

First multi-turn cleaning simulations of the ATS optics

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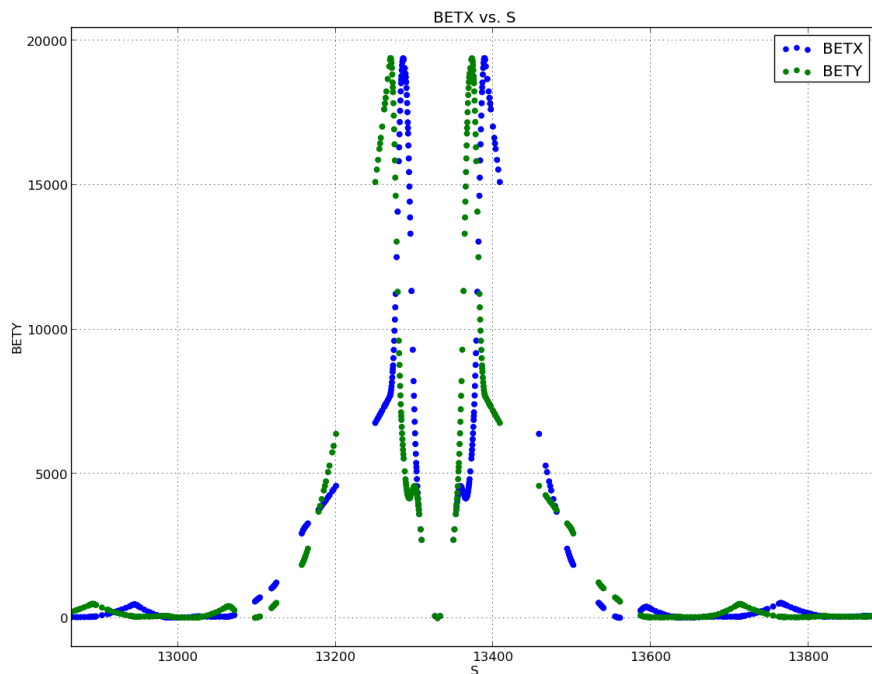
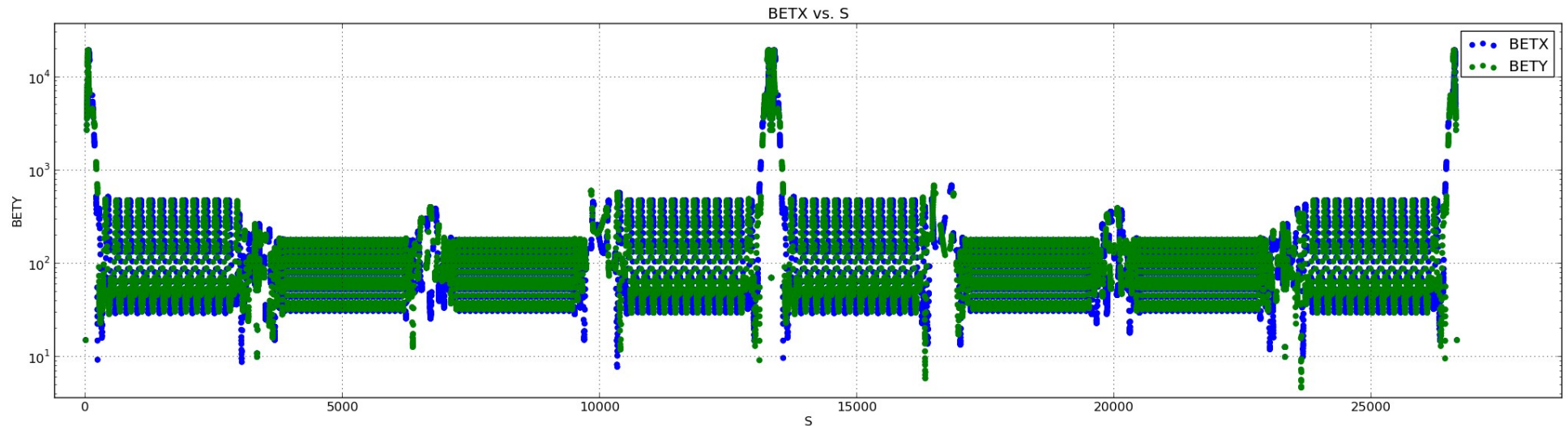
Outline

