WIGGLER MAGNET DESIGN DEVELOPMENT FOR THE ILC DAMPING RINGS

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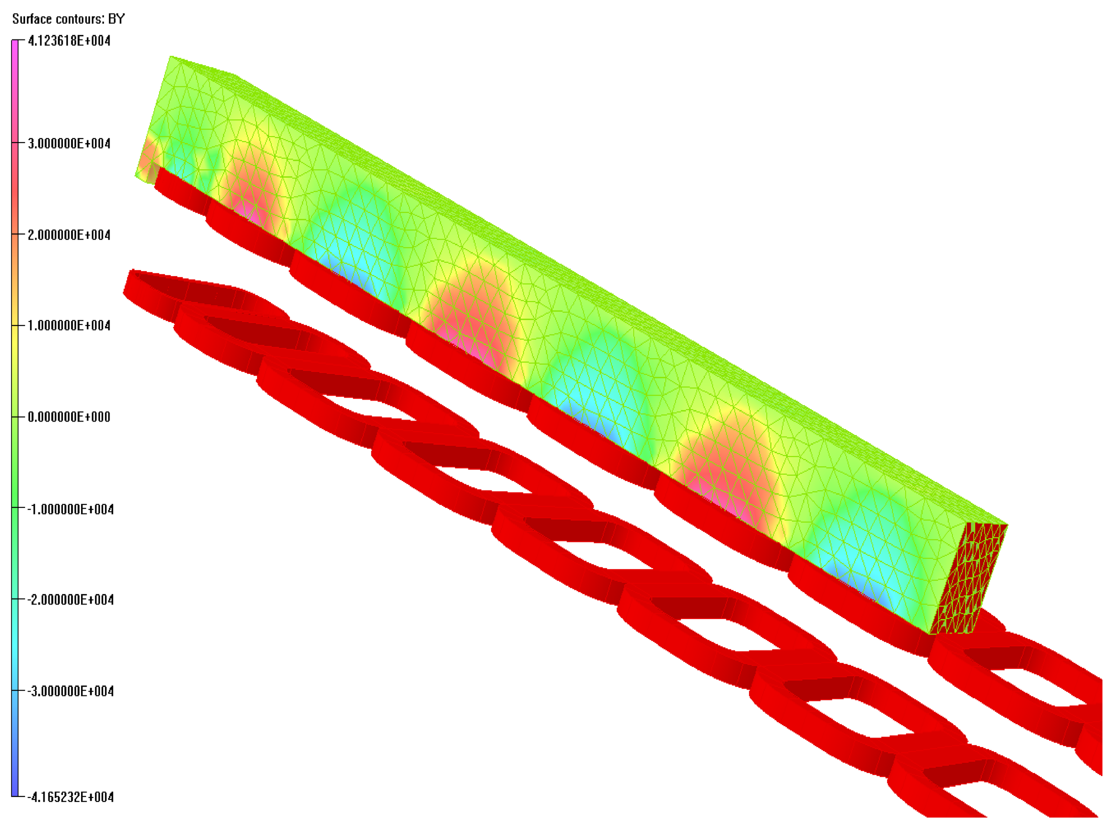
The baseline damping ring lattice for the International Linear Collider employs 54 wigglers at peak field 1.51 T for the 5 Hz mode and 2.1 T for the 10 Hz mode to provide the damping necessary to achieve the specified horizontal emittance. We describe the OPERA-based finite-element model developed for the 14-pole, 30-cm period, 7.62-cm gap superferric design which meets the 2.1 T peak field requirement.

