Toward a Muon Beam Ring Cooler

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LBNL
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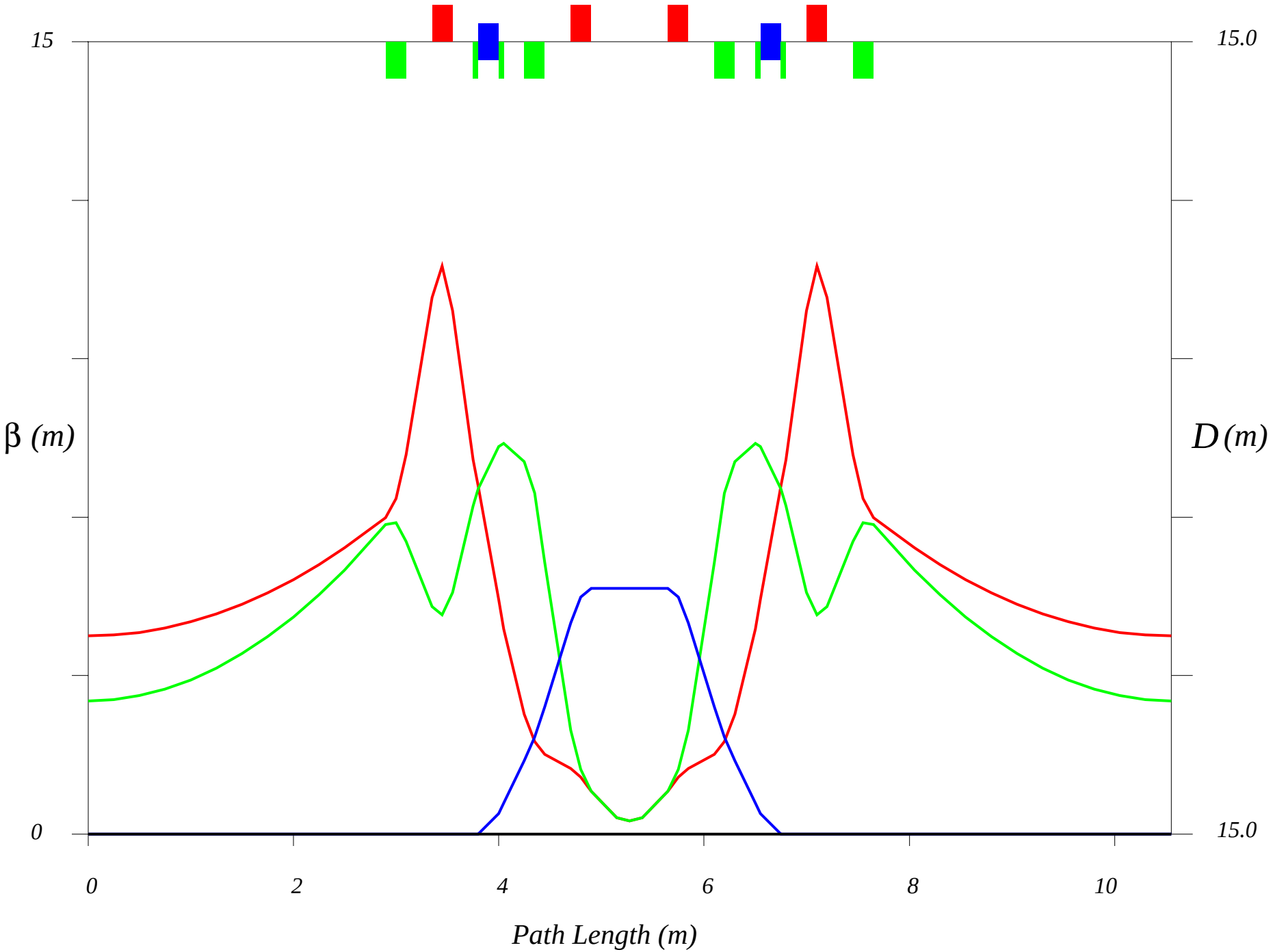
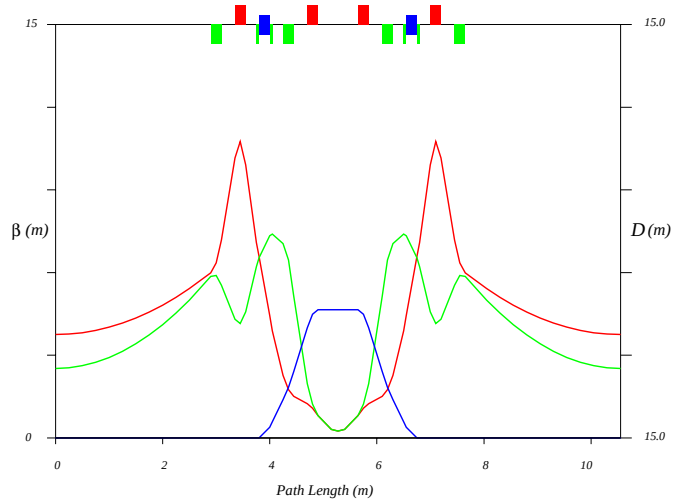
Outline