- Introduction
- Simulation setup
 - Optics
 - Halo and beam parameters
- Preliminary results
 - Loss maps
 - Impact distributions
- Conclusion

Introduction

- Goal: predict collimation cleaning for HL-LHC
- Setting up multi-turn halo simulation for the baseline optics choices: ATS optics
- ATS: Achromatic Telescopic Squeeze
 - Baseline option: $\beta^* = 15$ cm
- First attempt to use this optics with the collimation version of SixTrack for loss maps
- /!\ preliminary results, for discussion
 - Focus on simulation setup
 - Preliminary settings for collimators
 - Aperture layout not finalised

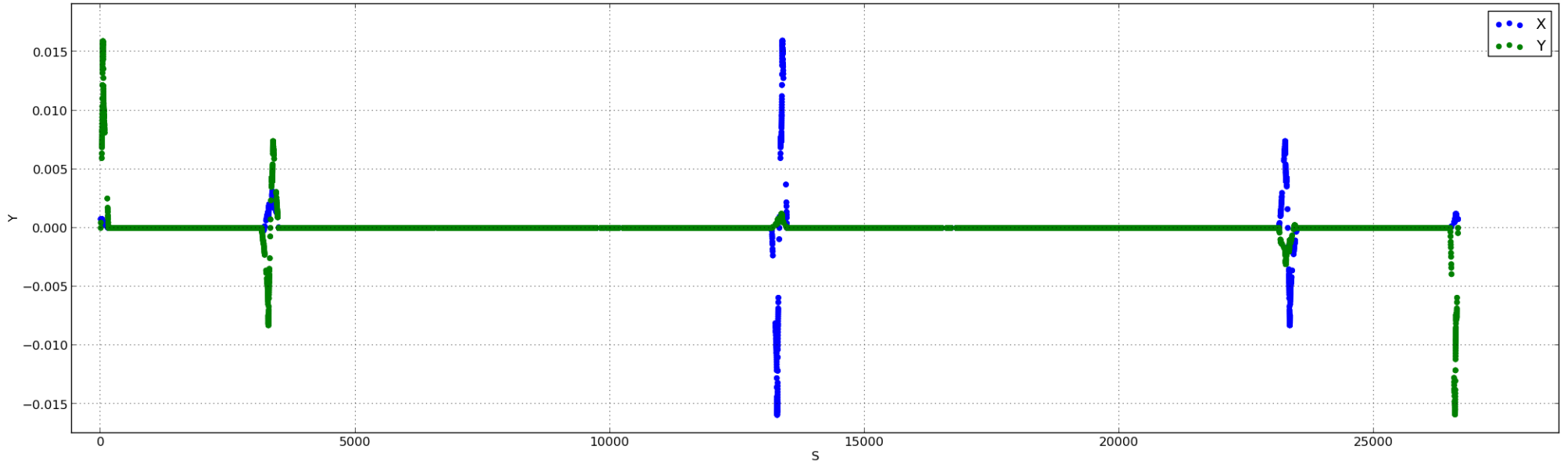
ATS optics: β_x, β_y



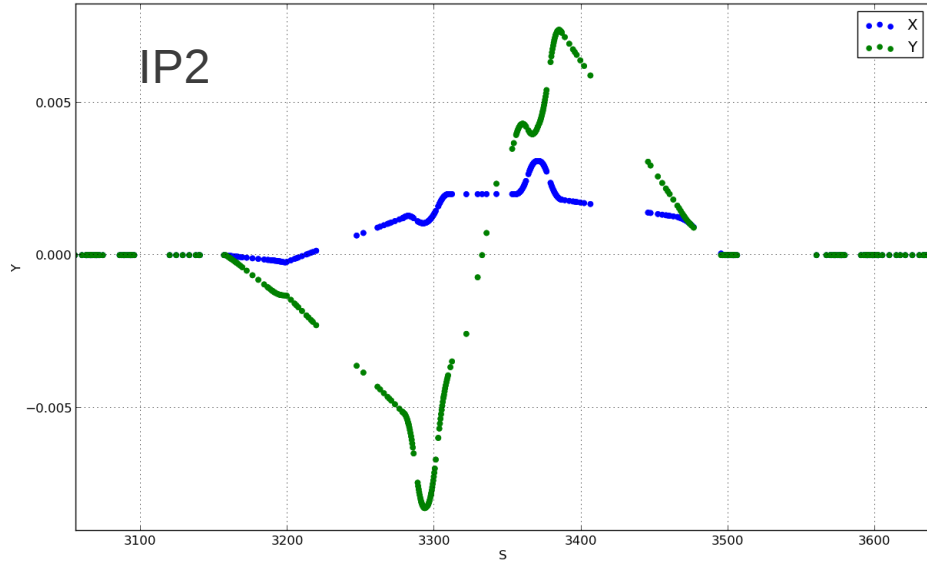
- Thin optics: IP1/IP5: $\beta^* = 15$ cm
- Latest layout: as-built 2012 (updated TCTV layout in IR2)
- Different β functions in arcs
- Sequence courtesy of R. de Maria (cf. CoLUSM #6)

