Status of multi-turn particle debris tracking

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Outline

- Introduction
- Creating the new inputs distributions
  - Distributions of transverse kicks and energy changes due to collisions (FLUKA)
  - Initial distributions without collision
  - New initial distributions with effect of collisions
- Preliminary results of tracking
  - 4 TeV nominal
  - 4 TeV, TCL @14 σ
- Conclusion

Introduction

- Goal: study the losses due to debris from IPs (instead of regular beam losses) by tracking them around the ring
- This talk focuses on the setup of the tools: inputs & results are still preliminary
  - Further iterations needed (cuts, elastic contributions...)
- Two effects of the collisions:

  - Shift in momentum

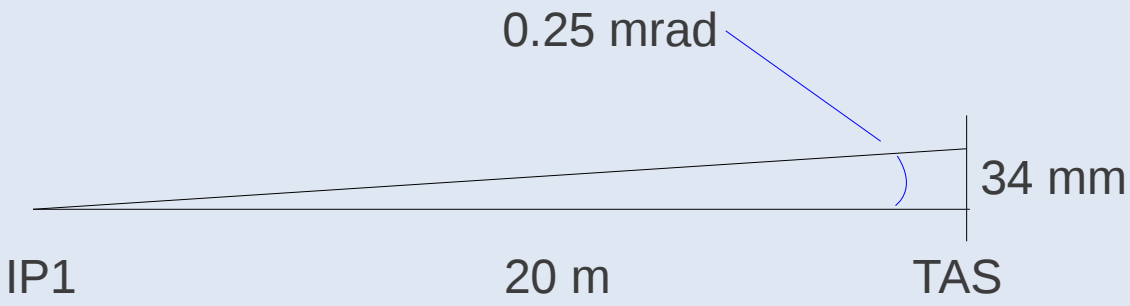
  - Extra kicks: x', y'
- Distributions courtesy of F. Cerutti
- Presented during ColUSM3

F. Cerutti's presentation ColUSM #3

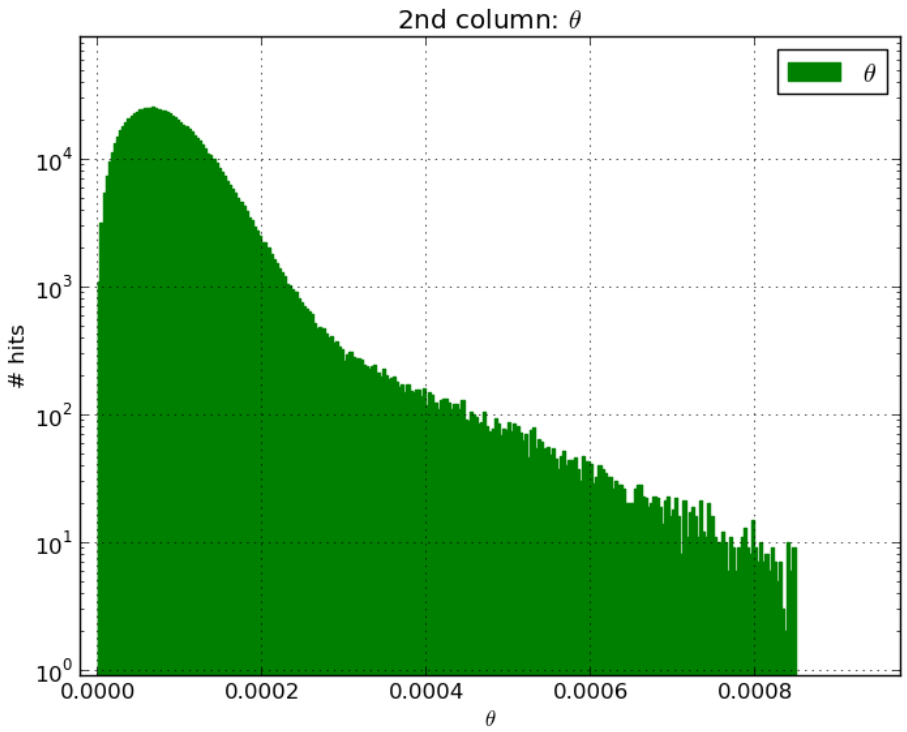
- Distributions of θ and dp/p from FLUKA.
- Only inelastic contributions
- $x' = tan(\theta)sin(\varphi)$
- $y' = tan(\theta)cos(\varphi)$

