Resistive wall effect in the CLIC BDS

CLIC- Beam Physics Meeting 25/11/2009

R. Mutzner

- Multi-particle tracking code including multi-bunch effects (long range)
- Simulation done for both 3TeV and 500GeV cases
- Stainless steel and copper pipes
- Initial arbitrary offset, classical wake function (later compared with a more detailed model):

$$W(z) = \frac{cZ_0}{\pi b^3}\sqrt{\frac{1}{Z_0\sigma_r\pi z}}$$

- Different aperture models were used for simulations:
  1. Constant radius along the BDS (3TeV and 500GeV)
  2. Realistic aperture model (3TeV)
  3. Aperture model+collimators (spoilers and absorbers) at 3TeV

Resistive wall effect in the CLIC BDS

About Results

$$\Delta y'_i \propto N_e \sum_{n=1}^{N-i-1} W_{tr}\left(nc\Delta t_b\right)\left\langle y\right\rangle_n$$

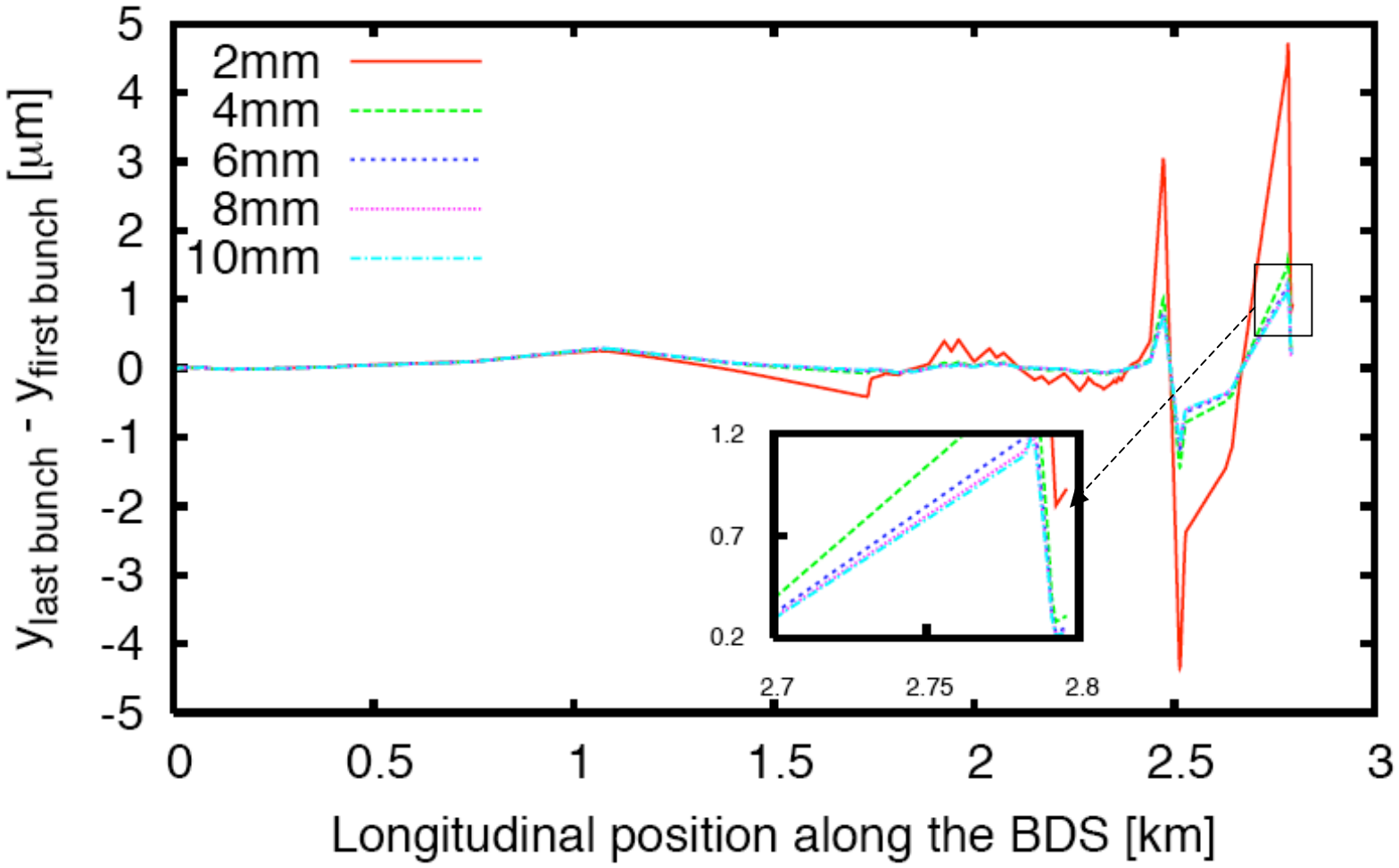
➡ Last bunch feels the effect of all the preceding bunches

Plots: we display the difference between the offsets of the last bunch and the first bunch (unaffected by the wake, reference)

➡ Effect becomes negligible when the difference in offsets are converging to the same value for different radii