ATS optics: closed orbit

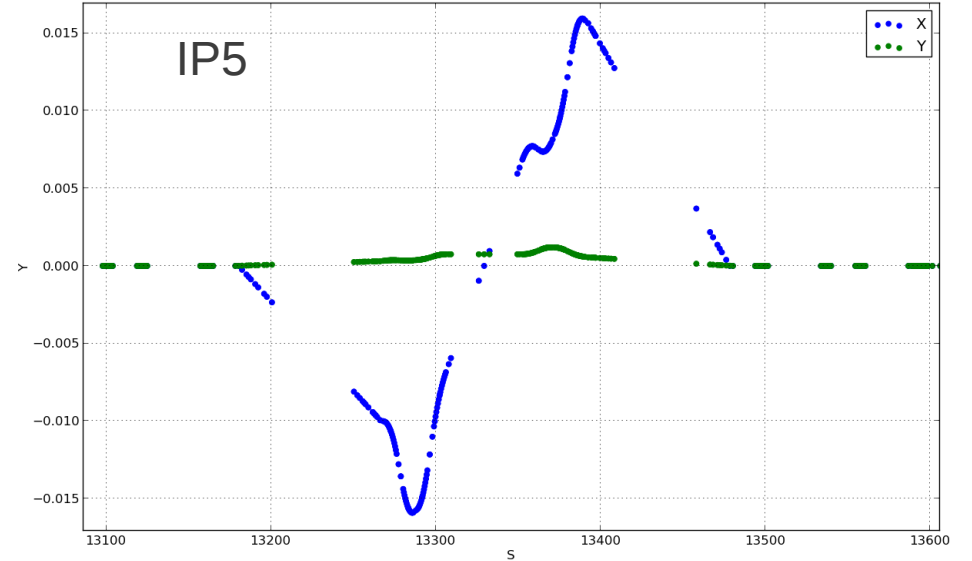
X vs. S



X vs. S



X vs. S



Simulation parameters

- Energy: 7 TeV, 6.4 million particles, 200 turns
- $\epsilon_N = 3.5 \text{ mm.mrad}$, $\epsilon_x = \epsilon_y = 0.503\text{e-}09$
- IP1/IP5: $\beta^* = 15 \text{ cm}$
- Halo: 6σ in the considered plan (= setting of primary)
Smear = 0.0015σ , no pencil beam.
- Crossing angle X1 = 142.5, X2 = 80, X5 = -142.5, X8 = 130
- Parallel separation ON at all IP (no collision, but most critical case for aperture)
- $dp/p = 1.129\text{e-}4$ or OFF, bunch length = 75.5 mm or OFF
- No beta beating, no offset or tilt

