Coupler’s RF-Kick and Wakefields PLACET Simulations

in ML, BC1 and BC2

(UPDATE: Correct Wakes in the ML Couplers)

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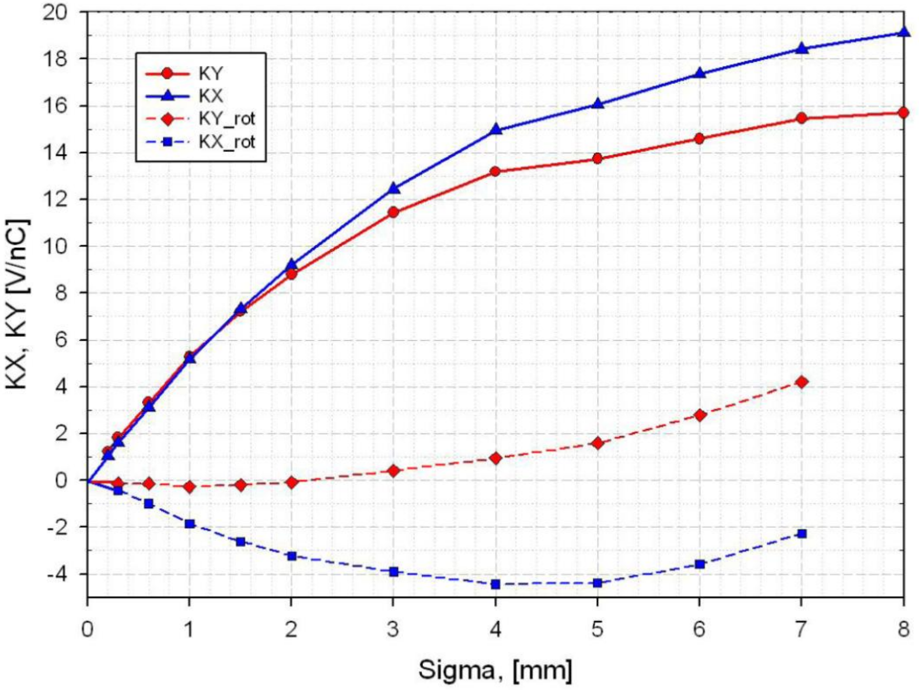
A. Latina, A. Lunin, K. Ranjan,
N. Solyak, V. Yakovlev

History (I)

- Originally people believed that couplers' wakes were independent of the bunch length
- Afterwards we found that for:
  - Short bunches it depends linearly on the bunch length
  - For longer bunches it depends (about) on the square root of the bunch length

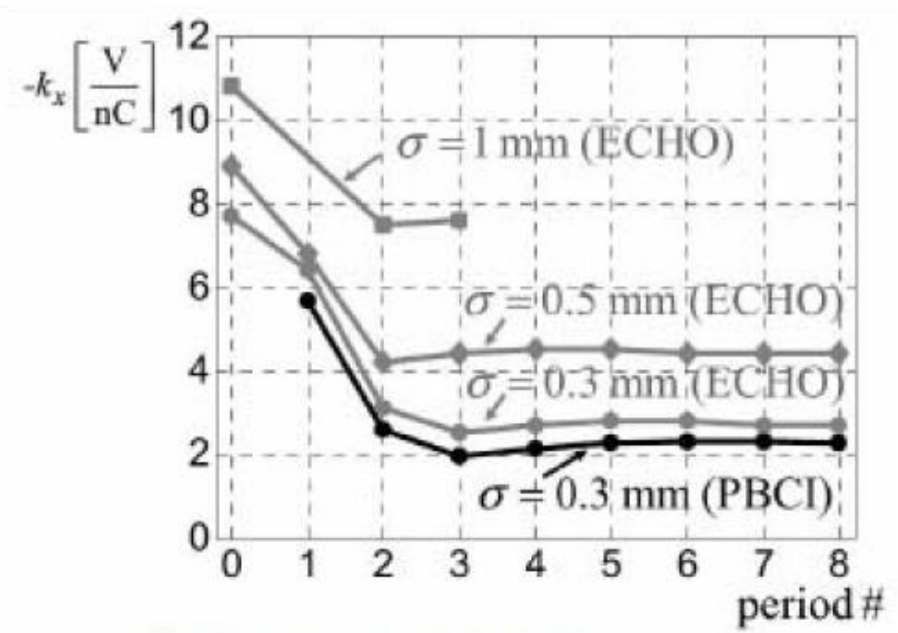
  - for 0.3 mm is about 3 times smaller than for 1 mm bunch length (that was used for earlier calculations)