Resistive wall effect in the CLIC BDS

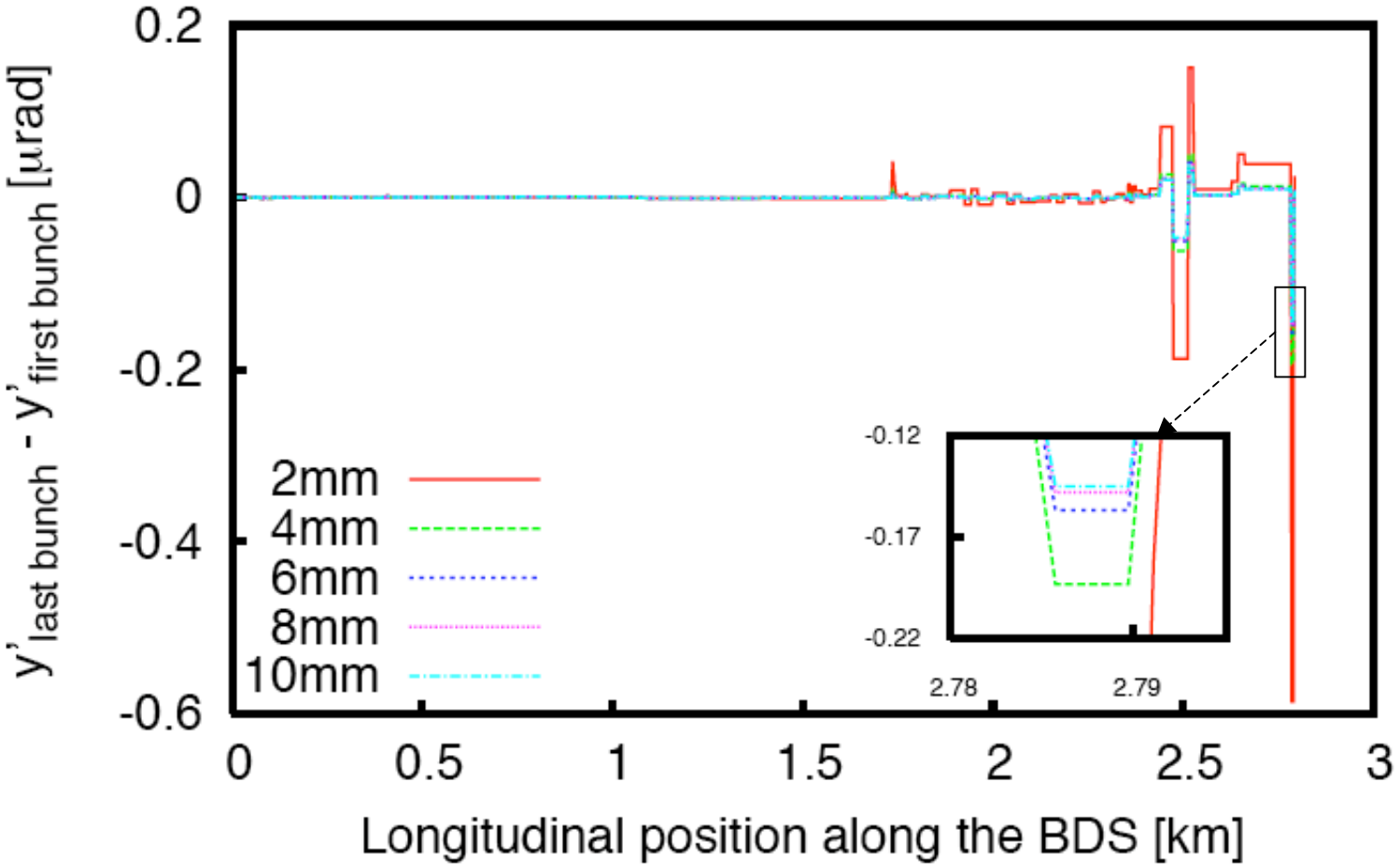
3TeV copper - constant radius



Minimum tolerable aperture 6mm, safe choice is 8mm

Resistive wall effect in the CLIC BDS

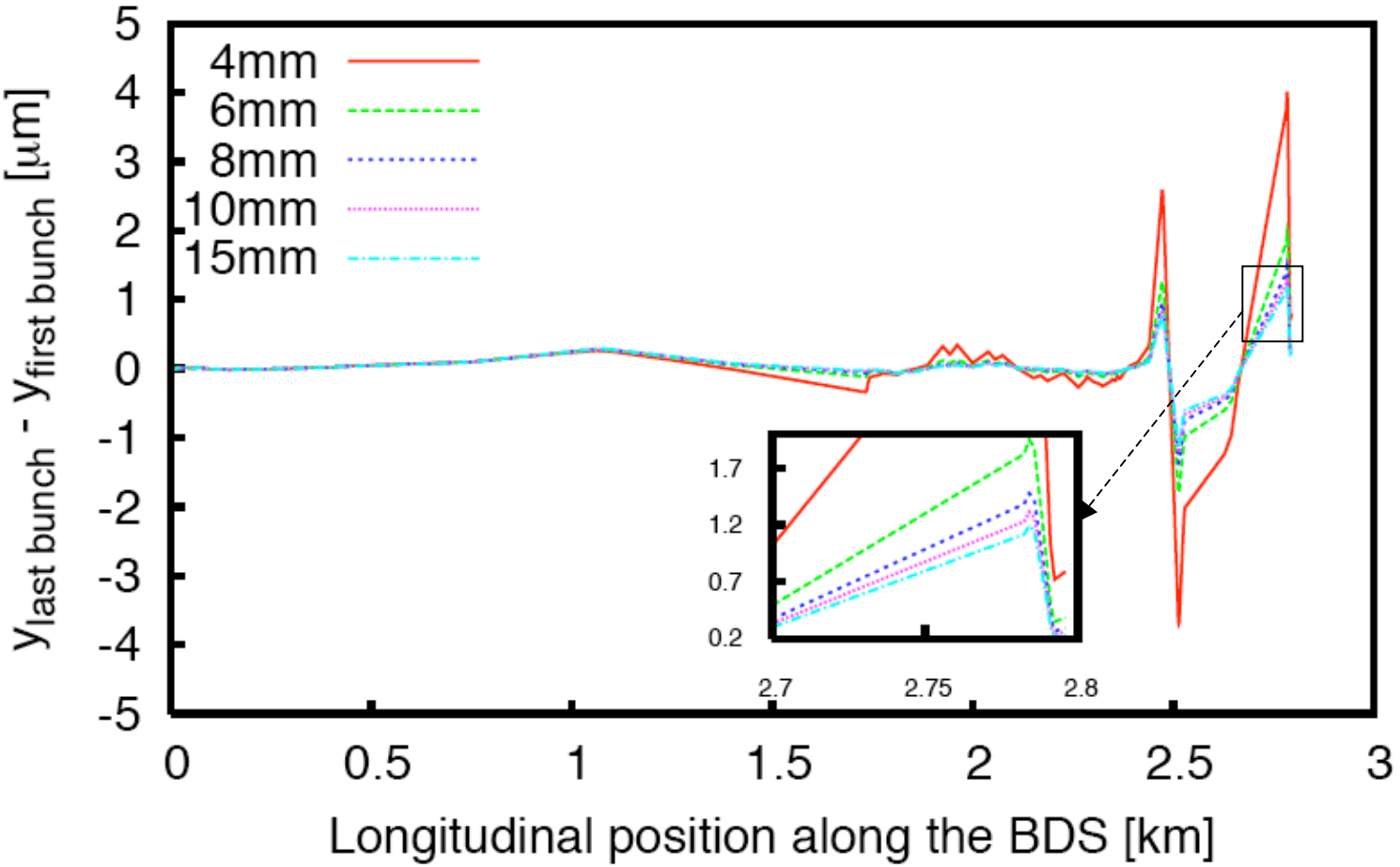
3TeV copper - constant radius (angles)



