ColUSM #14

Update on TCL scans & debris tracking simulations

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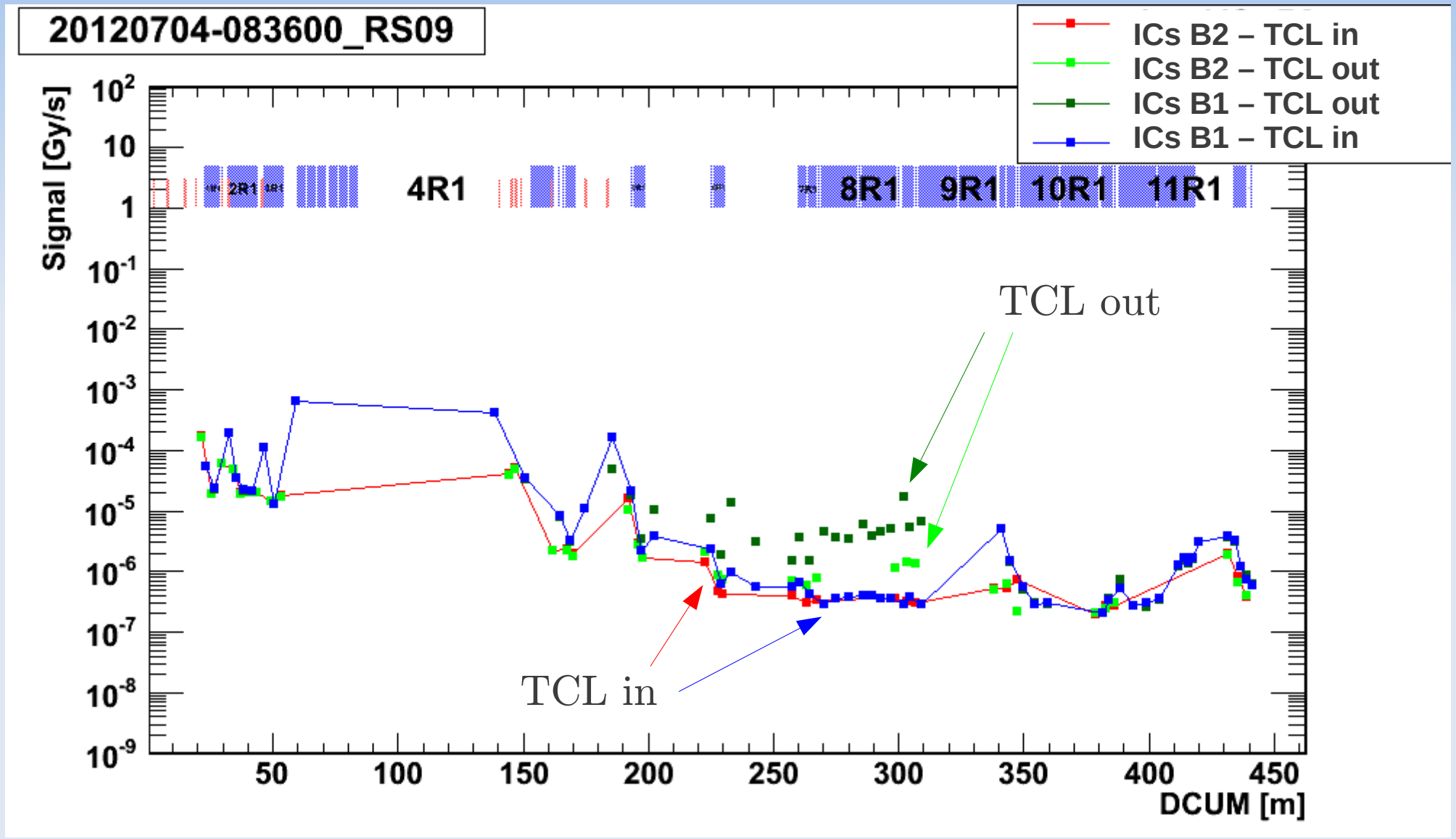
Introduction

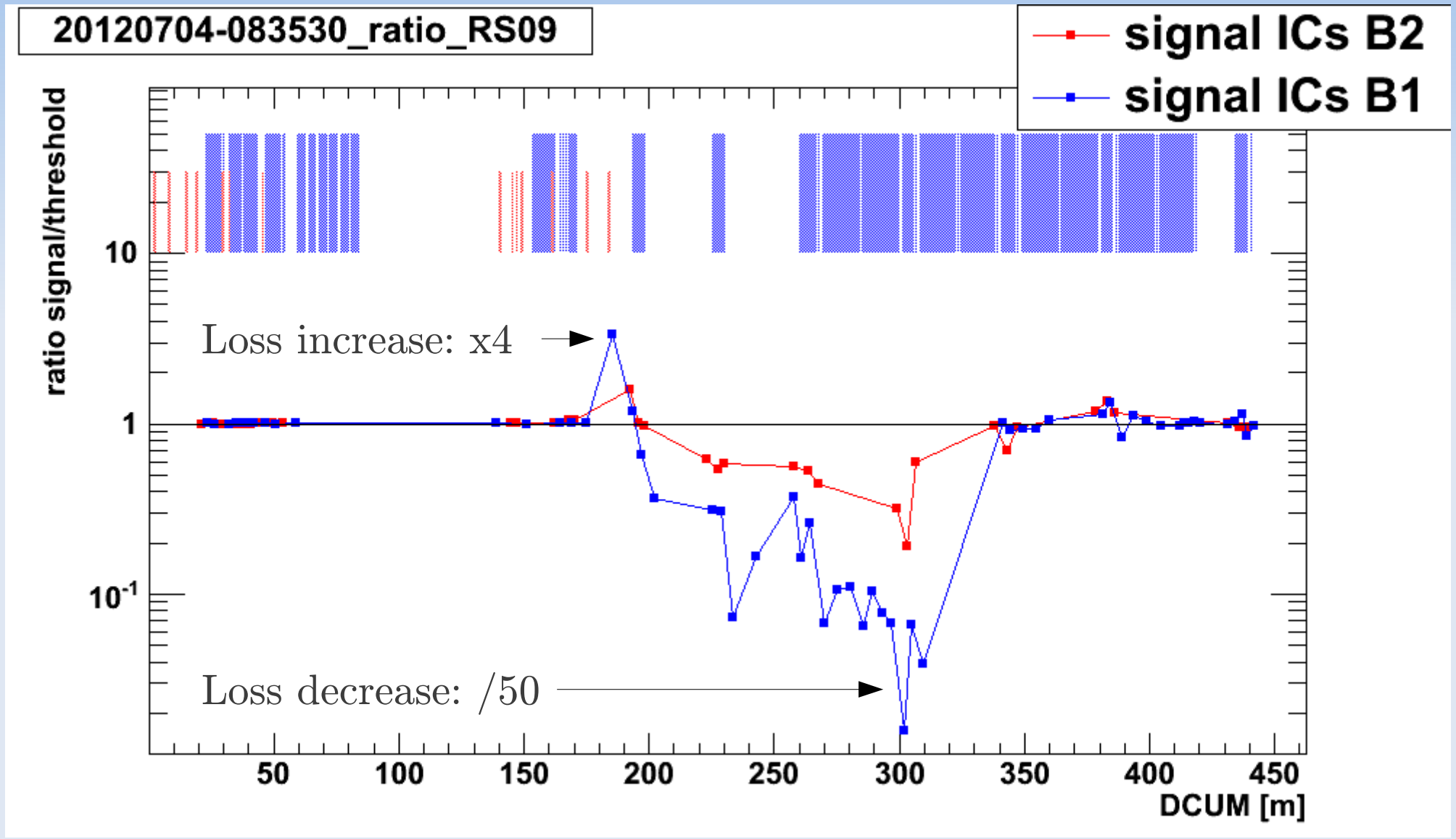
- Goal: study the losses due to debris from IPs (instead of regular beam losses) by tracking them around the ring
- Generating the output of collisions:
  - Keeping only protons
  - Cut in dp/p (< 0.1) and kicks ($\theta < 0.85$ mrad)
  - Distribution (and help) courtesy of F. Cerutti
  - Tracking only perturbed particles
- Effect of collisions:
  - Extra kicks, shift in momentum
- TCL scan $10 \rightarrow 60$ σ, measurements + simulations

