6-D Weak-Strong Simulation of RHIC head-on beam-beam compensation

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What's New in Coding Since CM13

1. 6-D weak-strong beam-beam interaction a la Hirata
   at IP6 and IP8 where p-p interactions take place

2. E-lens Modeling

   2.0 meter long

   1.0 meter from IP10

   8 slices, each slice modeled as
   (drift -- 4d beam-beam kick --- drift)

3. Re-did all previous studies with Yun's code SimTrack

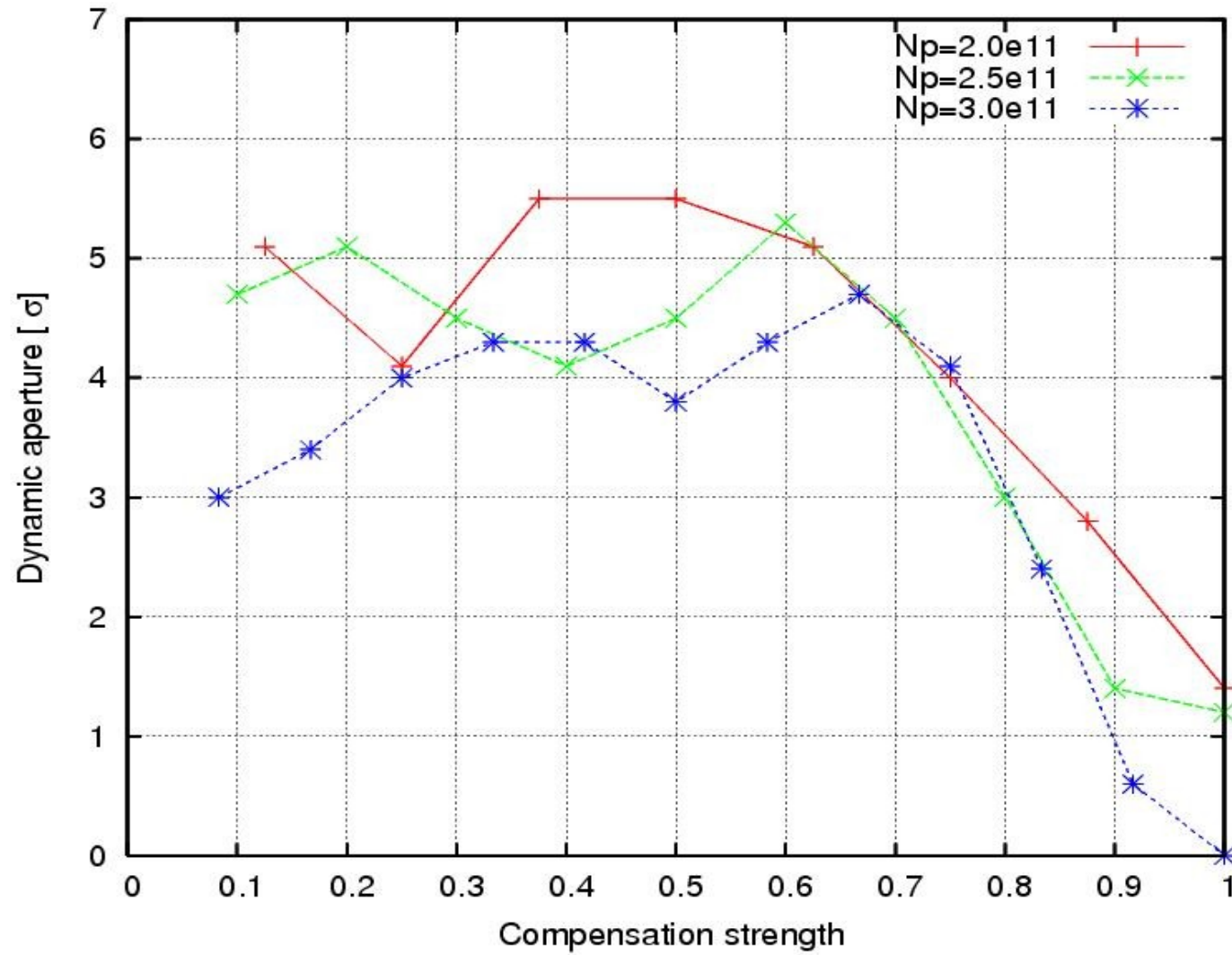# DA versus compensation strength

Figure 10: Calculated minimum dynamic aperture versus the compensation strength.
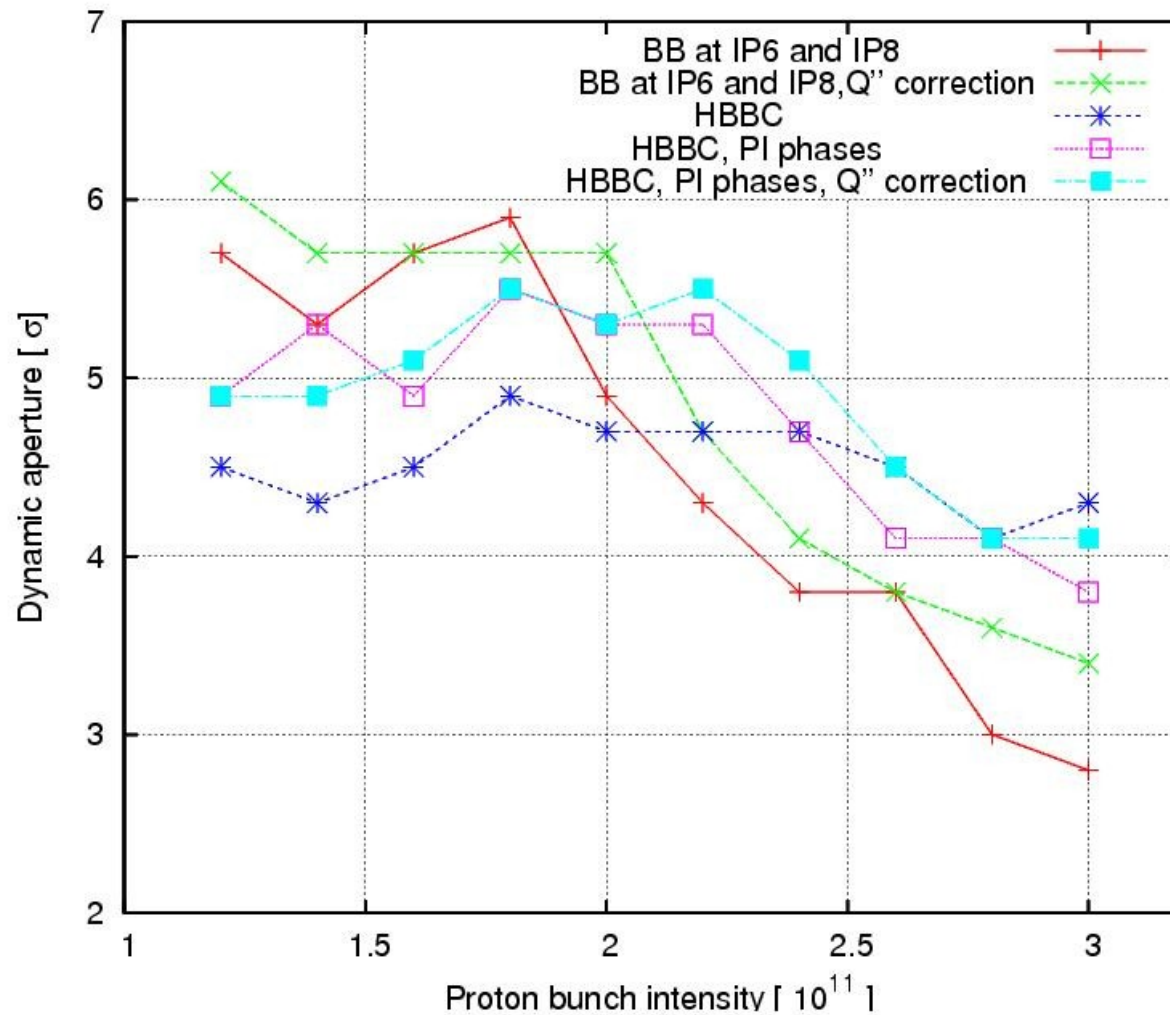
DA with Q'' and phase adjustment

Figure 9: Calculated minimum dynamic aperture with half head-on beam-beam compensation in the scan of proton bunch intensity