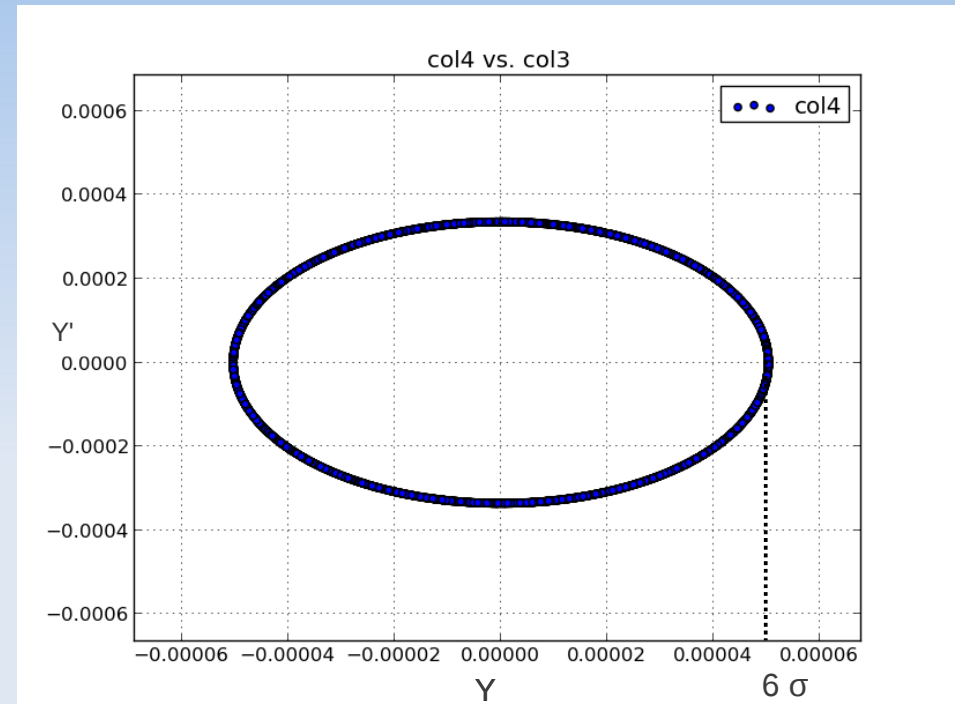
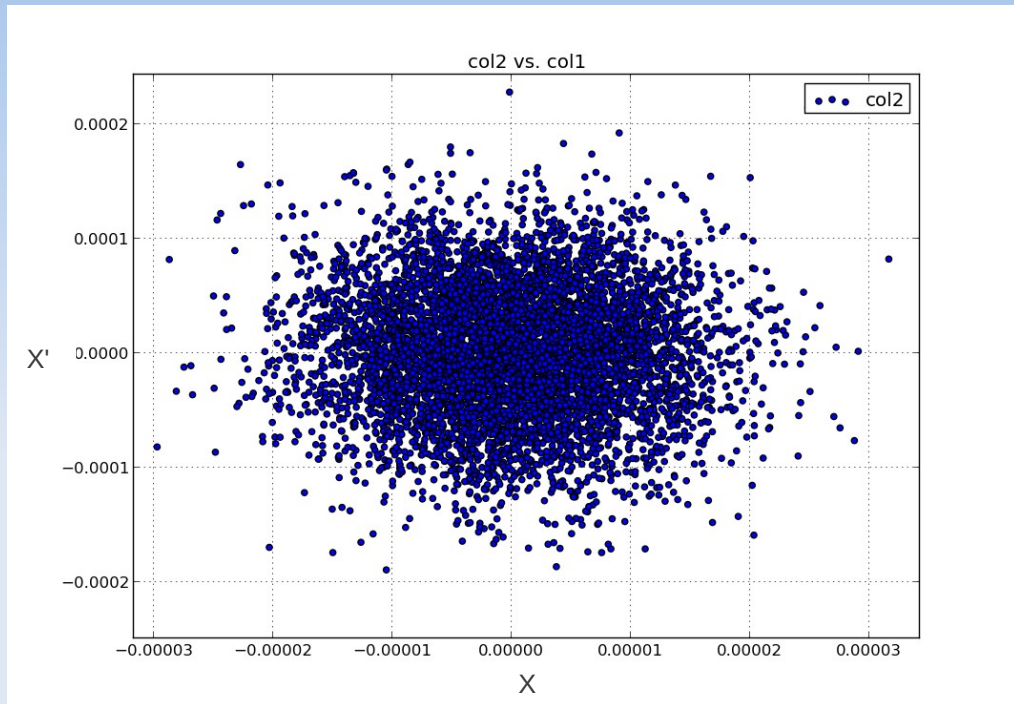
Collimator settings

Coll. setting	σ
TCP IR7	6.
TCSG IR7	7.
TCLA IR7	10.
TCP IR3	12.
TCSG IR3	15.6
TCLA IR3	17.6

Coll. setting	σ
TCLP	12.
TCLI	open
TCSTCDQ IR6	7.5
TCDQ IR6	8.
TDI	open
TCT IR1/5/8	8.3
TCT IR2	12.

