Detector Solenoid effects in CLIC

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CLIC Workshop

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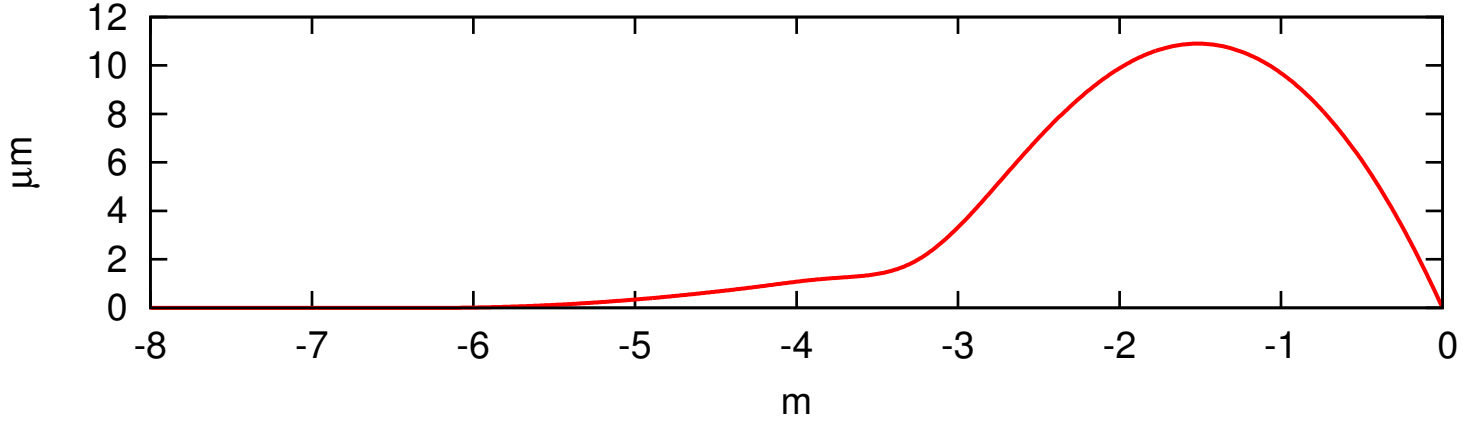
Introduction

- Motivation
- Tuning Studies
- Updated Field Maps
- Anti-Solenoid Effects

Detector Solenoid for lepton colliders

- Large (horizontal) crossing angle -> strong (horizontal) magnetic field on beam -> strong (vertical) orbit deflection
- Orbit deflection produces:
  - Dispersion at IP.
  - Coupling at IP (mainly y-x').
  - Incoherent synchrotron radiation -> emittance increase (not recoverable).



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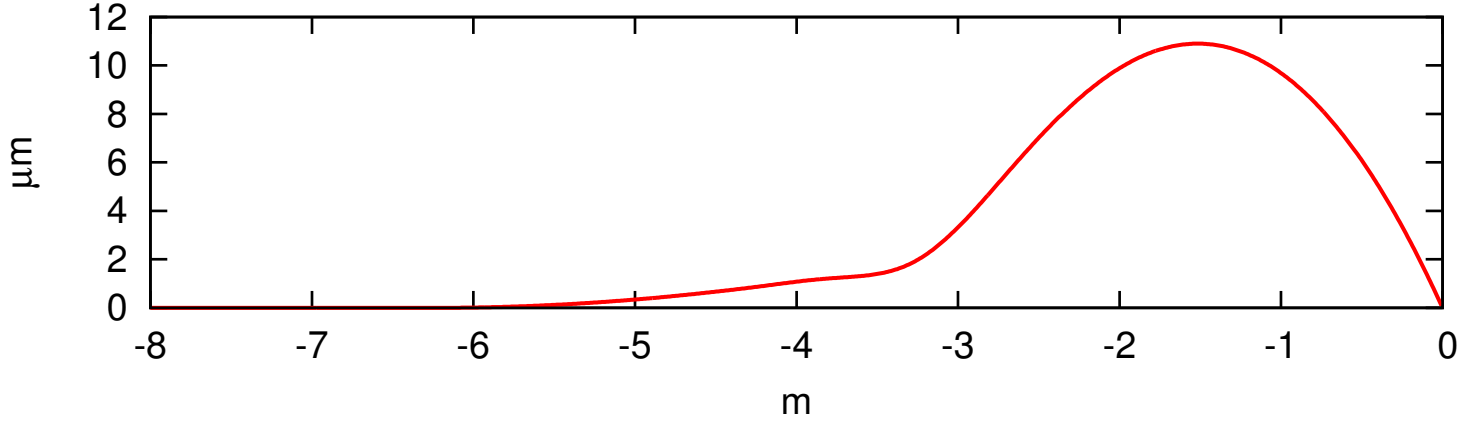

