Update on ATS loss map simulations with SixTrack

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ATS updates

- Peaks in arc 78 and 81:
  - At maximum of dispersion and beta function
  - Needed more statistics to validate smallest peaks
  - ⇒ Simulations with 10x more particles (64 millions)
  - Once peaks are characterised, establish protection
- Beam 2:
  - New sequence
  - Updated aperture file
  - New protection limitations

Setting used (not definitive)

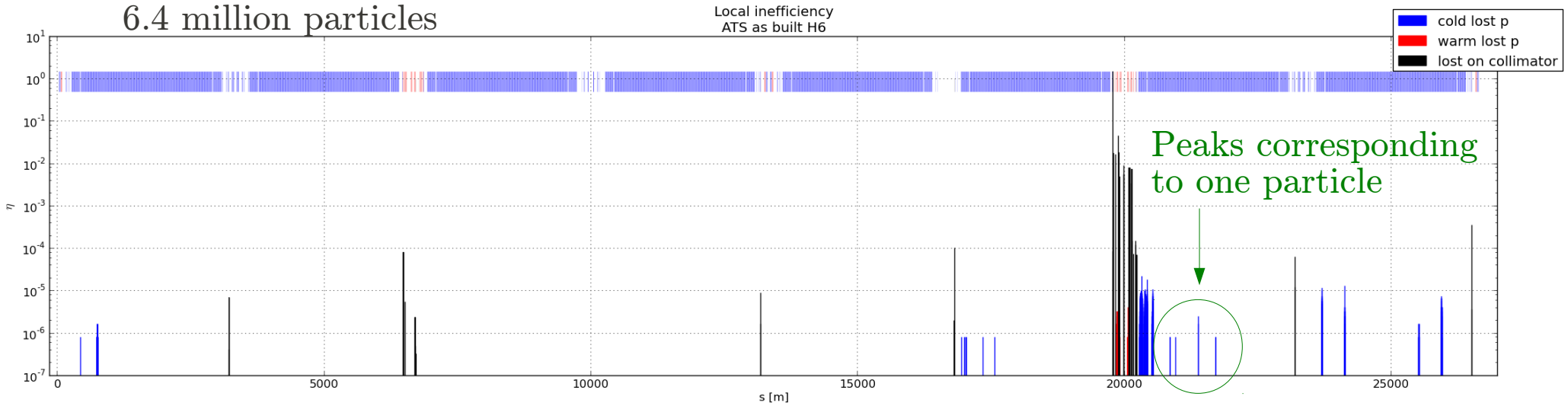
Coll. setting	σ
TCP IR7	6.
TCSG IR7	7.
TCLA IR7	10.
TCP IR3	12.
TCSG IR3	15.6
TCLA IR3	17.6

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.

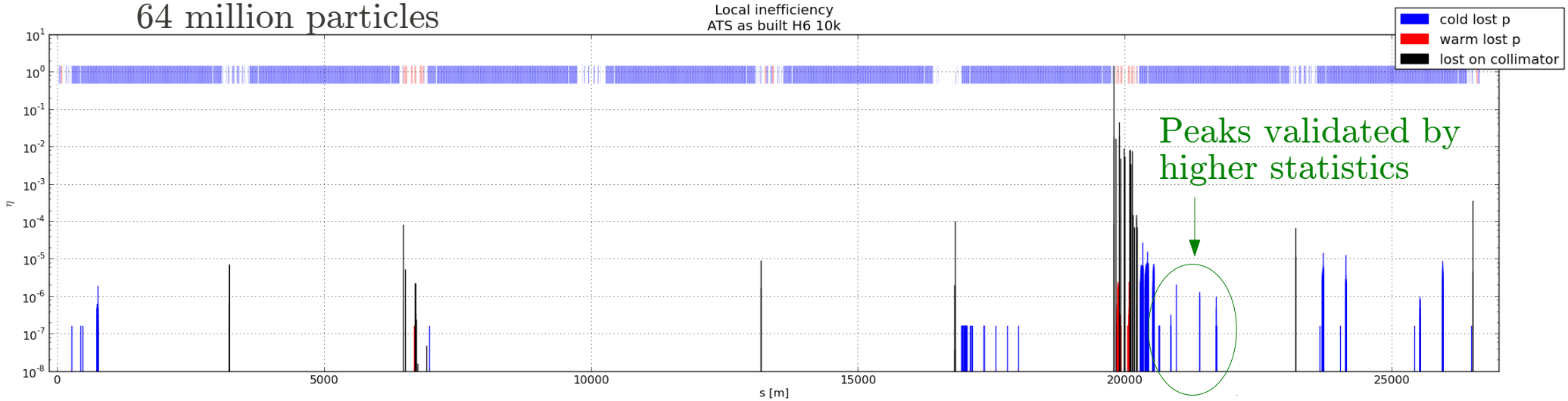
- The setting of the new TCLDs, under study, is still to be decided. It is 10σ here.
- The TCTs around points 2 and 8 will be open more (unsqueezed optics)

