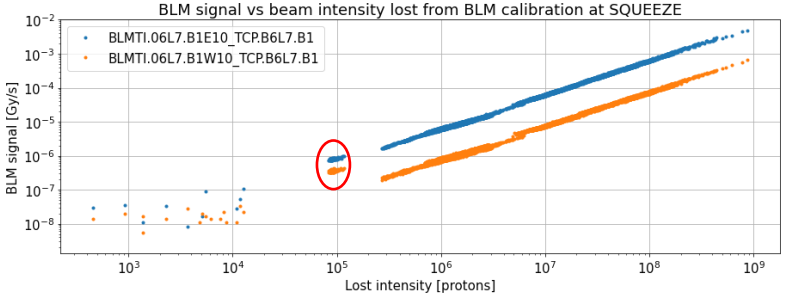


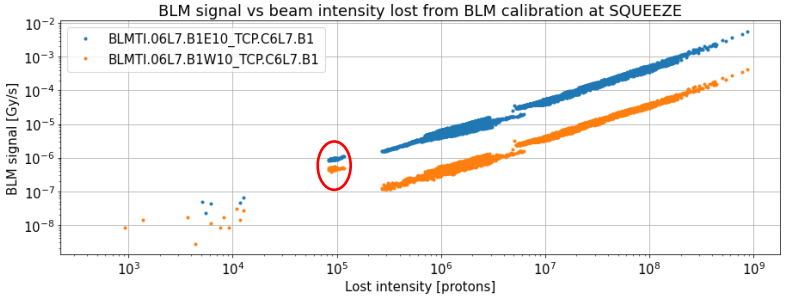


In all cases signal in new BLMs visible from losses well below 1e6 protons/s

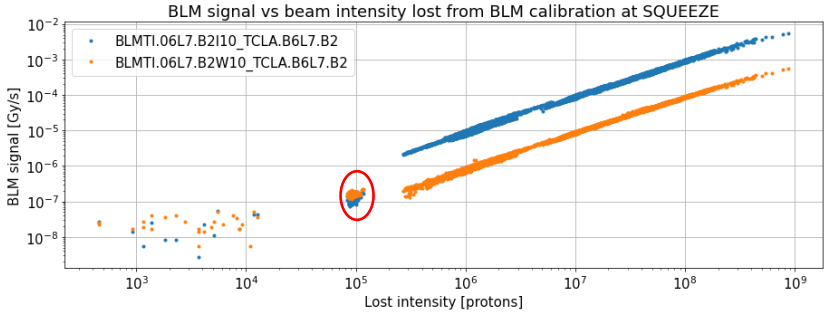
Sensitivity of new detectors on the wall

- Comparison of signal of “wall” and ”old” BLM vs lost intensity from BLM calibration
- SQUEEZE beam modes with a minimum of 1e12 protons in the machine (intensity ramp-up from 12 bunches included)





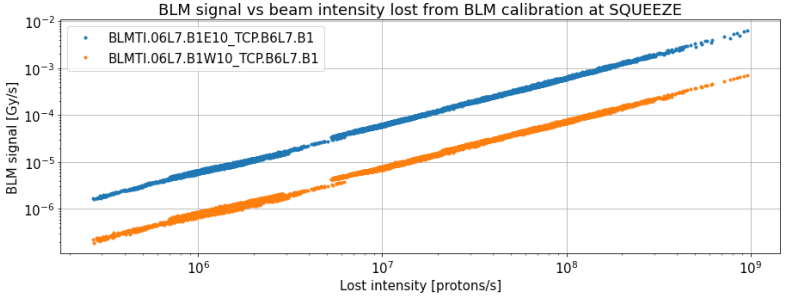
Signal in red circle corresponding to minutes after a beam dump in which beam mode was not changed -> mix of residual radiation and signal noise **Removed for next slide**

