Summary and conclusions from loss map validation after TS2

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On behalf of the LHC Collimation and OP team

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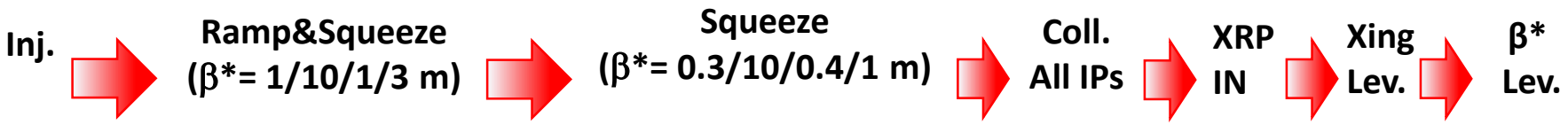
Introduction

In this presentation I will focus only on the Standard Physics Loss Map (LM) validation.

What was done?

- **Standard Physics commissioning:**
  - Loss map validation: betatron and off-p LMs performed at each static point of the cycle.
    - Including crossing angle and β* levelling.



- **After TS1:**
  - Standard Physics re-validation: all betatron LM + Off-p LM for one sign.
  - In addition other configurations were validated:
    - VdM and High β* run optics also validated.
    - LM for different ATLAS and CMS IP shift.

- **After TS2:**
  - Re-validation: all betatron LM + Off-p LM for alternating sign w.r.t. TS1.

Loss map matrix after TS2

❑ Summary of LMs for Standard Physics

	450 GeV		Ramp & Sq	6.5 TeV							
	Inj. Prot. IN	Inj. Prot. OUT		FT	Sq. Cont.	End Sq.	Physics (XRP-OUT) β*=30 cm xing 160 urad	Physics (XRP-IN) β*=30 cm xing 160 urad	Physics (XRP-IN) β*=30 cm xing 130 urad	Physics (XRP-IN) β*=27 cm xing 130 urad	Physics (XRP-IN) β*=25 cm xing 130 urad
B1H	✓	✓	✓	✓	—*	✓	✓	✓	✓	✓	✓
B1V	✓	✓	✓	✓	—*	✓	✓	✓	✓	✓	✓
B2H	✓	✓	✓	✓	—*	✓	✓	✓	✓	✓	✓
B2V	✓	✓	✓	✓	—*	✓	✓	✓	✓	✓	✓
+δp	✓	✓	—	✓	—	✓	—	✓	—	—	✓
-δp	✓	✓	—	✓	—	✓	—	✓	—	—	✓
ASD	✓	—	—	✓	—	✓	—	✓	—	—	✓

+All betatron from 160 urad to 130 urad in steps of 10 urad ✓

*Not longer required

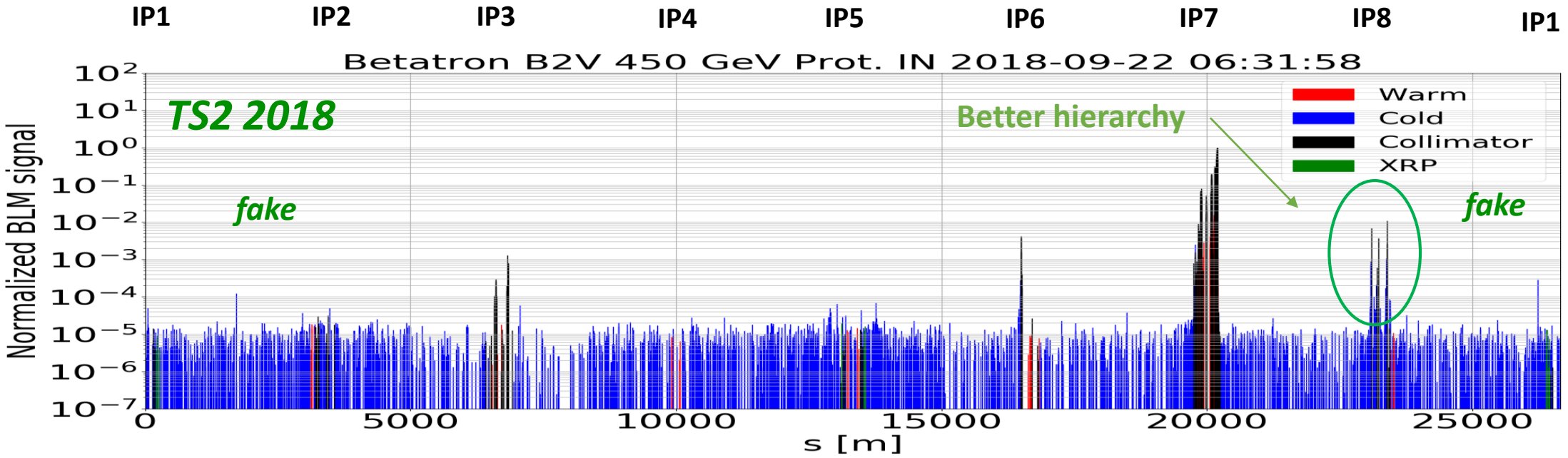
— = not requested
✓ = performed and validated in TS1
✓ =additional ones performed and validated in the commissioning and TS1

