



# Loss Map Mini Revalidation Commissioning 2023

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*On behalf of the LHC Collimation and OP teams*

# Outline

- 1 Introduction
- 2 New collimation settings
- 3 Summary of Results
- 4 Conclusion
- 5 All Loss Maps

# First round of validation loss maps

- Detailed discussion in LHC CWG #272, [indico link](#)
- General performance similar to 2022
- **Worse DS inefficiency** wrt. 2022 from Q-change, for B1H
- **High banana factor** i.e. max losses right (left) of IR7 for B1 (B2), for B1H
  - TCSPM.E5R7.B1 and TCSPM.6R7.B1 were known to have a large tilt
- Tests on 13/4 showed that with full angular alignment in IR7 and after **retracting the TCSPM.E5R7.B1 by 500  $\mu\text{m}$  the cleaning can be improved** → Initial plan: to be addressed in a future dedicated MD; setting update after TS1

# Dump on losses

- Dumps on losses seen, e.g. in fill #8694 (1/5)
- Dumped on BLM at TCLA.D6R7.B1.
  - Triggered at  $\sim 31$  kW
- The dump on losses indicated:
  - Issues with lifetime, as well as decreased cleaning performance, which were **blocking the intensity ramp up**
  - **Need for reviewing the collimator settings before the MDs:** TCSPM.E5R7.B1 and TCSPM.6R7.B1

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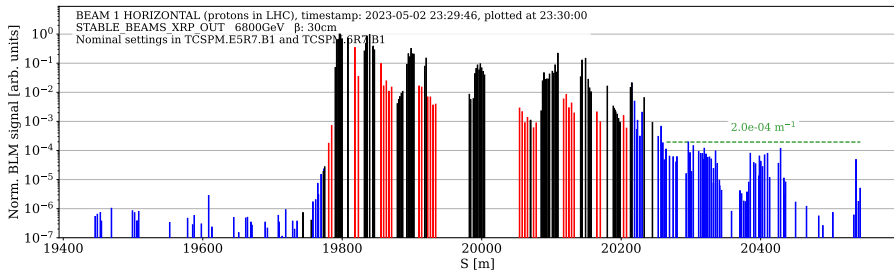
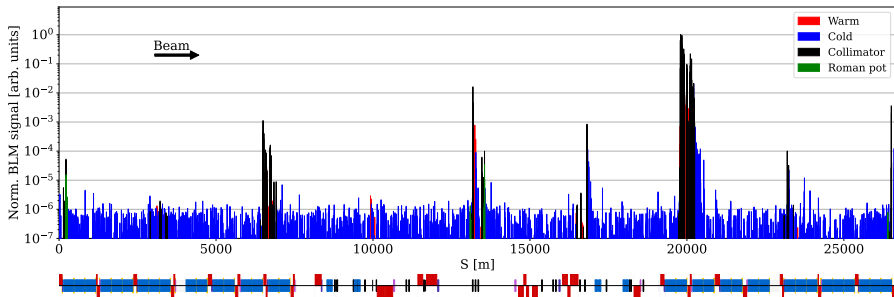
# Investigate TCSPMs settings

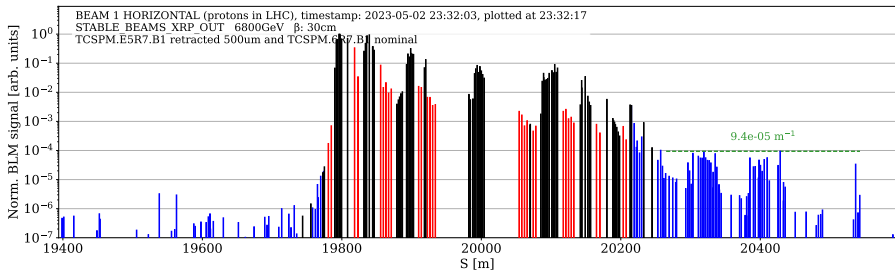
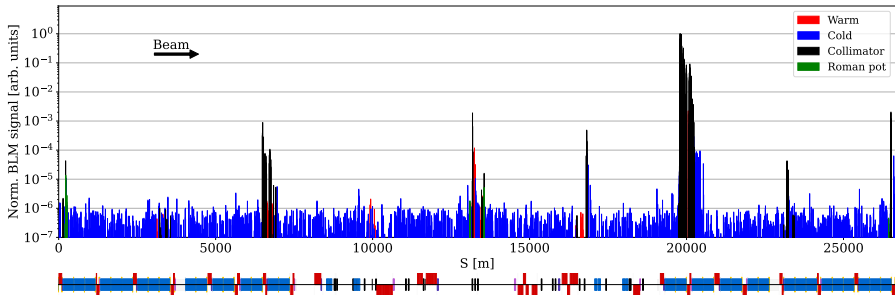
- Four different configurations were tested for  $\beta^*=30$  cm (motivated by the studies on 13/4)
  - Nominal settings for TCSPM.E5R7.B1 and TCSPM.6R7.B1
  - TCSPM.E5R7.B1 retracted 500  $\mu\text{m}$  ( $8.2 \sigma$ ) and TCSPM.6R7.B1 with nominal settings
  - TCSPM.E5R7.B1 with nominal settings and TCSPM.6R7.B1 tilt corrected, by moving the two corners out, leading to an effective retraction at  $7 \sigma$
  - TCSPM.E5R7.B1 retracted 500  $\mu\text{m}$  ( $8.2 \sigma$ ) and TCSPM.6R7.B1 tilt corrected with effective retraction at  $7 \sigma$

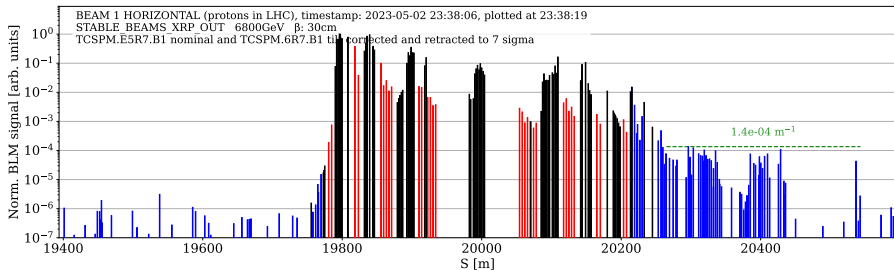
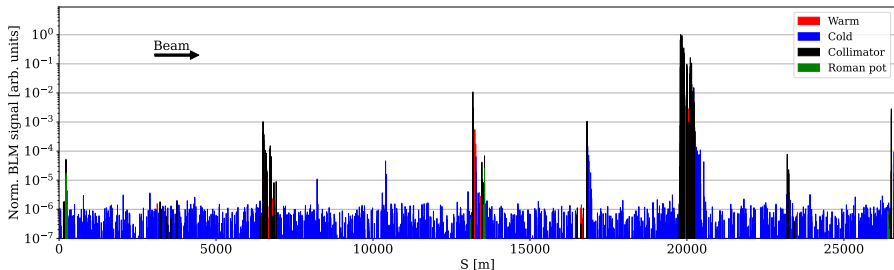
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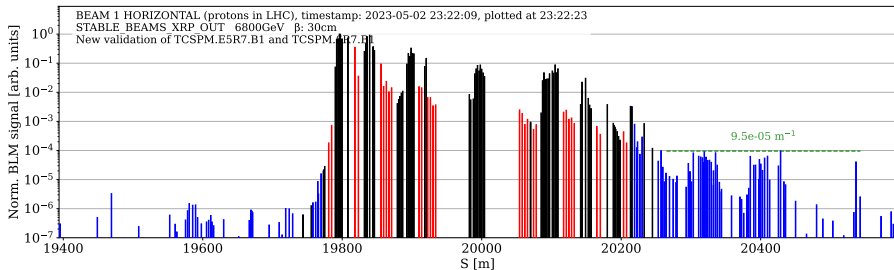
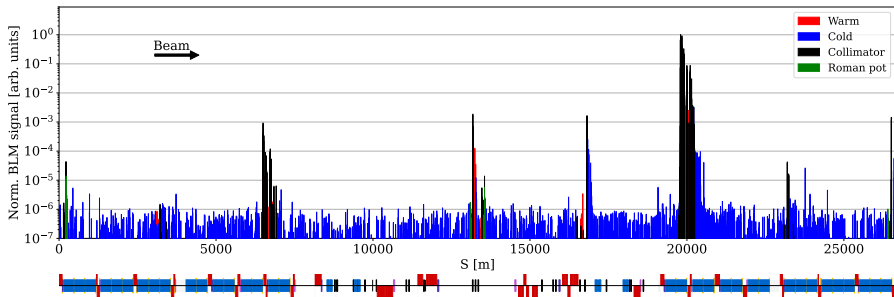
- General improvement of the DS inefficiency and the banana factor with the new settings for TCSPM.E5R7.B1 and TCSPM.6R7.B1
- The **best scenario** was to **retract the TCSPM.E5R7.B1 by 500  $\mu\text{m}$**  and **keep the TCSPM.6R7 with the nominal settings**, since it results in the best cleaning efficiency, TCT losses, and losses in IR6.
  - New collimation settings to be used operationally defined











# Loss Maps Revalidation Matrix 2023

- In addition to the change in IR7, vertical IR1 TCTs were re-aligned (on 3/5), due to a crossing angle change in ATLAS
- For the revalidation a subset of the betatron loss maps from flat top to 30 cm were performed. Off-momentum loss maps and ASDs only at 60 cm and at 30 cm, with the wires powered on.

# Loss Maps Revalidation Matrix 2023

450 GeV		6.8 TeV																													
Injection		Non colliding			Colliding XRP OUT			Colliding XRP IN																				WIRE			
Prot. IN	Prot. OUT	FT	EoS / EoR	QC	120 cm	60 cm	30 cm	Anti-telescopic										Telescopic										30 cm			
								120 cm	112.5 cm	105.5 cm	99 cm	93 cm	87.5 cm	82.5 cm	77.5 cm	72.5 cm	68 cm	64 cm	60 cm	56 cm	52 cm	48.5 cm	45 cm	41.5 cm	38.5 cm	35.5 cm	32.5 cm		30 cm		
B1H		✓						✓					✓					✓				✓							✓	✓	
B1V		✓						✓					✓					✓				✓						✓	✓	✓	
B2H		✓						✓					✓					✓				✓						✓	✓	✓	
B2V		✓						✓					✓					✓				✓						✓	✓	✓	
+dp/p																						✓								✓	
-dp/p																						✓								✓	
ASD																						✓								✓	

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# Summary of Results

- **Inefficiency:**

- normalised local inefficiency in the DS in IR7
- back to 2022 levels for B1H

- **Banana factor:**

- max losses right of IR7 (left of IR7 for B2)
- back to 2022 levels for B1H

- **TCSF losses**

- Losses in IR6 are at similar levels with the first validation round of 2023 till  $\beta^*=60$  cm, for all lossmaps.
- For B1H, clear improvement from  $\beta^*=52$  cm

