Operational Performance

D. Wollmann,

R.W. Assmann, F. Burkart, R. Bruce,

M. Cauchi, S. Redaelli, A. Rossi, G. Valentino,

OP-Team, BLM-Team

Outline

- Introduction: Collimator Settings and Qualification of Cleaning
- Change of cleaning inefficiency since June
  - Leakage into cold aperture
- Losses during stable beams (16.10.2010, 02:20 – 03:24)
  - TCPs, B1+B2
  - Primary losses for different integration times
  - Development of cleaning inefficiency (1.3s integration time)
- Conclusion

Collimator Settings

	Injection optics	Injection optics	Squeezed optics
Energy [GeV]	450	3500	3500
Primary cut IR7 (H, V, S) [σ]	5.7	5.7	5.7
Secondary cut IR7 (H, V, S) [σ]	6.7	8.5	8.5
Quaternary cut IR7 (H, V) [σ]	10.0	17.7	17.7
Primary cut IR3 (H) [σ]	8.0	12	12 (B1) / 10 (B2)
Secondary cut IR3 (H) [σ]	9.3	15.6	15.6
Quaternary cut IR3 (H, V) [σ]	10.0	17.6	17.6
Tertiary cut exp. (H, V) [σ]	15-25	40-70	15
TCSG/TCDQ IR6 (H) [σ]	7-8	9.3-10.6	9.3-10.6

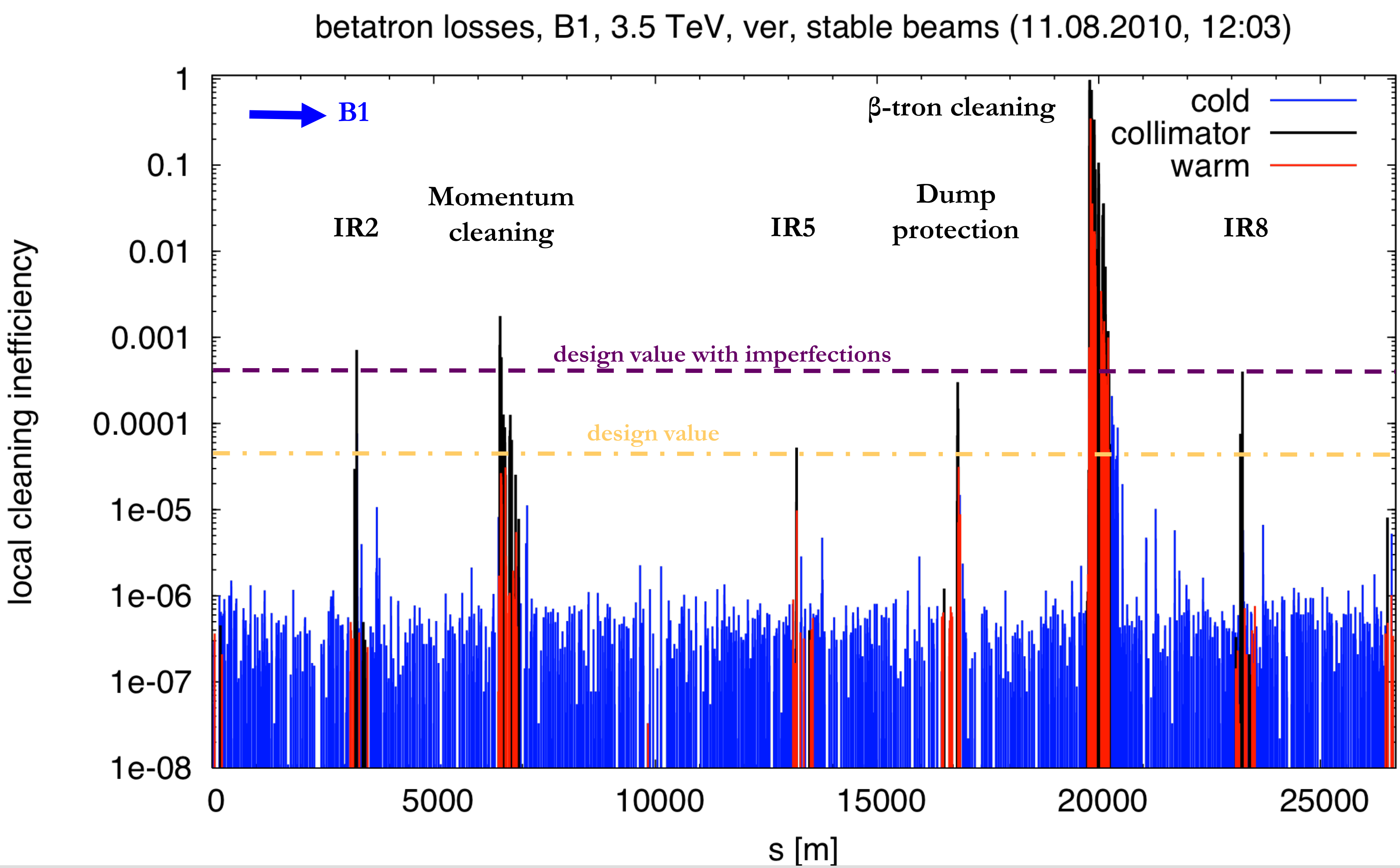
- Additional intermediate steps: end of ramp, reduced crossing angle, β^*=7m, β^*= 3.5m separated beams
- Beam based setups performed in June 2010, with bunch trains in mid of September 2010

