# 200 MHz Cooling Experiment Design

**R. B. Palmer, R Fernow**
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## 1 Introduction

I have tried to use the coil dimensions from Mike Green's latest presentation:

http://hep04.phys.iit.edu/cooldemo/cm/cm3/mice_cost-green.pdf

The numbers in () I scaled from his drawings
The number in red and [] is a possible alternative.
The number with a * I modified to keep the current density down

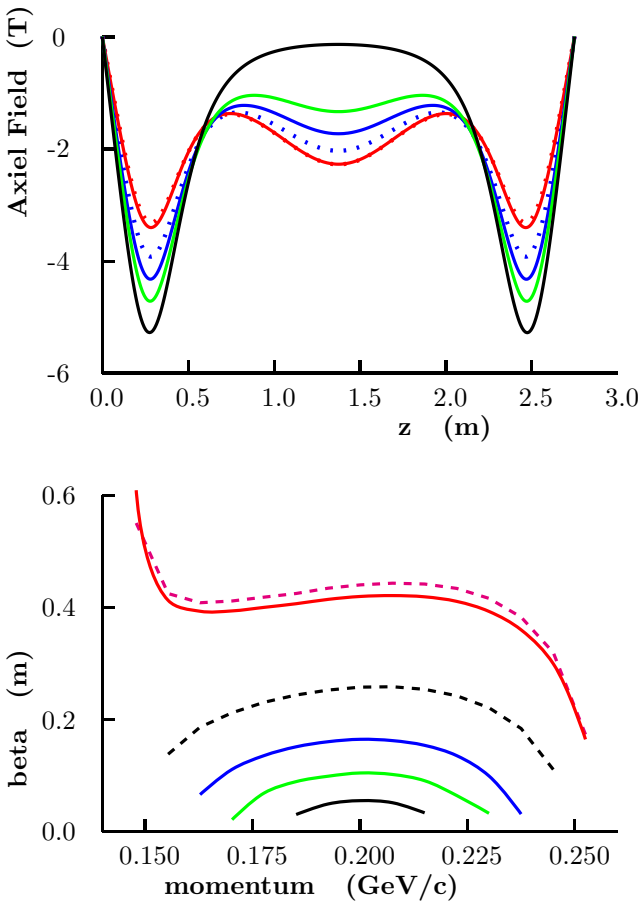
| Coil | inner rad cm | rad thickness cm | length cm | etc cm |
|---|---|---|---|---|
| Focus | 25.5 | (7.5) /[9.0] | 16.7 | c to c=51.7 |
| Coupling | 69 | (8.5) | 30 | |
| Solenoid | 25 | (4.5) | (126) | |
| Correctors | 25 | 7.5* | (12) | gap=(6) |

I can use these and see how I do, but they will not be "final".

I ran the above with differing current densities and ratios to obtain solutions with differen minimum betas. The entries 5 and 6 are with the 9 mm focus coil thicknesses.

| | jfocus A/mm$^2$ | jcoupling A/mm$^2$ | beta cm | dp/p ± % | ref. mom MeV/c |
|---|---|---|---|---|---|
| 1 | 138 | 105 | 42 | 25 | 200 |
| 2 | 182 | 78 | 16 | 18 | 200 |
| 3 | 201 | 58 | 10 | 14 | 200 |
| 4 | 231 | 0 | 5.5 | 8 | 200 |
| 5 | 115 | 105 | 44 | 25 | 200 |
| 6 | 139 | 93 | 26 | 20 | 200 |
| 7 | 139 | 127 | 44 | 25 | 242 |

the following figures give the axial field vs length and the betas vs momentum. The dotted lines are for the cases with 9 mm focus coils.




Consider the cases with 7.5 mm focus coils (#'s 1-4): only example #1 has a current density (138 A/mm$^2$) that is probably feasible with "Green" technology.

With the increased focus coil thickness two examples are possible within this current density: case #5 with 115 A/mm$^2$, and case #6 with 139 A/mm$^2$).

I will assume that we will not want to try the very small betas (cases 3 and 4). In a real lattice with such betas, the beam would be much smaller and the coils would be brought in. To attempt this case with the coils at their current radius is putting an artificial burden on the experiment. This could be said, to a lesser extent, of case 2), but I can understand Alain's wanting to demonstrate some flexibility.

Case #7 is like case #5, but at a reference momentum of 242 MeV/c. This case has the same beta's and fractional momentum acceptance as #5, but all currents in the lattice increased by the factor 242/200. The current density in the solenoid could be kept the same and the coupling cirrents appropriatly

modified.

I now give matched solutions of the first two examples into the 4 T detection solenoid.

I am assuming three field flips, and unlike my earlier efforts, I am keeping the currents and thus betas, the same in all three. This is thus a more honest test of 2.5 cells than when I allowed the current in the end focus coils to be modified.