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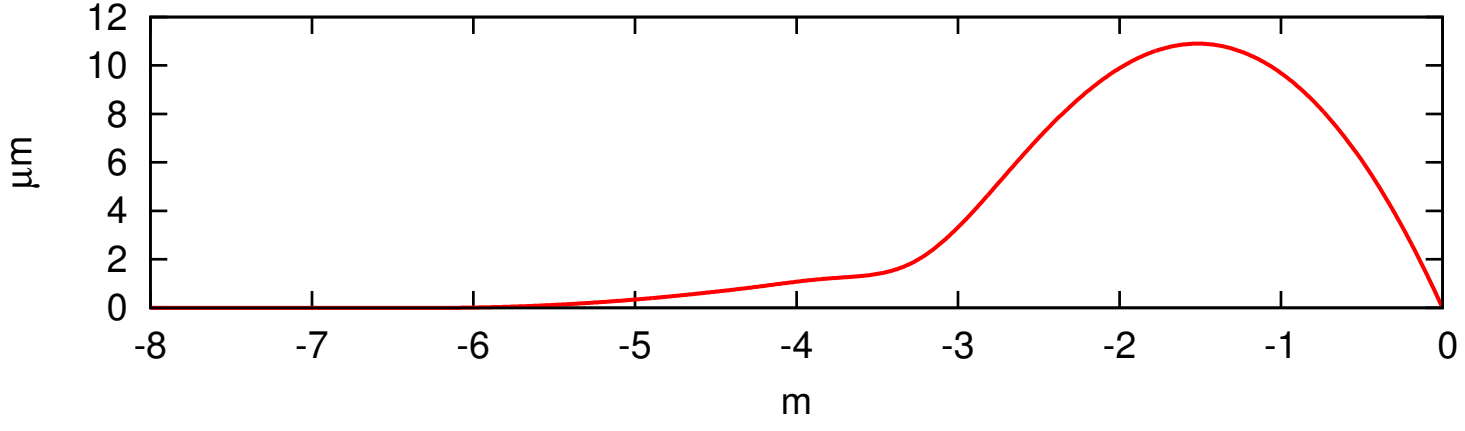
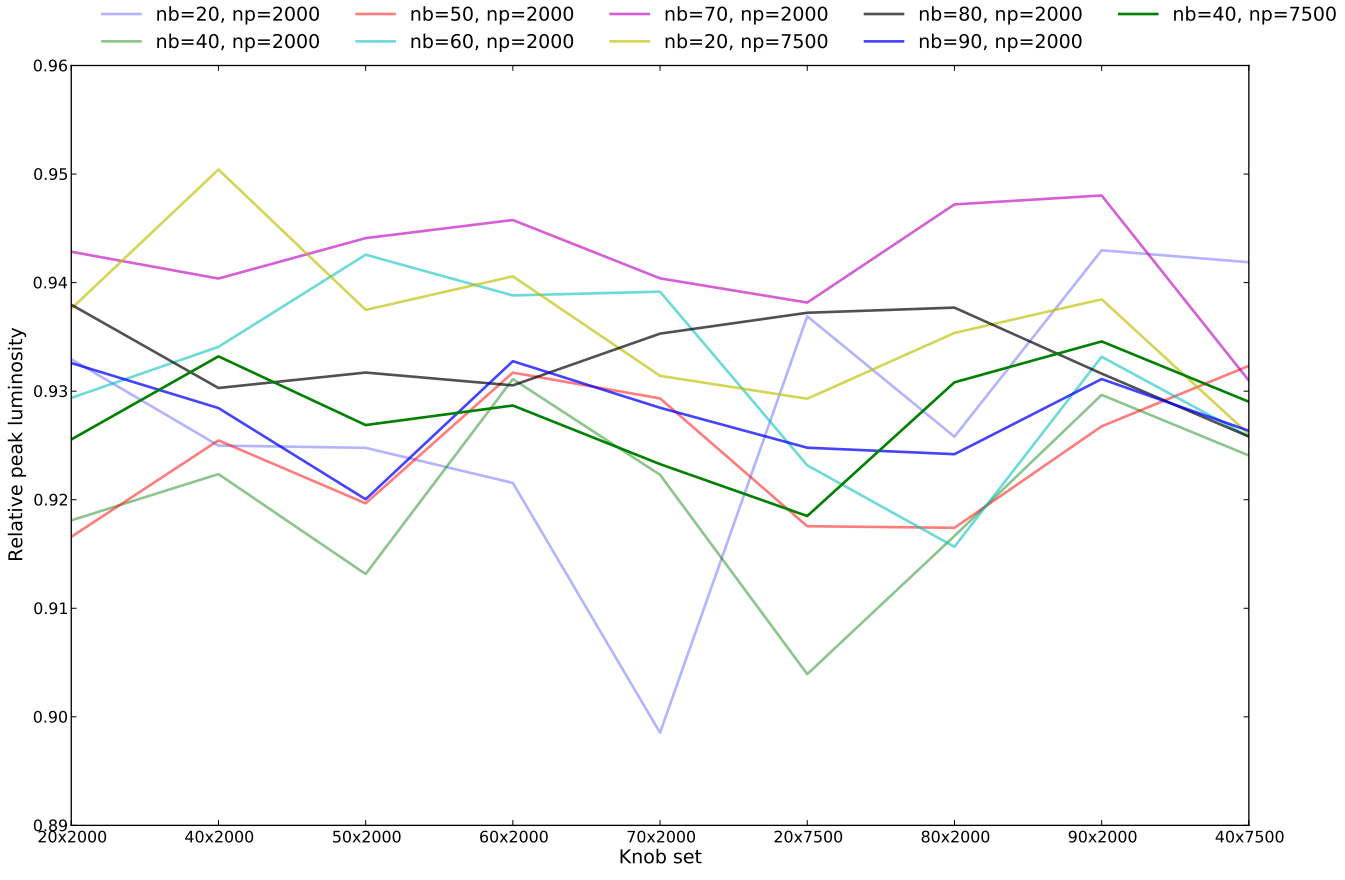


