
Solenoid Compensation

Super-B Workshop

SLAC

7 October 2009

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- Detector solenoid field may limit excitation of SC quads
 - Main concern at quad ends; windings must turn around, field is parallel to detector solenoid
- Detector solenoid causes x-y coupling

- Use “bucking solenoids” around beamline components
- Nominally cancel B_z at SC quad locations
- Overcompensate B_z where quads are absent
- Goal: $\int_{IP}^{\infty} B_z dz = 0$
 - This cancels coordinate plane rotation at IP (no x-y coupling when IP quads are unexcited)

Parameters



SuperB Parameters July 22 2009

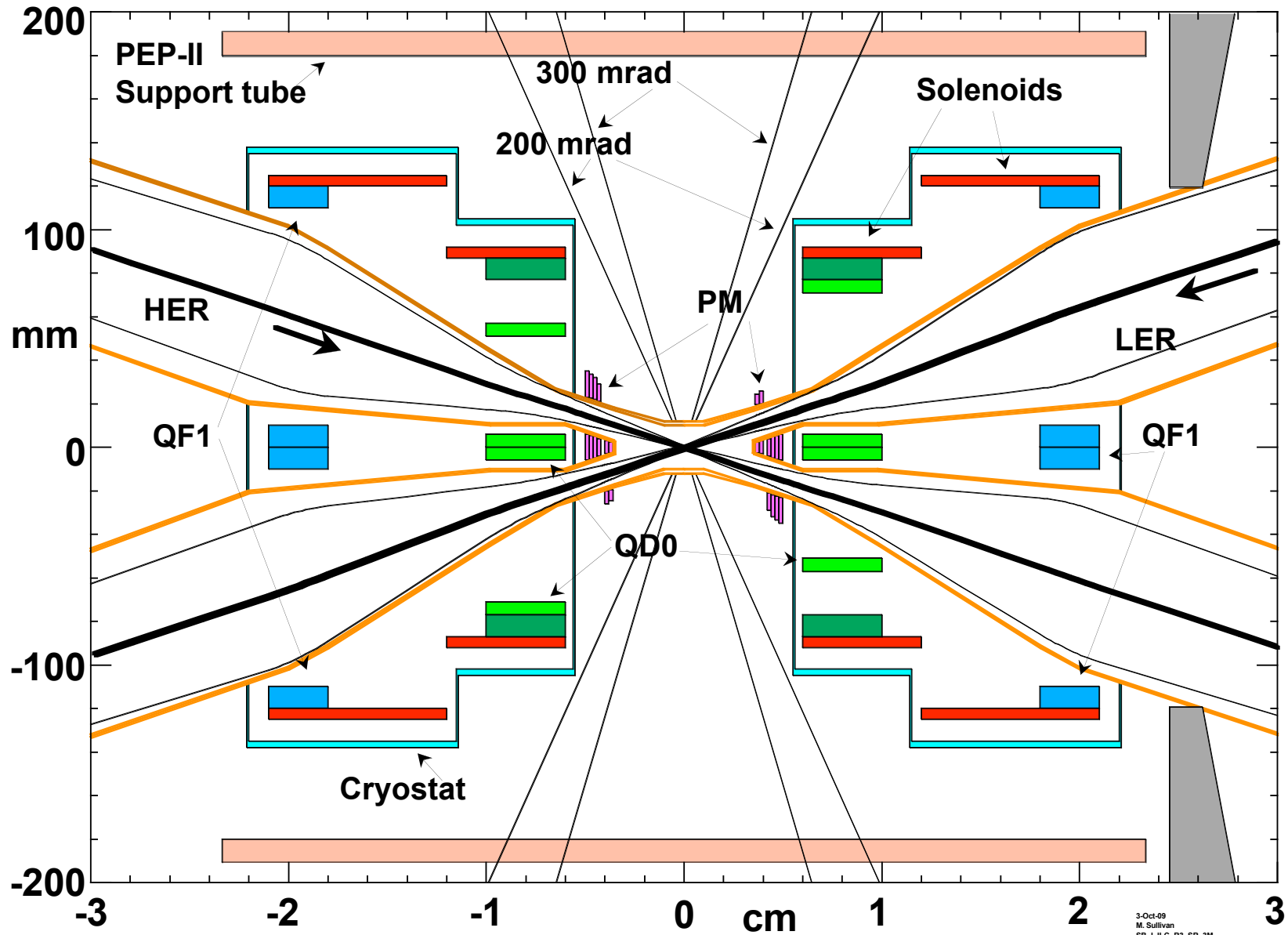
SuperB Parameters		(in bold: computed values)	
Parameter	Units	Super-B TorVergata 1-Mar-09 with SR	Super-B LNF 22-Jul-09 with SR LER
E HER (positrons)	GeV	6.9	6.7
E LER (electrons)	GeV	4.06	4.18
Energy ratio		1.70	1.60
r0	cm	2.83E-13	2.83E-13
X-Angle (full)	mrاد	60	60
Beta x HER	cm	2	2
Beta y HER	cm	0.037	0.032
Coupling (high current)		0.0025	0.0025
Emit x HER	nm	1.6	1.6
Emit y HER	nm	0.004	0.004
Bunch length HER	cm	0.5	0.5
Beta x LER	cm	3.5	3.2
Beta y LER	cm	0.021	0.02
Coupling (high current)	%	0.0025	0.0025
Emit x LER	nm	2.8	2.56
Emit y LER	nm	0.007	0.0064
Bunch length LER	cm	0.5	0.5
I HER	mA	2200	2120
I LER	mA	2200	2120
Circumference	m	2105	1315
N. Buckets distance		2	2
Gap		0.97	0.97
Frf	Hz	4.76E+08	4.76E+08
Fturn	Hz	1.43E+05	2.28E+05
Fcoll	Hz	2.31E+08	2.31E+08
Num Bunch		1619	1011
N HER		5.96E+10	5.74E+10
N LER		5.96E+10	5.74E+10
Sig x HER	microns	5.657	5.657
Sig y HER	microns	0.038	0.036

