Tuning MICE

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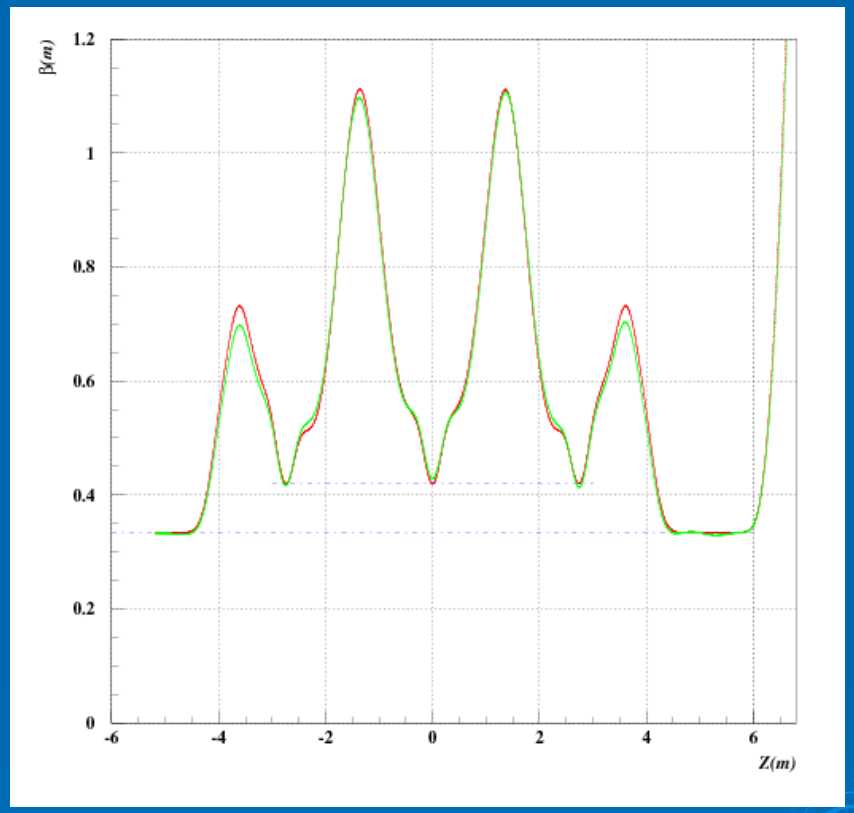
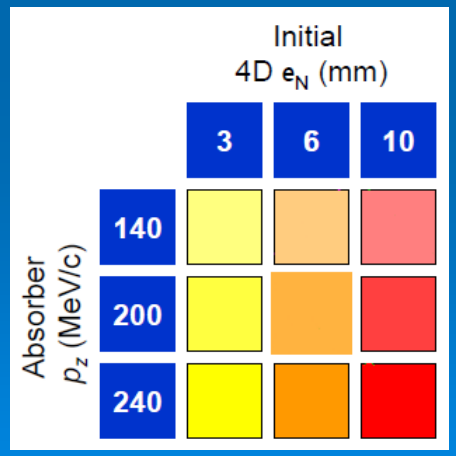
Current Set-up

- Baseline coil set-up from Wang NMR.
- Matching Coils tuned in 2006 (note 153).