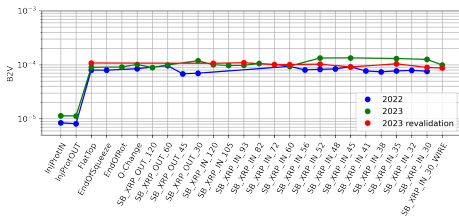
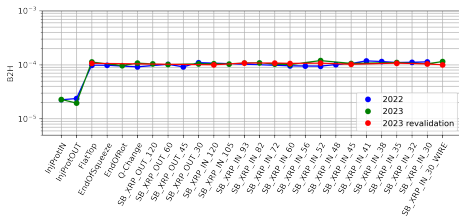
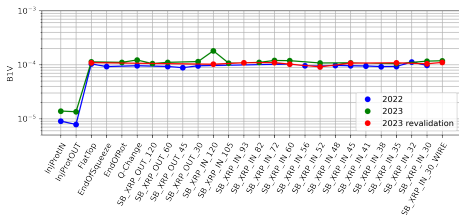
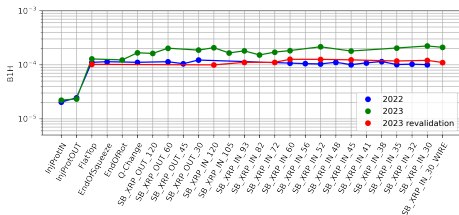
- **TCT losses**

- **IP1** clearly lower than 2022 at small  $\beta^*$  ( $\leq 35$  cm)
- **IP5** clearly lower than 2022 at small  $\beta^*$  ( $\leq 45$  cm)



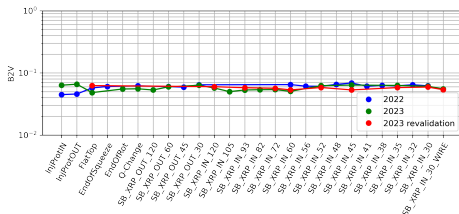
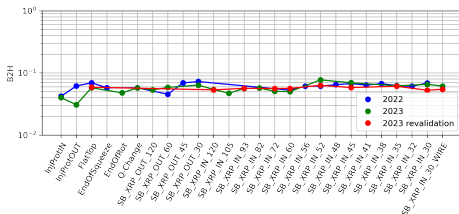
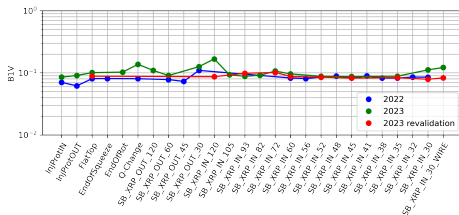
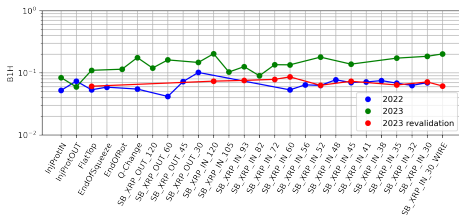
# Inefficiency

Normalised local inefficiency in the DS in IR7



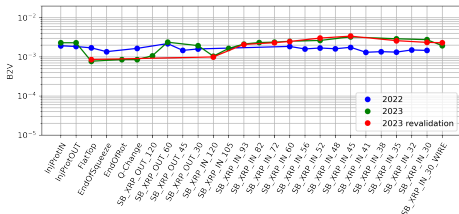
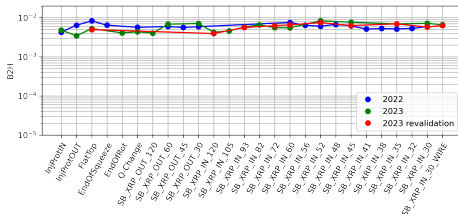
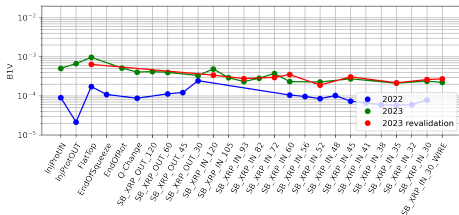
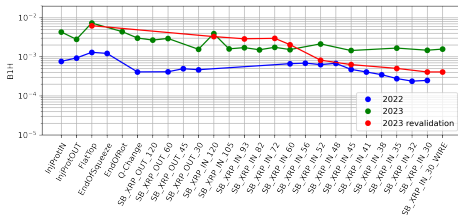
# Banana Factor

Maximum secondary collimator loss in IR7 (downstream of IP)



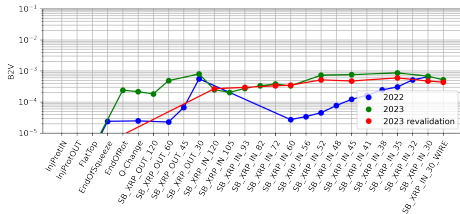
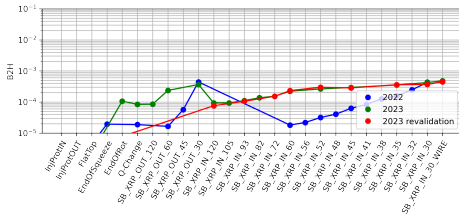
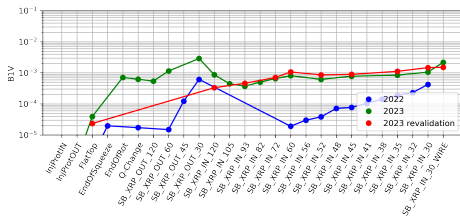
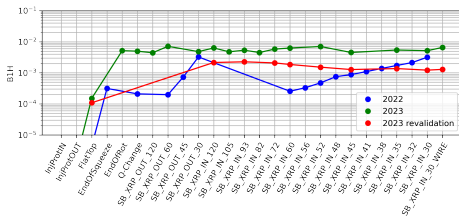
# IR6 TCSP losses

Normalised losses on the TCSP



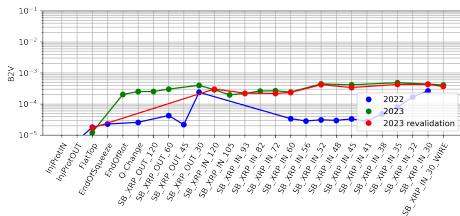
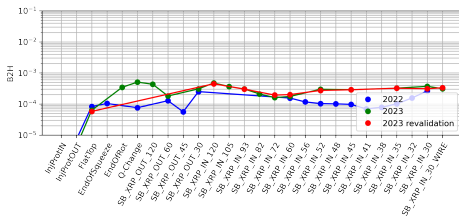
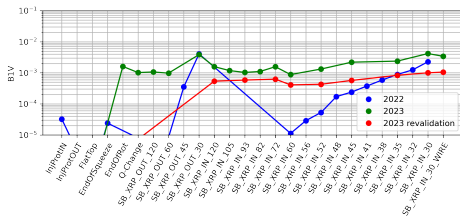
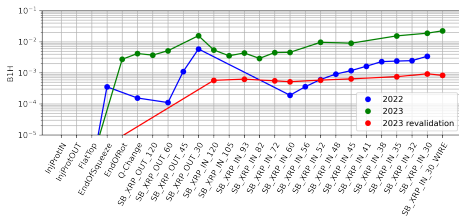
# TCT losses in IP1

Normalised losses on the TCT in IP1



# TCT losses in IP5

Normalised losses on the TCT in IP5



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# Conclusion

- New collimator settings after dump on losses:
  - TCSPM.E5R7.B1 retracted by 500  $\mu\text{m}$
- Generally improved cleaning compared with the first validation round of 2023
- Cleaning for B1H back to 2022 levels
- TCSP losses in IR6 in similar levels with the first validation round up to  $\beta^*=60$  cm, clearly improved after 52 cm, for B1H
- TCT losses clearly lower than 2022 at small  $\beta^*$  for B1H
- Need to understand the worse cleaning performance for B1H, observed in the first round of validation loss maps in 2023  
→ Simulations campaign planned

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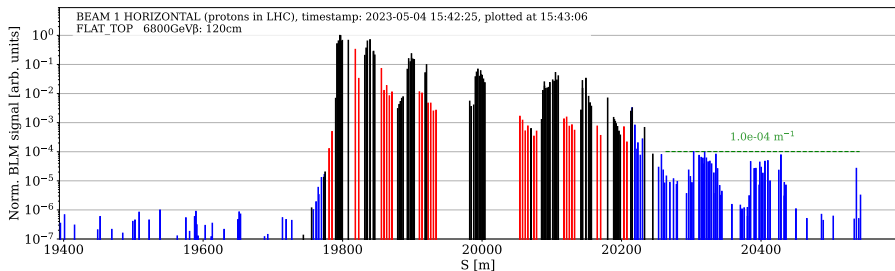
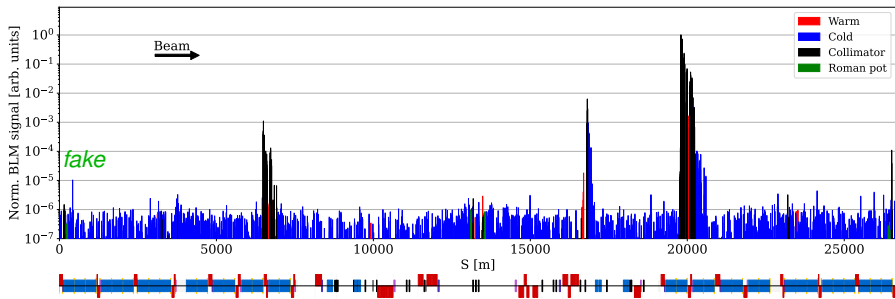


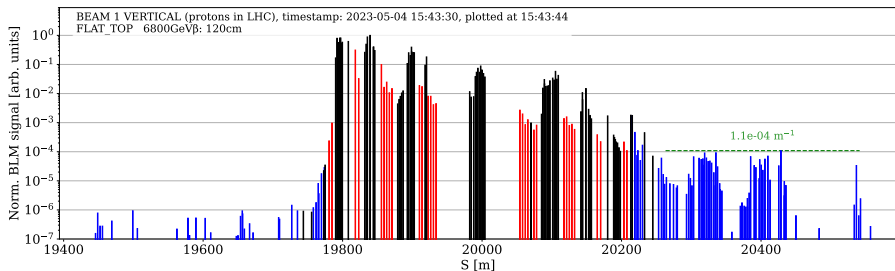
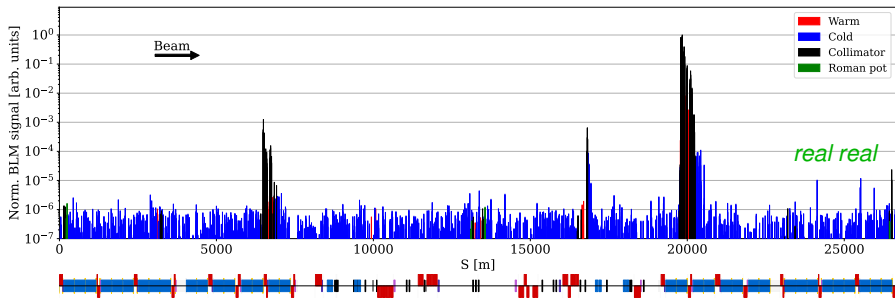
# All Loss Maps