ATS loss maps with 10x more particles

6.4 million particles

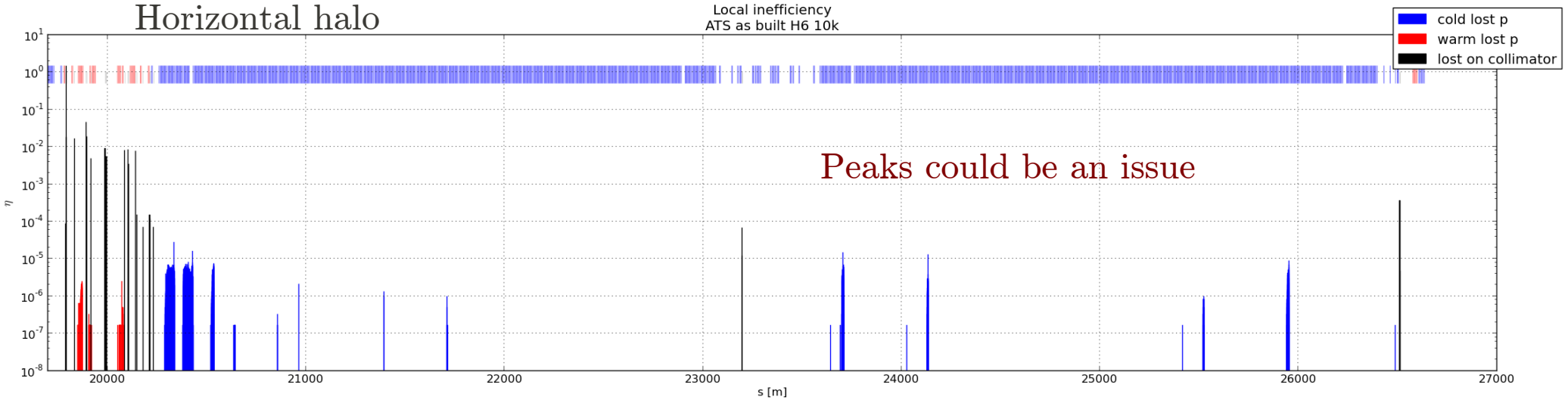


64 million particles

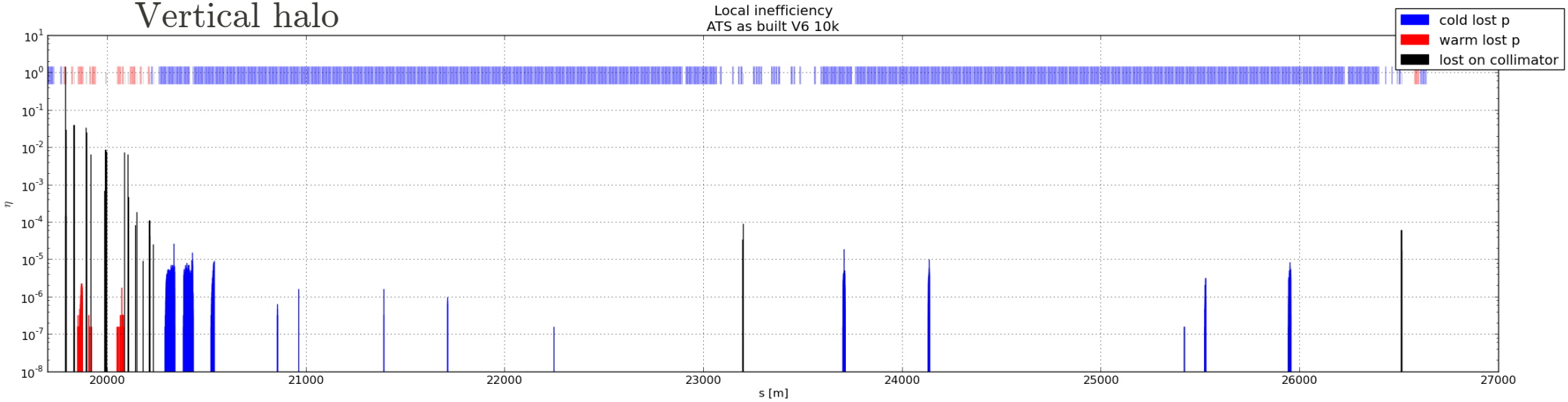


64 million particles

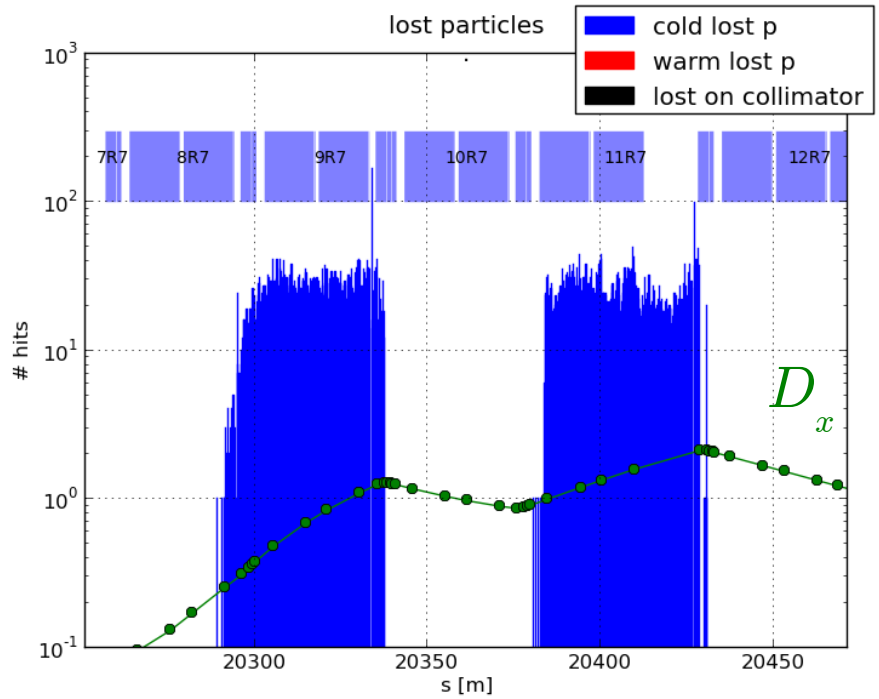
Horizontal halo

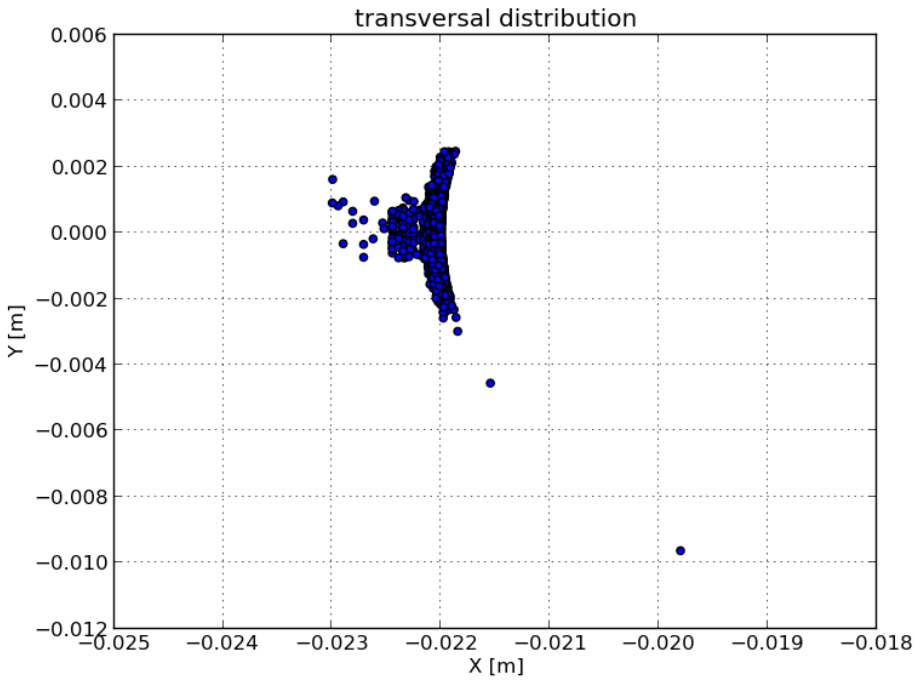


Vertical halo