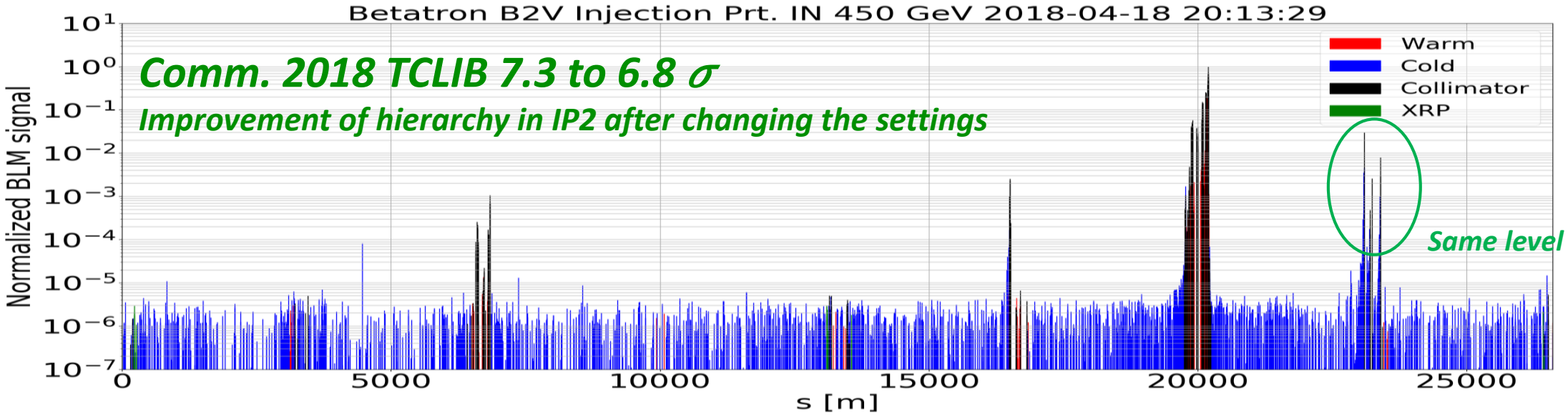
LMs validation overview 2018

	Commissioning	TS1	TS2
LM performed/requested	56/64	44/48	41/41
Fills required (LM+ASD)	9	7	4

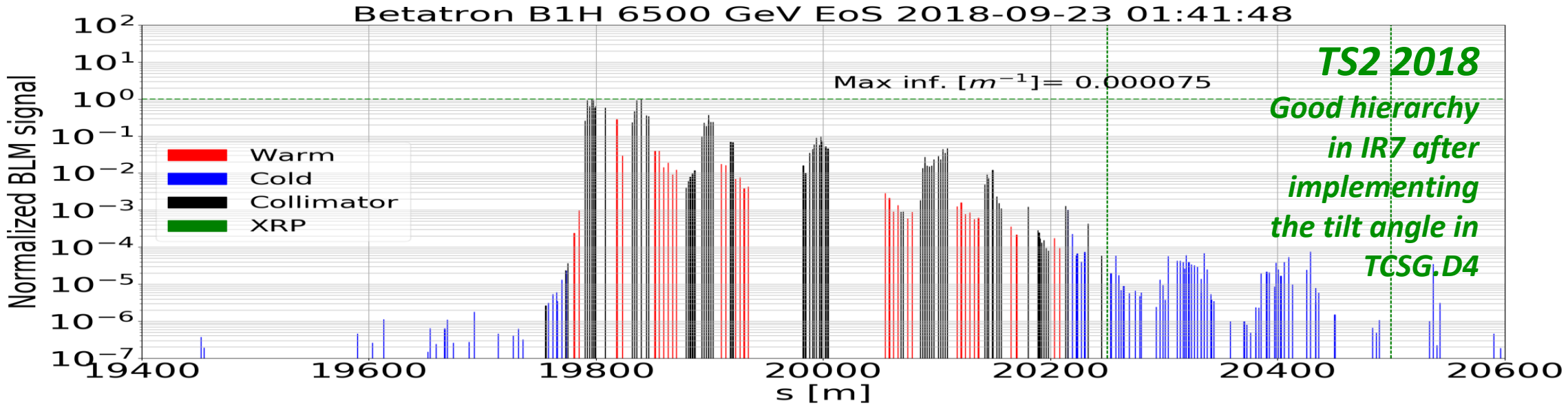
- **Commissioning:**
  - **Injection protection IN:** B2V hierarchy broken in IP2 (TCLIB > TDI) -> TCLIB from 6.8-7.3 σ.
  - **Flat top energy:** B1V hierarchy broken in IP7 (TCSG D4 > TCP) -> implement measured tilt angle.
  - Some issues with the **Off-p LM**: only 1 dump but shifts in frequency too low-> low data quality.
- **After TS1:**
  - Not good hierarchy in IR2 with **injection-prot IN-**> followed by improvement on the orbit in IP2 and ALICE polarity same as in commissioning.
  - Some issues with **Off-p LM**, some needed to be repeated.
- **After TS2:**
  - **Smooth validation and no major issues encountered**.
  - **New Off-p LM tool** (Thanks to B. Salvachua and D. Mirarchi) -> better off-p LM resolution.
    - One dump could not be prevented but problem was understood to be due to a bug on the tool and fixed.

