Option for detector solenoid compensation without inner counter-solenoids

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Solenoid effects

Detector solenoid affects:

1) Coupling
2) Polarization (spin rotation)
3) Vertical orbit because the crossing angle
4) Vertical dispersion because the crossing angle

All these effects have to be minimized

Solenoid effects

The hardest contribution to minimized is the emittance growth due to SR from vertical kicks
A possible strategy is to decouple the minimization of this effect from the coupling/spin compensation

Starting from coupling and spin rotation, a simple solution is to do the compensation “A la Daphne”:

Starting from the IP the beam reference frame rotates because the solenoid, the FD quads are set on the rotated reference system.

After the last FD quad it will be necessary a counter-solenoid with integrated strength equal to half of the Detector one.

Upstream the IP the set-up is mirror-like.

Since the quad rotations are small, weak skew-quads wrapped around the FD quads could be used instead (to be assessed).

The integrated longitudinal field is zero, so the spin orientation will be preserved as well.

Coupling and spin-precession compensation

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Starting from coupling and spin rotation, a simple solution is to do the compensation “A la Daphne”:

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In total 2 counter-solenoids (OUTSIDE the detector and Final doublets) per beam (and per IP) are needed

Since the quad rotations are small, weak skew-quads wrapped around the FD quads could be used instead (to be assessed).

Additional skew quads in the FF could also be used (to be studied) to relax the requirements on the FD skew quads.

The integrated longitudinal field is zero, so the spin orientation is naturally preserved (spin bumps could be studied as well)

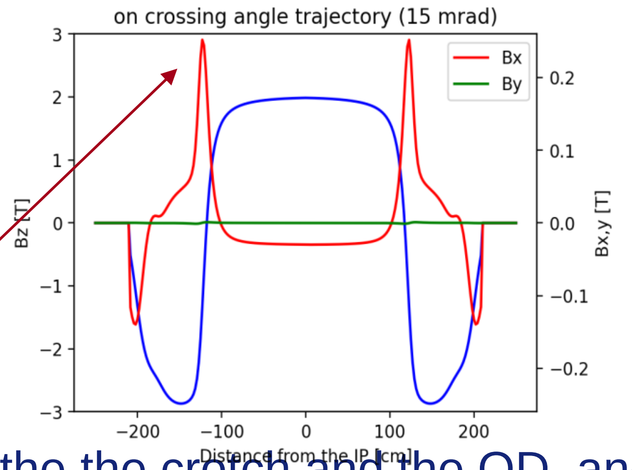
Vertical orbit and dispersion compensation

The first meter or so of Bx=Bs*theta/2=30mTesla generates (starting from the IP) about:

dyp =200urad

dy =100um

The cancelation of this bump before the first FD quad is very hard, in particular a large contribution to the vertical emittance (and synchrotron radiation) comes from the negative Bx necessary to bring the beam back on axis before the QD.



It is possible to use a much weaker dipoles to be placed in the chambers between the the crotch and the QD, and additional dipoles thereafter to bring the orbit back on axis.

The combination studied consists of (identical for each beam and on incoming/outgoing arms):