OPERA 3D Model



Copper Vacuum Chamber Design with Clearing Electrode

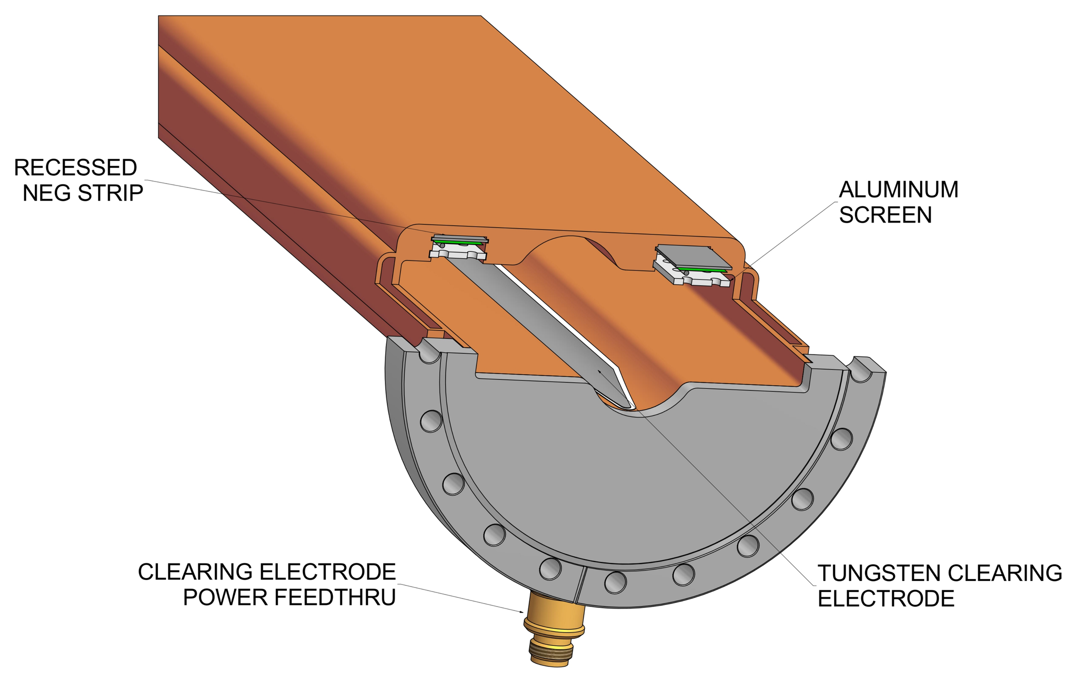
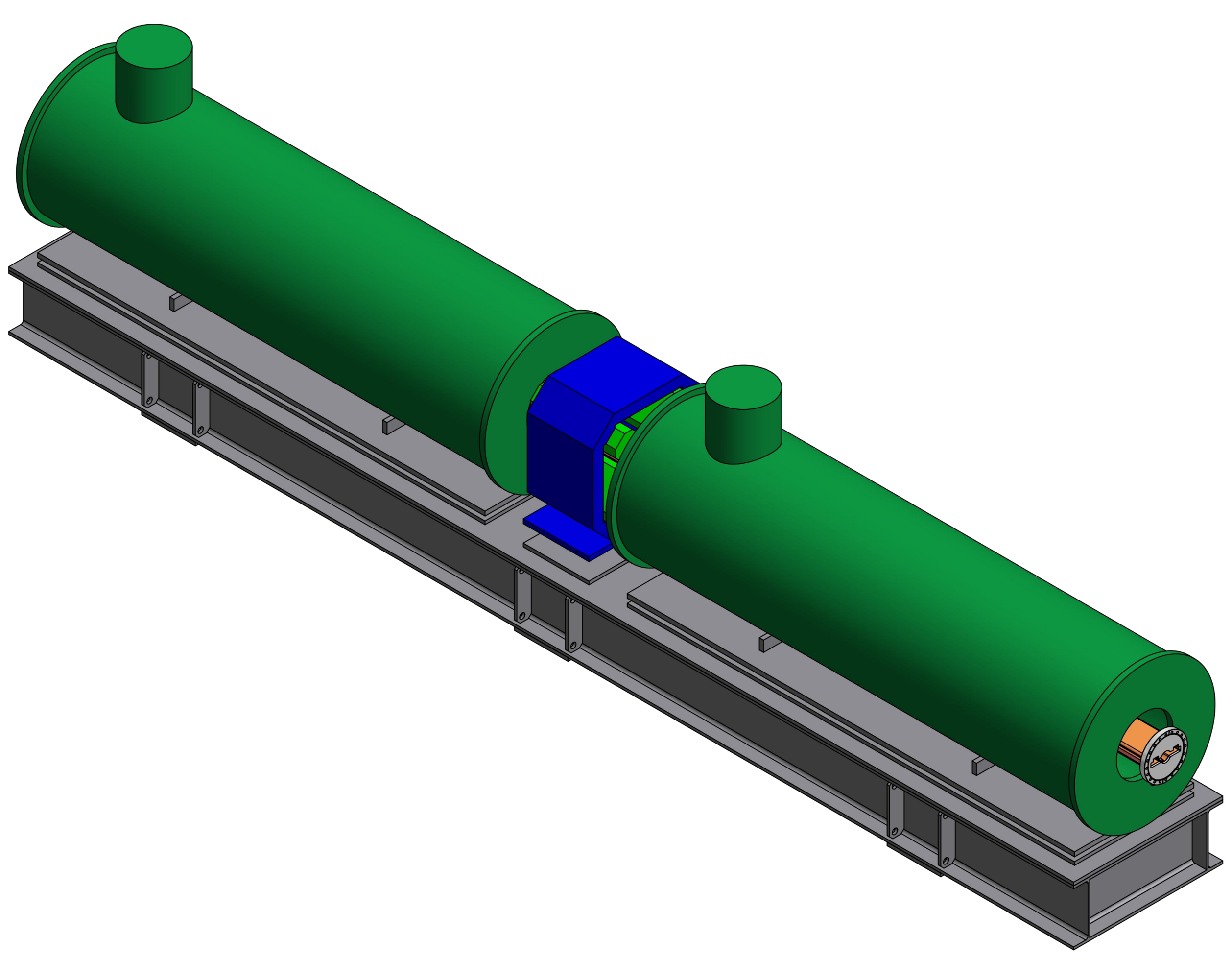


