Progress on a realistic front end design for Study 2A

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Outline

- plan for a realistic baseline design
- alternatives to baseline design
- ongoing front end simulation work
- effects on performance (J. Gallardo)
- progress on the magnetic lattice

Plan for a realistic baseline front end design

1. produce Maxwellian magnetic lattice for entire front end
   - remove disconnects between separated designed FE regions
   - replace constant field in drift, buncher, rotator with periodic solenoids
   - fine-tune capture and match regions to optimize performance
   - produce table showing location and properties of every solenoid
2. model radial constraint of beam pipe inside capture solenoid
3. add RF windows in the buncher
4. discretize RF frequencies in buncher and rotator to a small number (~10)
5. end FE exactly at 201.25 MHz
6. generate new particle distribution
   - provide field map over the Hg target to MARS
7. use MARS to make radiation map 50 m downstream from the target
   - check if radius of periodic drift solenoids is OK
8. do a Geant confirmation of final design?

Alternatives to baseline design

1. study optimized B profiles for capture and decay channel
2. compare window and absorber materials and thicknesses
   LiH, Li, Be
3. try to shorten phase rotator
4. check effect of lowering RF gradient in cooler

Ongoing front end work

1. Juan
   - periodic transport solenoids, buncher windows, retuning FE parameters
2. Rick
   - magnetic design of capture solenoids, match into cooler
3. Bob
   - match into cooler
4. Kevin and Harold
   - MARS radiation map
5. Harold
   - new MARS particle distribution
6. Kevin
   - optimized B profile for capture and decay configuration
7. Dave
   - material effects, rotator length
8. Yasuo
   - effects of RF gradient in cooler

Front End Performance

Table 1: Study-2; Palmer; B_z periodic in drift and buncher: [1] R=0.32 [2] R=0.43; Maxwellian and Be windows in the buncher

	λ	ϵ_T		ϵ_L		ϵ_6		N_0		N_1		N_2	
ST-2.		7.7	2.7	95.0	25.6	6.0	0.2	0.37	0.22			0.08	0.16
Palmer.	0.	9.5	6.5	72.4	62.5	6.6	2.7	0.51	0.42	0.20	0.24	0.08	0.12
D.&B.[1]	0.5/0.75	9.6	6.7	69.3	65.7	6.5	3.0	0.47	0.39	0.17	0.21	0.08	0.11
D.&B.[2]	0.5/0.75	9.7	6.6	76.3	63.0	7.3	2.7	0.45	0.37	0.17	0.20	0.08	0.11
Maxw.	0.5/0.75	9.8	6.6	68.1	60.2	6.7	2.7	0.44	0.36	0.17	0.20	0.07	0.10
+win.	0.5/0.75	9.9	7.4	93.9	93.8	9.2	5.3	0.27	0.21	0.08	0.08	0.04	0.03

The first value of ϵ_T is at 266 m and the second at 315.48 m; likewise with the other variables

N_0 total μ/p

N_1 within $\epsilon_T = 30$ mm-rad and $\epsilon_L = 150$ mm

N_2 within $\epsilon_T = 15$ mm-rad and $\epsilon_L = 150$ mm

Muon Collaboration

Work on magnetic lattice

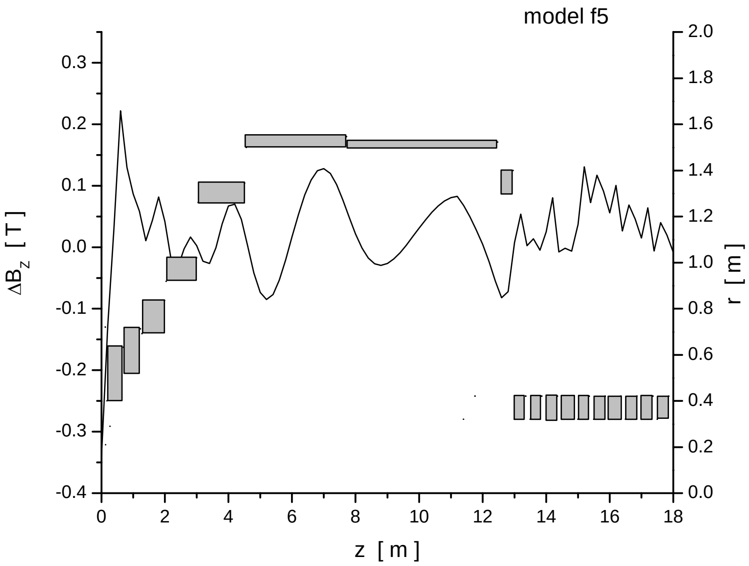
1. prepare preliminary coil file
- coil positions matched to accelerator layout
- strengths scaled to Palmer design values
- constant B in decay, buncher and rotator replaced by periodic channels
- adiabatic transitions at jumps in coil geometry

