Tolerances on magnetic field along the beamlines from accelerator physics point of view

Tentative, suggested for discussion at
IRENG07 WG-D meeting, August 15, 2007

Background information

- Magnetic field along the detector axis or along the beamline cause Y shift of the IP position and beam size growth via coupling and other terms

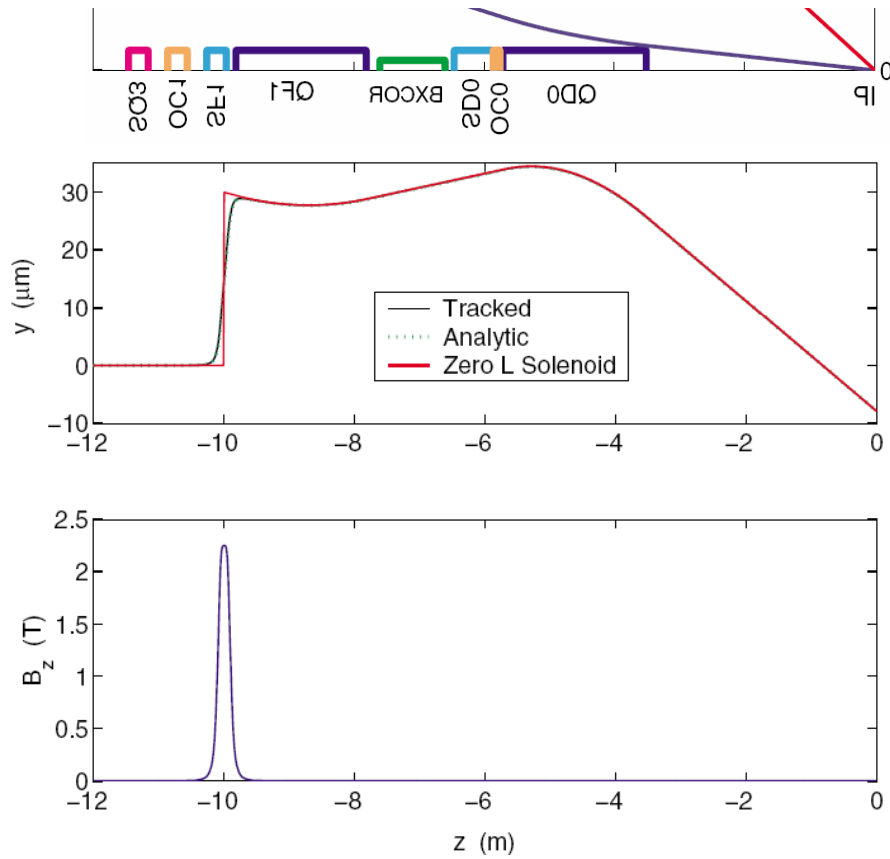- In details this is considered (for somewhat different parameters and optics) at Phys. Rev. ST Accel. Beams 8, 021001 (2005) http://prst-ab.aps.org/abstract/PRSTAB/v8/i2/e021001

FIG. 9. (Color) Orbits with a short test solenoid of $B\ell = 0.5$ T m placed *on the detector axis* at 10 m from the NLC IP. Orbits are obtained using particle tracking and analytical integration of the field for the exact model, and with a zero length approximation of the solenoid. IP is at $z = 0$ m.
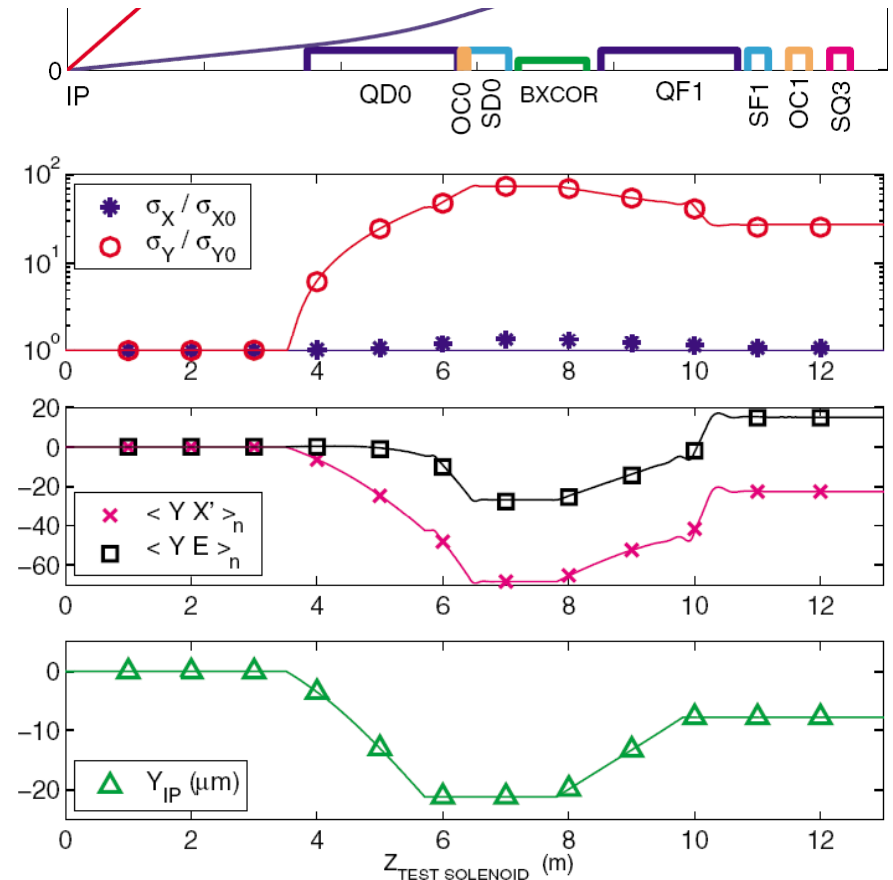
FIG. 10. (Color) Beam size, major correlations, and Y position at the IP for the short test solenoid placed on the detector axis at distance z from IP. Symbols: tracking; solid line: analytic solutions. IP is at $z = 0$ m.

Effects from short 0.5T*m solenoid placed on detector axis

Summary of effects

- For older version of optics and old parameters, the effects from 0.5 T*m (or 5000 Gs*m) along the detector axis for Z>10m are, roughly:
  - coupling term ~20
  - IP orbit offset ~10microns
- The offset is to be compared with
  - ¼ sigma or 1nm of maximum tolerable bunch-to-bunch jitter in the train with 300ns between bunches
  - about 100nm of train-to-train offset which intratrain feedback could comfortably capture (0.2s between trains)
  - roughly 10nm which intratrain feedback could follow with time-constant of ~100 bunches (0.03ms) for duration of the train (1ms)
- The coupling effect should be compared with
  - desired tuning stability time, say 10 hours
    - (coupling term 0.2 would give 2% effect on beam size)

Tolerances for magnetic field on the beamline outside detector, tentative

- Time scale, max integrated field:
- 300ns   < 0.5 Gs*m
- 0.03ms to 1ms   < 5 Gs*m
- 0.2 s   < 50 Gs*m
- up to 10 hrs   < 50 Gs*m