Studies of crossing angle and SR effects for CLIC TENTATIVE

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TILC-08

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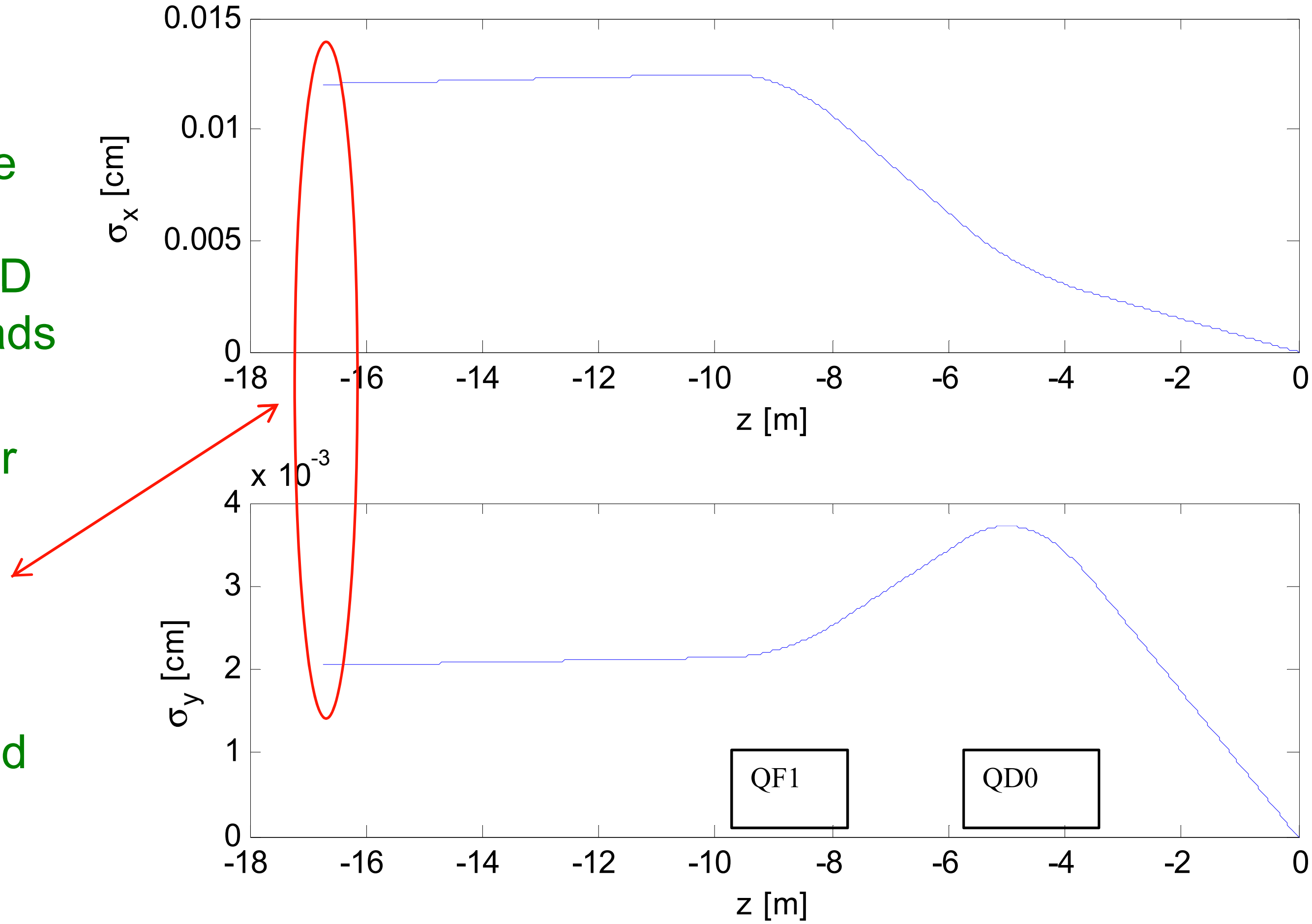
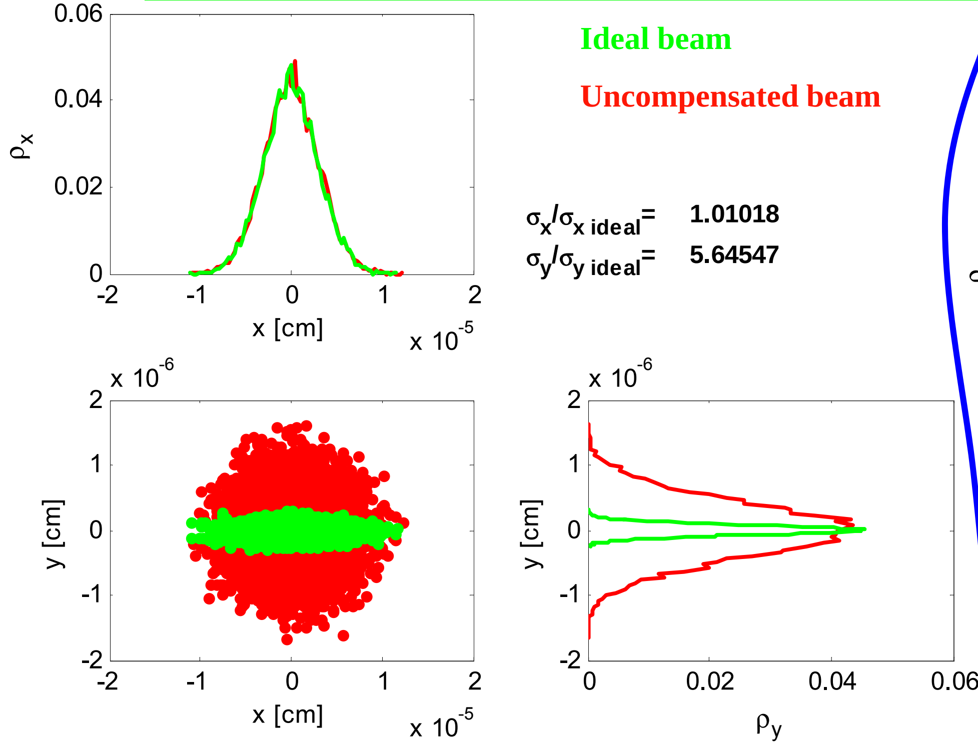
Preparations

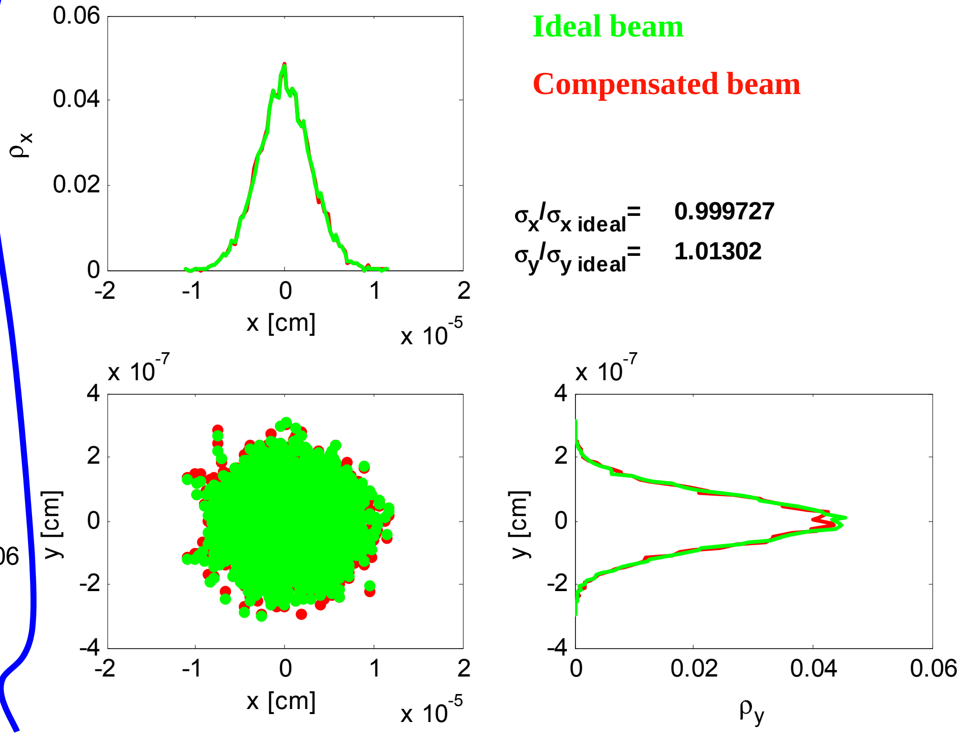
- We start with the beam at the IP (β_x=0.4cm, β_y=0.009cm, $\gamma\varepsilon_x$=660·10^{-7}cm·rad, $\gamma\varepsilon_y$=20·10^{-7}cm·rad, E=1.5TeV/beam) and back-track it through the ILC-like final doublet (with DS-WAS field set to zero).