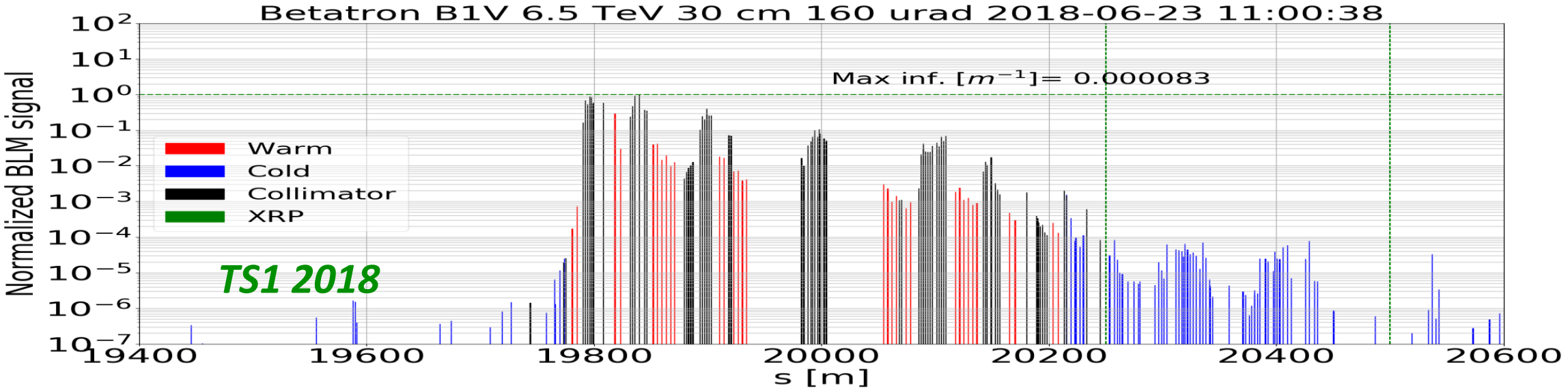
B2-V Injection protection IN





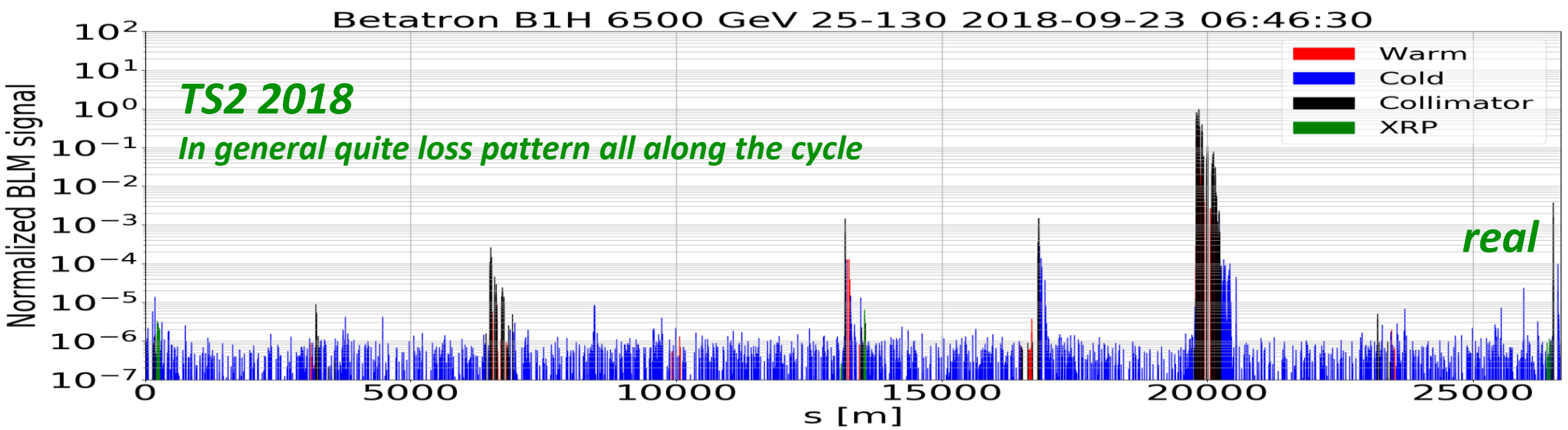
B1-V EoS IR7 zoom

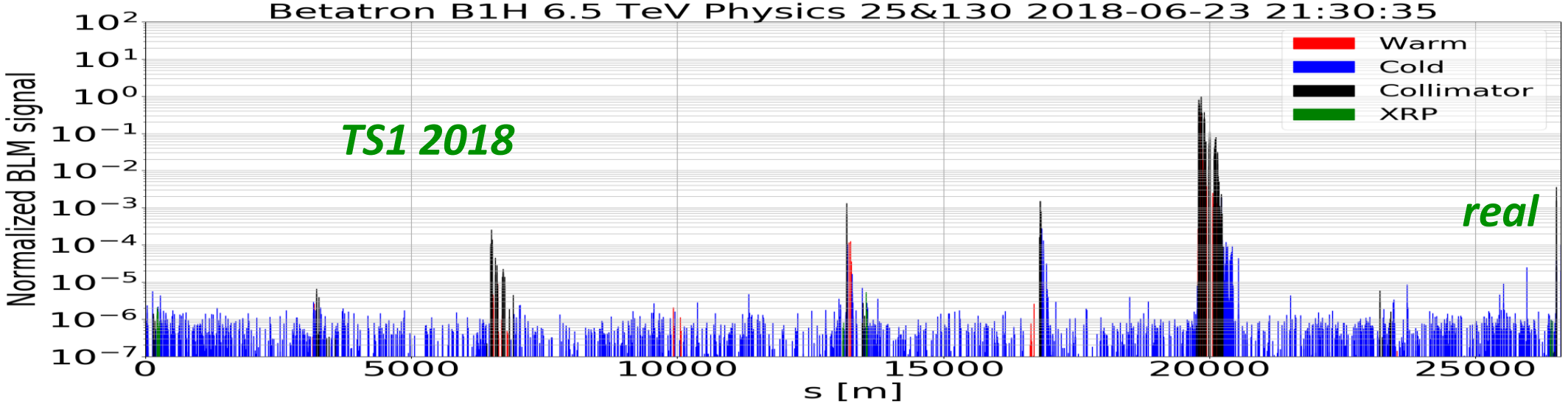




B1H Physics 25 cm β*

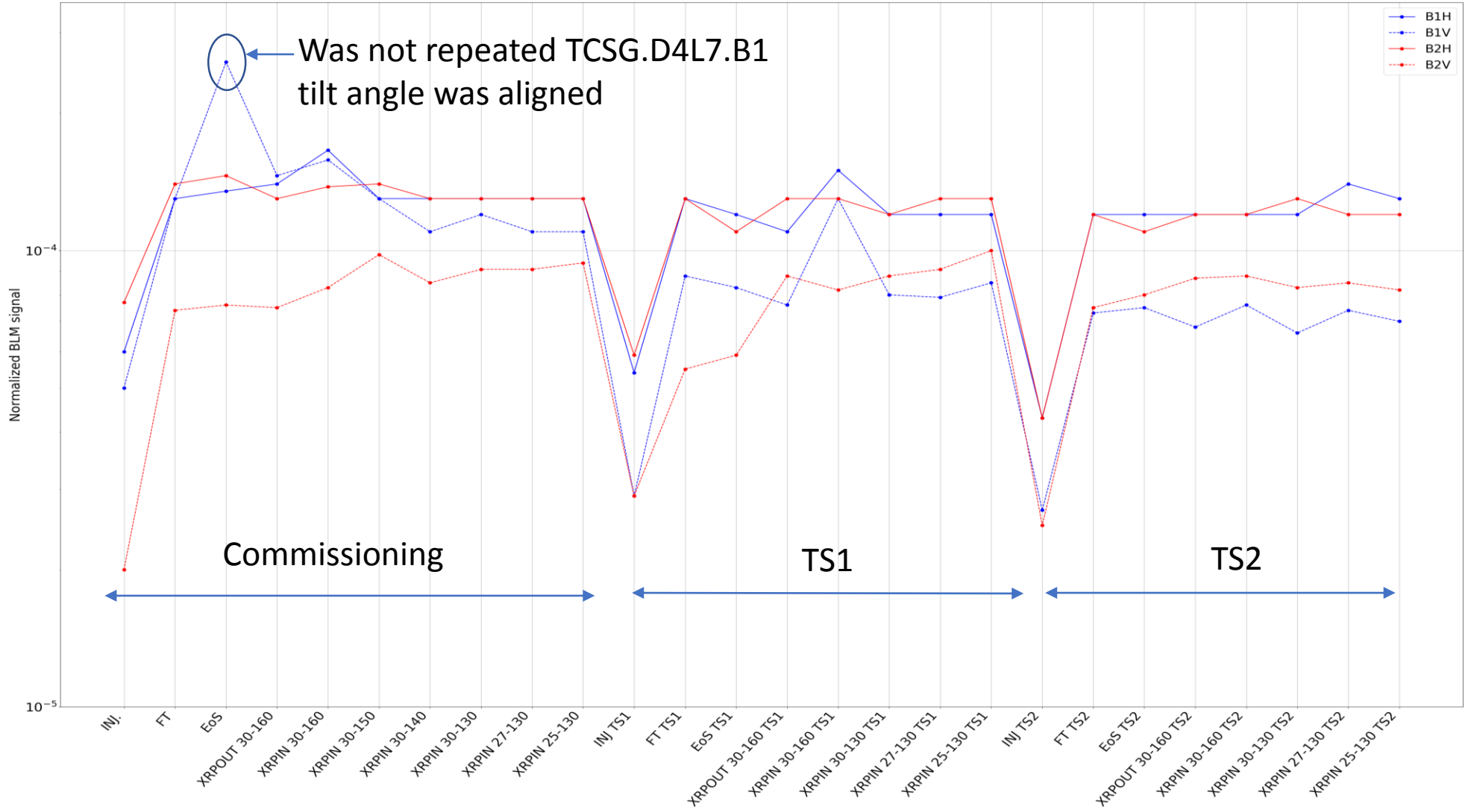
