Recent Progress on Guggenheim Simulations

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2. Multilayer scheme
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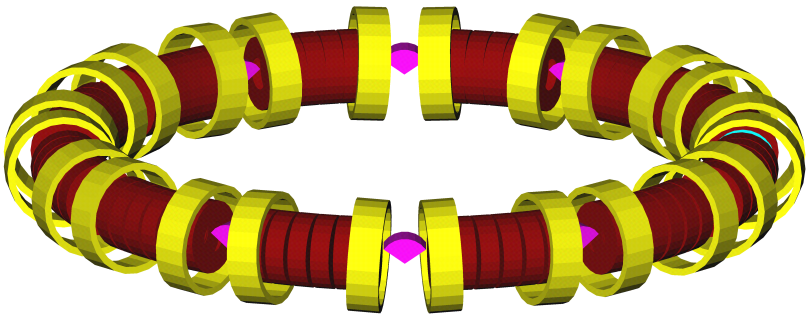
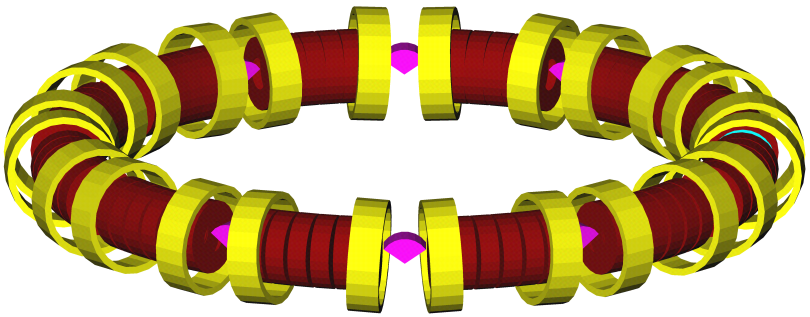
RFOFO ring & helix