- The sextupoles and octupoles are set to zero. Quads have the same geometric parameters K (in MAD notation) the ILC quads have.
- Obtained beam is our initial beam at the entrance to the IR, which we use in simulations
- Use SiD solenoid field for all cases



L*=3.51m; SiD; θcross=20mrad

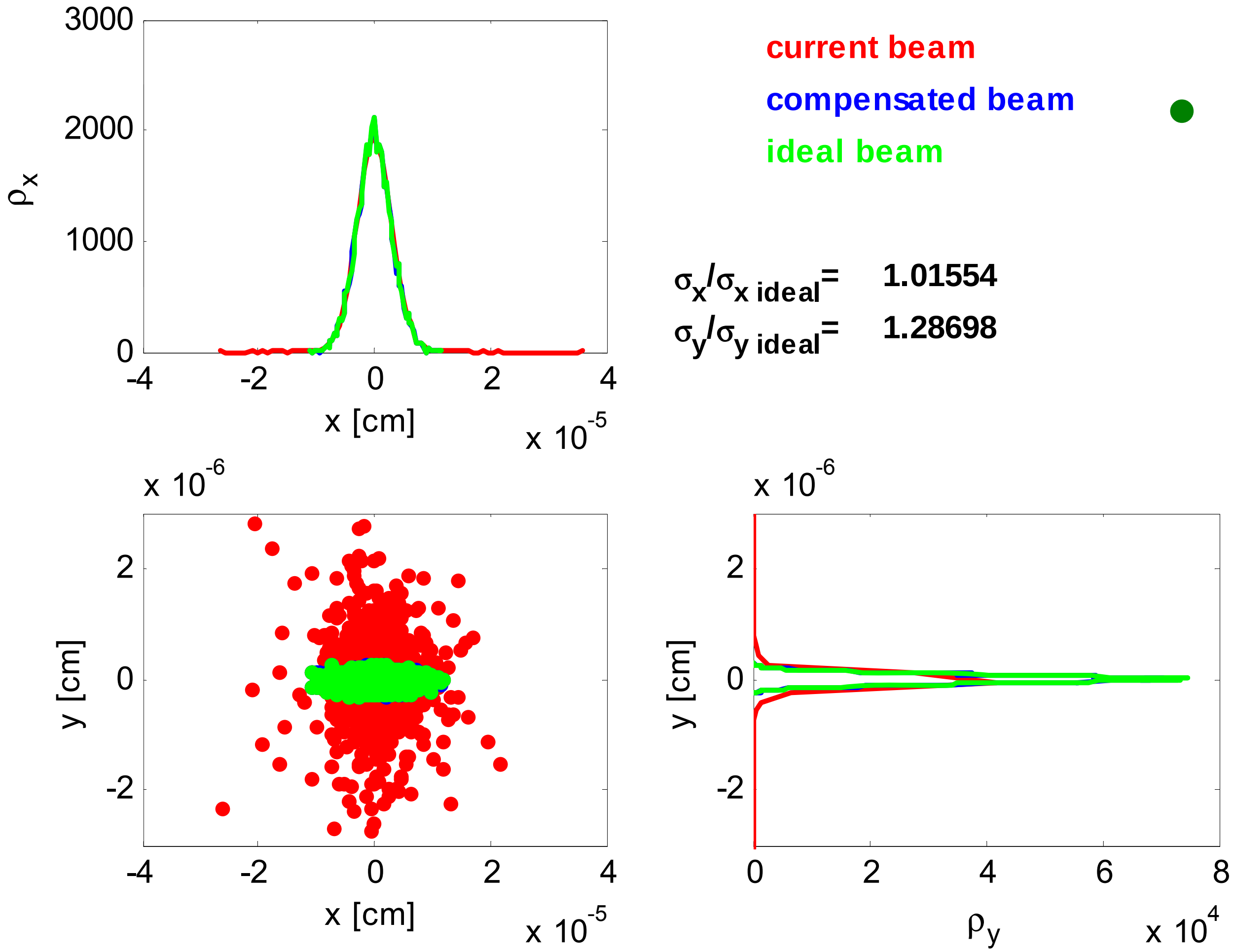




- To see the SR effect in the realistic field of DS-WAS, we start with the beam in the field of DS only (left plot), and then compensate it with the WAS (right plot).

SR effect (L*=3.51m; SiD; θcross=20mrad)

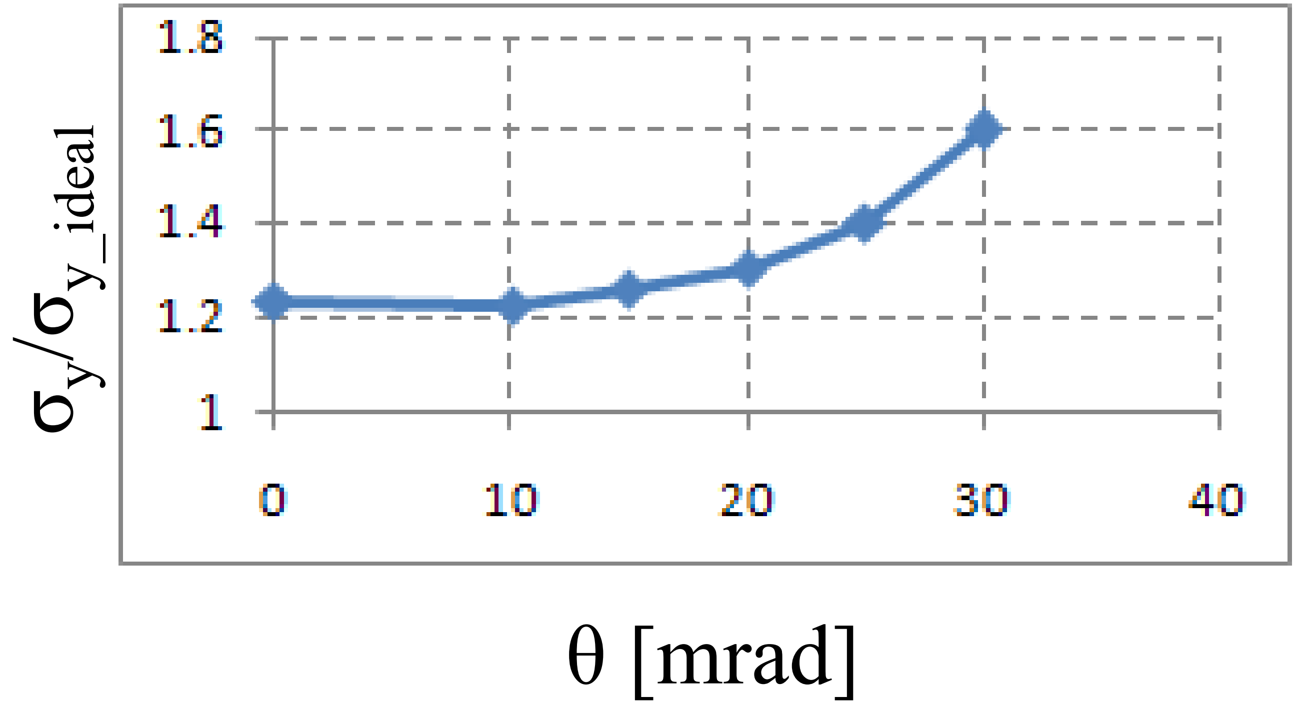
- Now we “turn on” the SR effect:



- It leads to 30% growth of vertical beam size

Results

- We went through described procedure for different crossing angles:

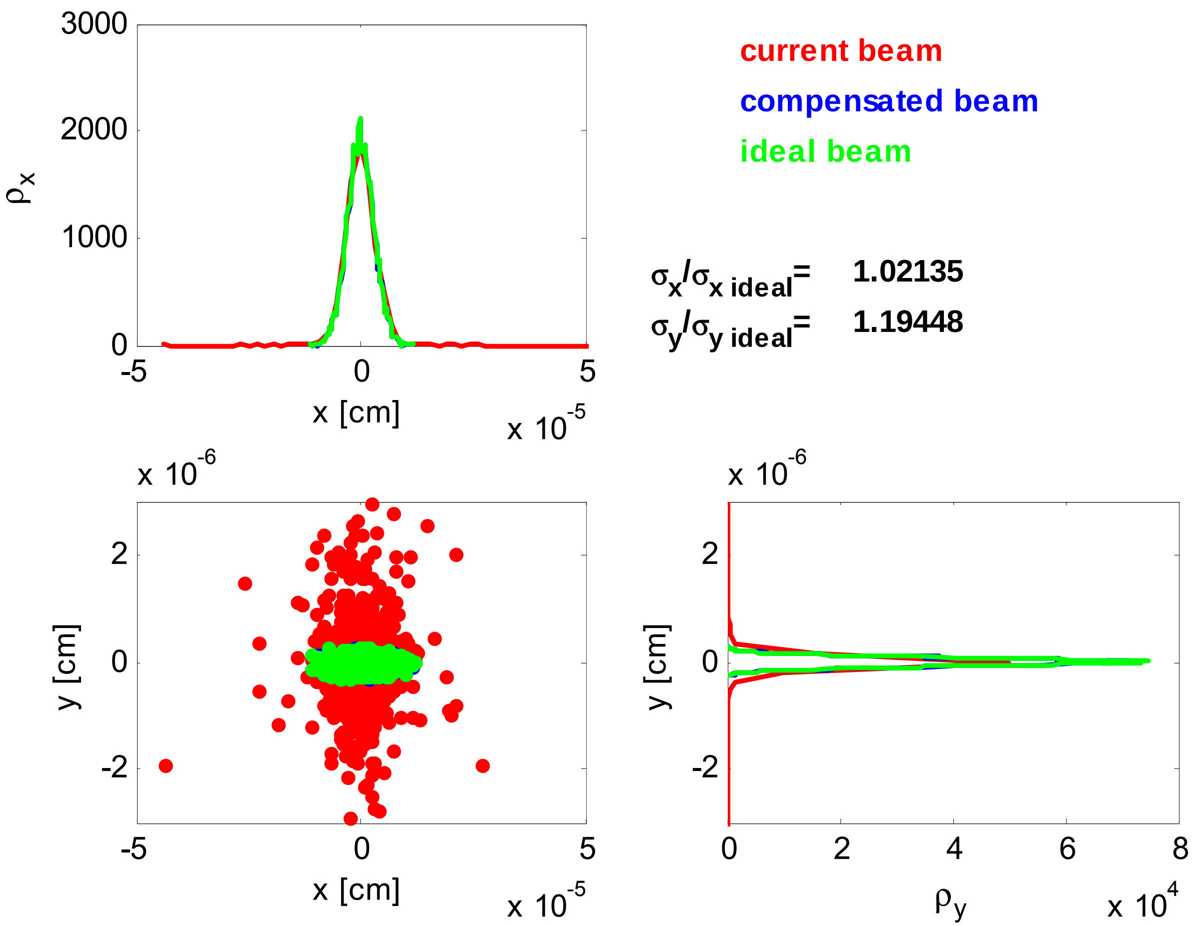


Discussion

- It looks like there is a lot of beam size growth from SR in the quads (I will give some proof of it in the following slides).
- Probably scaling up ILC quads’ strengths to fit the CLIC beam in the IP was not the right thing to do?

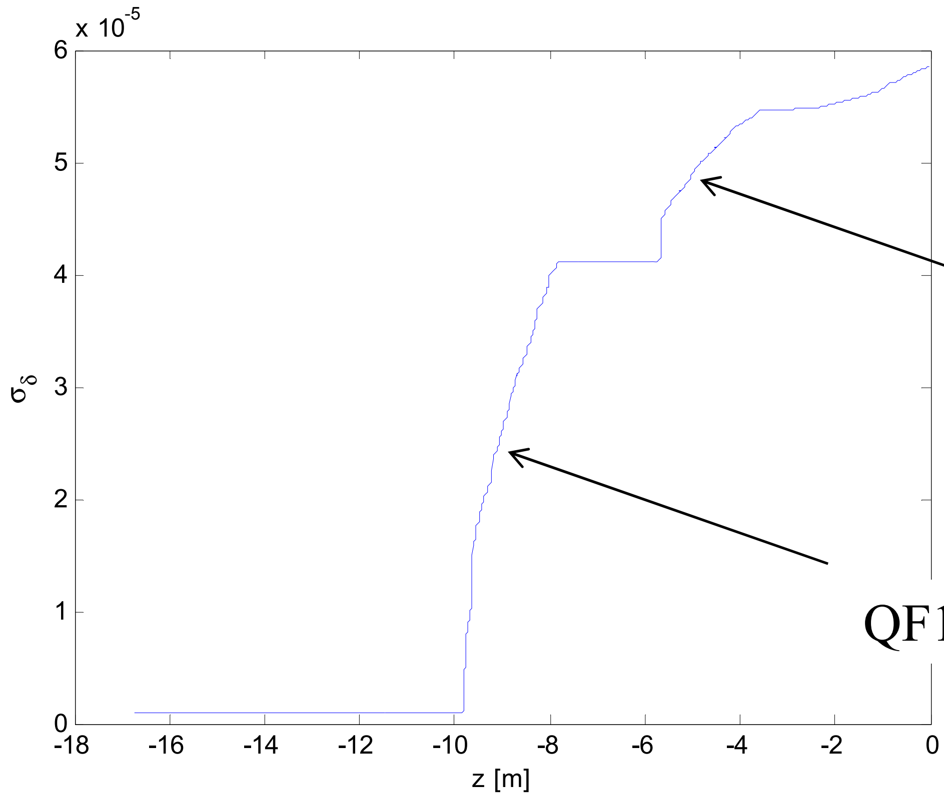
SR effect with the same IR optics and zero WAS-DS field

- One can see that probably SR input to the beam size growth is as much due to the strong focusing in the final doublet, as due to the curved trajectory in the WAS-DS field.

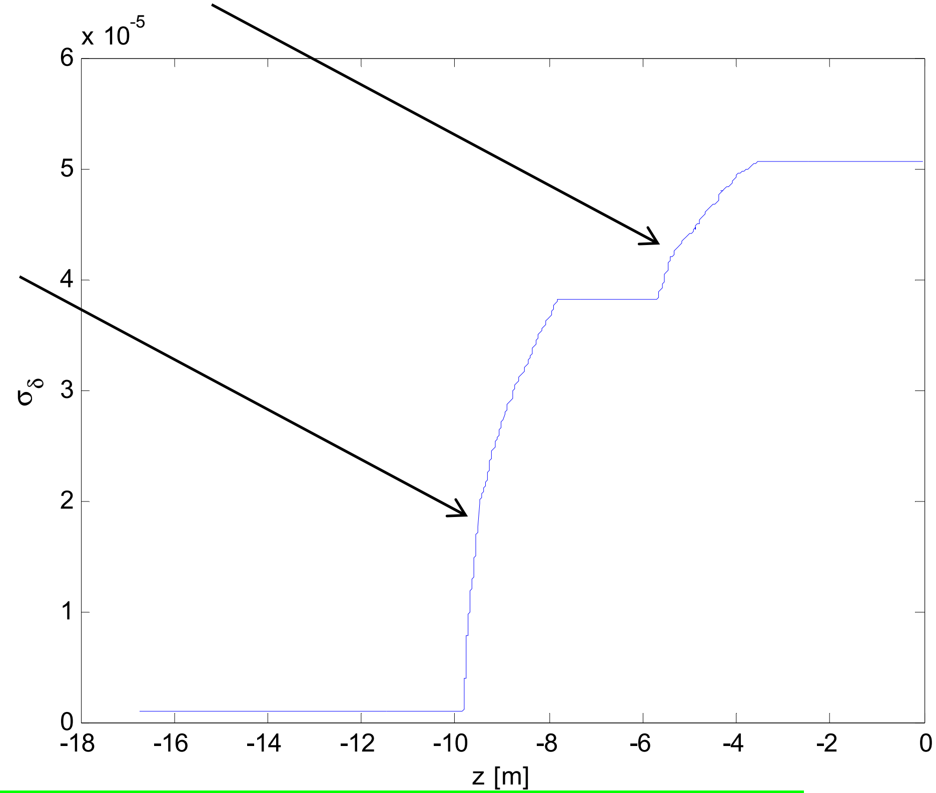


- One sees 20% growth of vertical beam size from SR in the absence of the WAS-DS field.
- Scaling up the strength of the ILC final doublet quads for CLIC energy might be unreasonable