IP1 IP2 IP3 IP4 IP5 IP6 IP7 IP8 IP1





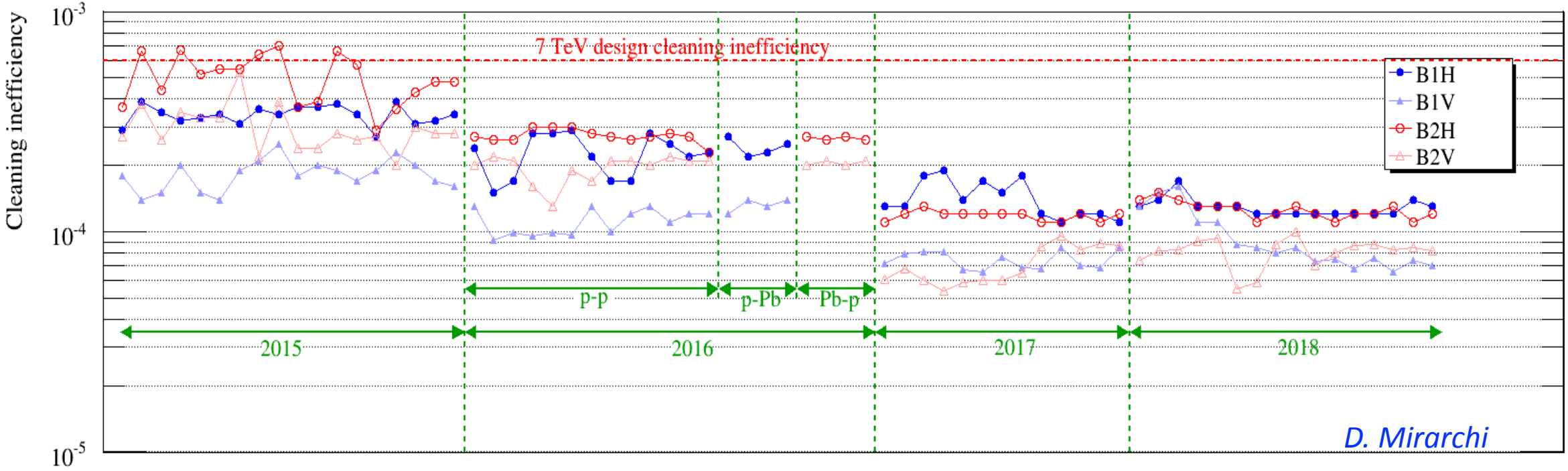
2018 Inefficiency in IR7 along the cycles

- Maximum inefficiency peak in the DS in IR7 for each beam and plane different points in the cycle.