Example of Tuning Simulations



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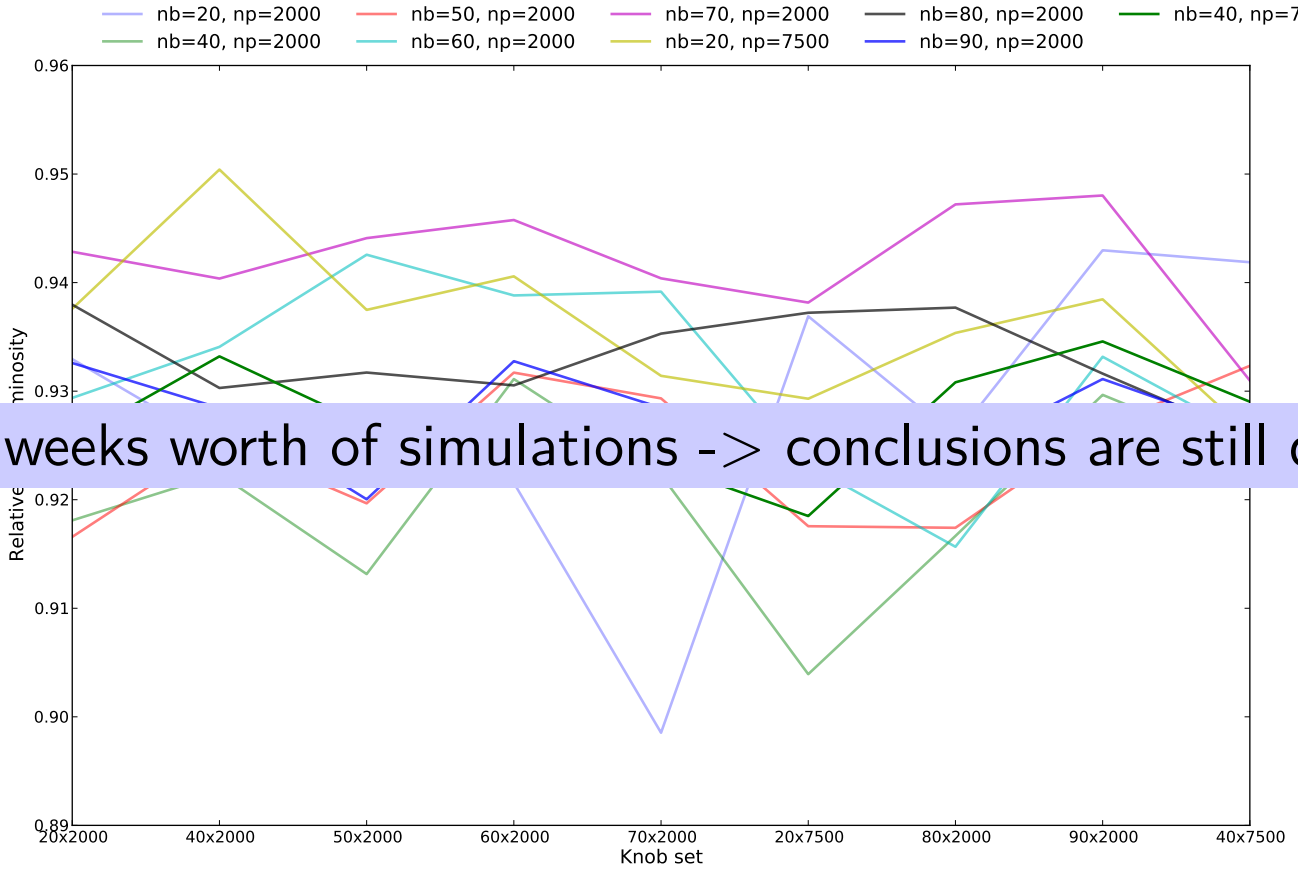

Several weeks worth of simulations -> conclusions are still difficult

"Deterministic" Simulation Procedure

- See earlier presentations for details (or ask me afterwards).
- Basically: Start with an ideal distribution at IP, track backwards through beamline without synchrotron radiation, finally track forward with synchrotron radiation.
- Obtains: The luminosity loss due to ISR from the solenoid field alone, excluded of losses due to coupling/correction (since beam is already corrected).

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Tuning Simulations

Should be able to end up with **same luminosity loss** as "forward-backward-forward" simulations if we find the ideal correction?

- 5 sextupoles in BDS -> 5 horizontal and 5 vertical knobs.
- QD0 vertical displacement provide one additional knob.
- See e.g. PRSTAB 15, 051006 for details about these knobs.
- Algorithm: Iterate over knobs and do a parabola fit for each.