Same result with angles: 6mm, 8mm safer

Resistive wall effect in the CLIC BDS

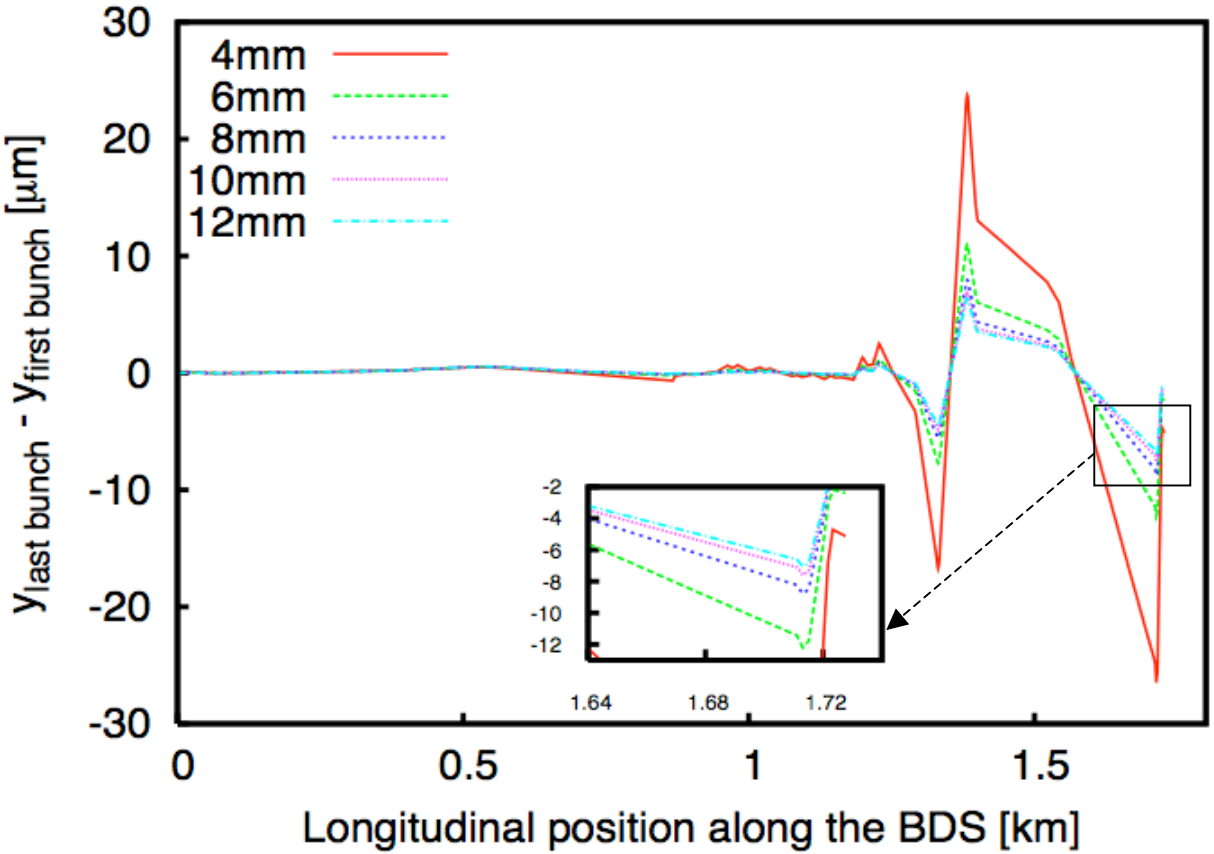
3TeV stainless steel - constant radius



Minimum aperture 10mm, safer choice is 12mm

Resistive wall effect in the CLIC BDS

500GeV copper - constant radius

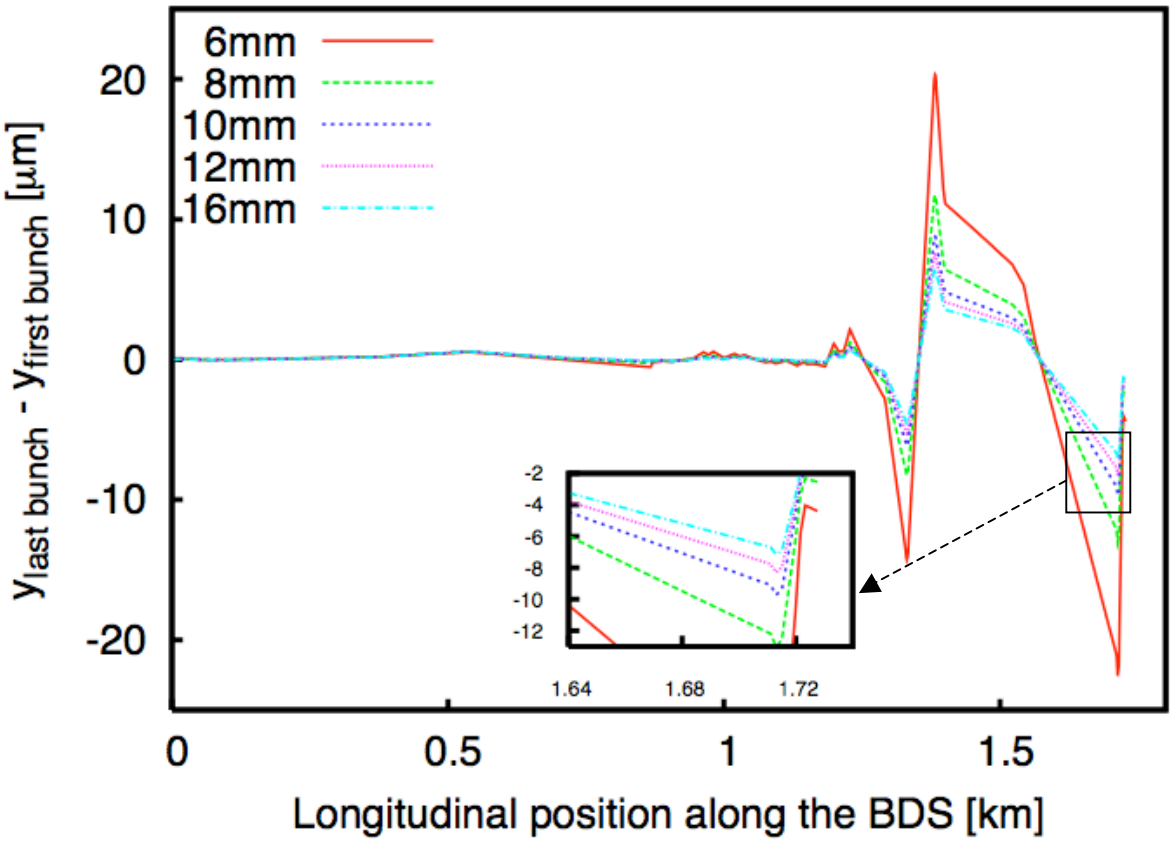