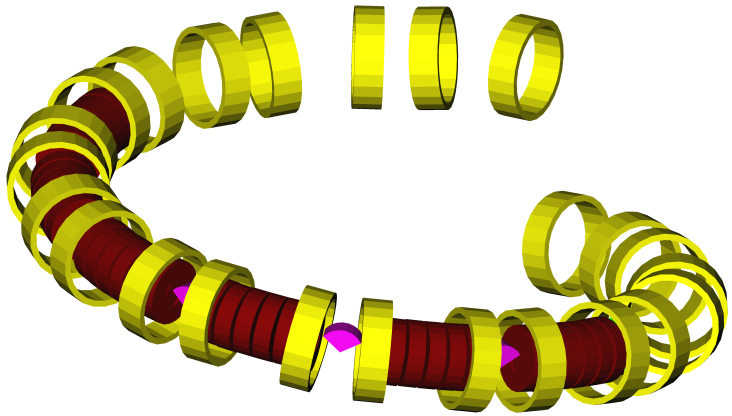


- RFOFO ring

RFOFO ring & helix



- RFOFO ring



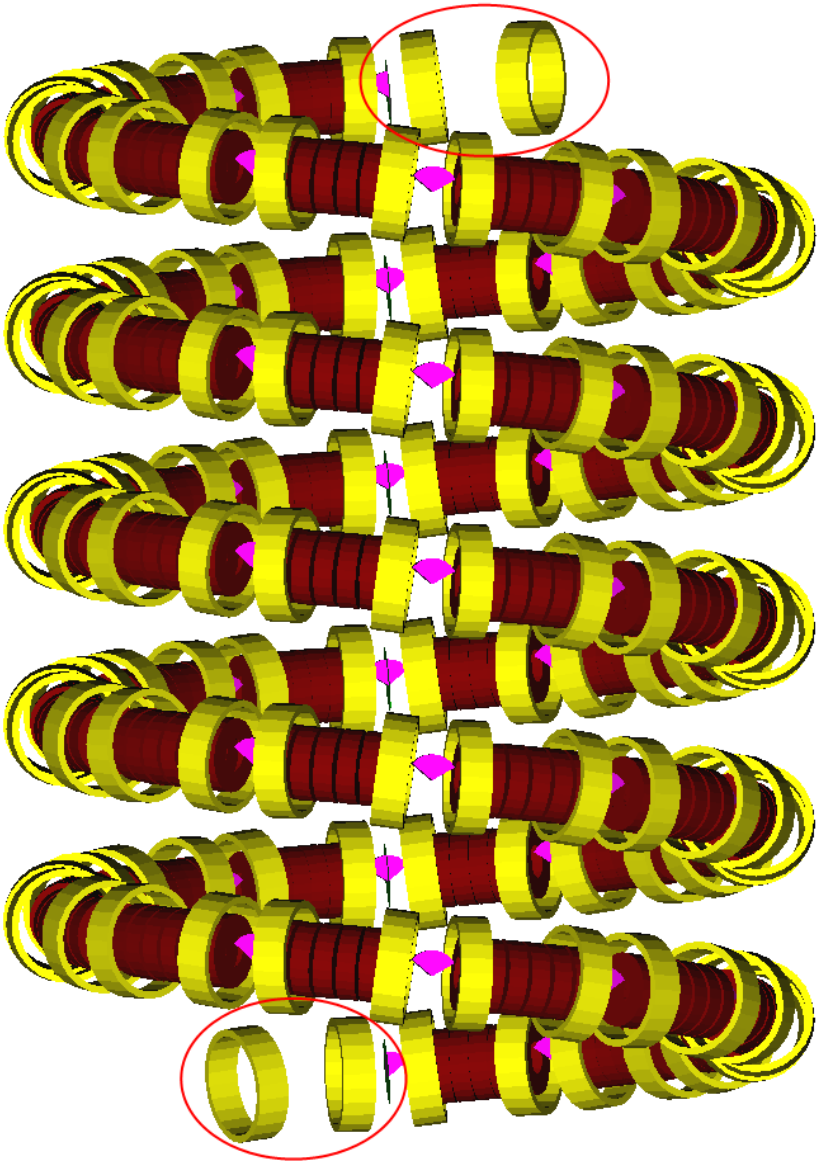
- RFOFO helix

RFOFO ring & helix

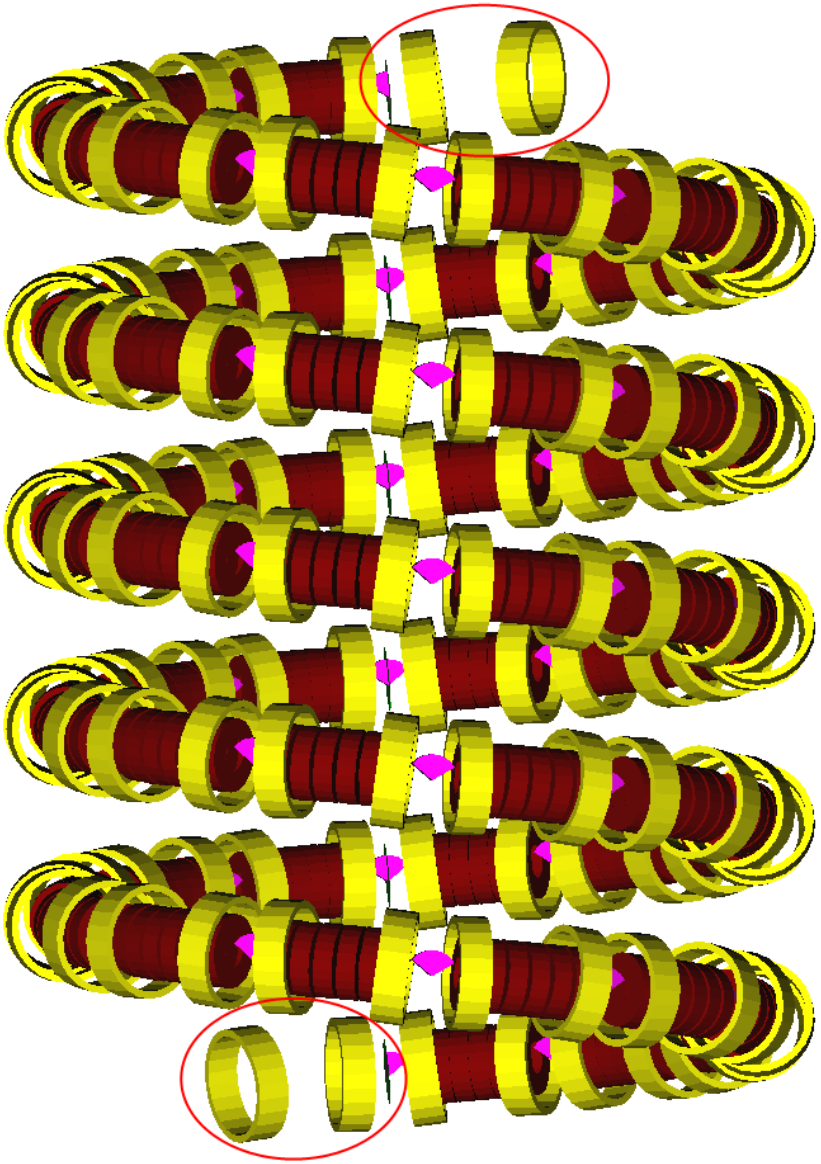
Table: RFOFO and Guggenheim parameters

	RFOFO	**Guggenheim**
Circumference, [m]	33.00	33.00
Pitch, [m]	0	3.00
Pitch angle, [deg]	0	5.22
Radius, [mm]	5252.113	5230.365
Maximum axial field, [T]	2.77	2.80
Coil tilt (wrt orbit), [deg]	3.04	3.04
Average momentum, [MeV/c]	220	220
Reference momentum, [MeV/c]	201	201
RF frequency, [MHz]	201.25	201.25
RF gradient, [MV/m]	12.835	12.621
Absorber angle, [deg]	110	110
Absorber thickness on beam axis, [cm]	27.13	27.13