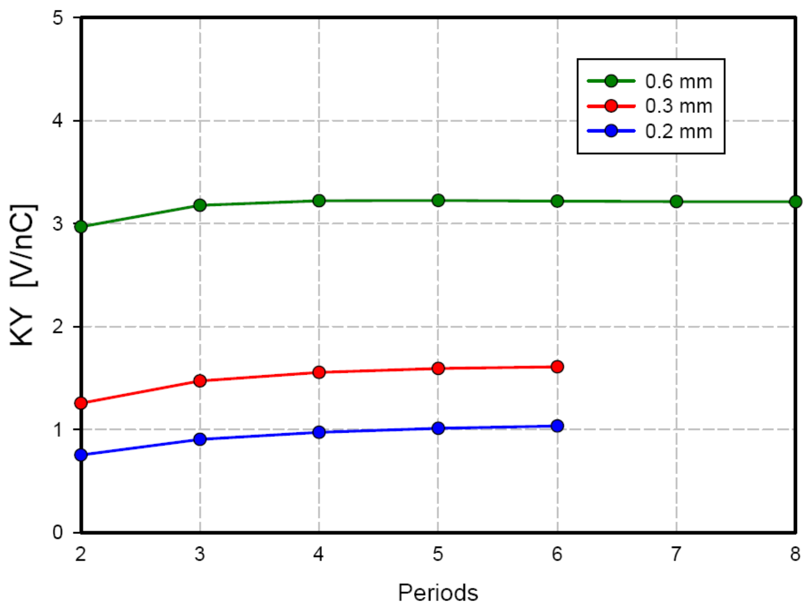
History (II)

- Karl Bane found a simple explanation for this (EPAC2008)

- Then two calculation were performed:
    - By Igor, using ECHO 3D and PBCI : indirect integration and considering the beamline wakes
    - By us, using GdFidL : no indirect integration (i.e. no beamline wakes) <= Warner Bruns' suggestion to save computational time
        - Asymptotic behavior is the **same**



M. Dohlus et al., MOPP013



by Vyacheslav Yakovlev (Slava)