Measurements

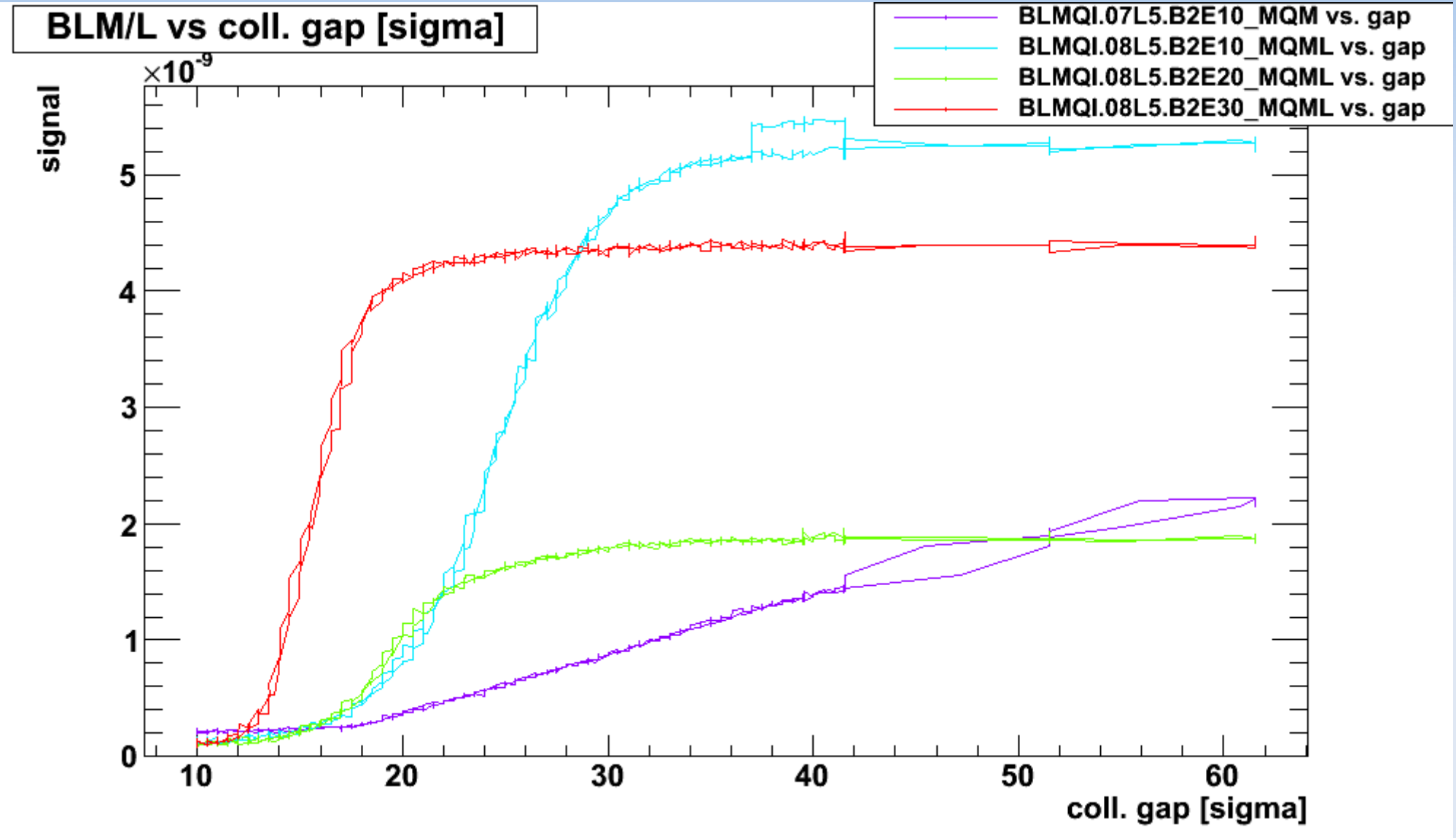
Effect of the TCL in the LHC

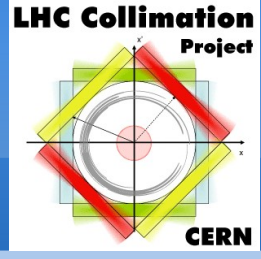


Ratio in/out


20120704-083530_ratio_RS09
signal ICs B2
signal ICs B1
ratio signal/threshold
10
1
10^{-1}
Loss increase: x4
Loss decrease: /50
50
100
150
200
250
300
350
400
450
DCUM [m]