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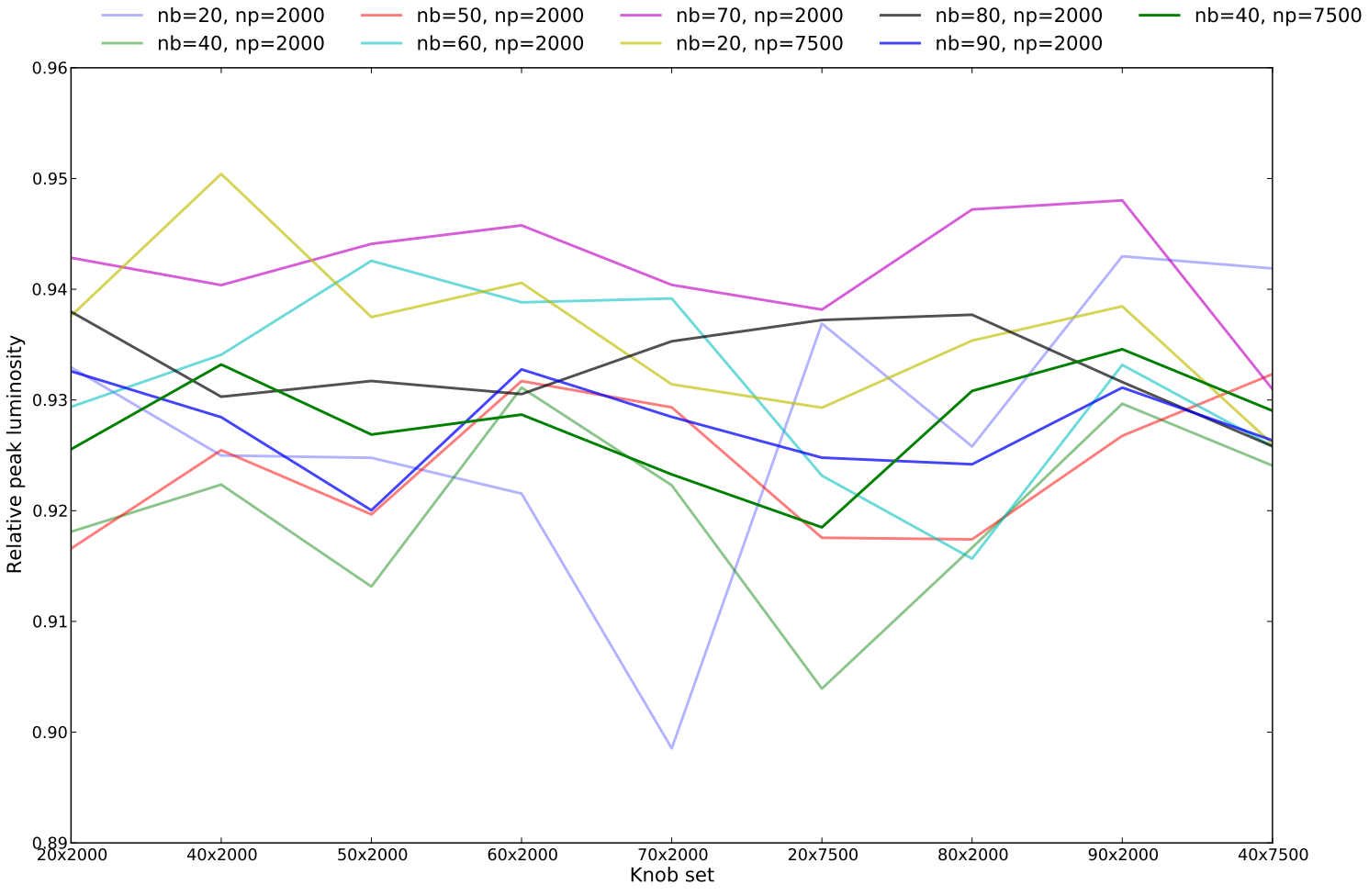