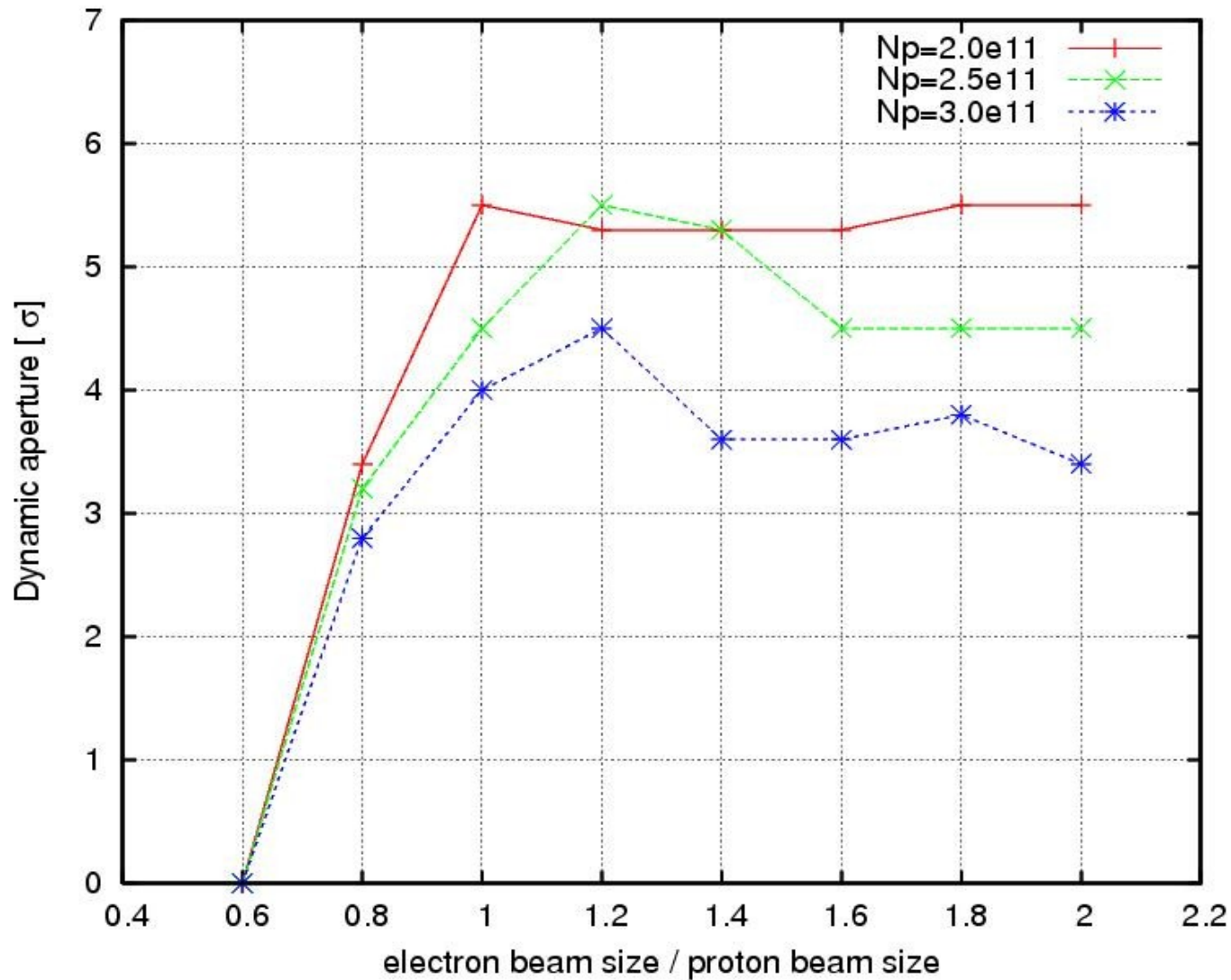# DA versus electron beam size

Figure 11: Calculated minimum dynamic aperture versus electron beam size.

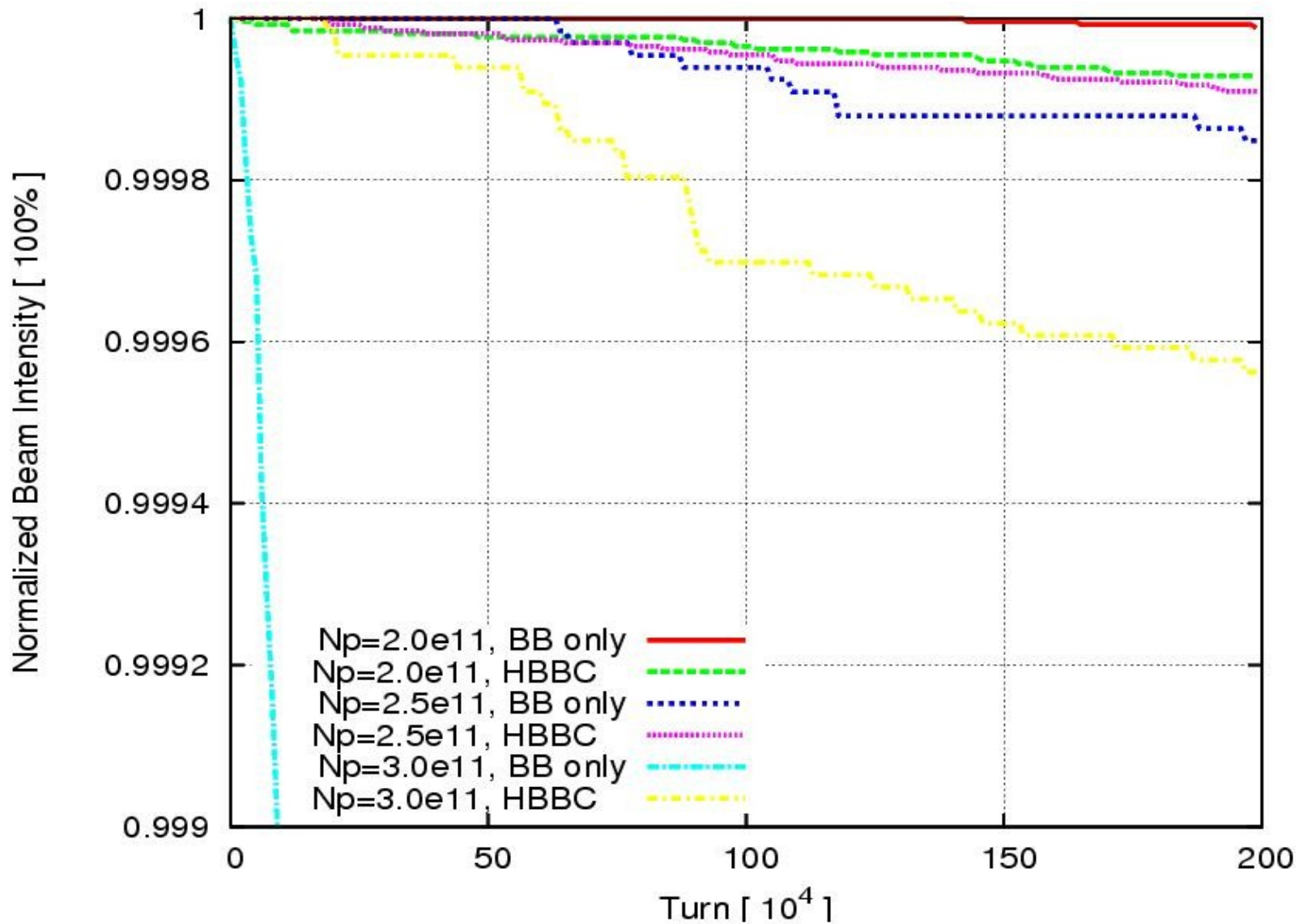# Relative beam loss with and without HBBC