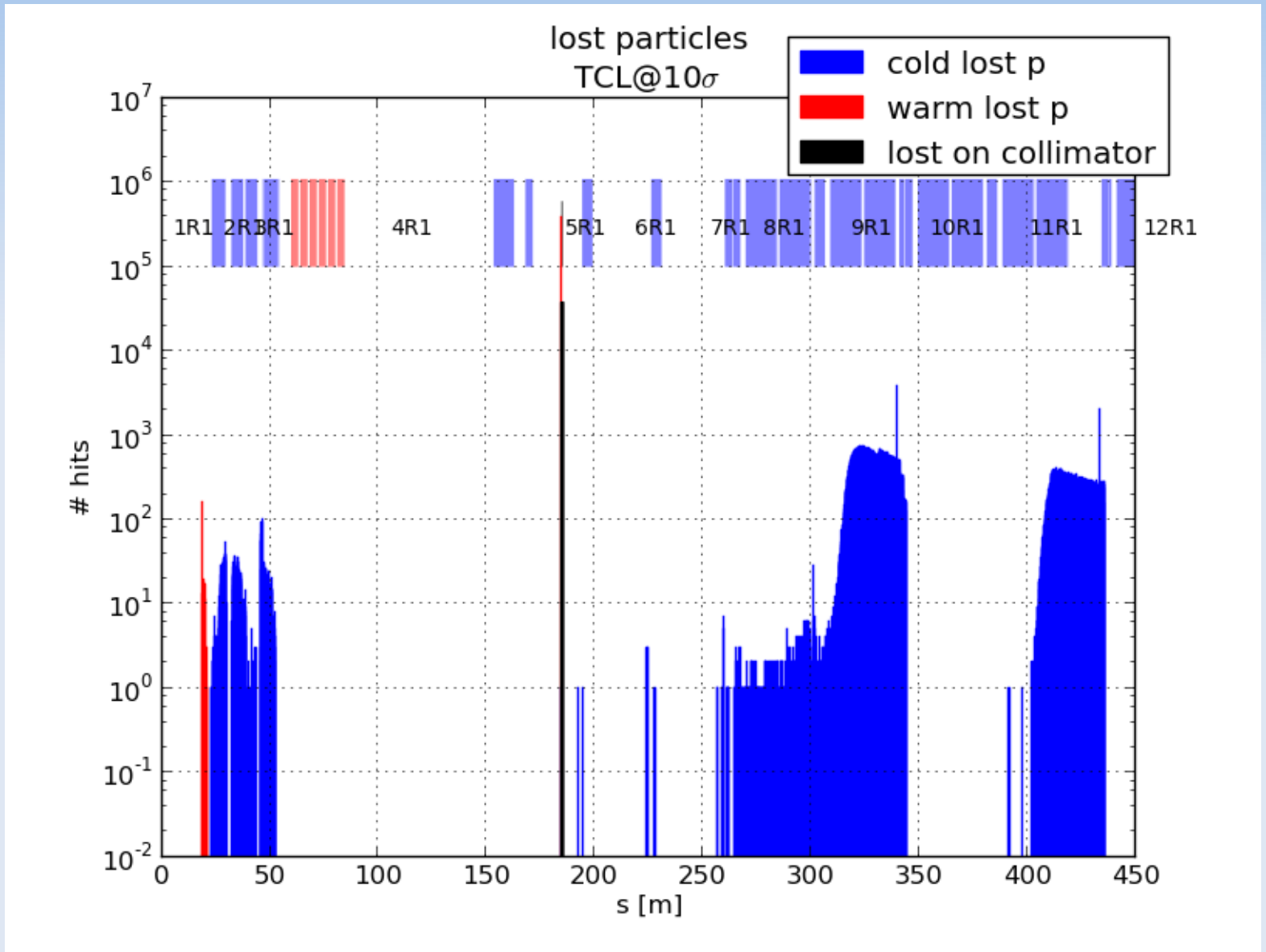
BLM signal vs. TCL setting



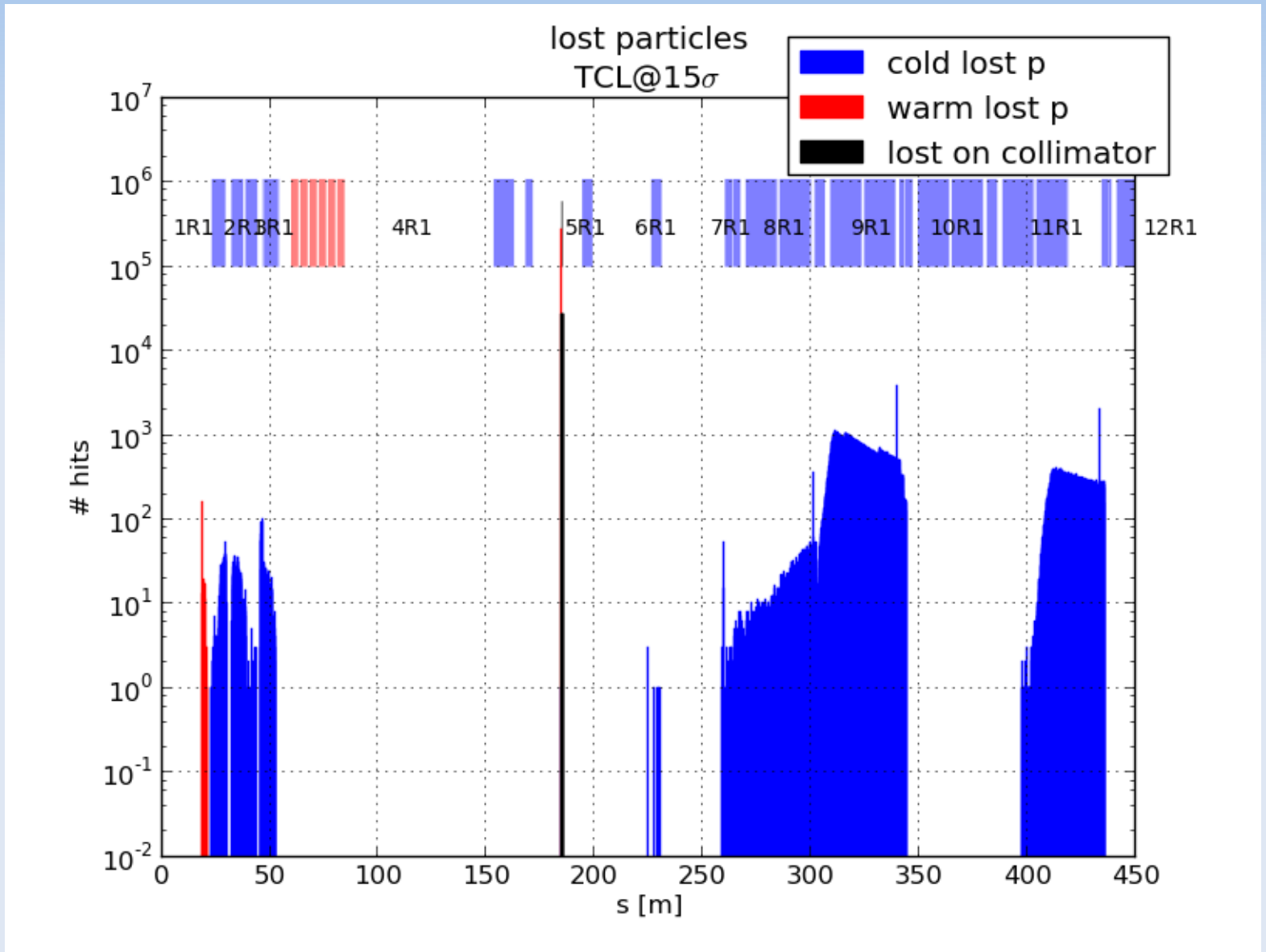


Simulations

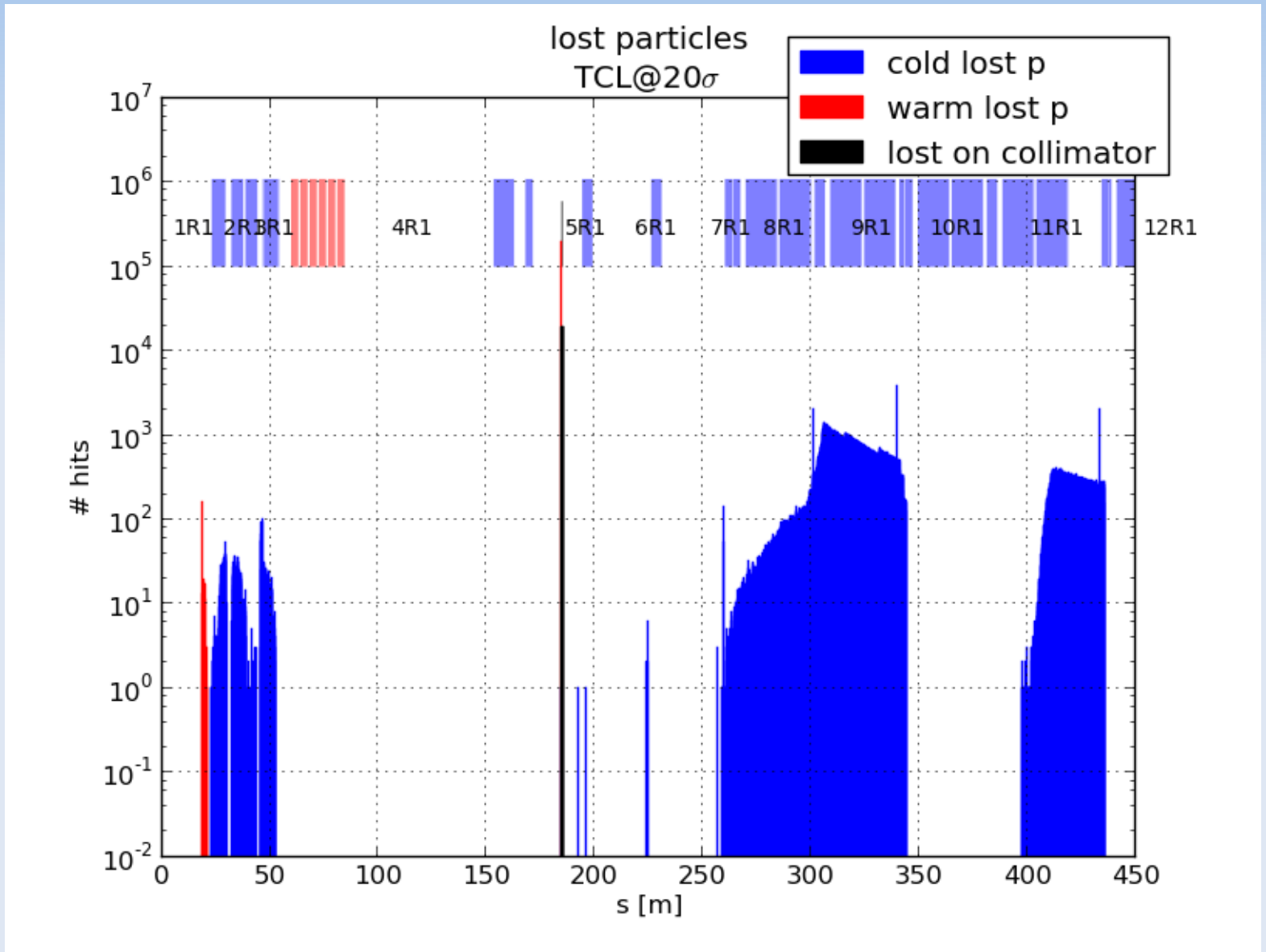
Scan TCL


lost particles
TCL@10σ
cold lost p
warm lost p
lost on collimator
1R1
2R1
3R1
4R1
5R1
6R1
7R1
8R1
9R1
10R1
11R1
12R1
hits
s [m]
10^7
10^6
10^5
10^4
10^3
10^2
10^1
10^0
10^-1
10^-2
0
50
100
150
200
250
300
350
400
450

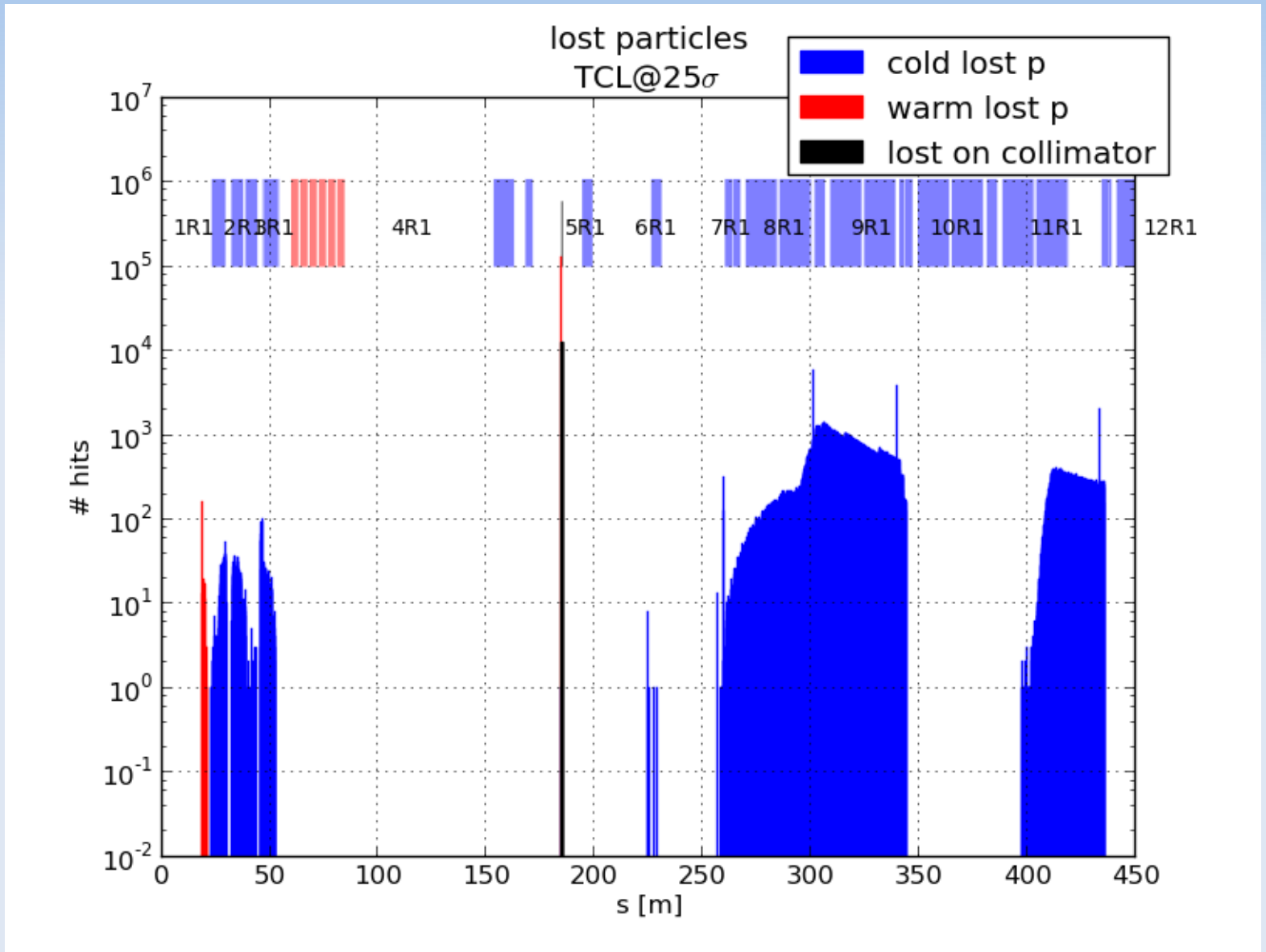
Scan TCL


lost particles
TCL@15σ
cold lost p
warm lost p
lost on collimator
1R1
2R1
3R1
4R1
5R1
6R1
7R1
8R1
9R1
10R1
11R1
12R1
hits
s [m]
10^7
10^6
10^5
10^4
10^3
10^2
10^1
10^0
10^-1
10^-2
0
50
100
150
200
250
300
350
400
450