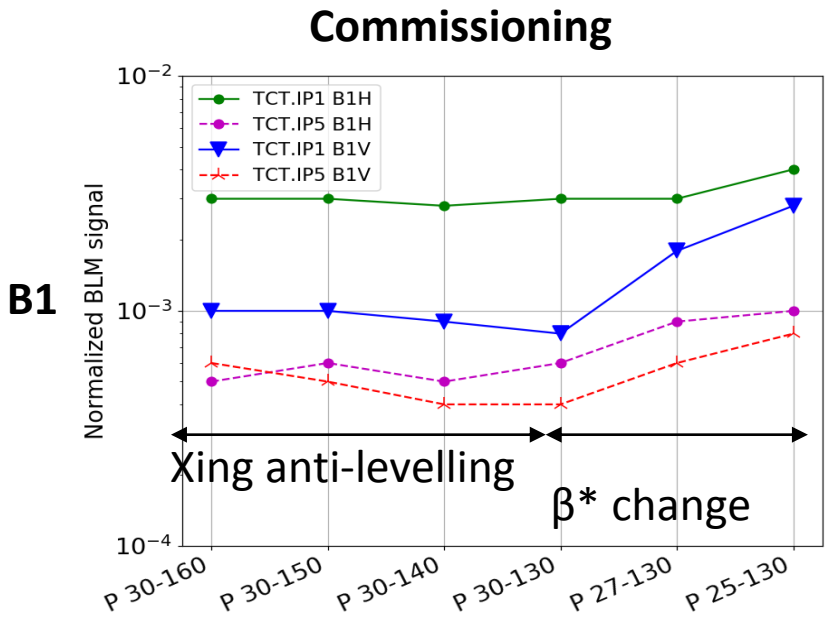
Inefficiency in IR7 along the years

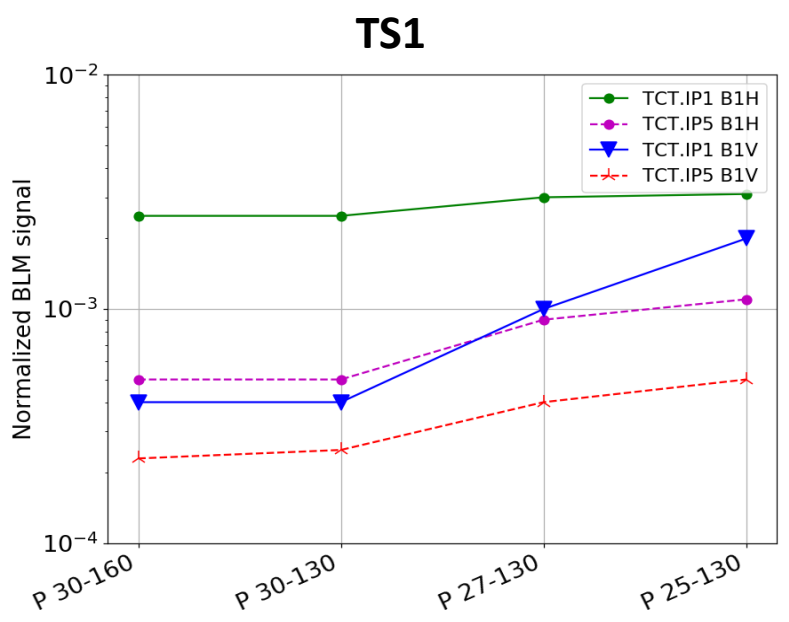
- Maximum inefficiency peak in the DS in IR7 for each beam and plane for FLAT TOP energy.

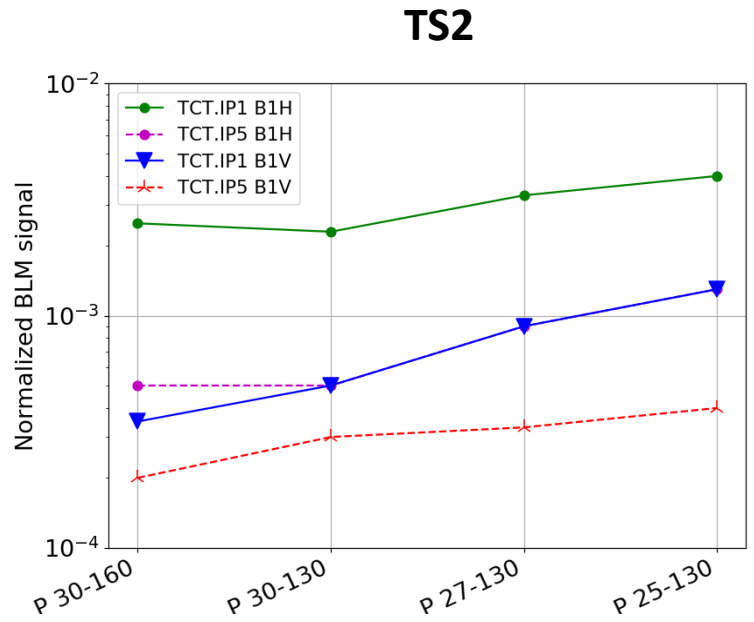


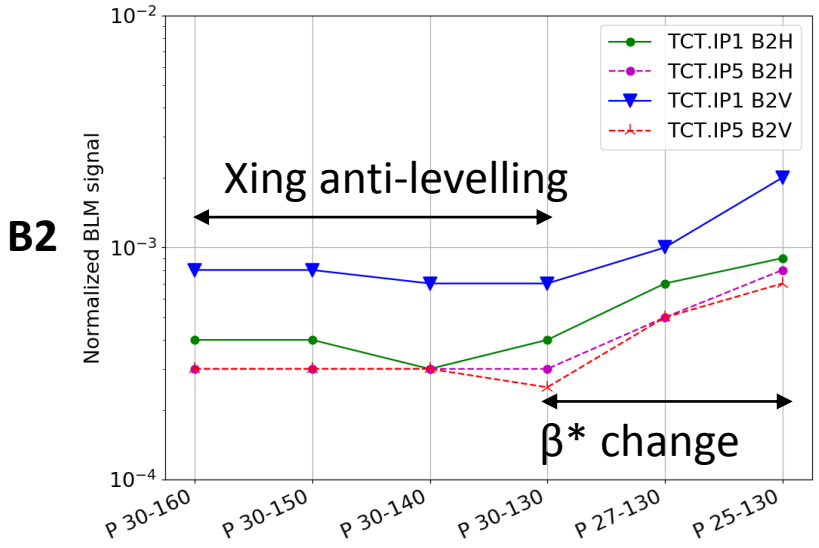
- Similar level as at the end of 2017 with similar hierarchy between beams and planes