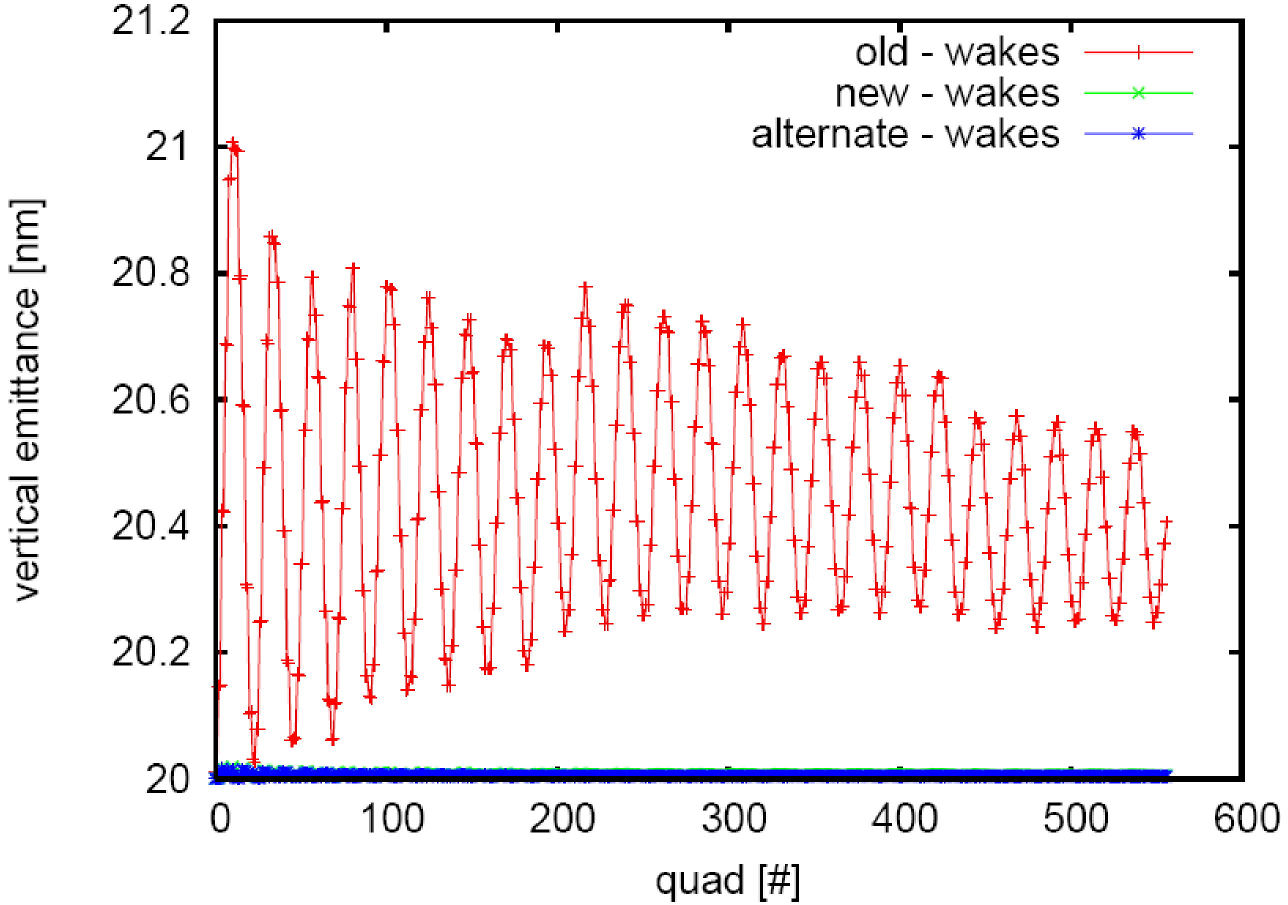
Simulation Setup

- All simulations performed using PLACET
- Lattice: ILC2007b
- ML: positron line

	BC1	BC2	ML
charge	$2 \cdot 10^{10}$ e	$2 \cdot 10^{10}$ e	$2 \cdot 10^{10}$ e
b.length	9 mm	1 mm	300 μm
e.spread	0.15 %	2.5 %	1.07 %
initial energy	5 GeV	4.88 GeV	15 GeV
Emittance x/y	8 μm / 20 nm	8 μm / 20 nm	8 μm / 20 nm

Main Linac: Coupler’s Wakefields

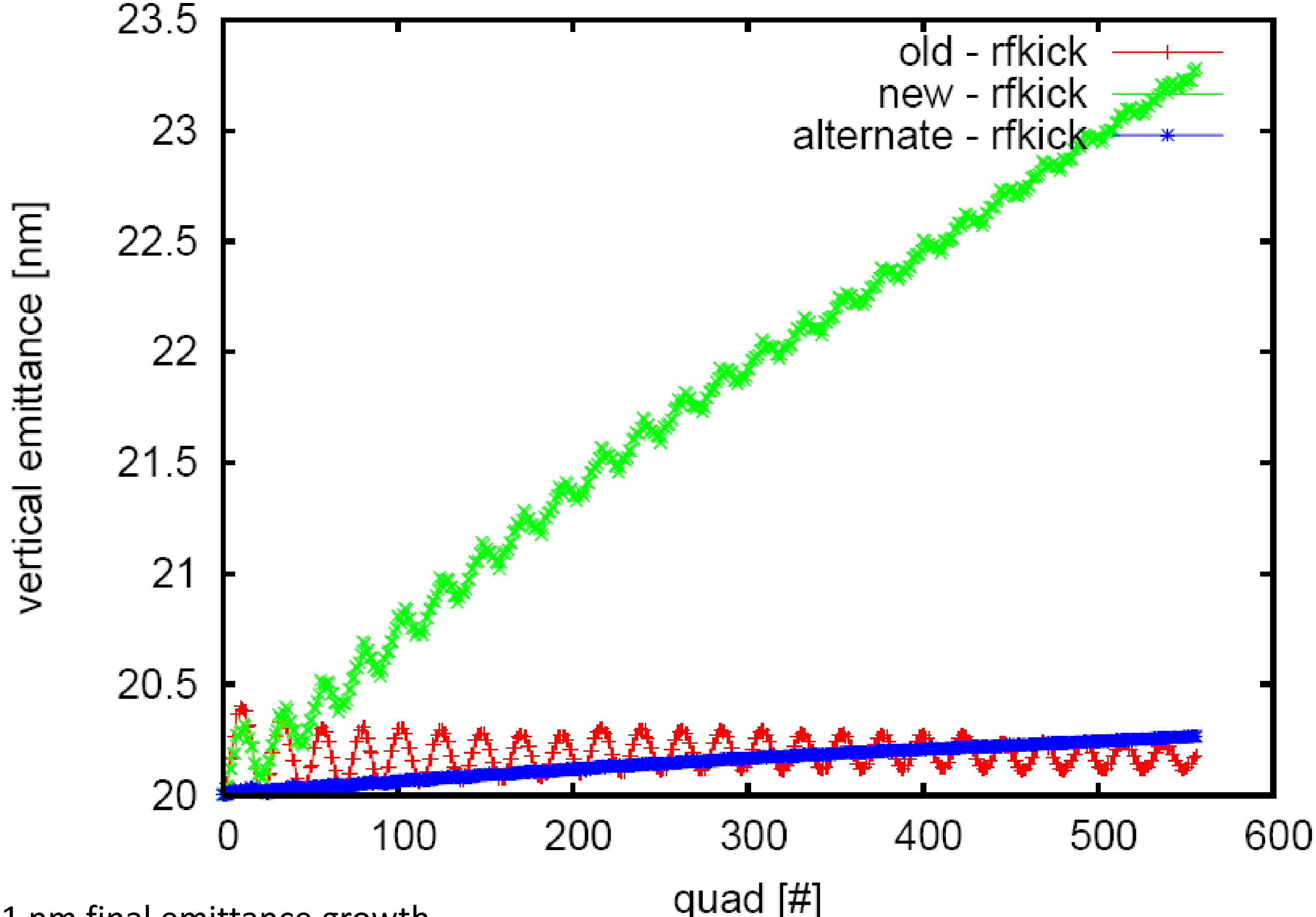
•ILC 2007b lattice
• Wakefields only
• Comparison “old”, “new”, “alternate”: notice that “new” configuration was expressly introduced to set at zero the wakes’ kick