- different beta functions
- lower energy: factor 6
- shorter system
- more bunches

Minimum aperture: 10mm or 12mm

Resistive wall effect in the CLIC BDS

500GeV stainless steel - constant radius

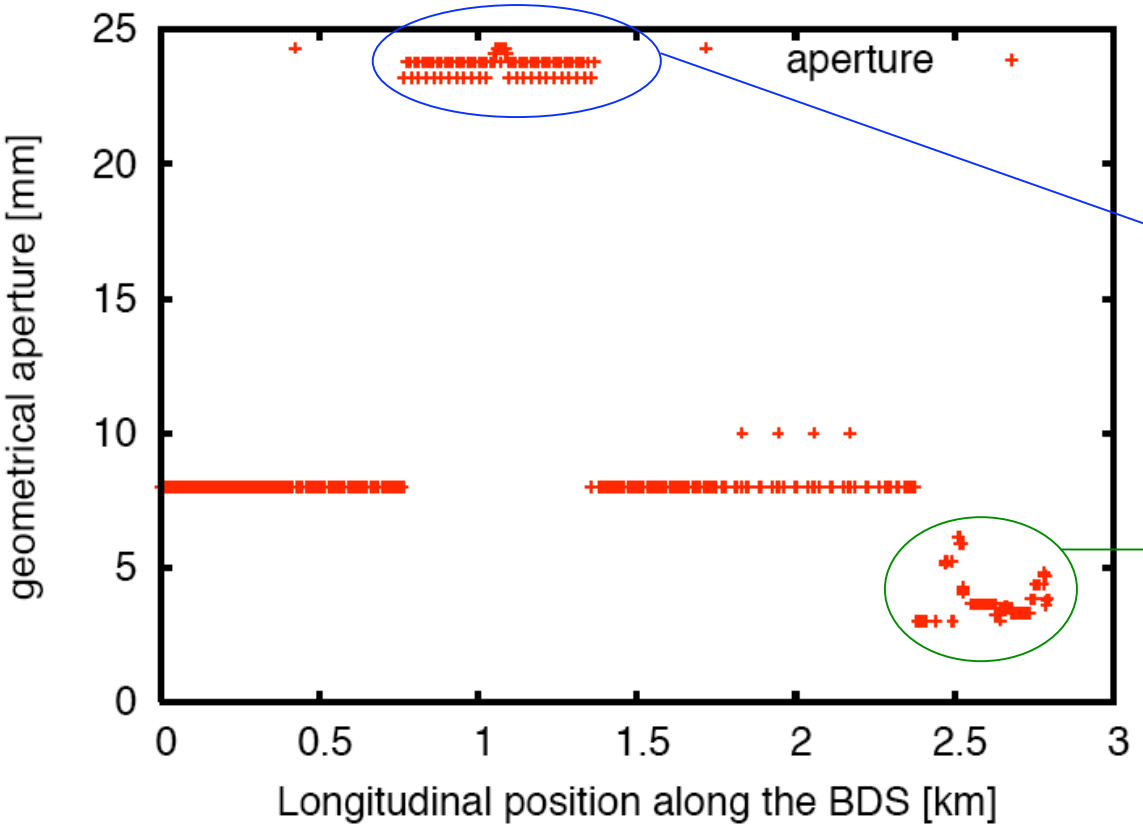


- different beta functions
- lower energy: factor 6
- shorter system
- more bunches