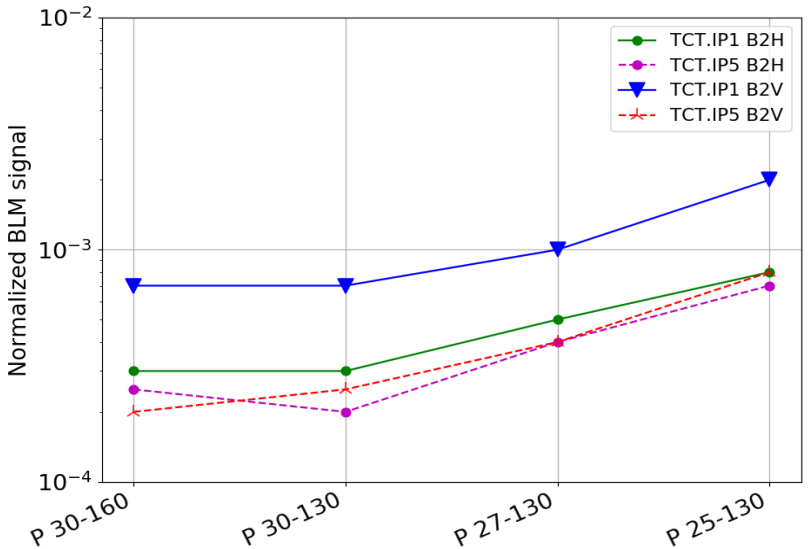
Losses at the TCTs during crossing angle and β* levelling