Figure 4: Particle loss without and with half head-on beam-beam compensation.

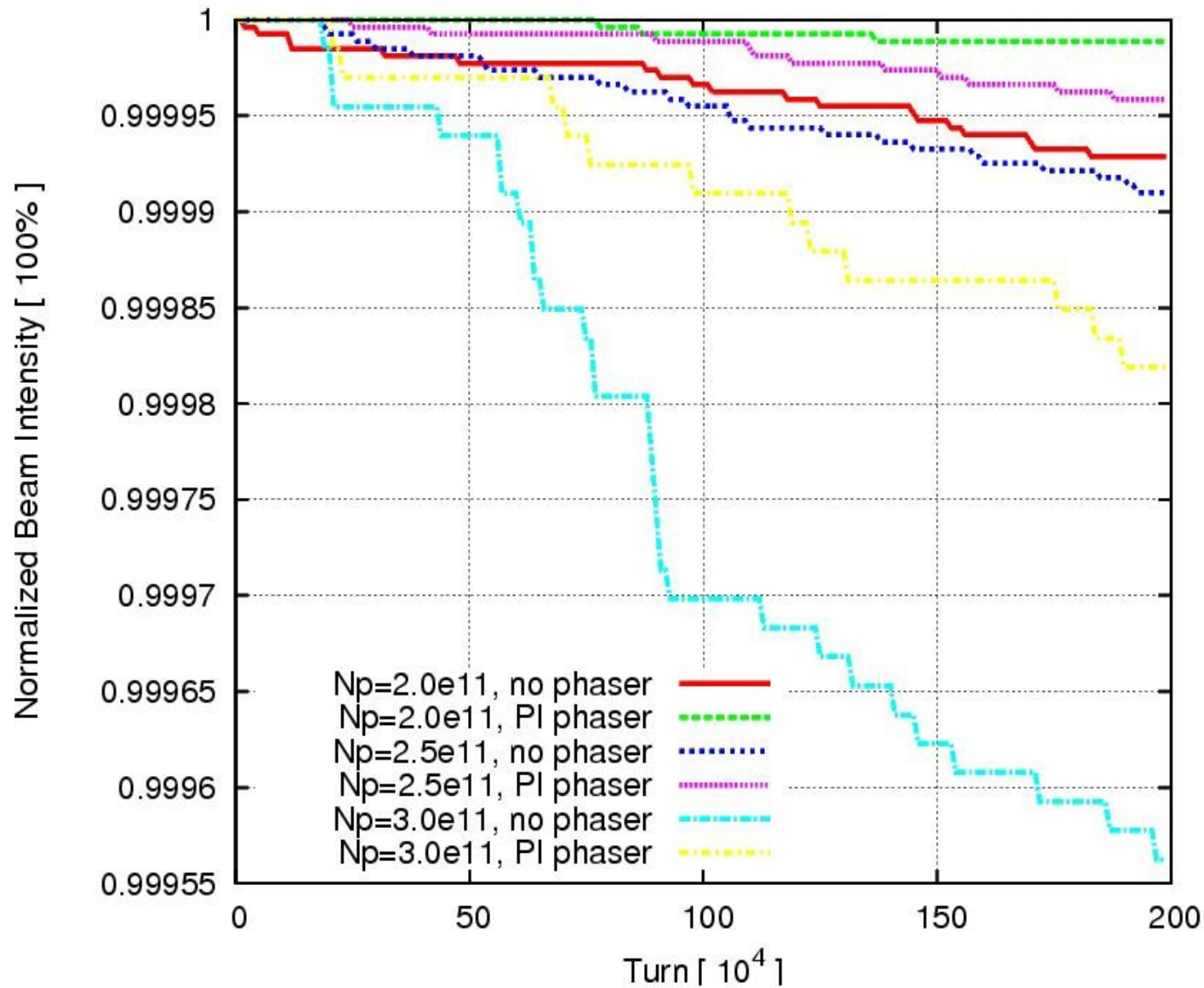# Relative beam loss with and without phase adjustment

Figure 5: Particle loss without and with multiple π phase advances between IP8 and e-lens.