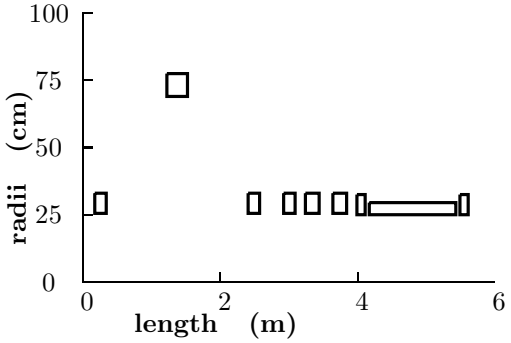
I used two matching coils at each end, so that I could achieve a match in the two cases by adjusting currents alone.

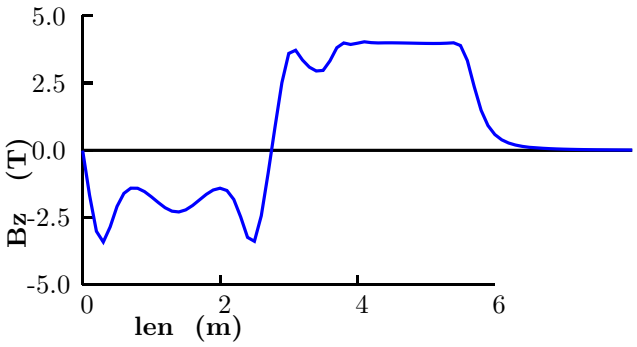
Neither match is achromatic, although the first is better than the second. But I expect both will be good enough.

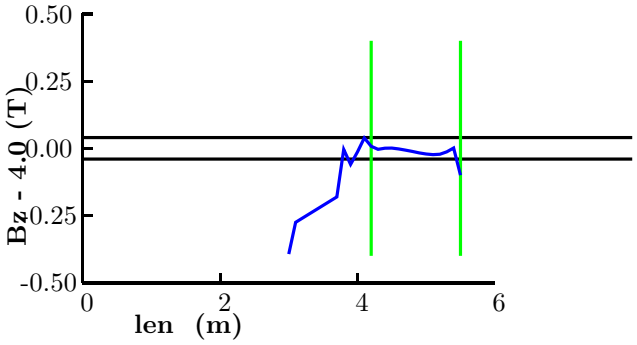
In both cases, I show only half the experiment, starting at its center.

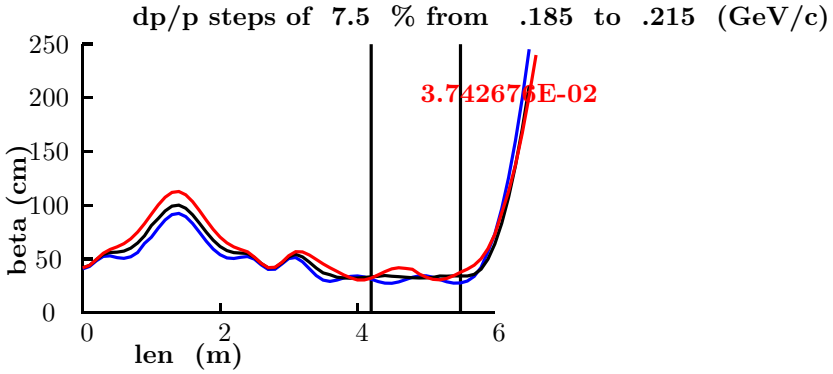
## 2 Beta=42 cm Solution

| len1 m | gap m | dl m | rad m | dr m | I/A A/mm$^2$ | n I A | n I l A m |
|---|---|---|---|---|---|---|---|
| 0.175 | 0.175 | 0.167 | 0.255 | 0.075 | -138.92 | 1.74 | 3.20 |
| 1.225 | 0.883 | 0.300 | 0.690 | 0.085 | -105.88 | 2.70 | 12.43 |
| 2.408 | 0.883 | 0.167 | 0.255 | 0.075 | -138.92 | 1.74 | 3.20 |
| 2.925 | 0.175 | 0.167 | 0.255 | 0.075 | 138.92 | 1.74 | 3.20 |
| 3.242 | 0.150 | 0.200 | 0.255 | 0.075 | 44.40 | 0.67 | 1.22 |
| 3.642 | 0.200 | 0.200 | 0.255 | 0.075 | 86.95 | 1.30 | 2.40 |
| 3.992 | 0.150 | 0.120 | 0.250 | 0.075 | 93.33 | 0.84 | 1.52 |
| 4.172 | 0.060 | 1.260 | 0.250 | 0.045 | 71.96 | 4.08 | 6.99 |
| 5.492 | 0.060 | 0.120 | 0.250 | 0.075 | 128.89 | 1.16 | 2.10 |