Minimum aperture: 12mm, 14mm safer

Resistive wall effect in the CLIC BDS

Step 2: 3TeV realistic aperture model

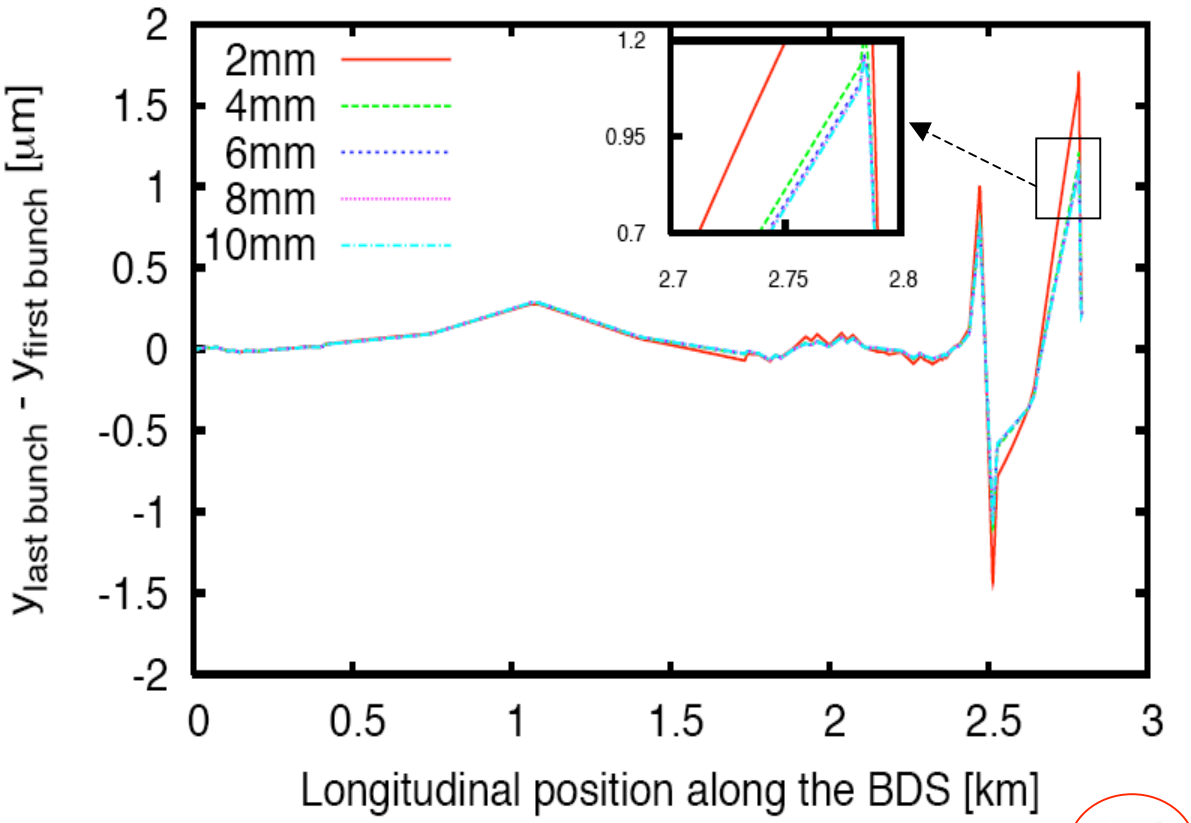


Importance of the energy collimation (big aperture)

Final Focusing System

Resistive wall effect in the CLIC BDS

3TeV copper - realistic aperture model



Test of the model ⇒ Importance of the energy collimation (big aperture)