$$\varphi \in [0\ ;\ 2\pi]$$

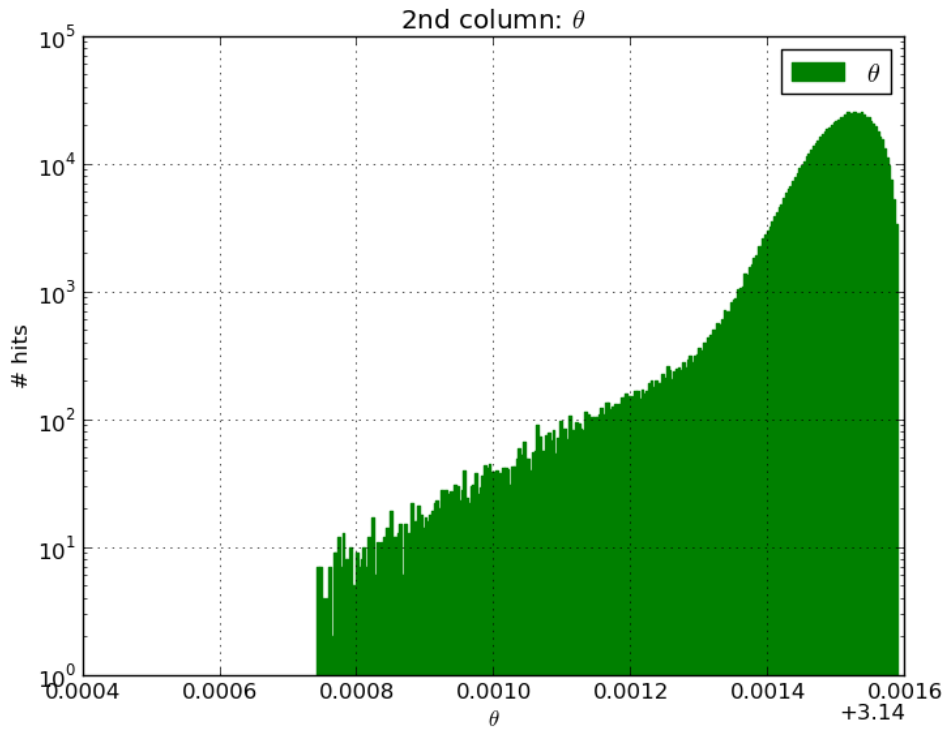
- 4 TeV:
  - Distribution of θ is cut at the opening of the TAS
  - Distribution of dp/p is cut at 0.1



Distributions of θ (4 TeV)