SR with and without WAS-DS field



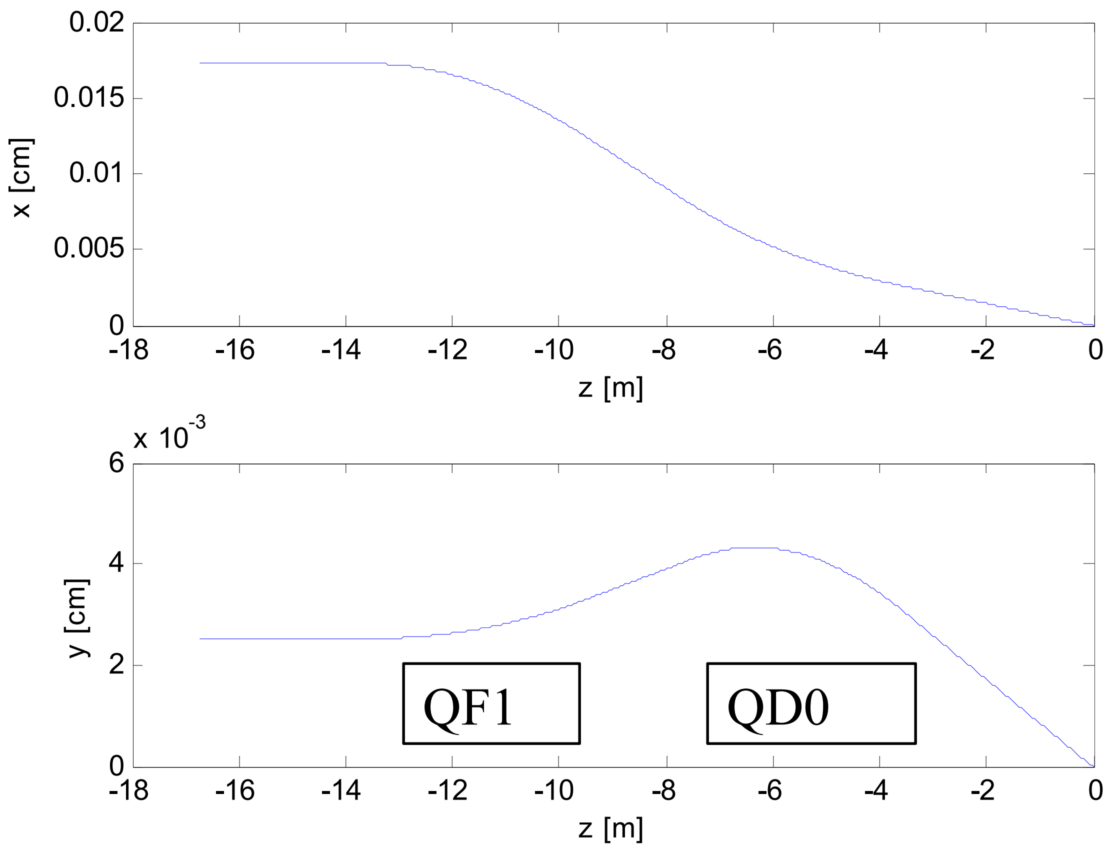
- Upper plot shows width of energy spread through the IR (WAS-DS is on)



- Lower plot shows width of energy spread through the IR with WAS-DS field turned off

Matched FD

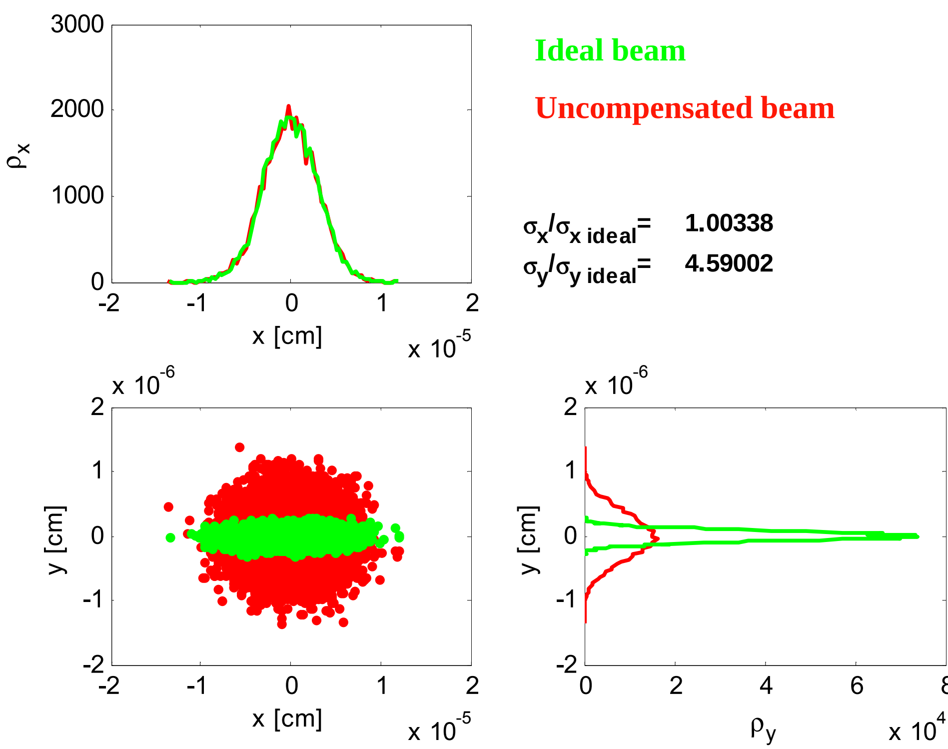
- We increased the lengths of both QF1 and QD0 by factor of two and matched the beam at the entrance to the IR (α_x=0, α_y=0). Eventually the SR effect due to the FD focusing is ~14% (!) of the vertical beam size.

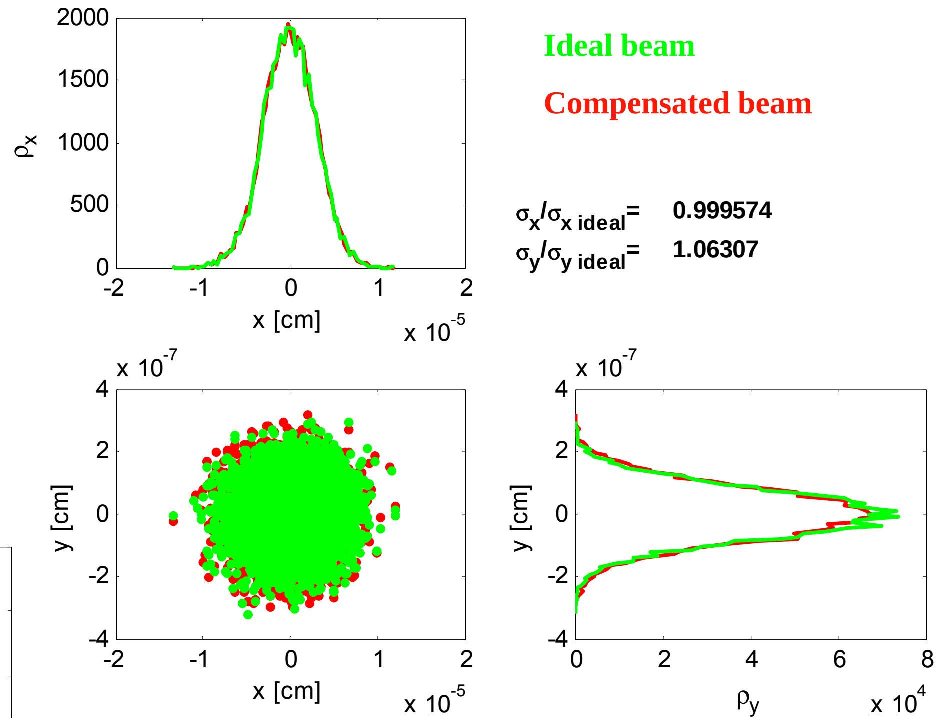


- IP beam has CLIC parameters (βx=0.4cm, βy=0.009cm, $\gamma\varepsilon x=660\cdot10^{-7}$cm·rad, $\gamma\varepsilon y=20\cdot10^{-7}$cm·rad).