Qualification of Collimation

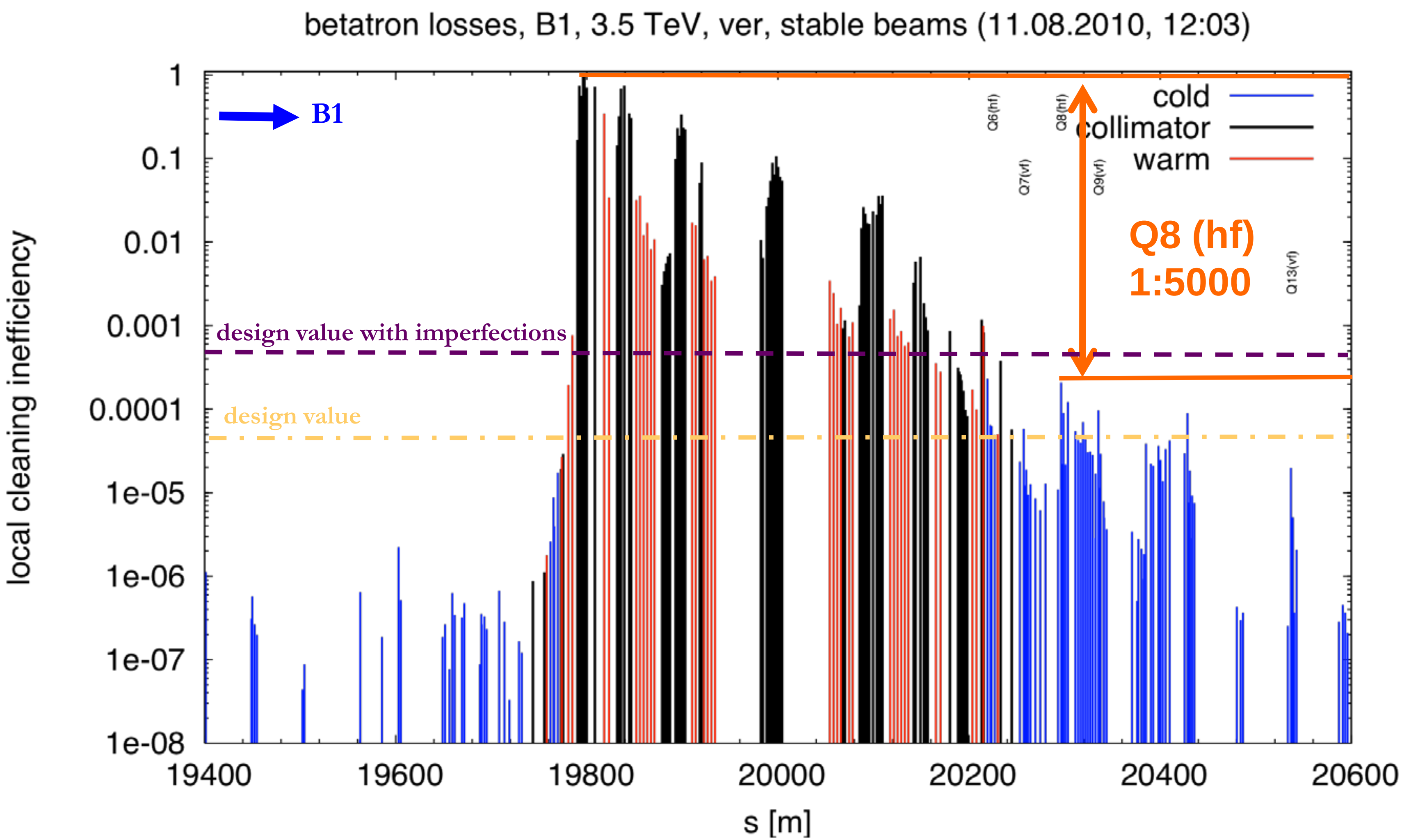
- The cleaning efficiency and the correct hierarchy of the collimation system are regularly qualified by intentionally creating slow losses
- β-tron losses by crossing a third integer tune resonance (B1-h, B1-v, B2-h, B2-v)
- Momentum losses by changing the RF frequency (± 1000 Hz, B1+B2)