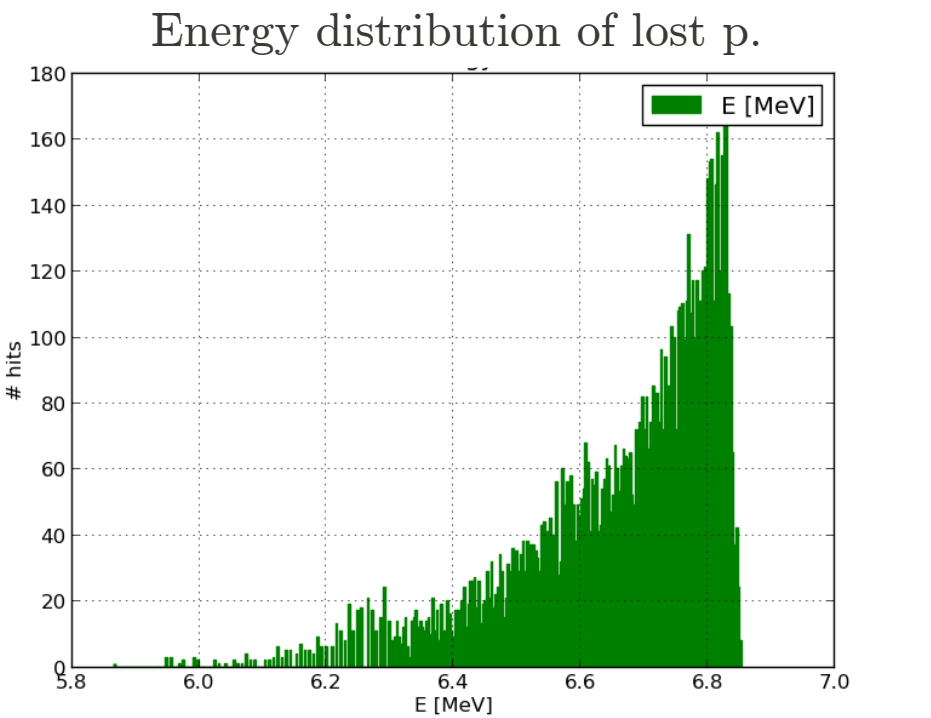
First peaks in Dispersion Suppressor

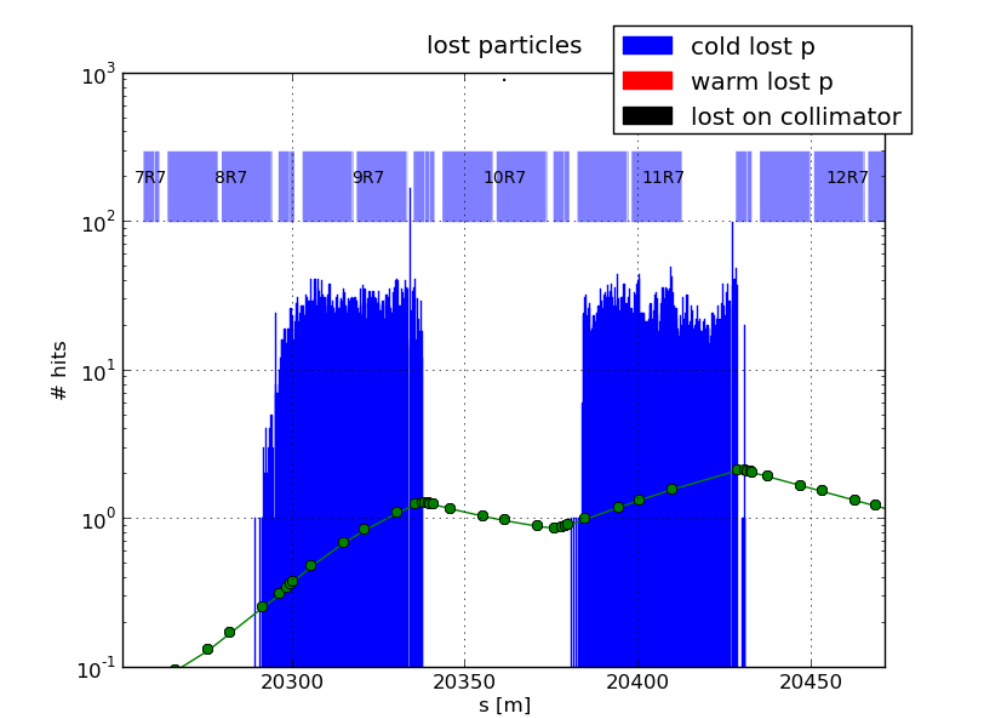




- For lost particles, y is centred around zero, x is negative (aperture)
- Dispersion is positive $\Rightarrow$ momentum losses

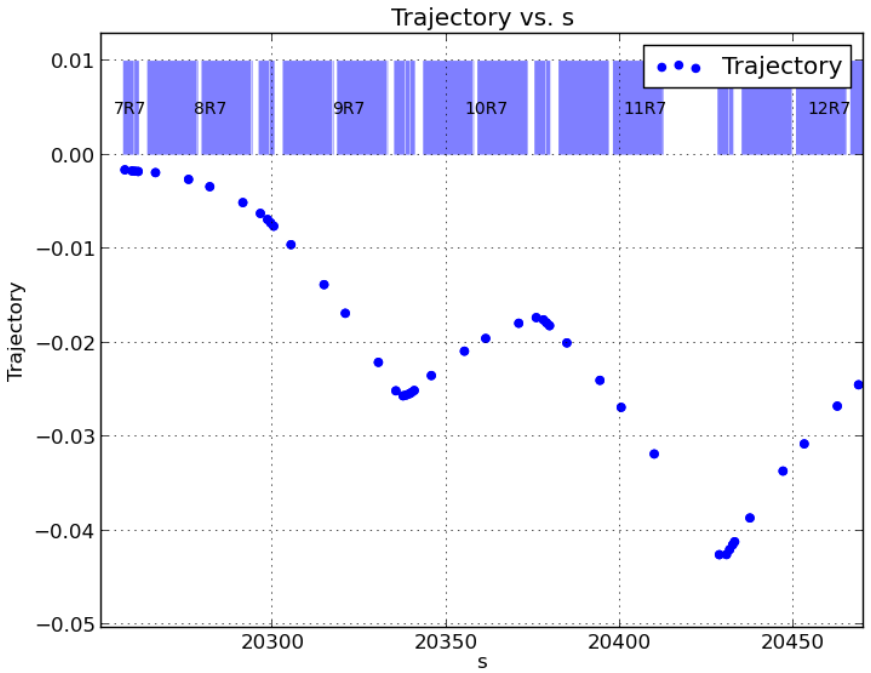
Acceptances (1st peak)