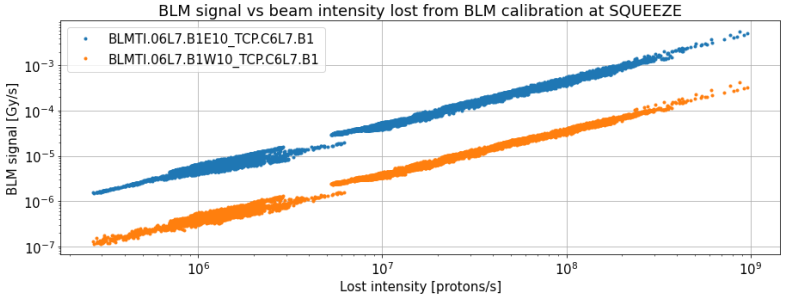


In all cases signal in new BLMs visible from losses around 3e5 protons/s

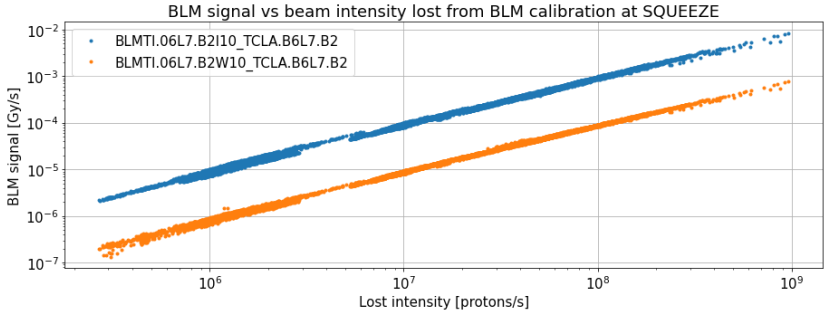
Sensitivity of new detectors on the wall

- Comparison of signal of “wall” and ”old” BLM vs lost intensity from BLM calibration
- SQUEEZE beam modes with a minimum of 1e12 protons in the machine (intensity ramp-up from 12 bunches included)





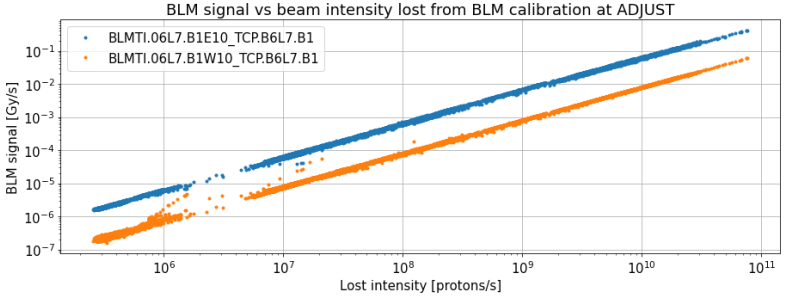
500kW -> 5.8e11 protons/s
Good sensitivity around 6 orders of magnitude below max loss allowed for RS09

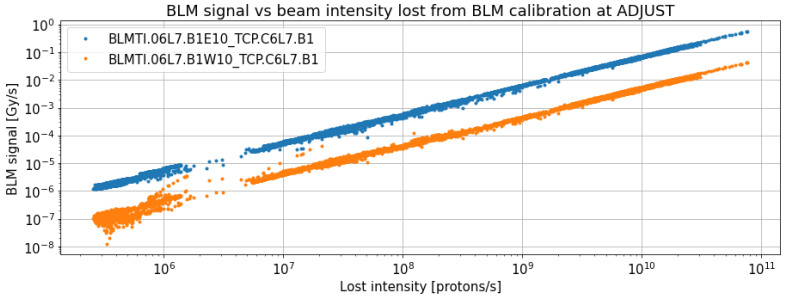


In all cases signal in new BLMs visible from losses around 3e5 protons/s

Sensitivity of new detectors on the wall

- Comparison of signal of “wall” and ”old” BLM vs lost intensity from BLM calibration
- ADJUST beam modes with a minimum of 1e12 protons in the machine (intensity ramp-up from 12 bunches included)





