Coupler's RF-Kick Simulations

with PLACET and Lucretia

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RF-Kick Simulation

- Asymmetries of couplers generate transverse RF field in the accelerating cavities

$$\vec{V} = a\vec{V}_z \times e^{i\varphi}$$

- Period:

upstream rf-kick - **drift space1 – accelerating cavity** - **drift space1** - **downstream rf-kick** - **drift space2**

- Parameters (calculated using Gdfidl):

	Amplitude	Phase ϕ [deg]
Upstream , V_x/V_a	**68.9 10^{-6}**	**-176.9**
Upstream , V_y/V_a	**48.4 10^{-6}**	**176.0**
Downstream, V_x/V_a	**75.5 10^{-6}**	**118.9**
Downstream, V_y/V_a	**43.5 10^{-6}**	**19.5**

- Kick for an off-phase particle

$$\vec{V}(s) = aGLe^{i(\varphi+\psi+ks)}$$

RF-Kick Simulation

$$\vec{V}(s) = (\vec{V}_0 / V_a) GL e^{i(\varphi+\psi+ks)}$$

$$\mathrm{Re}\,\vec{V}(s) = aGL\cos(\varphi + ks) = aGL(\cos\varphi \cdot \cos ks - \sin\varphi \cdot \sin ks)$$

For a short bunch

$$\mathrm{Re}\,\vec{V}(s) \approx -aGL(\cos\varphi + \sin\varphi \cdot \sin ks)$$

- The first term doesn't depend on *s* and may be compensated by static alignment
- The second term responsible for the emittance dilution is equal to

RF-Kick Simulation

The RF-Kick is simulated using a Crab Cavity :