• “old” configuration gives 0.4 nm final emittance growth

Main Linac: RF-Kick

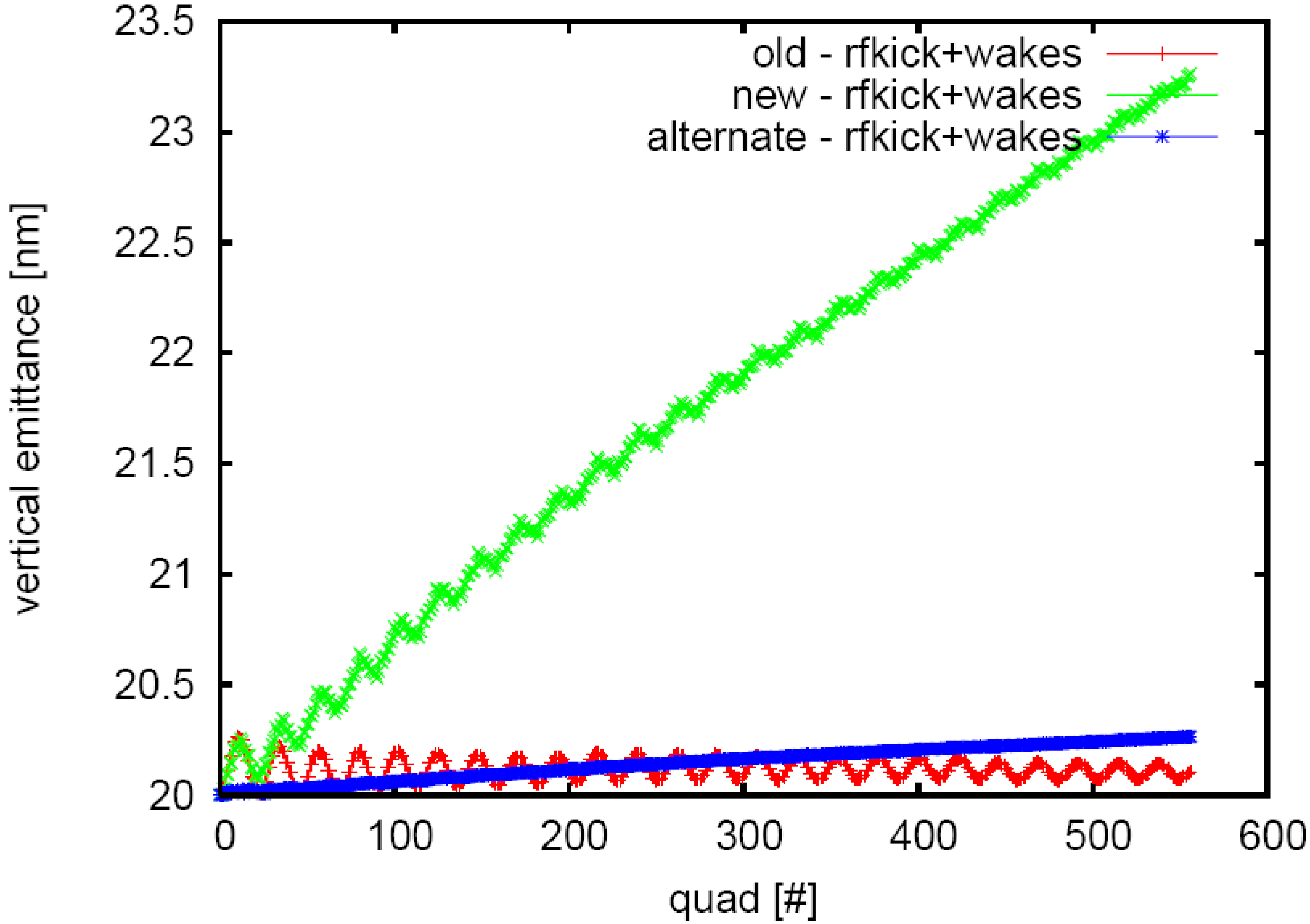
- ILC2007b, positron linac
- The opposite of the wakes: *old* is better, *new* is much worse
- Comparison: “new”, “old”, “alternate”: notice that the “alternate” configuration was adopted to reduce the effect of the RF-Kick, that is critical in the “new” configuration