→ **Empty channel**

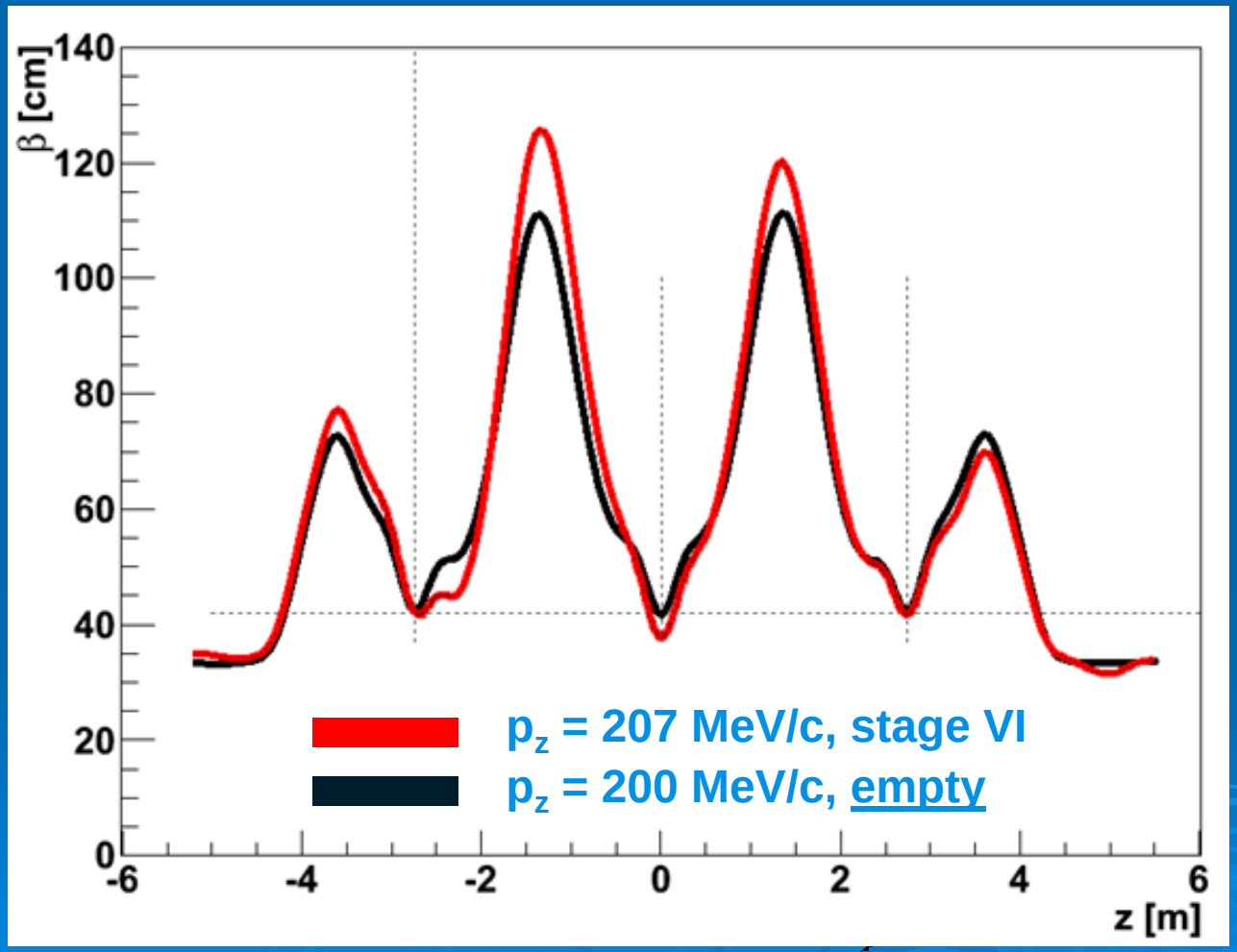
→ **$\langle p_z \rangle$ = 200 MeV/c**





TRD (**green line**) for p_z = 200 MeV/c & β = 42 cm at the absorbers

Simulating in G4MICE



Build Fields & Beta Fn.

- Need a faster way to generate fields & β fn. than with G4MICE.
- Bz on axis calculated from coil positions & currents.
- Divide 18 MICE coils into current sheets at different radii, and use:

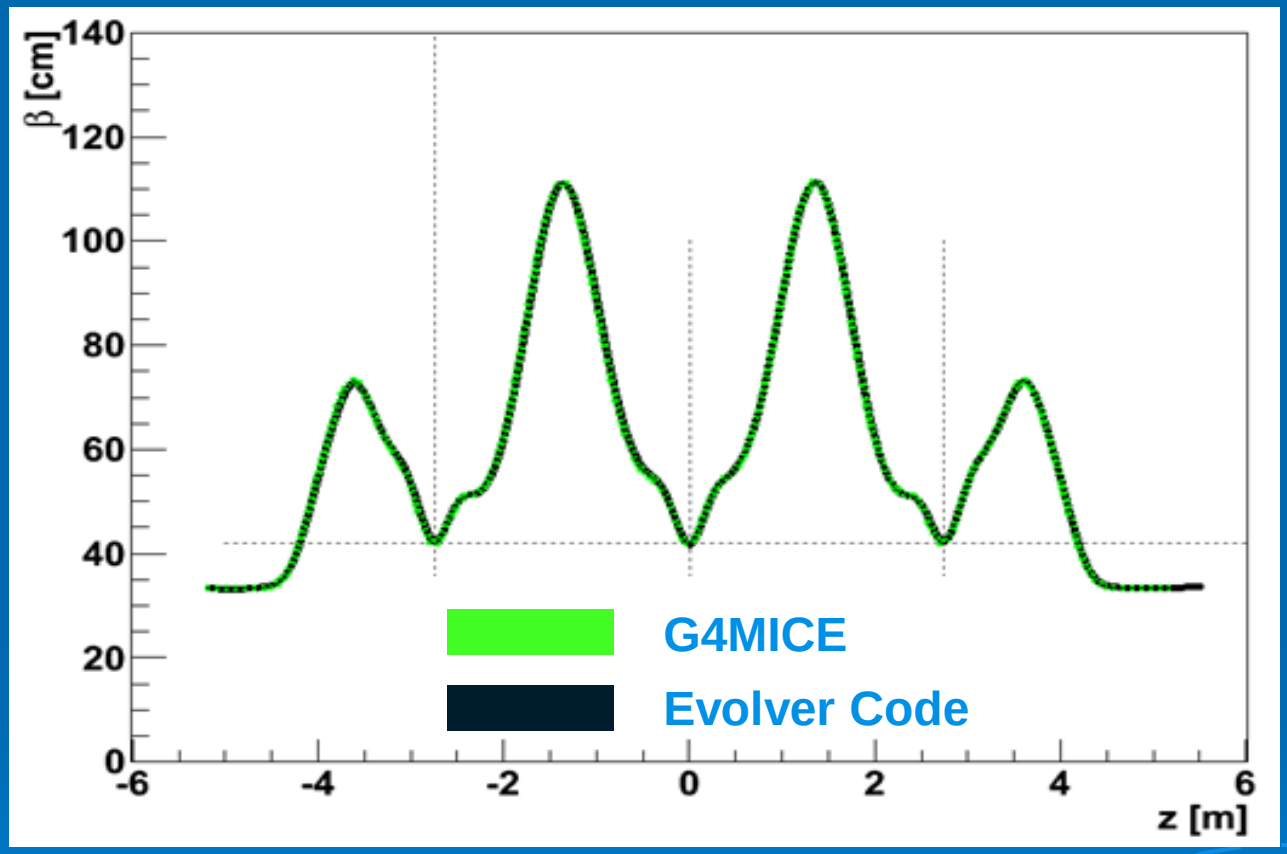
$$B_z = \frac{\mu_0 I n}{2}(\cos\alpha - \cos\beta)$$