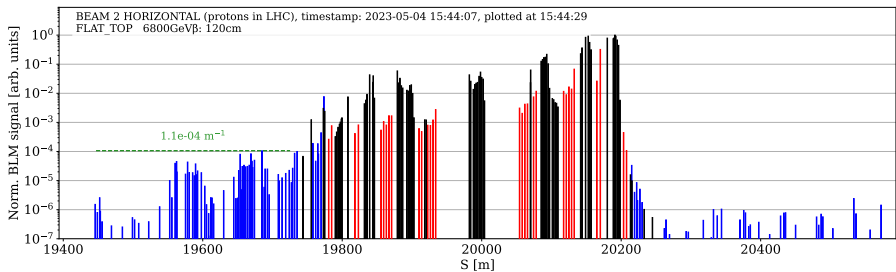
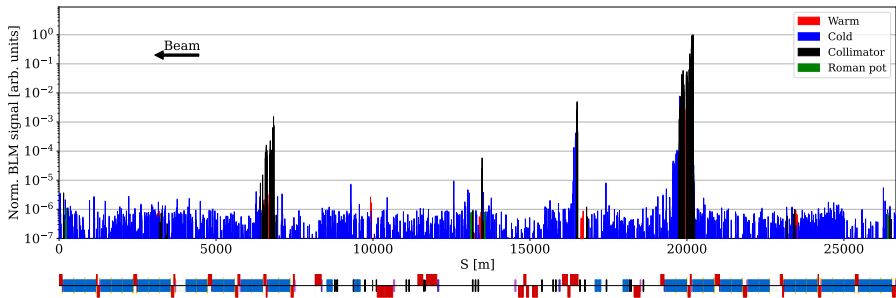
6 Non-Colliding

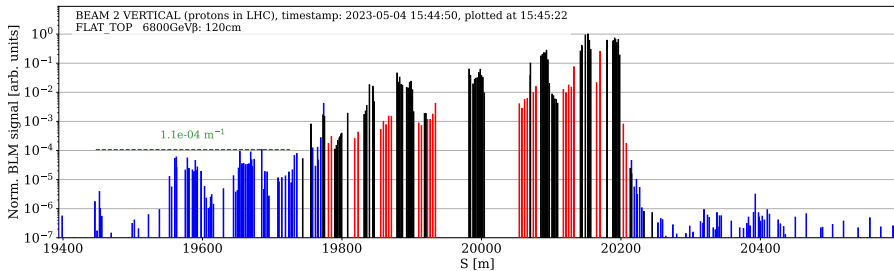
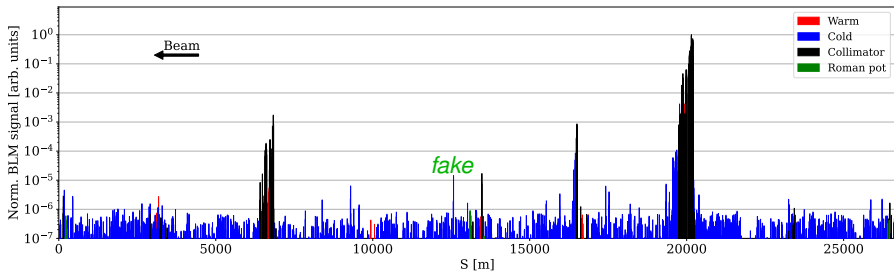
7 Colliding Loss Maps - XRP IN

# Flat Top









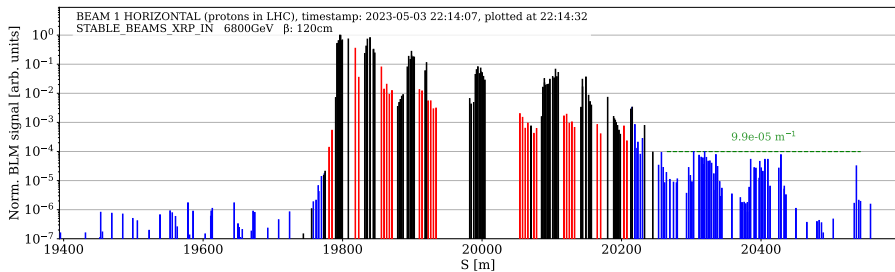
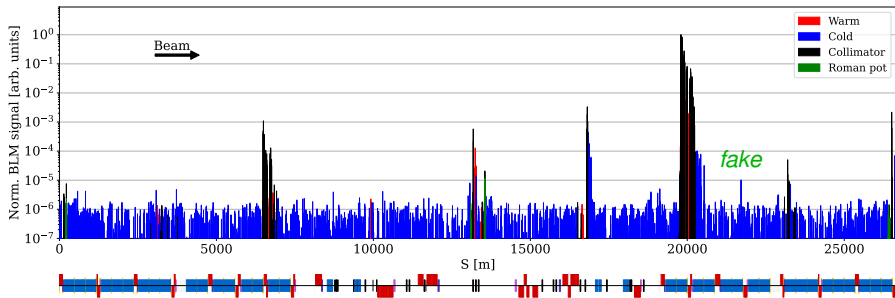
# All Loss Maps

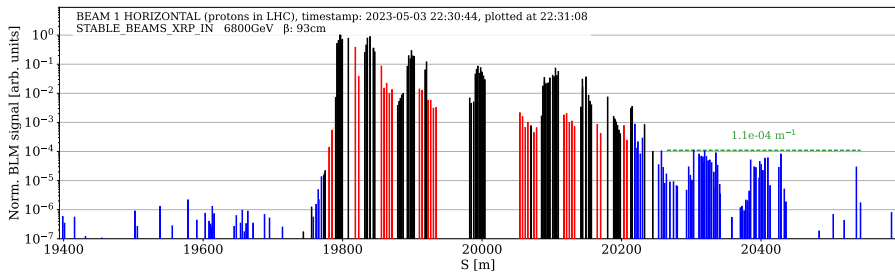
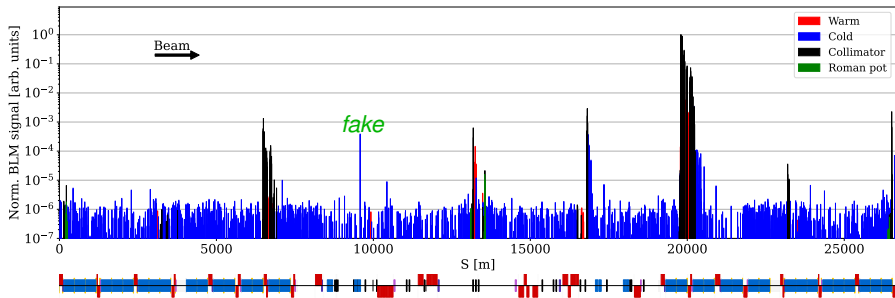
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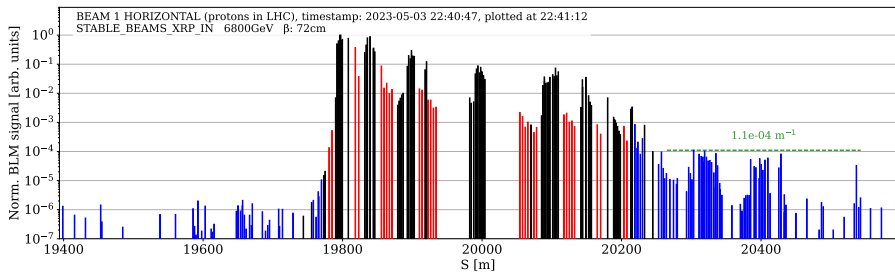
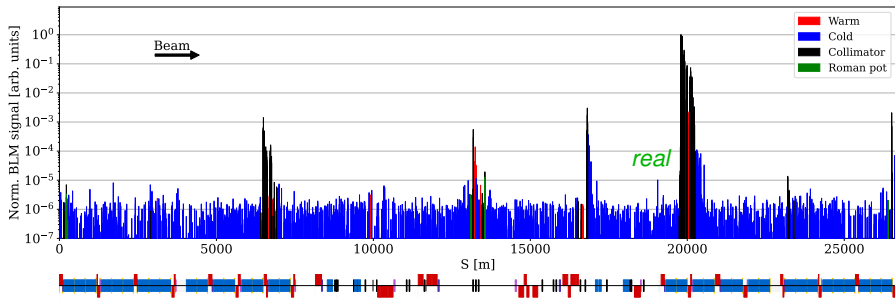
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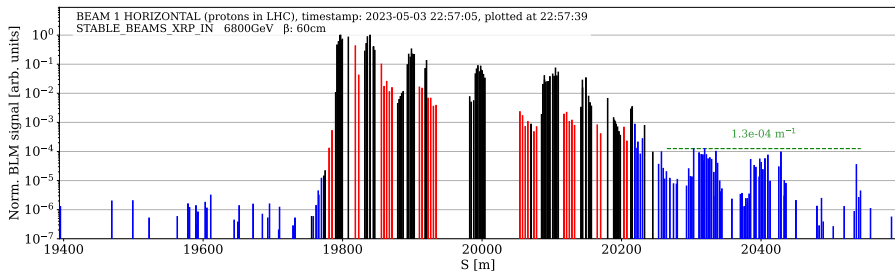
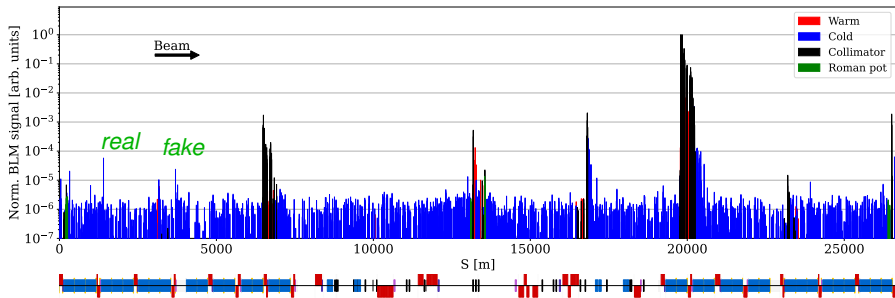
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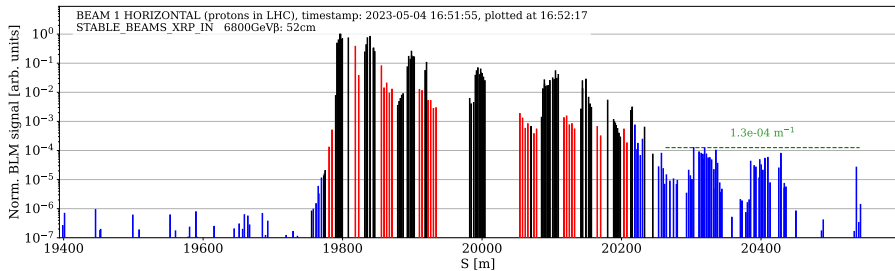
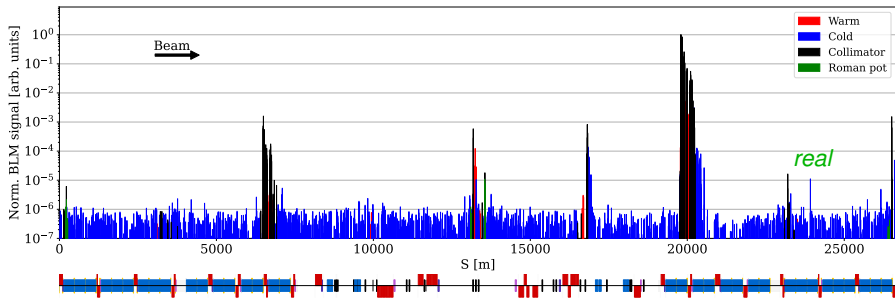