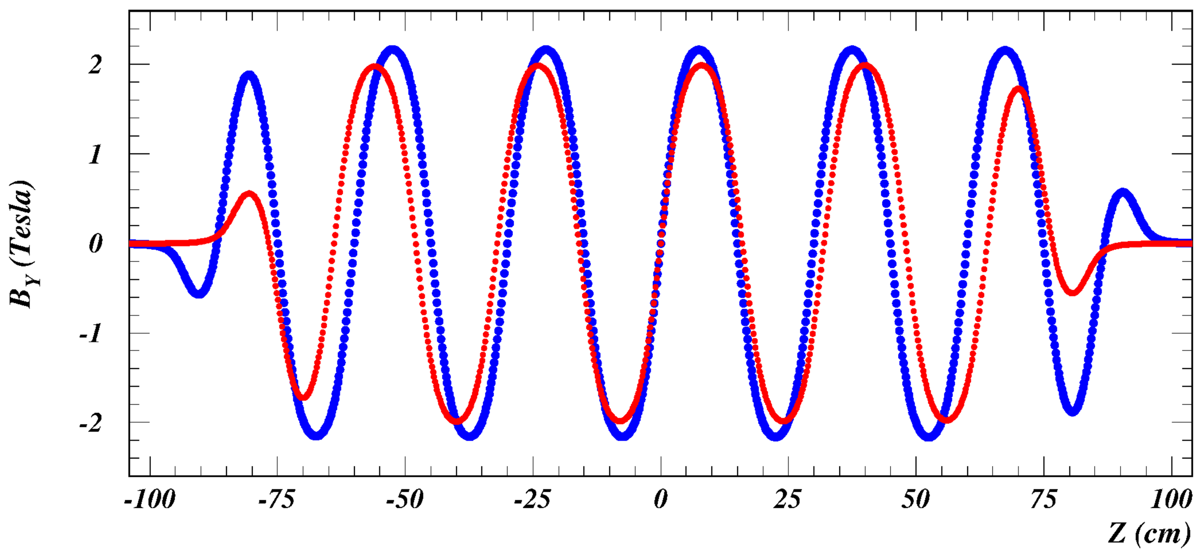
Table 1: Superferric Wiggler Comparison

Parameter	Unit	CESR-c	ILC Baseline	ILC Optimized	ILC Optimized/Higher Field
Peak Field	T	2.10	1.67	1.95	2.16
No. Poles		8	14	12	14
Length	m	1.3	2.5	1.68	1.875
Period	m	0.40	0.40	0.32	0.30
Pole Width	cm	23.8	23.8	23.8	23.8
Pole Gap	cm	7.6	7.6	8.6	7.6
dB/B (x=10mm)	%	0.0077	0.0077	0.06	0.06
Coil Current	A	141	112	141	141
Beam Energy	GeV	1.5–2.5	5	5	5