- Nominal settings at 7 TeV
- Note: TCT partially closed in IR2/8 even if IP not squeezed (to be reconsidered)
- Presented in more details in ColUSM #6

Example of initial distribution at IP1 (V)

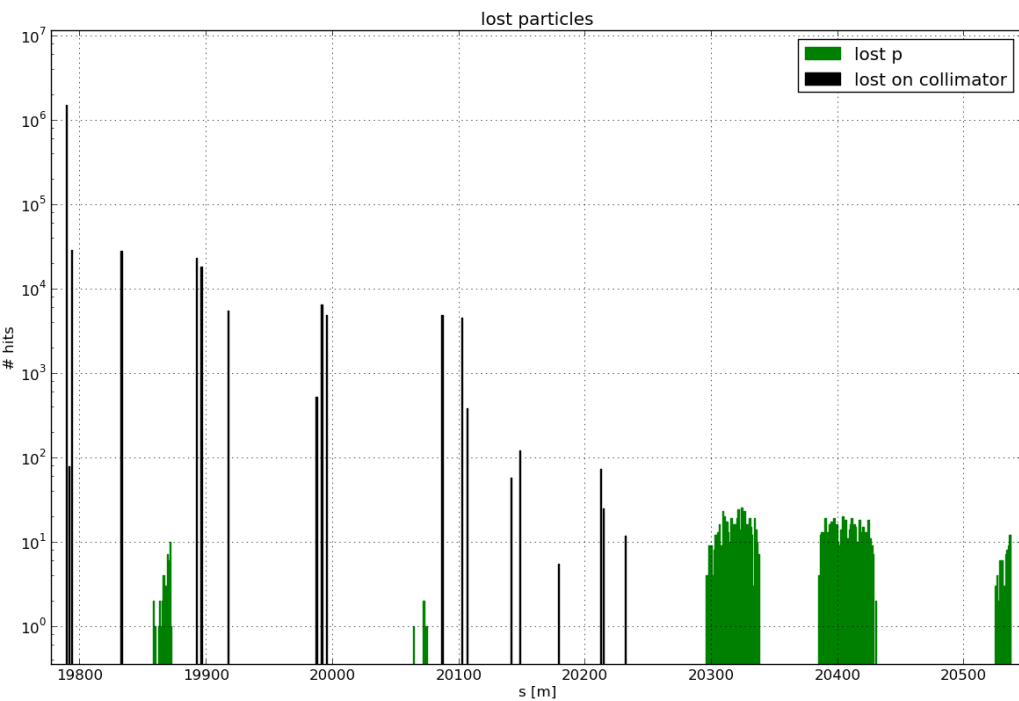
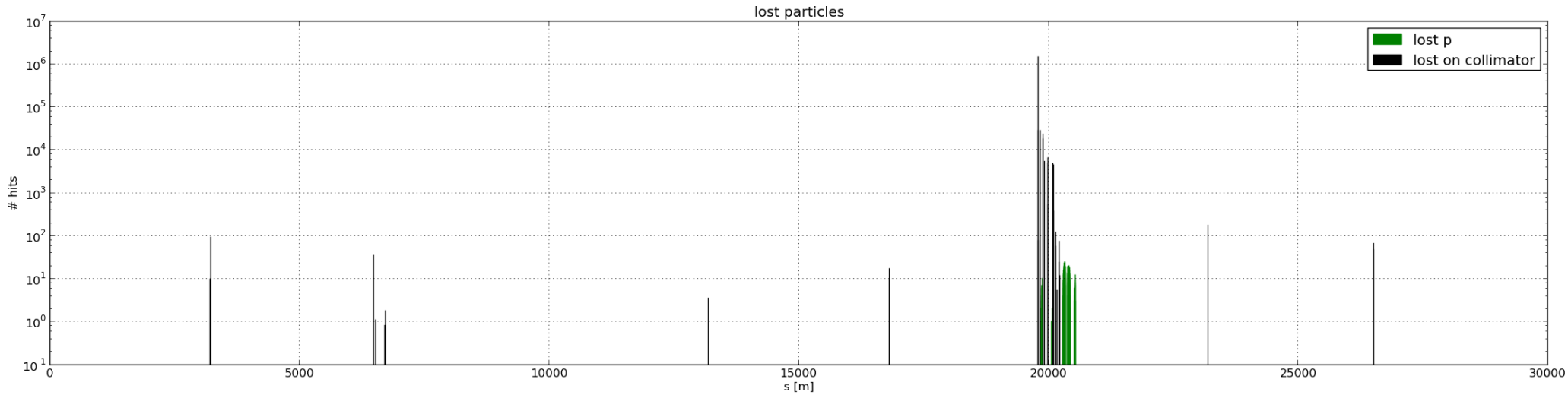