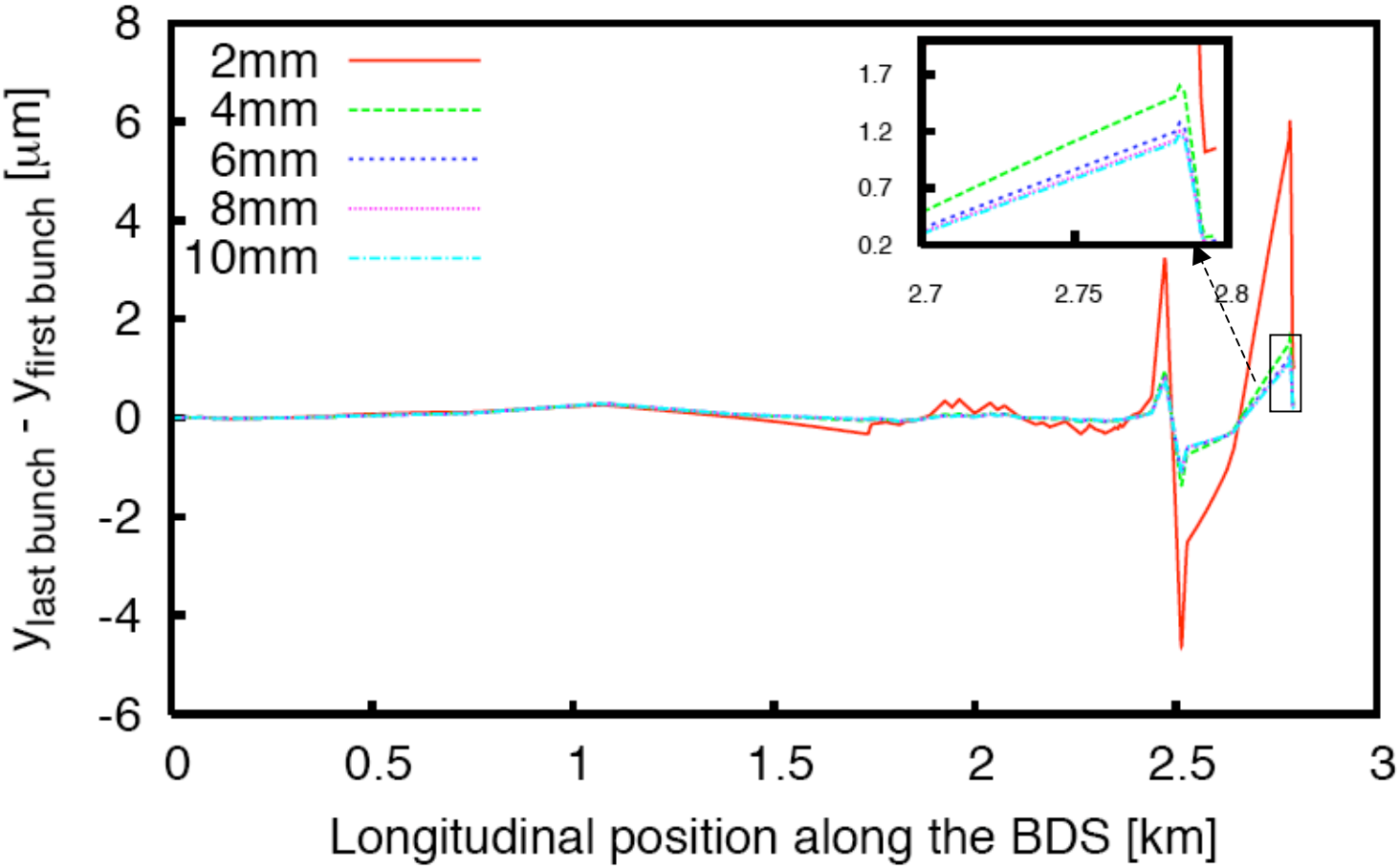
Lower kick ⇒ stabilization of the beam

$$\Delta y' \propto N_e \sum_{n=1}^{N-i-1} W_{\perp d}(nc\Delta t_b)\langle y\rangle_n$$

Minimum aperture: 6mm

Resistive wall effect in the CLIC BDS

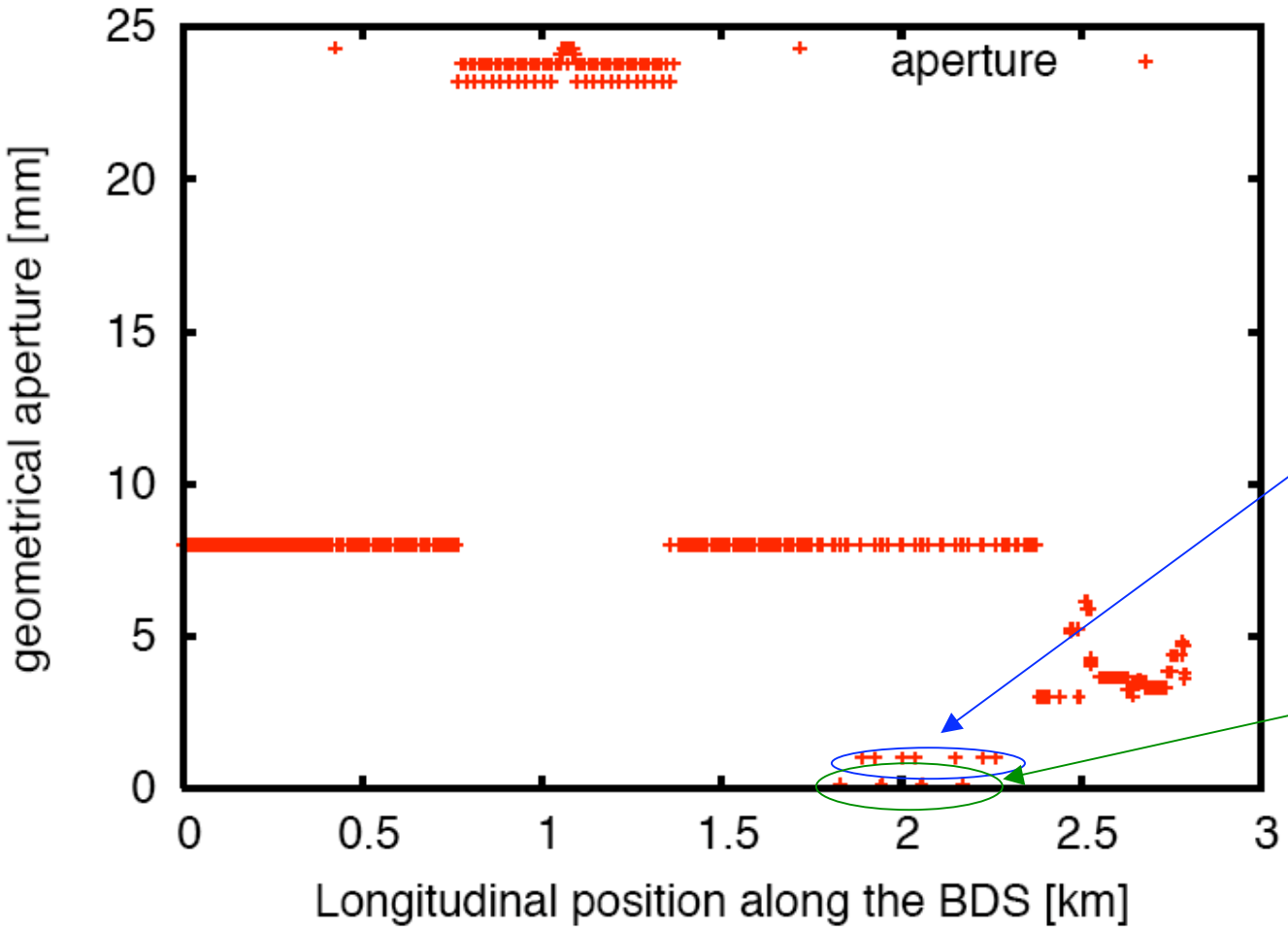
3TeV stainless steel - realistic perture model