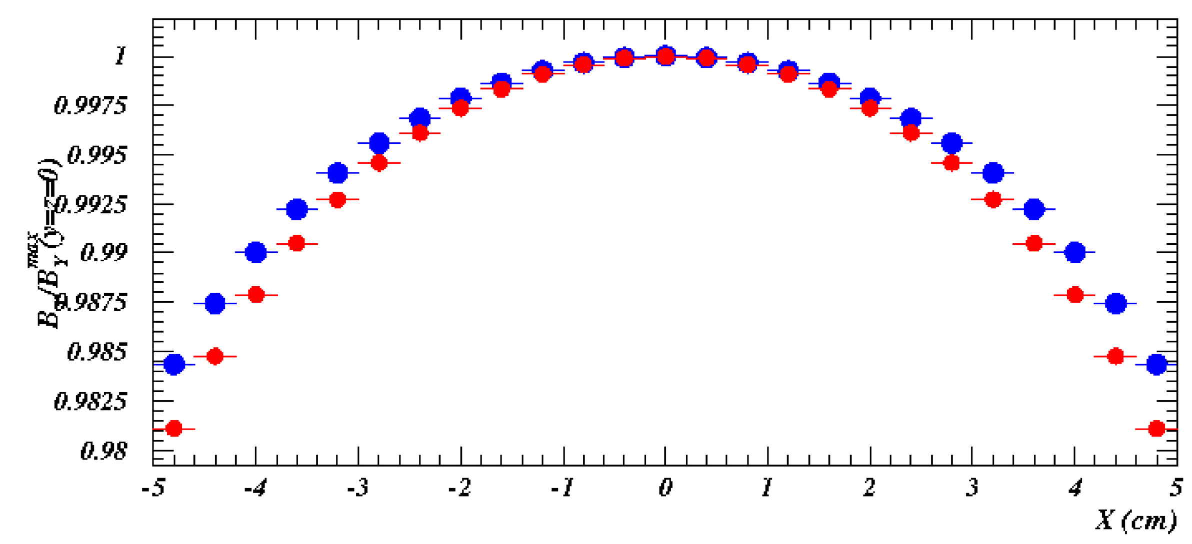


Comparison of Previous ILC Optimized Wiggler with New Higher-Field Design

Vertical Field Component

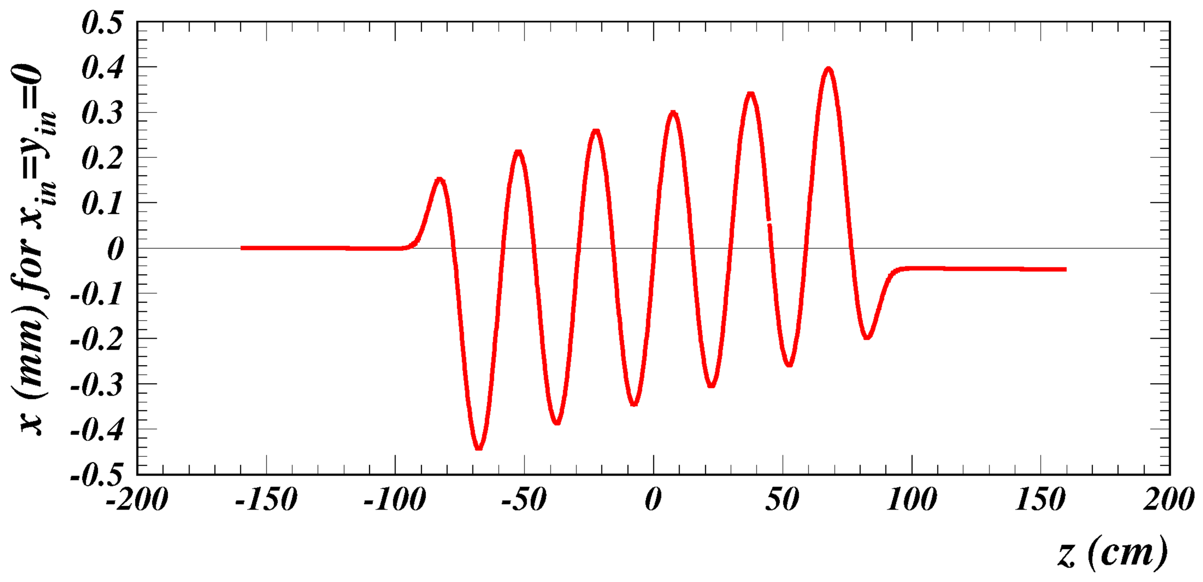


Transverse Field Uniformity in Central Pole

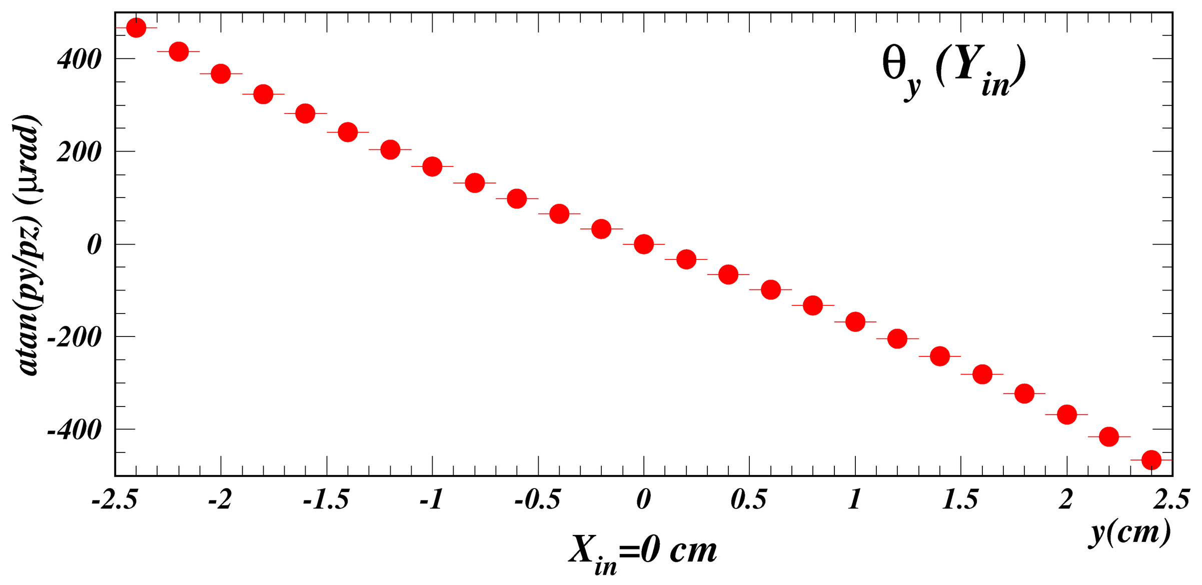


Plan View of 5 GeV Trajectory

The 3/4- and 1/2-pole-length tapering in the end poles has been maintained as in the CESR design. The end poles have been simplified, omitting the trim coils used to tune the second integral. Instead, the number of turns in the end pole coil has been adjusted to limit residual horizontal orbit displacement for 5 GeV particles incident on axis to about 50 m. There are 158~turns in the end-pole coils in this design.