Initial compensation (matched FD; SiD; θcross=20mrad)

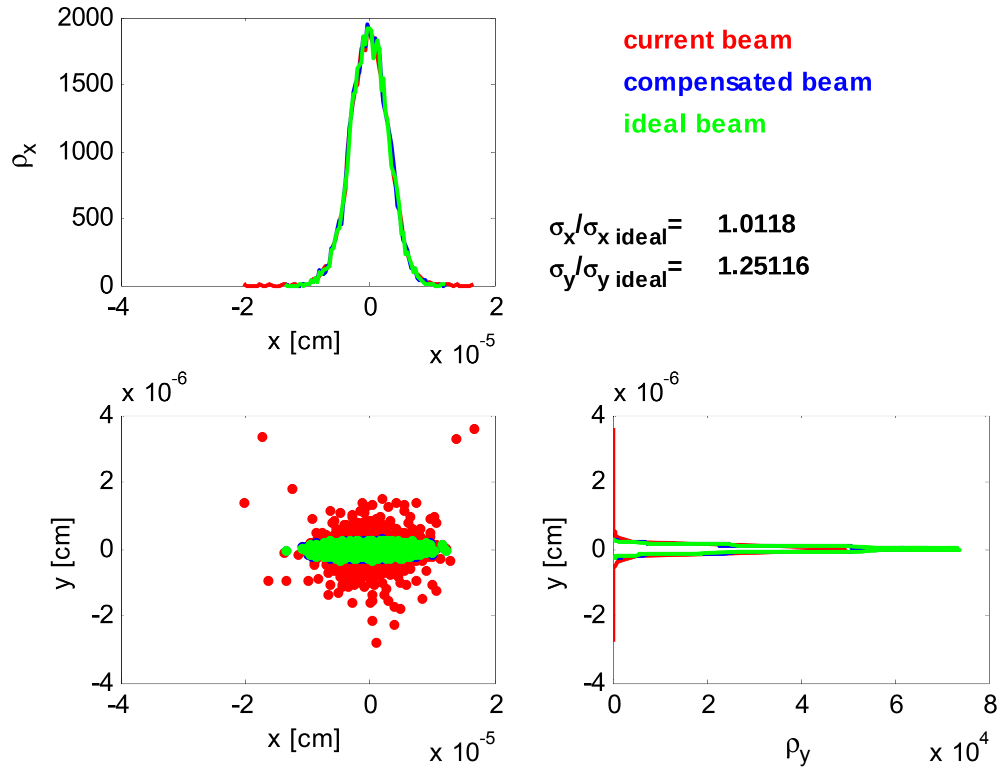
- To see the SR effect in the realistic field of DS-WAS, we start with the beam in the field of DS only (left plot), and then compensate it with the WAS (right plot).