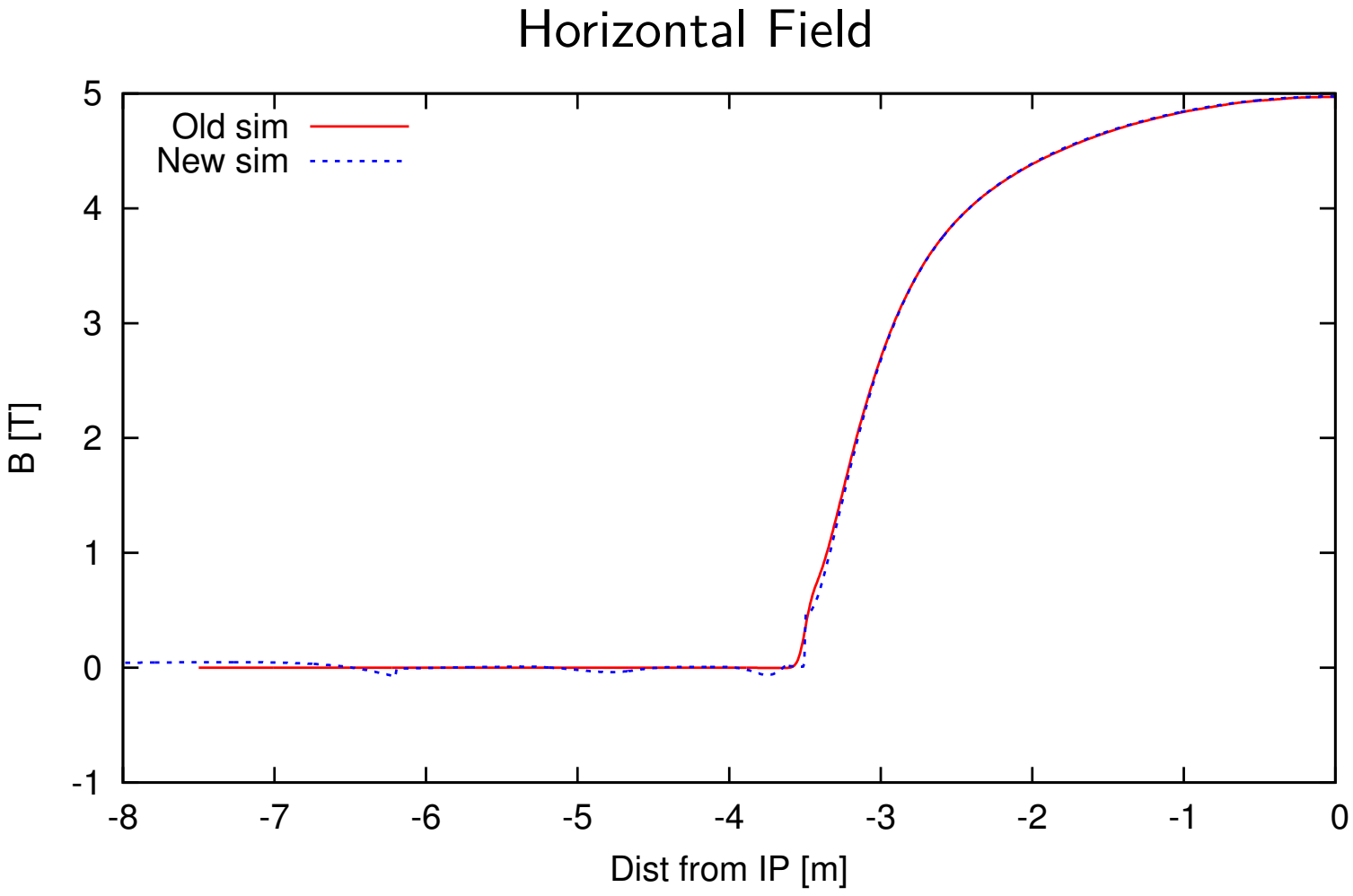
Code Improvements

Parallelized track routine using OpenMP ->
3x faster on quad core in testing.

- Parallelizing regular sbend algorithm ->
  TestNoCorrection 2x faster for BDS
- Looks very promising as a general PLACET improvement.

Barbara is implementing tracking through bends and solenoid together.

New Solenoid+Anti-Solenoid Field Simulation



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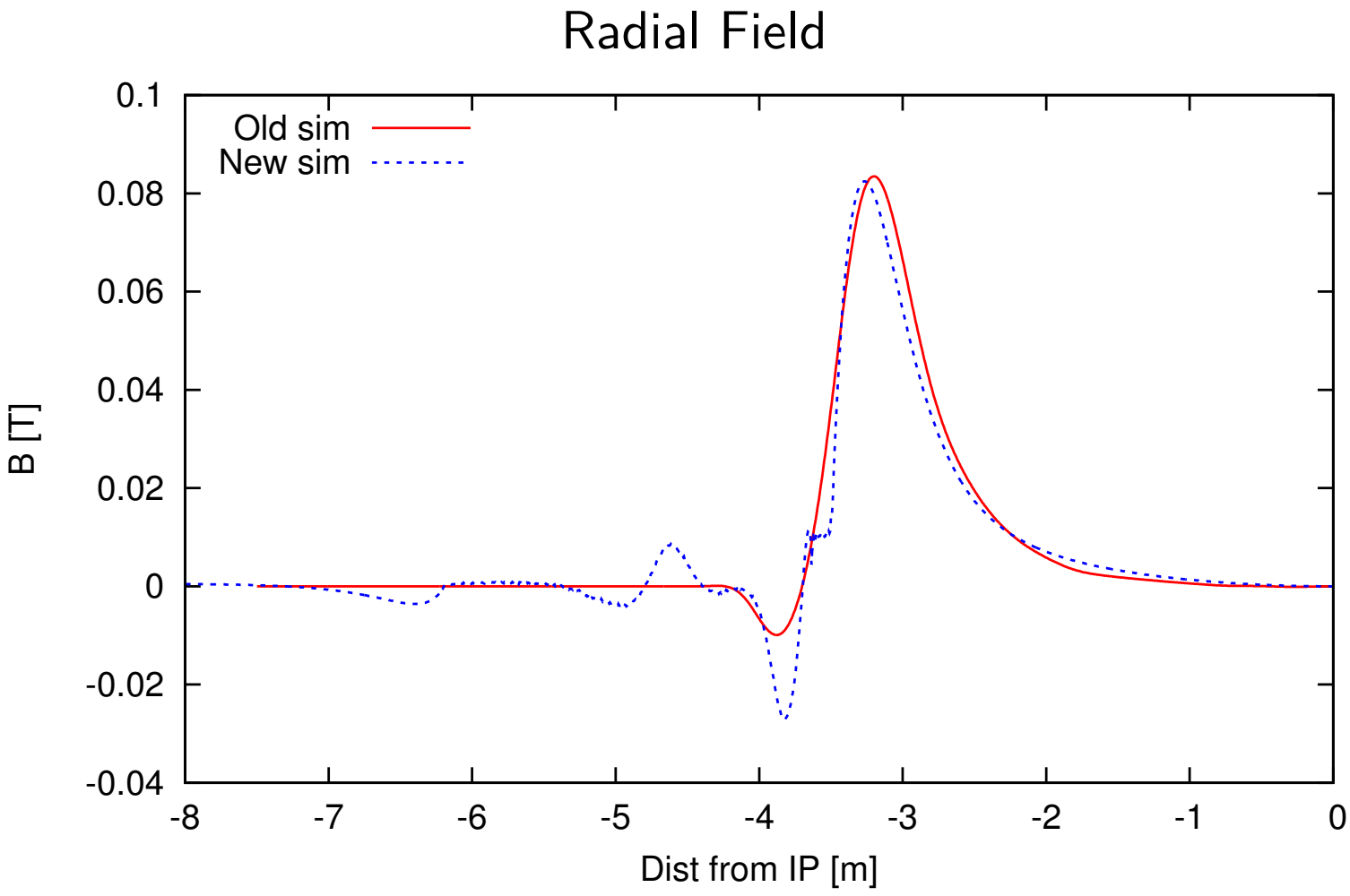