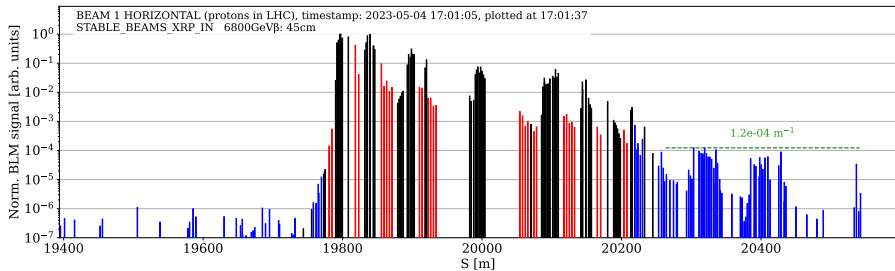
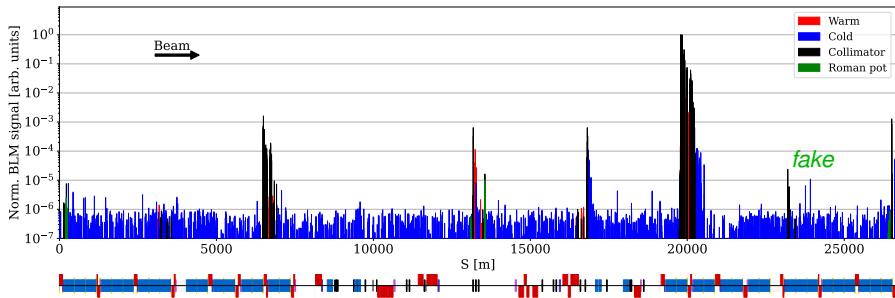


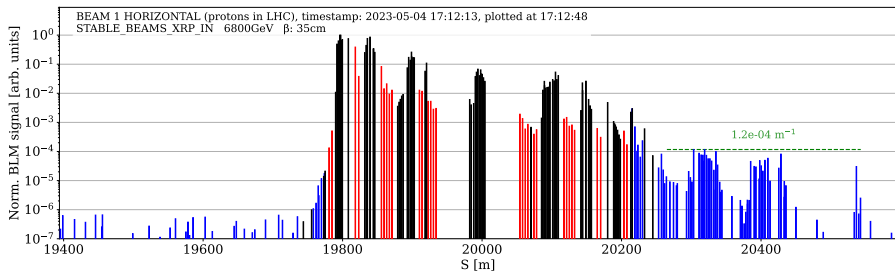
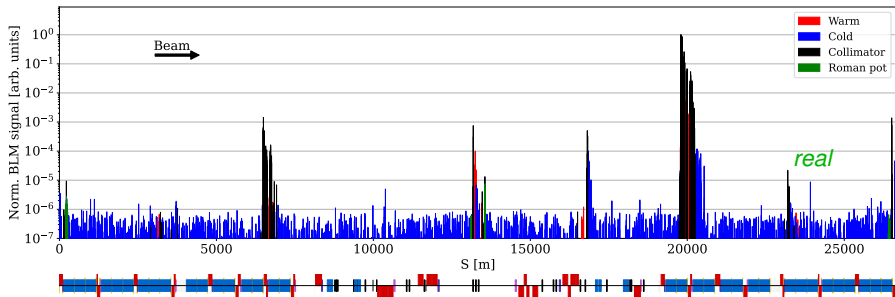


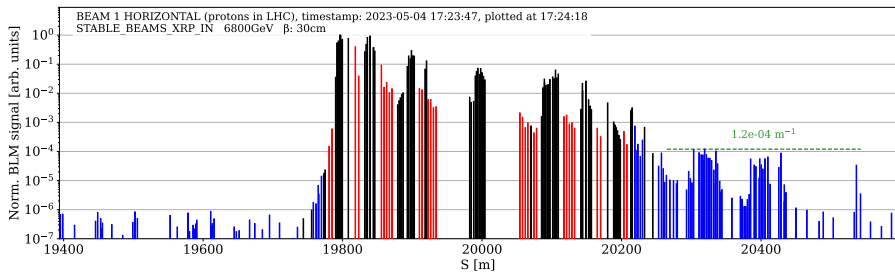
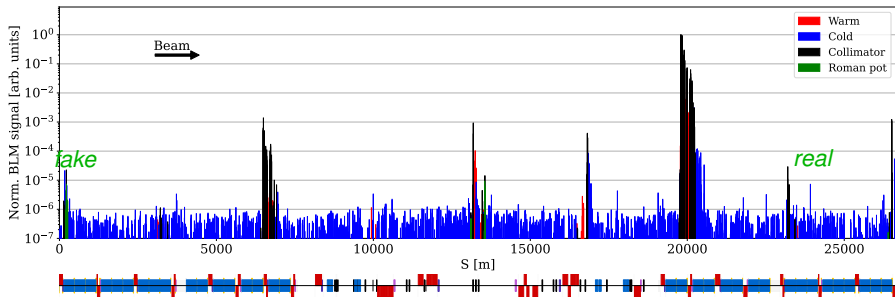




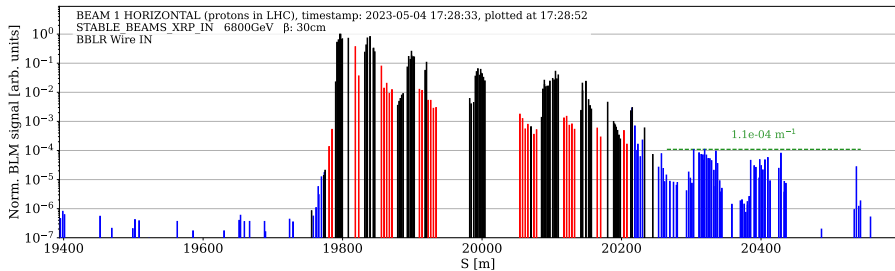
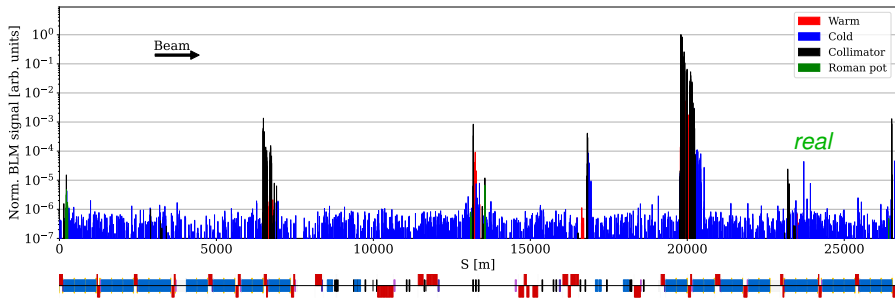




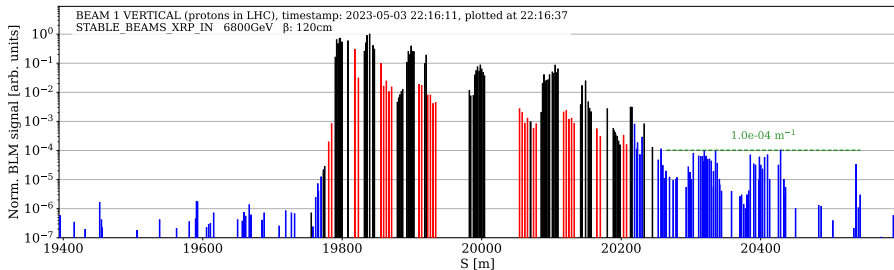
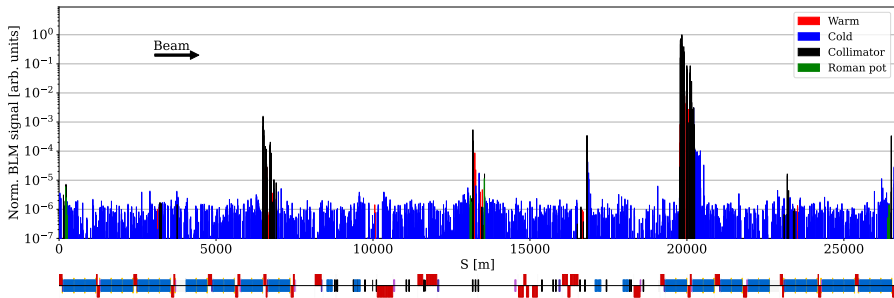


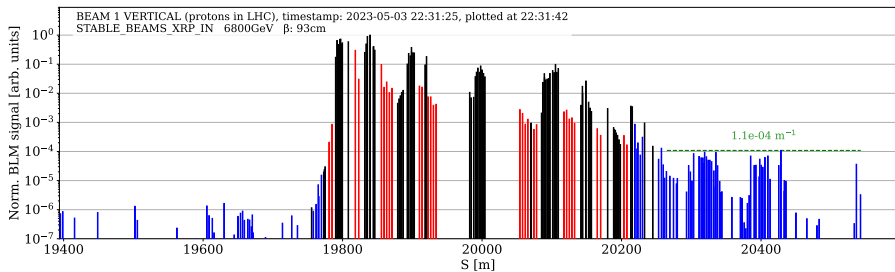
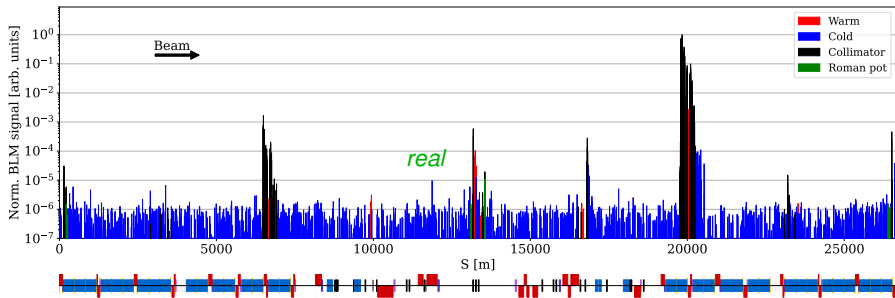


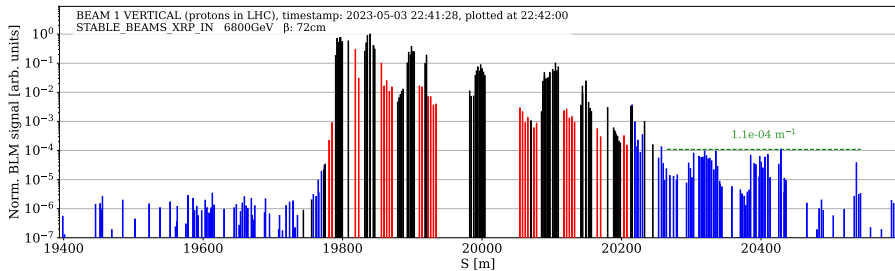
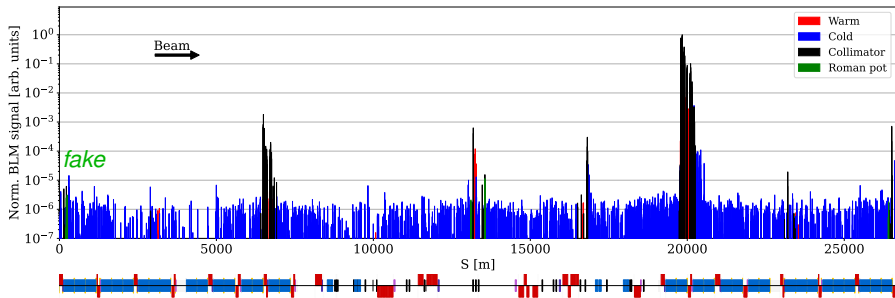