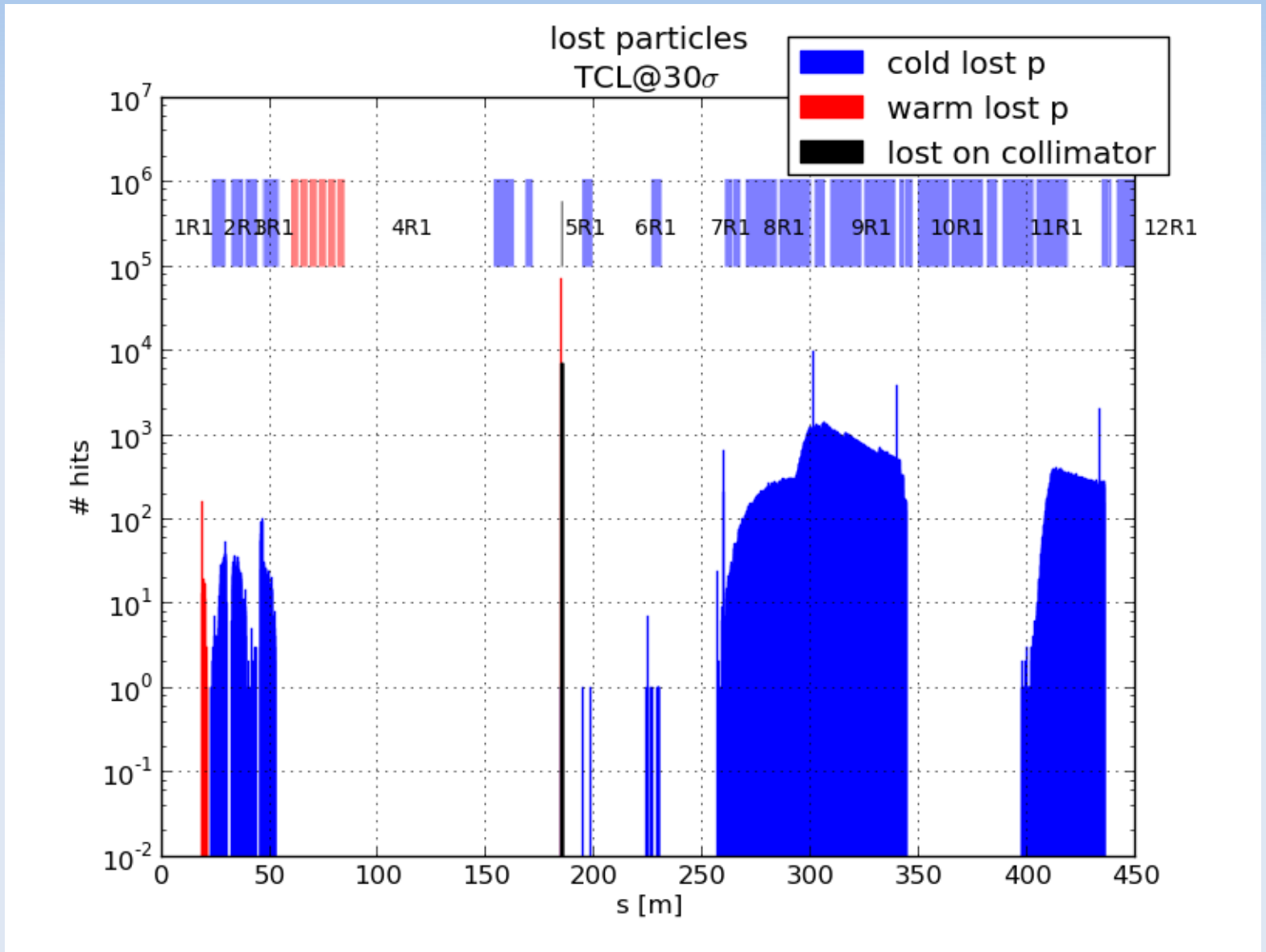
Scan TCL


lost particles
TCL@20σ
cold lost p
warm lost p
lost on collimator
1R1 2R1 3R1
4R1
5R1
6R1
7R1 8R1
9R1
10R1
11R1
12R1
hits
s [m]
10^7
10^6
10^5
10^4
10^3
10^2
10^1
10^0
10^-1
10^-2
0
50
100
150
200
250
300
350
400
450

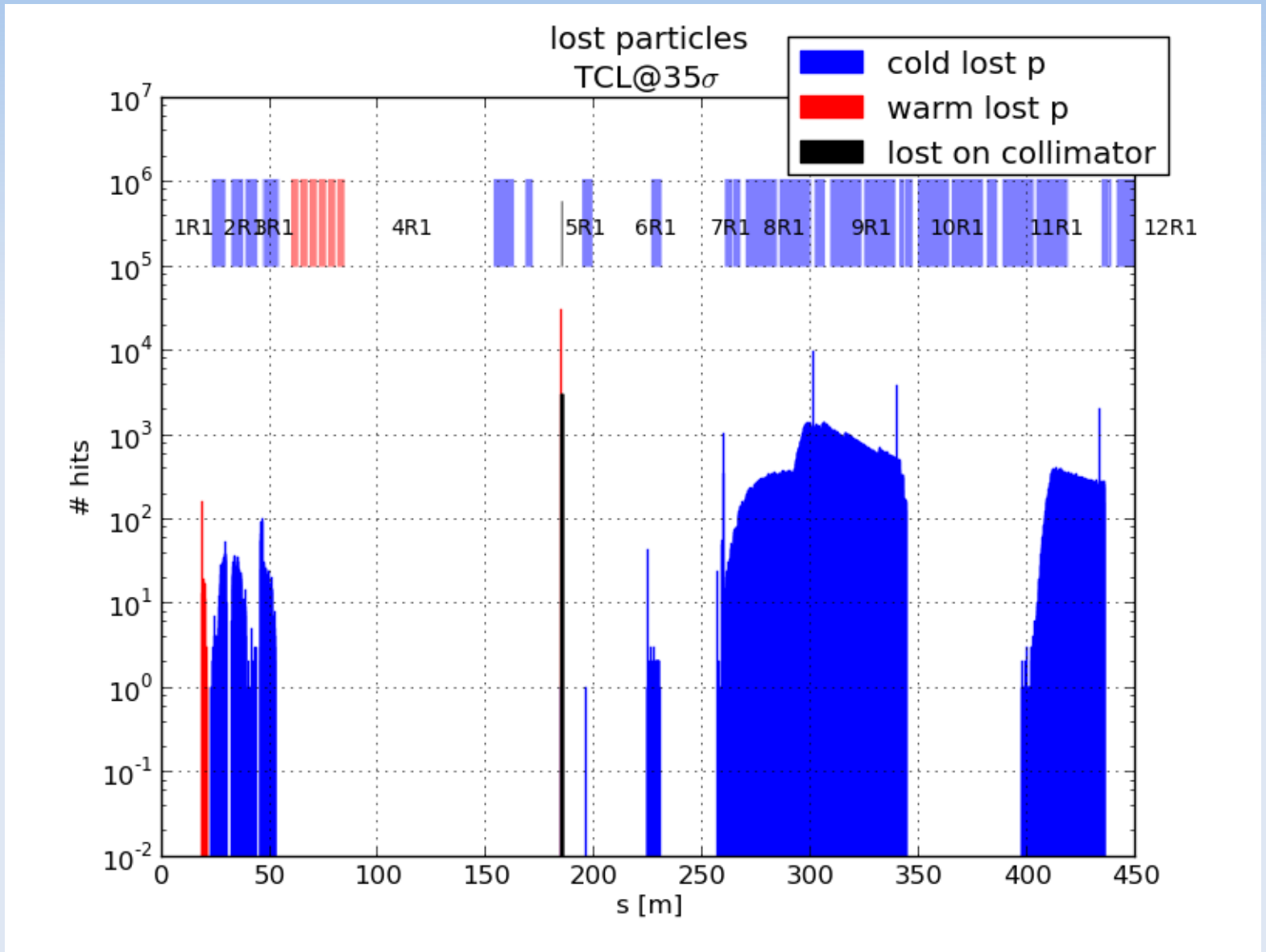
Scan TCL


lost particles
TCL@25σ
cold lost p
warm lost p
lost on collimator
1R1
2R1
3R1
4R1
5R1
6R1
7R1
8R1
9R1
10R1
11R1
12R1
hits
s [m]
10^7
10^6
10^5
10^4
10^3
10^2
10^1
10^0
10^-1
10^-2
0
50
100
150
200
250
300
350
400
450

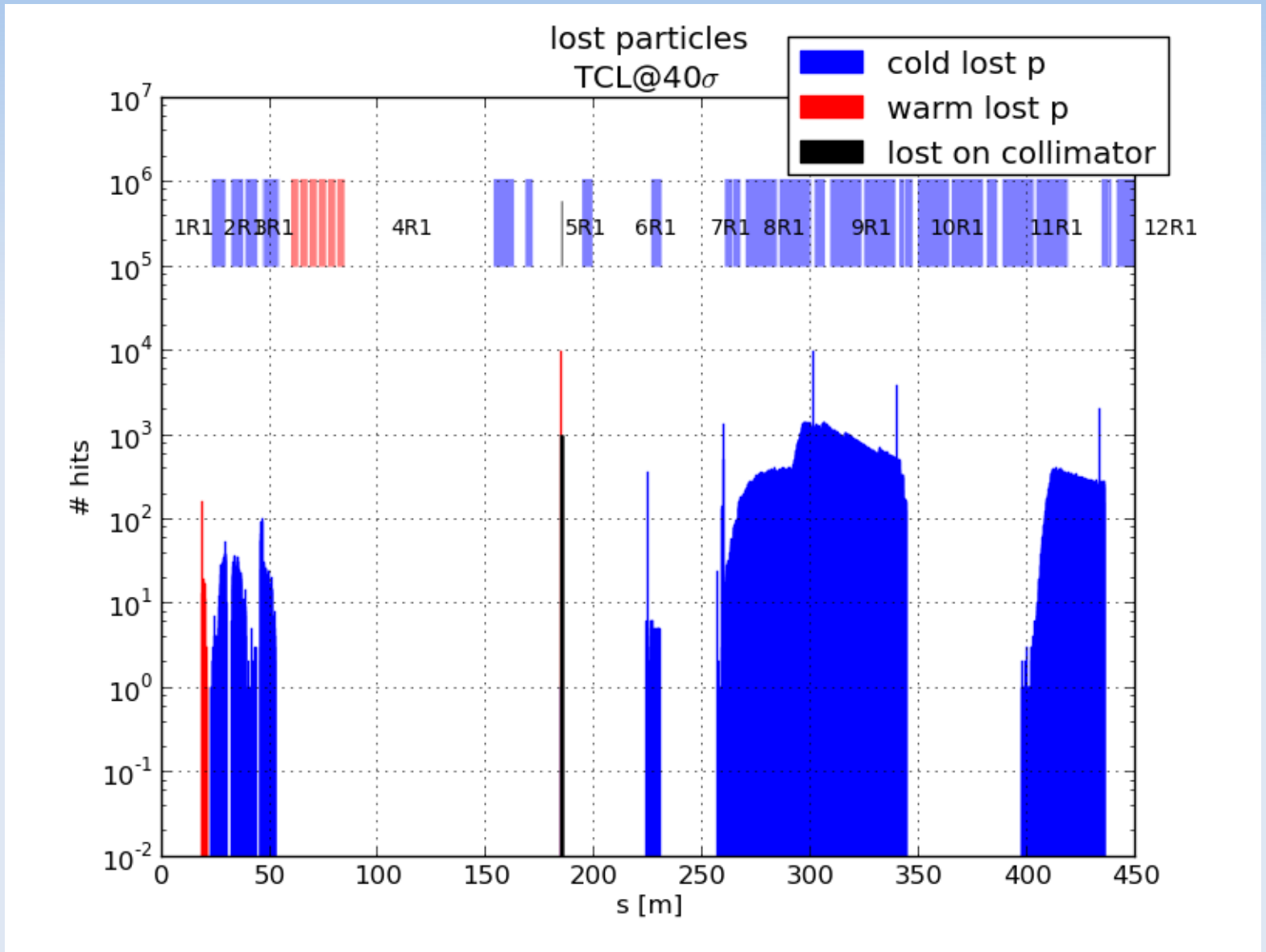
Scan TCL


lost particles
TCL@30σ
cold lost p
warm lost p
lost on collimator
1R1 2R1 3R1
4R1
5R1
6R1
7R1 8R1
9R1
10R1
11R1
12R1
hits
s [m]
10^7
10^6
10^5
10^4
10^3
10^2
10^1
10^0
10^-1
10^-2
0
50
100
150
200
250
300
350
400
450