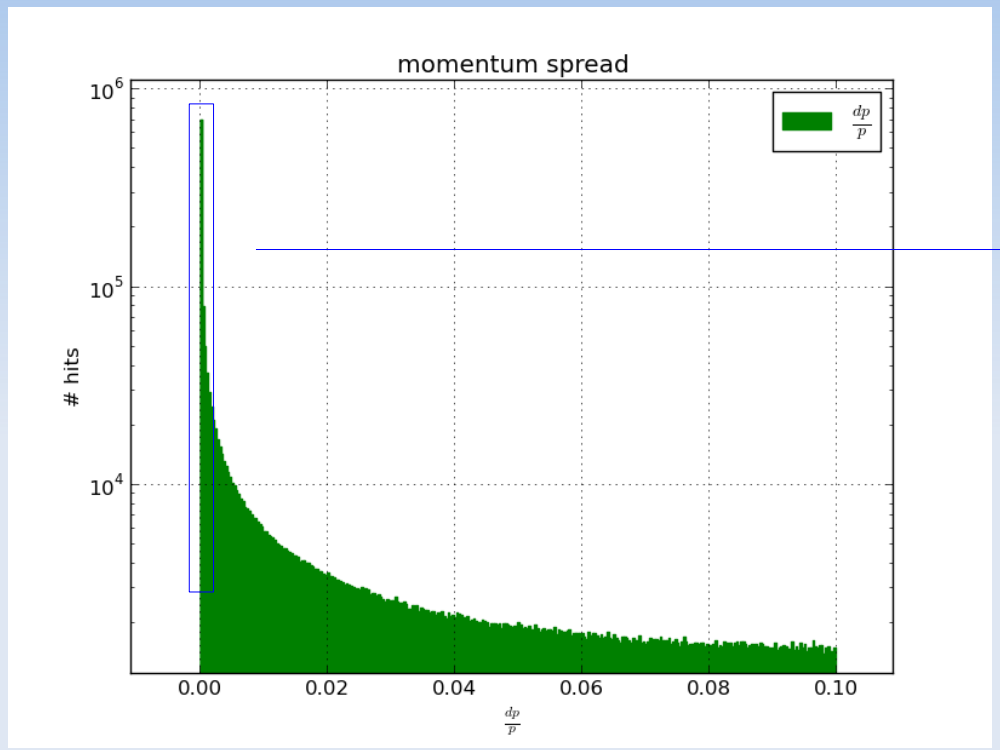
around 0

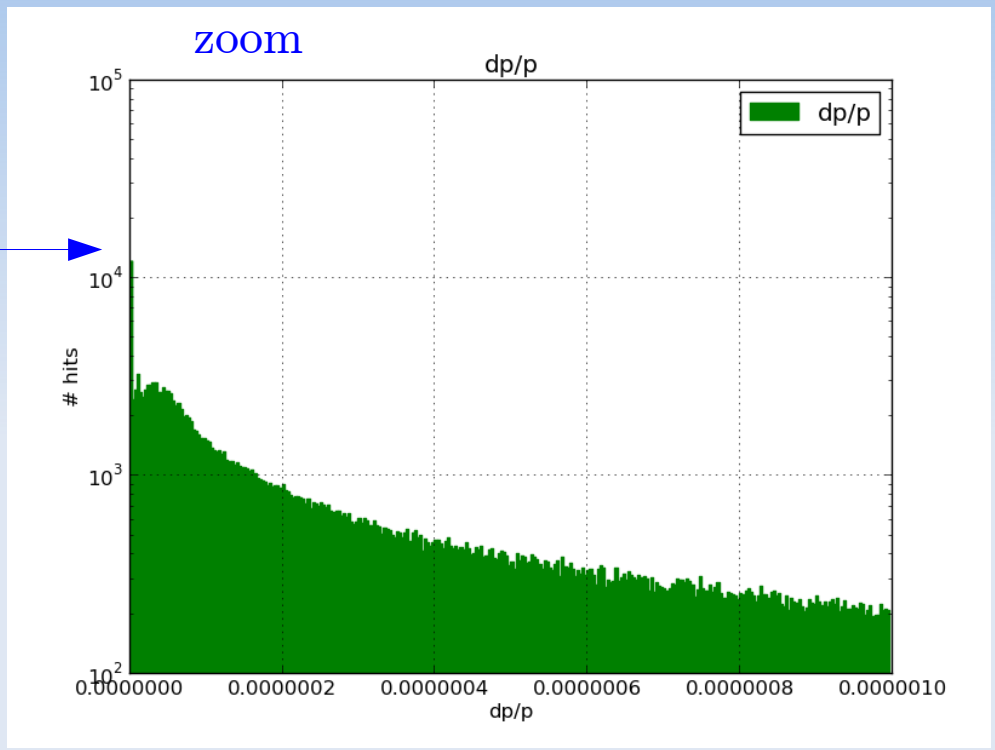


around π

- Notice the effect of the cut
- Distributions for colliding protons coming from opposite directions can be folded to double the statistics

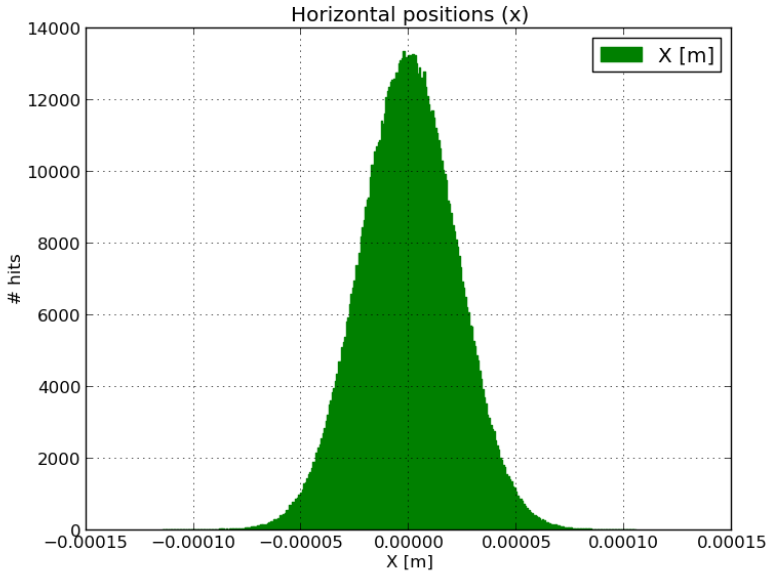
Distribution of dp/p (4 TeV)