- “old” is better: 0.1 nm final emittance growth

Main Linac: RF-Kick + Wakes

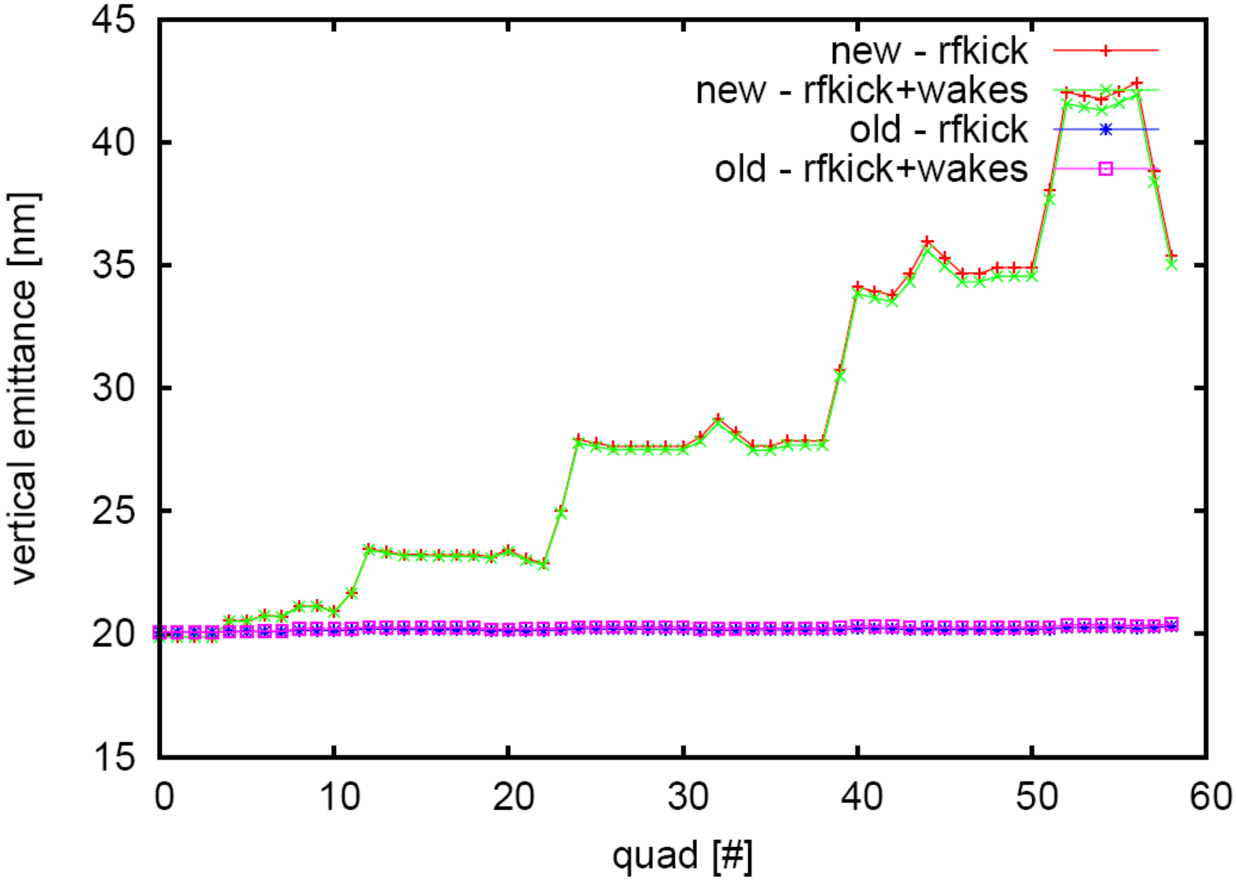
- ILC2007b, positron linac
- Comparison: “new”, “old”, “alternate”