Multilayer scheme

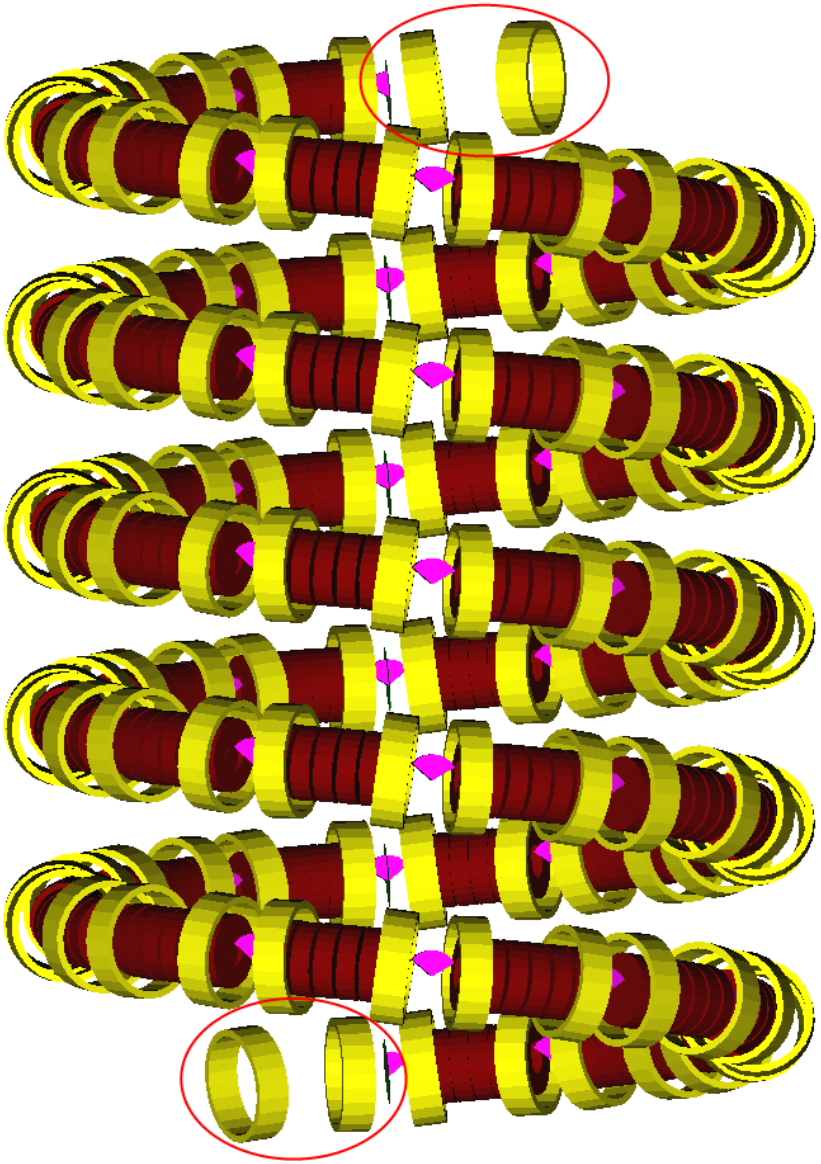


Multilayer scheme



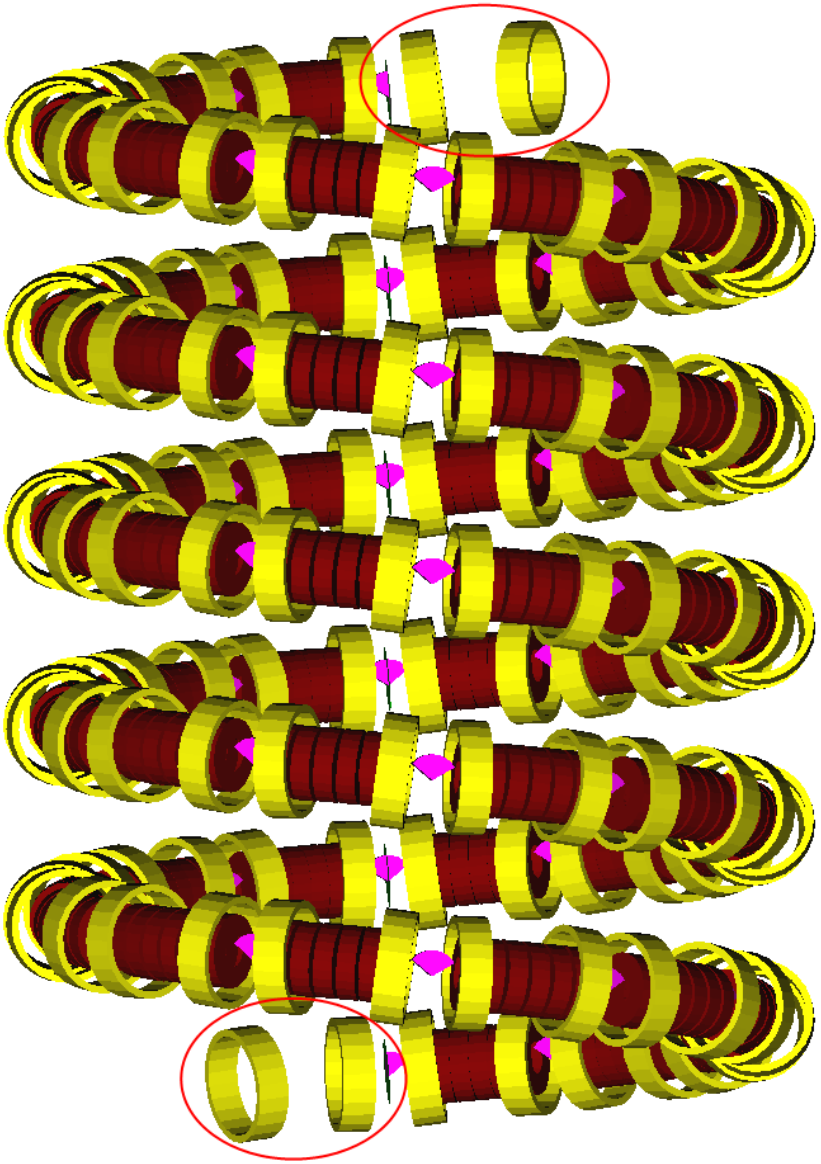
- 5 layers = 165 m

Multilayer scheme



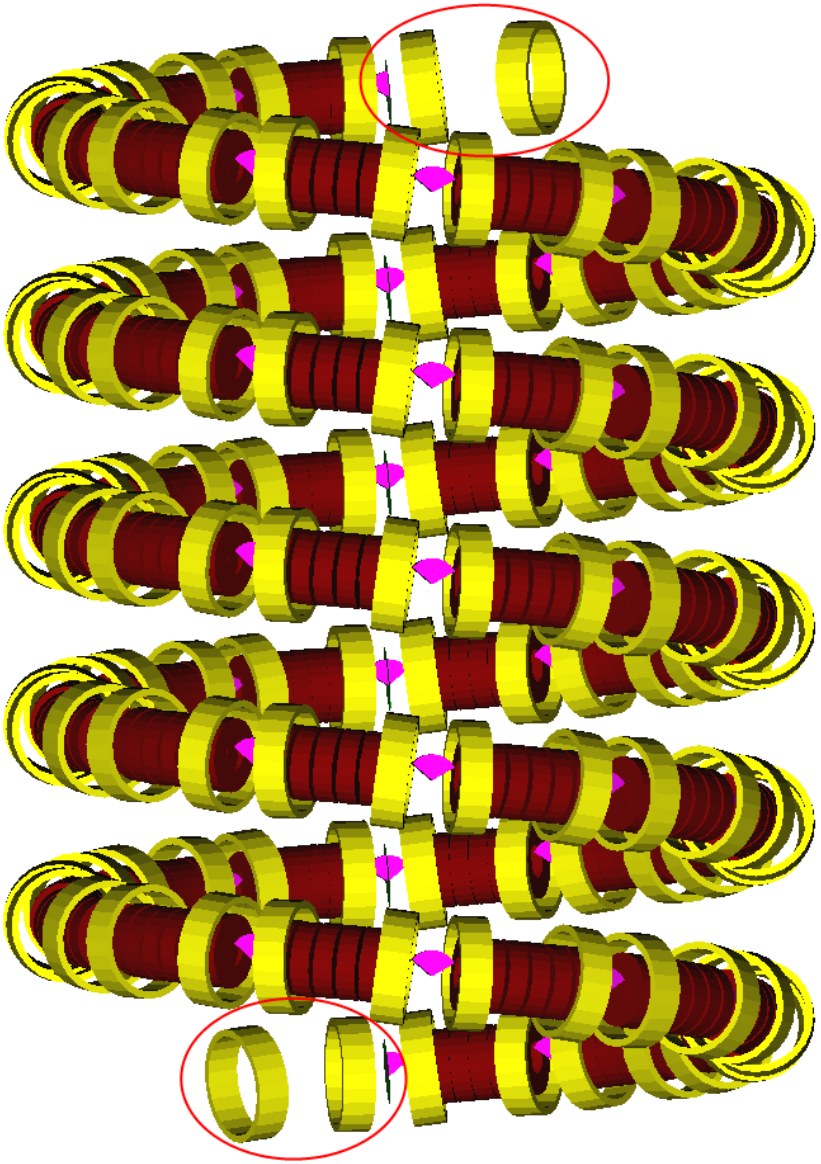
- 5 layers = 165 m
- no shielding between layers

Multilayer scheme



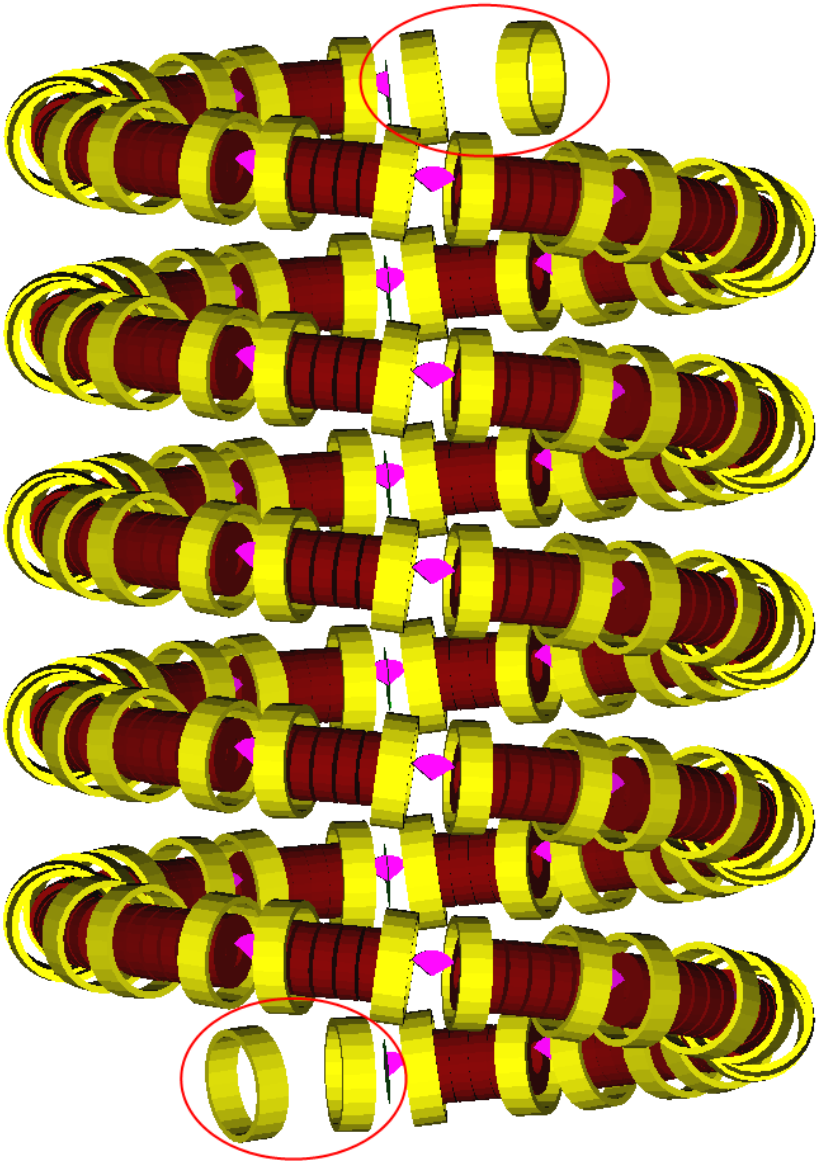
- 5 layers = 165 m
- no shielding between layers
- no shielding of outer layers

Multilayer scheme



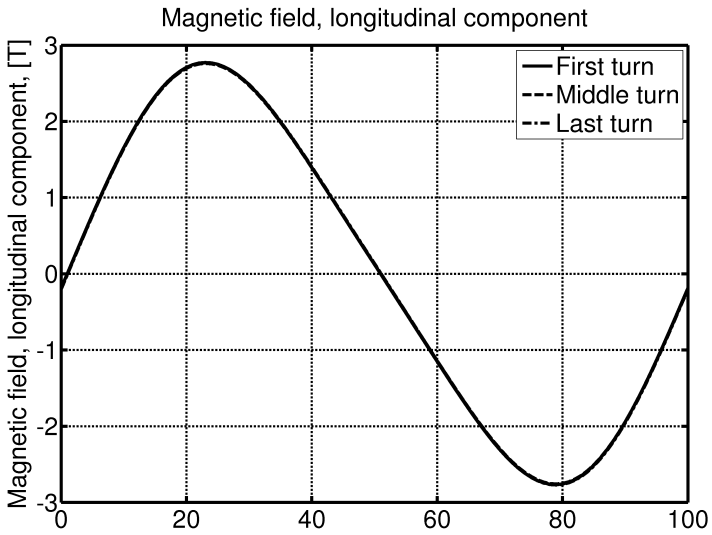
- 5 layers = 165 m
- no shielding between layers
- no shielding of outer layers
- the magnetic field at any point of the trajectory is generated by all the coils

Multilayer scheme

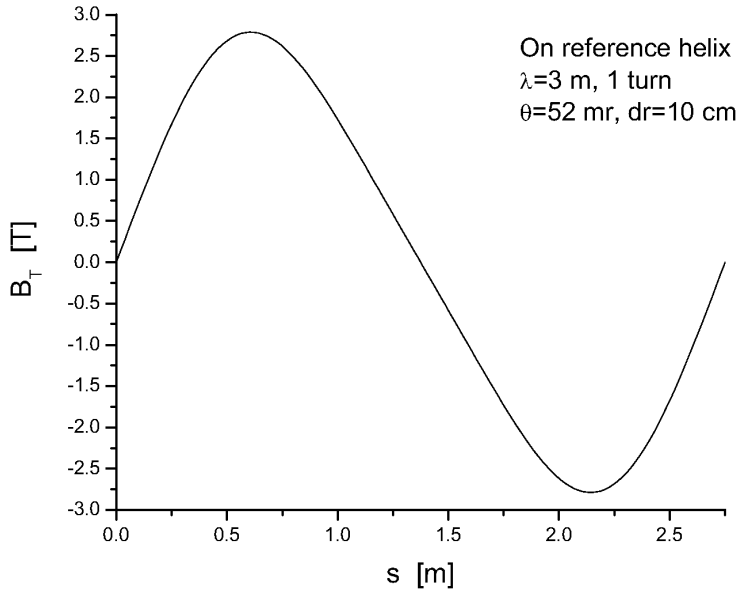


- 5 layers = 165 m
- no shielding between layers
- no shielding of outer layers
- the magnetic field at any point of the trajectory is generated by all the coils
- compared to the case with shielding between layers