$$\Delta\vec{V} = (-aGL \cdot \sin\varphi)\sin ks$$

- Tilted by 90 deg to give a kick in the Y-Z plane
- Voltage is 364 V

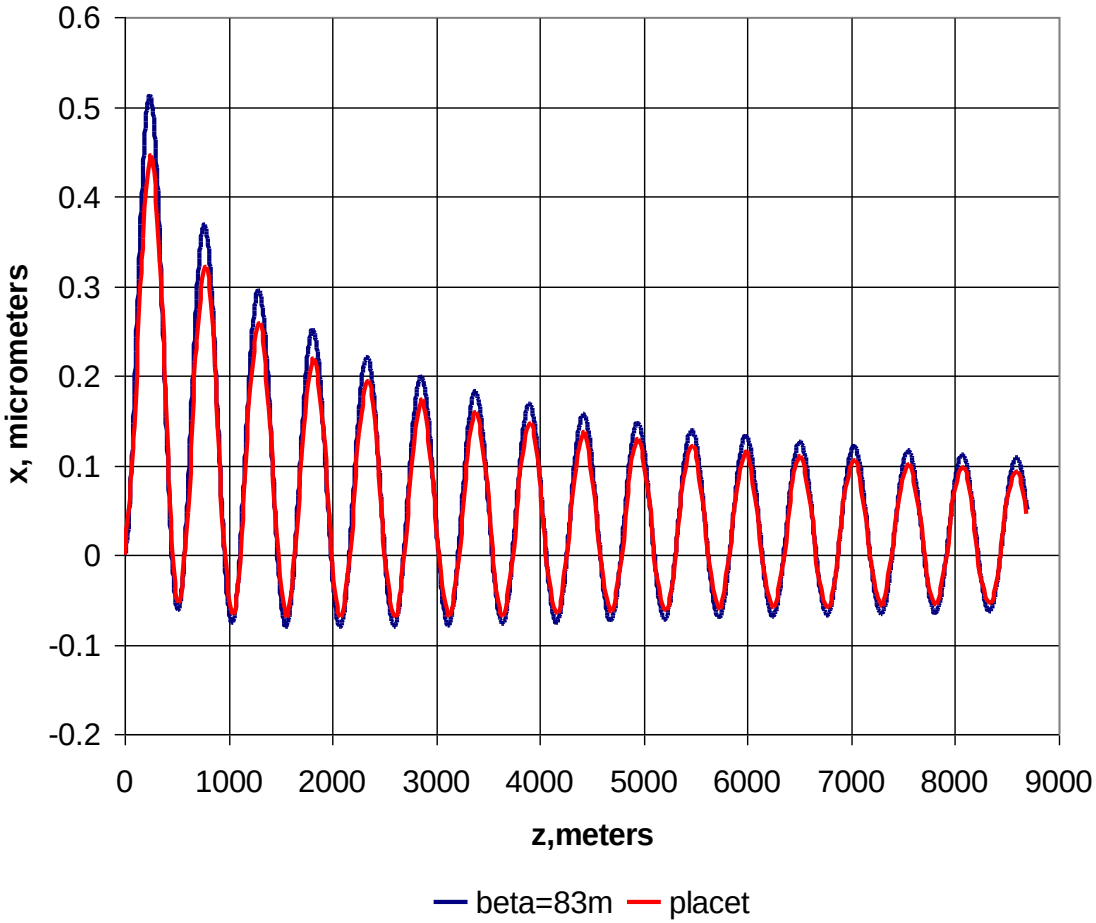
PLACET vs. analytical calulations