- Performed with one nominal bunch at 3.5TeV and stable beams conditions
- Needs dedicated fills (one for β-tron cleaning and two for momentum cleaning)
- Qualification of the collimation system is regularly needed to check the validity of the setup and track the changes in cleaning efficiency over time

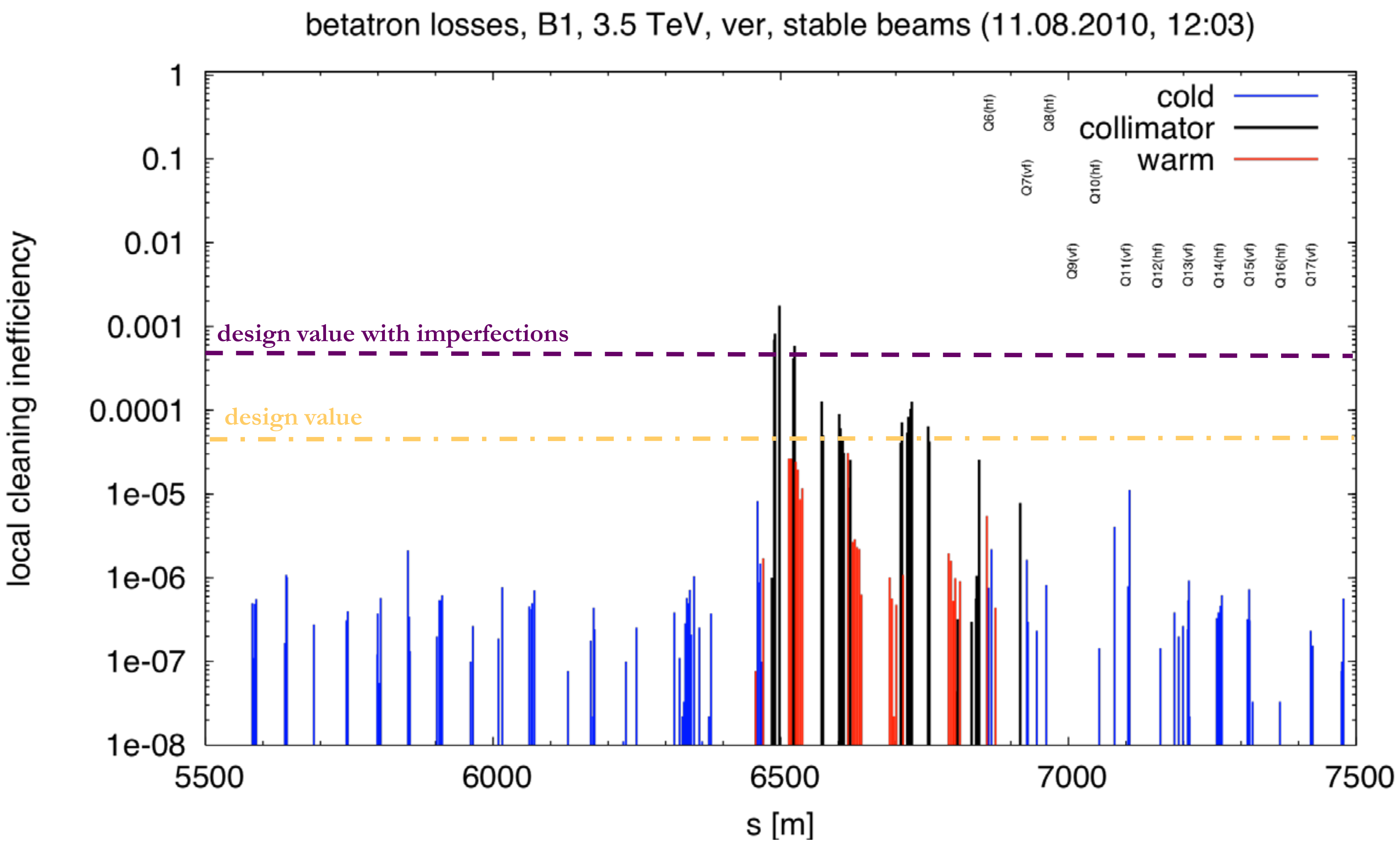
β-tron losses, B1v, 3.5TeV, β*=3.5m



β-tron losses, B1v, 3.5TeV, β*=3.5m IR7



β-tron losses, B1v, 3.5TeV, β*=3.5m IR3



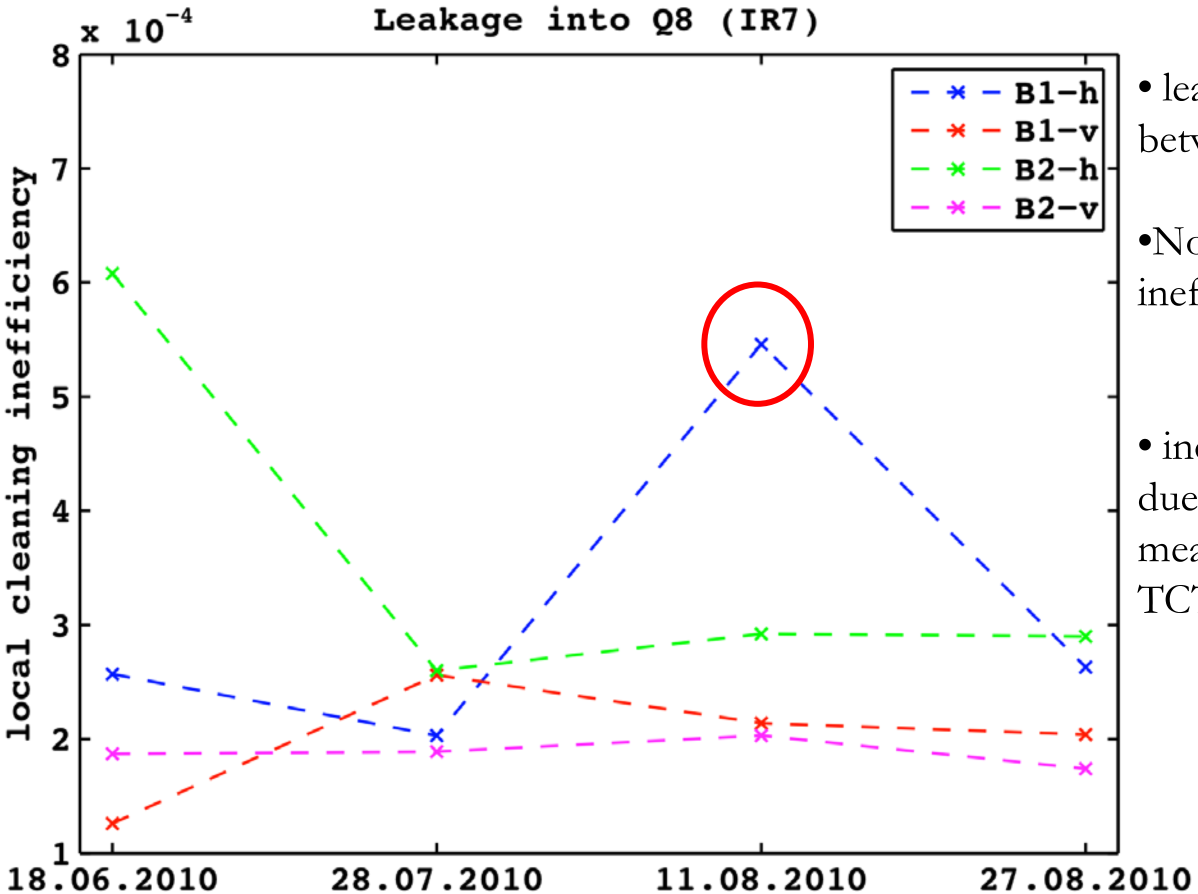
Development of β-tron local cleaning inefficiency (1.3s integration)

Leakage into cold aperture (Q8, IR7)