- Beta Function calculated using:

$$2\beta\beta'' - (\beta')^2 + 4\beta^2\kappa^2 - 4 = 0$$

where $\kappa = 0.15 * B[T]/p_z$

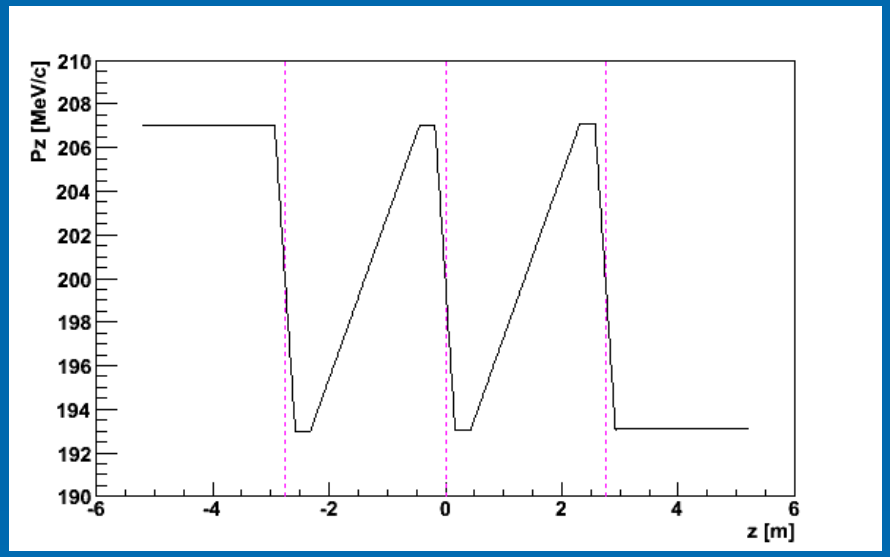
Empty channel



- G4MICE and Numerical method agree well.

RF & LH2 Consideration

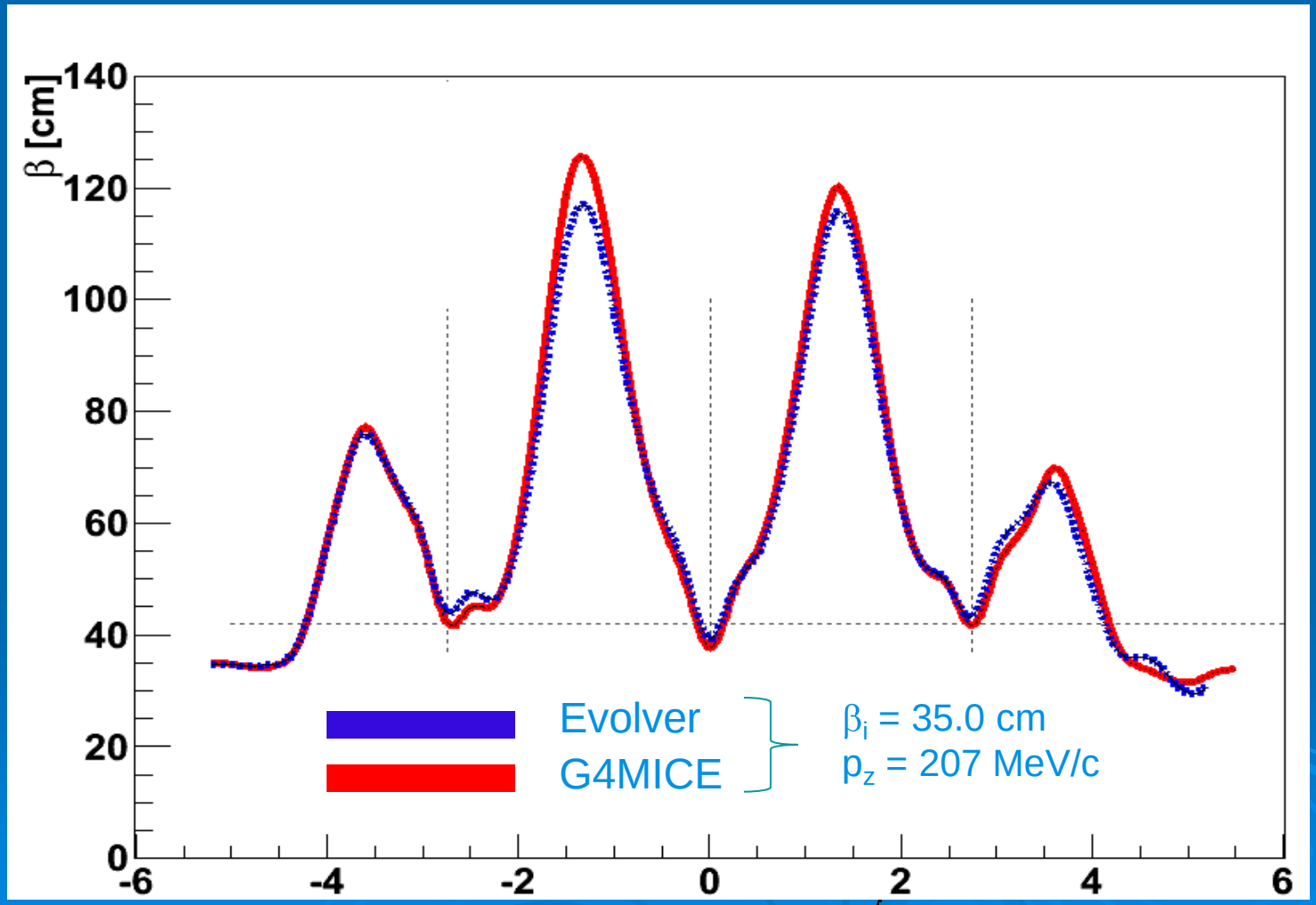
- Assume p_z loss of ~ 14 MeV/c in LH2
- Re-inject in RF.
- Ignore windows etc.