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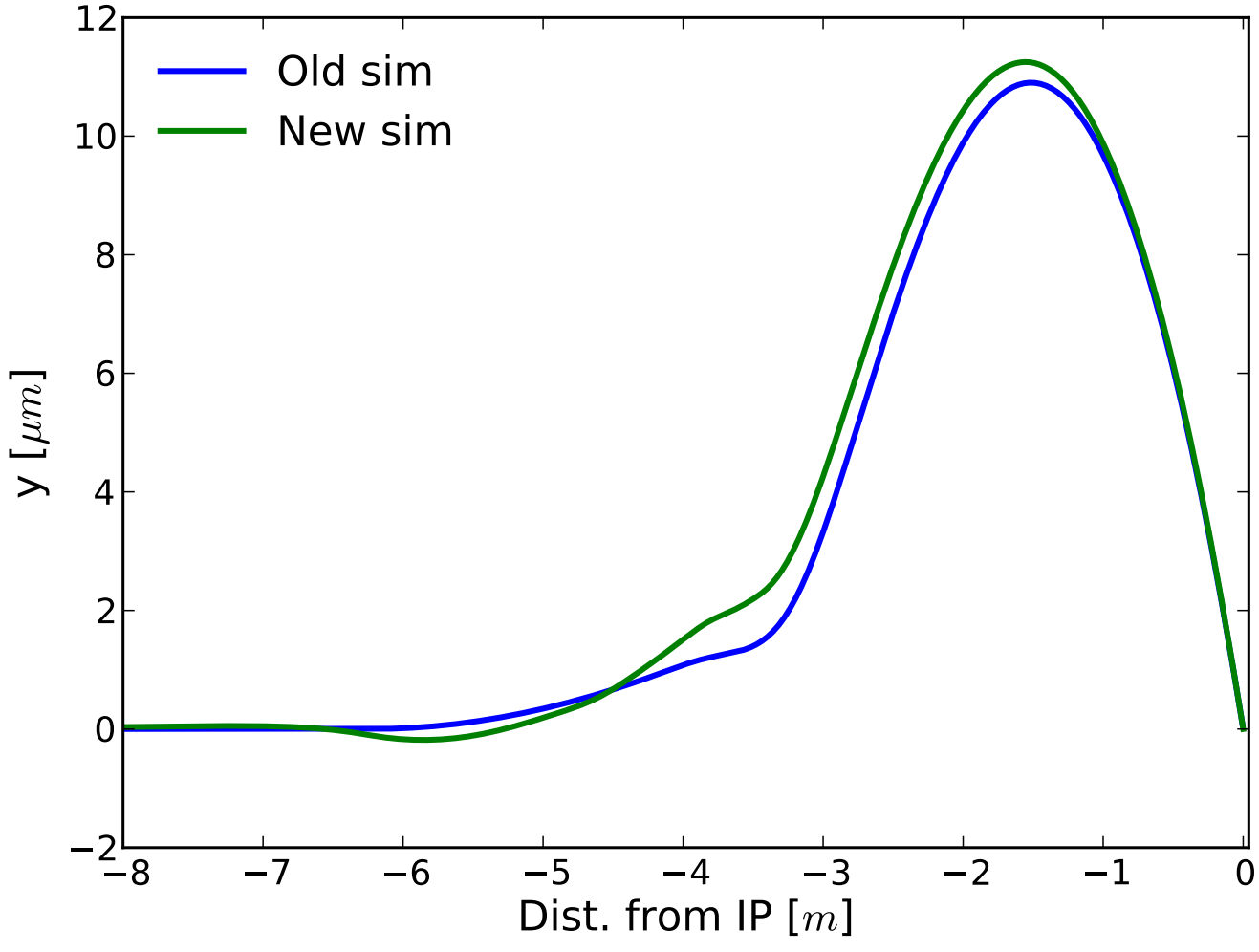
Deterministic Simulation: Orbit Deflection