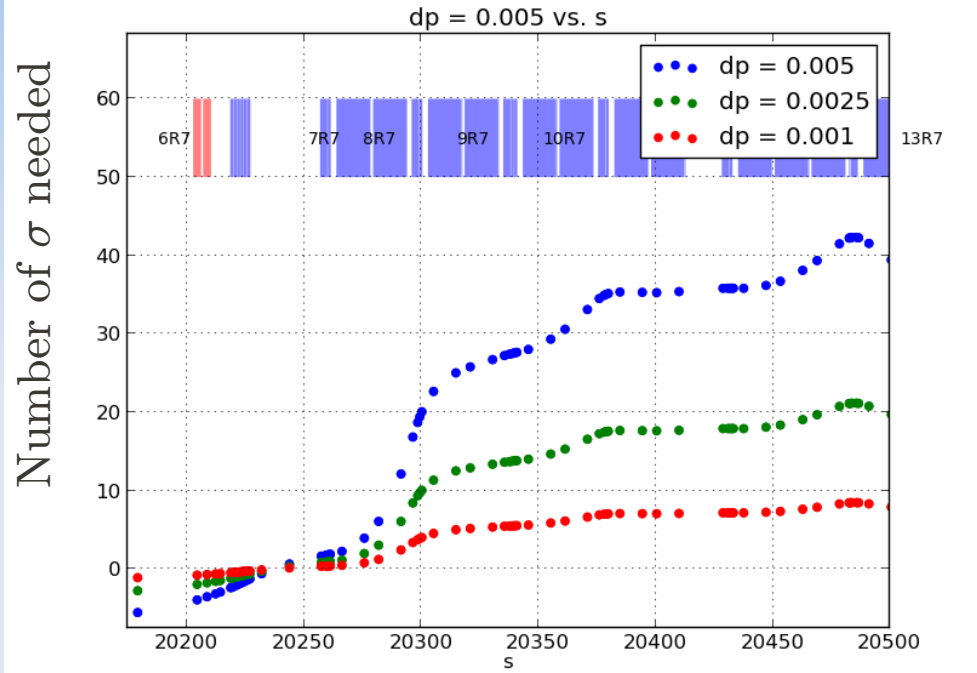




- Momentum acceptance: 6.86 TeV
- dp/p = -0.02
- Aperture: A_x = -0.022 m
- Dispersion: D_x = 1.1 m

How to catch a particle (simplified model)