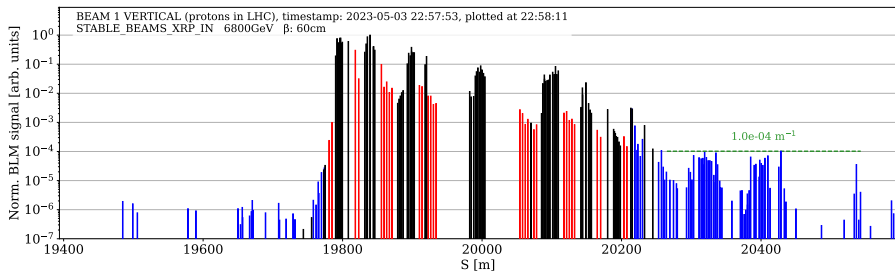
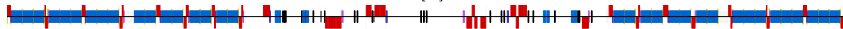
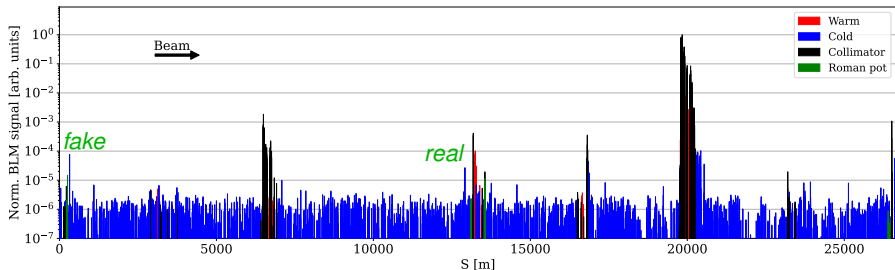


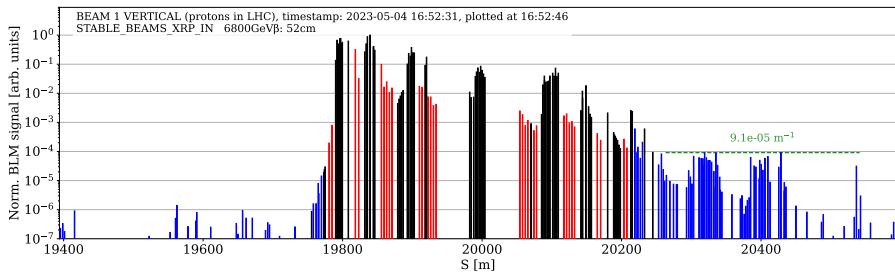
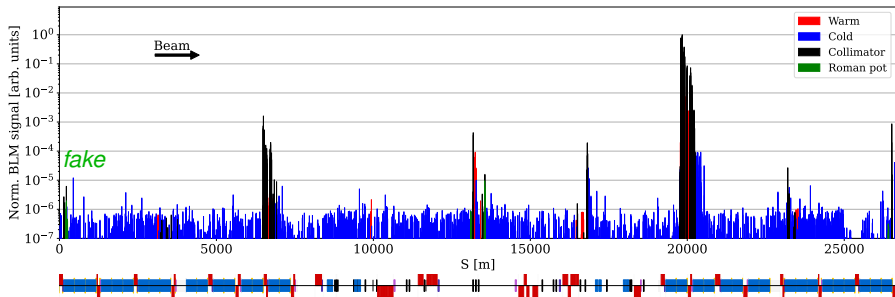
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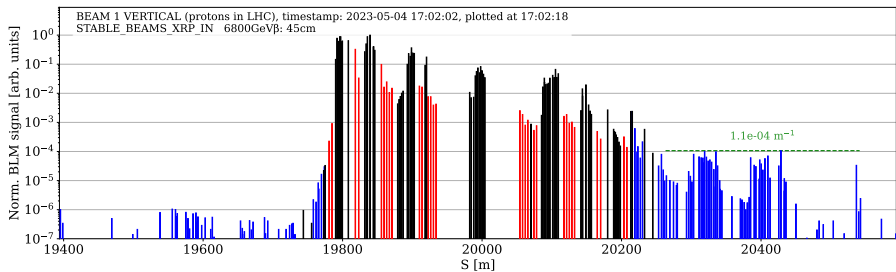
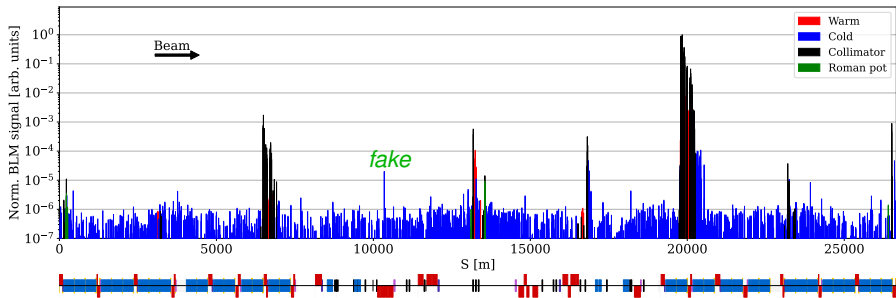




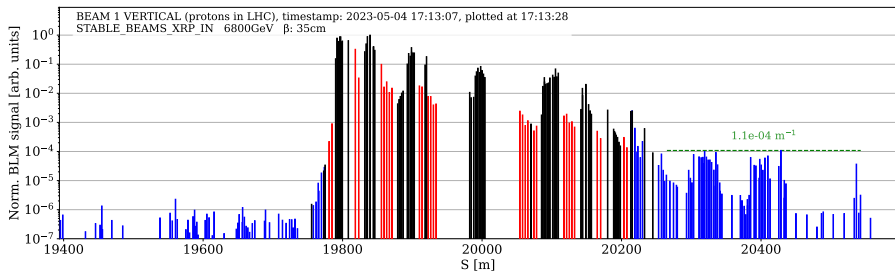
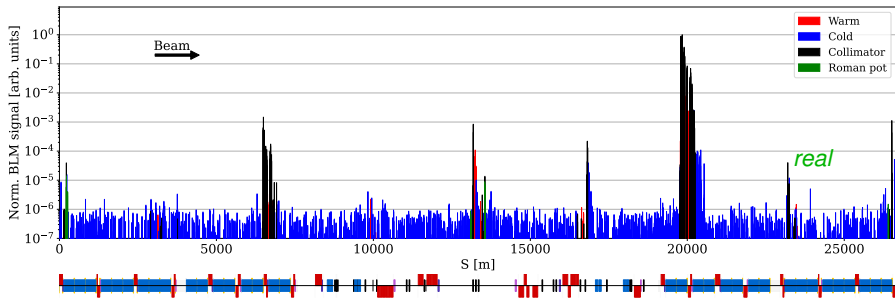


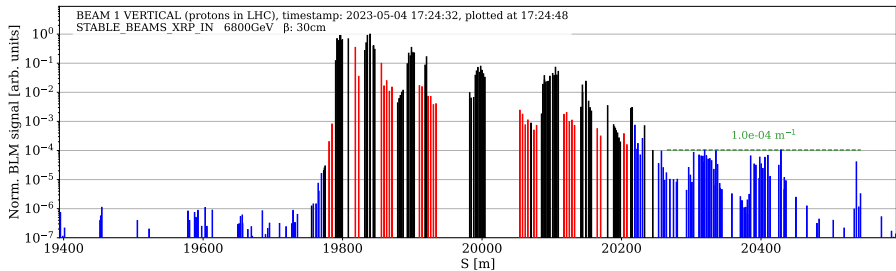
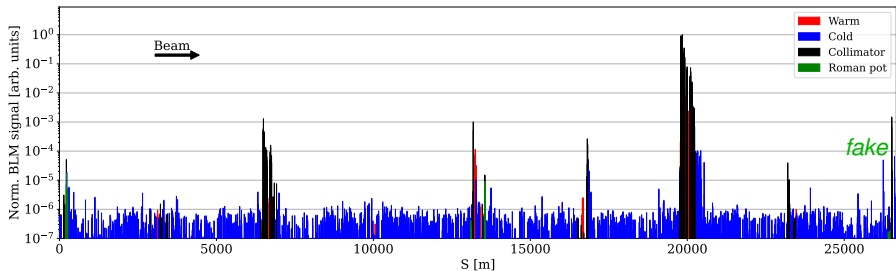


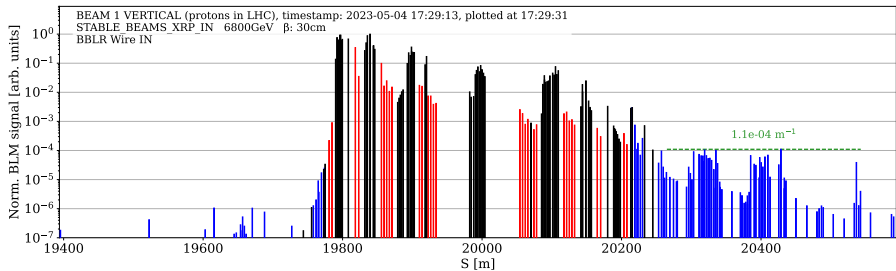
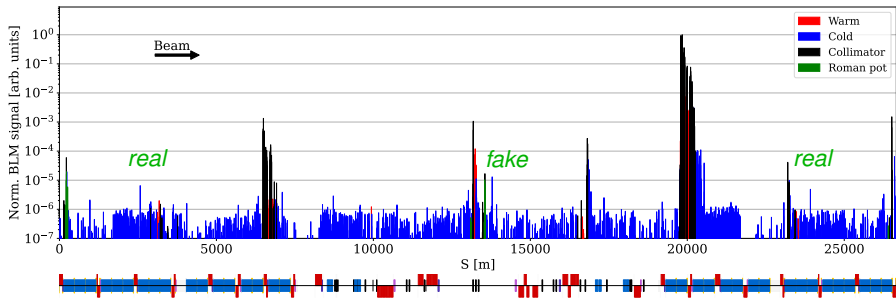




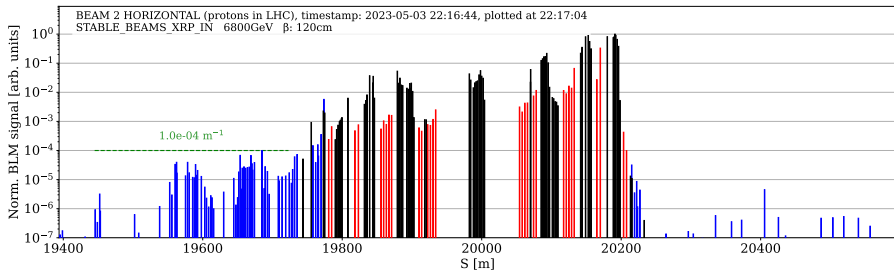
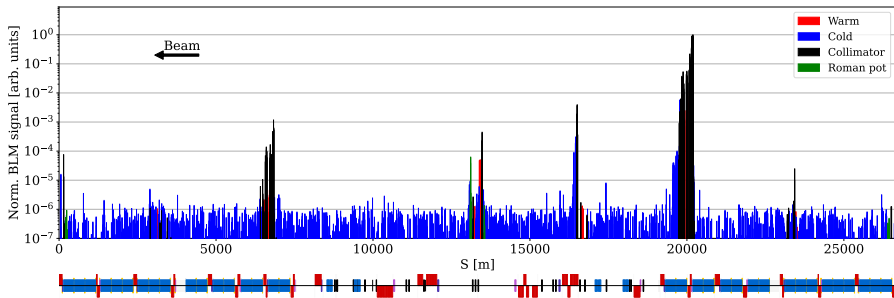