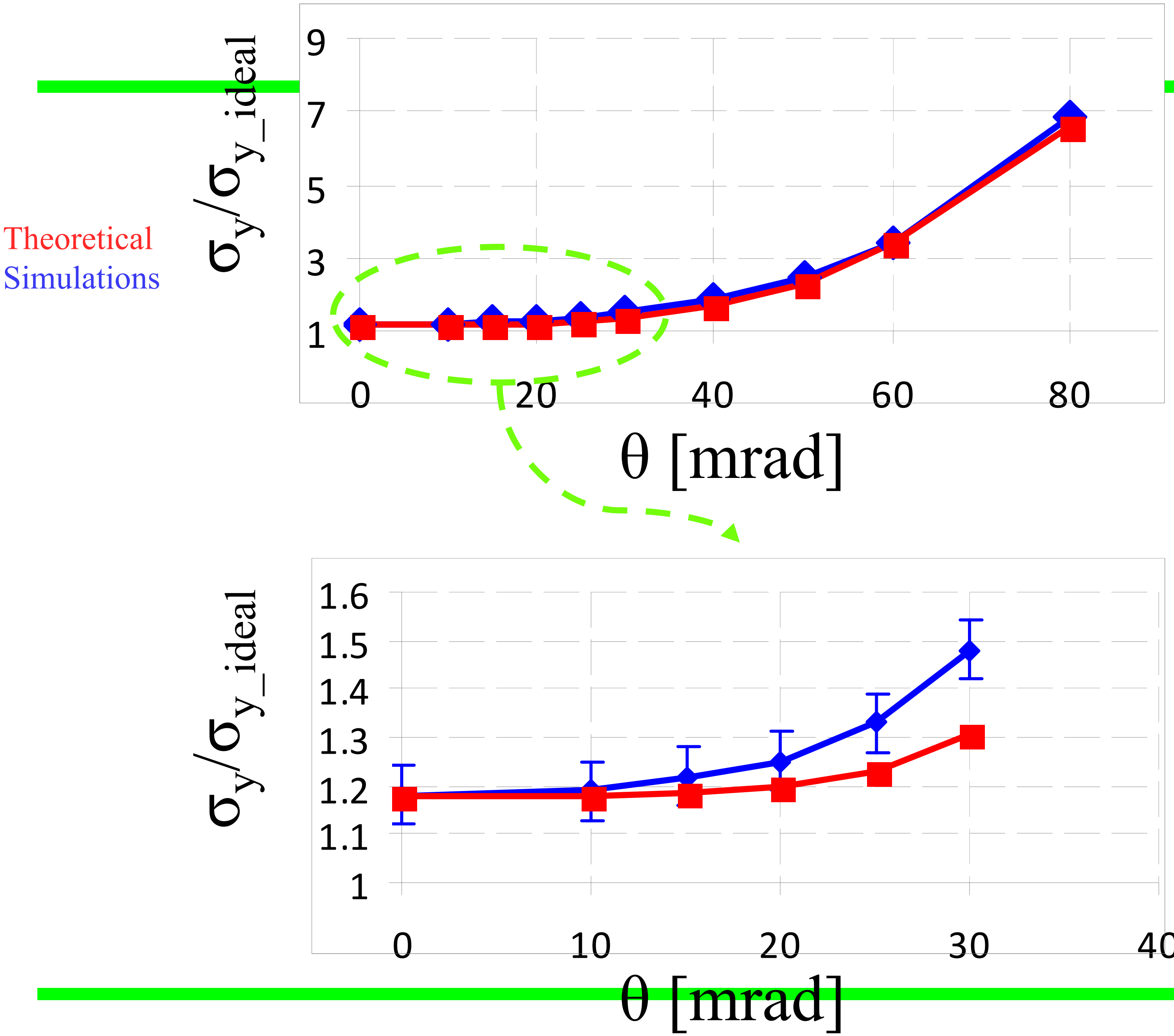




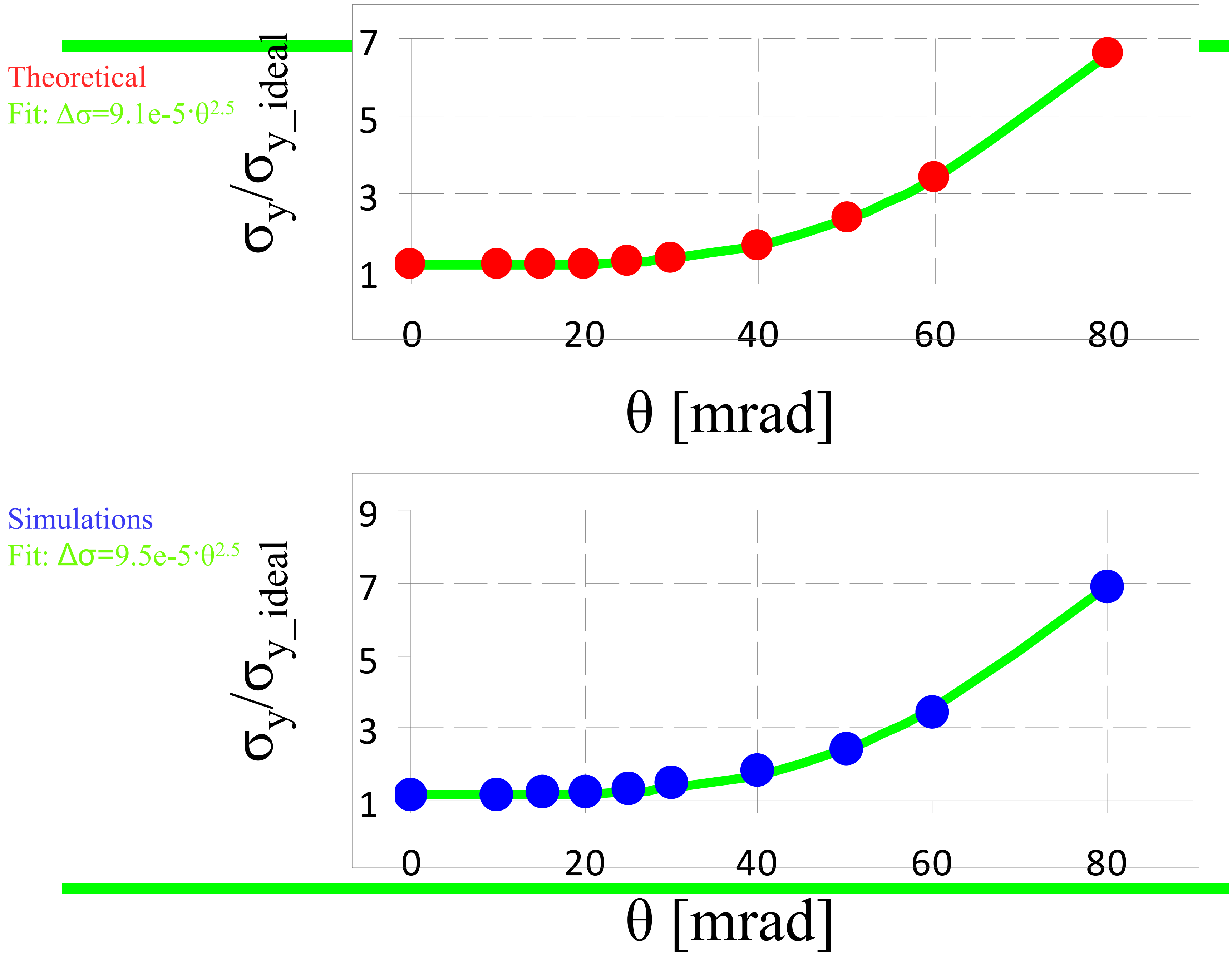
SR effect (matched FD; SiD; θcross=20mrad)

- As we turn on the SR effect we observe 25% growth of the vertical beam size (including SR effect from FD focusing):



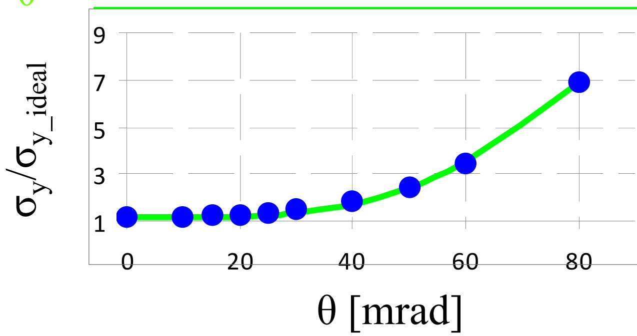


Theoretical
Simulations
$\sigma_y/\sigma_{y\_ideal}$
9
7
5
3
1
0
20
40
60
80
θ [mrad]
$\sigma_y/\sigma_{y\_ideal}$
1.6
1.5
1.4
1.3
1.2
1.1
1
0
10
20
30
40
θ [mrad]


Theoretical
Fit: Δσ=9.1e-5·θ2.5
σy/σy_ideal
7
5
3
1
0
20
40
60
80
θ [mrad]
Simulations
Fit: Δσ=9.5e-5·θ2.5
σy/σy_ideal
9
7
5
3
1
0
20
40
60
80
θ [mrad]

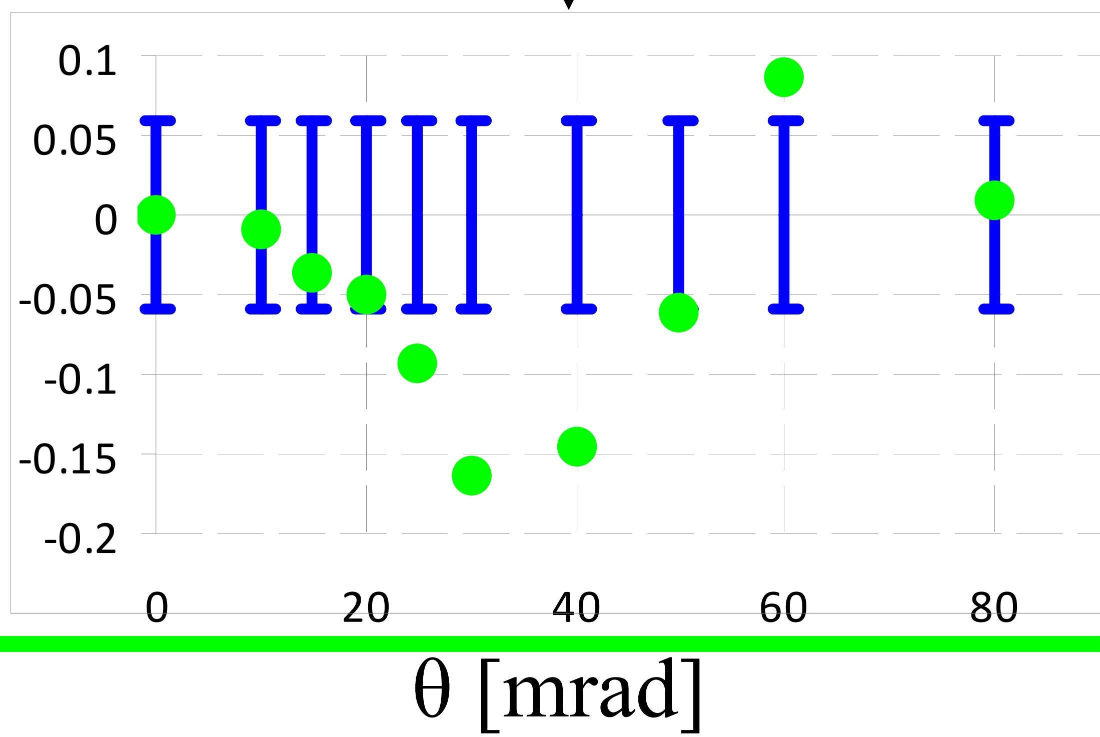
Simulations

Fit: $9.5e\text{-}5 \cdot \theta^{2.5}$



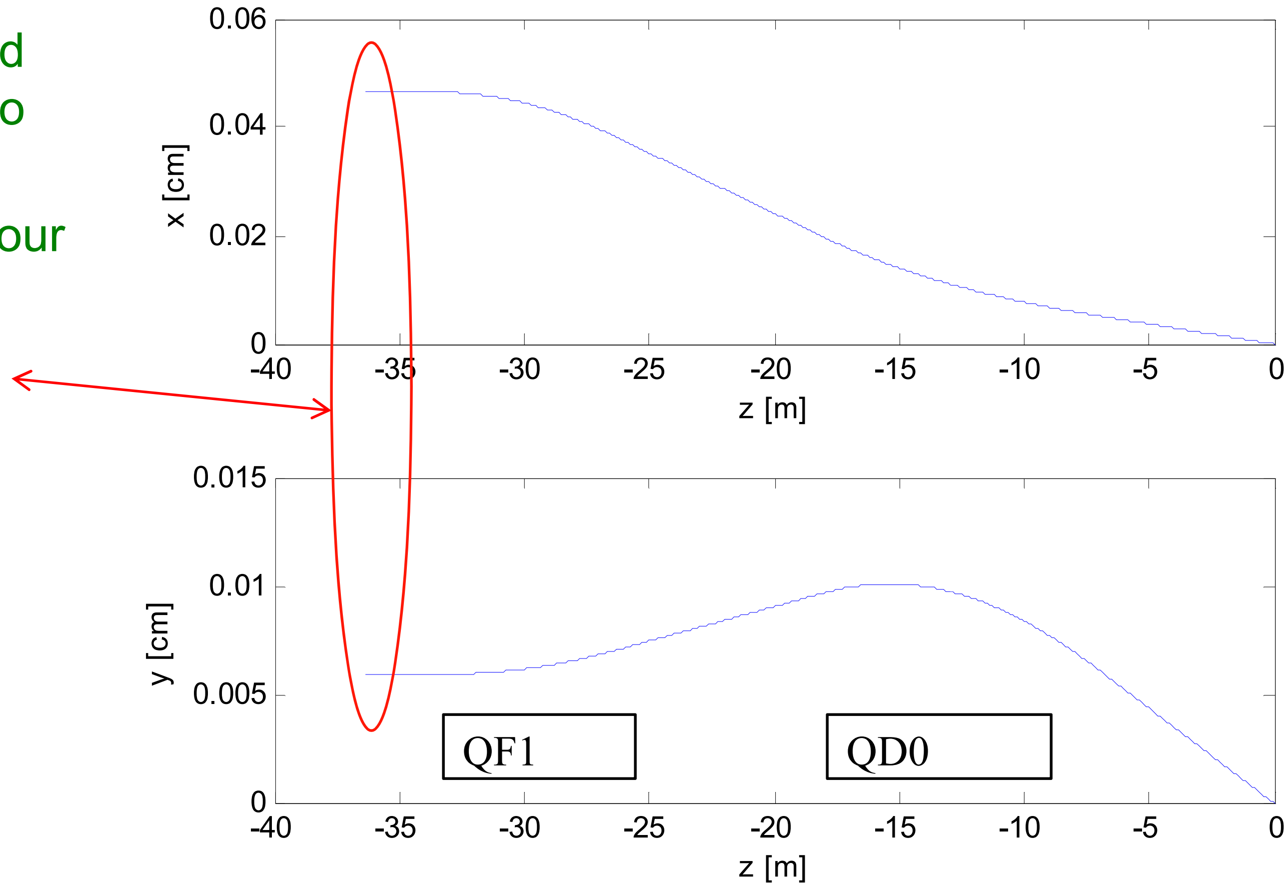
+-3σ of the “measurements”