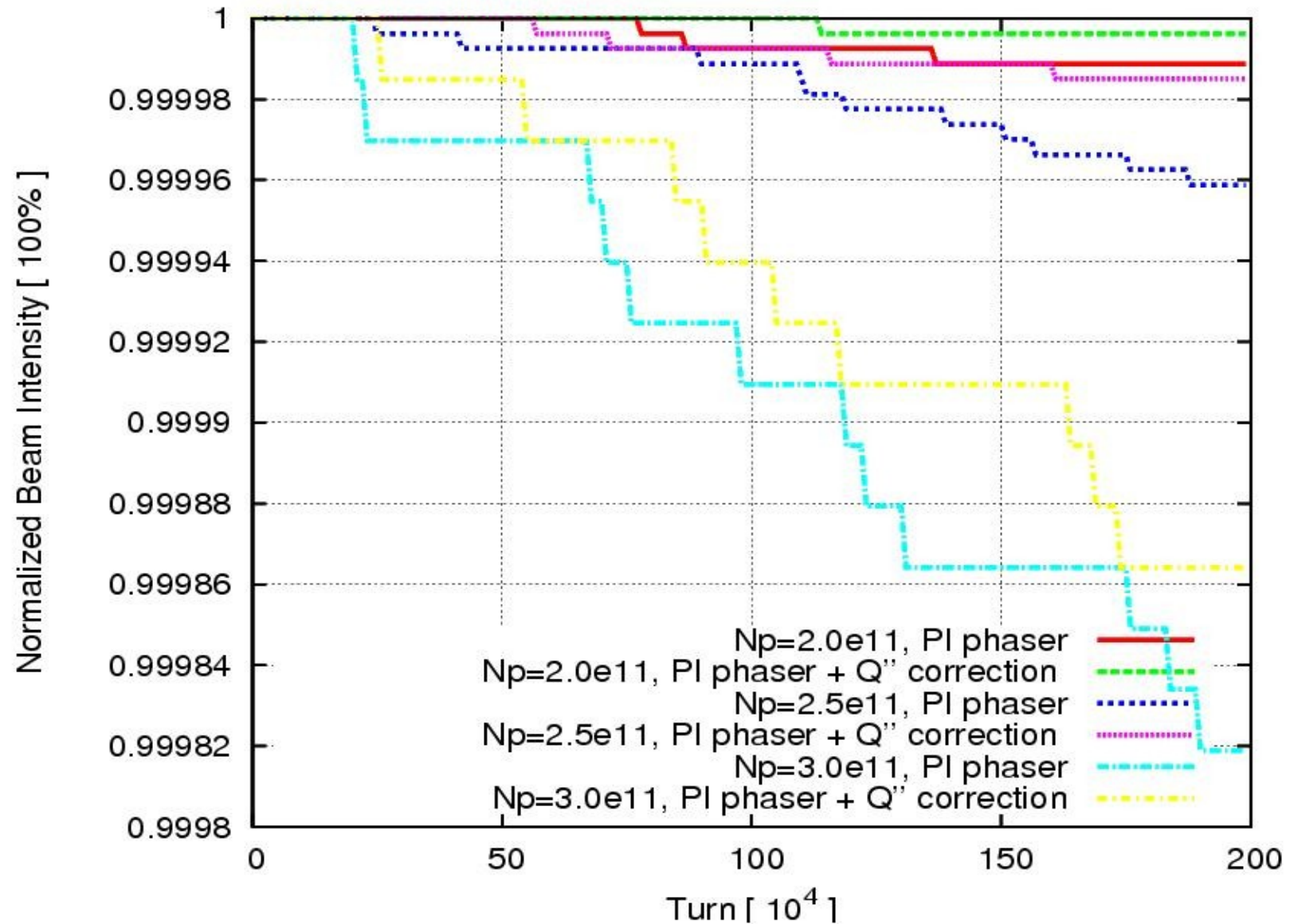# Relative beam loss with and without Q" corrected