- Phase space
- Distribution centered around 0

- Phase space
- 6σ vertical halo
- $\sigma = 8.68 \mu\text{m}$
- $(\beta^* = 15 \text{ cm}, \epsilon = 3.5 \mu\text{m})$

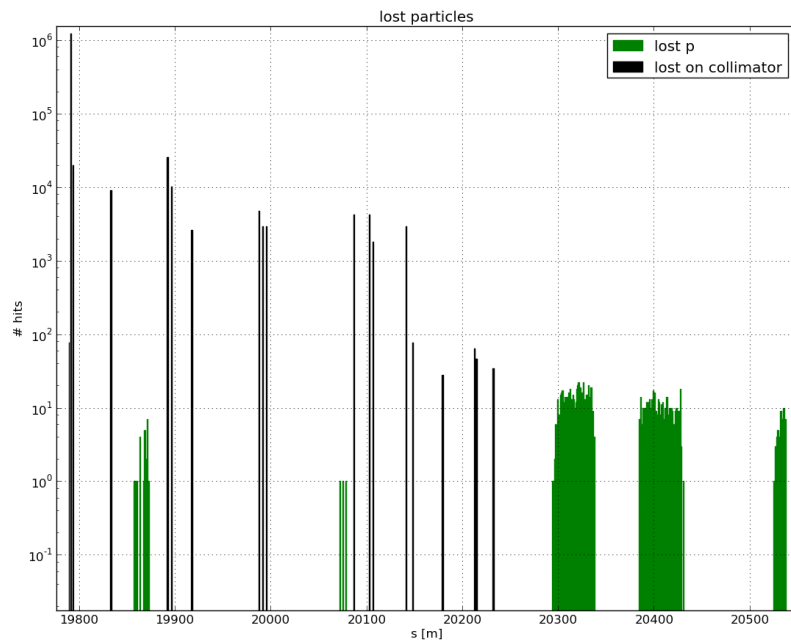
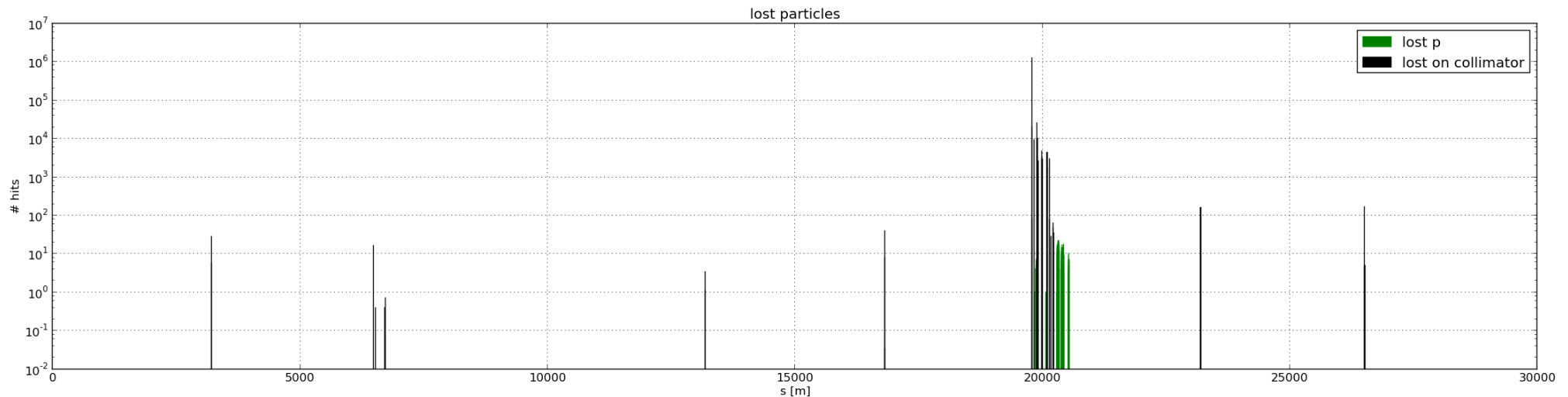
Results