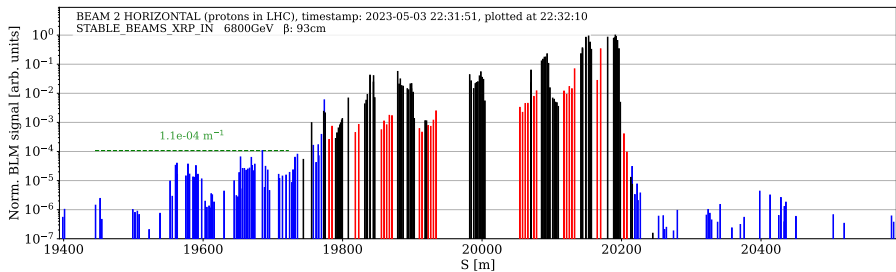
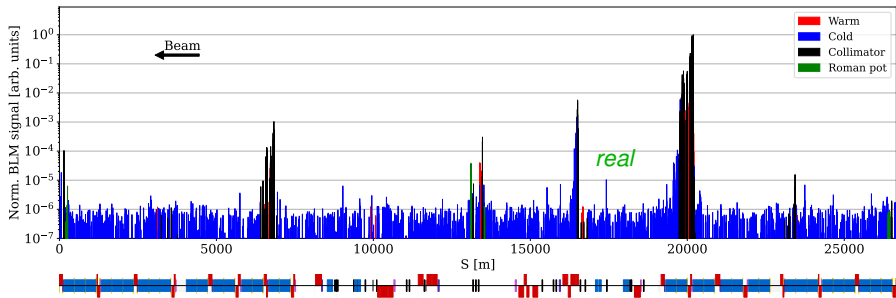


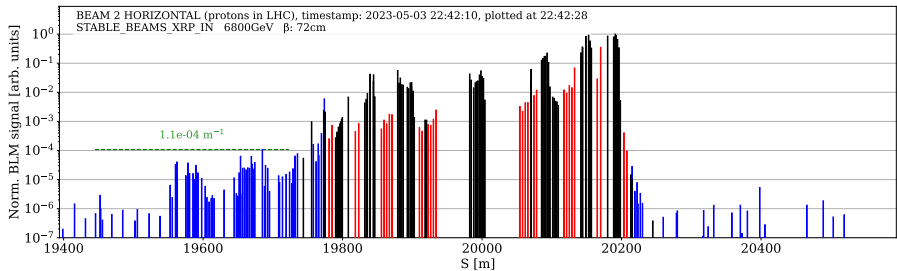
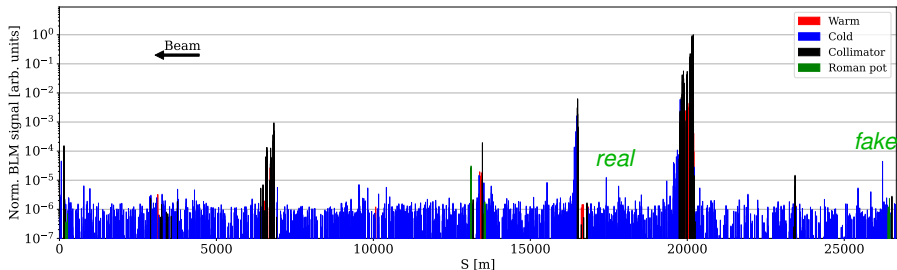


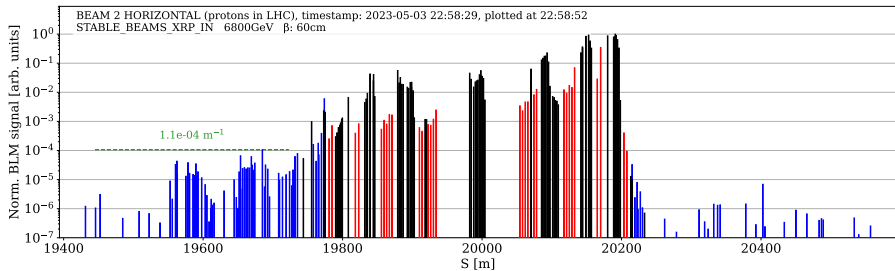
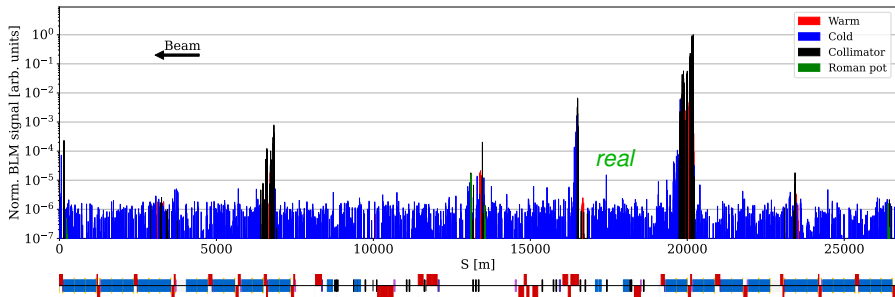


# B2H

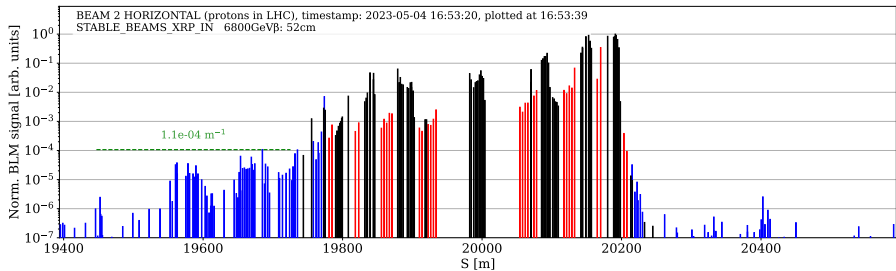
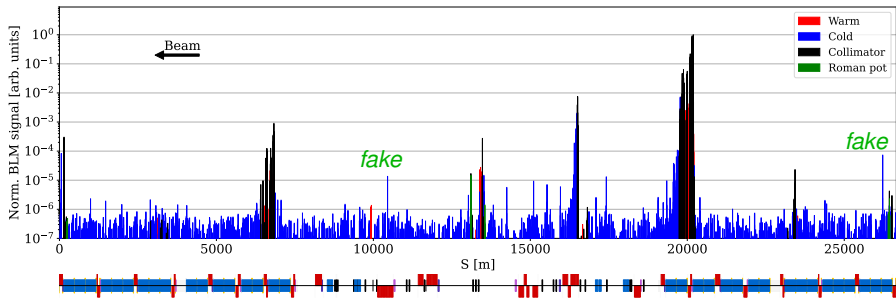


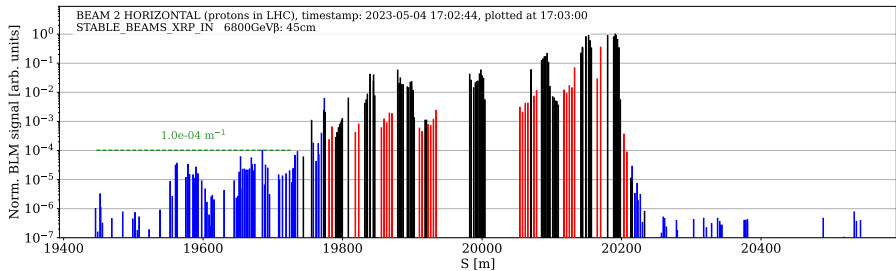
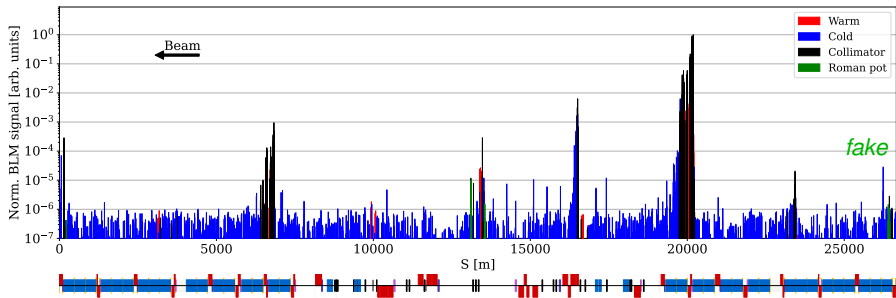


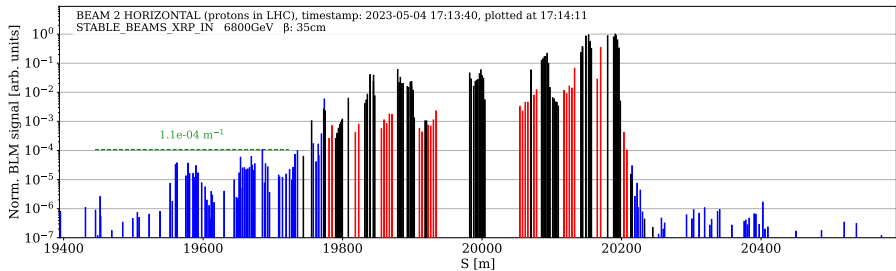
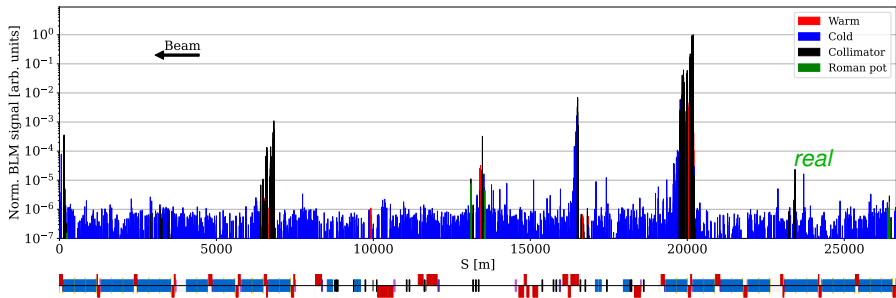


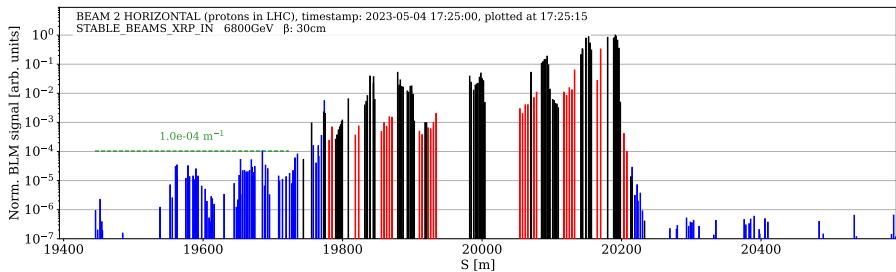
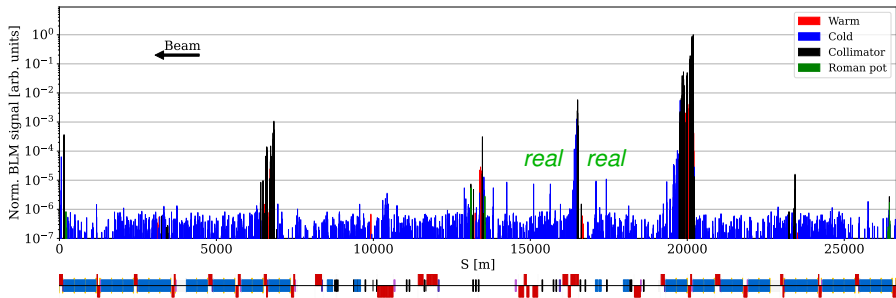