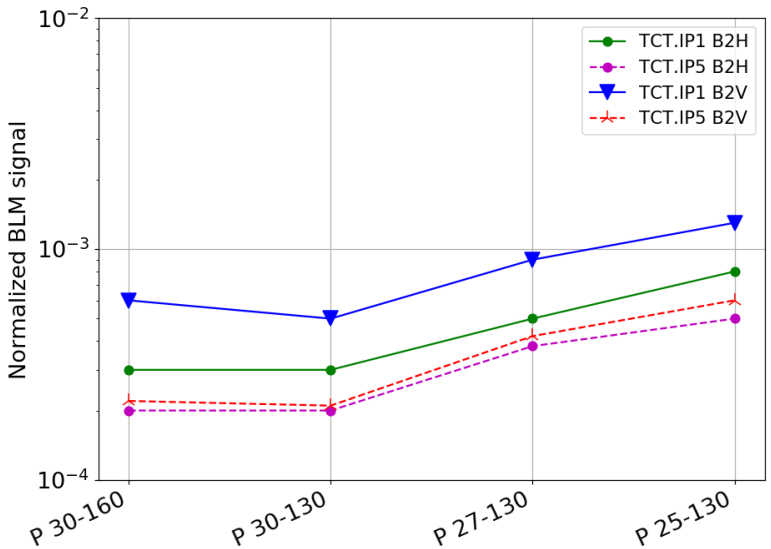




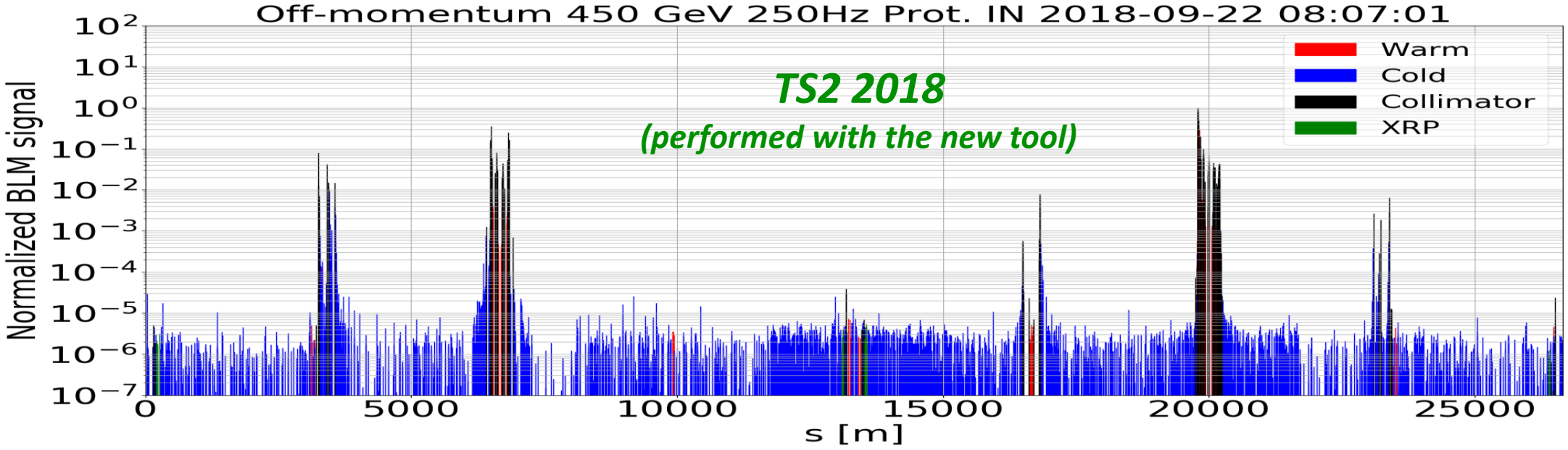


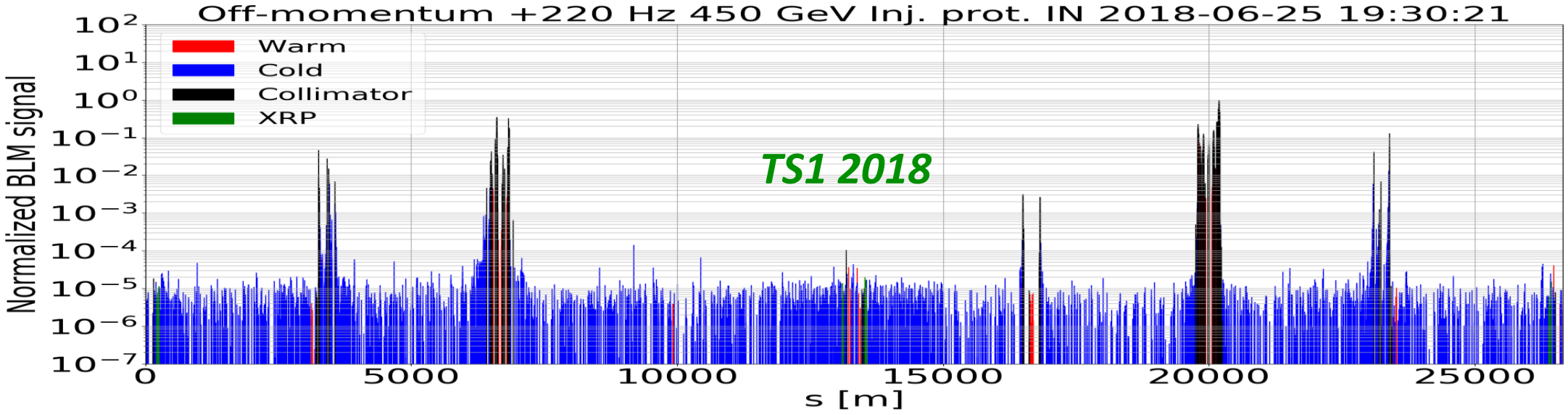




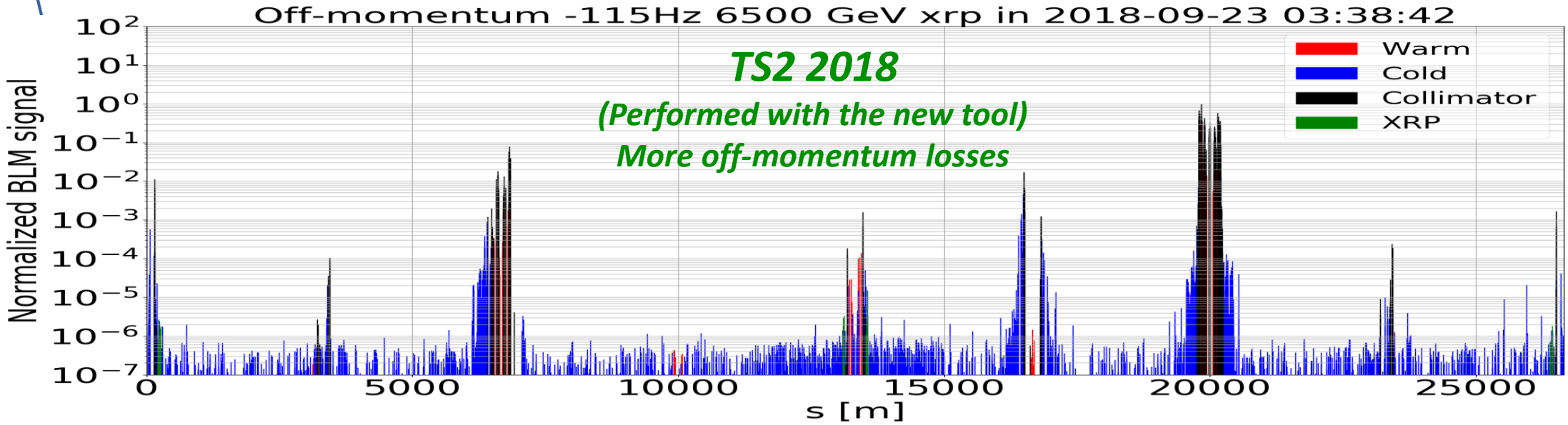


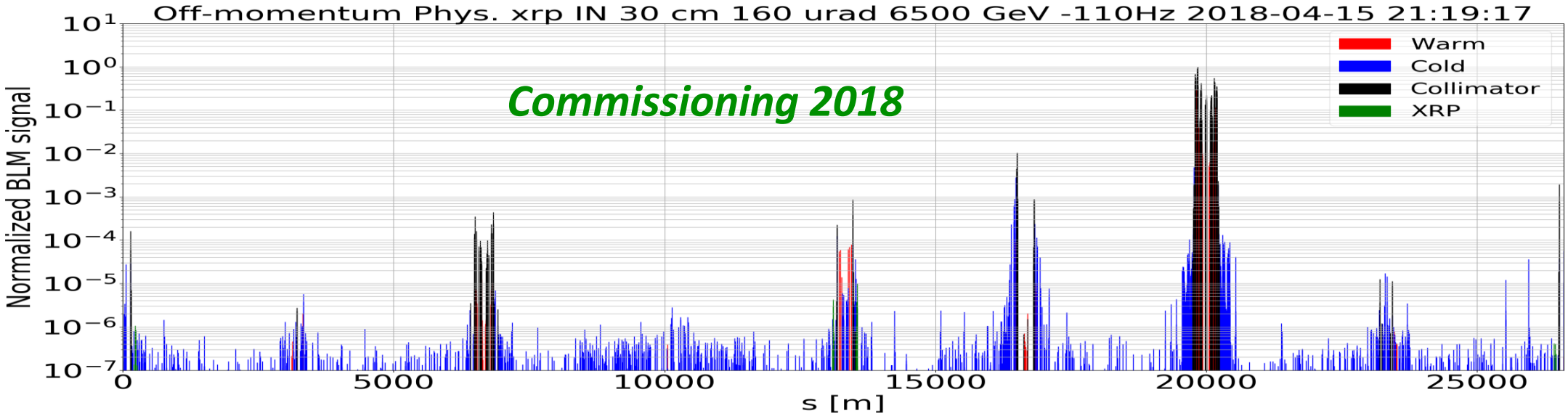
Off-momentum LM at INJECTION





Off-momentum LM in PHYSICS





Conclusions

- In general the loss map validation was stable along the year.
  - Collimator hierarchy consistent along the year and very small changes on the overall loss pattern.
  - Consistent increase on the level of losses in the TCTs during the β* levelling.

- The most delicate part of the LM validation had been the Off-p LM and not as stable as the betatron loss maps.