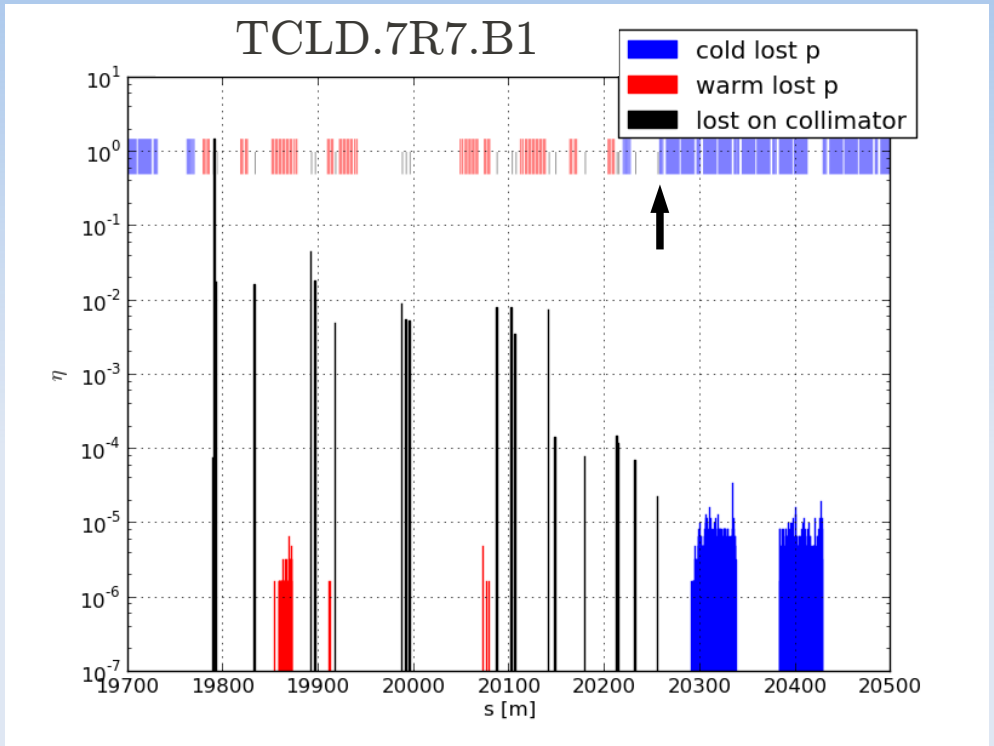


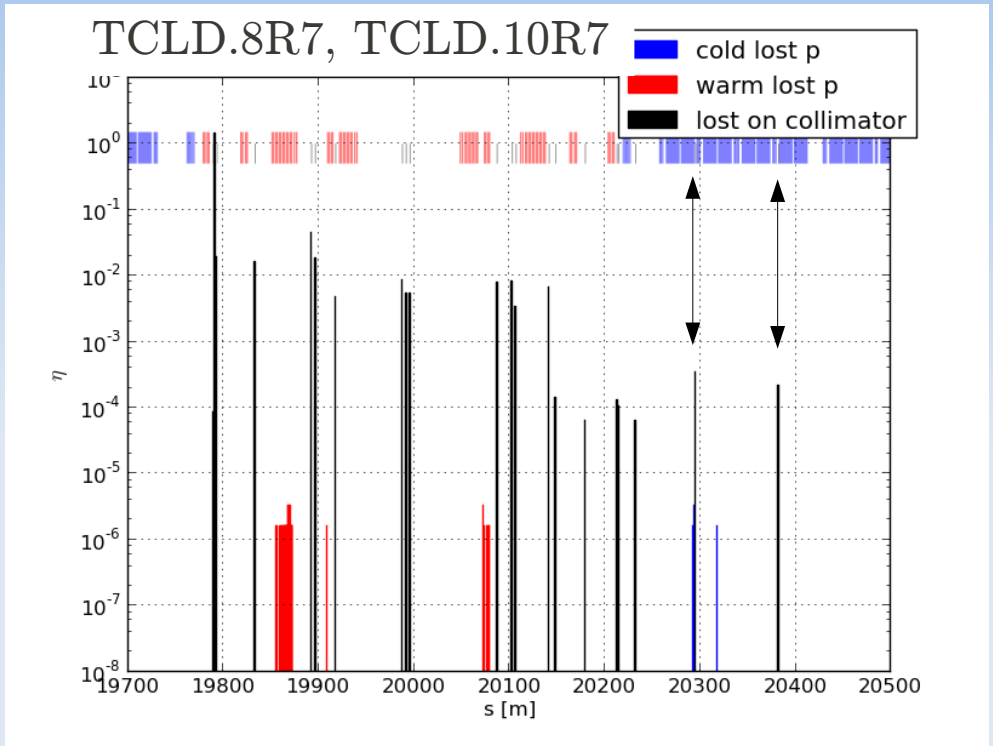


- Trajectory of particle with dp/p = -0.02 (and no beta oscillation)
- Meters
- Inverse of dispersion

- $x = n \cdot \sigma = n \cdot \sqrt{\beta \epsilon}$ and $x = D_x \cdot \frac{\delta p}{p}$
- Solve for n, number of sigma needed to catch a particle with given dp/p
- $n = \frac{D_x}{\sqrt{\beta_x \epsilon}} \cdot \frac{\delta p}{p}$

Example with extra TCLs

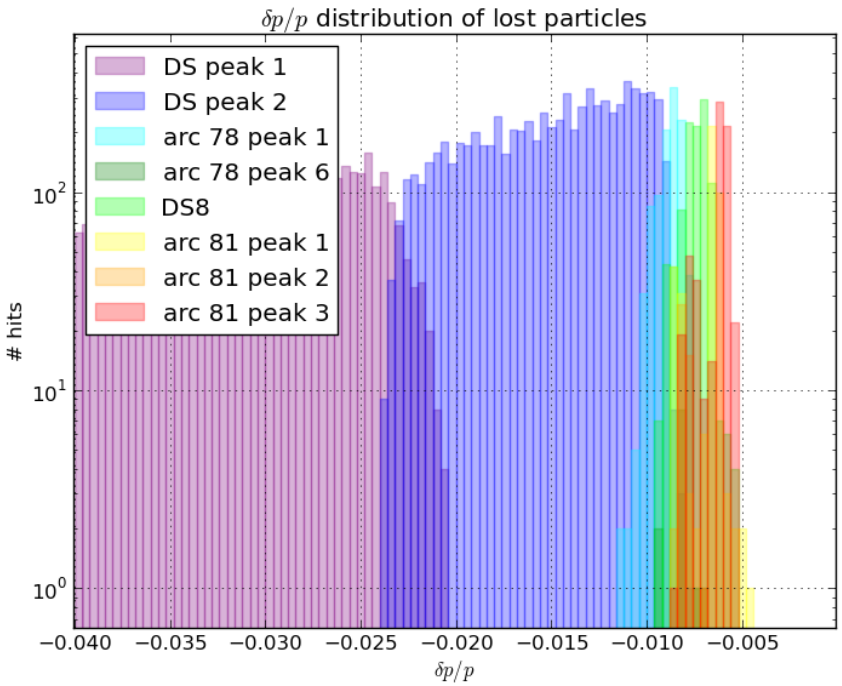


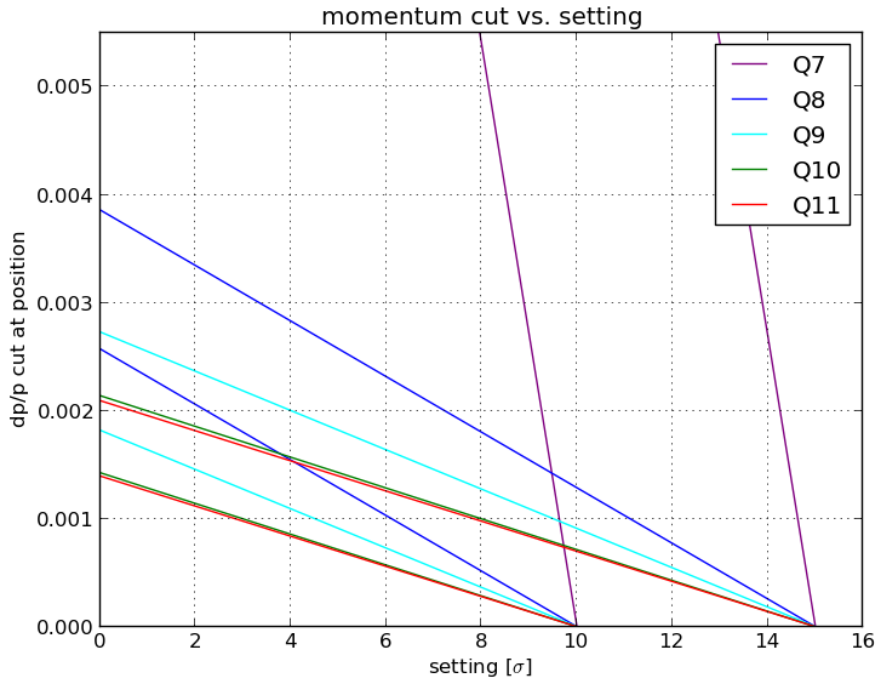


- TCL.7R7.B1 @10σ
- Not enough to stop these particles...
- $D_x = 0$ for S = 20240 m

- TCL.8R7.B1 @10σ
  TCL.10R7.B1 @10σ
- They stop all particles and protect the arcs
- Same thing at 15σ