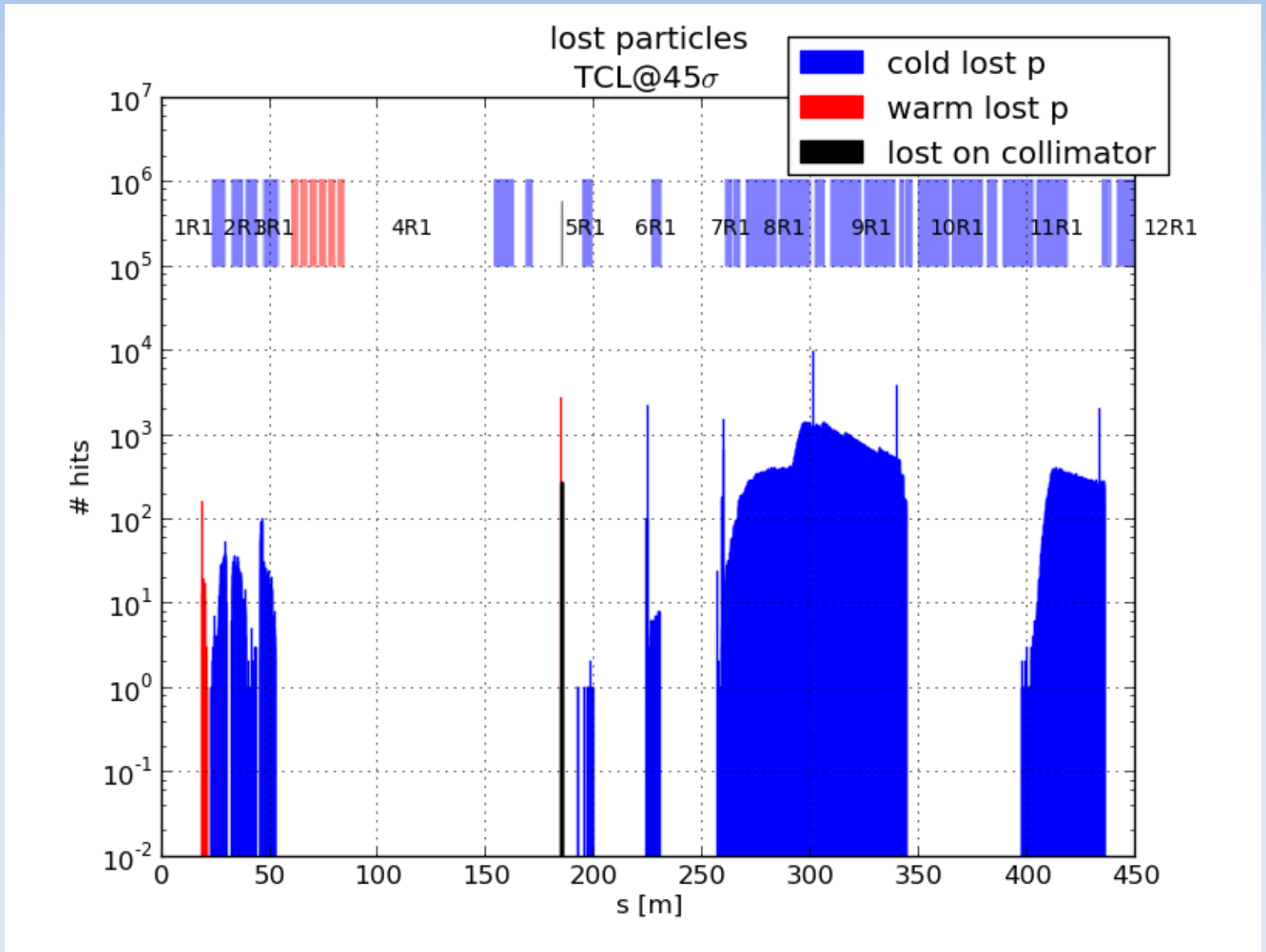
Scan TCL


lost particles
TCL@35σ
cold lost p
warm lost p
lost on collimator
1R1 2R1 3R1
4R1
5R1
6R1
7R1 8R1
9R1
10R1
11R1
12R1
hits
s [m]
10^{7}
10^{6}
10^{5}
10^{4}
10^{3}
10^{2}
10^{1}
10^{0}
10^{-1}
10^{-2}
0
50
100
150
200
250
300
350
400
450

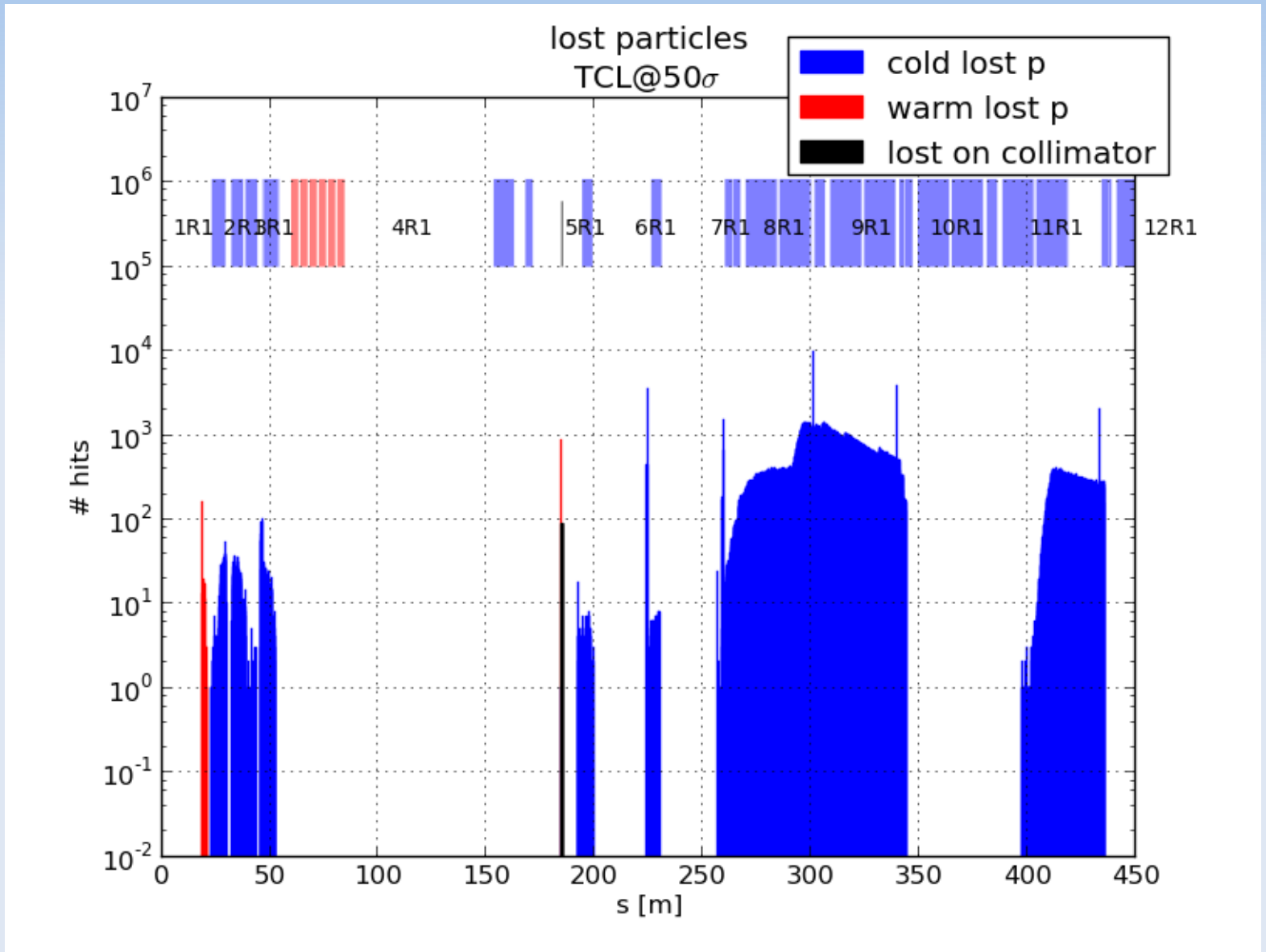
Scan TCL


lost particles
TCL@40σ
cold lost p
warm lost p
lost on collimator
1R1 2R1 3R1
4R1
5R1
6R1
7R1 8R1
9R1
10R1
11R1
12R1
hits
s [m]
10^7
10^6
10^5
10^4
10^3
10^2
10^1
10^0
10^-1
10^-2
0
50
100
150
200
250
300
350
400
450