Difference between the fit and simulations

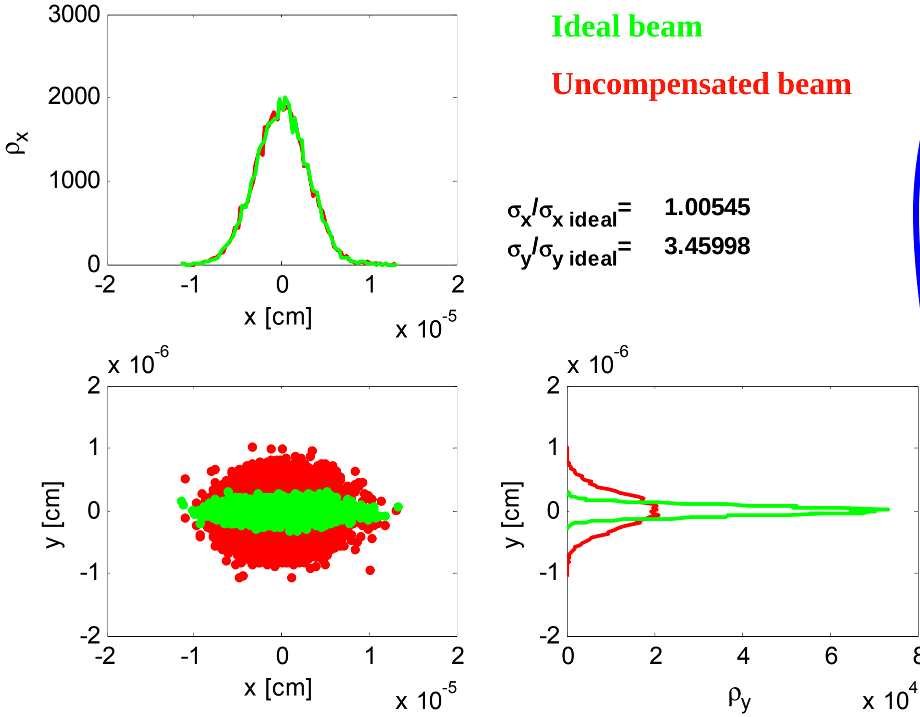


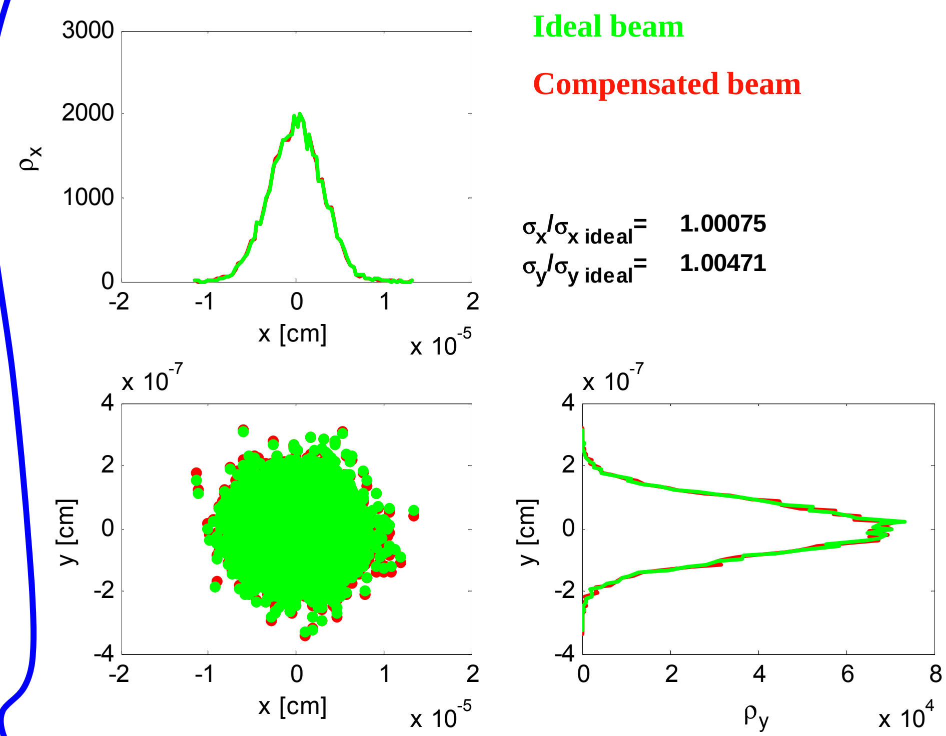
Doubling L*

- We start with the beam at the IP (β_x=0.4cm, β_y=0.009cm, $\gamma\varepsilon_x$=660·10^{-7}cm·rad, $\gamma\varepsilon_y$=20·10^{-7}cm·rad) and back-track it through L*=7m final doublet (with DS-WAS field set to zero).
- The sextupoles and octupoles are set to zero.
- Obtained beam is our initial beam at the entrance to the IR, which we use in simulations



L*=7m; SiD; θcross=20mrad

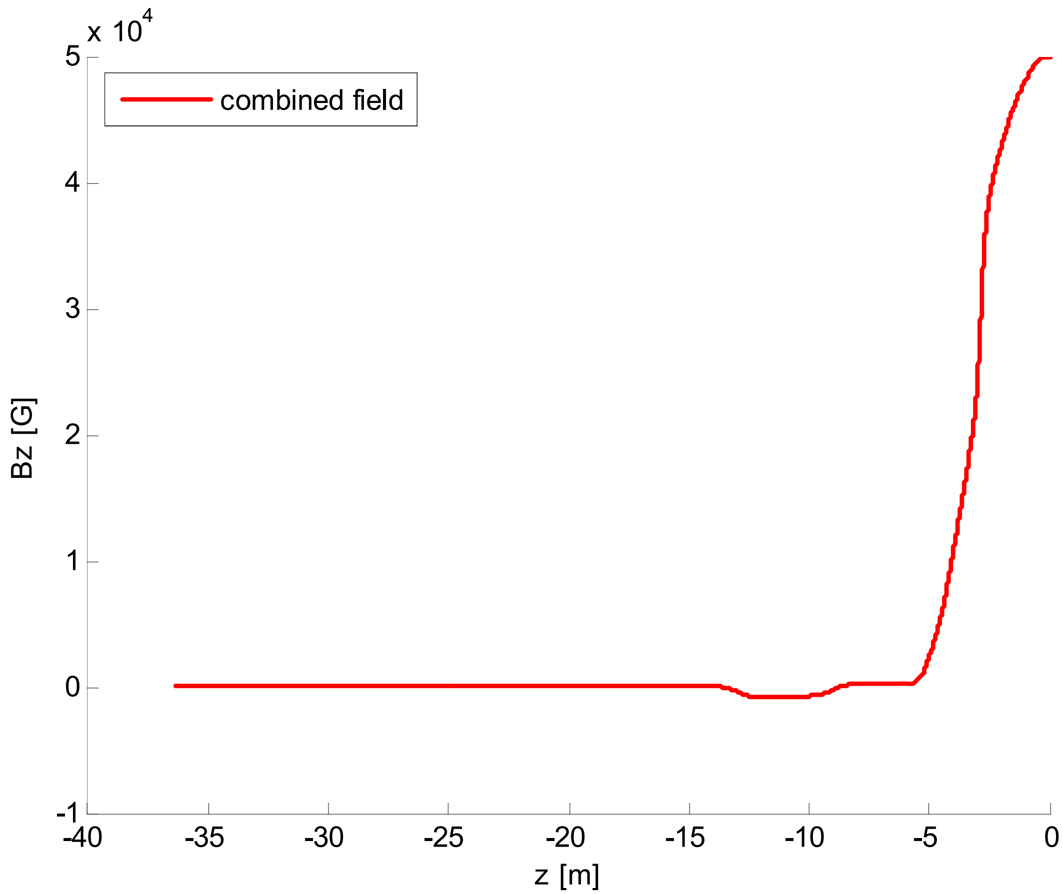




- To see the SR effect in the realistic field of DS-WAS, we start with the beam in the field of DS only (left plot), and then compensate it with the WAS (right plot).