Particles lost in all peaks of arcs 78 and 81





- dp/p distributions for particles lost in peaks
- First peak: lower dispersion, higher dp/p limit
- Overall dp/p limit: -0.005

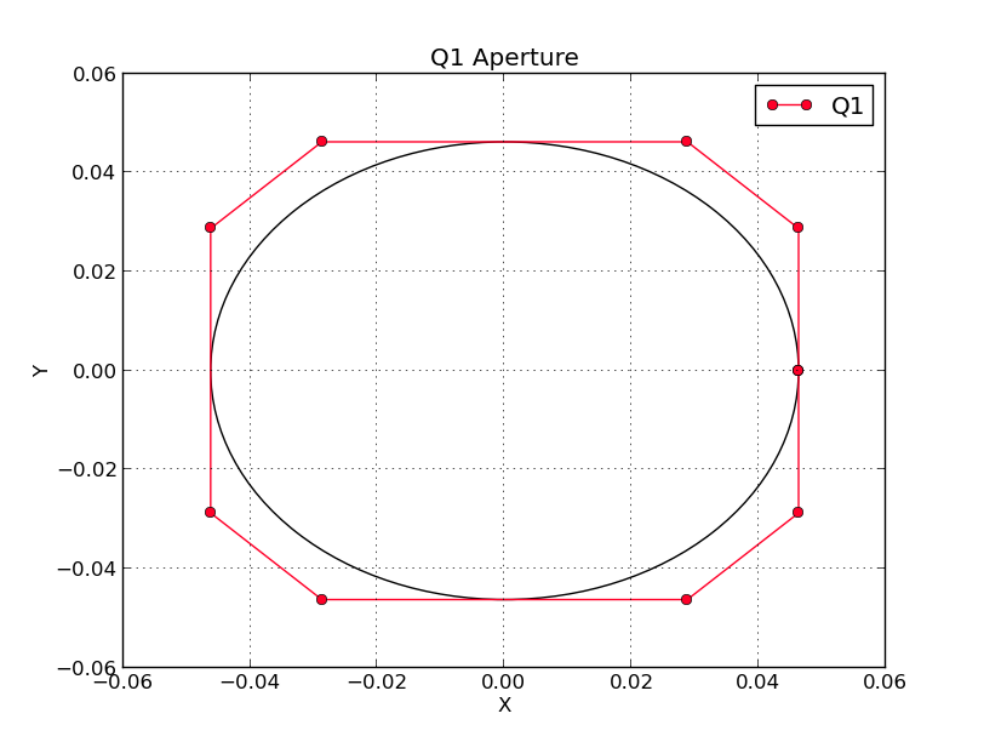
- Momentum cut vs. setting at quad. of the DS, for 10 and 15 σ
- Calculate value of sigma in mm at each position from beta function
- Calculate corresponding dp/p from dispersion

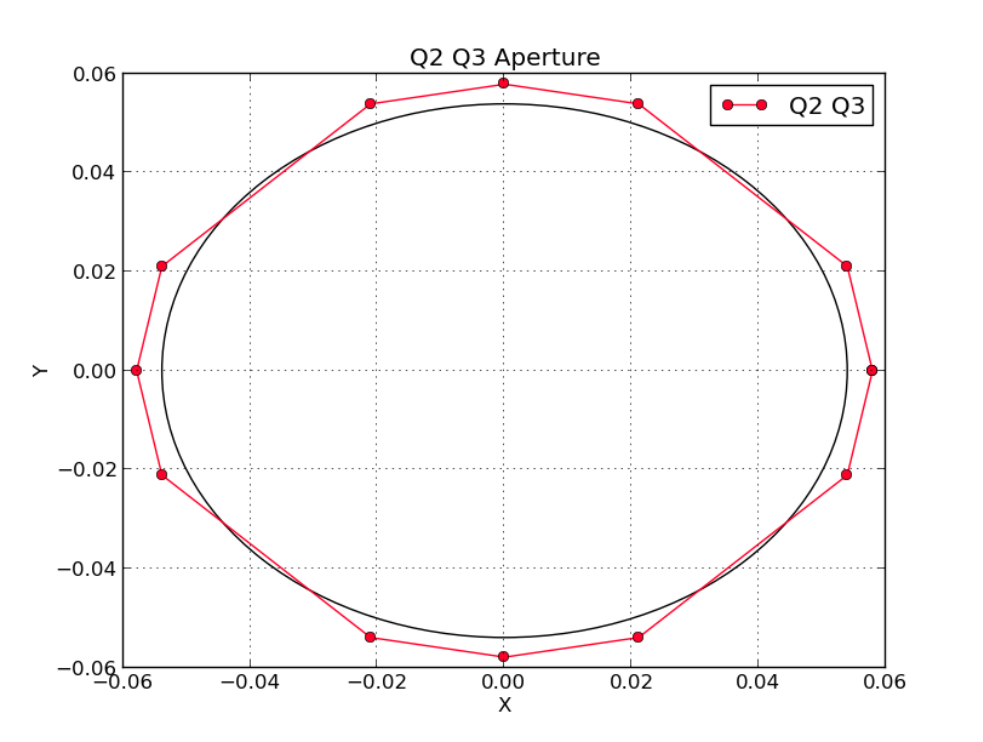
Conclusion on TCL DS

- From first simulations, DS collimators could protect against DS and arc losses (momentum losses)
- Dispersion has to be high enough (maximising $\frac{D_x}{\sqrt{\beta_x}}$) easily achievable
- One collimator at Q8 might be enough (TBC)
- Warning: approximations! Collimator added into thin lens lattice – settings not definitive.