- p_z ~ 200 MeV/c @ LH2 centre

- All G4MICE sims. N = 10000, 6mm, σ_{pz} = 1 MeV/c

G4MICE vs Evolver – Stage VI



Tuning the MC's

- Minimize**: $F = 0.5*(\beta\gamma_0 - \alpha\alpha_0 + \beta_0\gamma)$

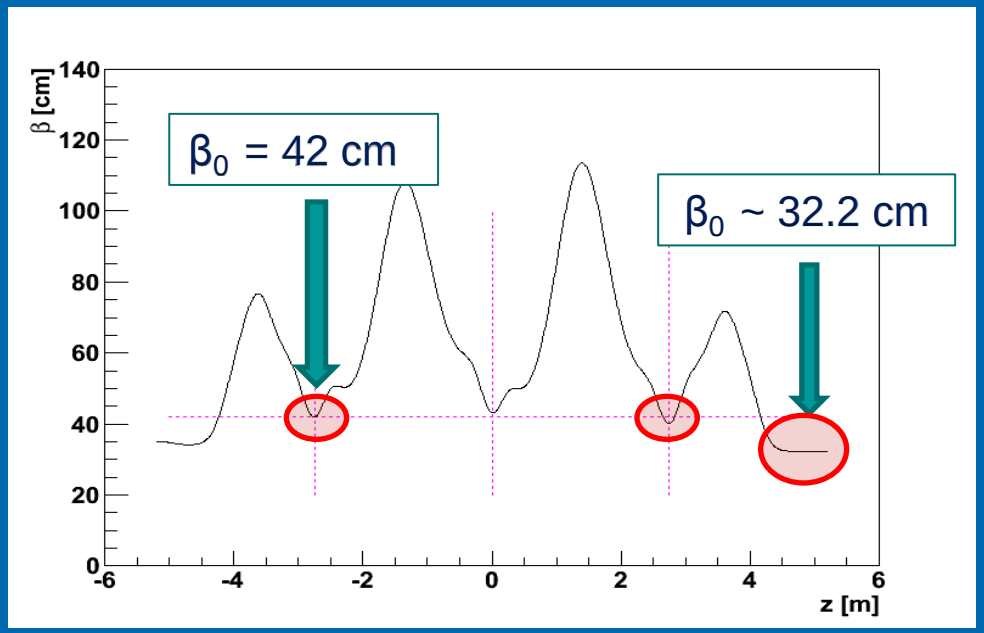
  where β_0 is specified, $\alpha_0 = 0$ and $\gamma_0 = (1+ \alpha_0) / \beta_0$