Figure 7: Particle loss without and with second order chromaticity correction.
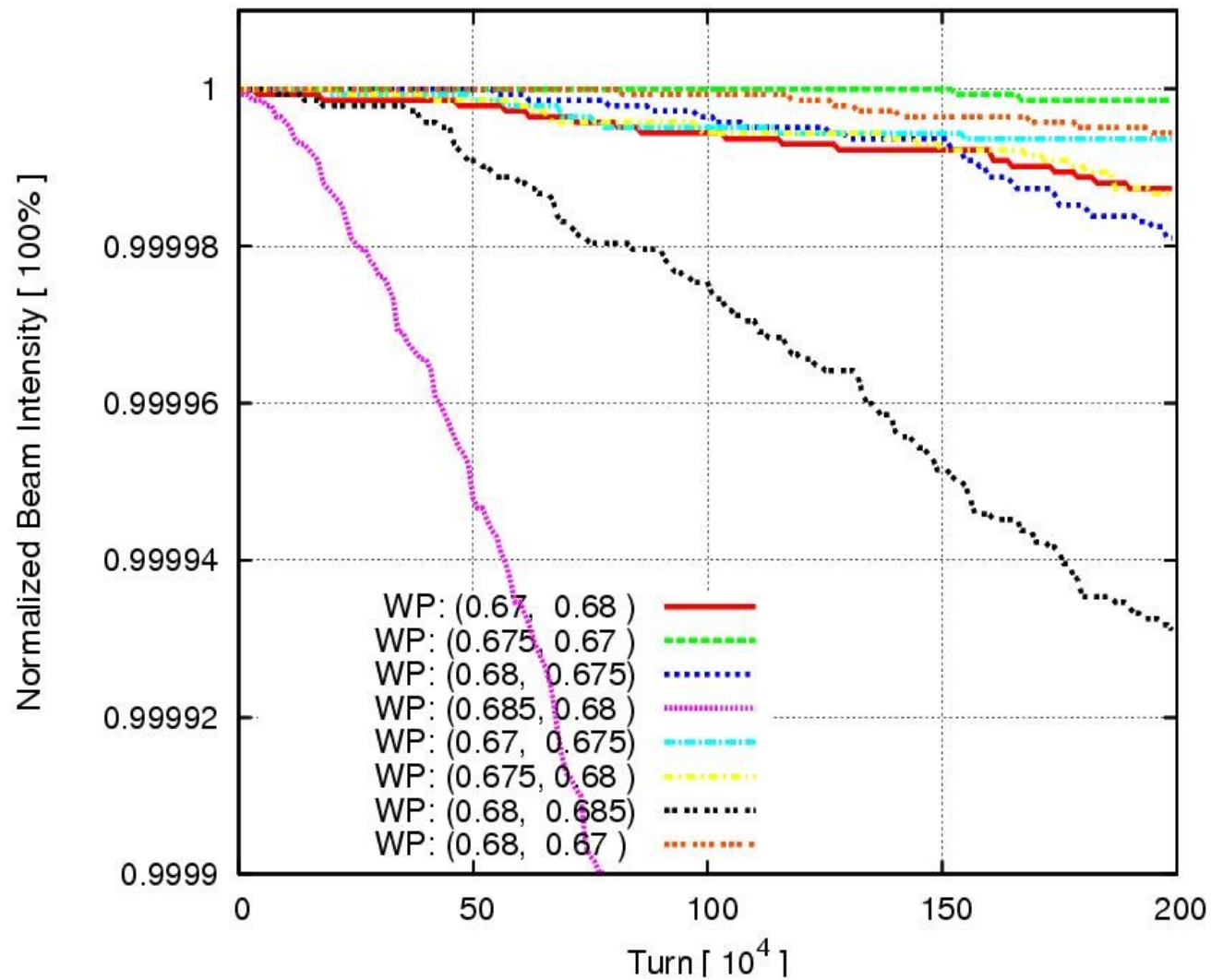
Relative beam loss with proton tunes

Figure 8: Particle loss with half head-on beam-beam compensation in the scan of proton working point.
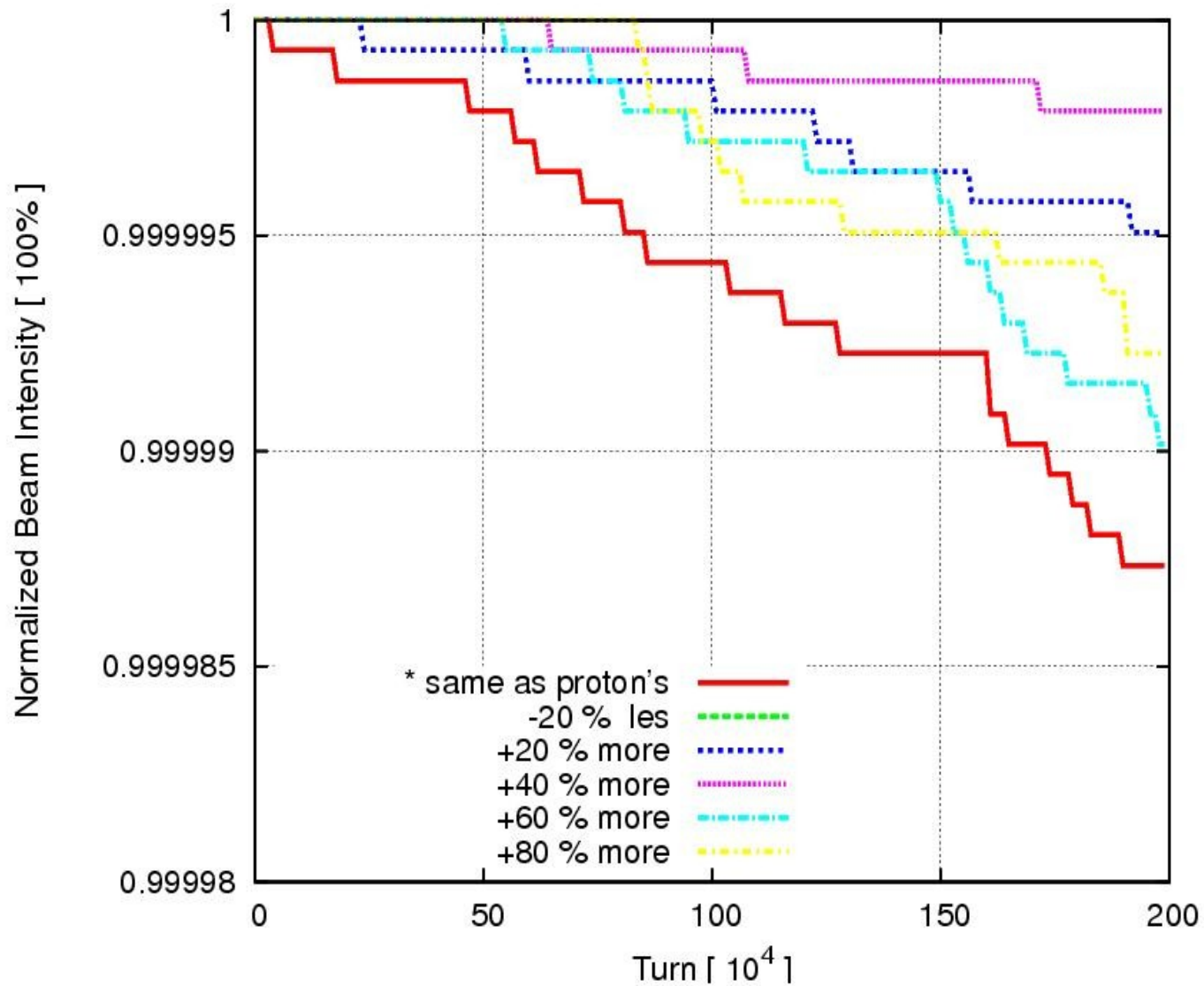
Relative beam loss with electron size