SuperB Parameters July 22 2009

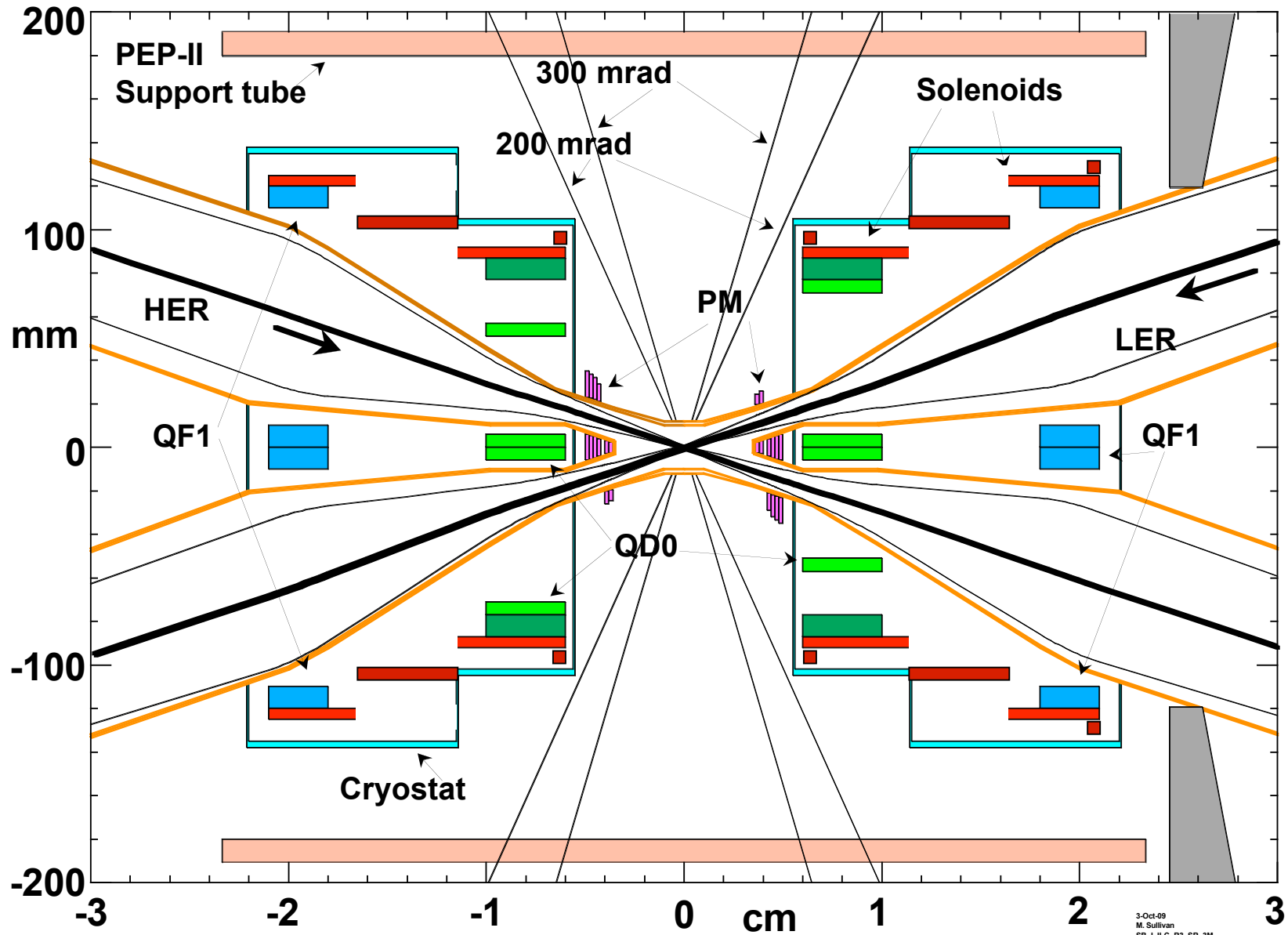
Sig x LER	microns	9.899	9.051
Sig y LER	microns	0.038	0.036
Piwinski angle HER	rad	26.52	26.52
Piwinski angle LER	rad	15.15	16.57
Sig x HER effective	microns	150.15	150.15
Sig x LER effective	microns	150.37	150.32
X-angle factor HER		0.038	0.038
X-angle factor LER		0.066	0.060
Cap Sig X	microns	11.402	10.673
Cap Sig Y	microns	0.054	0.051
R (hourglass factor)		0.900	0.900
Cap Sig X eff	microns	212.13	212.13
Lumi calc	/cm ² /s	1.02E+36	1.02E+36
Tune shift x HER		0.0018	0.0017
Tune shift y HER		0.1271	0.1170
Tune shift x LER		0.0052	0.0045
Tune shift y LER		0.1220	0.1170
Damping_long HER	msec	21	14.5
Damping_long LER	msec	20.0	22.0
Uo HER	MeV	2.3	2.03
Uo LER	MeV	1.40	0.83
alfa_c HER		3.50E-04	4.04E-04
alfa_c LER		3.20E-04	4.24E-04
sigma-EHER		5.80E-04	6.15E-04
sigma-E LER		8.20E-04	6.57E-04
CM sigma_E		1.00E-03	9.00E-04
SR power loss HER	MW	5.06	4.30
SR power loss LER	MW	3.08	1.76
Touschek lifetime HER	min	33	35
Touschek lifetime LER	min	17	16
Luminosity lifetime HER	min	5.20	4.95
Luminosity lifetime LER	min	5.20	4.95
Total lifetime HER	min	4.49	4.34
Total lifetime LER	min	3.98	3.78
RF plug power	MW	16.28	12.13

Parameter	HER	LER
Energy (GeV)	7	4
Current (A)	2.12	2.12
Beta X (mm)	20	32
Beta Y (mm)	0.32	0.20
Emittance X (nm-rad)	1.60	2.56
Emittance Y (pm-rad)	4.0	6.4
Sigma X (μm)	5.66	5.66
Sigma Y (nm)	38	36
Crossing angle (mrad)		+/- 30