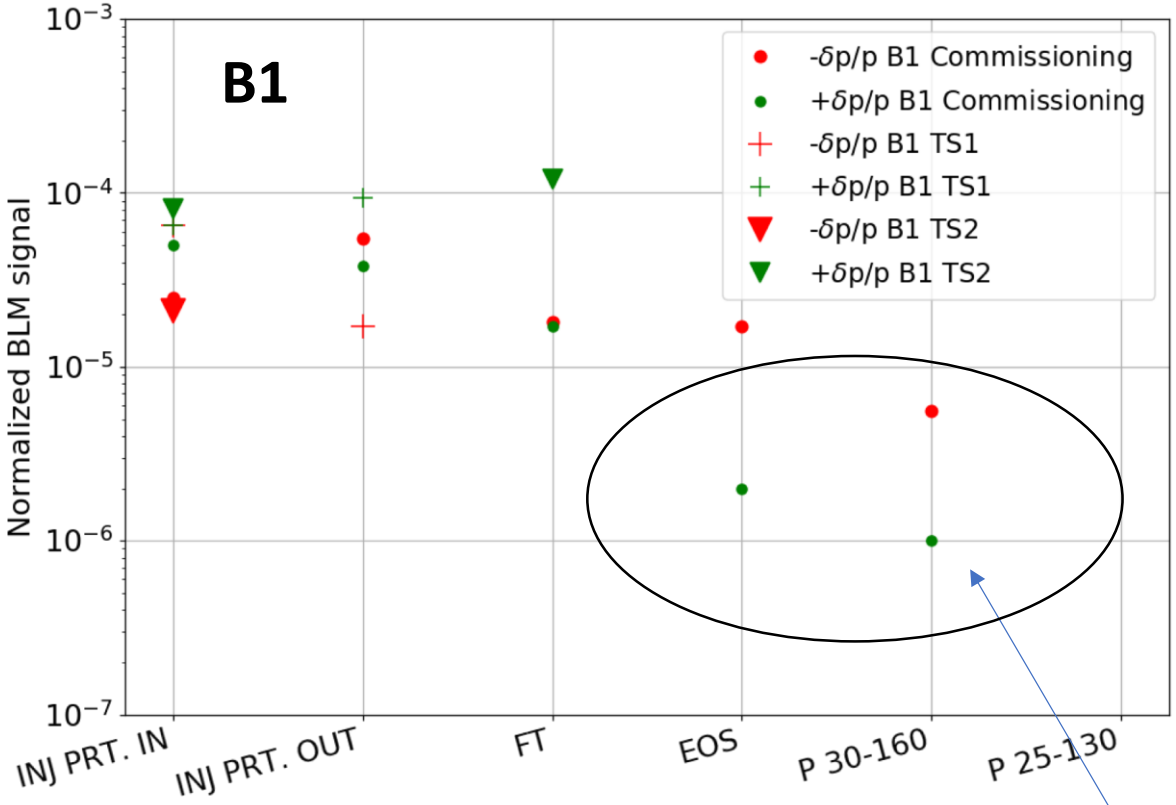
- The new tool developed by B. Salvachua and D. Mirarchi to automatize the Off-p LM worked very well for the first time operational in the LM validation after TS2. Higher resolution loss maps were obtained.

Back up…

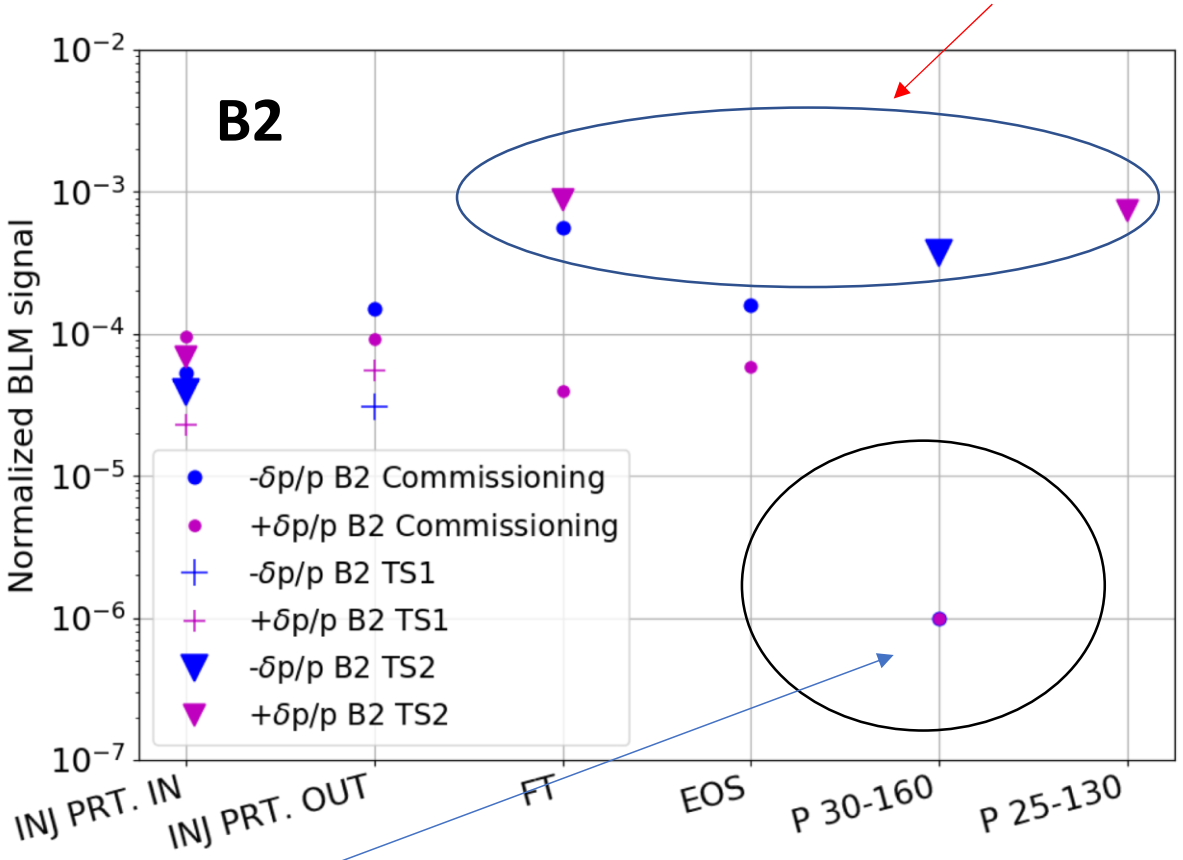
Off-momentum LM summary

- Maximum inefficiency peak in the left (B2) and right (B1) DS in IR3.

Preliminary



Good resolution with new OP tool!



Small frequency shift

NOTE:

- not all LM made for the same point of the cycle performed with the same frequency shift.
- Missing values are at the background level.