Vertical halo, 6σ , $dp/p = 0$ loss map



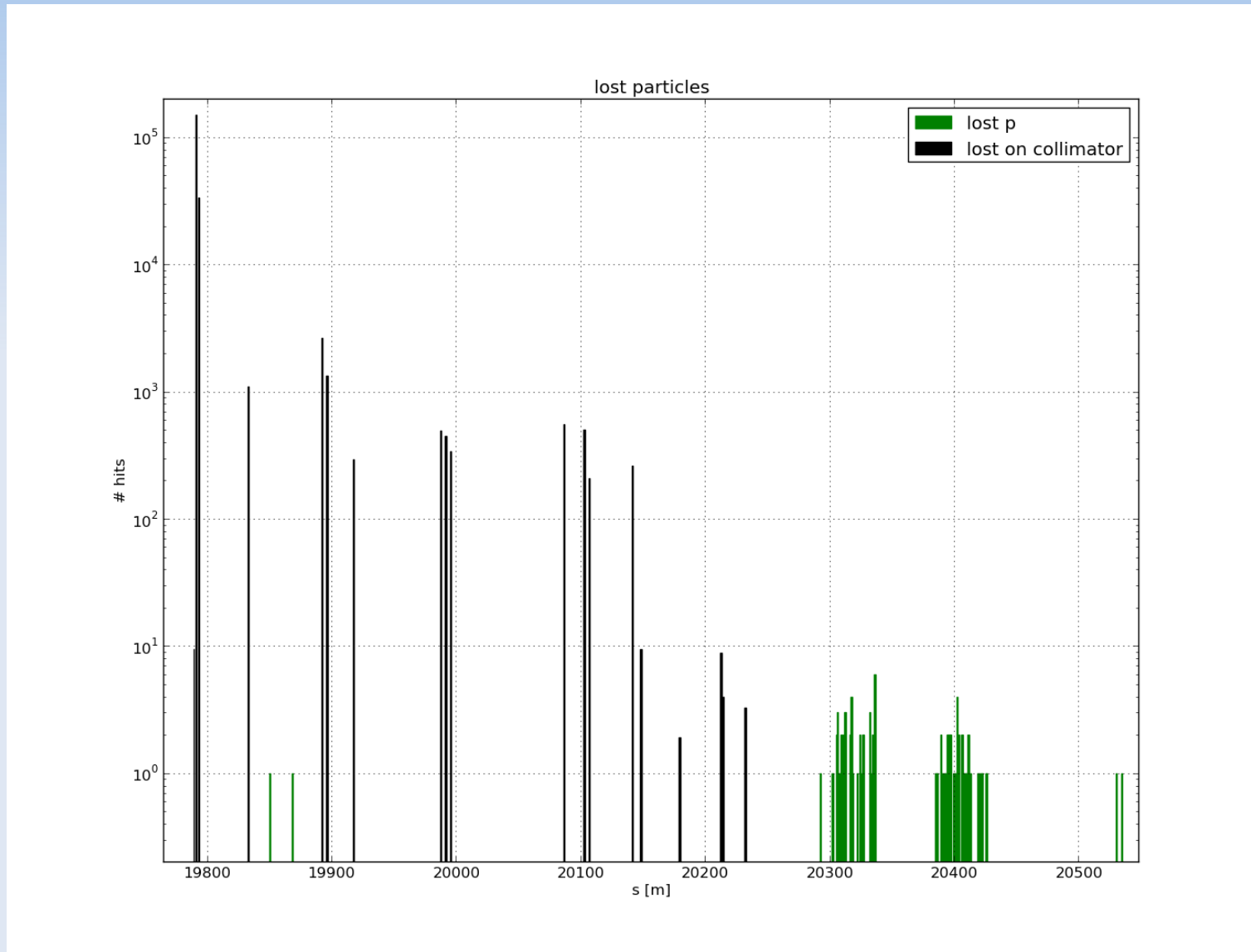
- Global loss map with standard simulation parameters
- Simulation set-up worked at first attempt
 - MadX, Sixtrack, Collimation, trajectory
- Still working on impact parameter