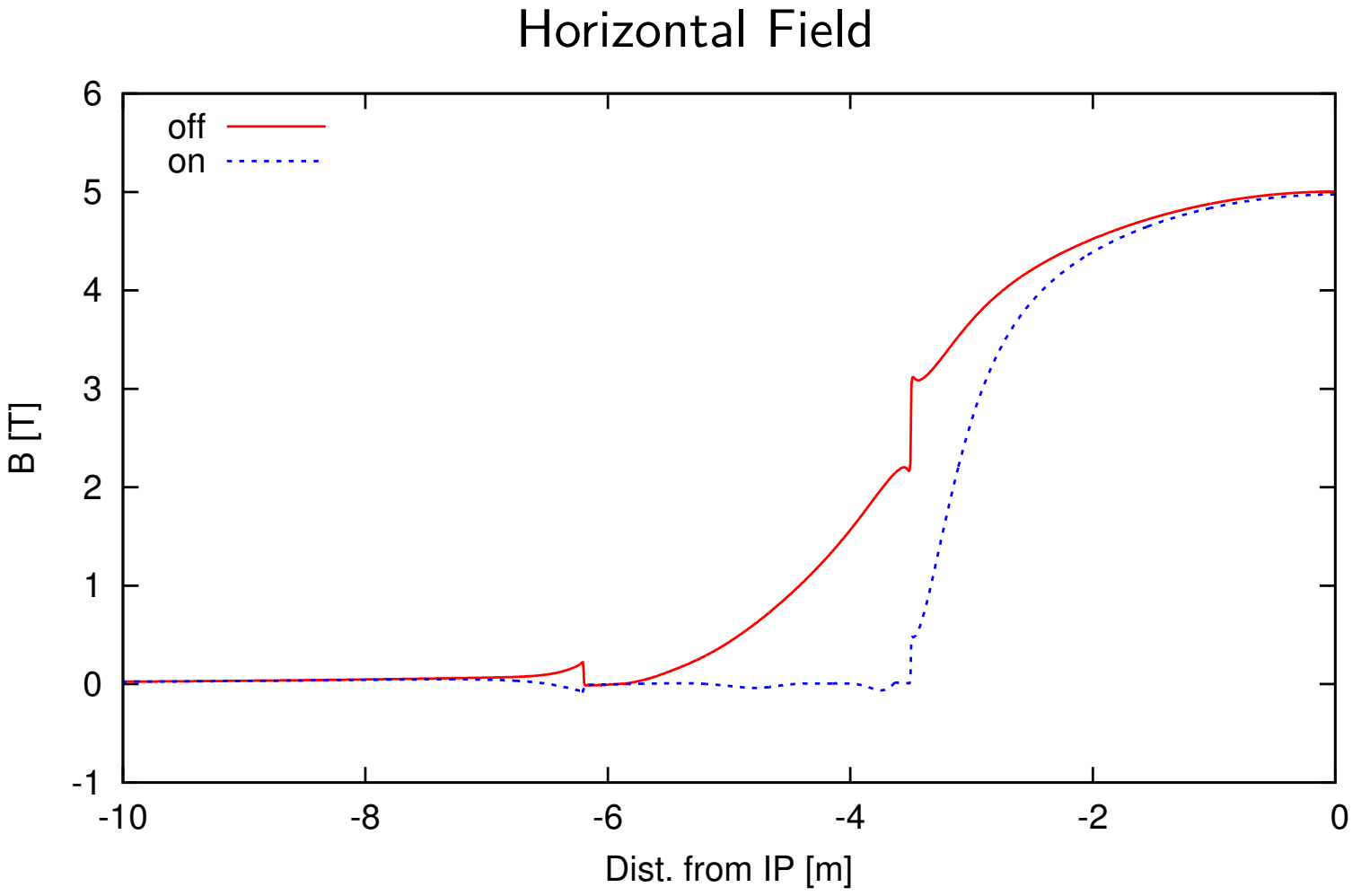


Deterministic Simulation: Luminosity Loss

	Old Simulation [% of ideal]	New Simulation [% of ideal]
L_{peak}	96.5	95.9 ± 0.2
L_{tot}	96.1	96.3 ± 0.2

(statistical error from multiple simulations)

Effect of the Anti-Solenoid



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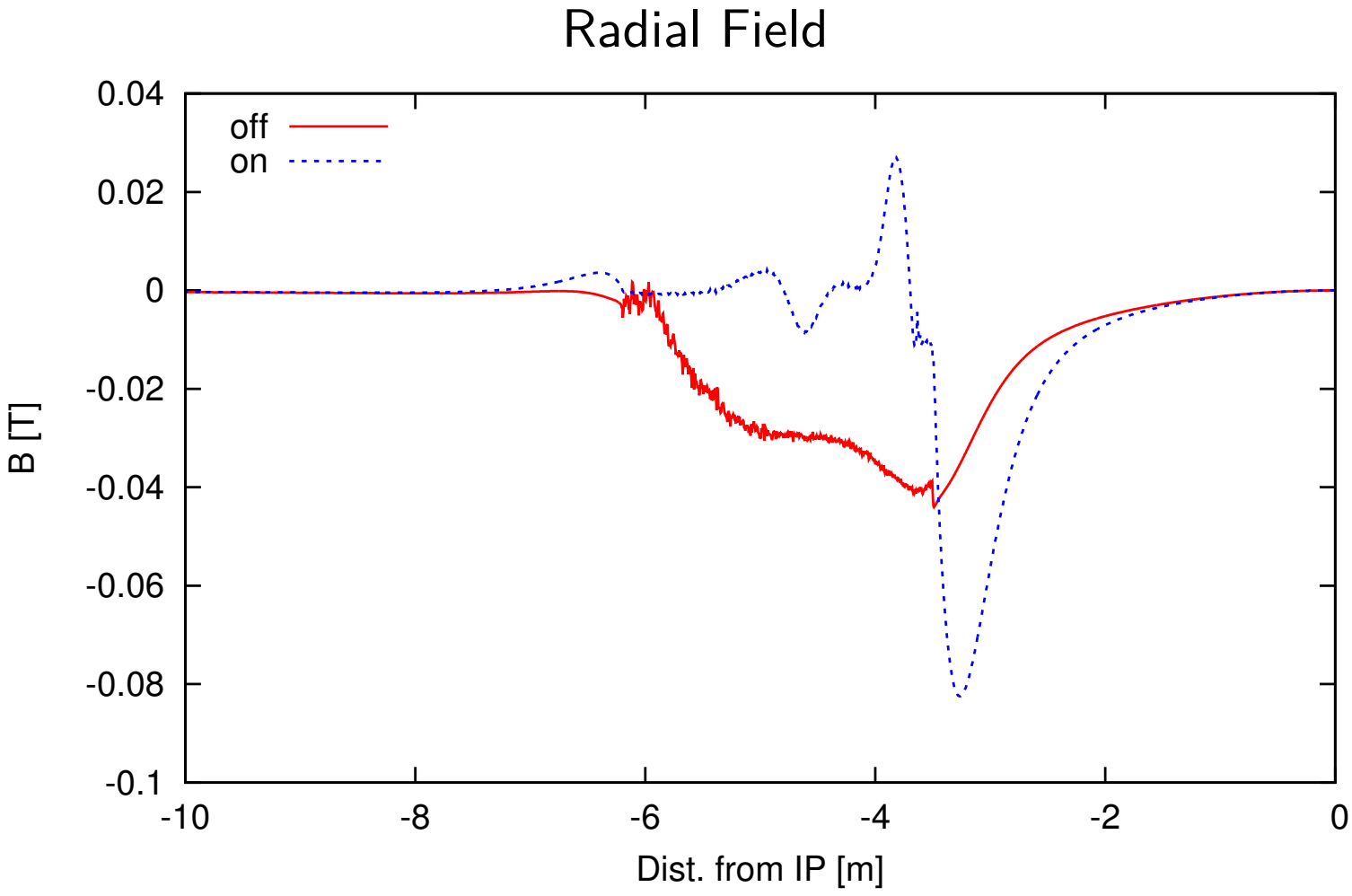

