Tracking Simulation of a Ring Cooler with a Lithium Lens

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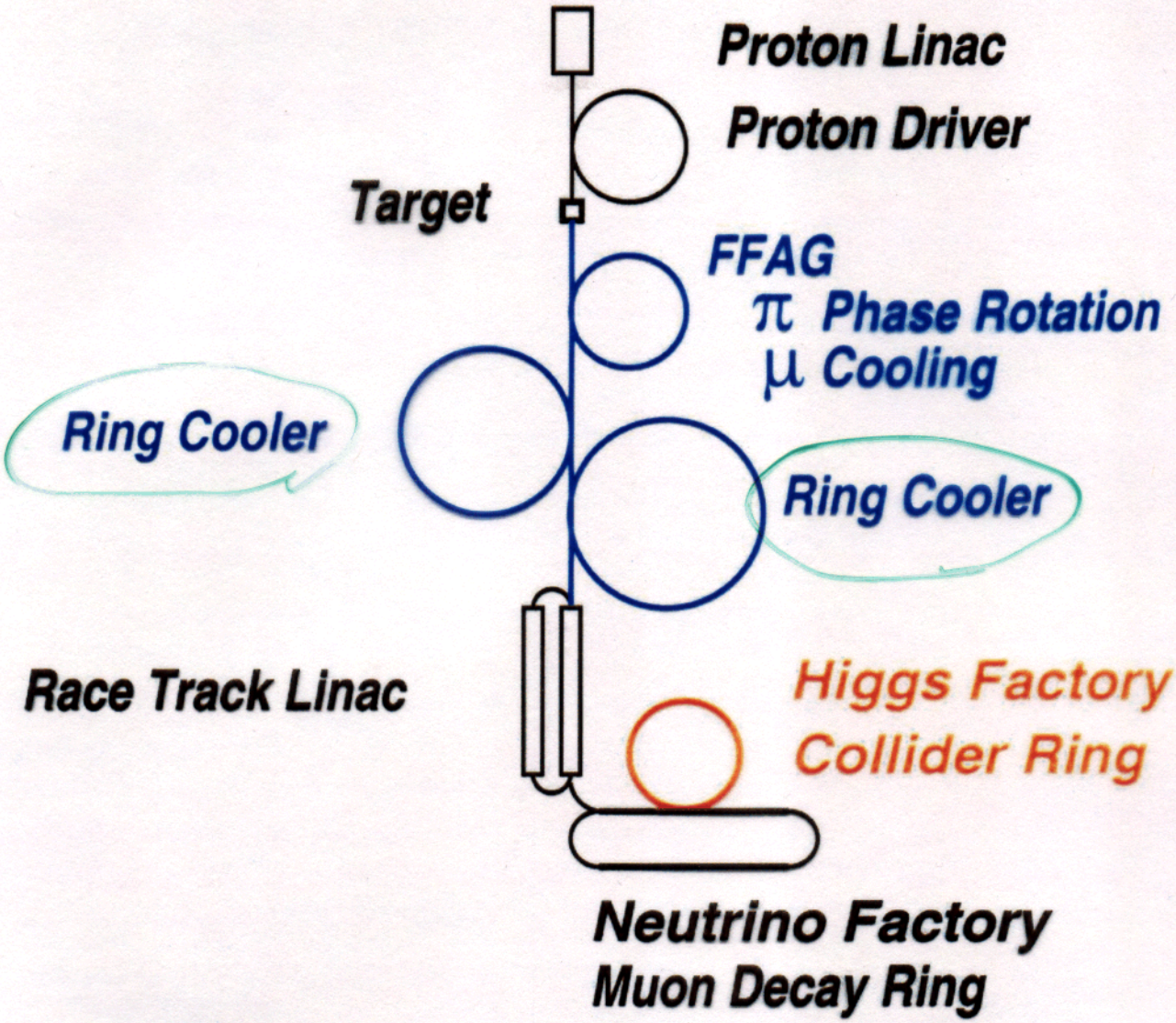
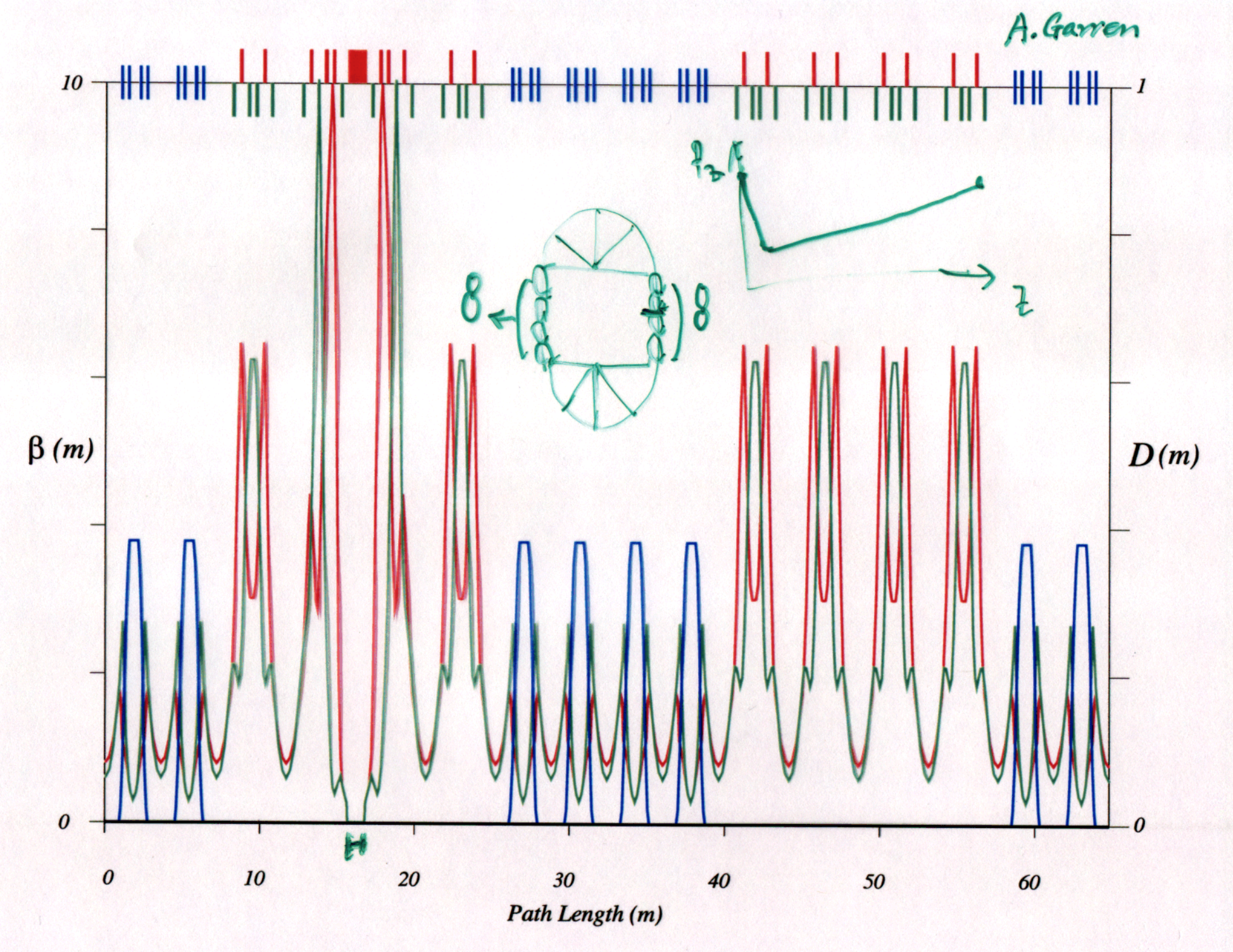
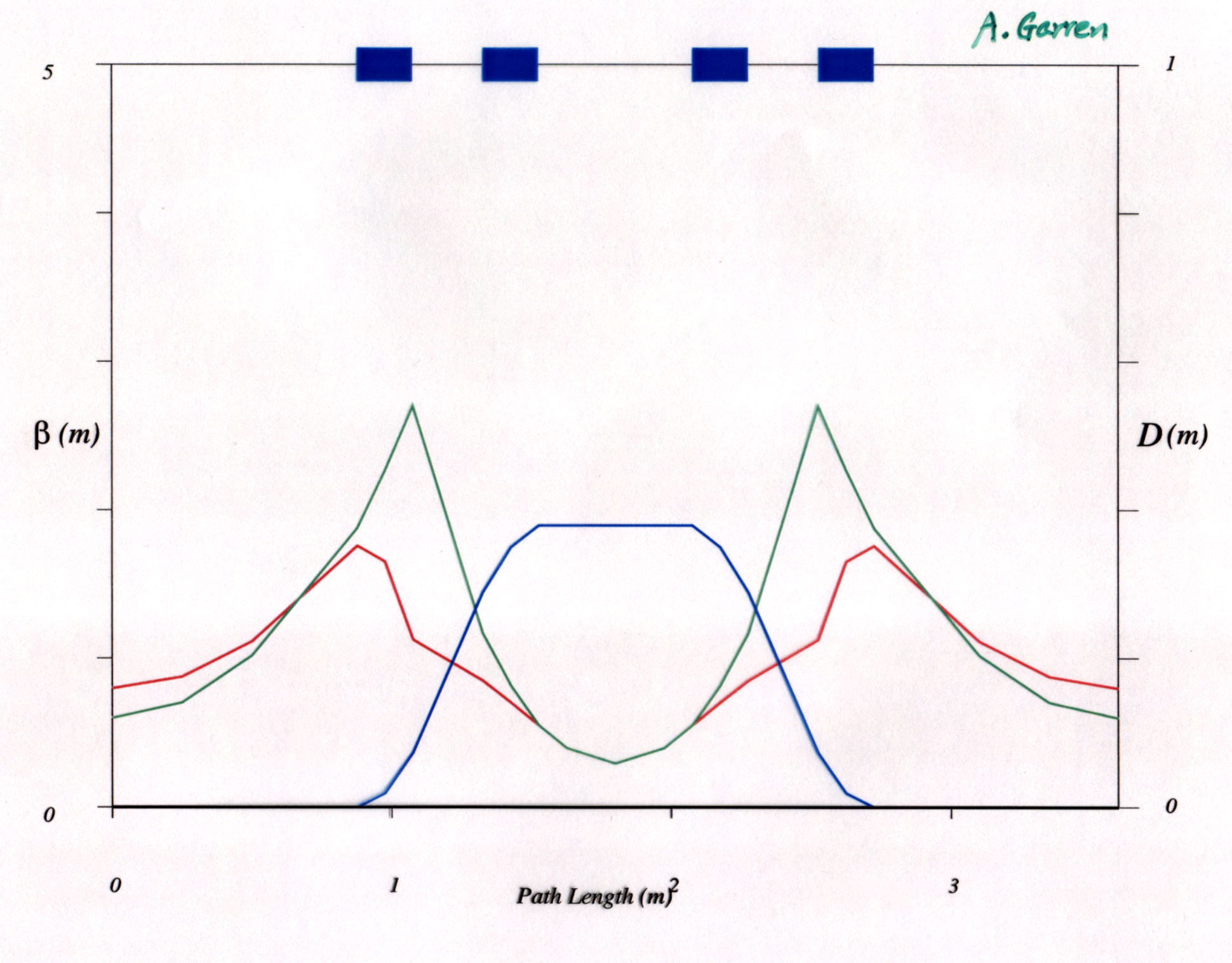
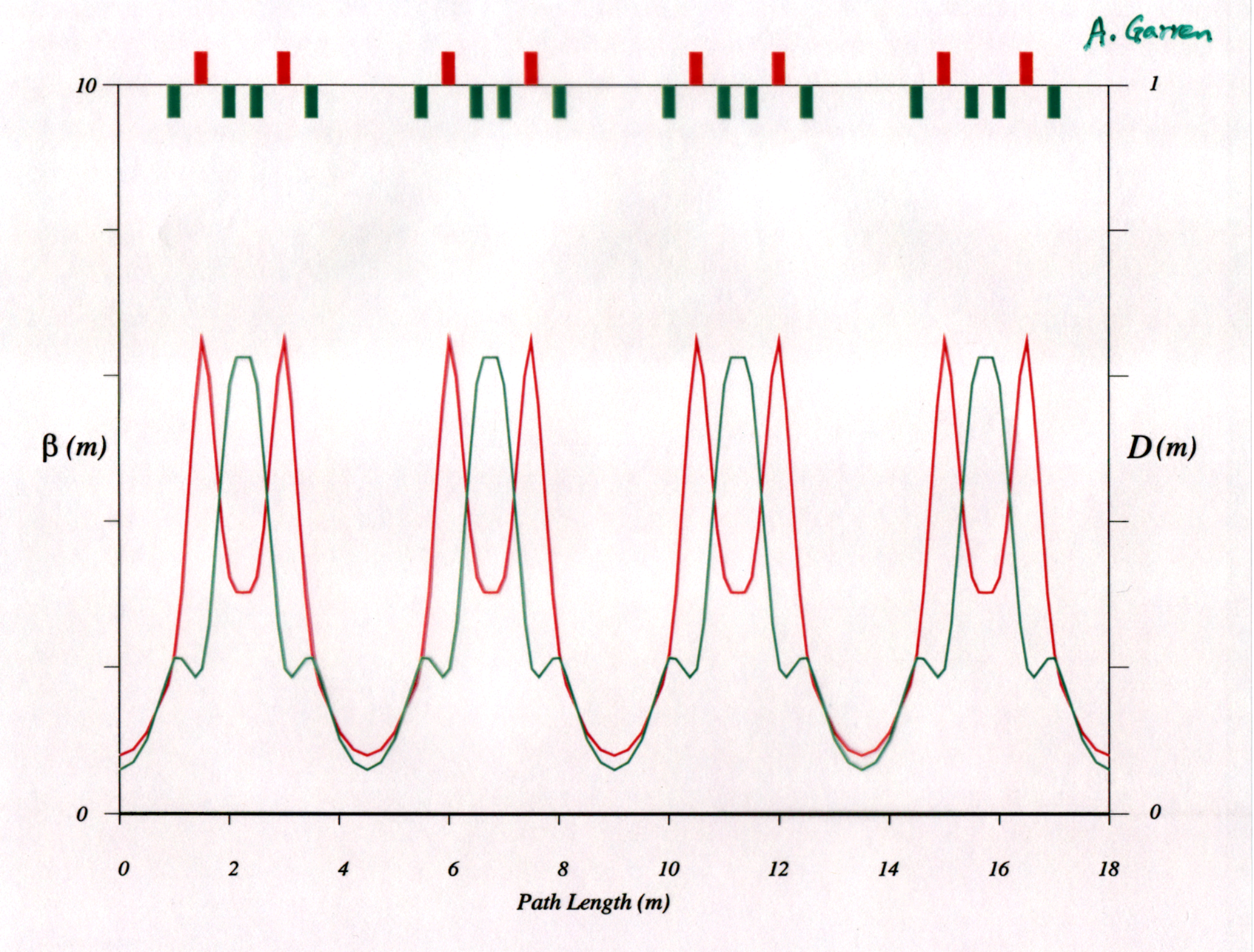
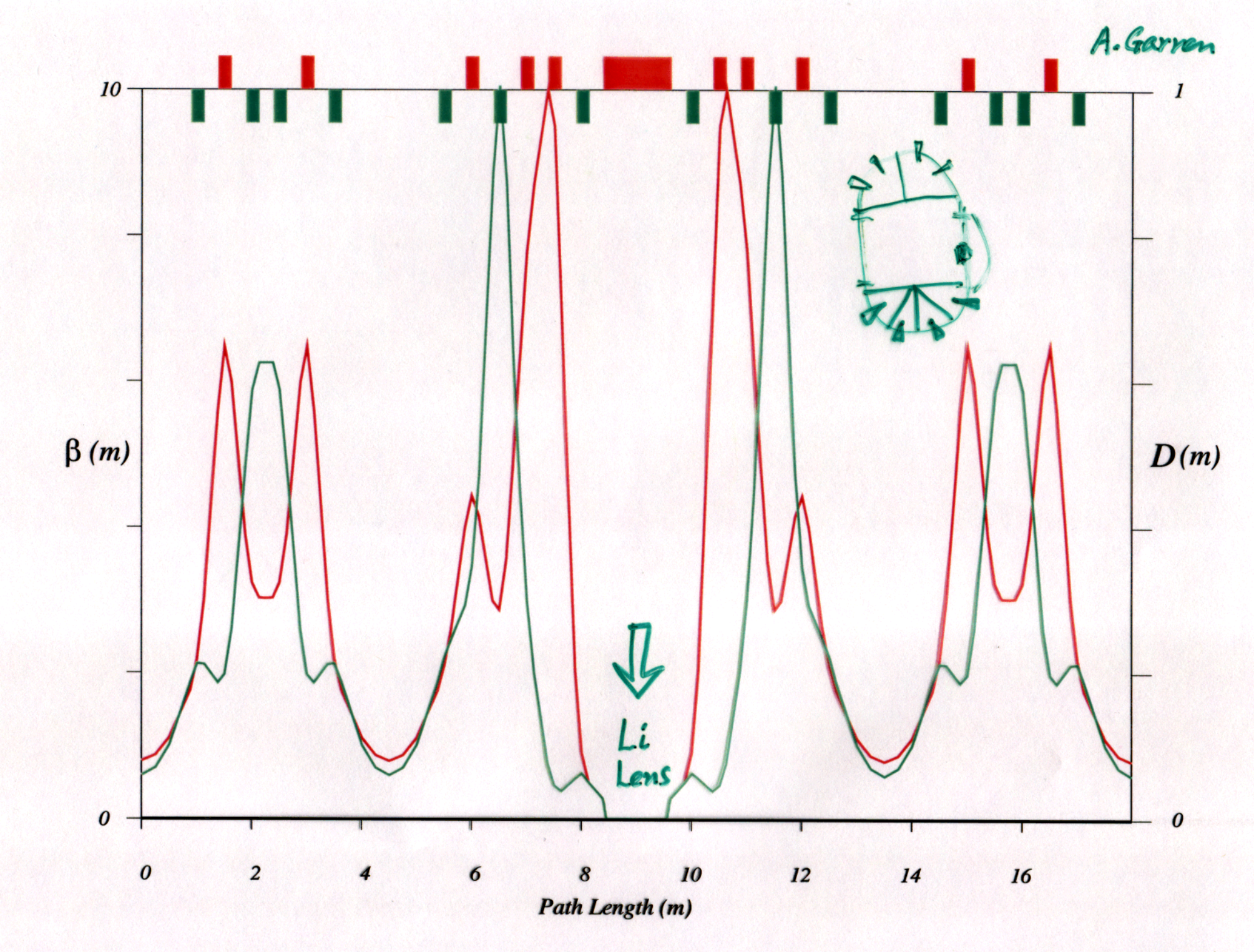
- Non-Solenoidal Ring Cooler has demonstrated emittance exchange and the 6D cooling with tracking simulation. A step closer to the complete cooling simulation for a Higgs factory or a muon collider.
- Al Garren has designed a revolutionary linear model for a cooling ring with a Lithium Lens.
- Work is in progress in getting the 6D cooling in tracking simulation with ICOOL.
  - failed to get 6D cooling in the initial try with SYNCH output. (Why?)
  - a Ring Cooler with 45 degree bend cell works.
  - a Ring Cooler with 2*2 straight cells works.
  - failed to get transverse cooling in the straight channel with Lithium Lens with SYNCH output. (Why?)
- Need this Lithium Lens scheme to achieve lower transverse emittance