Horizontal halo, 6σ , $dp/p = 0$ loss map

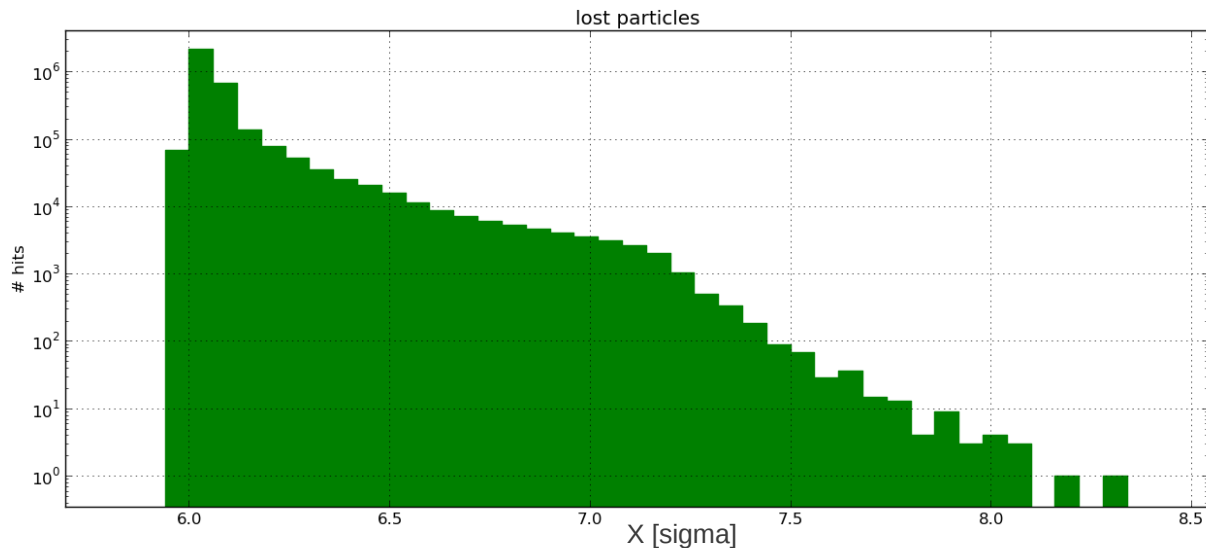


- Global loss map with standard simulation parameters
- Similar to vertical one
- Other loss maps with different halo and dp/p (not shown)
- => Still working on impact parameter

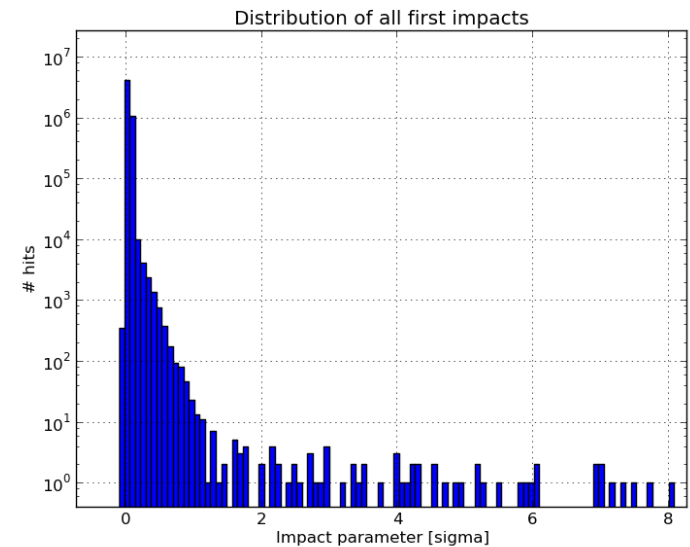
Horizontal halo, 5.9σ , $dp/p = 0$



Horizontal, 6σ , $dp/p = 0$ Impact parameters



Distribution of fluka impacts at the primary



First impacts at the primary

- Surprisingly high first impacts
- $\sigma = 265.74 \mu\text{m}$
- To be understood.

Conclusion

- Presented first simulation for cleaning with ATS optics at 7 TeV → Preliminary results!
 - Case study: beta = 15, H/V halo
- Full simulation chain (including loss maps with preliminary aperture model) running smoothly
- Major problem with impact parameter being addressed
- Immediate follow-up
 - Simulations for the other beam (input required from optics team)
 - Update the aperture model for present ATS layout
 - Consider different IR collimation layout (DS collimators)
 - Set up the simulations for physics debris

Normalised aperture, V , 6σ , $dp/p = 0$