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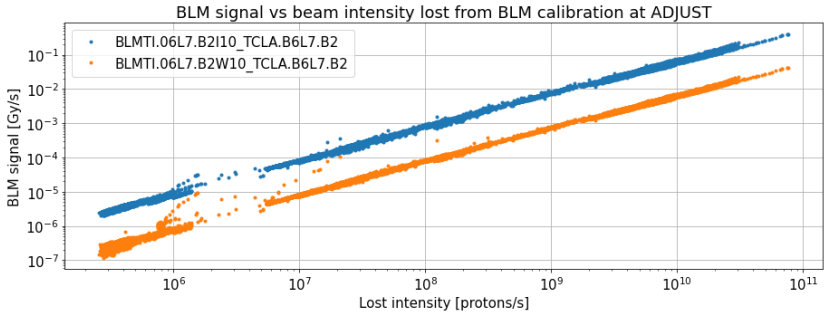
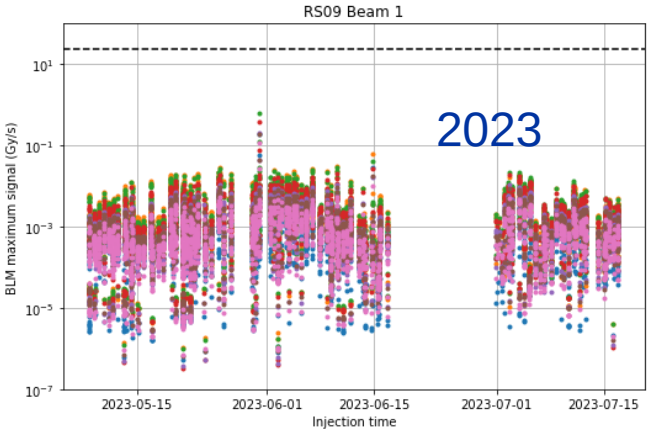
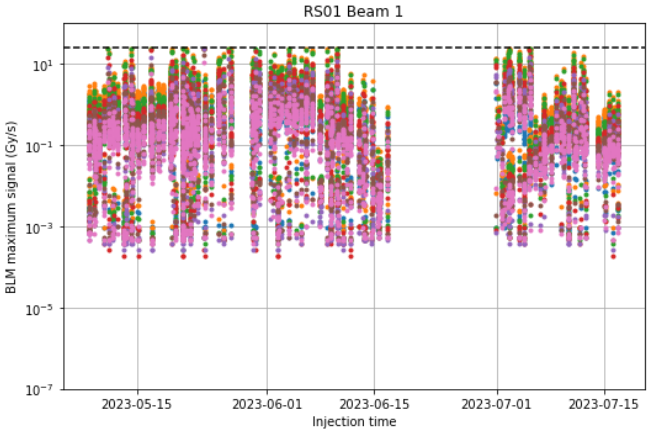
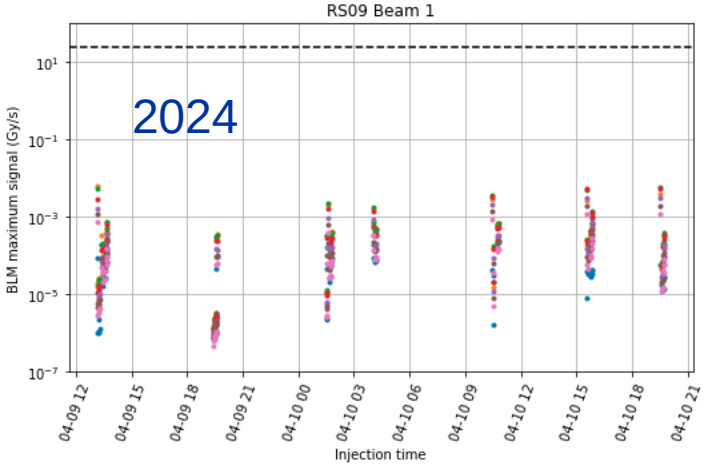


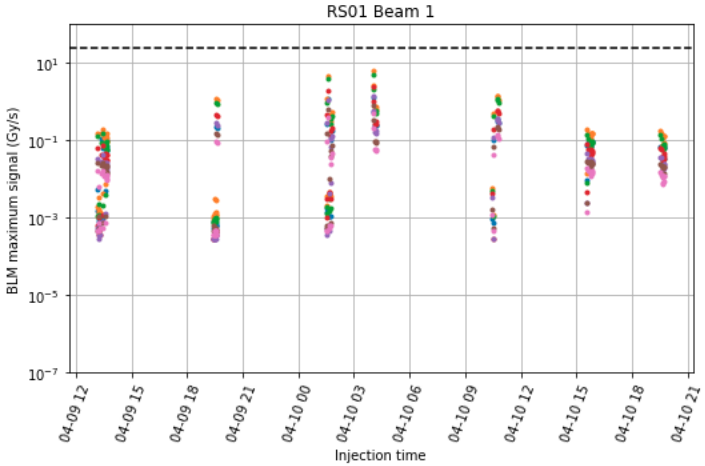
In all cases signal in new BLMs visible from losses around 3e5 protons/s