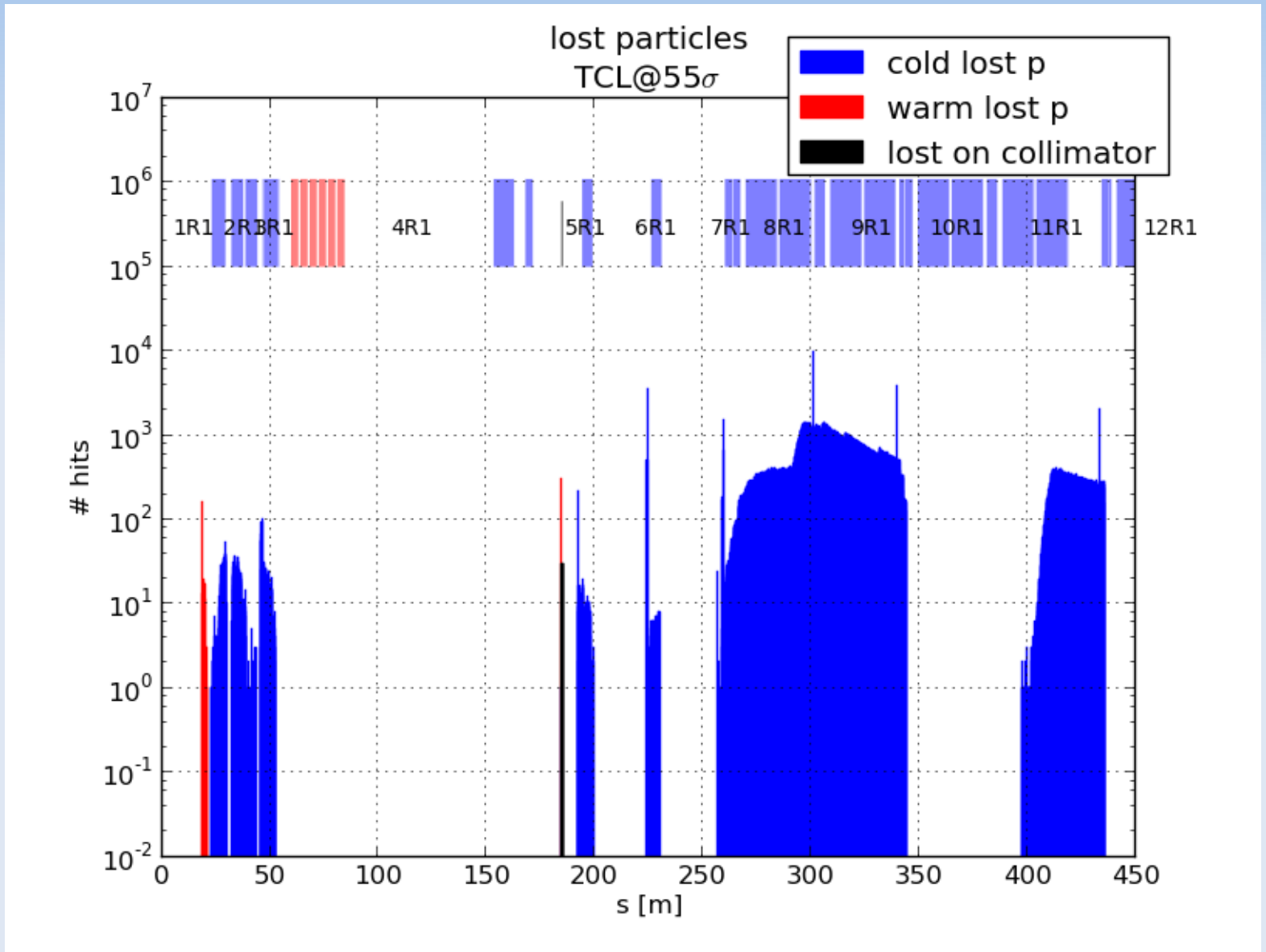
TCL scan


lost particles
TCL@45σ
cold lost p
warm lost p
lost on collimator
1R1
2R1
3R1
4R1
5R1
6R1
7R1
8R1
9R1
10R1
11R1
12R1
hits
s [m]
10^7
10^6
10^5
10^4
10^3
10^2
10^1
10^0
10^-1
10^-2
0
50
100
150
200
250
300
350
400
450

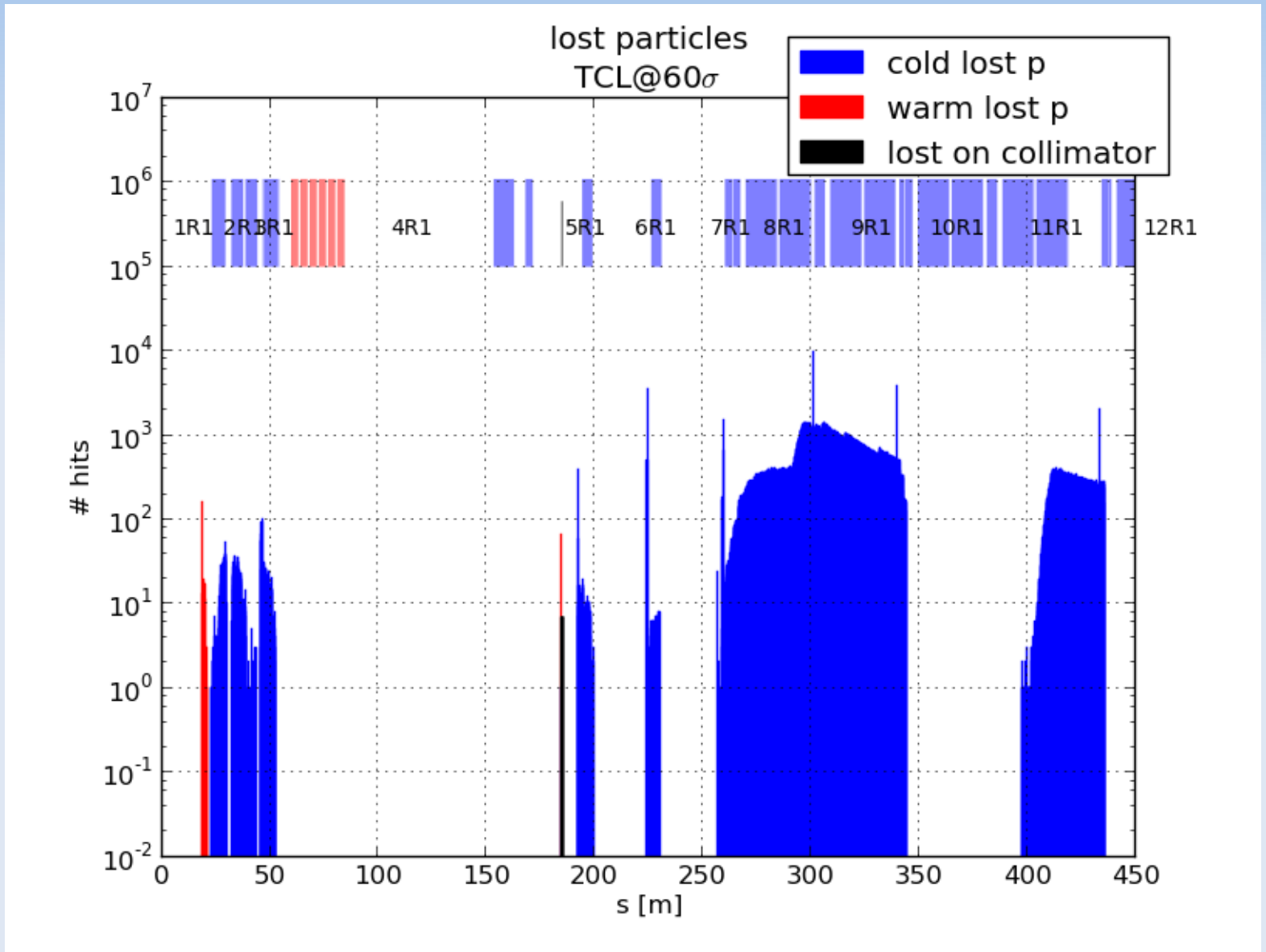
TCL scan


lost particles
TCL@50σ
cold lost p
warm lost p
lost on collimator
1R1 2R1 3R1
4R1
5R1
6R1
7R1 8R1
9R1
10R1
11R1
12R1
hits
s [m]
0
50
100
150
200
250
300
350
400
450