Longitudinal component

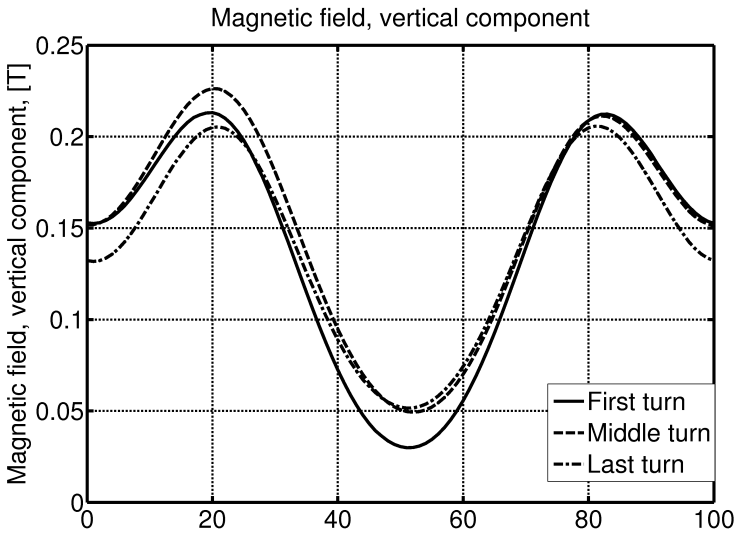


- G4Beamline



- ICOOL

Vertical component



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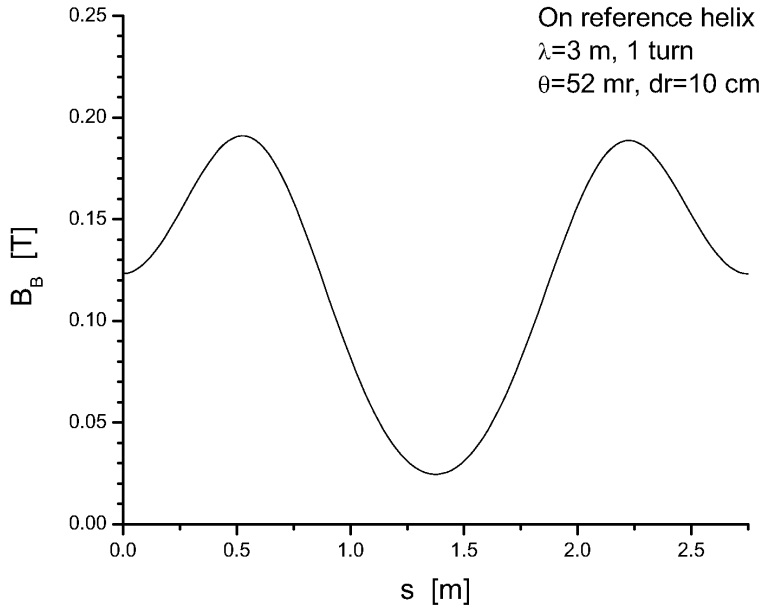
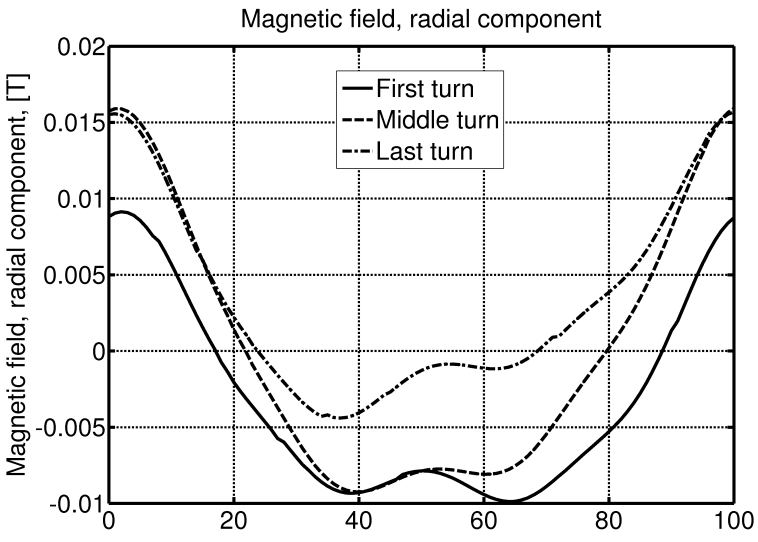


- ICOOL

Radial component



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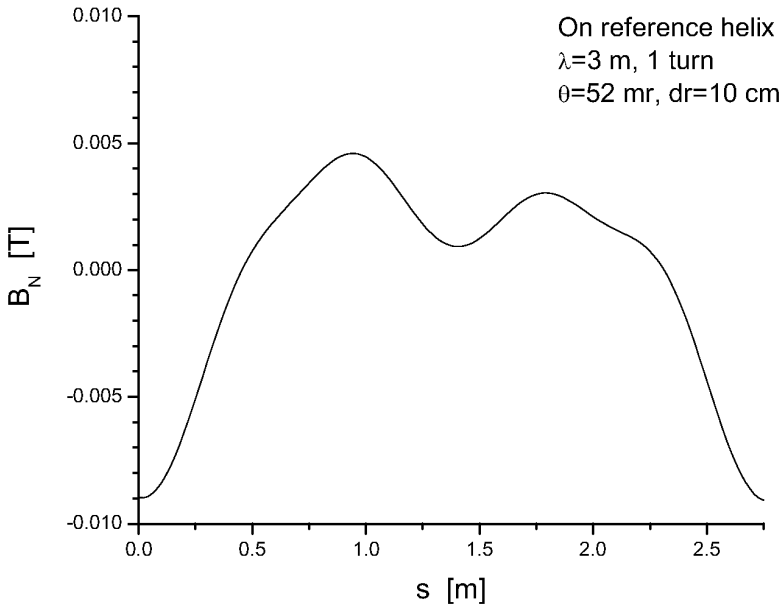
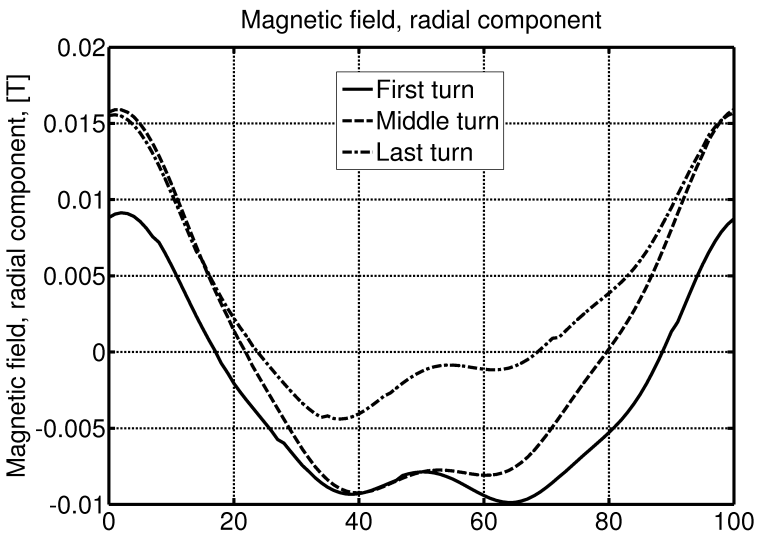
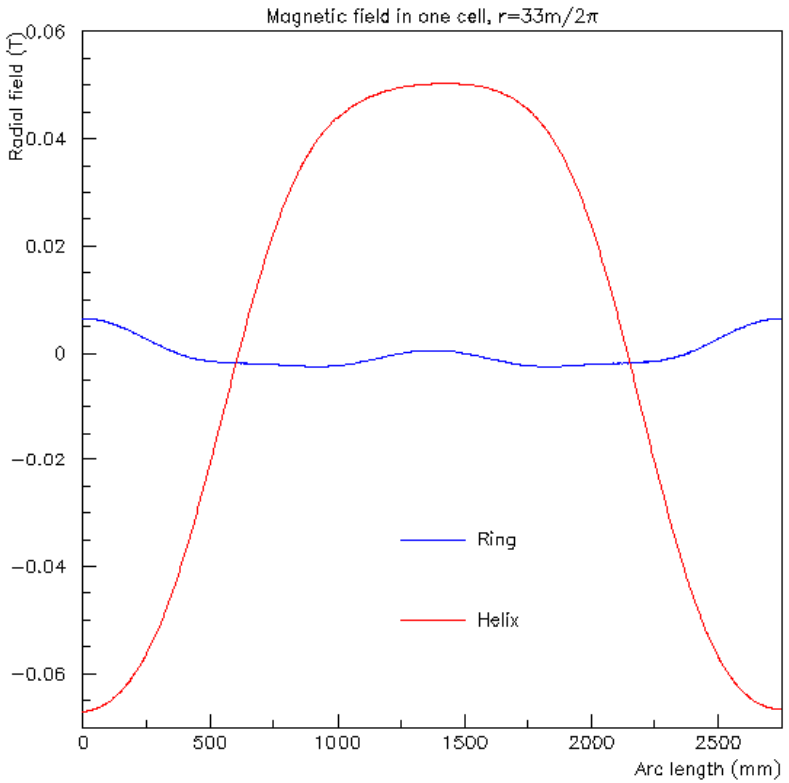