Slava Yakovlev

- Slava made an analytical calculation:

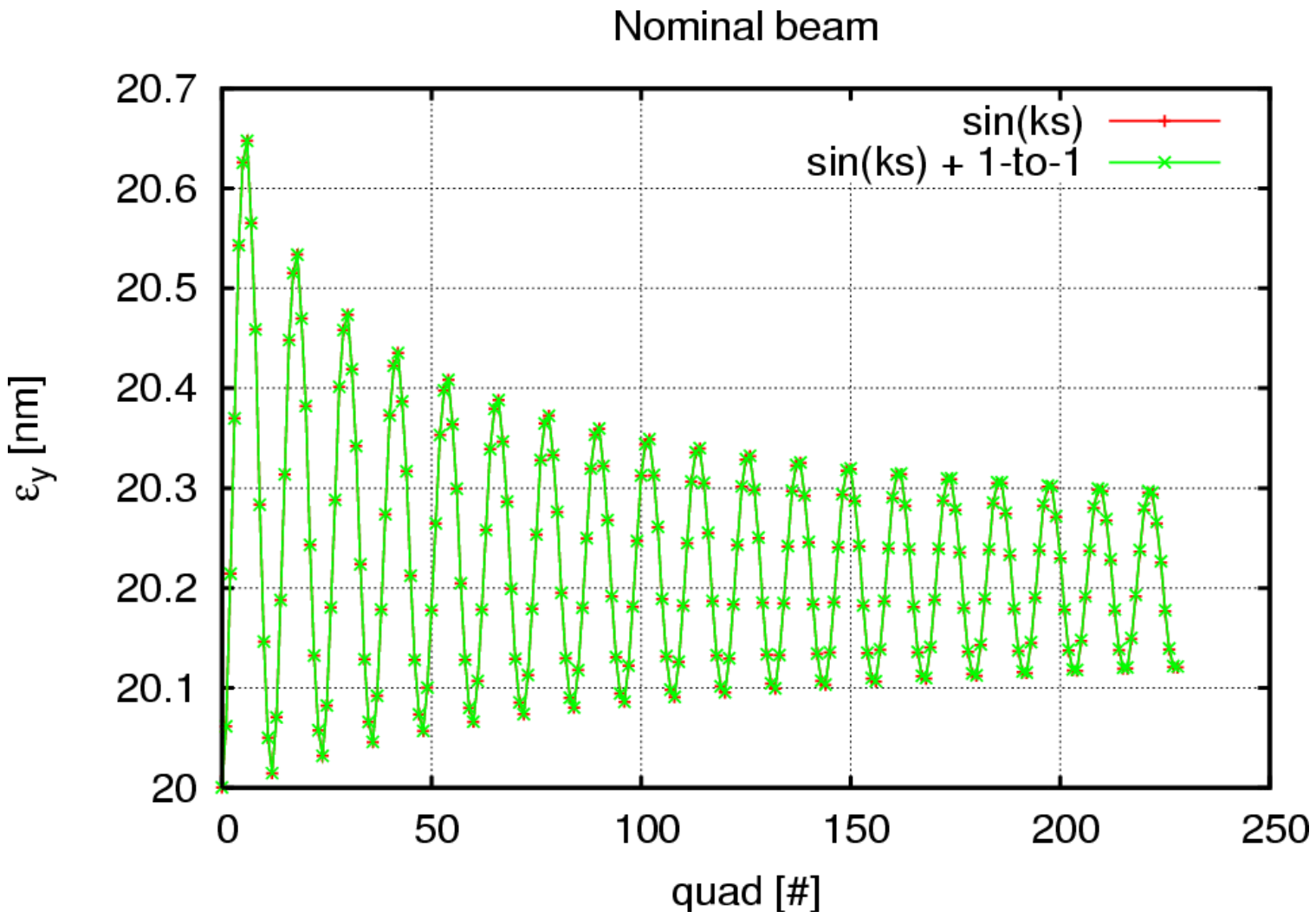
  1. Einitial=15 GeV;
  2. Efinal =223 Gev;
  3. Lacc = 8691 m;
  4. Vy=363.4 V;