Beam 2

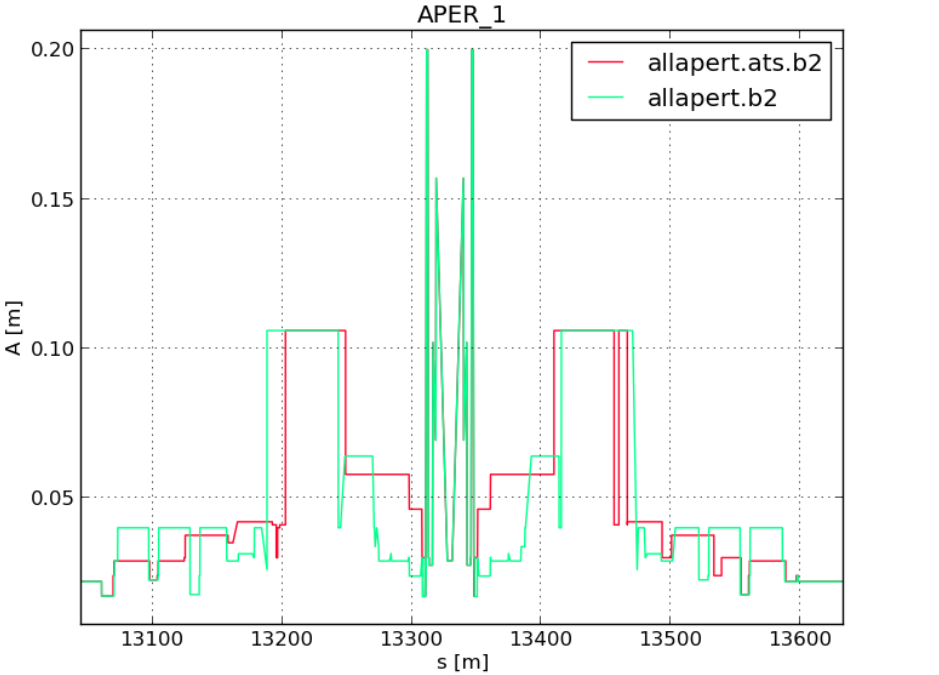
Updated Aperture file: Case of Q1, Q2, Q3

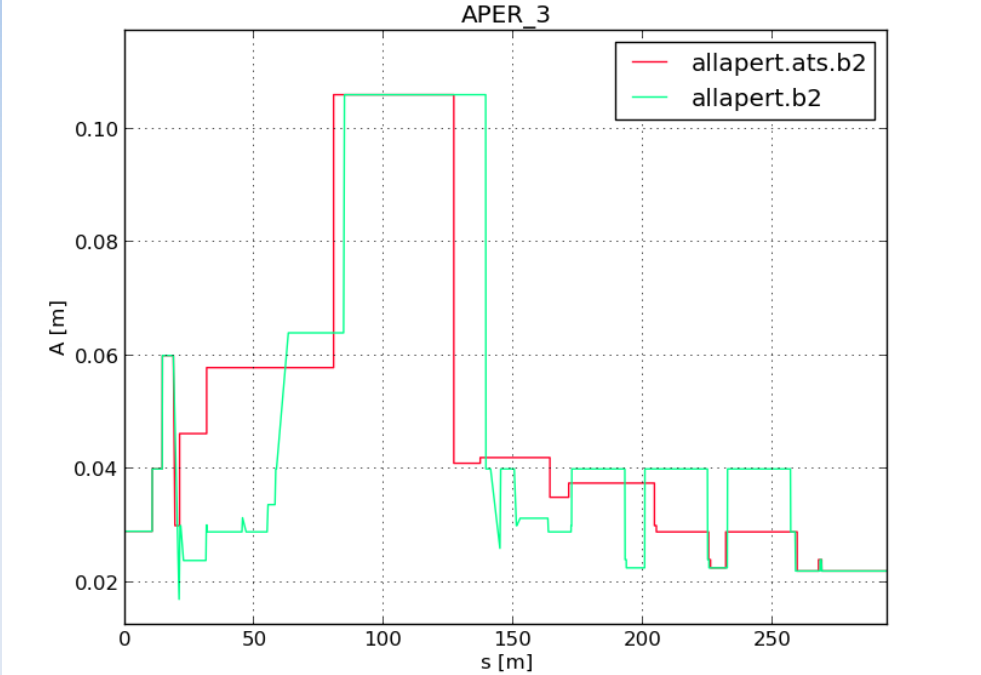




- Quick fix, waiting for proper aperture files
- Fitting circle in the real aperture (can be expressed as "rectellipse")
- Conservative