- ICOOL

Source of discrepancy

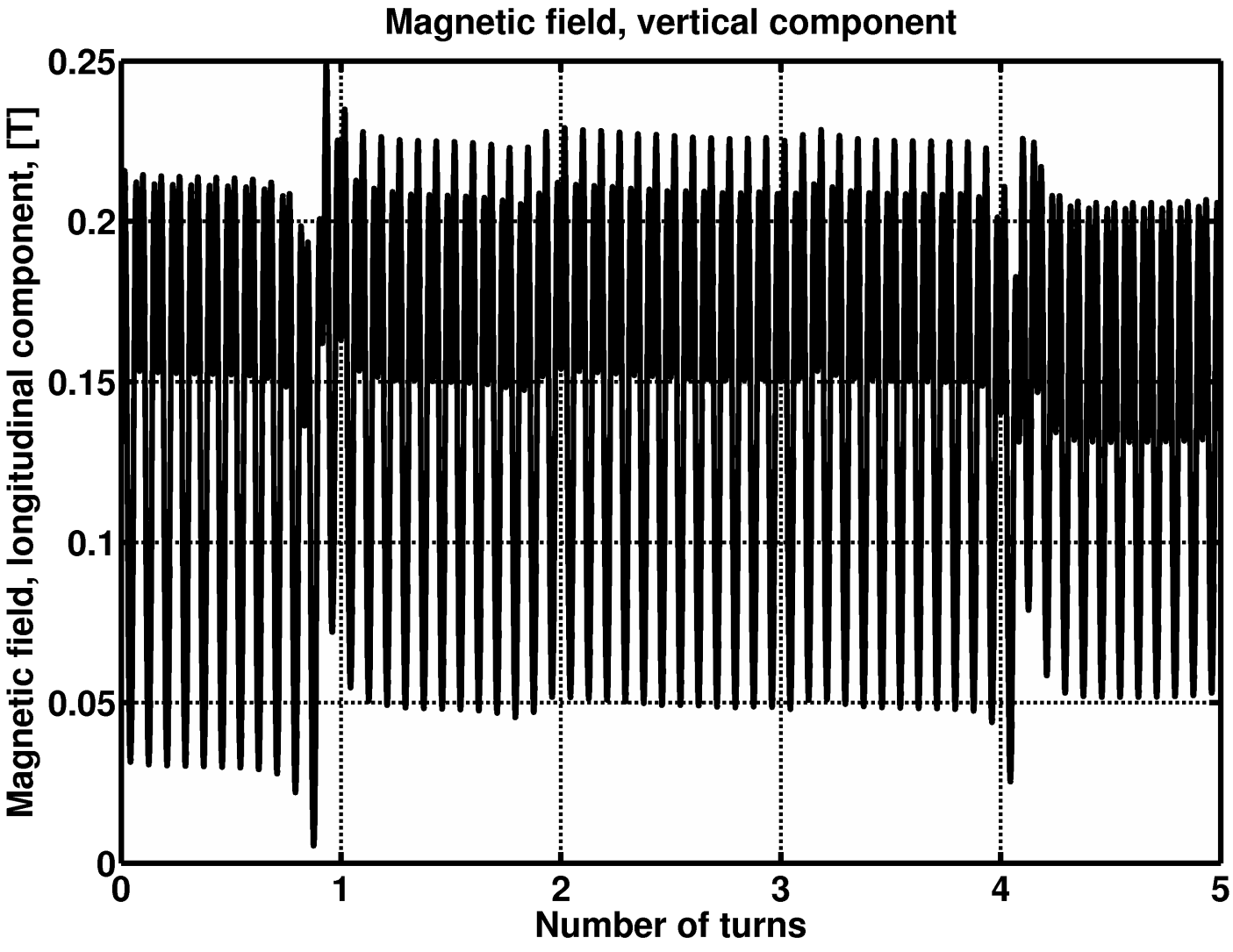


- G4Beamline (Pavel Snopok)

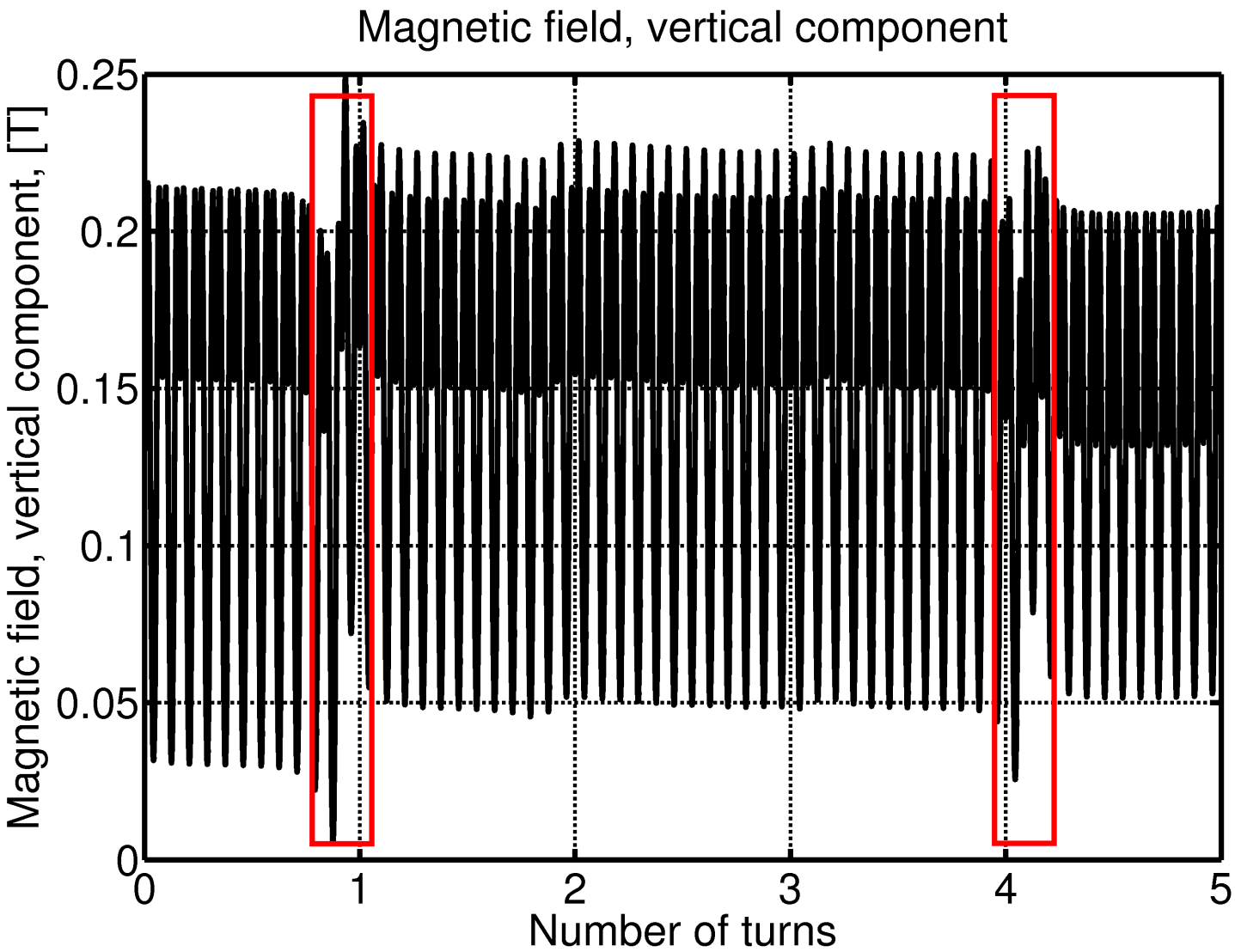


- G4Beamline (Amit Klier)