- →For Step VI channel & initial $<p_z>$ = 207 MeV/c

- Vary each MC pair in turn

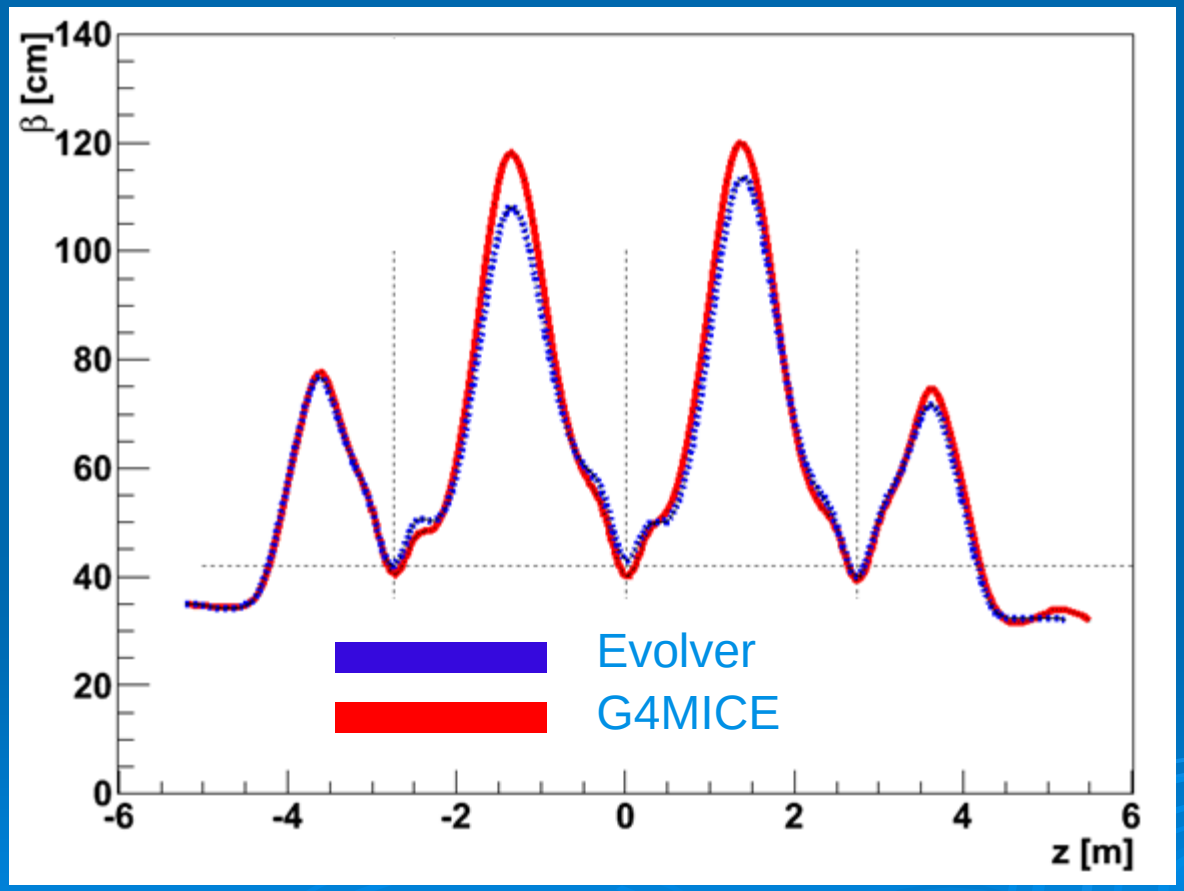
** from 'An Introduction to the Physics of High Energy Accelerators' – Edwards / Syphers