C0y ~ 80cm upstream generating ~ -50mTesla net

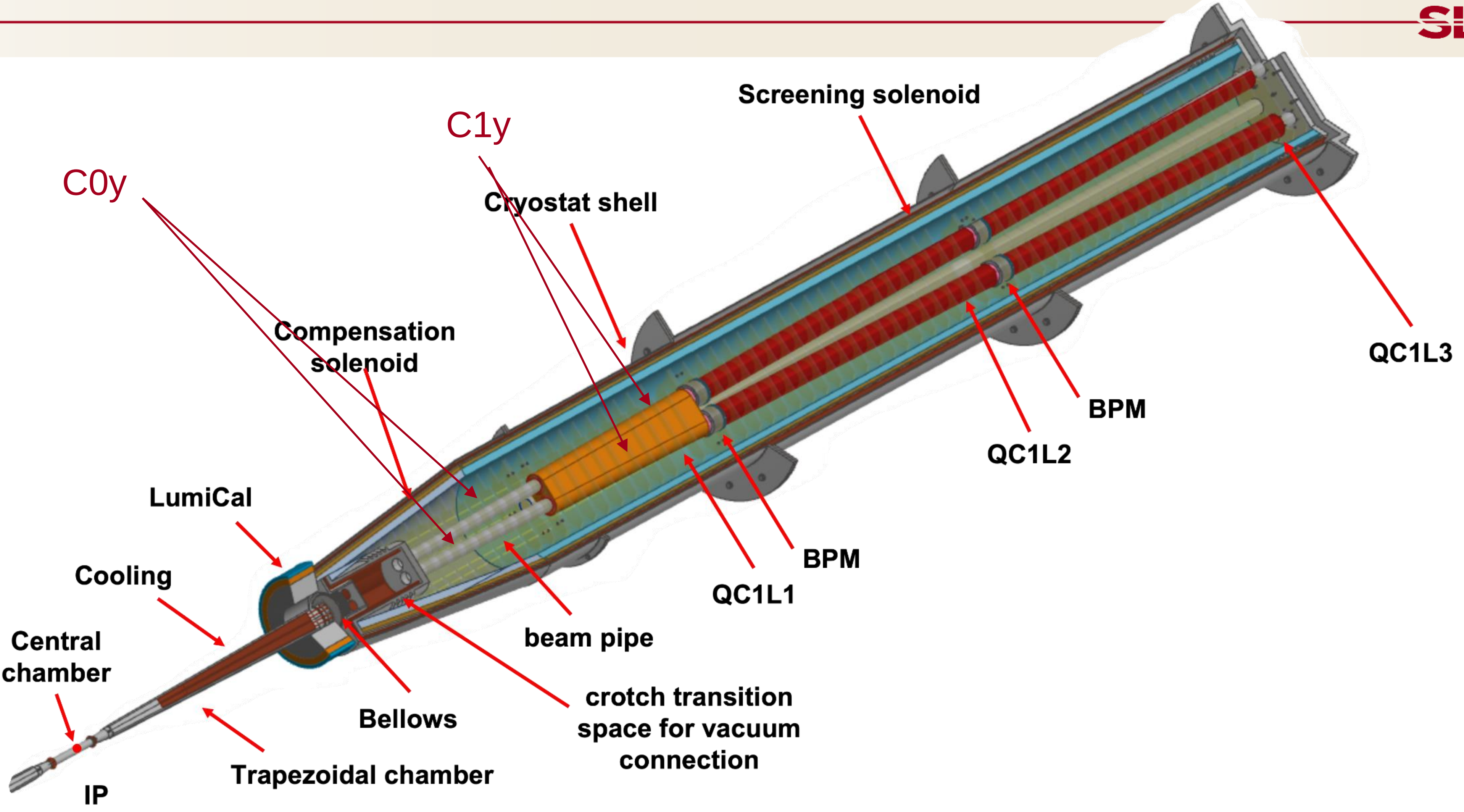
C1y ~ 1.5m wrapped around QD0 generating ~20 Tesla net

C2y ~ 0.4m between QDs and QFs (weak)

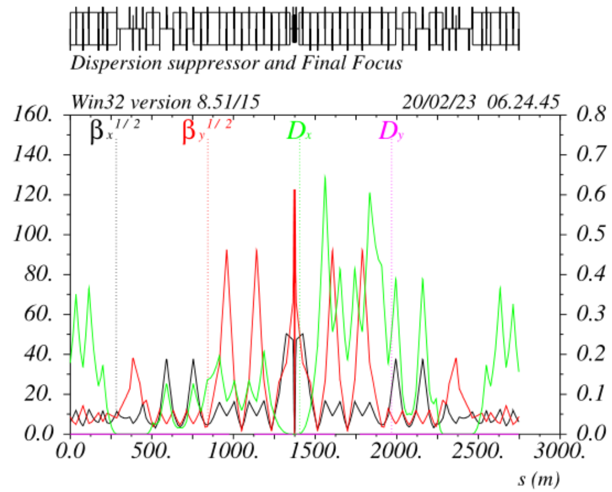
C3y ~ 0.4m after the FD (very weak)