- “alternate” reduces the RF-Kick and allows to use the “new” configuration, that compensates the wakes…
- nevertheless the “old” configuration is better: 0.1 nm final emittance growth

BC1: summary

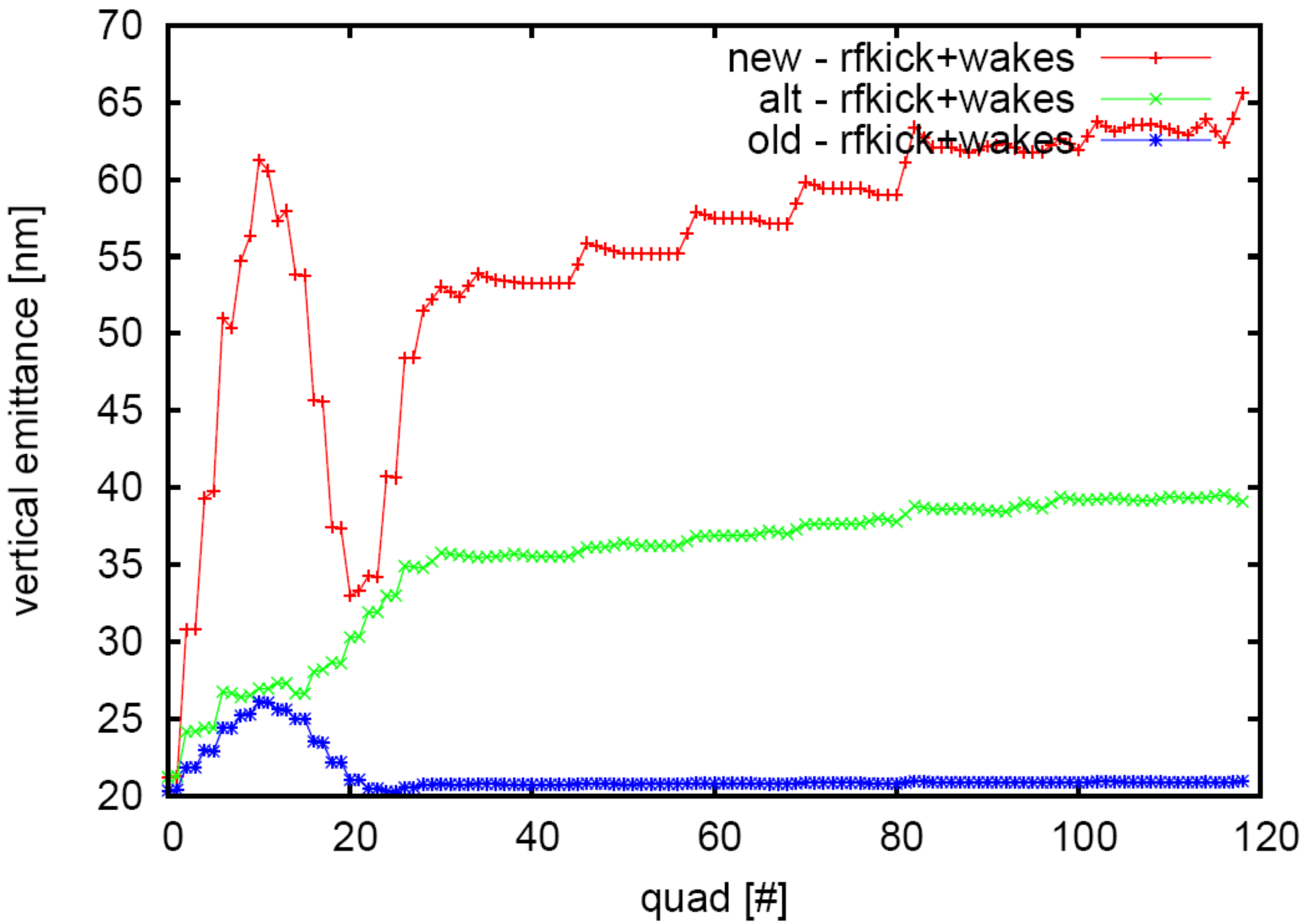
- RF-Kick and wakes are simulated
- with old config emittance growth is labout 0.4 nm