β-tron losses (cleaning inefficiency)	18.06.2010	28.07.2010	11.08.2010	27.08.2010	04.10.2010	18.10.2010
B1-H (Q8.R7)	2.57e-4	2.03e-4	5.46e-4	2.63e-4	3.32e-4	2.92e-4
B1-V (Q8.R7)	1.26e-4	2.56e-4	2.14e-4	2.04e-4	3.30e-4	1.89e-4
B2-H (Q8.L7)	6.08e-4	2.60e-4	2.92e-4	2.90e-4	1.94e-4	2.26e-4
B2-V (Q8.L7)	1.87e-4	1.89e-4	2.03e-4	1.75e-4	1.63e-4	1.76e-4

- Collimation setups in mid June and mid September
- Design cleaning inefficiency for phase I: 4.5e-5, with imperf. 5e-4

Development of β-tron local cleaning inefficiency (1.3s integration)



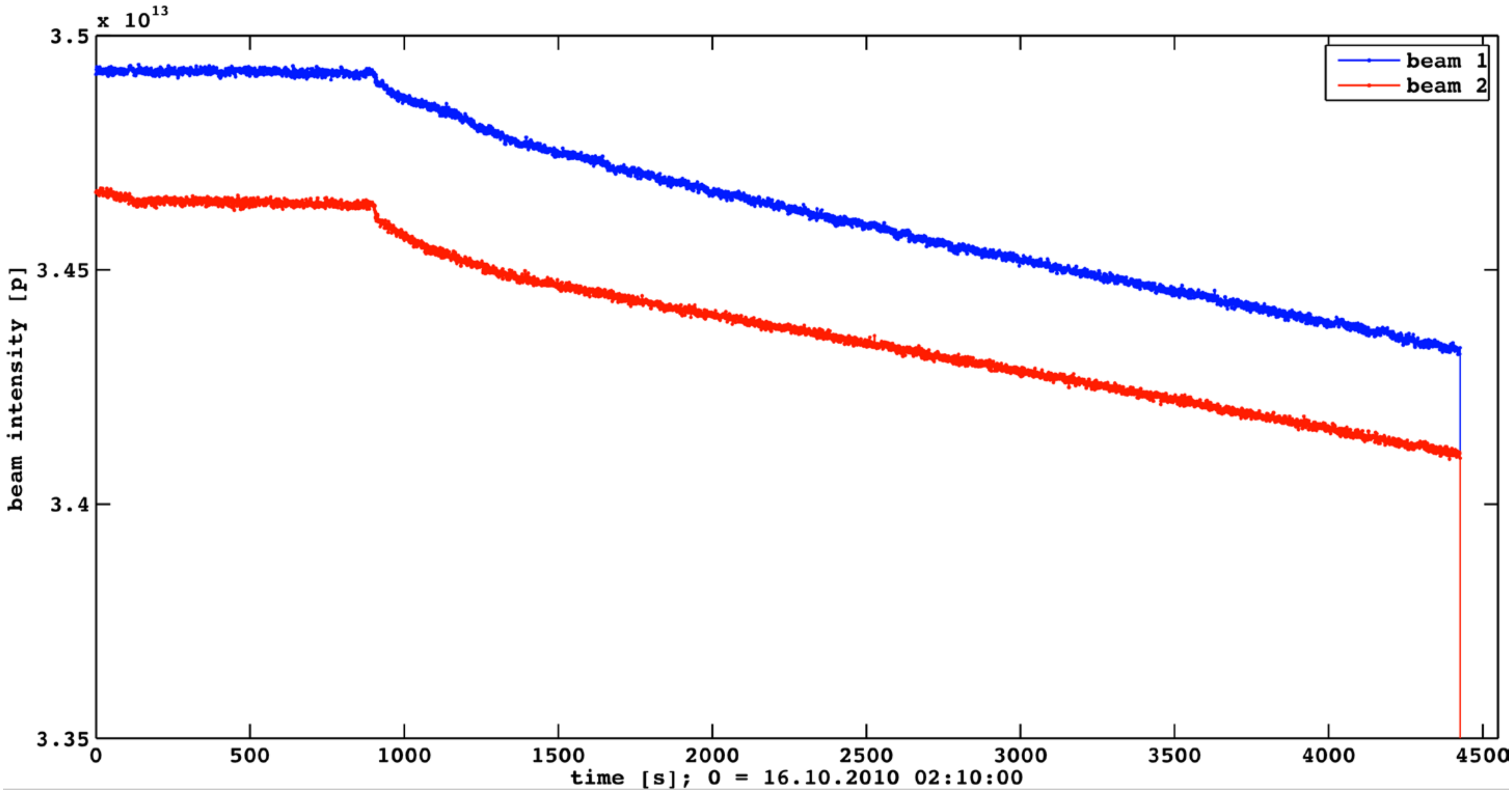
- leakage into cold aperture varied between 1.26e-4 and 6.08e-4
- No clear trend of increasing cleaning inefficiency
- increase in B1-h for 11.08.2010 maybe due to dump a few seconds after this measurement (seen also in TCTH and TCTV)