Figure 10: Particle loss with half head-on beam-beam compensation in the scan of electron transverse beam size.

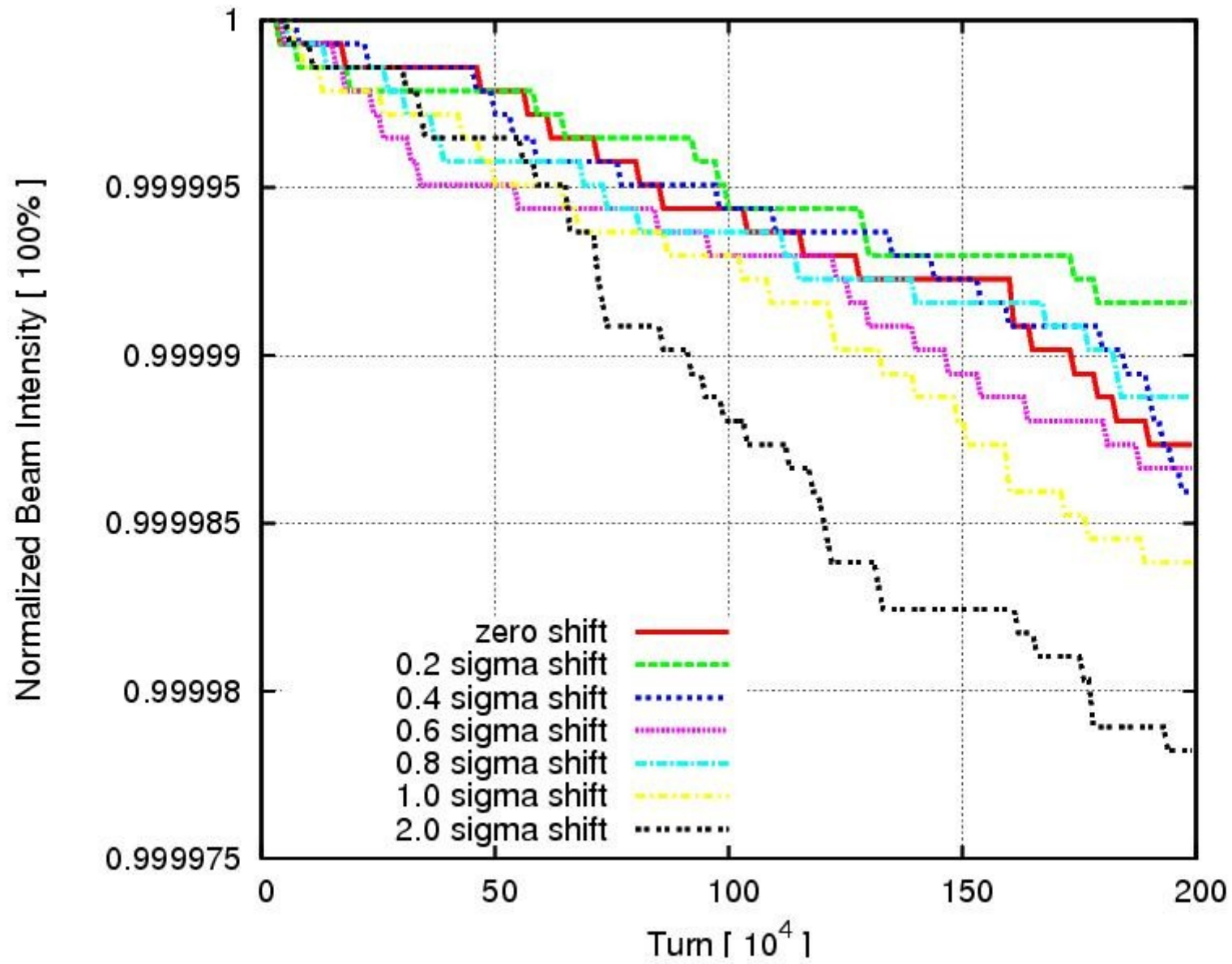# Relative beam loss with p-e X/Y misalignment

