Luminosity Loss Due to Main Linac Quadrupole Jitter

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1 Simulation Procedure

The simulations of the luminosity loss have been performed using PLACET to track the beam through the main linac and GUINEA-PIG to simulate the beam-beam collision. The beam delivery system has been represented by a transfer matrix which transforms the end of linac Twiss parameters into the ones at the IP. A perfect machine has been used in the simulation; the transverse emittance have been increased at the linac entrance to the values at the IP. The case with the nominal IP emittance has been simulated as well as one with only half the nominal emittance. At the end of the main linac an intra-pulse orbit feedback has been assumed that removes incoming beam position and angle error at a single point. The quadrupoles in the electron linac have been scattered while the ones in the positron linac are kept fixed. The main linac lattice with four module spacing (i.e. 32 cavities) between quadrupoles has been used.

At the interaction point a beam-beam scan has been performed to obtain three different values for the luminosity

1. The luminosity is optimised by performing a beam-beam offset scan.
2. A beam-beam offset scan is performed to recover the same BPM reading as before the intorduction of the quadrupole jitter. This simulates the case where no luminosity optimisation is performed but only the BPM ased feedback is used.
3. The value if no IP beam-beam feedback were present. This assumes that the beamn delivery system is perfectly stable.

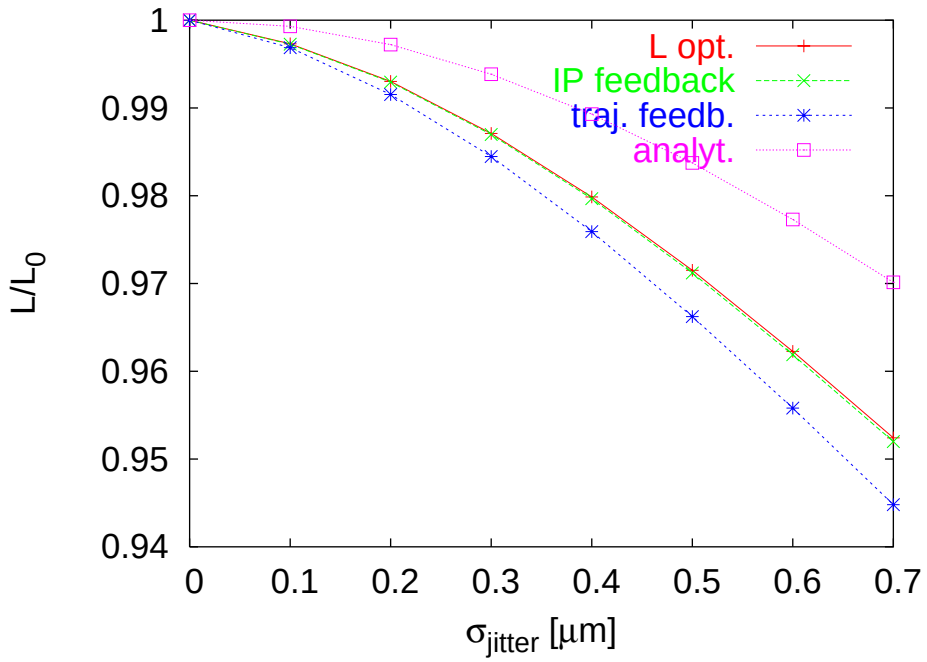

Figure 1: The luminosity as a function of the quadrupole jitter in the main linac for an IP vertical emittance of 40nm.

2 Results and Conclusion

The results are shown in Figs. 1 to 2. The following can be concluded from the simulations

- The BPM based beam-beam feedback feed and the luminosity optimisation feedback give very similar performance.
- The emittance is a reasonable measure for the luminosity performance. For small quadrupole jitter is is a bit optimistic for large ones slightly pessimistic.
- The beam-beam orbit feedback improves the luminosity performance compared to the case with no IP feedback.
- A quadrupole jitter of 100nm should be acceptable from the point of view of the luminosity loss at the interaction point. The luminosity