Losses during injection

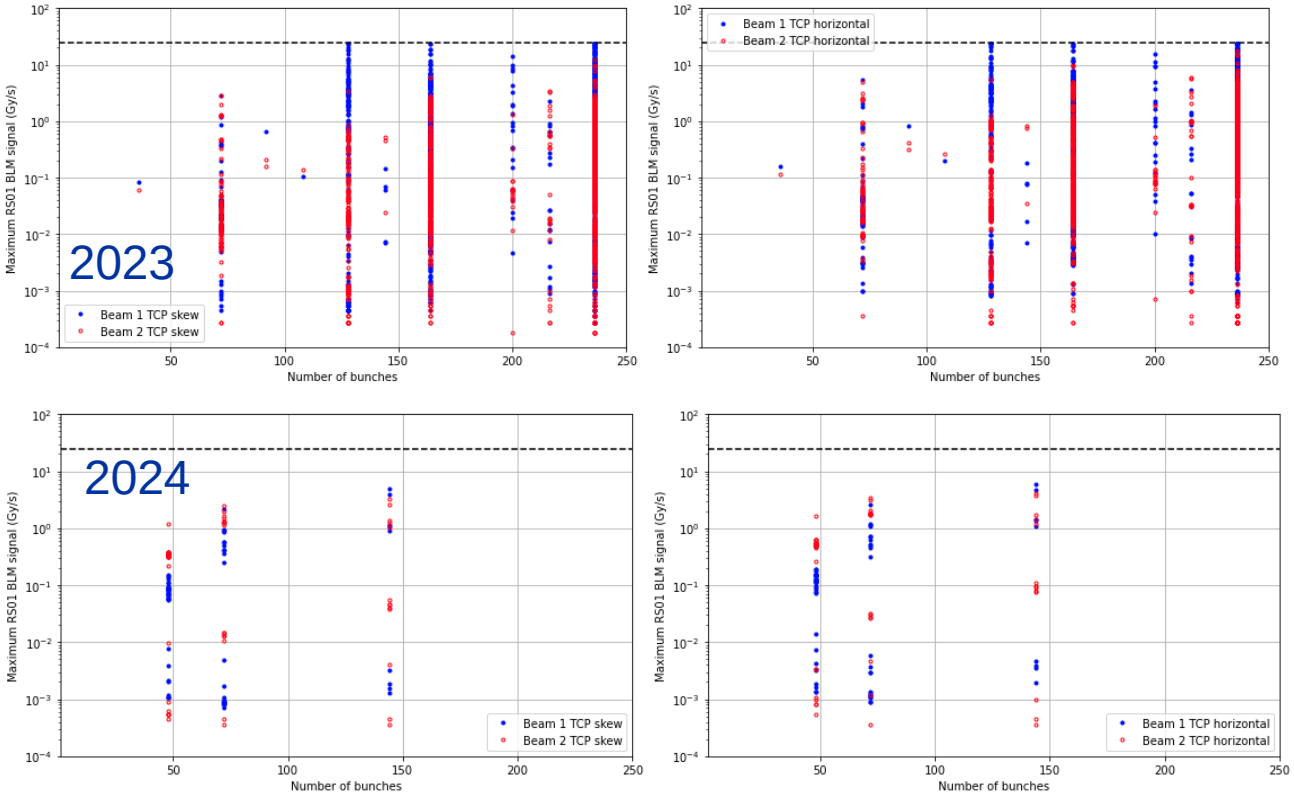






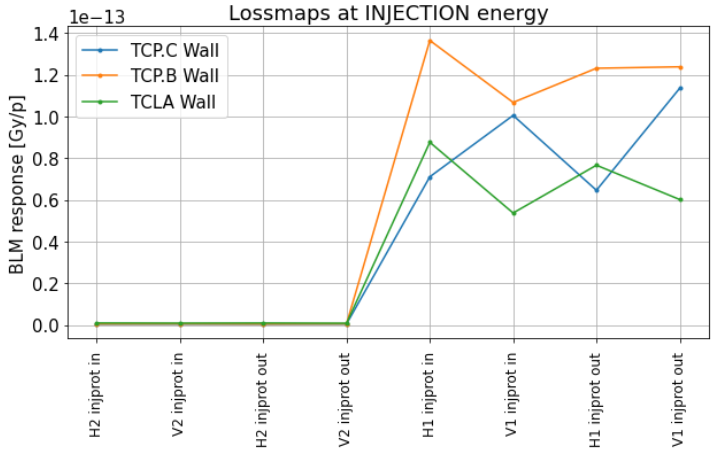


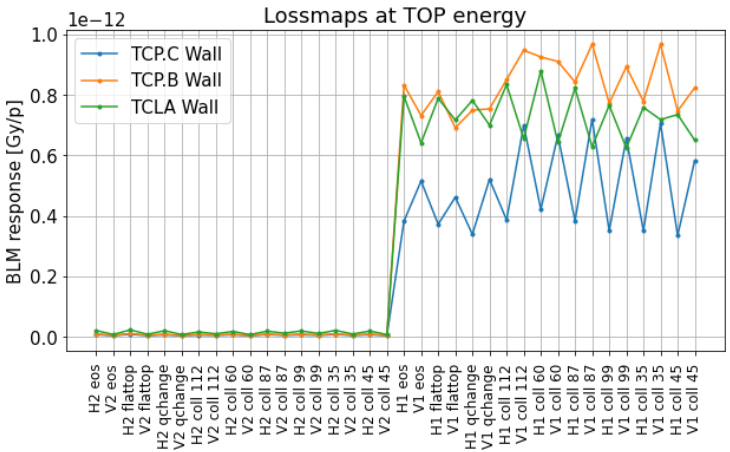
Maximum loss vs number of bunches



Response from lossmaps for new detectors in the wall

- Response analyzed from 2024 betatron lossmaps with final collimation settings at:
  - INJECTION: INJPROT IN and OUT
  - TOP energy: FLATTOP, EOS, QCHANGE, and during collisions with 6 different beta star values