Multilayer vertical component



Multilayer vertical component



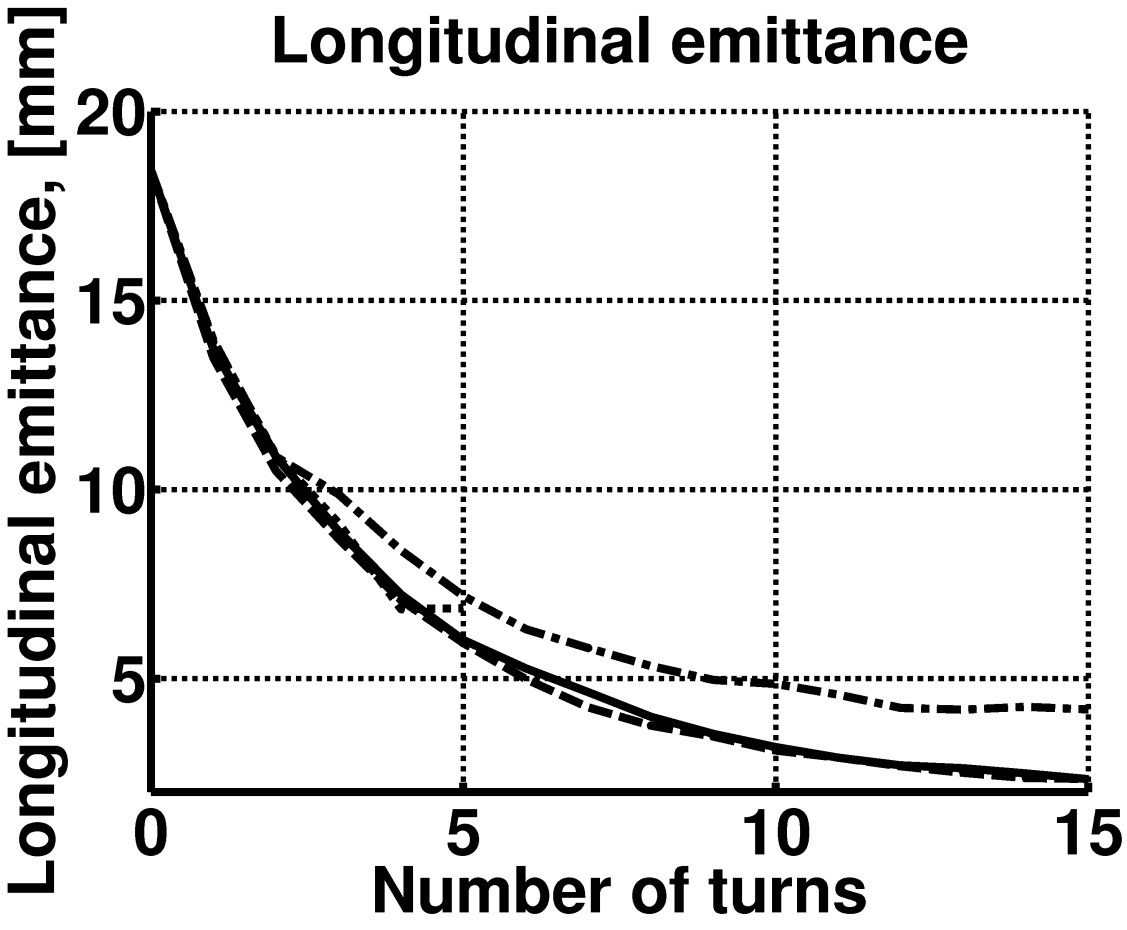
Performance characteristics compared

Performance characteristics compared

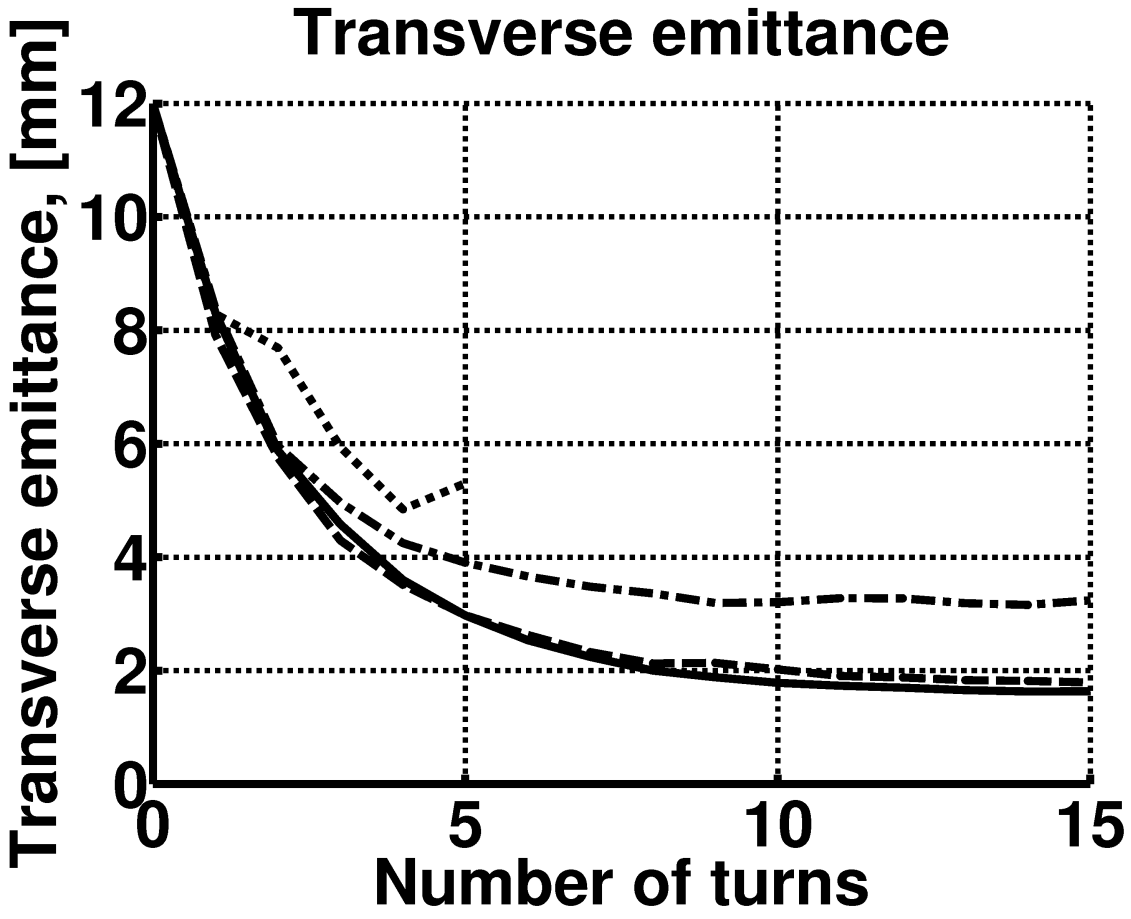
Four simulations are considered:

- Original RFOFO lattice
- Ideal Guggenheim (shielding between layers, single turn)
- "Realistic" Guggenheim (shielding between layers, single turn, RF cavities with windows, absorbers with windows)
- 5-layer "fair" Guggenheim (no shielding, all 5 layers contributing, all windows)