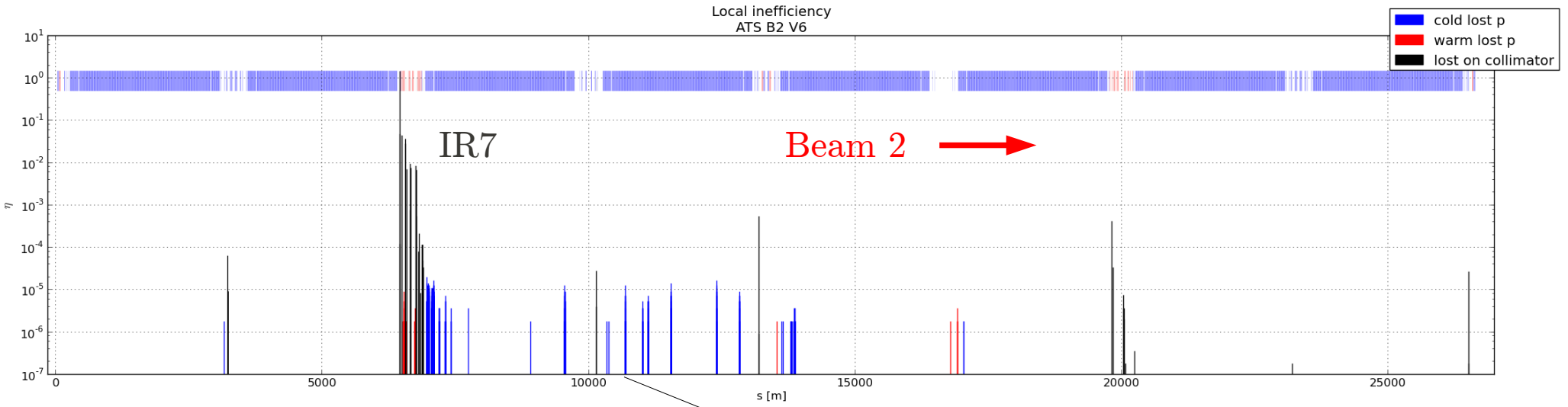
Updated aperture file: longitudinally



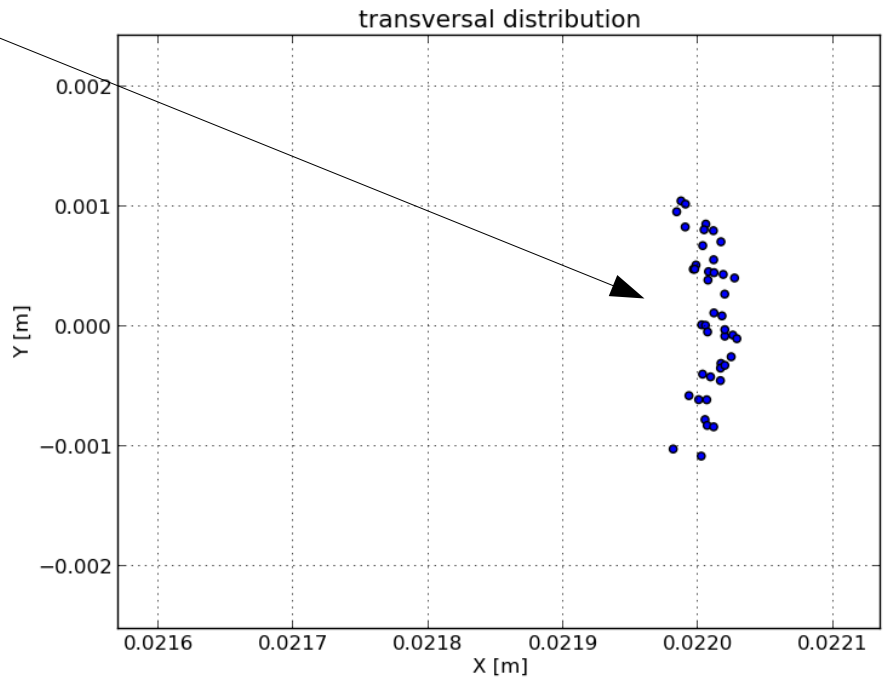


- Combining changes of positions and apertures, from aperture files and twiss files
- In some unclear drift cases, markers were set as wider choice; still conservative.
- Need official aperture file; need to update Crossing file

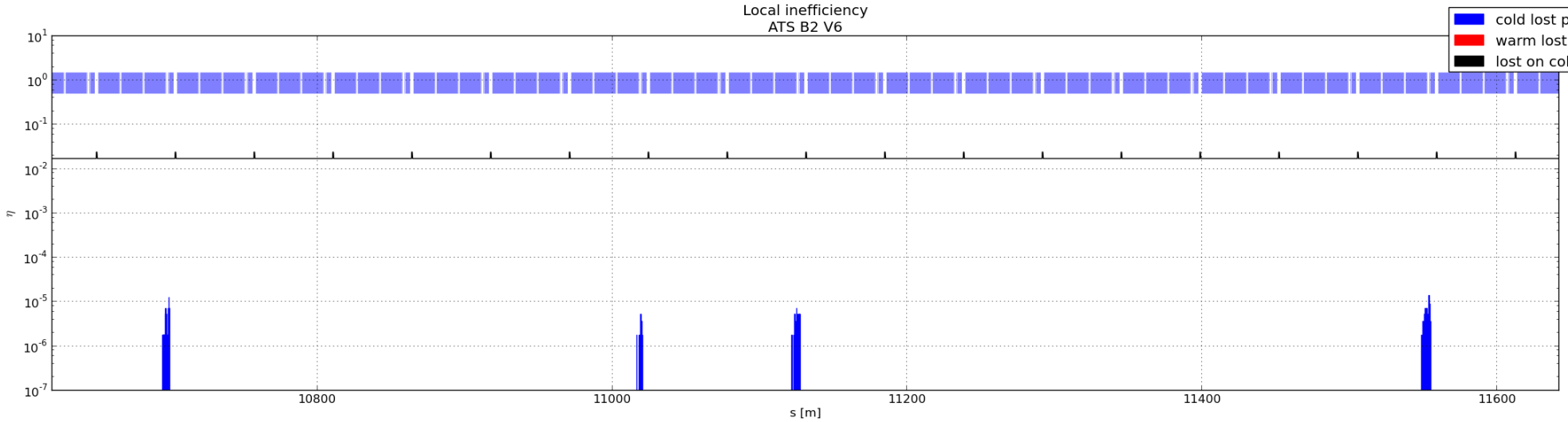
First preliminary results for Beam 2

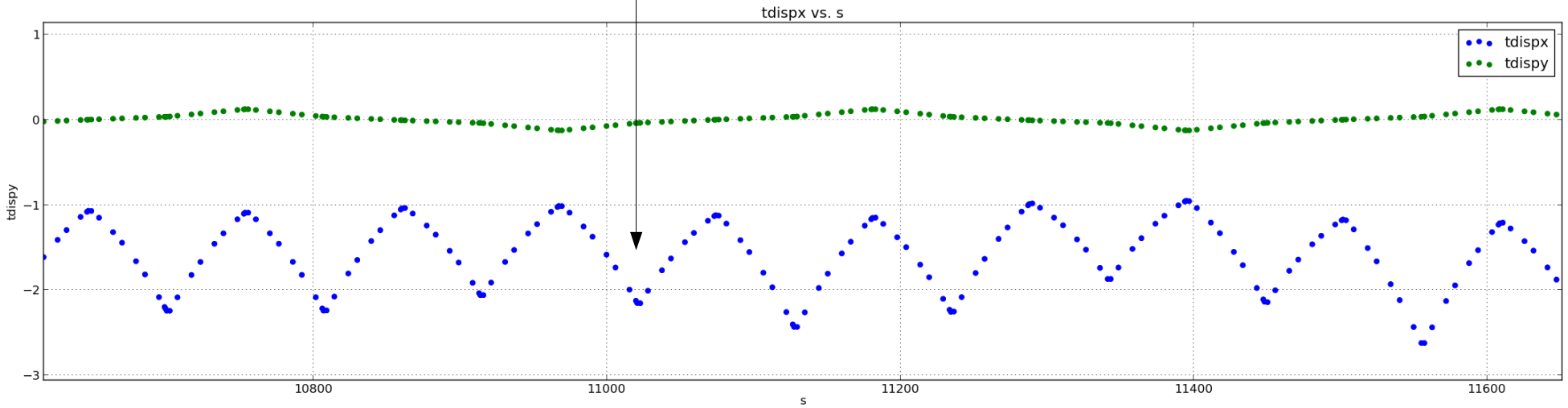


- "Beam 4": inverted
- Many losses in the arc downstream IR7
- Again, momentum losses at x = +0.022 m (dispersion is negative)



Arcs 67, 56: dispersion maximums





Conclusion

- Work in progress (lattice, setting)
- Confirmed results presented in Frascati
- “Momentum” losses seem to be a real issue
- First solution: losses can be limited by DS TCLD
- Would solve other problems around the ring (arcs 78 and 81)
- Approx results for b2, waiting fro better lattice
- Qualitatively similar, could be solved by cold collimator as well