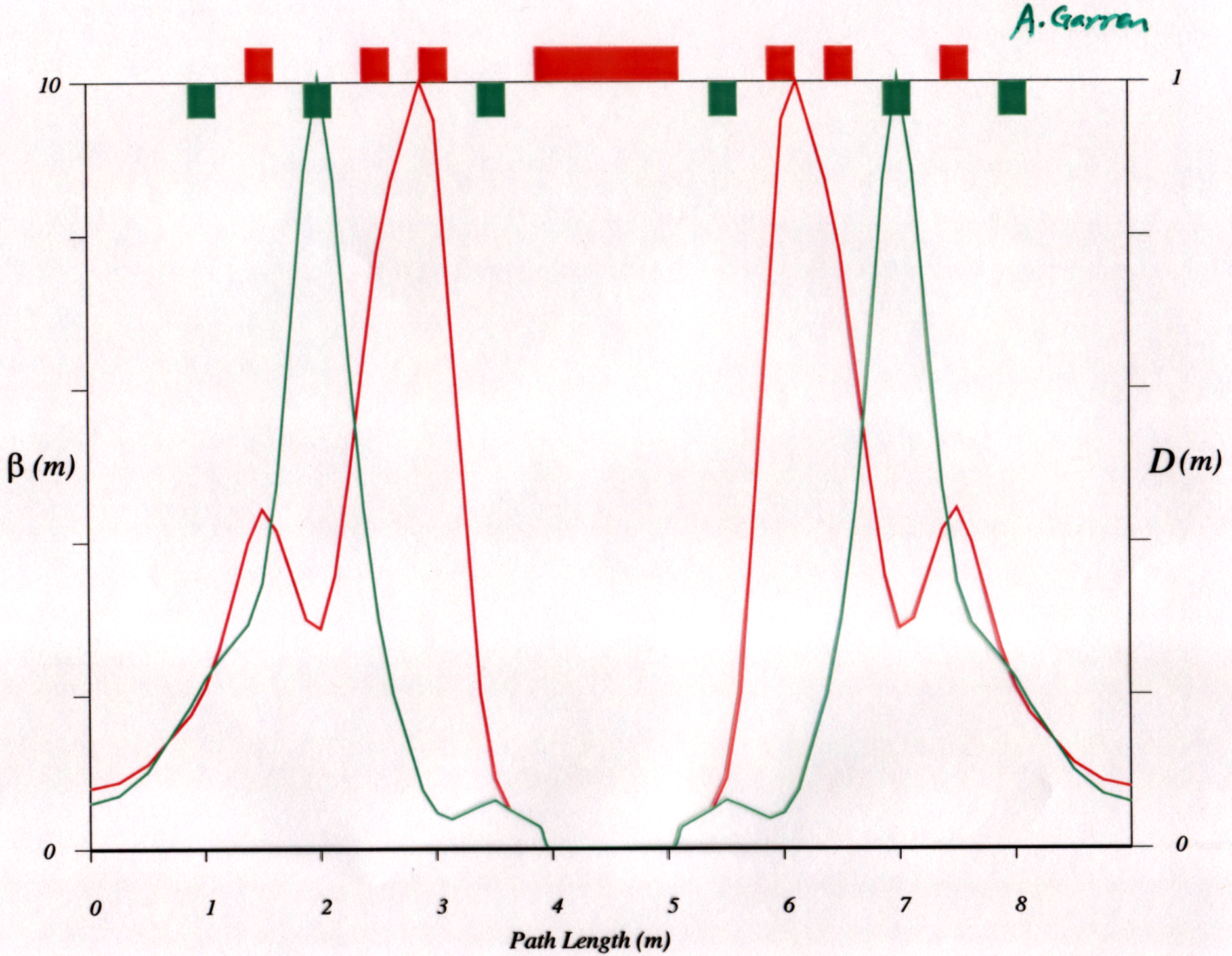

Proton Linac
Proton Driver
Target
FFAG
π Phase Rotation
μ Cooling
Ring Cooler
Ring Cooler
Race Track Linac
Higgs Factory
Collider Ring
Neutrino Factory
Muon Decay Ring