Minimum aperture: 8mm

Resistive wall effect in the CLIC BDS

Step 3: 3TeV realistic aperture model + collimators



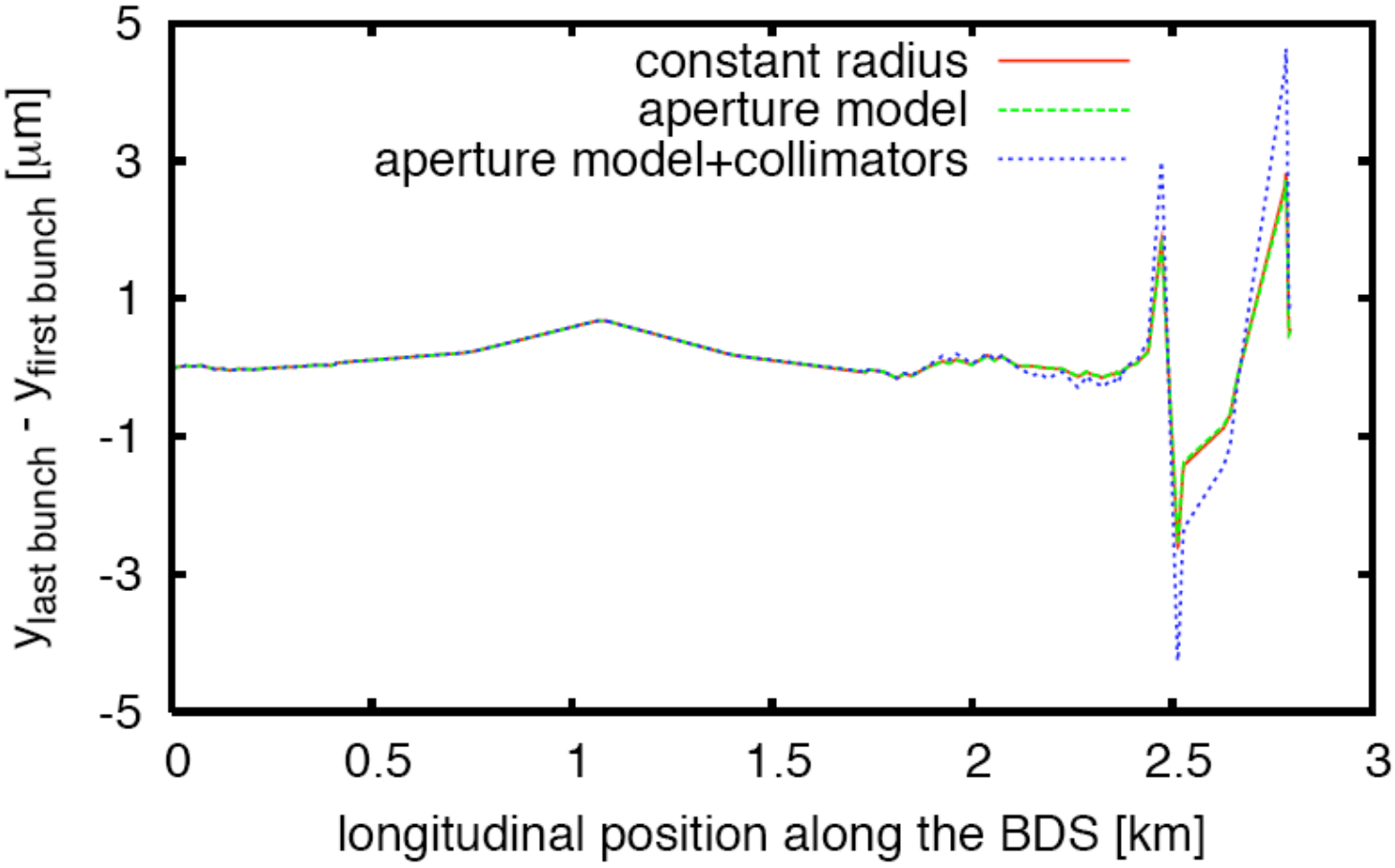
Absorbers: copper-coated Titanium (1mm)

Spoilers: Beryllium (0.1mm)