  - Reduction in response consistent with primary observations by Belen





Response for B2 losses much lower -> We keep only B1 lossmaps

Response from lossmaps for new detectors in the wall

- Response analyzed from 2024 betatron lossmaps with final collimation settings at:
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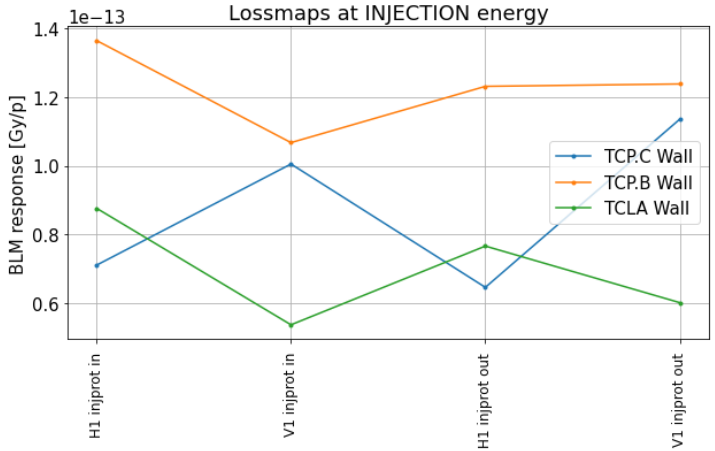