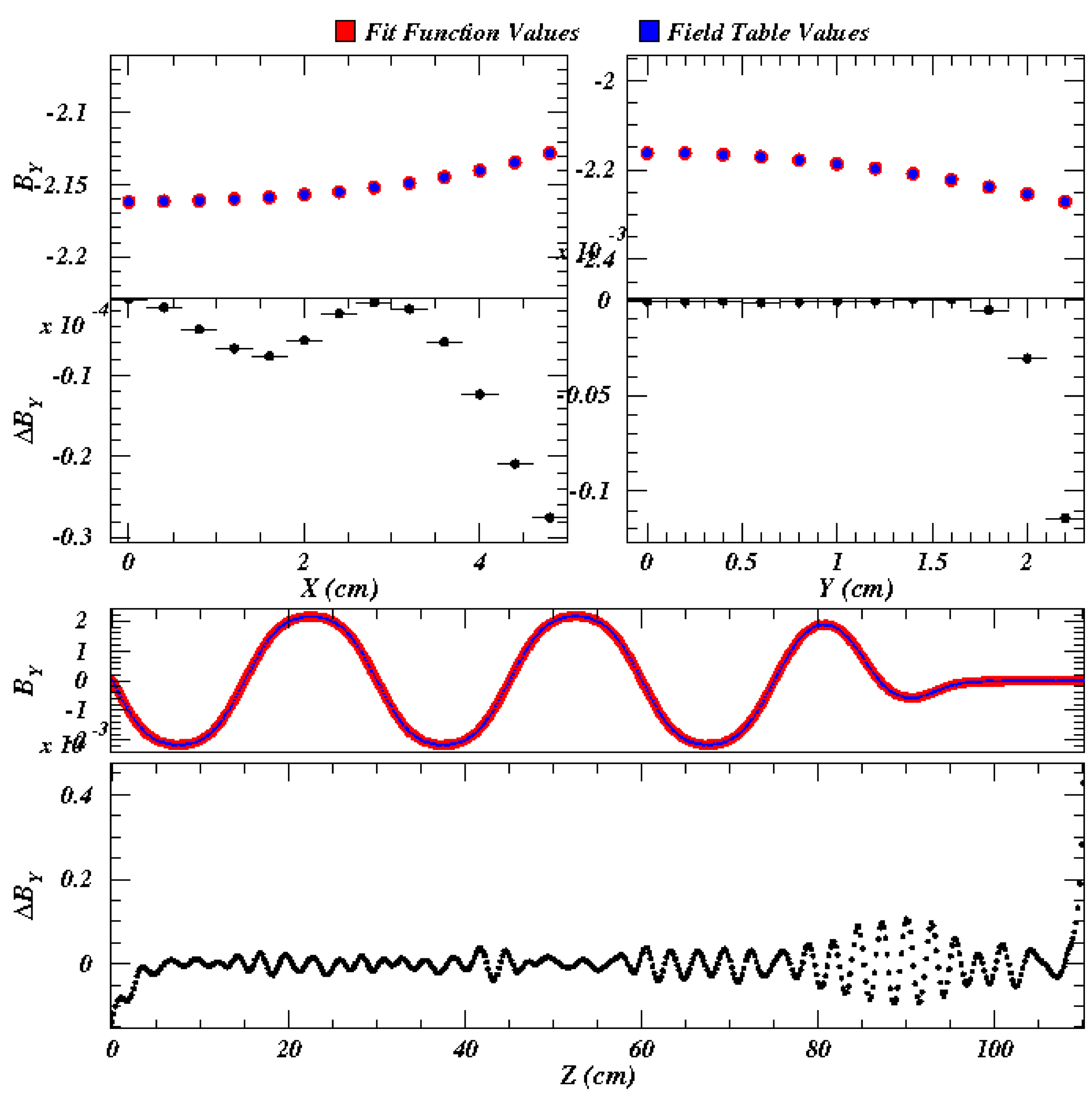
Vertical Focusing Resulting from Oscillatory Horizontal Trajectory with Longitudinal Field Component