Optimizing MC currents

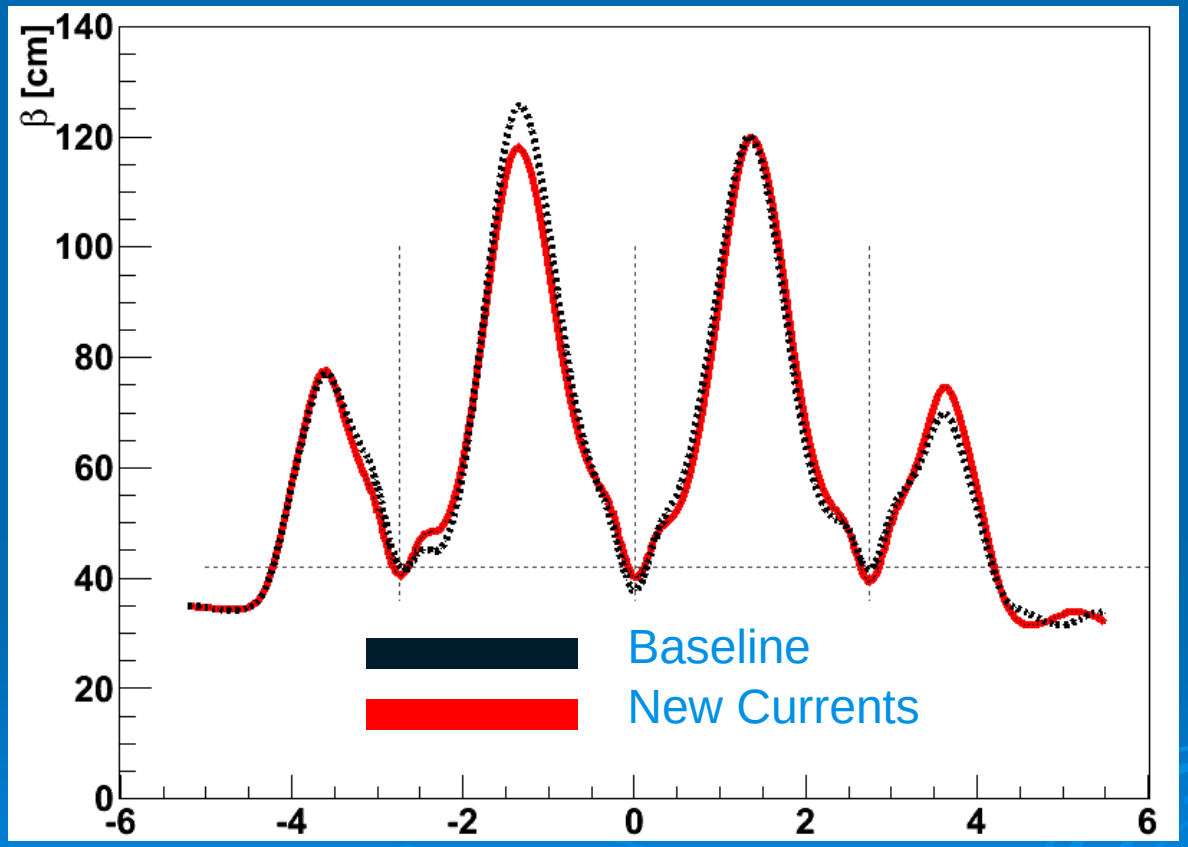


- Minimize F at centre of 1st LH2
  - (M1 & M2 - **Tracker. 1**)
- Repeat for 3rd LH2 and one point in 2nd Tracker
  - (M1[II] & M2[II] - **Tracker. 2**)

New Currents: Evolver vs. G4MICE



New Currents vs. Baseline in G4MICE



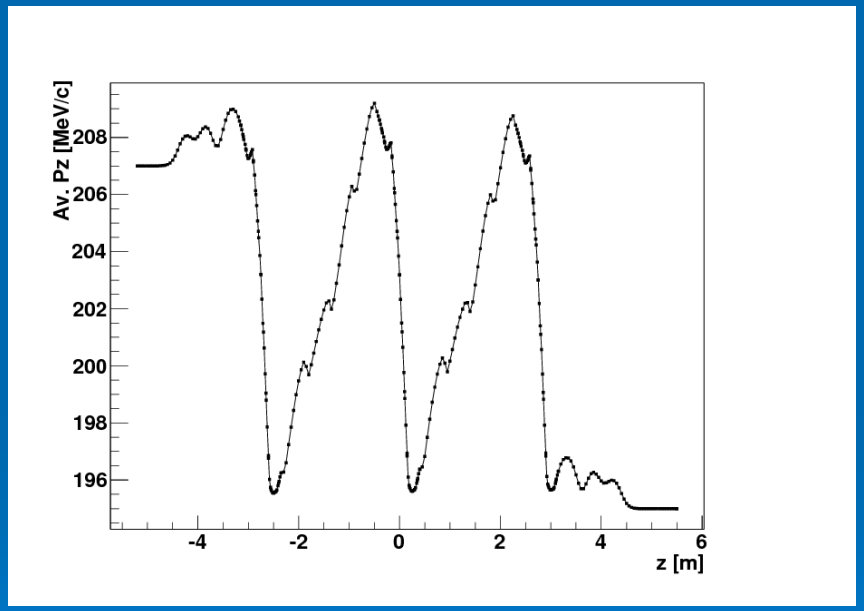
Summary

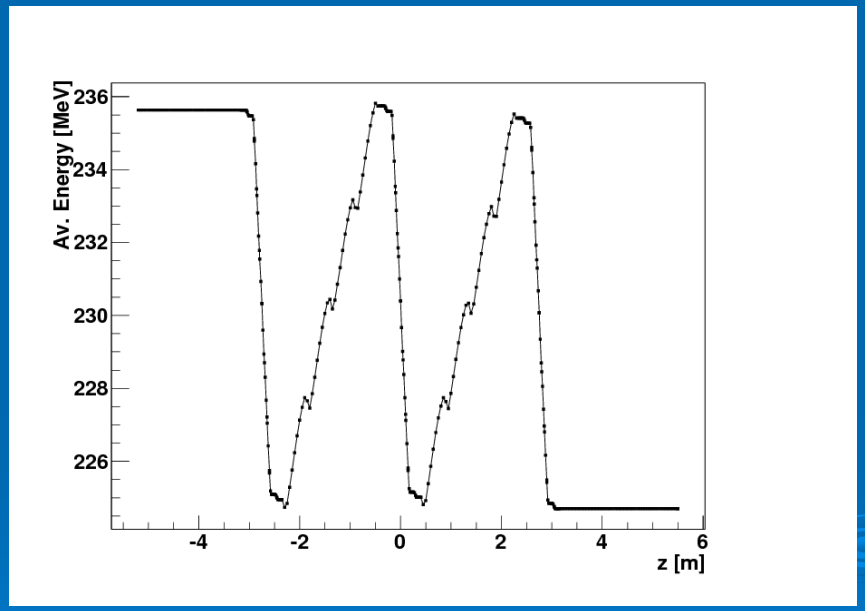
- Mismatching in Tracker 2 with baseline MC currents in G4MICE
- New currents :
  - M1: 124.267 (118.56) M2: 132.267 (137.13)
  - $M1^{||}$: 116.346 (118.56) $M2^{||}$: 135.854 (137.13)
- Optimal β_0 != 42.00 cm
- New currents don't sig. improve matching in 2nd Tracker
- [Annoyingly] no results at the moment for v. high statistics.
- Evolver is only an idealised model