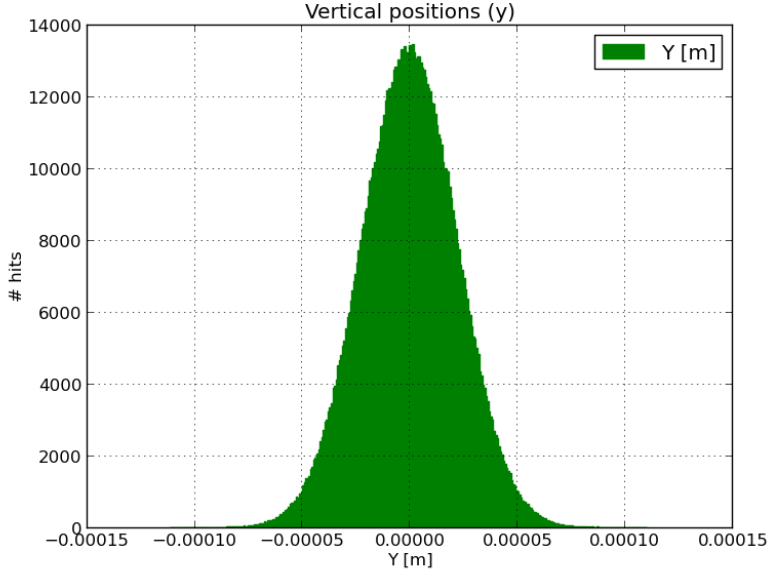


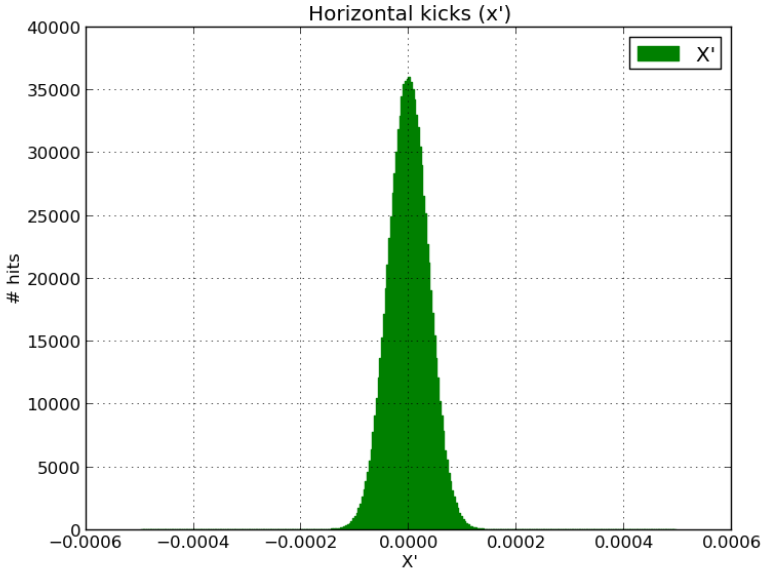


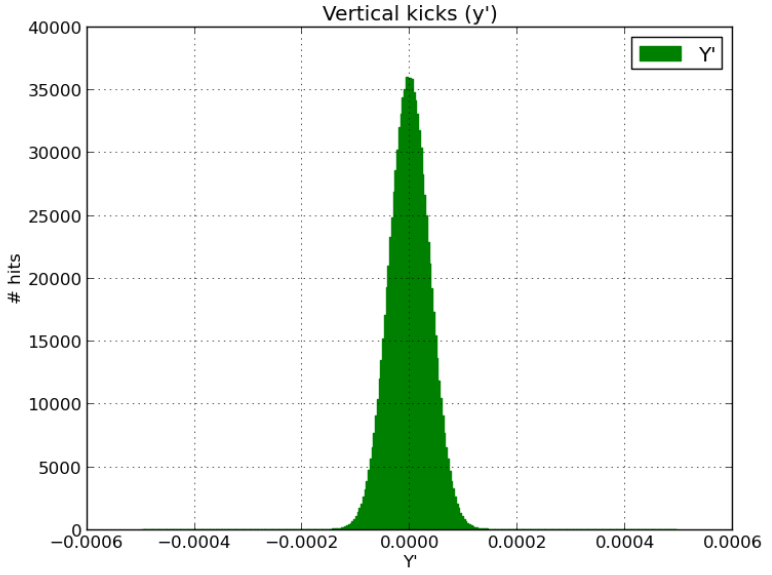
- p with higher θ or dp/p would be lost anyway during tracking.
- Some combinations of both could make particles above cut survive the TAS anyway.