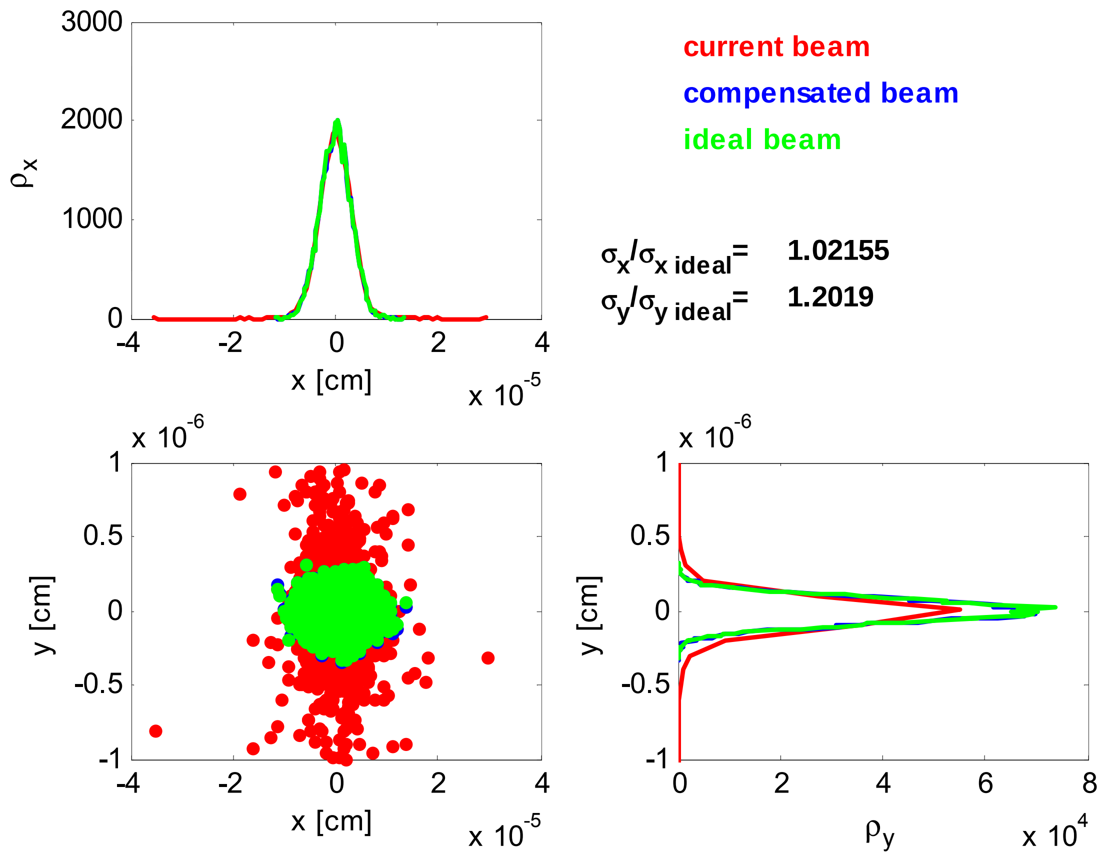
WAS-DS field

- Just in case, indeed we can compensate adverse DS effects with truly Weak AS.



SR effect (L*=7m; SiD; θcross=20mrad)

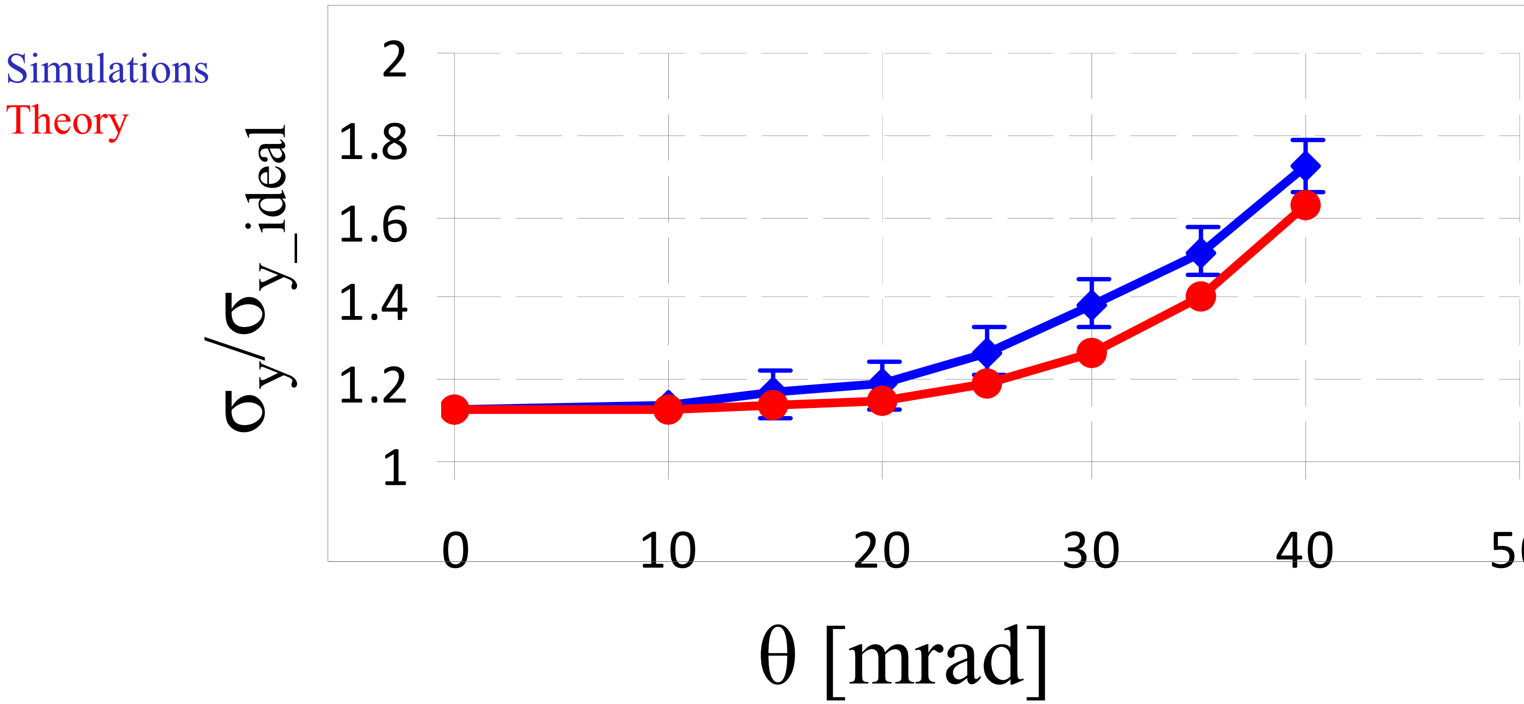
- Now we "turn on" the SR effect:



- It leads to 20% growth of vertical beam size

Results

- We went through described procedure for different crossing angles:



Conclusion

- Studies of crossing angle effect for CLIC started with simulation tools developed for ILC IR optimization
- Weak antisolenoid and SiD field were considered
- Tentative results were shown for dependence on crossing angle
- Doubled L* was considered
- Some difference between theory and simulation still exist
- Results are tentative