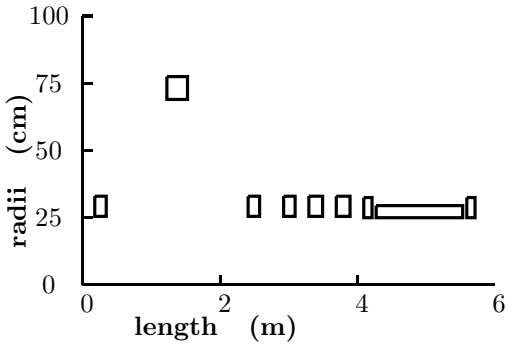

5.0
2.5
0.0
-2.5
-5.0
Bz (T)
0
2
4
6
len (m)

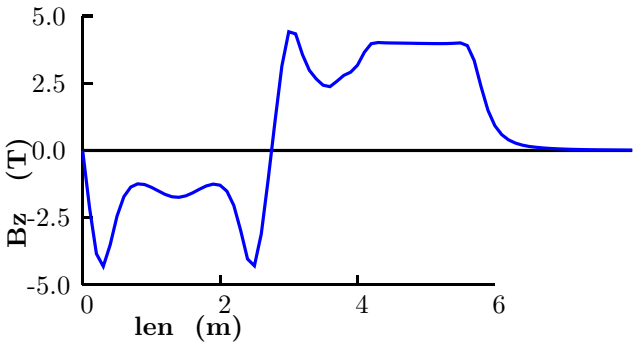

0.50
0.25
0.00
0.25
-0.50
Bz - 4.0 (T)
0
2
4
6
len (m)

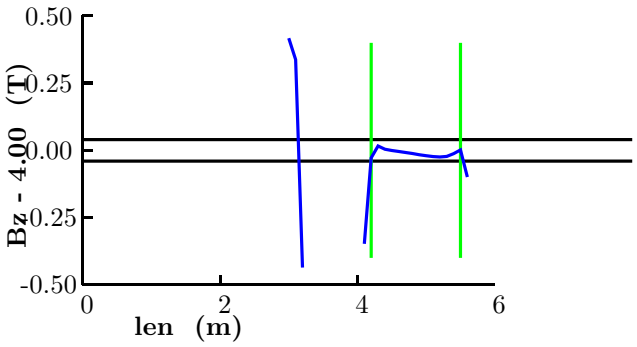

dp/p steps of 7.5 % from .185 to .215 (GeV/c)
3.742675E-02
250
200
150
100
50
0
beta (cm)
0
2
4
6
len (m)

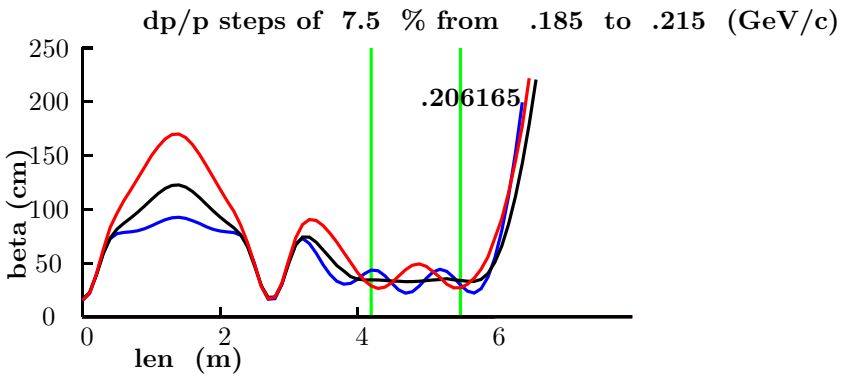
## 3 Beta=16 cm Solution

| len1 m | gap m | dl m | rad m | dr m | I/A A/mm$^2$ | n I A | n I l A m |
|---|---|---|---|---|---|---|---|
| 0.175 | 0.175 | 0.167 | 0.255 | 0.075 | -182.04 | 2.28 | 4.19 |
| 1.225 | 0.883 | 0.300 | 0.690 | 0.085 | -78.43 | 2.00 | 9.20 |
| 2.408 | 0.883 | 0.167 | 0.255 | 0.075 | -182.04 | 2.28 | 4.19 |
| 2.925 | 0.175 | 0.167 | 0.255 | 0.075 | 182.04 | 2.28 | 4.19 |
| 3.292 | 0.200 | 0.200 | 0.255 | 0.075 | 40.34 | 0.61 | 1.11 |
| 3.692 | 0.200 | 0.200 | 0.255 | 0.075 | 52.10 | 0.78 | 1.44 |
| 4.092 | 0.200 | 0.120 | 0.250 | 0.075 | 111.11 | 1.00 | 1.81 |
| 4.272 | 0.060 | 1.260 | 0.250 | 0.045 | 71.96 | 4.08 | 6.99 |
| 5.592 | 0.060 | 0.120 | 0.250 | 0.075 | 128.89 | 1.16 | 2.10 |




0.50
0.25
0.00
0.25
-0.50
Bz - 4.00 (T)
0
2
4
6
len (m)


dp/p steps of 7.5 % from .185 to .215 (GeV/c)
250
200
150
100
50
0
beta (cm)
.206165
0
2
4
6
len (m)