Initial distributions no collision



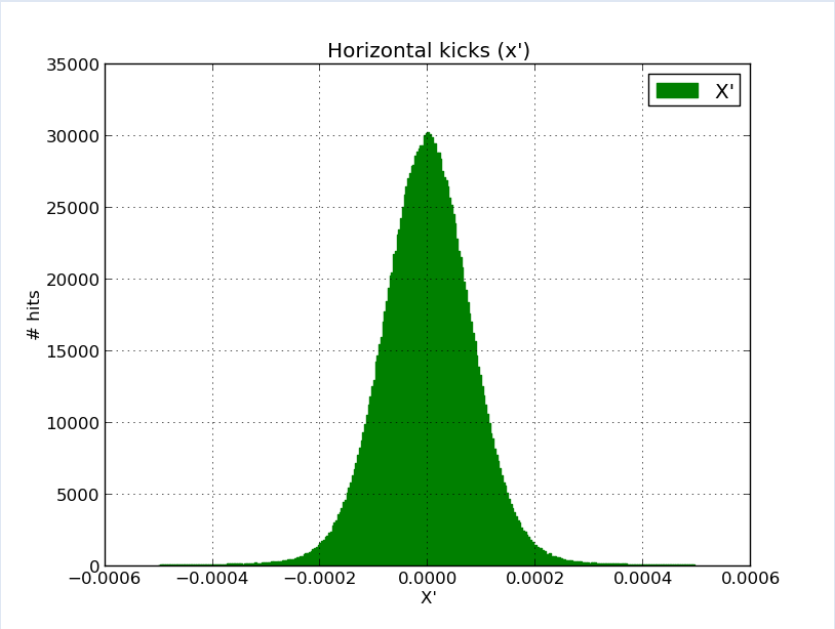


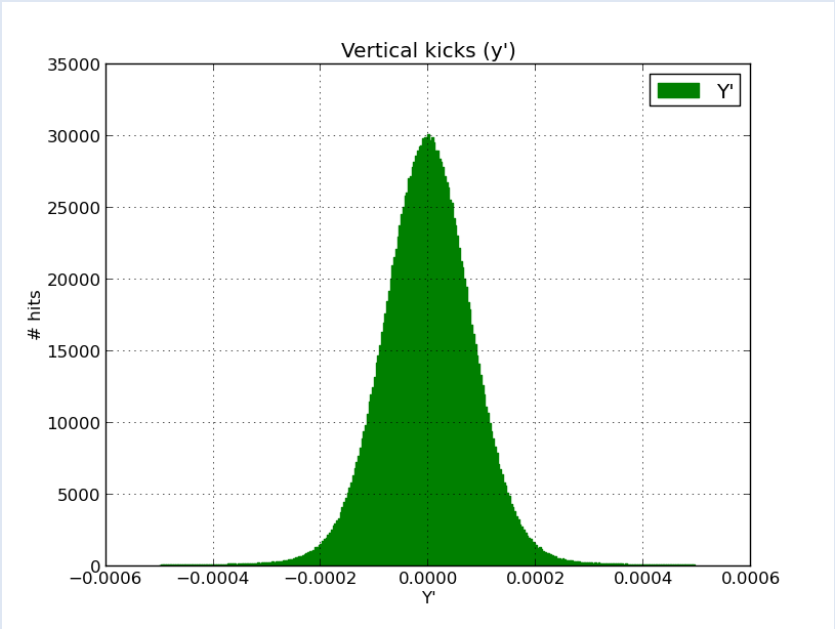




The new distributions

- Sums of the initial distributions + shifts induced by the collisions (same scale)
- The effect of collisions is larger





Simulation pre-processing

- Distributions are generated for simple p-p collisions
- FLUKA gives δx', δy', dp/p
- For a non-perturbed initial distribution, we have the 6 coordinates: x, x', y, y', l, E
- We sum the two:
  x, x'+δx', y, y'+δy', l, $E(1-dp/p)$
- The crossing angle is added by SixTrack
  (that's why the distributions are centered around 0)
- Then: standard tracking