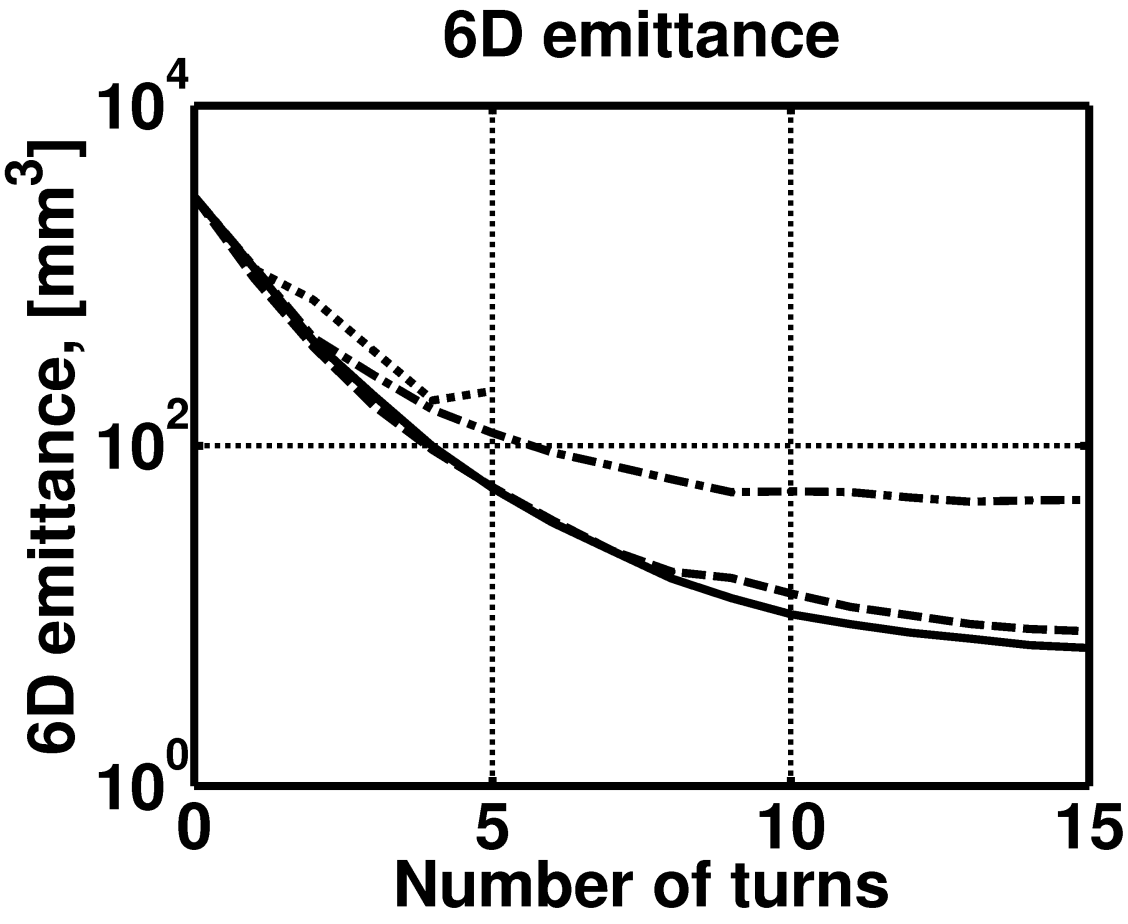
Longitudinal emittance



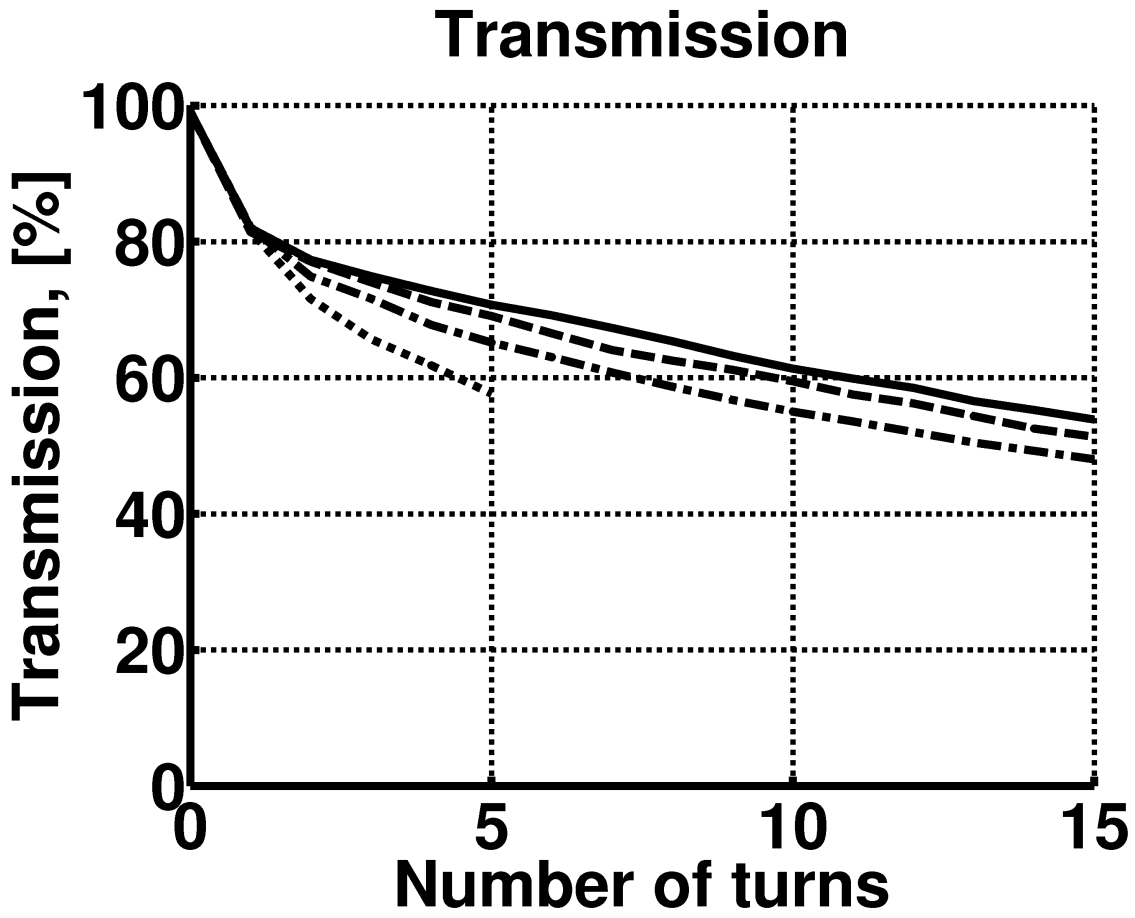
Transversal emittance



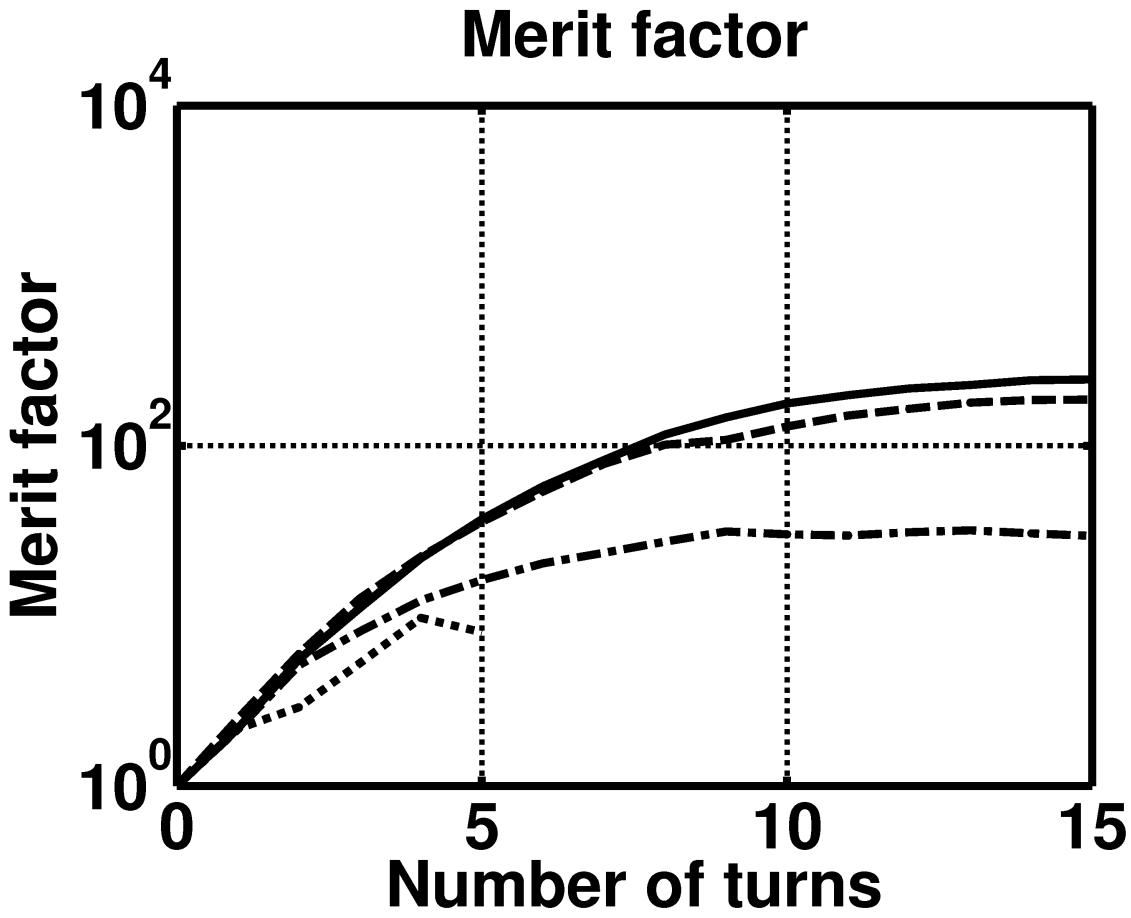
6D emittance



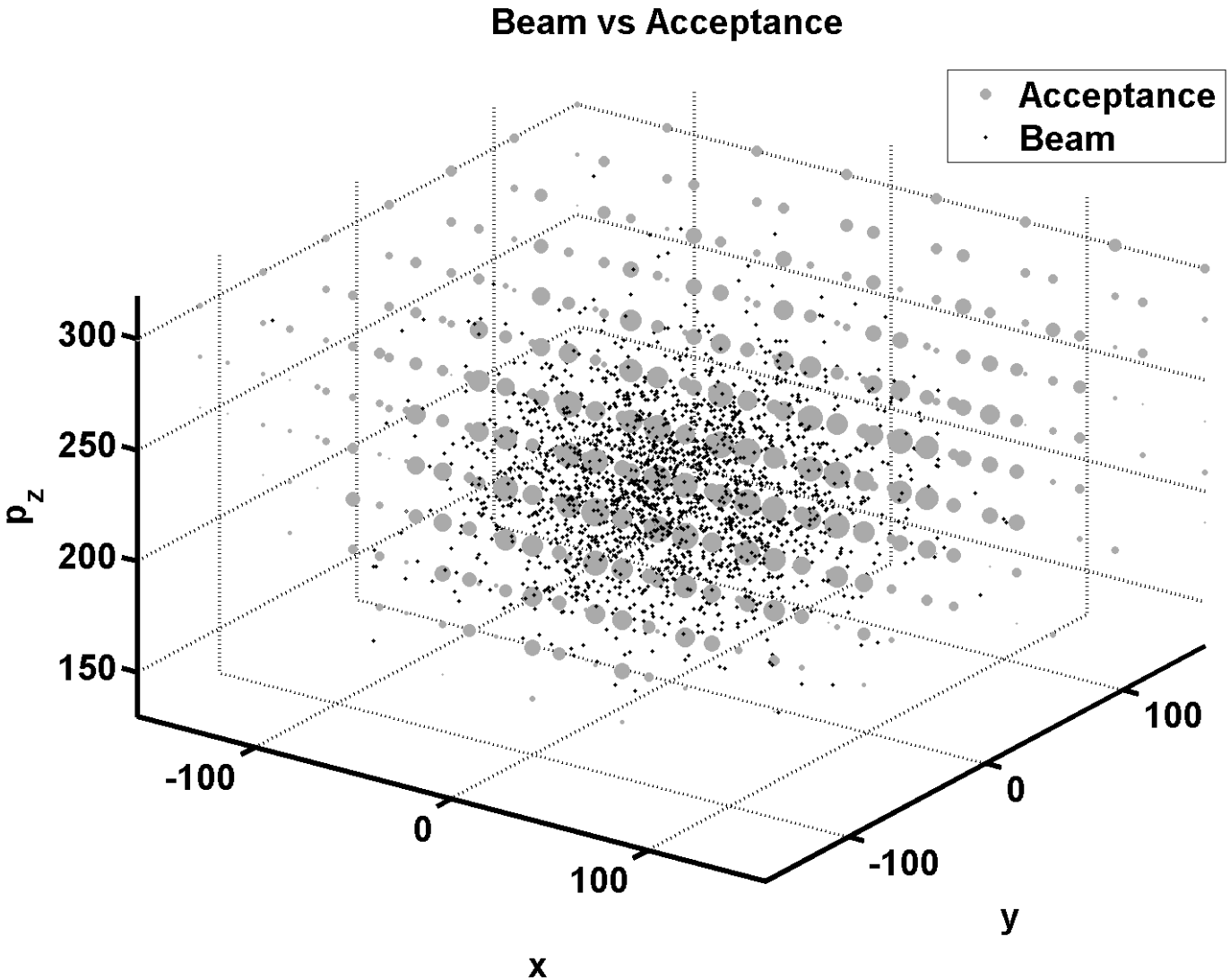
Transmission



Merit factor



Loss in transmission



		Structure			
Parameter	Turn #	RFOFO ideal	Guggenheim ideal	Guggenheim realistic	Guggenheim 5 layers
σ_x [mm]	0	41.79	41.79	41.79	41.79
	5	25.48	27.05	28.81	30.72
	10	19.62	20.74	25.58	-
	15	18.71	19.47	26.60	-
σ_y [mm]	0	42.86	42.86	42.86	42.86