Observing performance during runs in stable beams mode

- Analyzes of losses during stable beams mode:
  - development of losses,
  - cleaning inefficiency,
  - in which stage of operation do the highest losses appear
- Higher intensities in the machine (248, 312, 368, … bunches) result in better resolution (signal to noise ratio)
- Compare loss signals for different integration times in the BLM signal (80us, 0.64ms, 10.24ms, 1.3s)
- Run presented here: 16.10.2010, 02:30 – 03:24, 312 bunches

Change of intensity during stable beams, 312 bunches, 16.10.2010, 02:30-03:24

Beam intensity



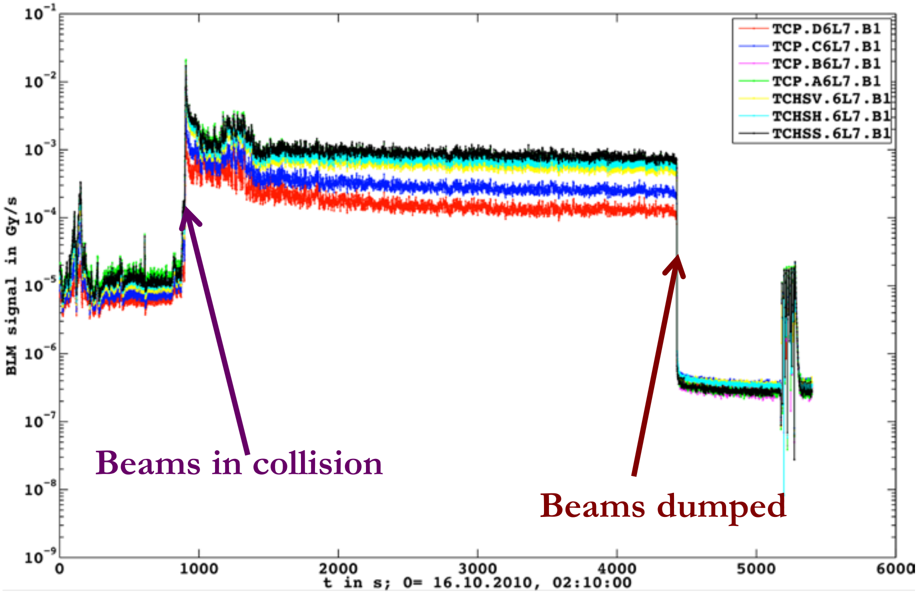
Primary losses during stable beams 312 bunches, 16.10.2010, 02:30-03:24

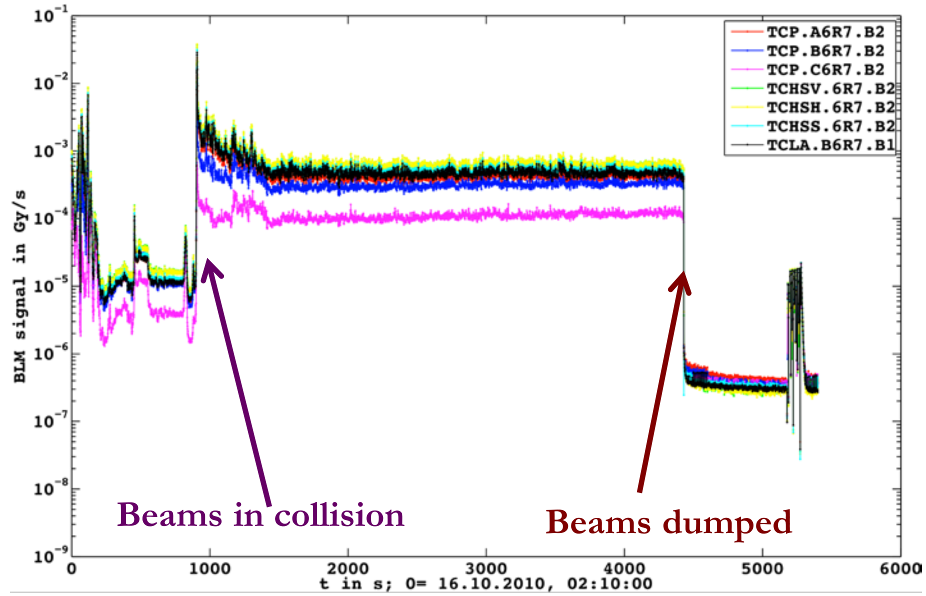
Primary losses in B1:

• Different BLMs around primary collimators in IR7

Primary losses in B2:

• Different BLMs around primary collimators in IR7

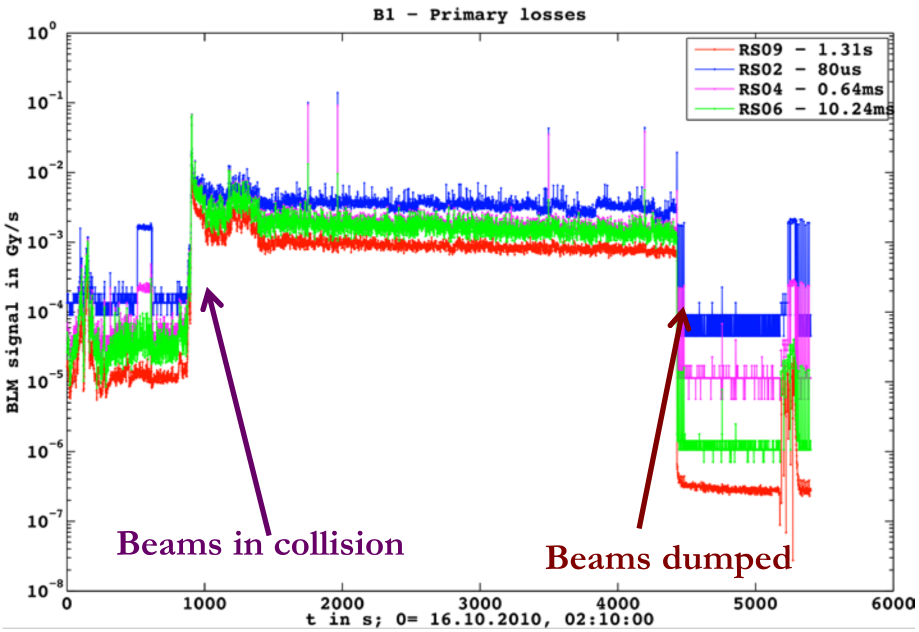




Primary losses during stable beams
312 bunches, 16.10.2010, 02:30-03:24

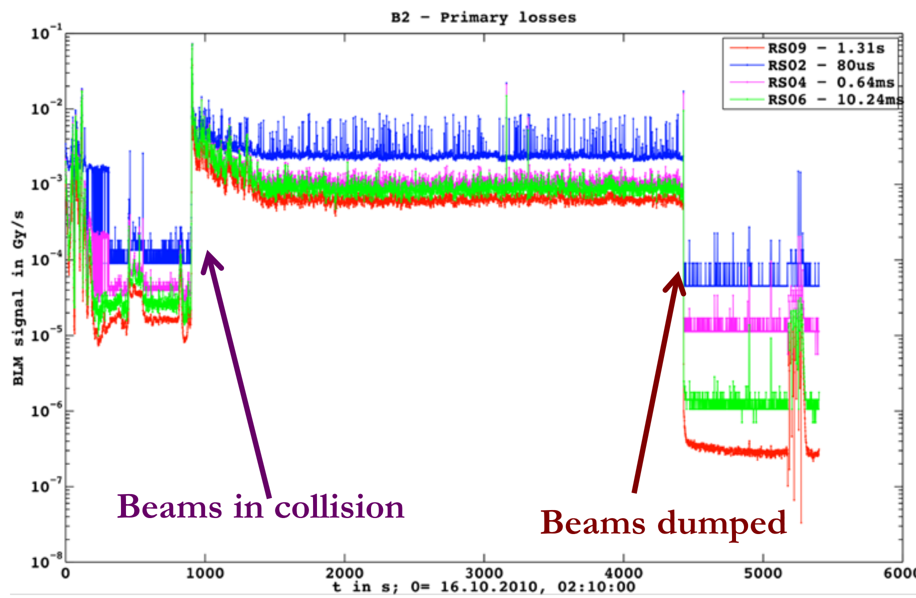
Primary losses in B1:

- Location with highest losses (TCHSS)
- Different integration times



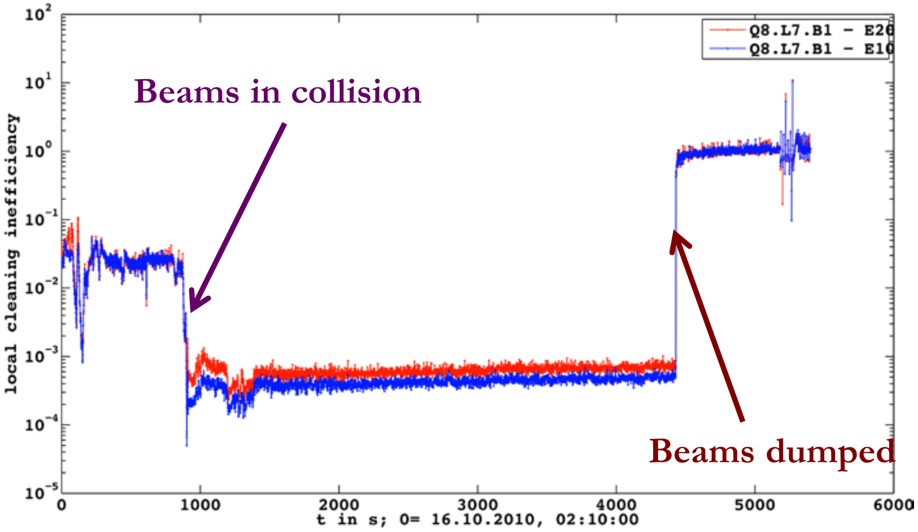
Primary losses in B2:

- Location with highest losses (TCHSH)
- Different integration times

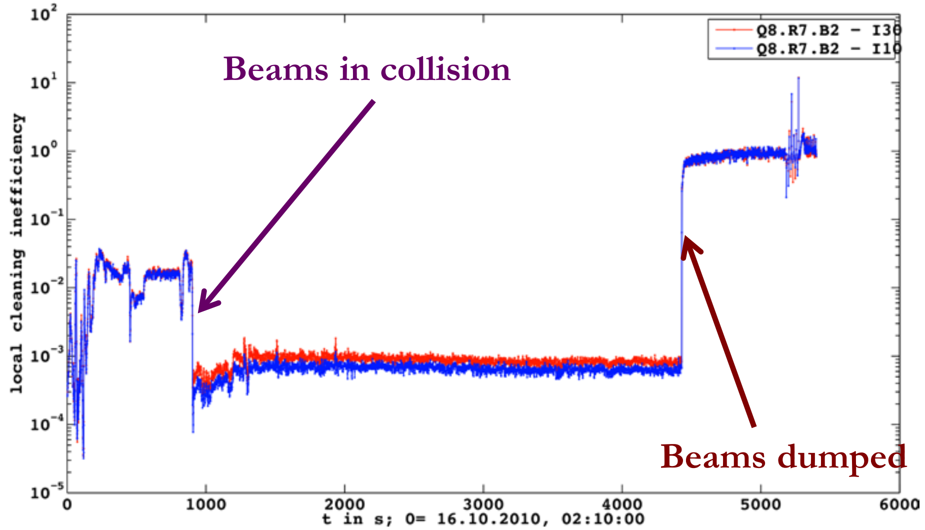


Cleaning during stable beams
312 bunches, 16.10.2010, 02:30-03:24

Local cleaning inefficiency Q8L7.B1



Local cleaning inefficiency Q8R7.B2



Conclusion

- Loss maps have to be performed for all cases to verify and regularly validate the settings of the collimation system (B1, B2, hor, ver, +1000Hz, -1000Hz)
- Limitation in dispersion suppressor: Q8 (cleaning inefficiency < 6.1e-4, i.e. cleaning efficiency > 99.939%; design values phase-I with imperfections: 5e-4, i.e. 99.95%)
- No clear general trend of decreasing cleaning efficiency to cold aperture
- Currently no regular monitoring of off-momentum losses

- First results from analyzing losses during stable beams mode:
- Highest losses when beams were put into collision (TCPs), afterwards losses stayed quite constant
- Local cleaning inefficiency in cold aperture (Q8) increased after beams were put into collision and stayed constant during the run

END