Extras

Simulation details

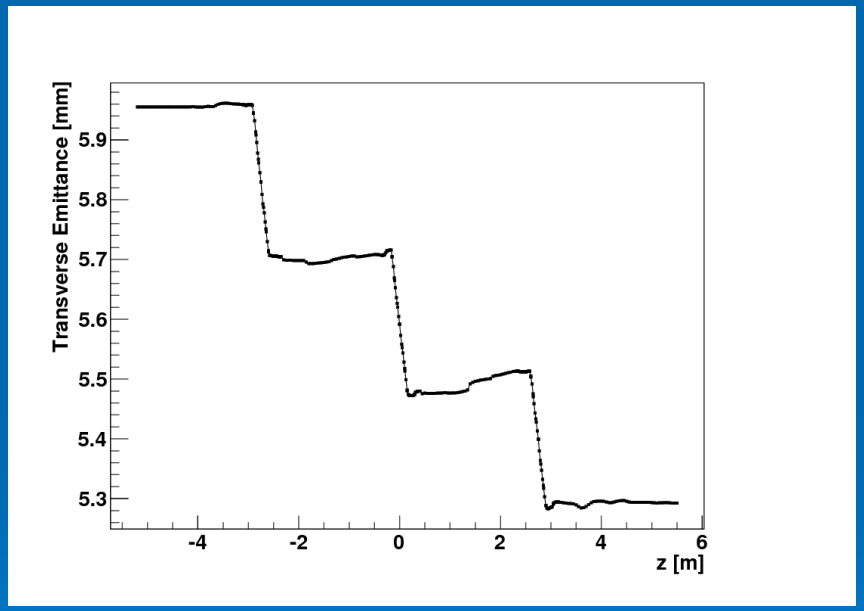
6mm beam, 9850 mu (after Transmission & quality cuts on Amplitude)
σ_{pz} = 1 MeV/c
Step VI, baseline currents





Δp_z ~ 11.5 MeV/c

RF - 9.3 MeV/m


Transverse Emittance [mm]
5.9
5.8
5.7
5.6
5.5
5.4
5.3
-4
-2
0
2
4
6
z [m]

Wang Coil set-up

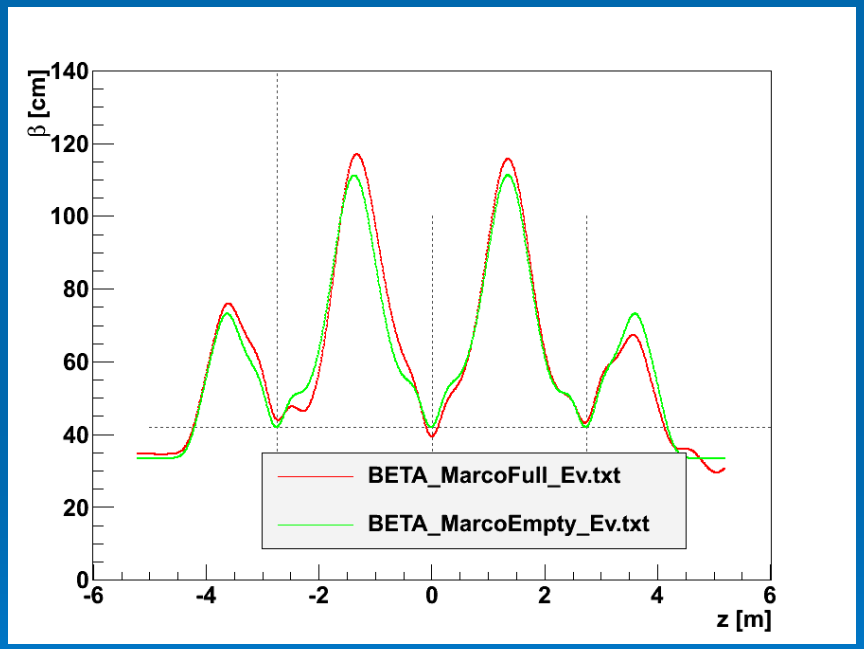
p=200, beta=42, Wang solenoids matched 11 July 2007