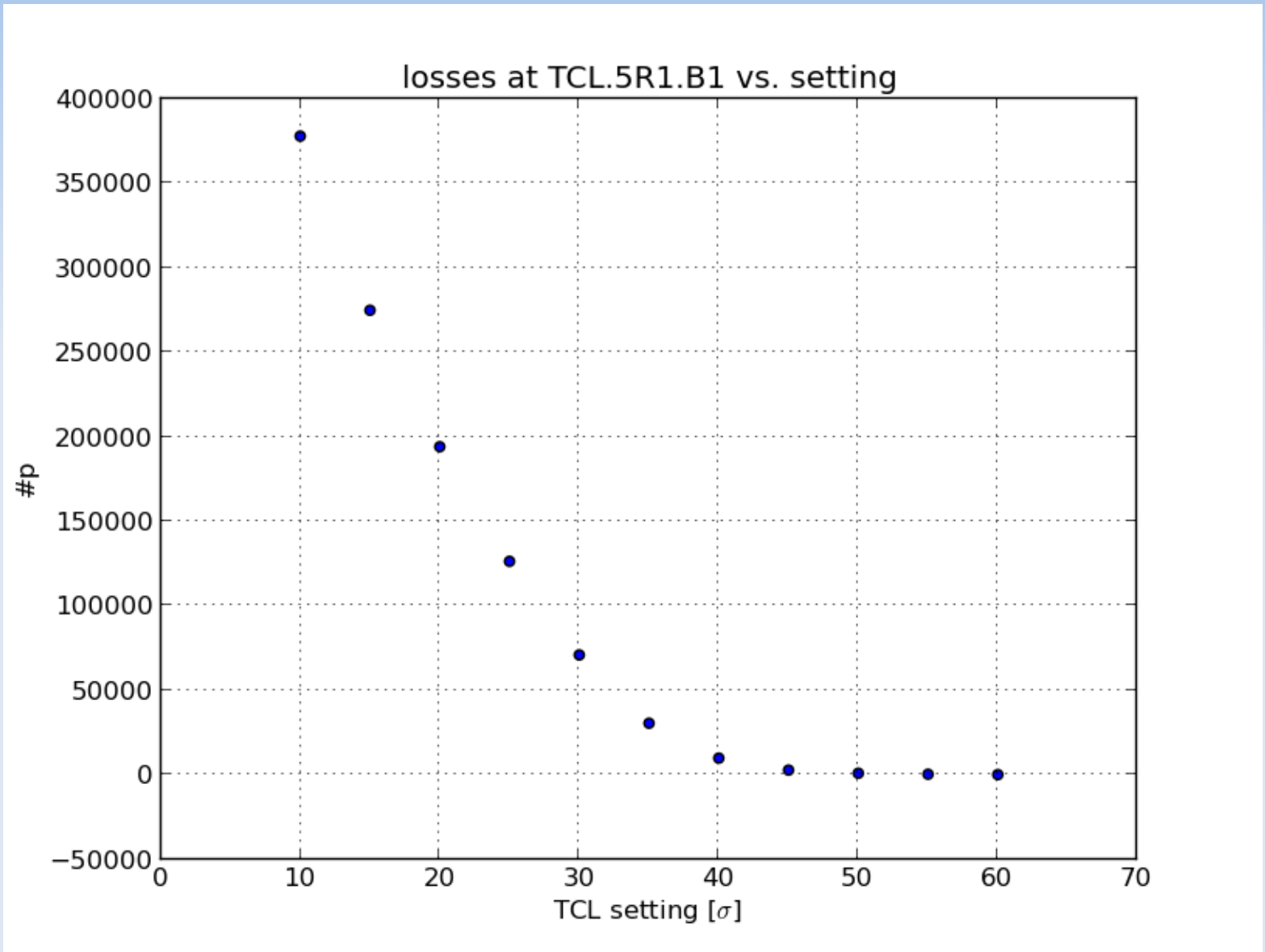
TCL scan


lost particles
TCL@55σ
cold lost p
warm lost p
lost on collimator
1R1
2R1
3R1
4R1
5R1
6R1
7R1
8R1
9R1
10R1
11R1
12R1
hits
s [m]
10^7
10^6
10^5
10^4
10^3
10^2
10^1
10^0
10^-1
10^-2
0
50
100
150
200
250
300
350
400
450

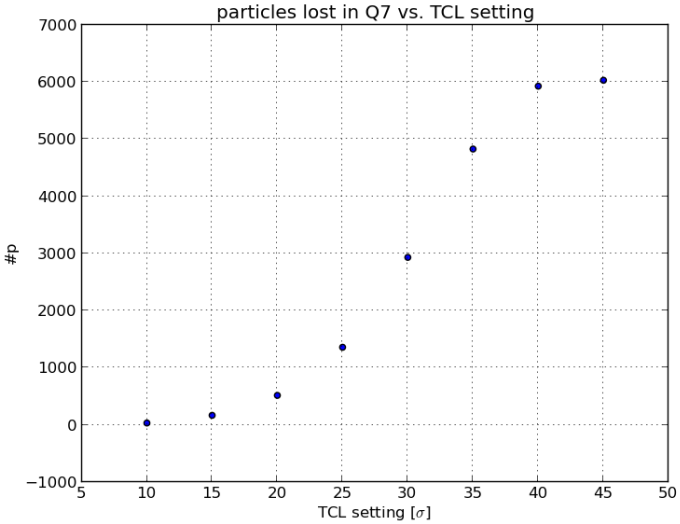
TCL scan

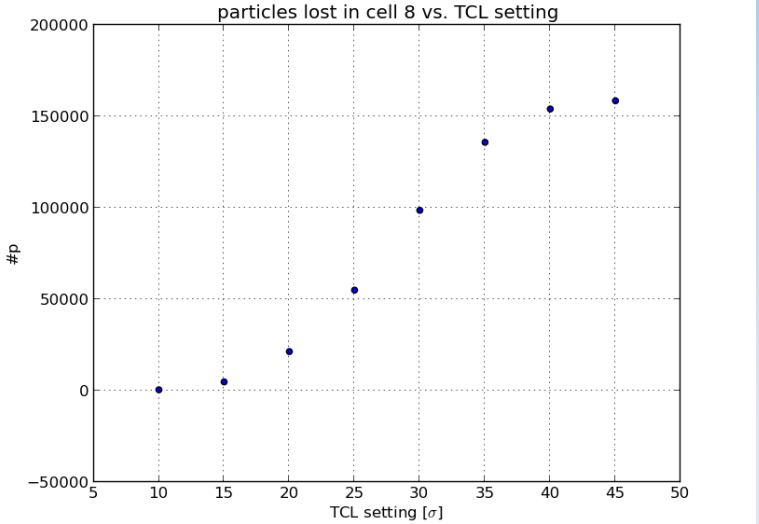

lost particles
TCL@60σ
cold lost p
warm lost p
lost on collimator
1R1
2R1
3R1
4R1
5R1
6R1
7R1
8R1
9R1
10R1
11R1
12R1
hits
s [m]
10^7
10^6
10^5
10^4
10^3
10^2
10^1
10^0
10^-1
10^-2
0
50
100
150
200
250
300
350
400
450