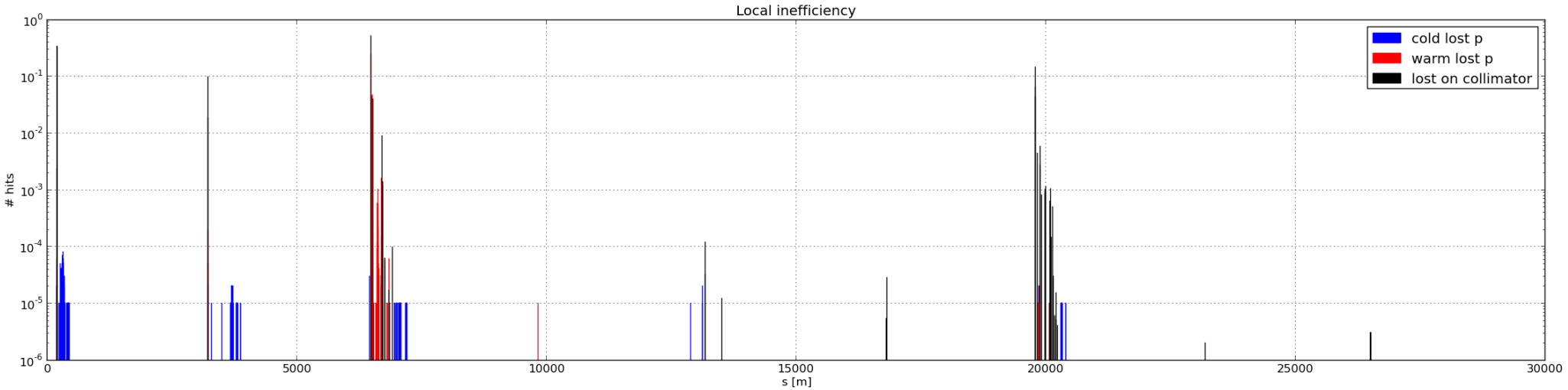
Tracking results

Particle tracking

- Not all particles are perturbed, but we track only particles that are perturbed
- With the present cuts at 4 TeV (TAS aperture, 0.1 dp/p), 17.7 % of the particles are given.
- If we'd track all particles, most of the non-disturbed particles would not be lost over 200 turns

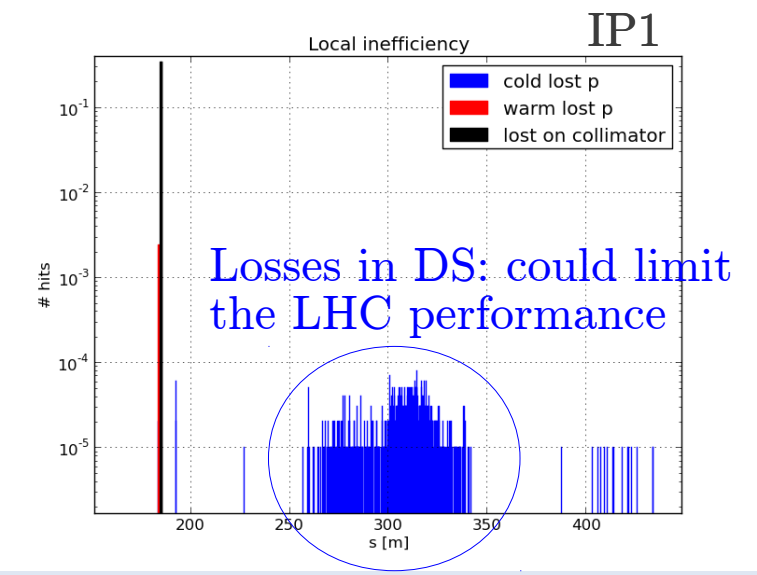
  (Remember that for usual multi-turn tracking, only the halo is generated)