  (first 100 FODO cells)



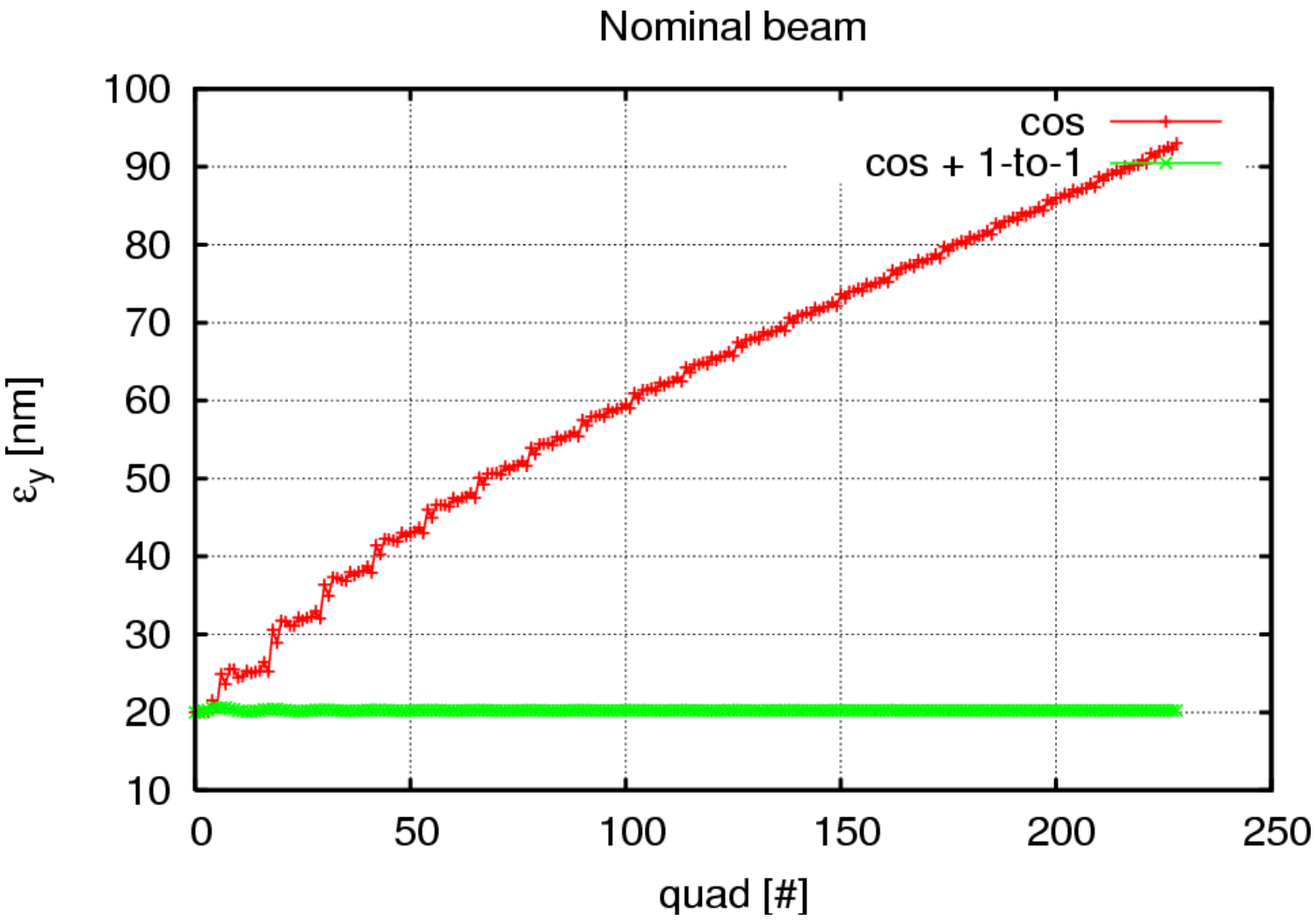
ML: Sin term

Placet Simulation



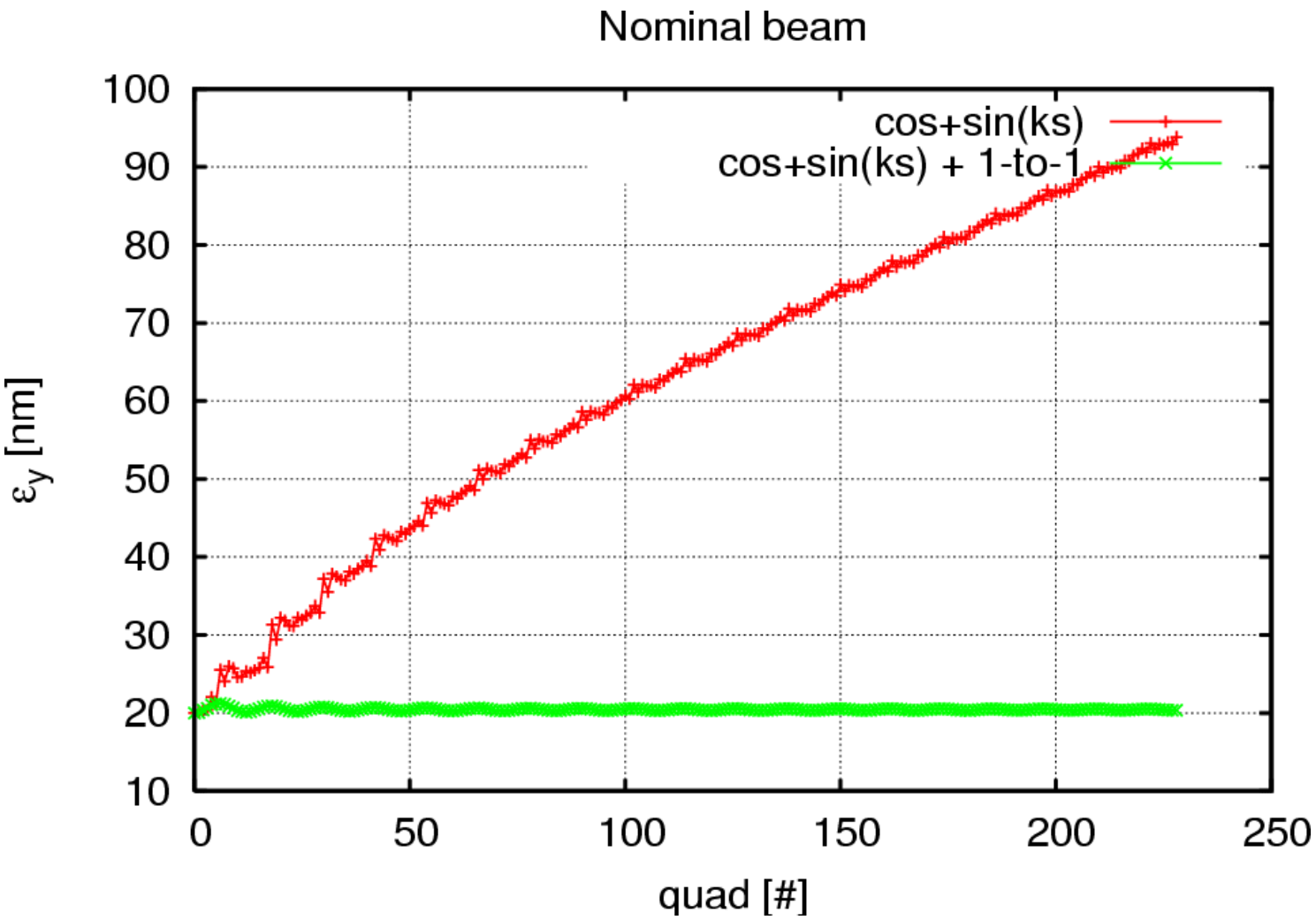
ML: Cos term

Placet Simulation



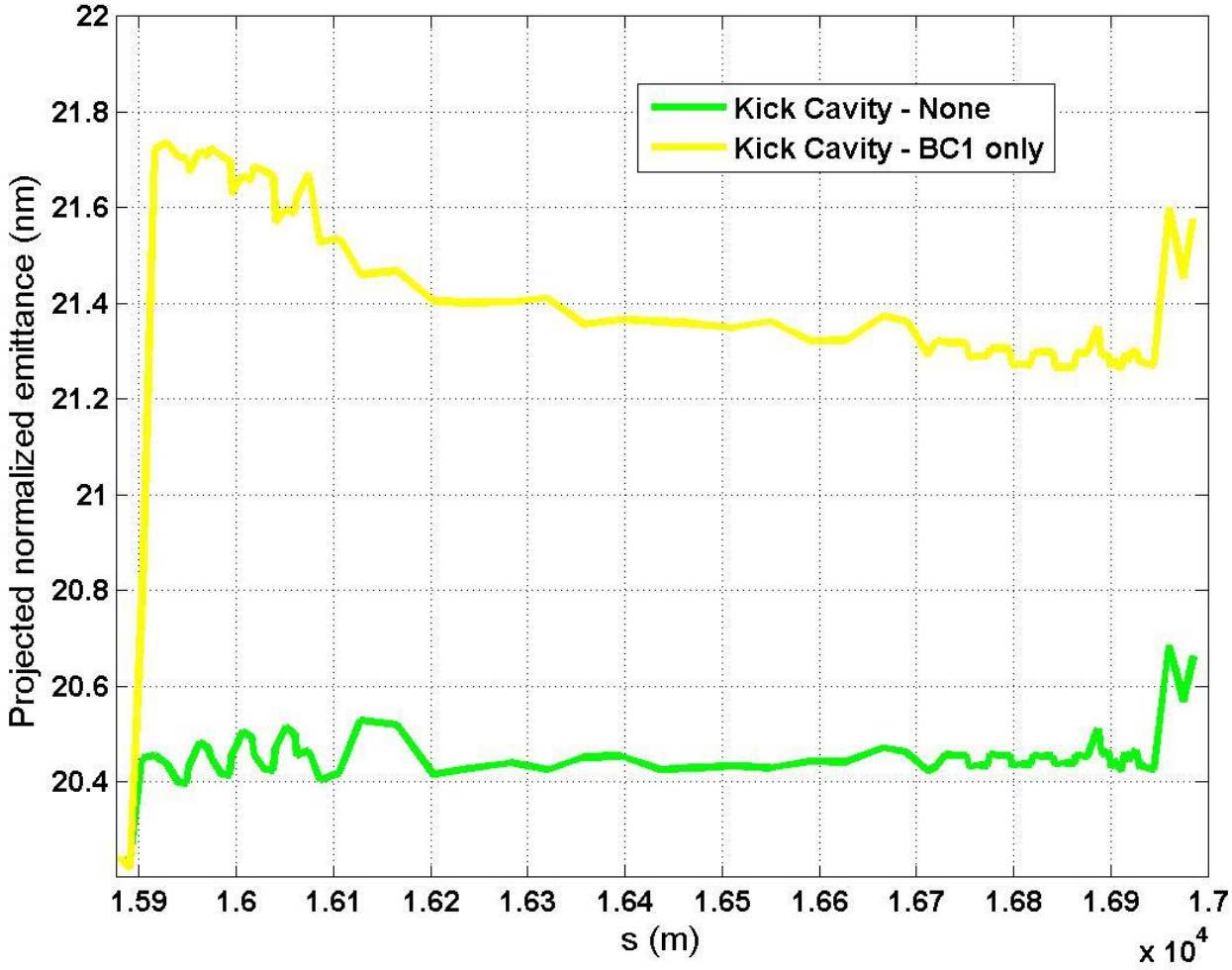