Resistive wall effect in the CLIC BDS

Effect of the aperture model and the collimators

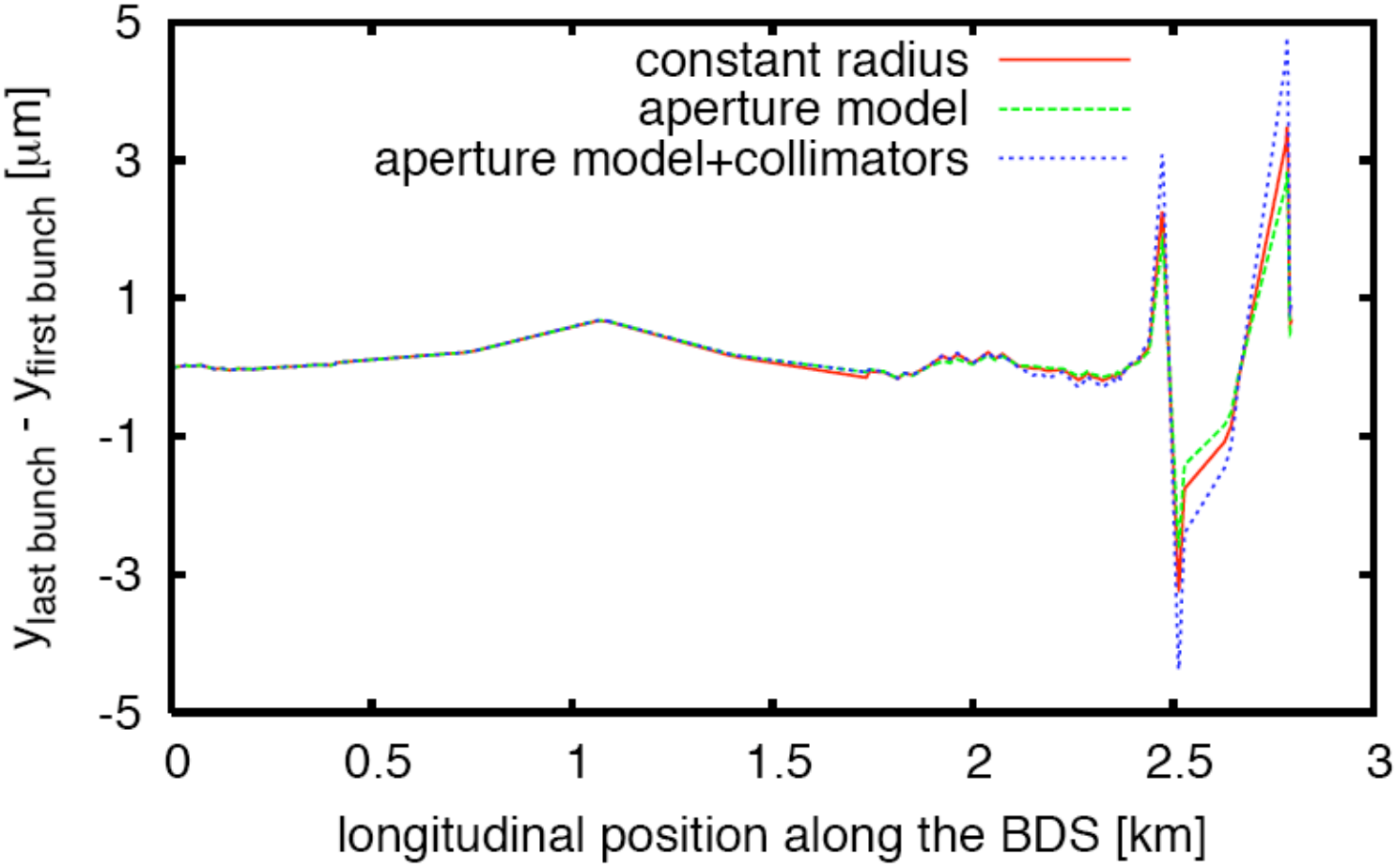
3TeV - copper - 6mm



Resistive wall effect in the CLIC BDS

Effect of the aperture model and the collimators

3TeV - stainless steel - 6mm



Resistive wall effect in the CLIC BDS

Resume:

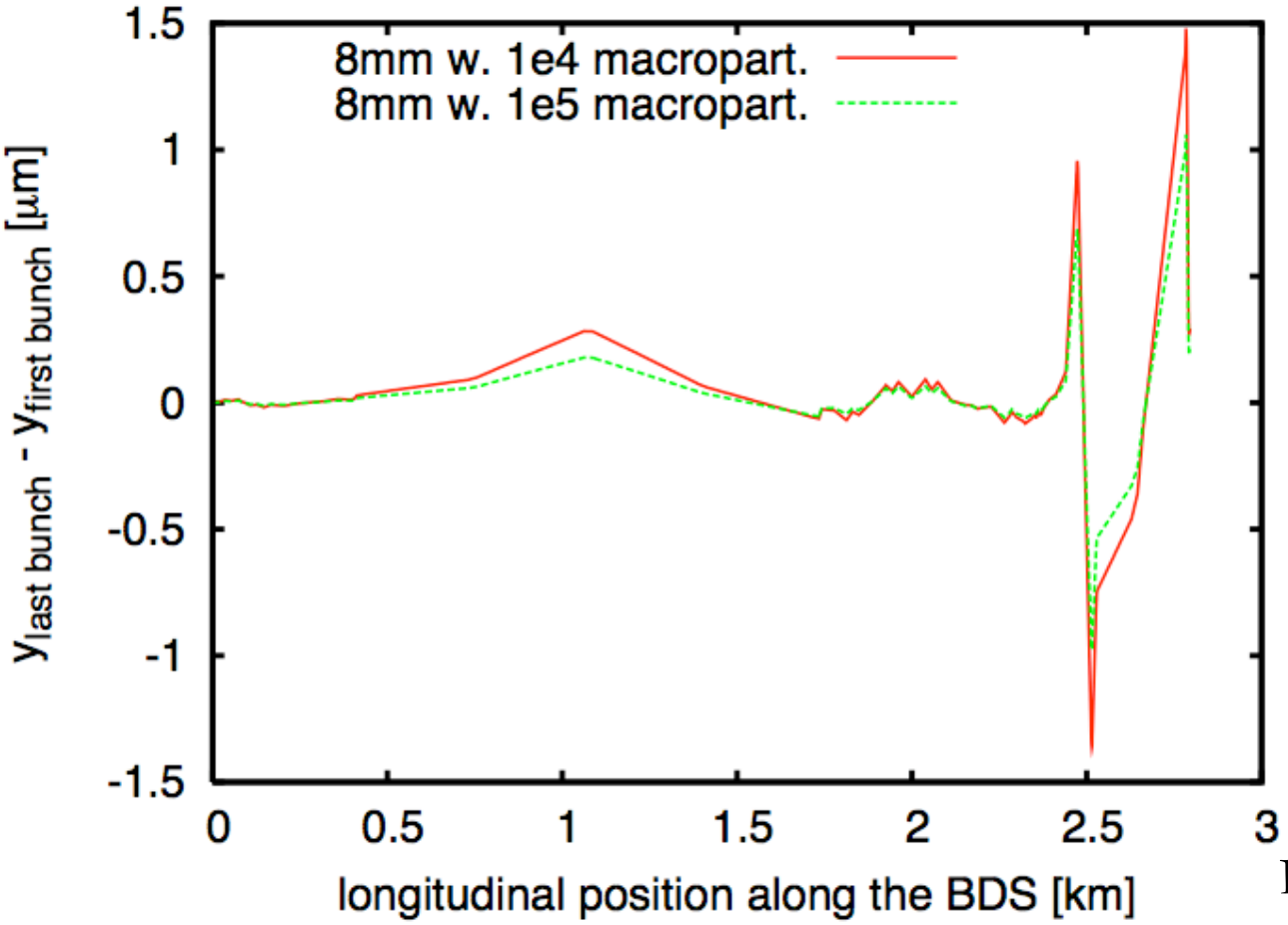
E	model	copper	Stainless steel
500GeV	Constant radius	10mm	12mm
3TeV	Constant radius	8mm	10mm
	Aperture model	6mm	8mm
	Aperture model + collimators	8mm (?)	10mm (?)

What's next?

1. implement the wake fields calculated by N. Mounet into the code (instead of classical formula), it may play a role for the collimators
2. aperture model for 500GeV
3. simulations for 1TeV
4. compare results with analytical model of D. Schulte
5. Single bunch effects (point 1 very important)

Resistive wall effect in the CLIC BDS

Numerical problem ?



We rised the number of macroparticles in the simulation:

↓

Difference between offsets gets smaller

↓

Numerical problem?

Propagation of the errors (especially where ß functions are high)