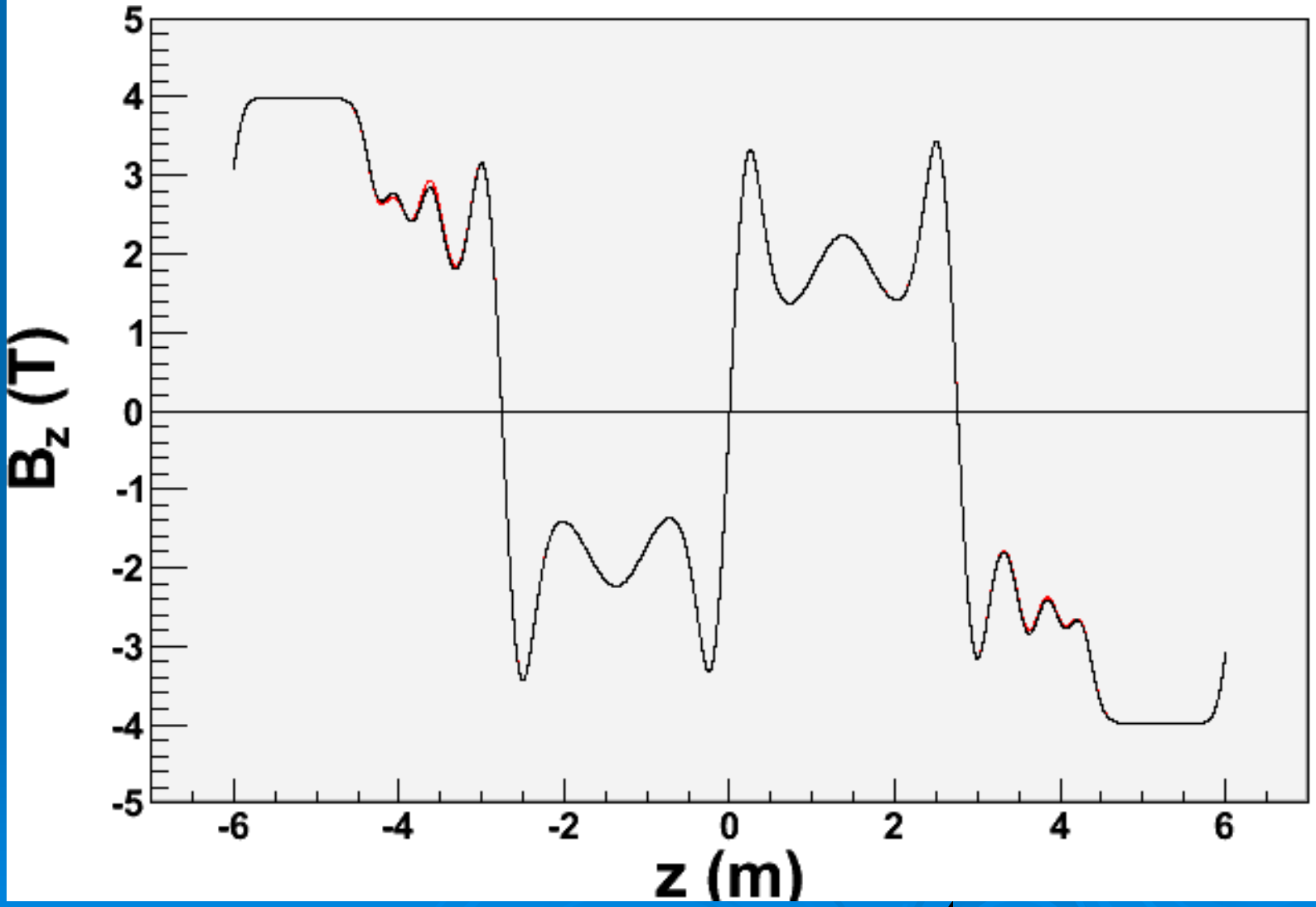
1	-6.0063	0.1106	0.2580	0.3240	-135.1800
2	-5.8582	1.3143	0.2580	0.2793	-152.4400
3	-4.5063	0.1106	0.2580	0.3176	-127.3700
4	-4.1508	0.1995	0.2580	0.2878	-137.1300
5	-3.7116	0.2012	0.2580	0.3027	-118.5600
6	-3.0600	0.2100	0.2630	0.3470	-113.9500
7	-2.6500	0.2100	0.2630	0.3470	113.9500
8	-1.5000	0.2500	0.7250	0.8410	96.2100
9	-0.3100	0.2100	0.2630	0.3470	113.9500
10	0.1000	0.2100	0.2630	0.3470	-113.9500
11	1.2500	0.2500	0.7250	0.8410	-96.2100
12	2.4400	0.2100	0.2630	0.3470	-113.9500
13	2.8500	0.2100	0.2630	0.3470	113.9500
14	3.5104	0.2012	0.2580	0.3027	118.5600
15	3.9513	0.1995	0.2580	0.2878	137.1300
16	4.3957	0.1106	0.2580	0.3176	127.3700
17	4.5439	1.3143	0.2580	0.2793	152.4400
18	5.8957	0.1106	0.2580	0.3240	135.1800

Matching coils M2, M1

Cooling lattice

Matching coils M1', M2'


β [cm]
140
120
100
80
60
40
20
0
-6
-4
-2
0
2
4
6
z [m]
BETA_MarcoFull_Ev.txt
BETA_MarcoEmpty_Ev.txt


5
4
3
2
1
0
-1
-2
-3
-4
-5
B_z (T)
-6
-4
-2
0
2
4
6
z (m)