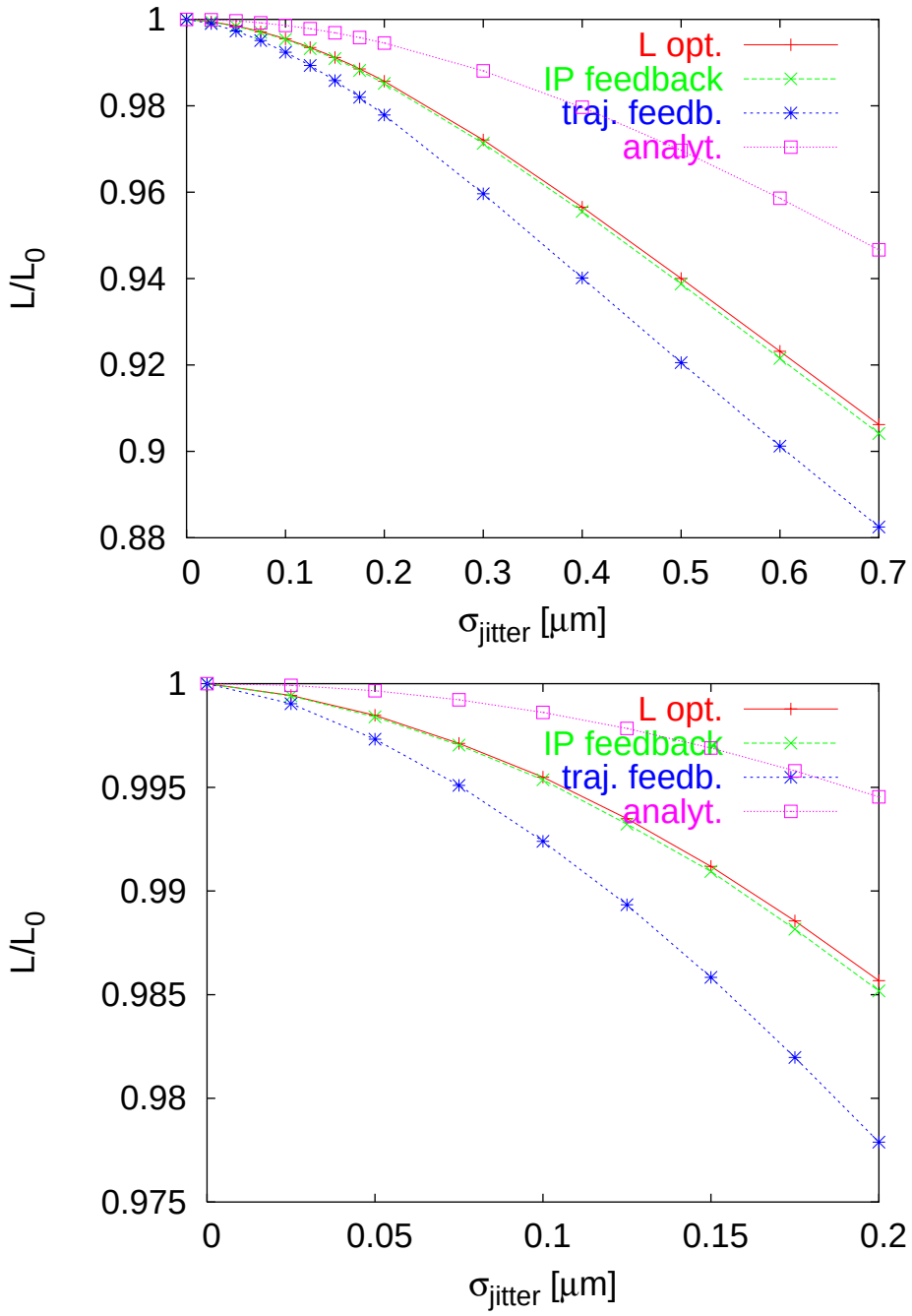

Figure 2: The luminosity as a function of the quadrupole jitter in the main linac for a IP vertical emittance of 20nm.

loss is slightly larger at this level than expected from the emittance growth. It however remains very small.

Further study should be performed to verify that the results also apply for initial imperfect machines.