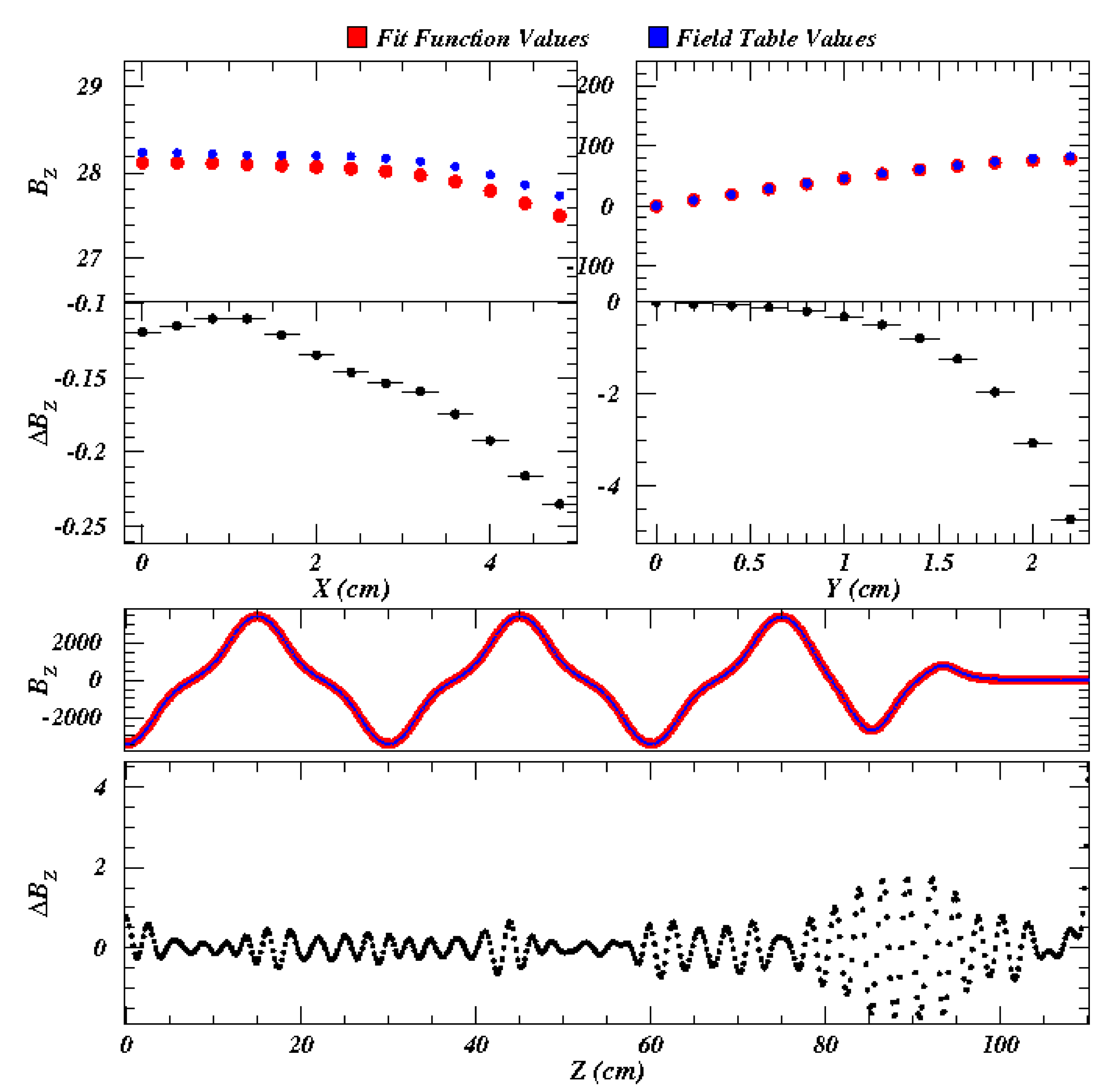
Analytic Model Fit to the OEPRA 3D Discrete Field Map

The analytic model used for the CESR-c wigglers to allow fast tracking for lattice development was successfully used for the ILC damping ring wiggler designs as well. We find that a good fit, including the finite pole width and the end effects, requires about 220 terms. Each term independently satisfies Maxwell's equations. Symplectic integration through this analytic representation of the field is used for long-term tracking.

Vertical Field Component
The three axes shown pass through the point (0,0,7.5) cm



Longitudinal Field Component
The three axes shown pass through the point (0,0.6,7.5) cm



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