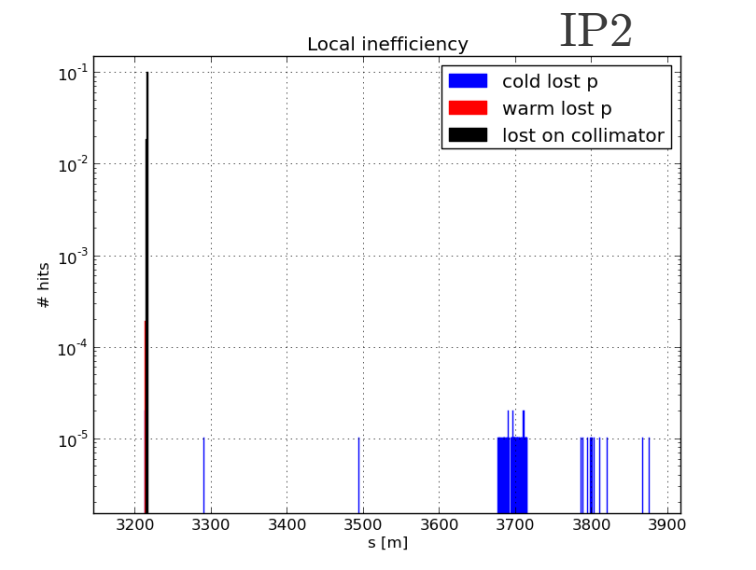
Loss map: 4 TeV, nominal settings

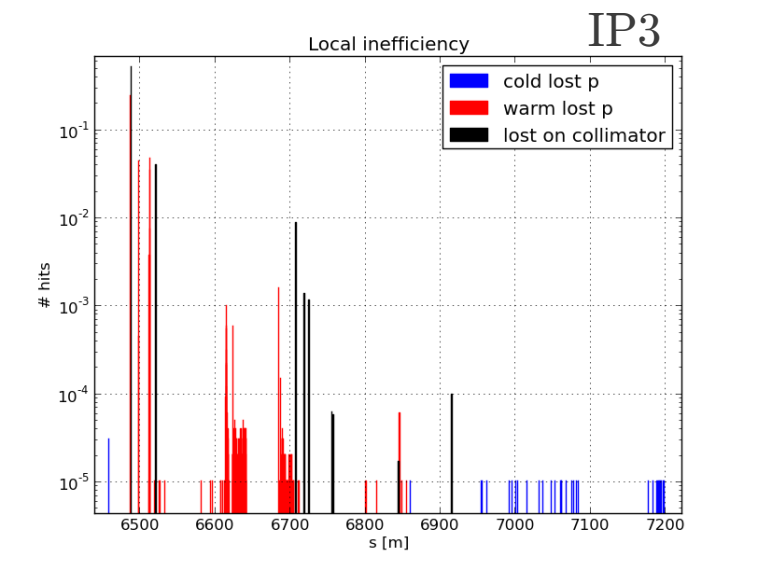


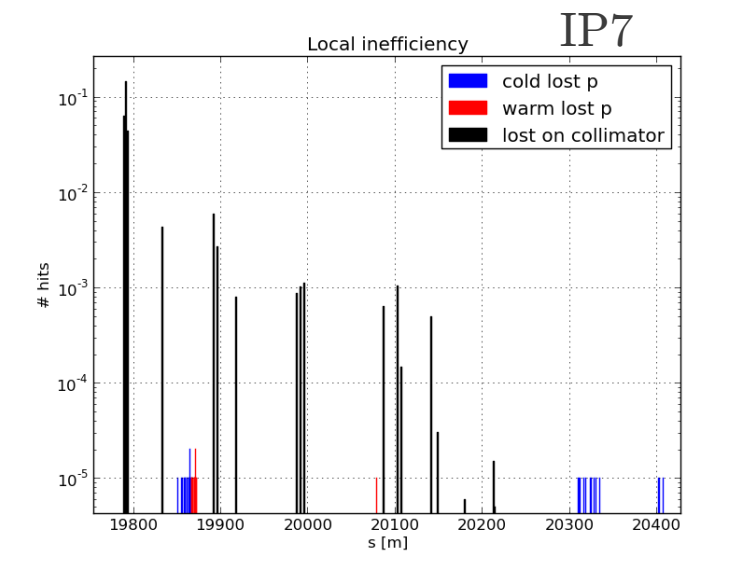
- Particles tracked from IP1
- Most losses at TCL.5R1.B1 (nominal: @10 σ)
- Specific loss locations outside collimators
- /!\ this is inefficiency
- /!\ preliminary results

Loss map (zooms)