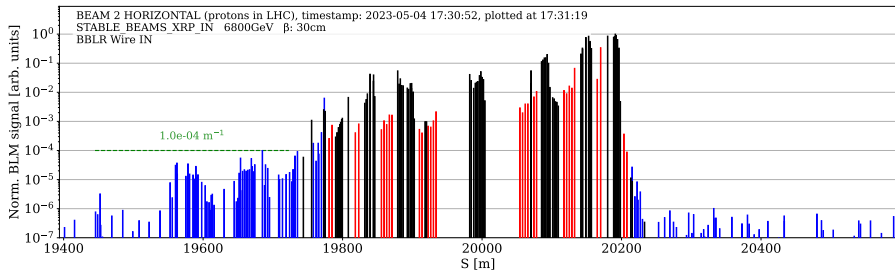
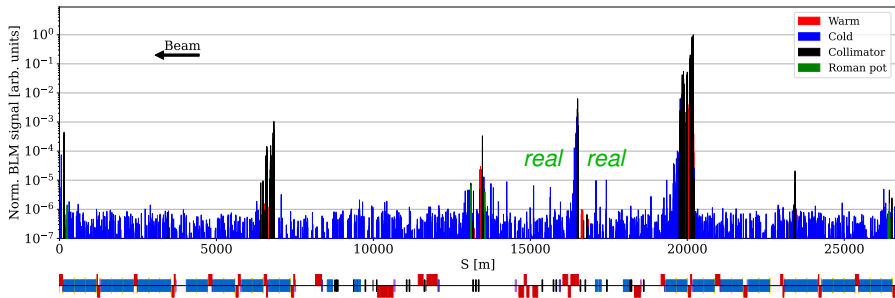




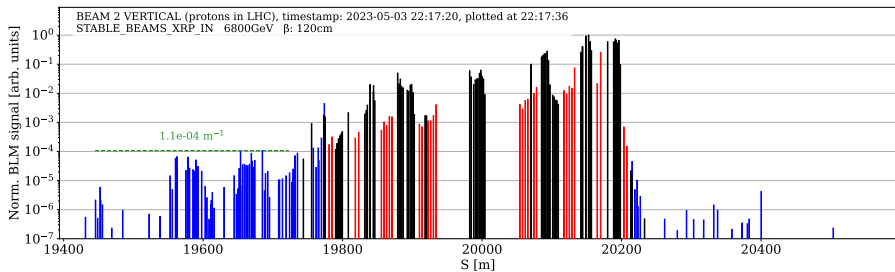
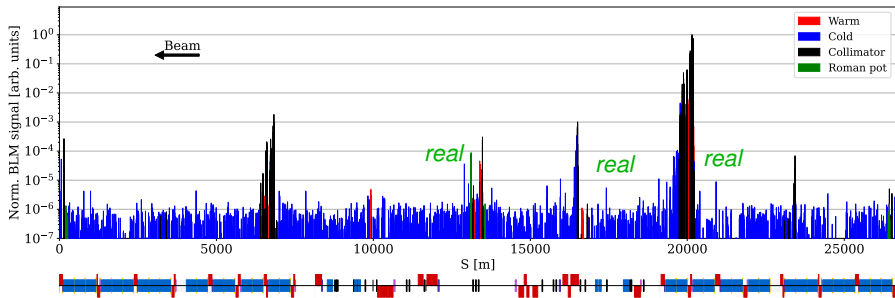


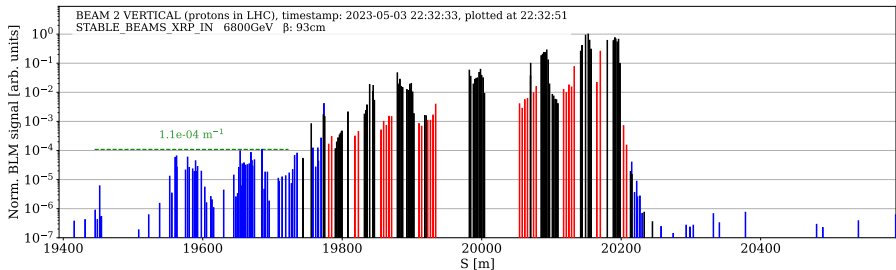
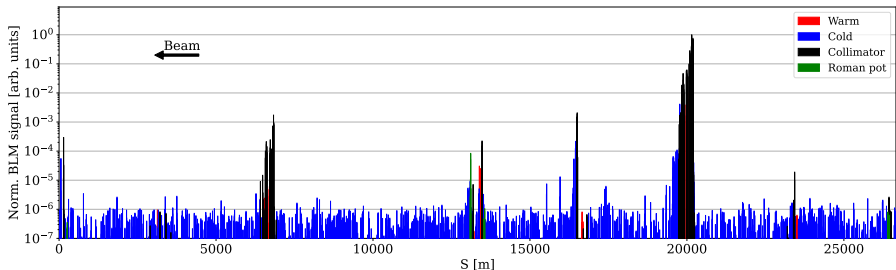




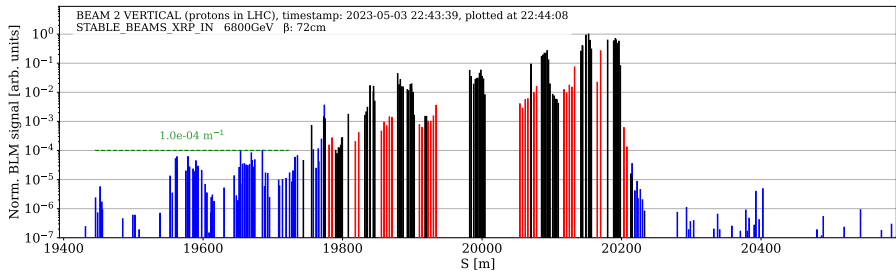
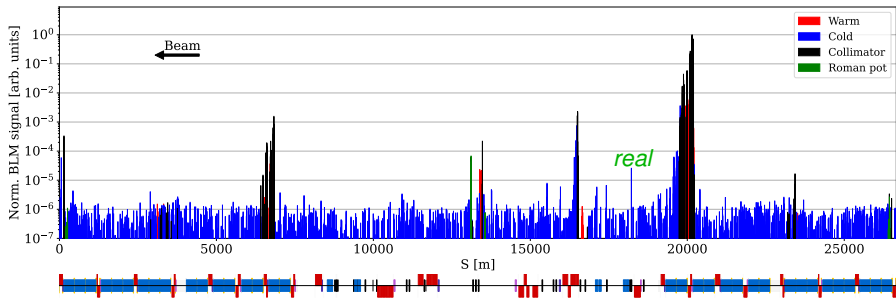


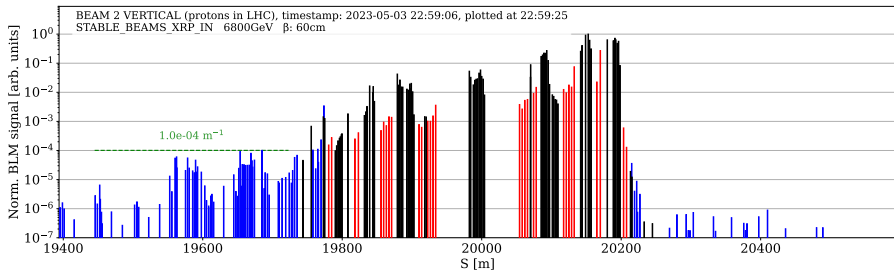
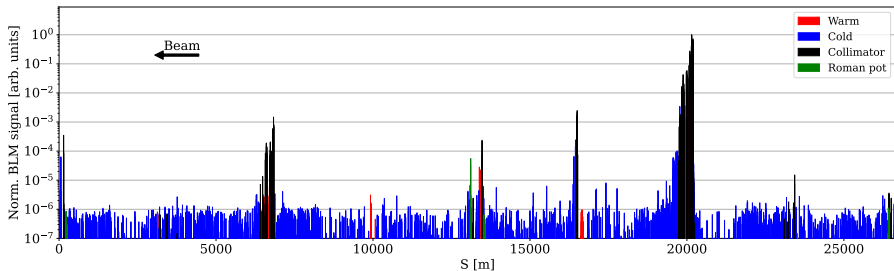
# B2V

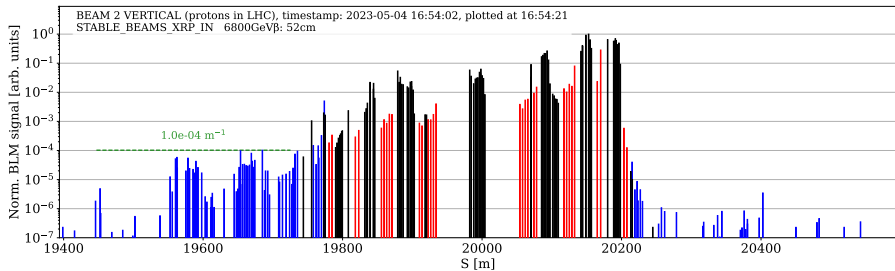
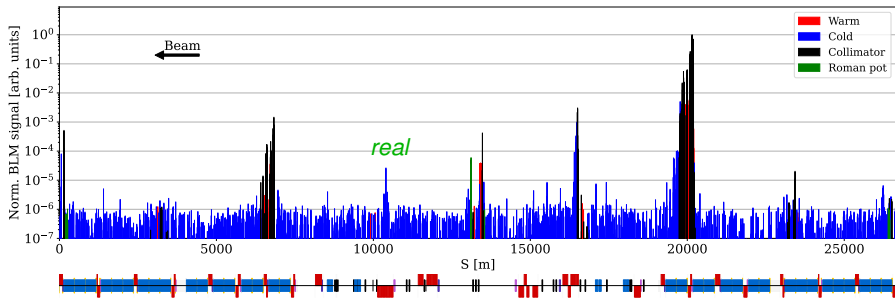


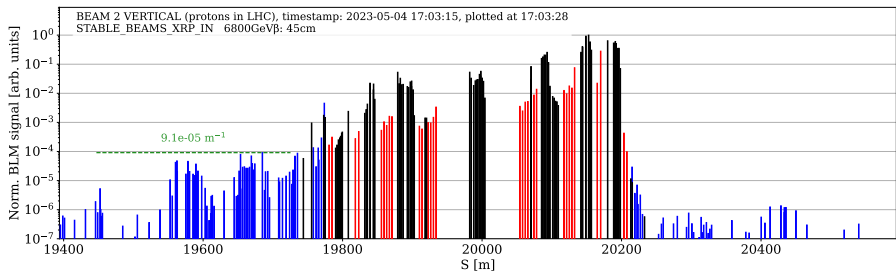
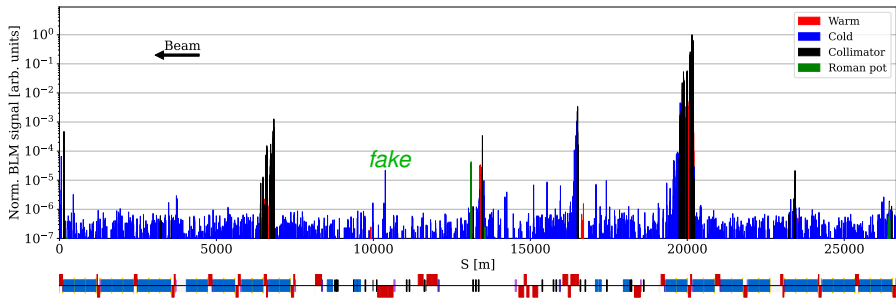