ML: Complete Kick

Placet Simulation



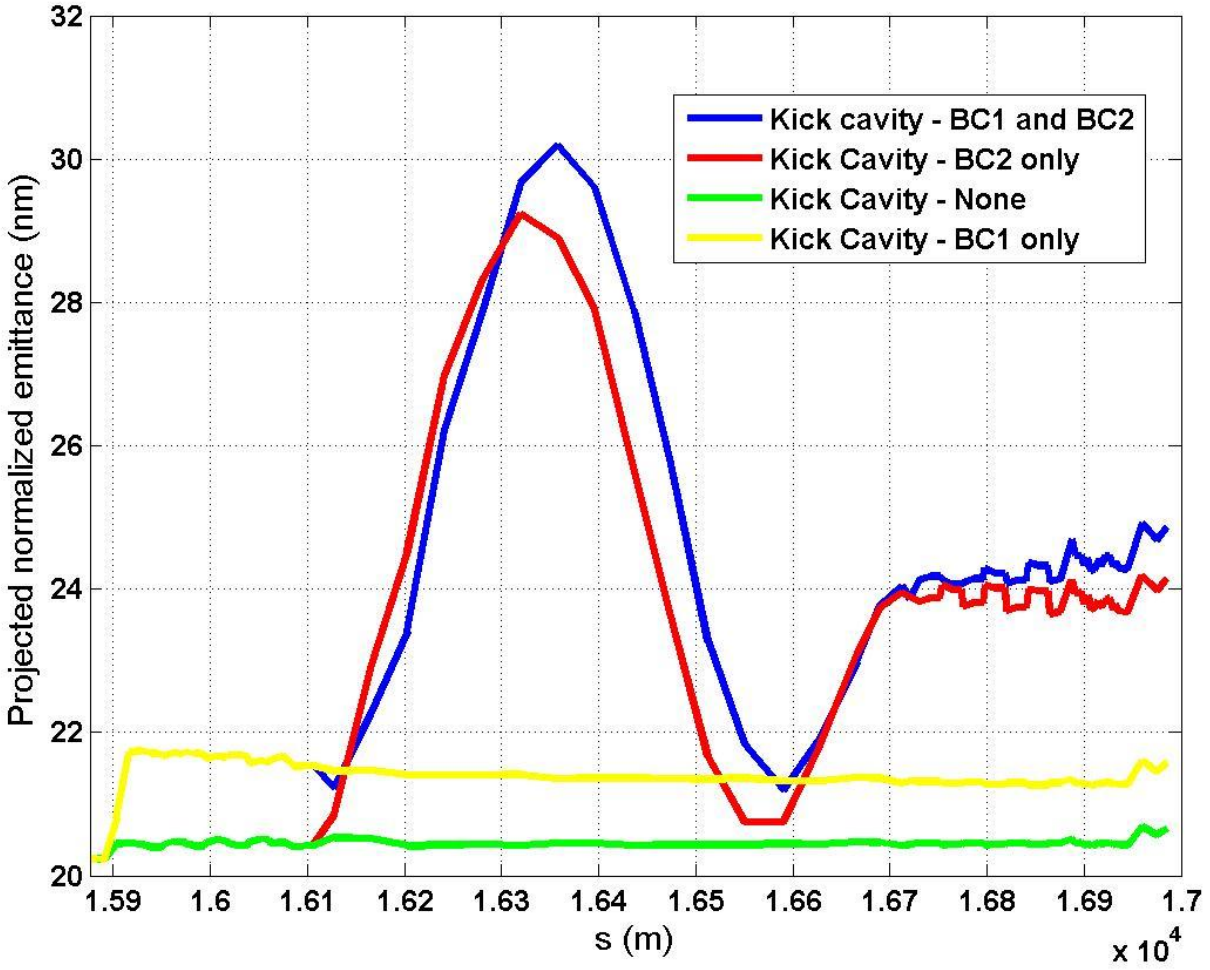
Bunch Compressor 1

Lucretia Simulation



Bunch Compressor 1+2

Lucretia Simulation



Conclusions

- Work still in progress
- Wake-fields not yet considered

- RF-Kick does not seem to be critical in the ML
- It seems to be more critical in the BC, where it cannot corrected using 1-to-1 correction.