Figure 13: Particle loss with transverse electron beam offset in the e-lens.
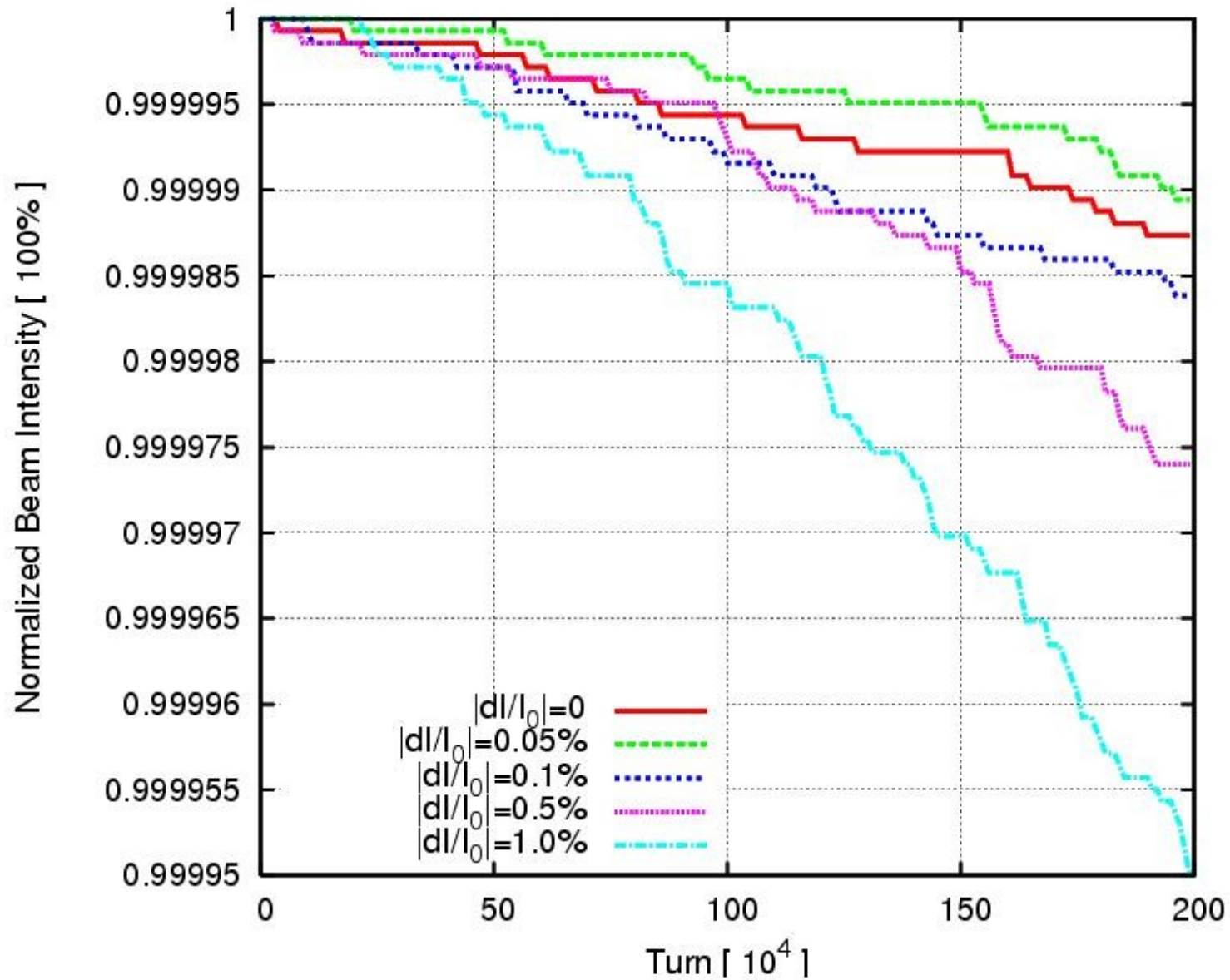
Relative beam loss with noise in electron current

Figure 14: Particle loss Layout of RHIC head-on beam-beam compensation.

What to do next

1. Benchmark the RHIC observed beam-beam lifetime with simulation

2. Compare lifetime results with BBSIM (Y-J. Kim)

3. Predict RHIC beam-beam lifetime in future runs

All simulation results reported here can be found in following two BNL C-AD AP Notes:

1) Y. Luo and W. Fischer, *6-D weak-strong beam-beam simulation study of proton lifetime in presence of head-on beam-beam compensation in the RHIC*, April, 2010

2) Y. Luo and W. Fischer, *Simulation study of dynamic aperture with head-on beam-beam compensation in the RHIC*, April, 2010