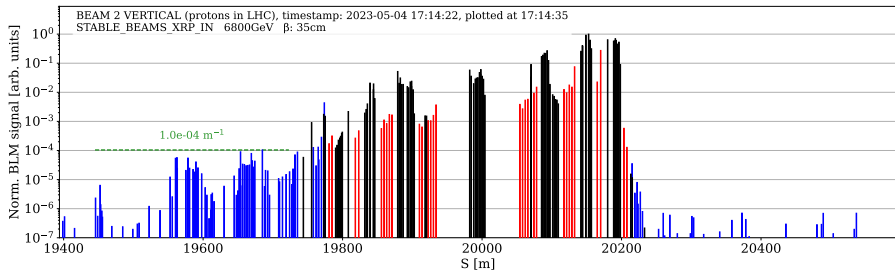
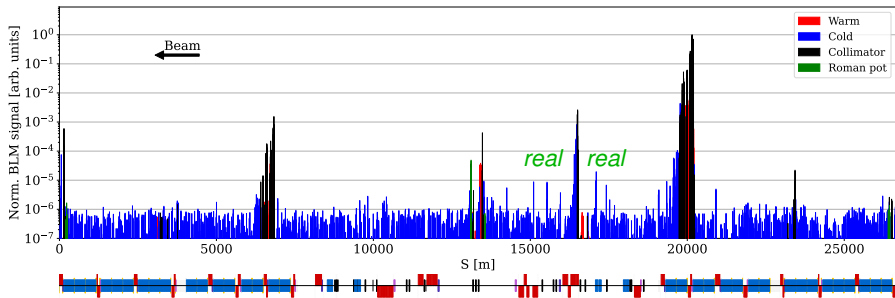


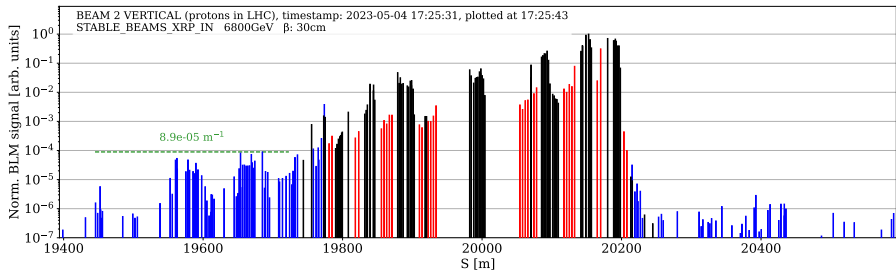
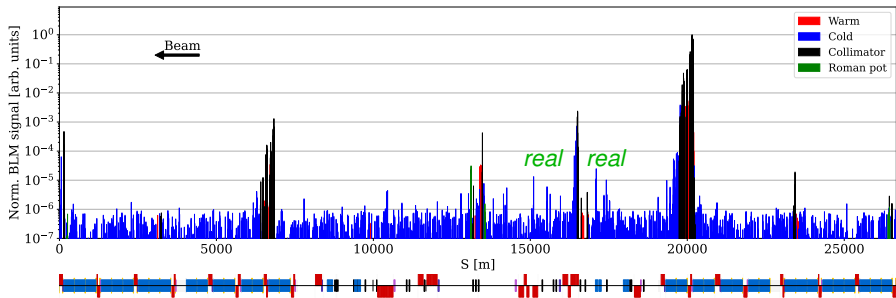


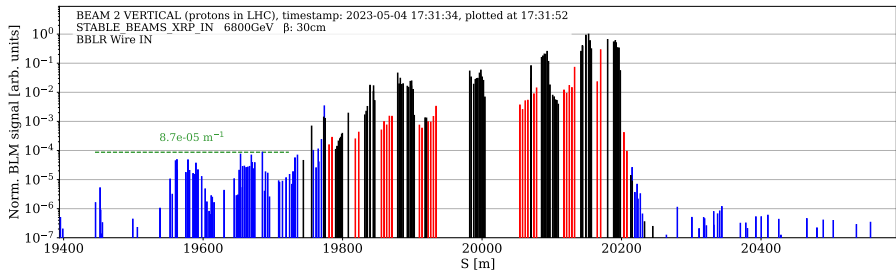
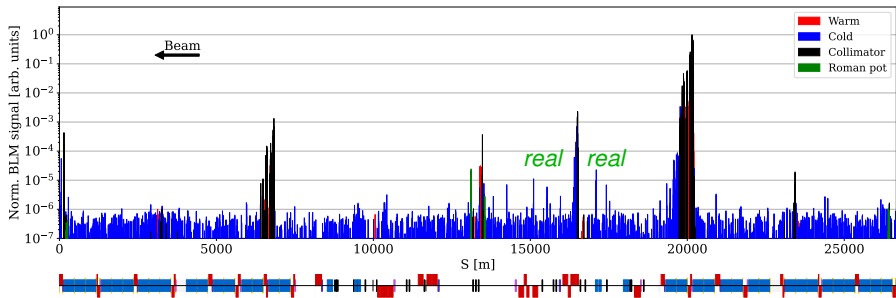






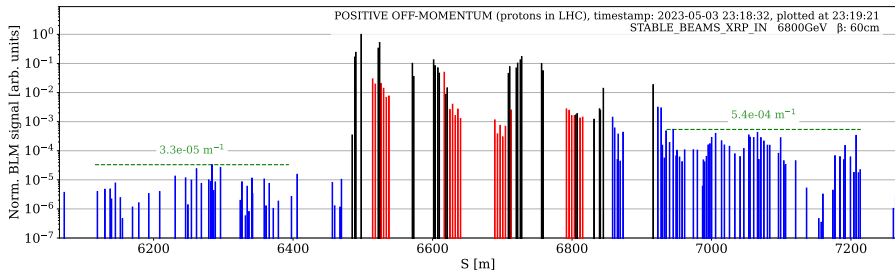
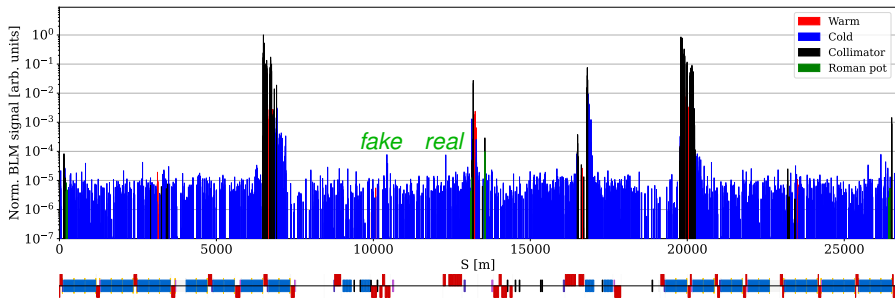


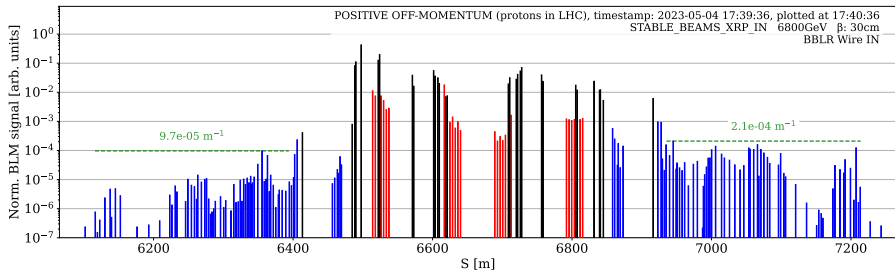
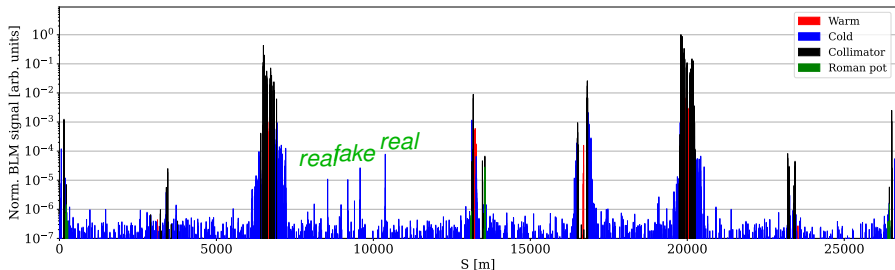




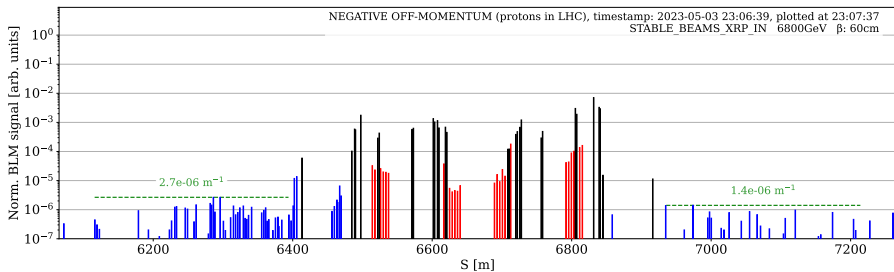
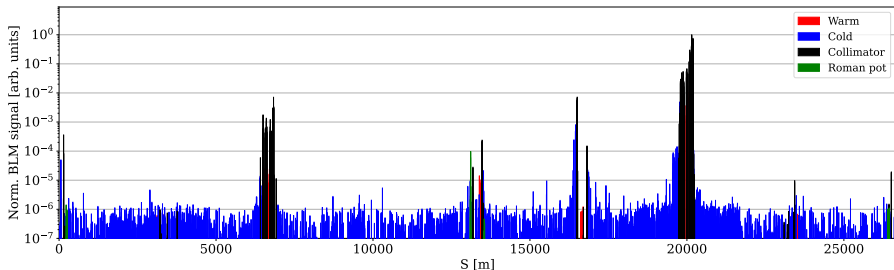
$$+ \frac{\delta p}{p}$$

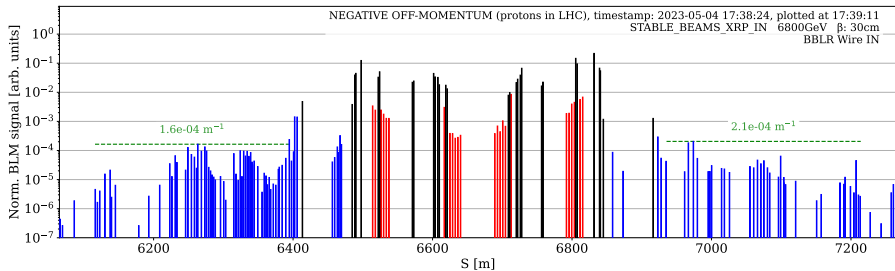
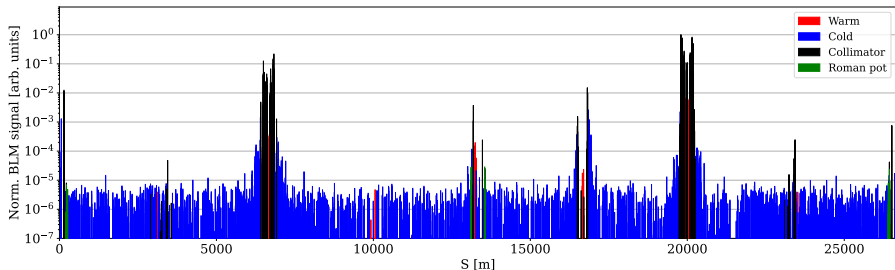






$$-\frac{\delta p}{p}$$





# Async Dump