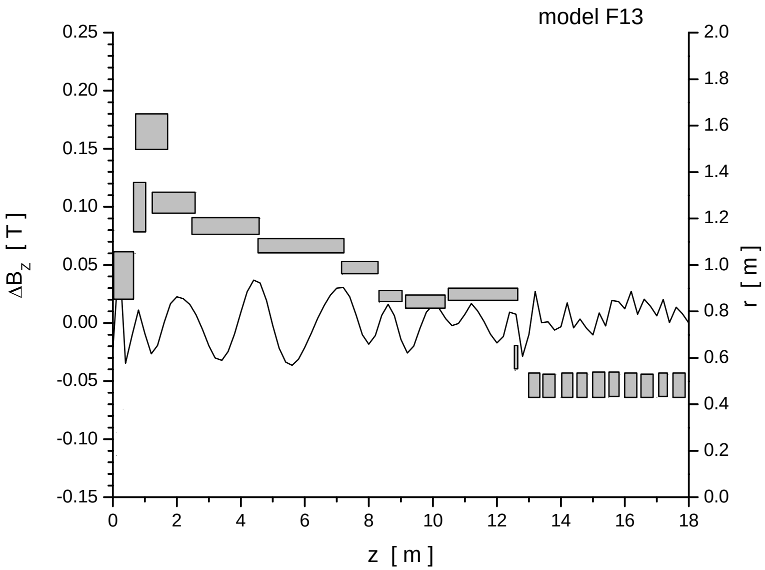
2. target and capture region
- require B_Z to follow FS2 theoretical profile
- keep radiation dose at superconducting coils below 1 MGy/yr
- keep J in copper below 24 A/mm^2
- keep J in superconductor below 80 A/mm^2
- minimize number of large radius coils