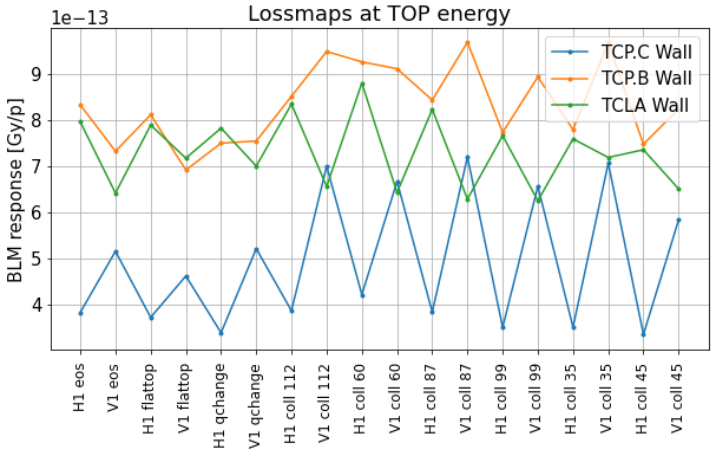

We keep only the maximum from each set of B1 lossmaps

Response from lossmaps for new detectors in the wall

- Response analyzed from 2024 betatron lossmaps with final collimation settings at:
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  - TOP energy: FLATTOP, EOS, QCHANGE, and during collisions with 6 different beta star values
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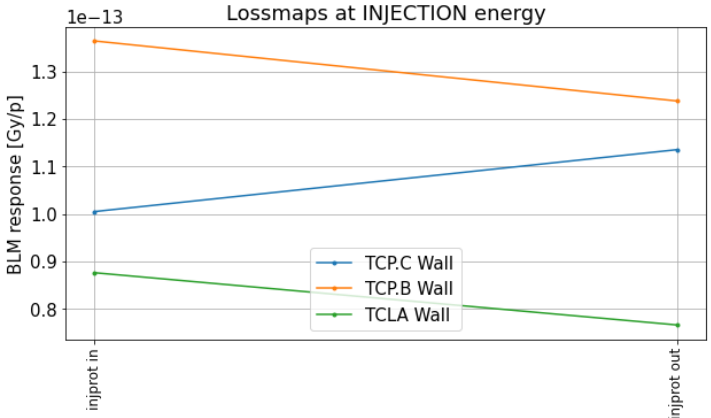

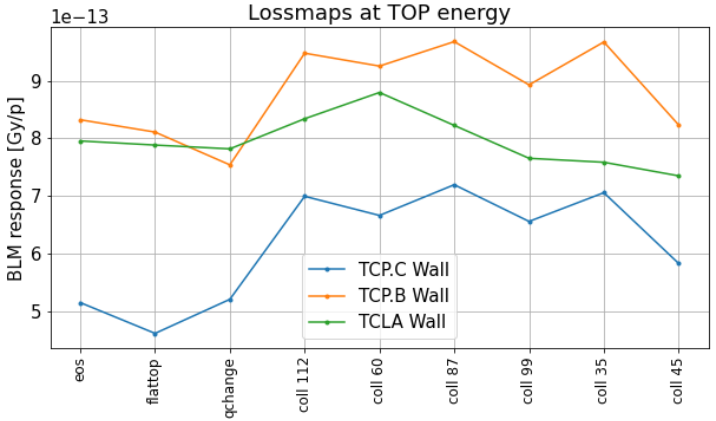

We compute the mean for INJECTION and TOP separately, convert to aC/p and do a linear fit with energy to get response curve

Response from lossmaps for new detectors in the wall

- Response analyzed from 2024 betatron lossmaps with final collimation settings at:
  - INJECTION: INJPROT IN and OUT
  - TOP energy: FLATTOP, EOS, QCHANGE, and during collisions with 6 different beta star values
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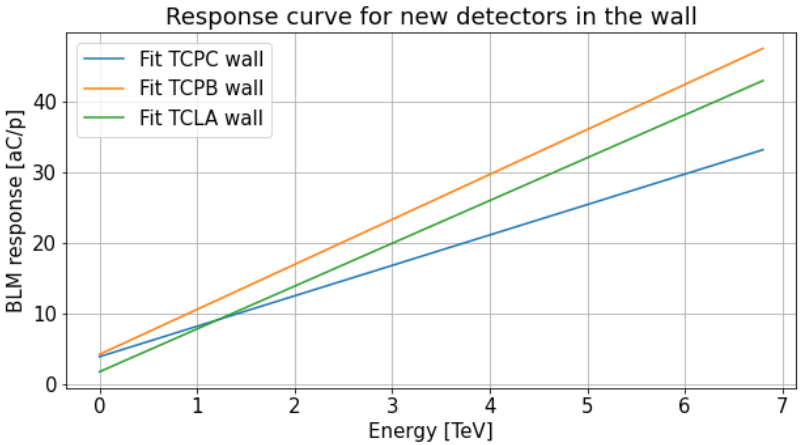