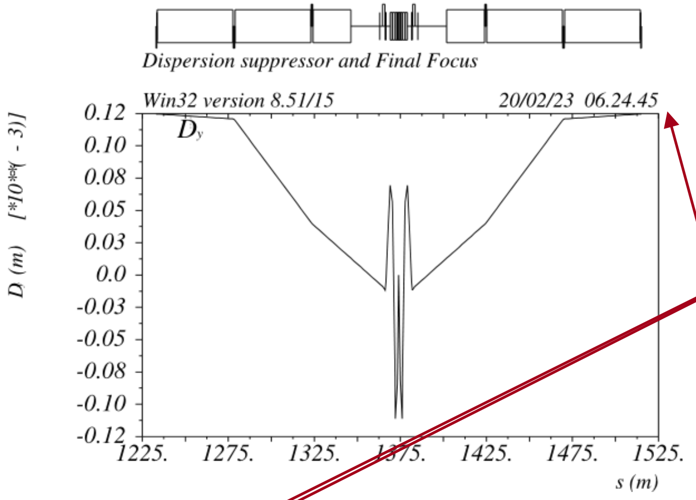
In fact it has been supposed Bx=0 everywhere else, a more consistent Bx profile past the QD should be used,

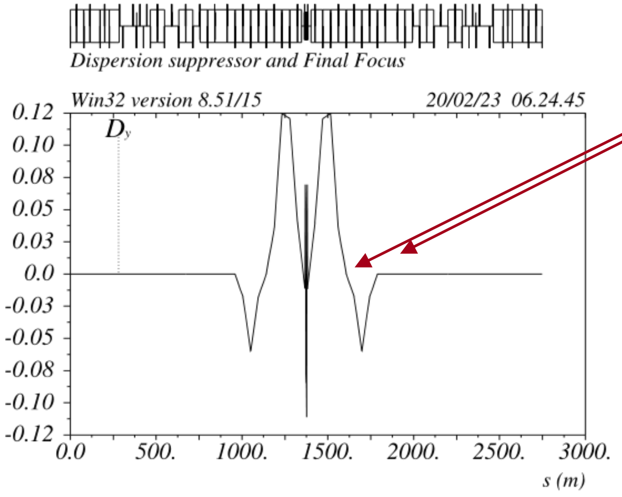
This is not critical since the largest contribution comes from C0y (and the first meter of uncompensated Bx)

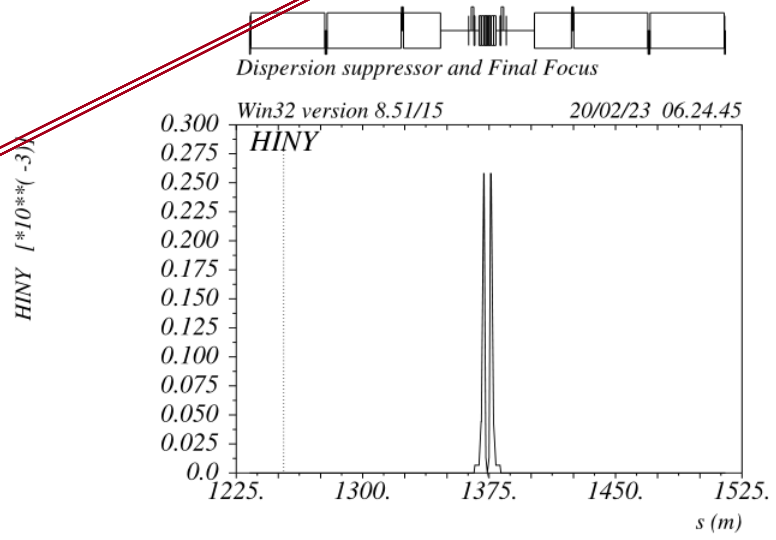

Screening solenoid
C1y
C0y
Cryostat shell
Compensation solenoid
QC1L3
BPM
QC1L2
LumiCal
BPM
Cooling
QC1L1
beam pipe
Central chamber
Bellows
crotch transition space for vacuum connection
Trapezoidal chamber
IP

Vertical dispersion compensation









Some dispersion leaks in the FF
And is canceled with two antisymmetric skew quads at the Y-CCs sextupole location that genetate y-eta@IP and

an additional skew at the first IP image point generates y-etap@IP

The dispersion rattling through the FF does not cause any emittance growth (as could be seen by the Y-curl-H)

The dispersion compensation could be done for any FF system…

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