3. compare performance of different coil configurations

4. matching section into cooler
- work just starting

Target and capture coil configurations

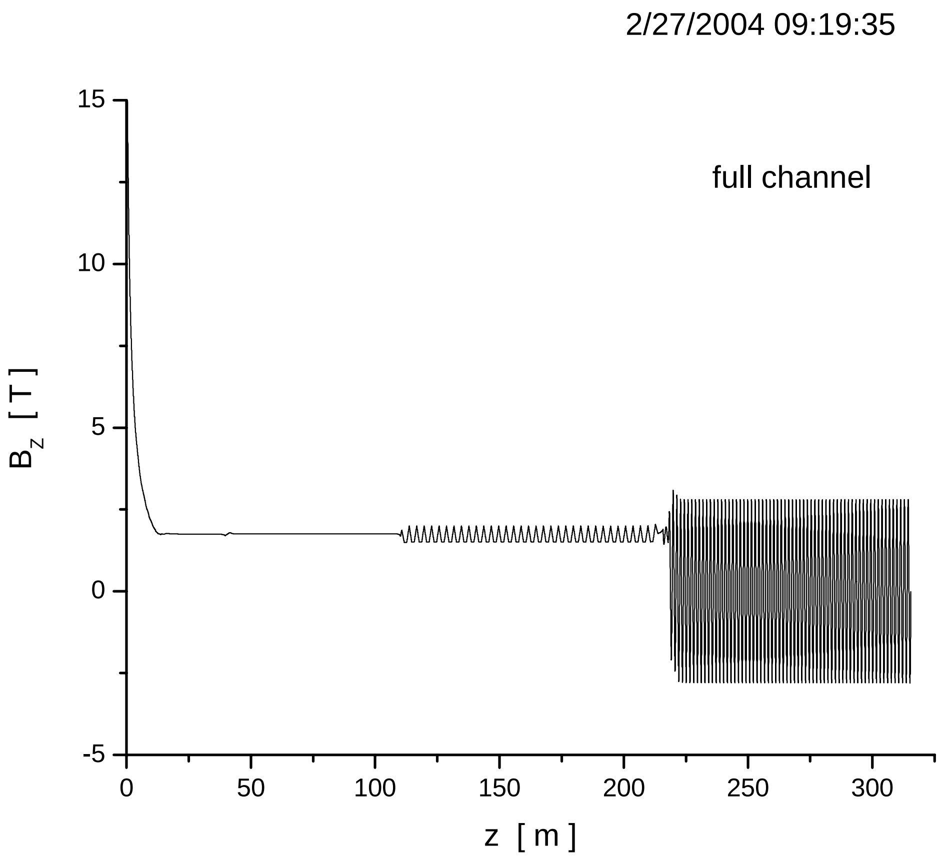




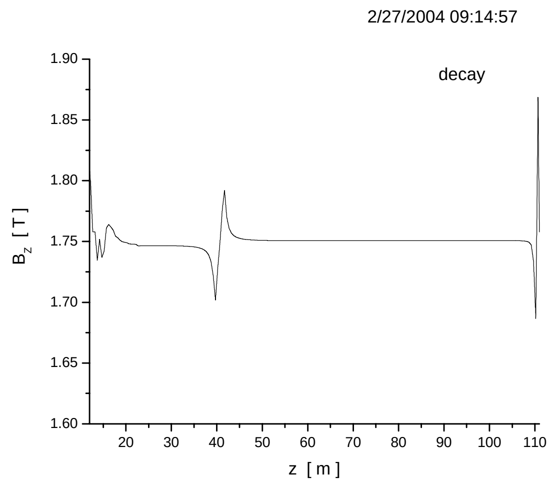
Performance comparison

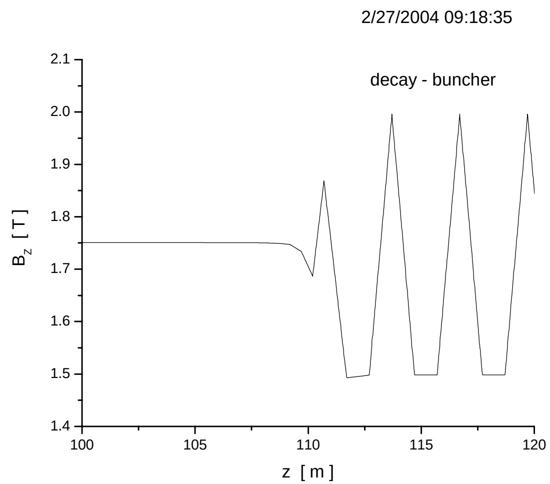
model	χ^2	μ/p (decay)	ε_{TN} [mm]	ε_{LN} [mm]	μ/p (cool)	μ/p (30 mm)
F5	0.49	0.430	6.71	68	0.380	0.200
F8	0.08	0.434	6.81	72	0.380	0.189
F11	0.36	0.430	6.94	65	0.381	0.200
F13	0.04	0.429	7.13	67	0.373	0.185