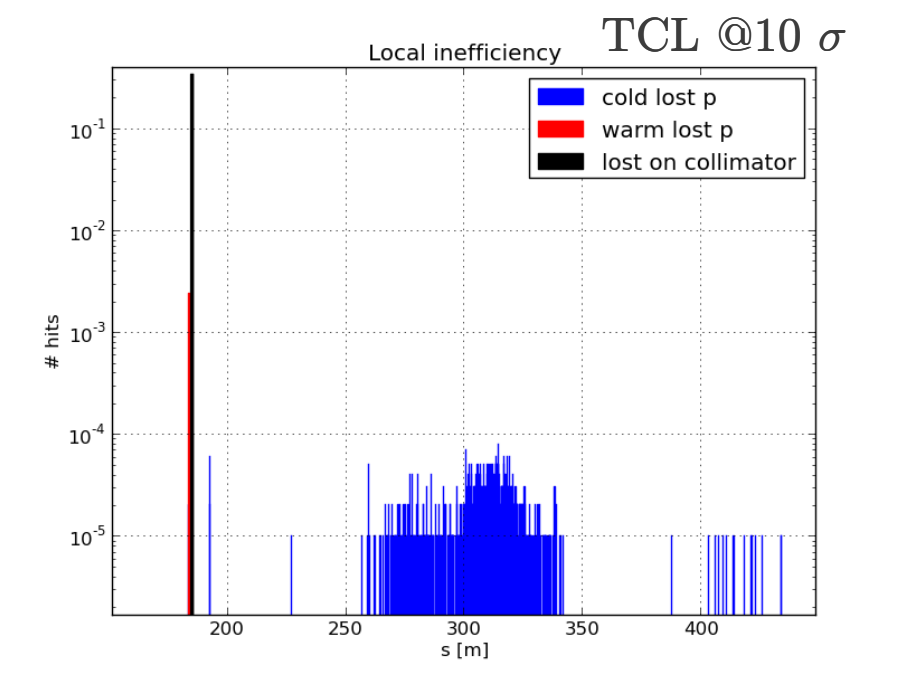


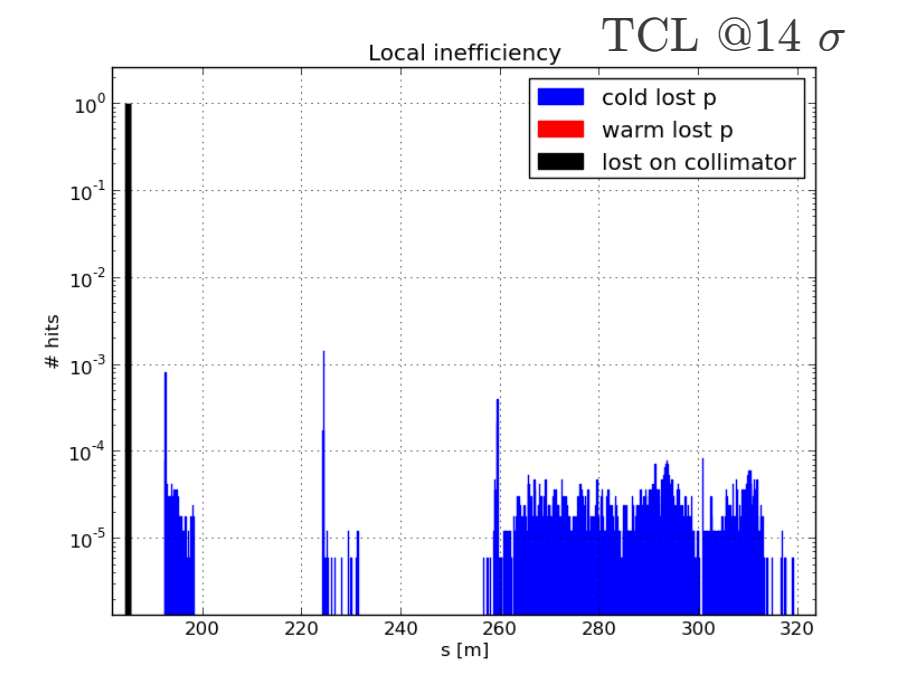






Comparison 10 σ/14 σ (4 TeV, IR1)





- This is our goal; /!\ preliminary results (rest of loss map is wrong...)
- More losses downstream of TCL when out
- Next step: full scan 10 $\sigma \rightarrow$ 60 σ

Conclusion

- Simulation setup for physics is running well.
- We have not yet physical results because the focus was on the technical aspects.
- Outlook:
  - Get physical results
  - Calibrate losses in physical units
  - Update FLUKA inputs (cuts, elastic interaction)
  - Reproduce losses measured during TCL scans
  - Setup tracking simulations starting at other IPs.
- Final goal: having reliable tools to study LS2 layout (next two months)