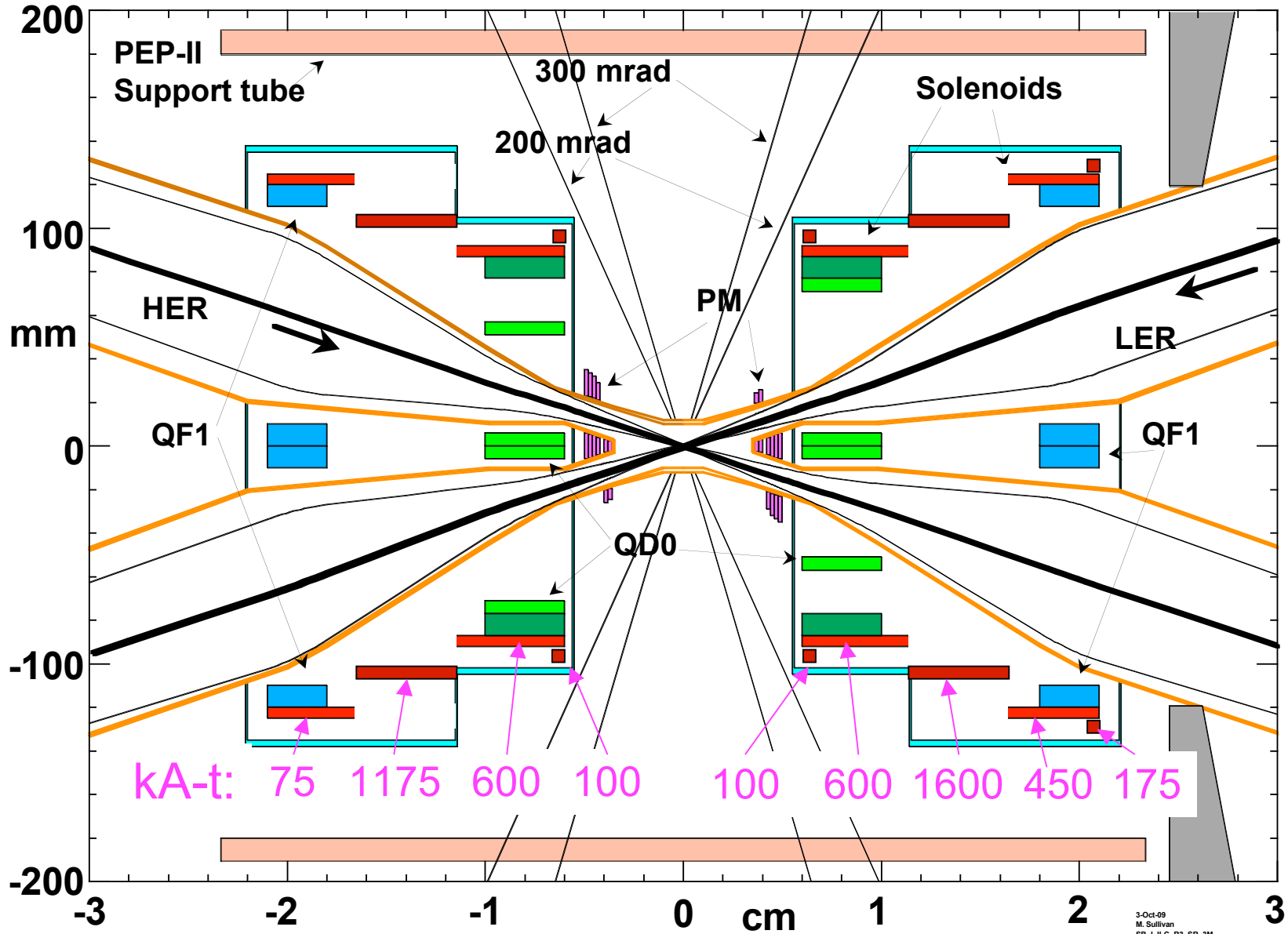
Present IR Design

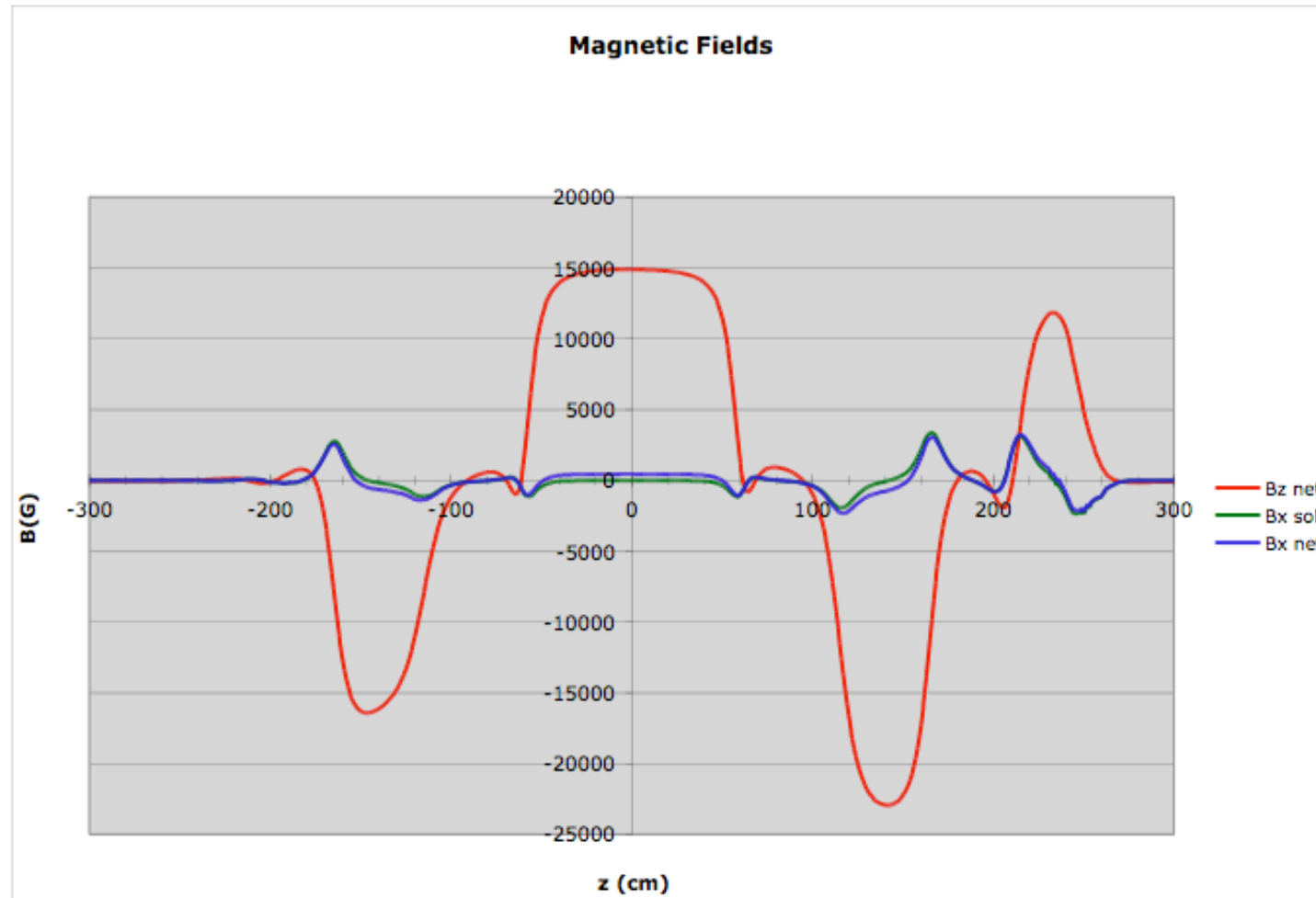


IR With Extra Solenoids



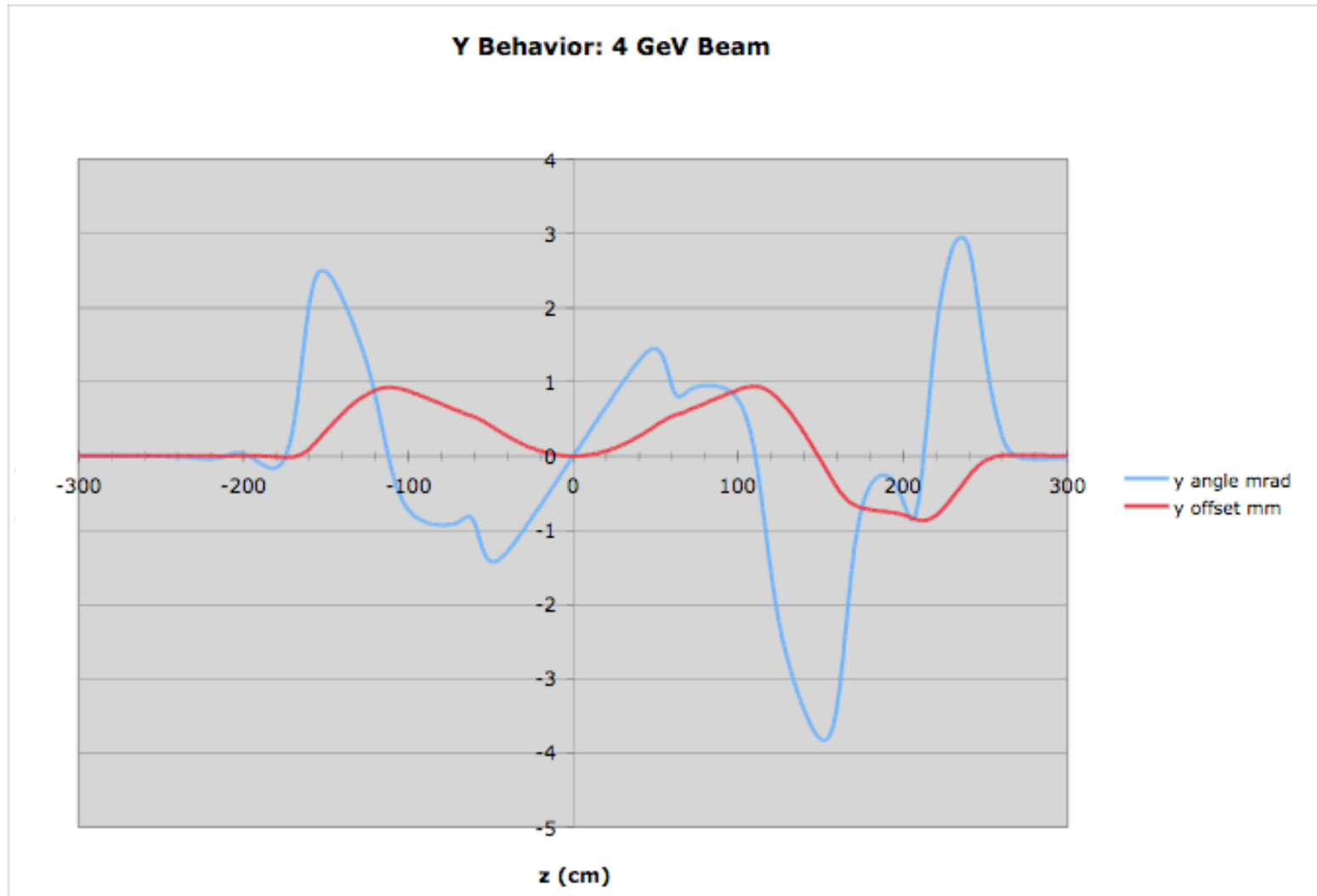
Solenoid Excitations

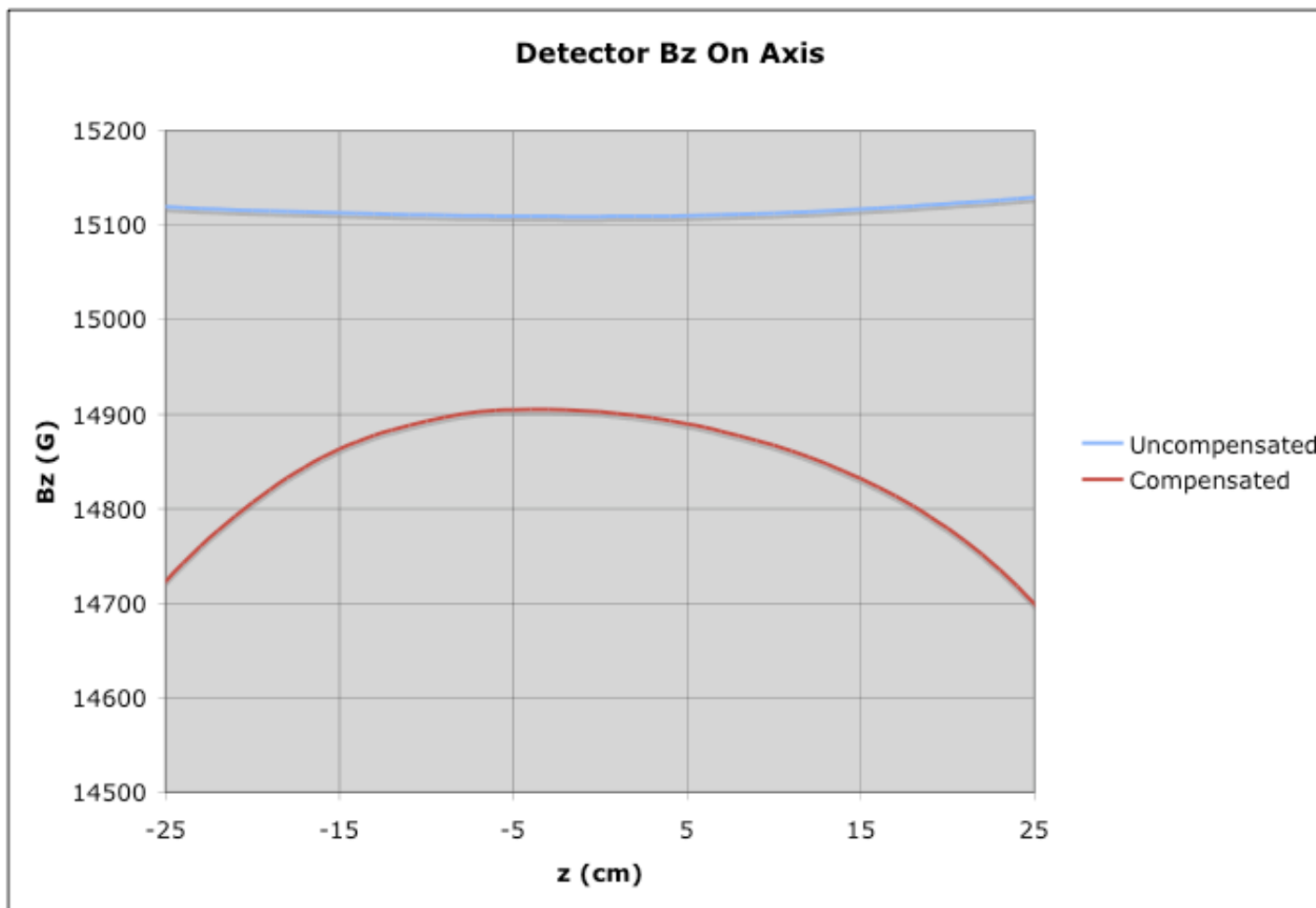




- $B_z < 1.5$ kG in SC quads, but high gradient at ends
- Mods to trim windings can improve this

Beam Offset & Angle (4 GeV)





- Compensating solenoids distort detector field
- Additional trim windings around PM quads would help

- Assumes quads do not steer or couple
 - Good assumption if quads are rolled and shifted
 - Fair assumption otherwise?
- Assumes solenoids have circular cross-section
 - Oval cross-section is attractive; will perturb results
- Will slightly perturb detector field
 - Additional trim solenoid over PM quads could flatten detector field
- Assumes PM quads are iron-free
 - Panofsky style PM quads would need additional solenoid
 - Solenoid would further perturb detector field