- OLD Config: Final emittance is 20.4 nm.

BC2: summary

- RF-Kick and wakes are simulated
  "old" config performs better; final emittance growth is 0.95 nm



- OLD Config: Final emittance is 20.95 nm

Summary tables and conclusions

Final emittance growth due to RF-Kick and Wakes (in nm)

RF-Kick + Wakes

	BC1		BC2			ML		
	old	new	old	new	alt	old	new	alt
no correction	1.55	95.88	4.89	7130.1	1971.2	50.54	7405.25	634.56
1-to-1 correction	1.20	15.03	0.95	53.06	22.68	0.16	11.64	0.96
1-to-1 disp free	0.40	15.03	0.95	45.59	19.08	0.11	3.26	0.26

Conclusion:

Couplers' RFKick+Wakes do not seem to be a problem in BC1, BC2 and ML

Note that the final emittance growth in the ML when one includes *both RF-Kick and wakefield kick* is smaller (0.11 nm) than the final emittance growth due to only the wakefield kick (0.4 nm).

ML: tables

Final emittance growth in nm

RF-Kick

	ML				
	old	new	alt	DESY/old	DESY/new
no correction	48.69	7407.3	634.7	-	-
1-to-1 correction	0.21	11.65	0.96	-	5.5
1-to-1 disp free	0.17	3.28	0.26	0.0	1.8

Wakes

	ML		
	old	new	DESY/new
no correction	0.45	0.0	0.0
1-to-1 correction	0.41	0.0	0.0
1-to-1 disp free	0.40	0.0	0.0

BC: tables

Final emittance growth in nm

RF-Kick

	BC1		BC2		
	old	new	old	new	alt
no correction	1.95	97.9	1.81	7408.74	1971.3
1-to-1 correction	0.69	15.39	0.32	52.73	22.59
1-to-1 disp free	0.31	15.39	0.32	45.23	18.91

Wakes

	BC1		BC2		
	old	new	old	new	alt
no correction	1.65	0.3	1.9	0.2	0.2
1-to-1 correction	1.61	0.2	1.3	0.2	0.2
1-to-1 disp free	0.3	0.2	1.3	0.2	0.2

References @ EPAC08

1. **RF Kick in the ILC Acceleration Structure** **MOPP042.PDF**

   V. P. Yakovlev, I. V. Gonin, A. Latina, A. Lunin, K. Ranjan, N. Solyak (Fermilab, Batavia, Illinois)

2. **Transverse Wake Field Simulations for the ILC Acceleration Structure** **MOPP043.PDF**

   V. P. Yakovlev, A. Lunin, N. Solyak (Fermilab, Batavia, Illinois)

3. **Simulation Studies on Coupler Wakefield and RF Kicks for the International Linear Collider with MERLIN** **TUPP047.PDF**

   D. Kruecker, I. Melzer-Pellmann, F. Poirier, N. J. Walker (DESY, Hamburg)

4. **Wakefield and RF Kicks due to Coupler Asymmetry in TESLA-type Accelerating Cavities** **TUPP019.PDF**

   Karl Leopold Freitag Bane, Chris Adolphsen, Zenghai Li (SLAC, Menlo Park, California), Martin Dohlus, Igor Zagorodnov (DESY, Hamburg), Ivan V. Gonin, Andrei Lunin, Nikolay Solyak, Vyacheslav P. Yakovlev (Fermilab, Batavia, Illinois), Erion Gjonaj, Thomas Weiland (TEMF, Darmstadt)