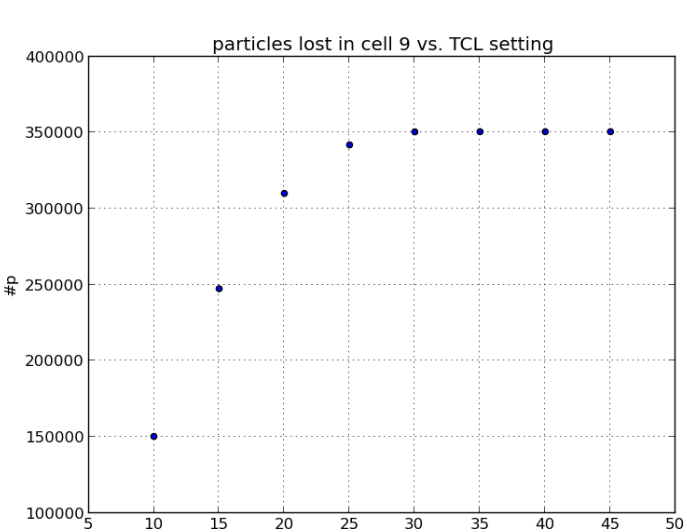
Losses at TCL vs. setting

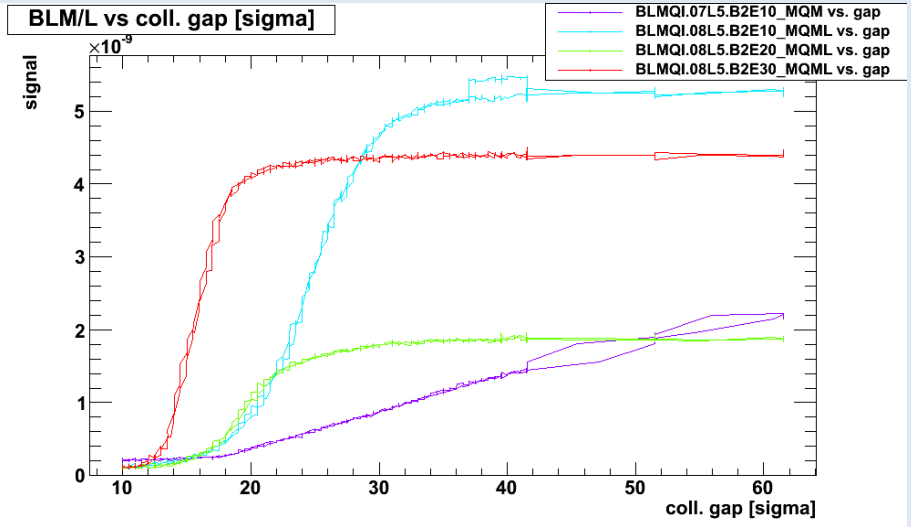


Simulations / measurements

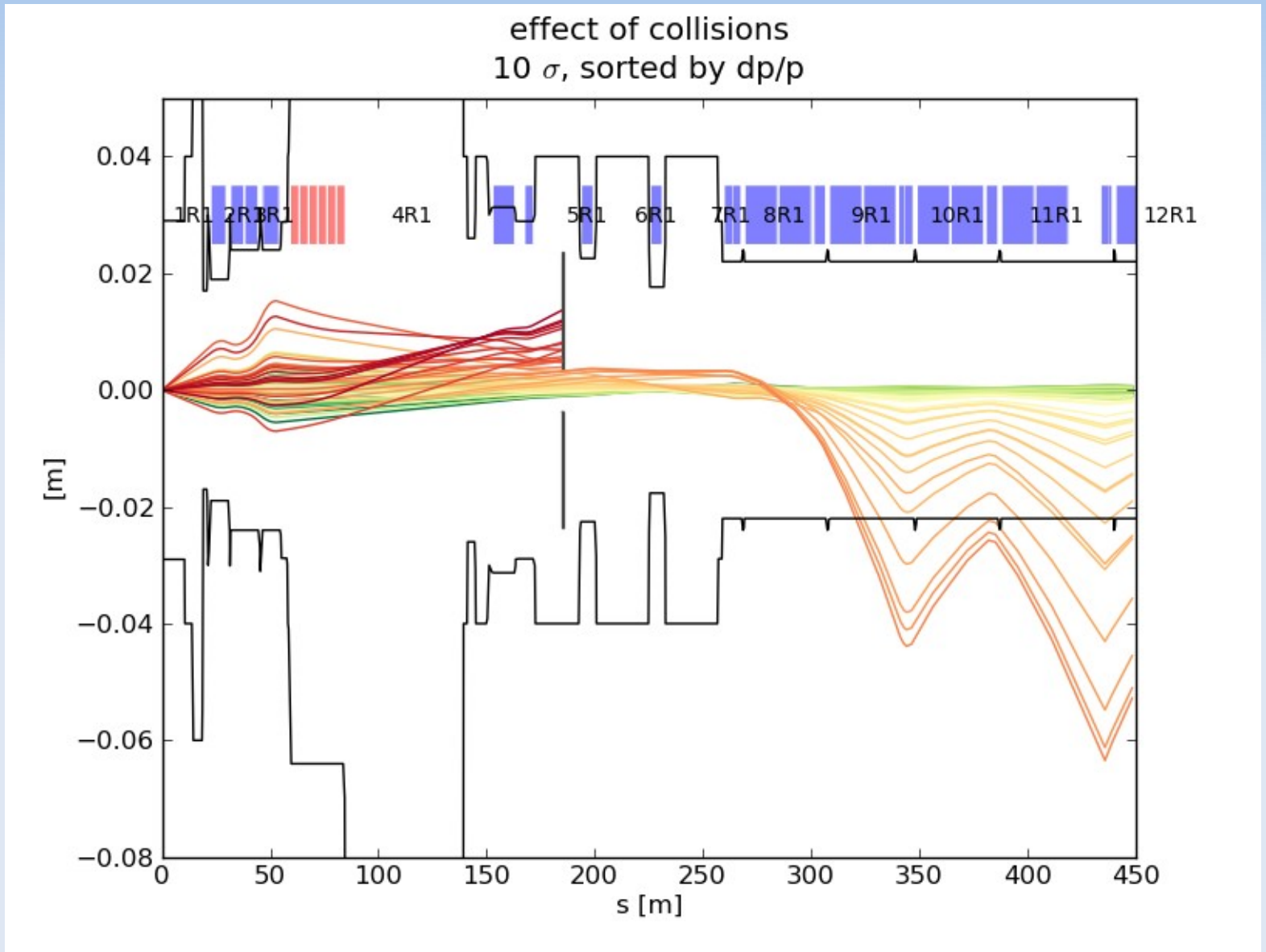




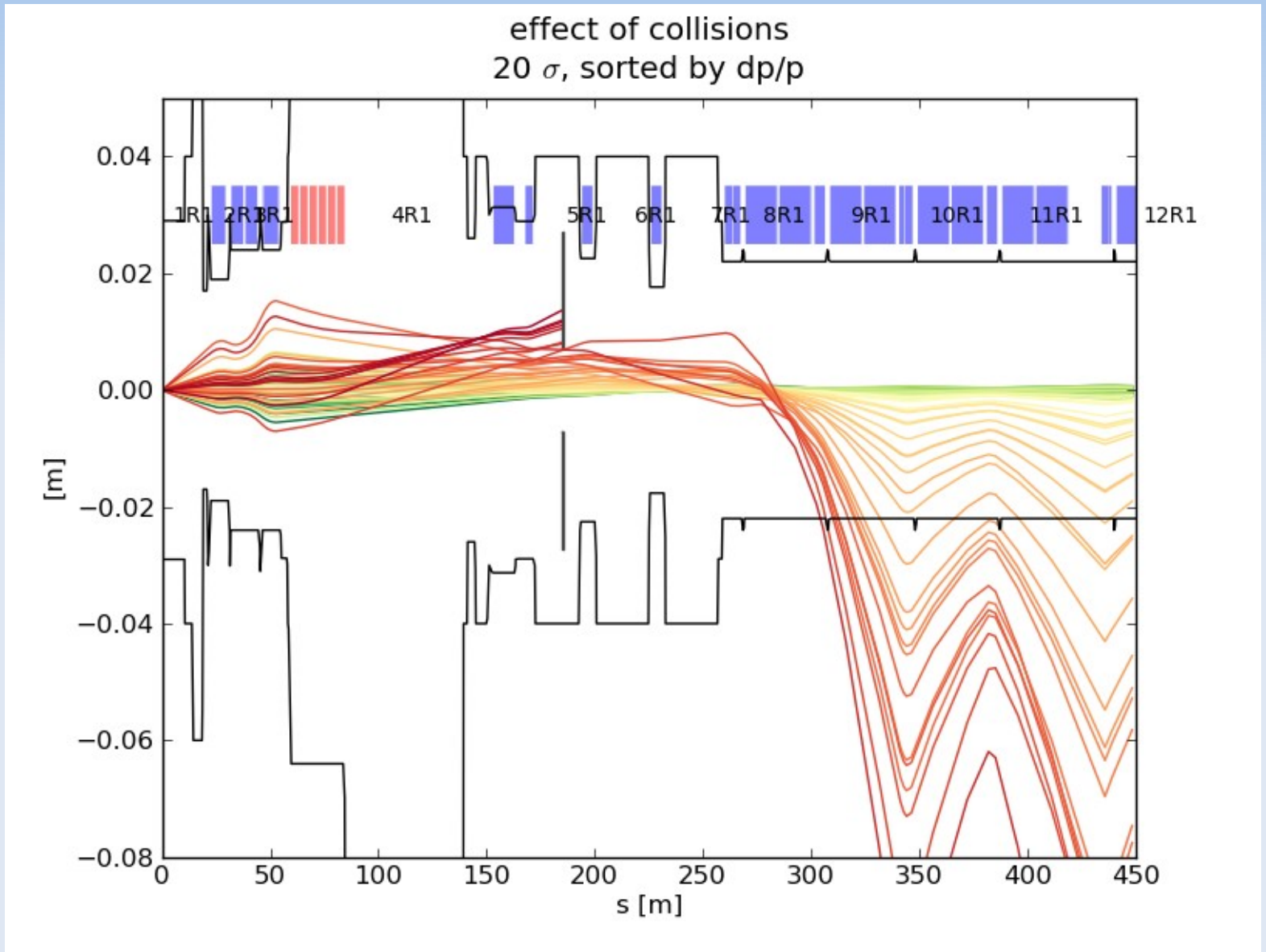




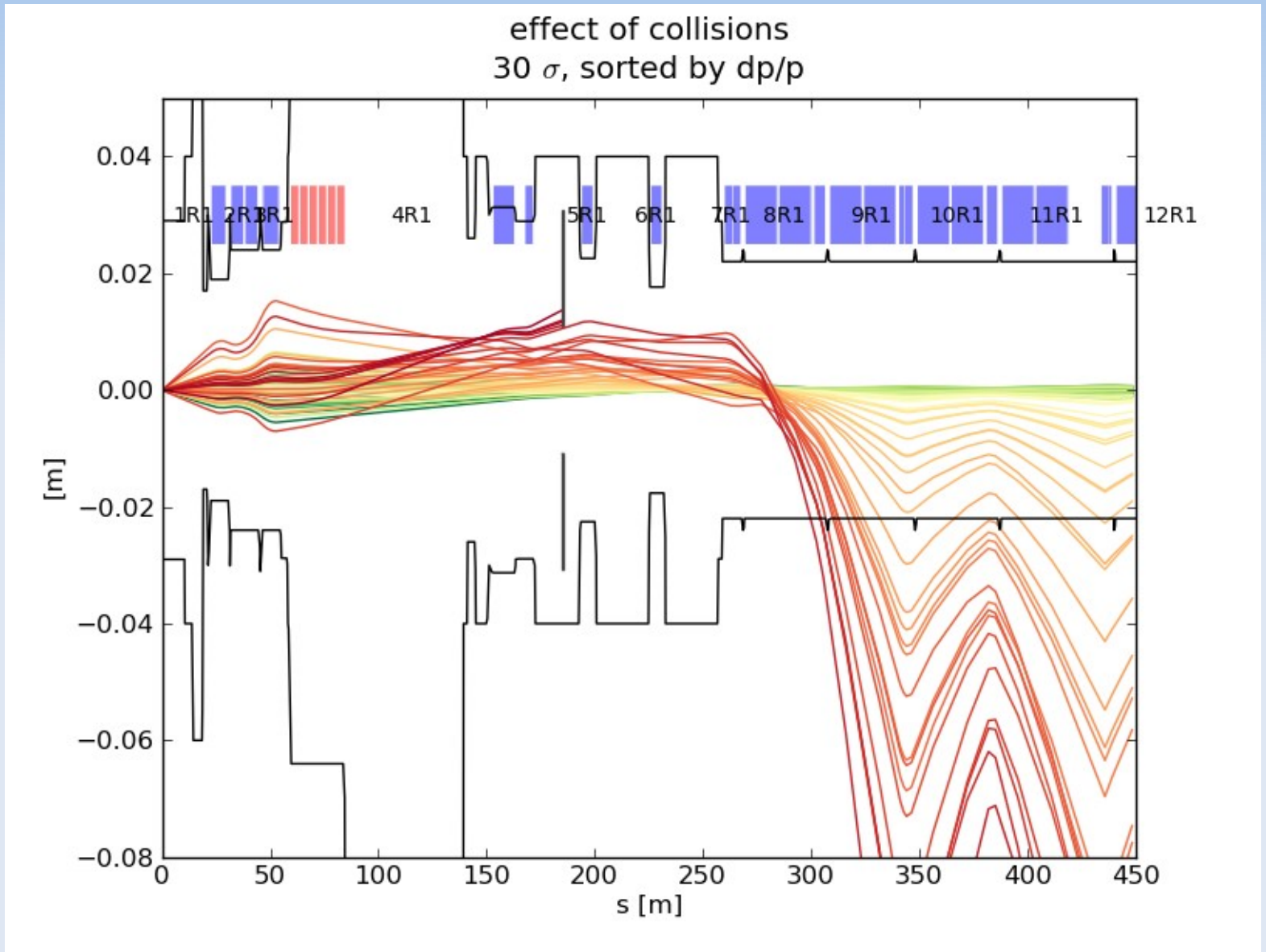
Trajectories: X vs. S



Trajectories X vs. S



Trajectories: X vs. S



Conclusion

- Debris loss maps with 2 turns, recording all p.
- TLC scan measurements are well reproduced
- Next steps:
  - Multi-turn tracking with tighter cuts
  - TCLP R4 scan
  - (new) TCLP R6 scan
  - Dispersion study
- Same with ATS optics and 7 TeV nominal...