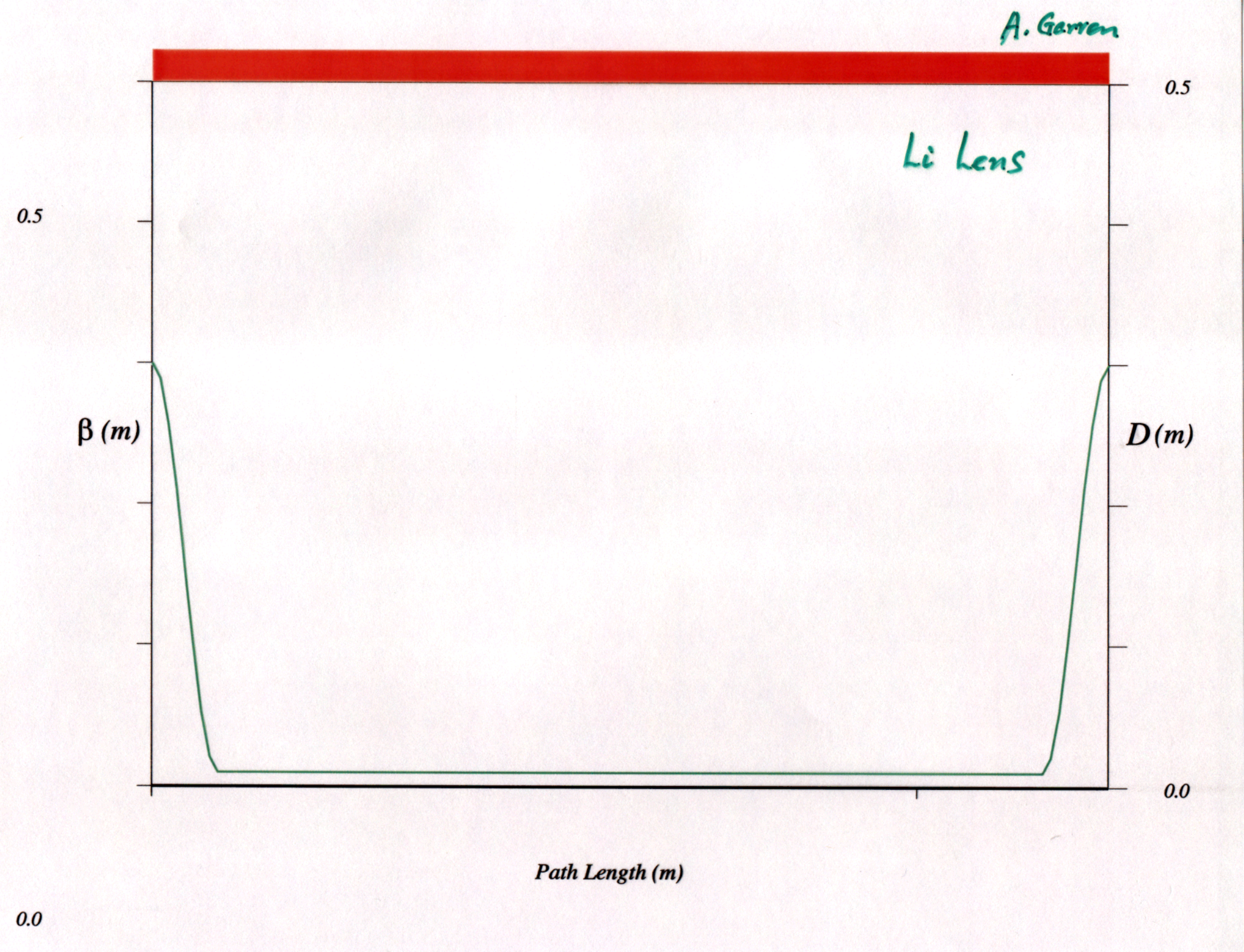

A. Garren
10
1
0
0
β (m)
D (m)
0
10
20
30
40
50
60
Path Length (m)
8
8
z


A. Garren
5
1
β (m)
D (m)
0
0
0
1
3
Path Length (m)

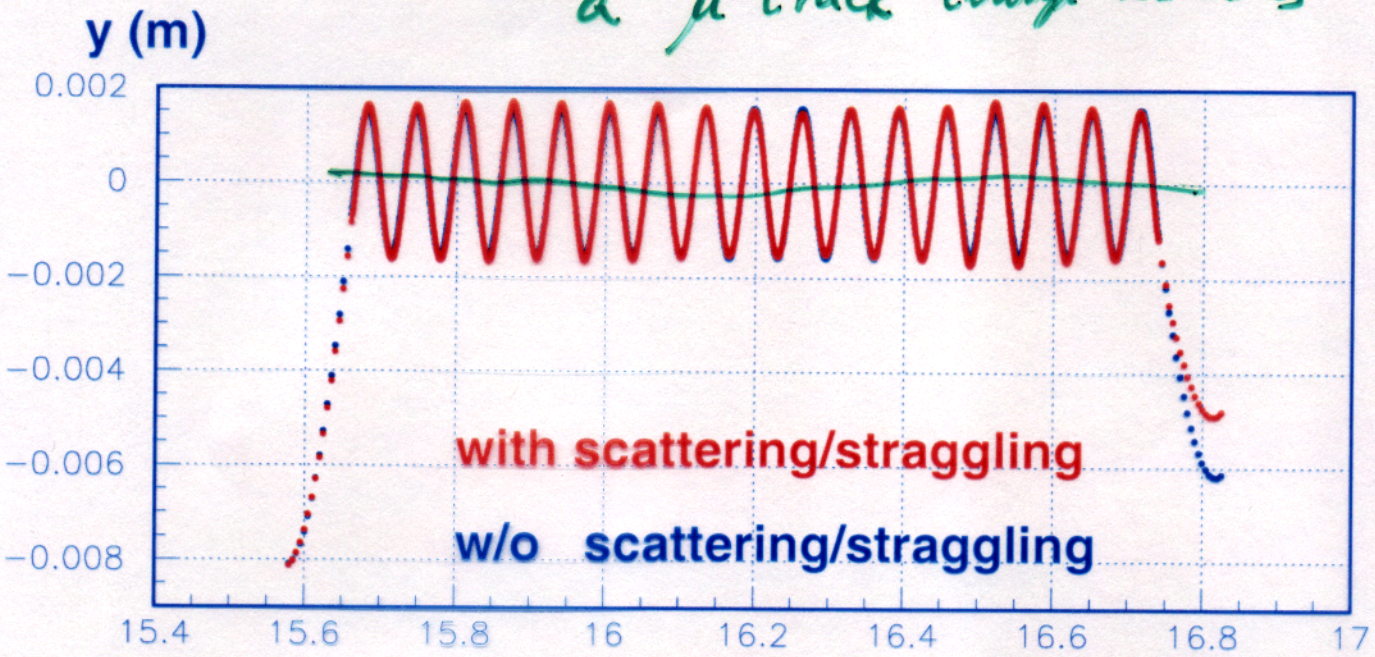

A. Garren
10
1
β (m)
D (m)
0
0
0
2
4
6
8
10
12
14
16
18
Path Length (m)

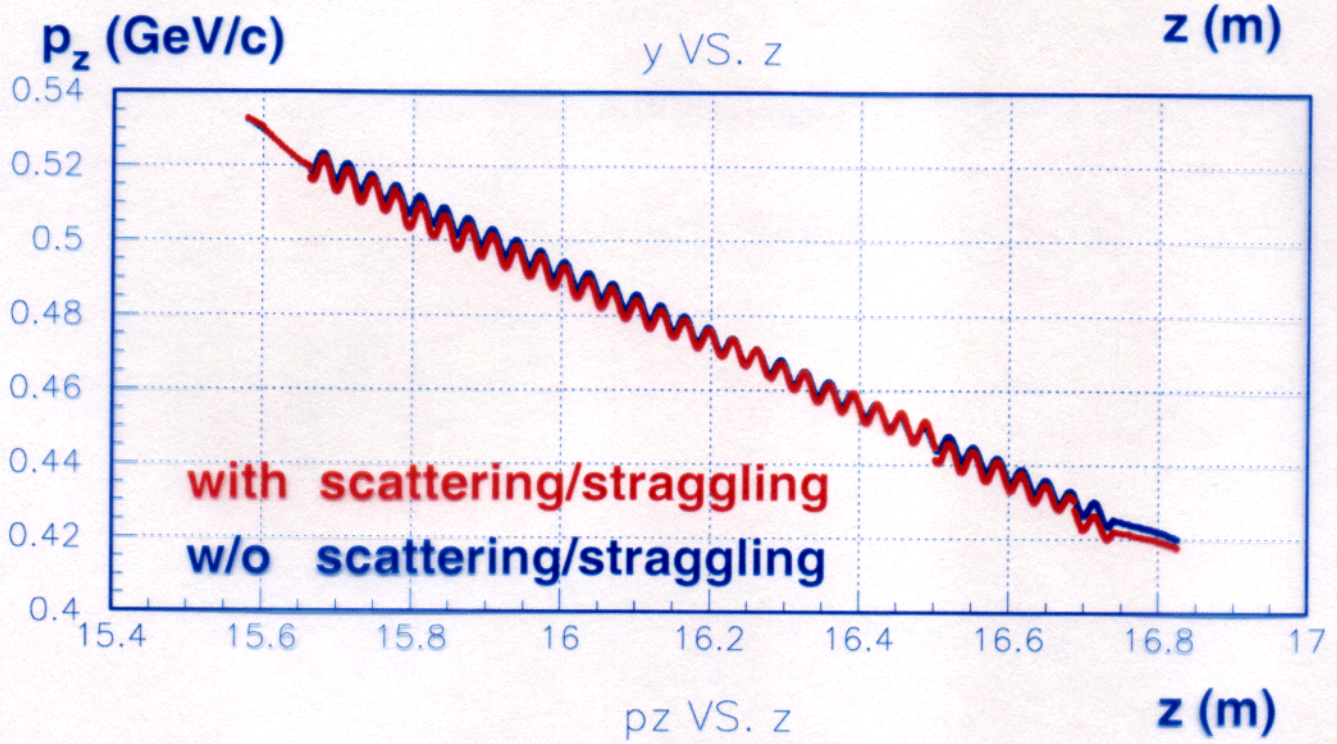

A. Garren
10
1
β (m)
D (m)
0
0
0
2
4
6
8
10
12
14
16
Path Length (m)
Li
Lens

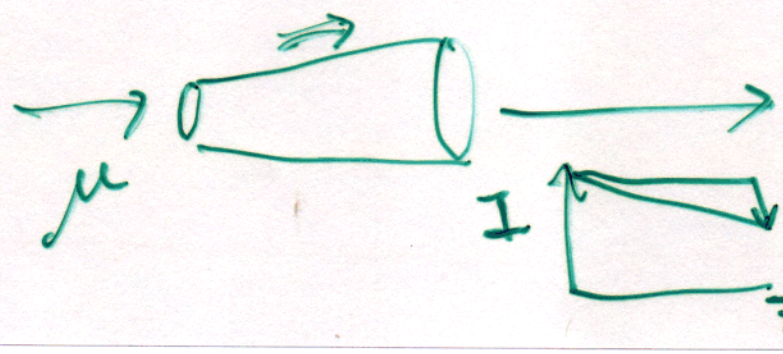