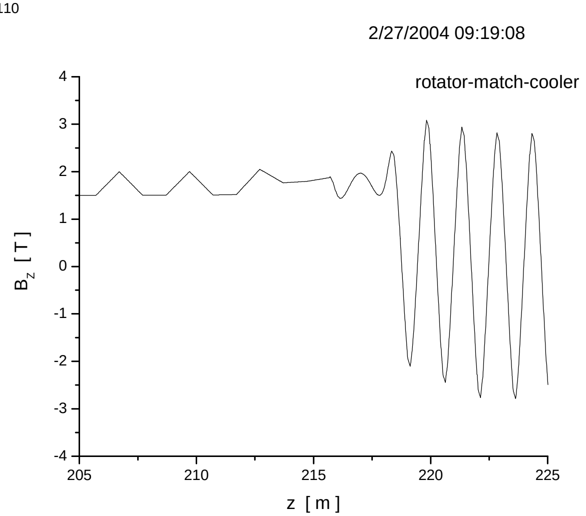
Front end magnetic field



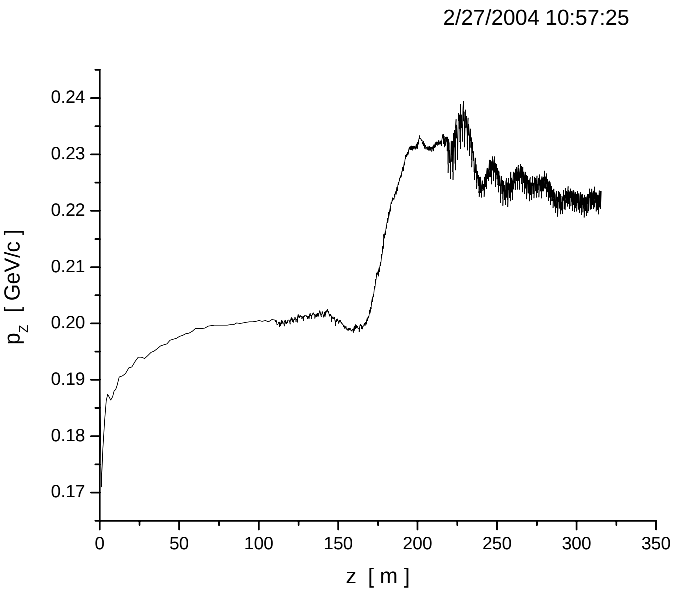
Transitions require attention

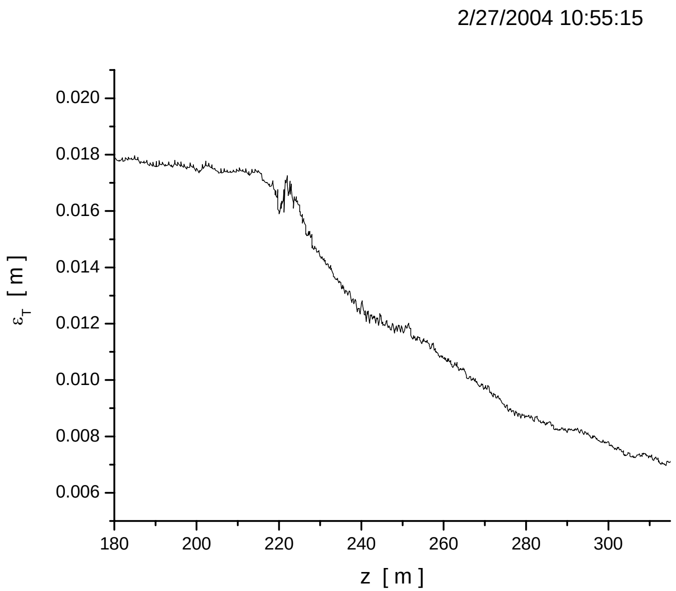




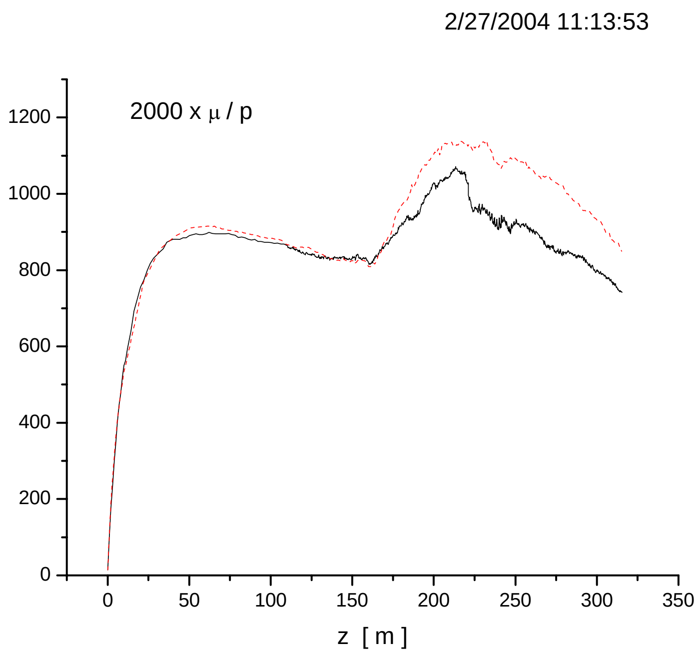


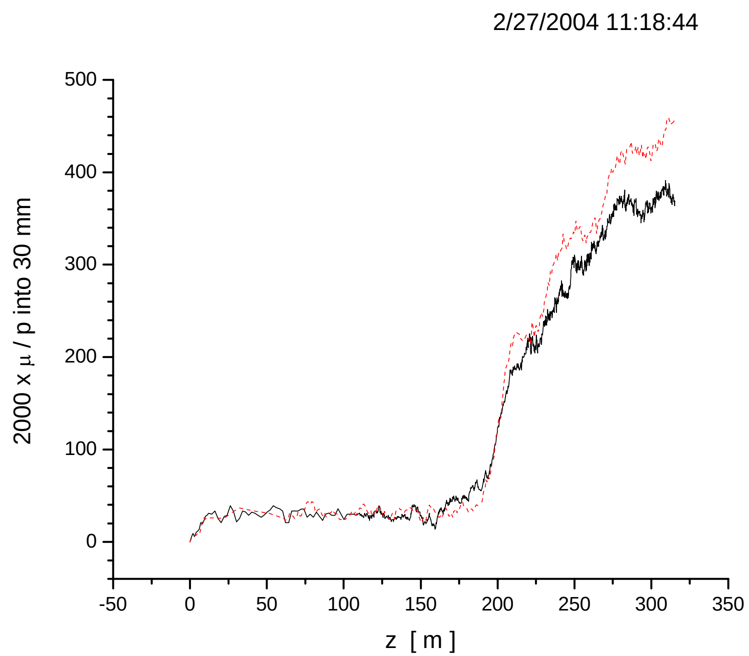
Momentum and transverse emittance





Transmission





Beta function at match

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