	5	24.14	27.72	30.10	38.08
	10	18.61	21.74	27.77	-
	15	18.24	20.81	26.73	-
σ_p [MeV/c]	0	27.85	27.85	27.85	27.85
	5	11.80	12.00	13.58	12.79
	10	7.98	8.40	11.55	-
	15	7.37	7.45	10.83	-
σ_t [ns]	0	0.298	0.298	0.298	0.298
	5	0.235	0.237	0.261	0.364
	10	0.171	0.166	0.201	-
	15	0.143	0.144	0.185	-

Table: Decrease in variation for different models

Summary

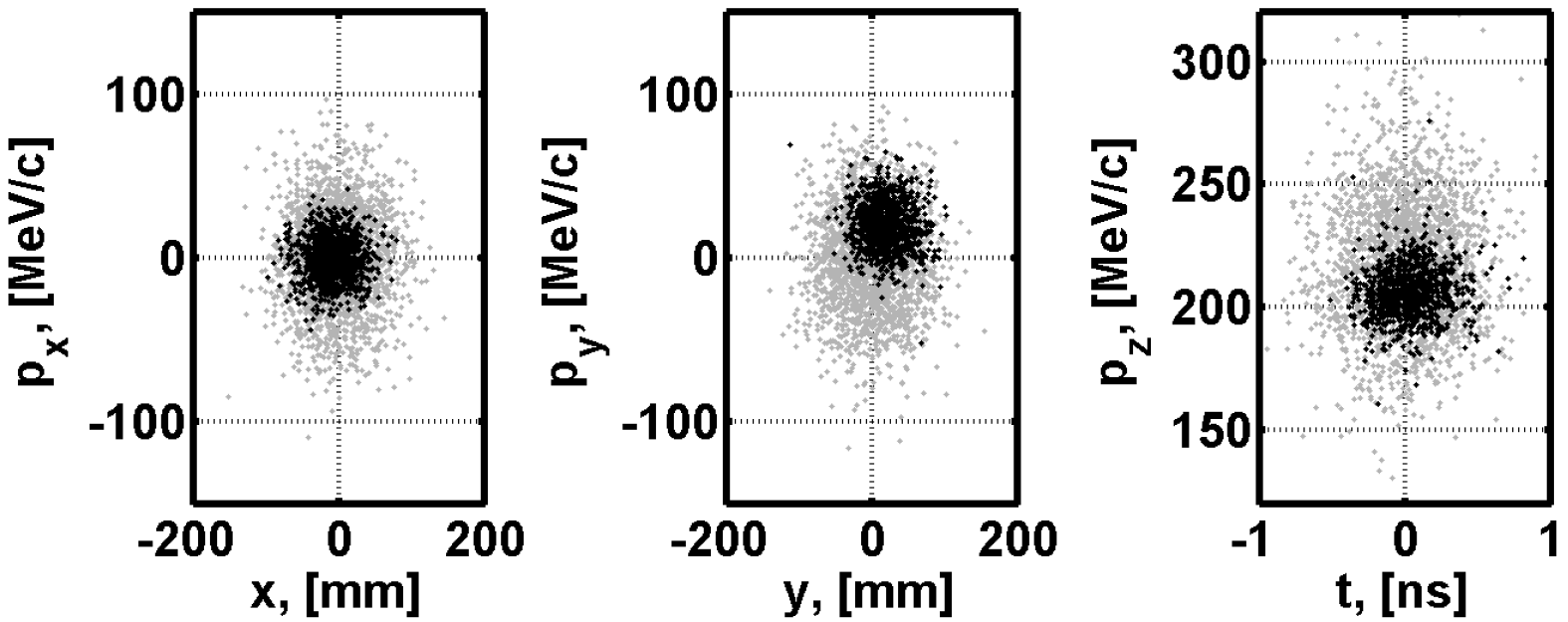


Figure: Reduction in the 6D phase space due to cooling. Gray – initial distribution, black – after 15 turns in the realistic Guggenheim cooling channel (495 m).