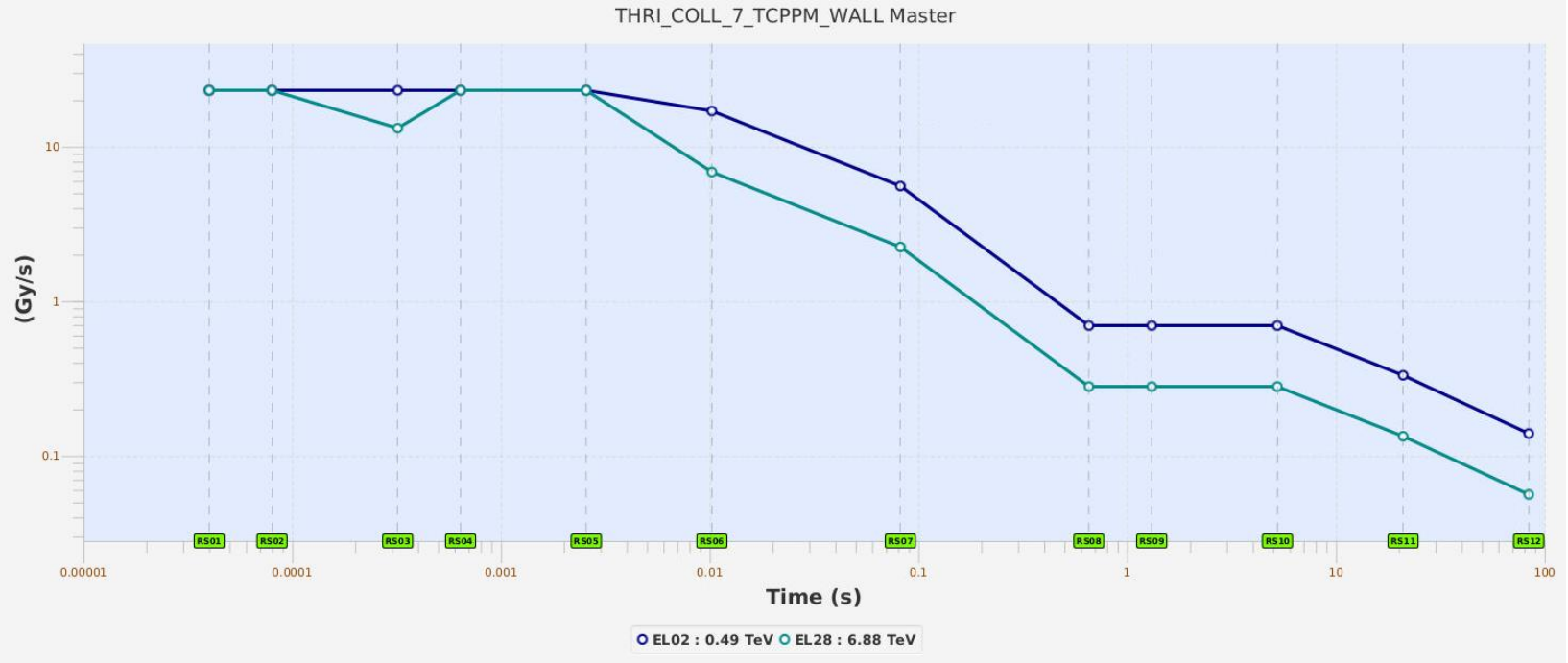
Proposal of BLM thresholds families for detectors in the wall

Family Name	2022 loss map values per proton [aC, aC/TeV]	Family Name	2024 loss map values per proton [aC, aC/TeV]	Ratio 2024 / 2022 [offset, slope]
THRI_COL_7_TCPPM	[66,44]	THRI_COLL_7_TCPPM_WALL	**[3.8, 4.3]**	[0.06,0.098]
THRI_COLL_7_TCP	[49, 47]	THRI_COLL_7_TCP_WALL	**[4.2, 6.4]**	[0.09,0.14]
THRI_COLL_7_TCLA_HI	[6, 88]	THRI_COLL_7_TCLA_HI_WALL	**[1.7, 6.1]**	[0.3,0.07]

Maximum allowed power loss from loss maps WITHOUT these BLMs:
H1 : 322.5 kW
V1 : 309.8 kW

Proposal of BLM thresholds families for detectors in the wall

Master thresholds for TCP.C Wall at injection and top energy



Proposal of BLM thresholds families for detectors in the wall

Master thresholds for TCP.B Wall at injection and top energy

Proposal of BLM thresholds families for detectors in the wall

Master thresholds for TCLA.B Wall at injection and top energy

Conclusions

- Sensitivity of new BLMs in the wall:
  - Injection: capable of observing losses from 1e6 protons/s
  - Top Energy: capable of observing losses below 3e5 protons/s
- Beam losses at injection seem to be of similar order than in 2023 for 144 bunches
- New response factors calculated from loss maps for the 3 new families