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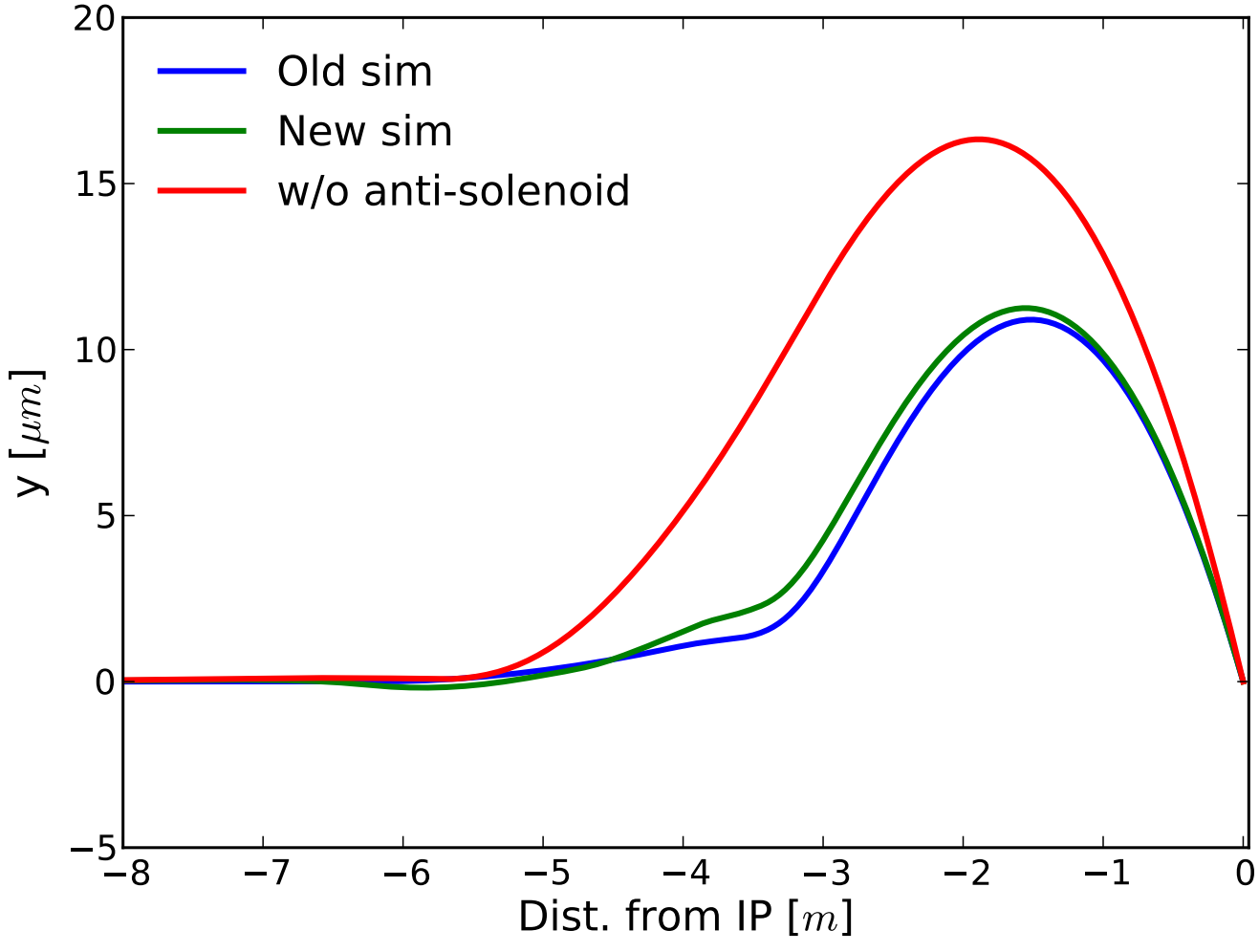

Deterministic Simulation: Luminosity Loss

	w/o anti-solenoid [% of ideal]	w anti-solenoid [% of ideal]
L_{peak}	95.0	95.9
L_{tot}	95.6	96.3

Summary

- Tuning studies so far recover $\sim 93\%$ of luminosity.
  - Compared to $\sim 96\%$ for "deterministic" simulation.
  - Might be able to improve the algorithm.
  - Fluctuating results makes these studies time-consuming and difficult to analyze.
- Improved solenoid field map give similar results as before.
- Anti-Solenoid reduce luminosity loss due to synchrotron radiation by about 1 %.

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