A. Garren
10
1
β (m)
D (m)
0
0
0
1
2
3
4
5
6
7
8
Path Length (m)

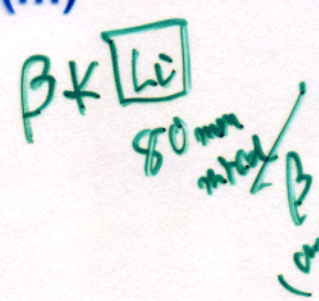

A. Garren
Li Lens
0.5
0.5
β (m)
D (m)
0.0
Path Length (m)
0.0

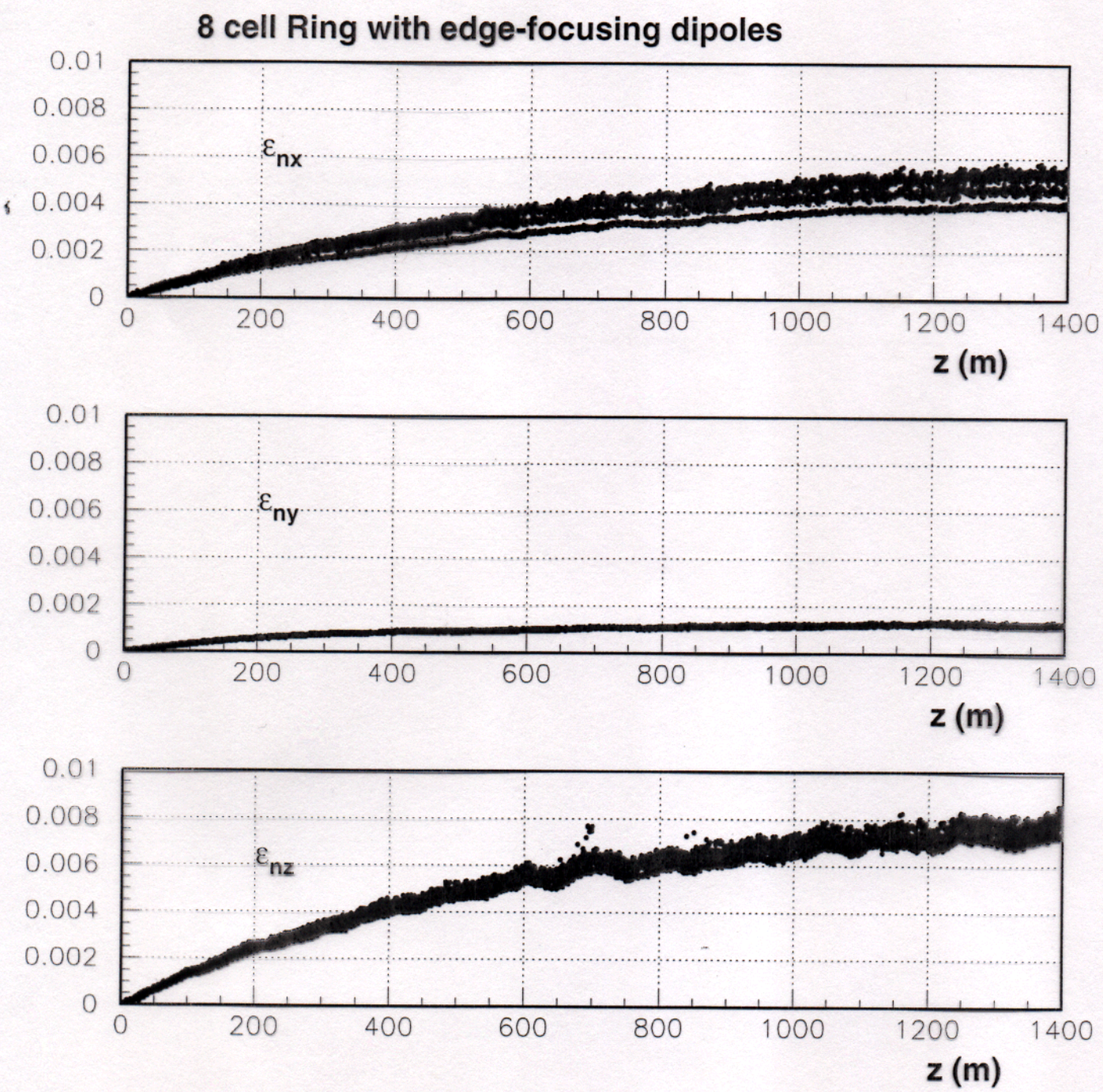
a μ track through a Li Lens



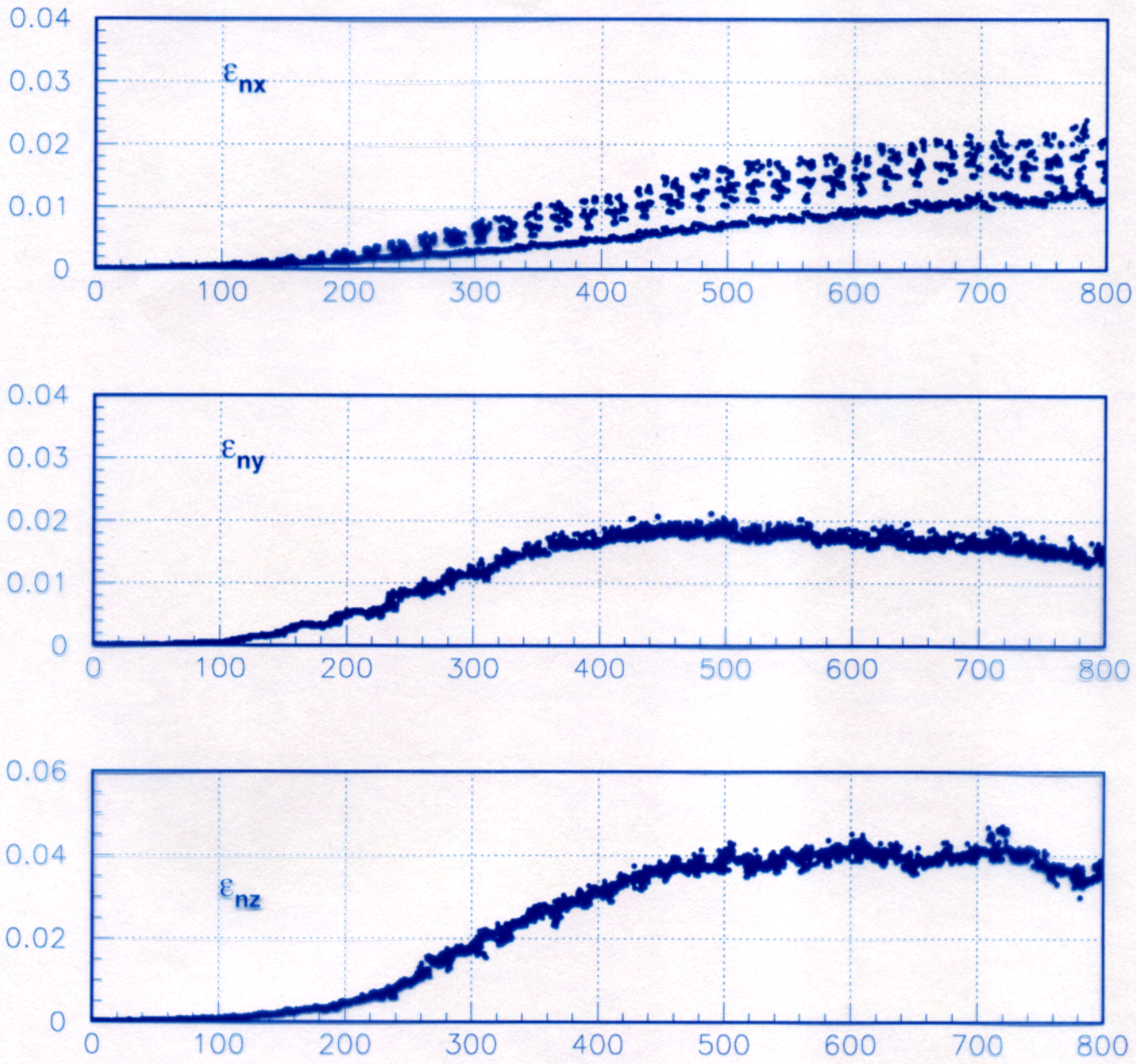


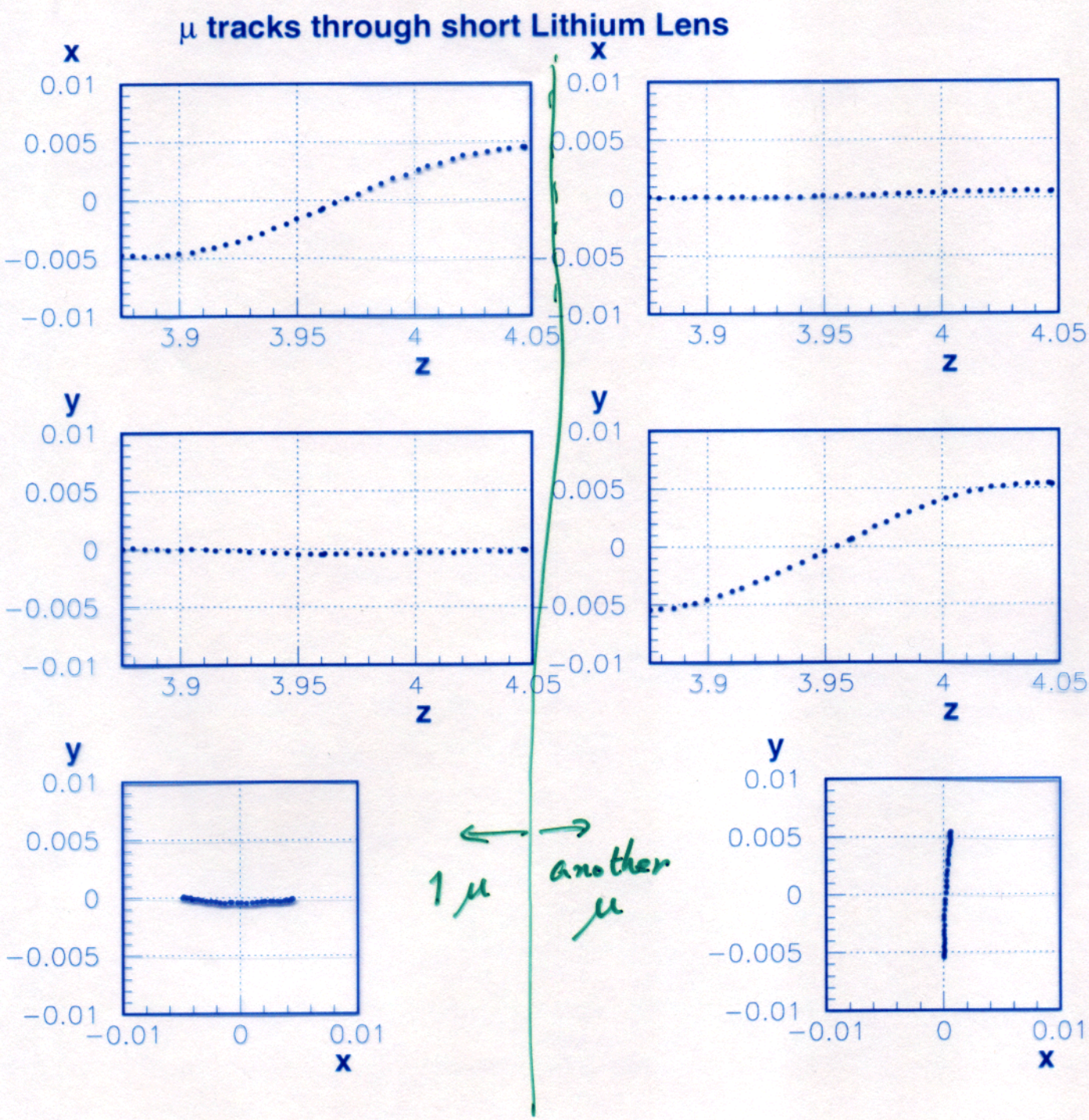


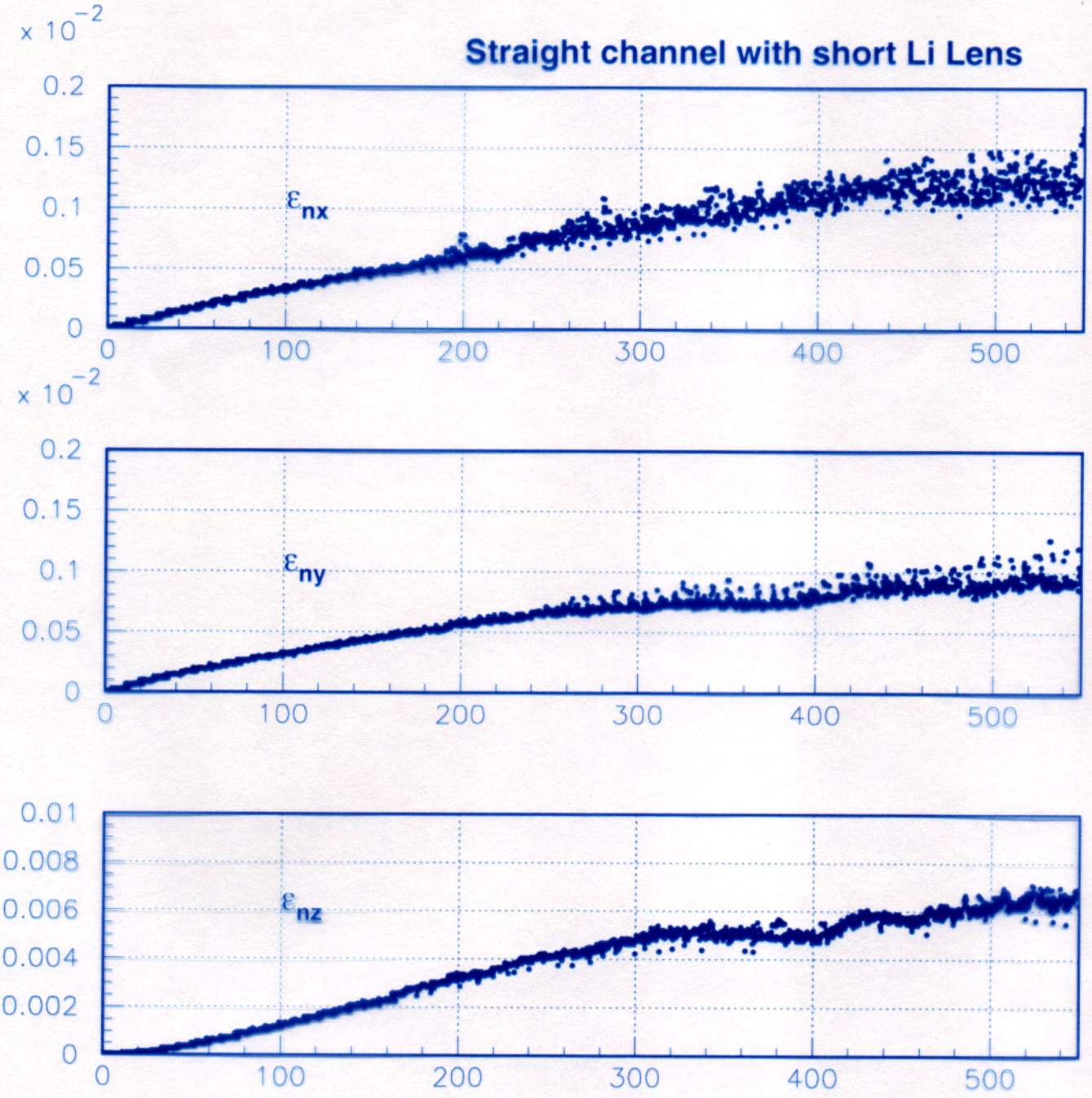



8 cell Ring with edge-focusing dipoles
0.01
0.008
0.006
0.004
0.002
0
ε_{nx}
0
200
400
600
800
1000
1200
1400
z (m)
0.01
0.008
0.006
0.004
0.002
0
ε_{ny}
0
200
400
600
800
1000
1200
1400
z (m)
0.01
0.008
0.006
0.004
0.002
0
ε_{nz}
0
200
400
600
800
1000
1200
1400
z (m)

Race Track Cooling Ring w/o Li Lens




μ tracks through short Lithium Lens
x
y
z
0.01
0.005
0
−0.005
−0.01
3.9
3.95
4
4.05
1 μ
another μ


Straight channel with short Li Lens
x 10^-2
0.2
0.15
0.1
0.05
0
εnx
0
100
200
300
400
500
x 10^-2
0.2
0.15
0.1
0.05
0
εny
0
100
200
300
400
500
0.01
0.008
0.006
0.004
0.002
0
εnz
0
100
200
300
400
500

Summary

- Racetrack Ring without Lithium lens shows equilibrium emittance in x,y,z.
- Straight channel with a short Lithium lens shows equilibrium emittance in x,y,z.
- work in progress in getting reasonable low equilibrium emittance in straight channels with along Lithium lens, and in a racetrack ring with Lithium lens.