1. Synch to ICOOL
2. Single Particle Dynamics
3. Beam Ensemble Dynamics
4. Summary

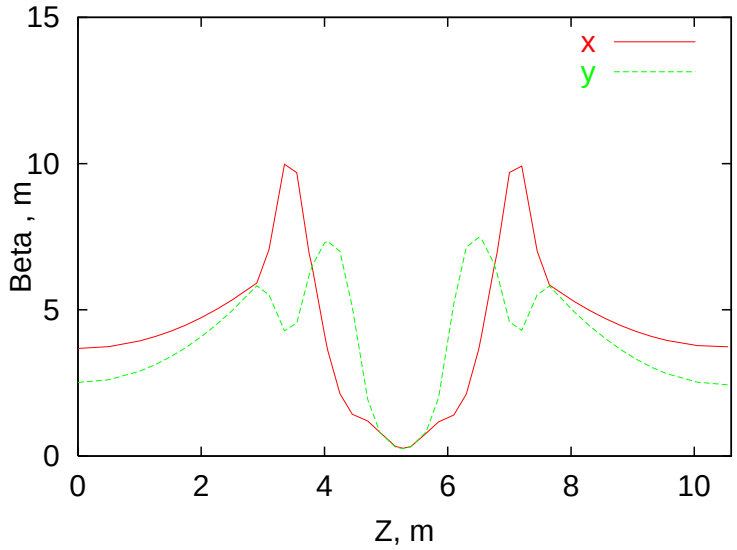

15
0
15.0
15.0
β (m)
D (m)
0
2
4
6
8
10
Path Length (m)

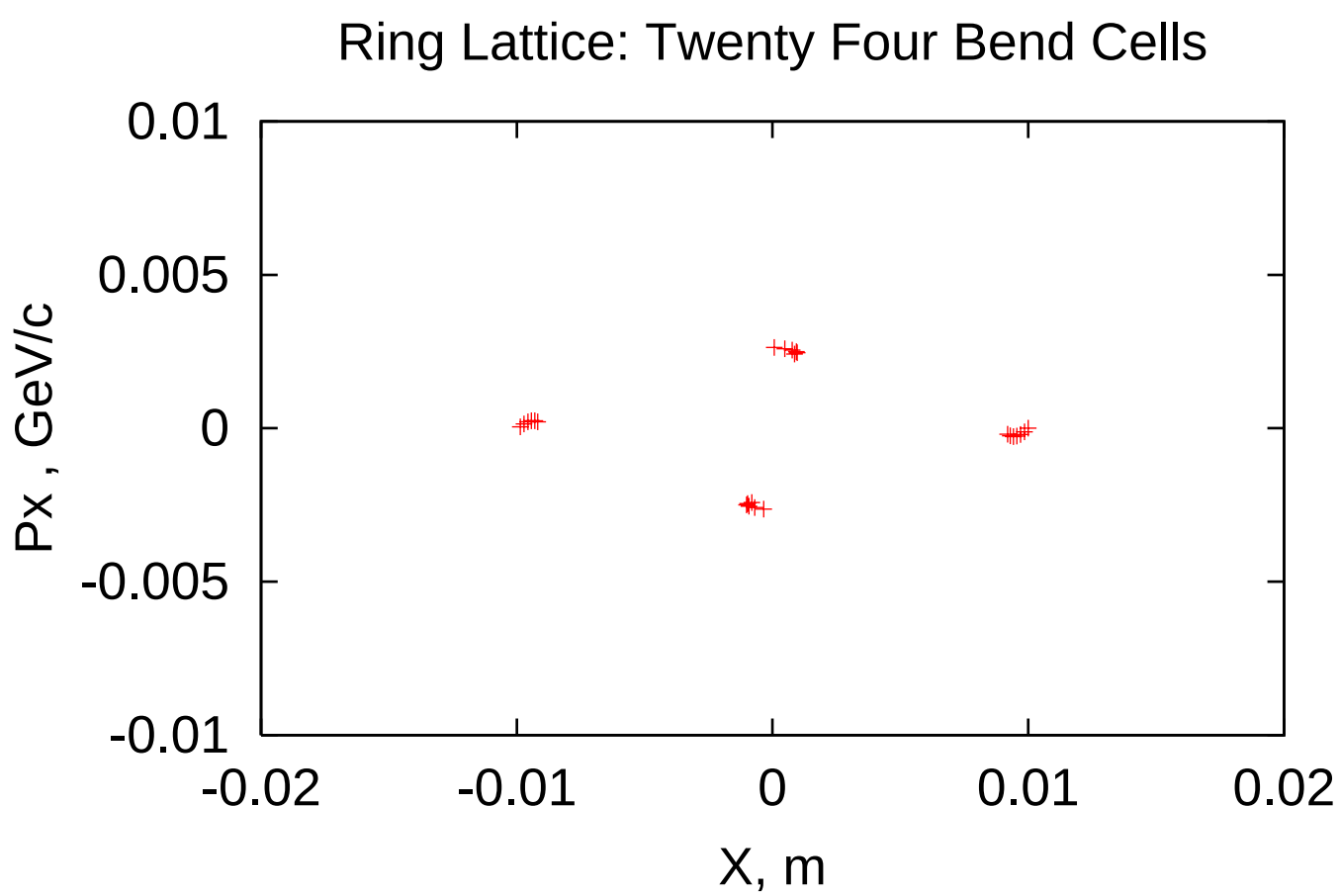
Cooling Ring: One Bending Cell

Synch Fit

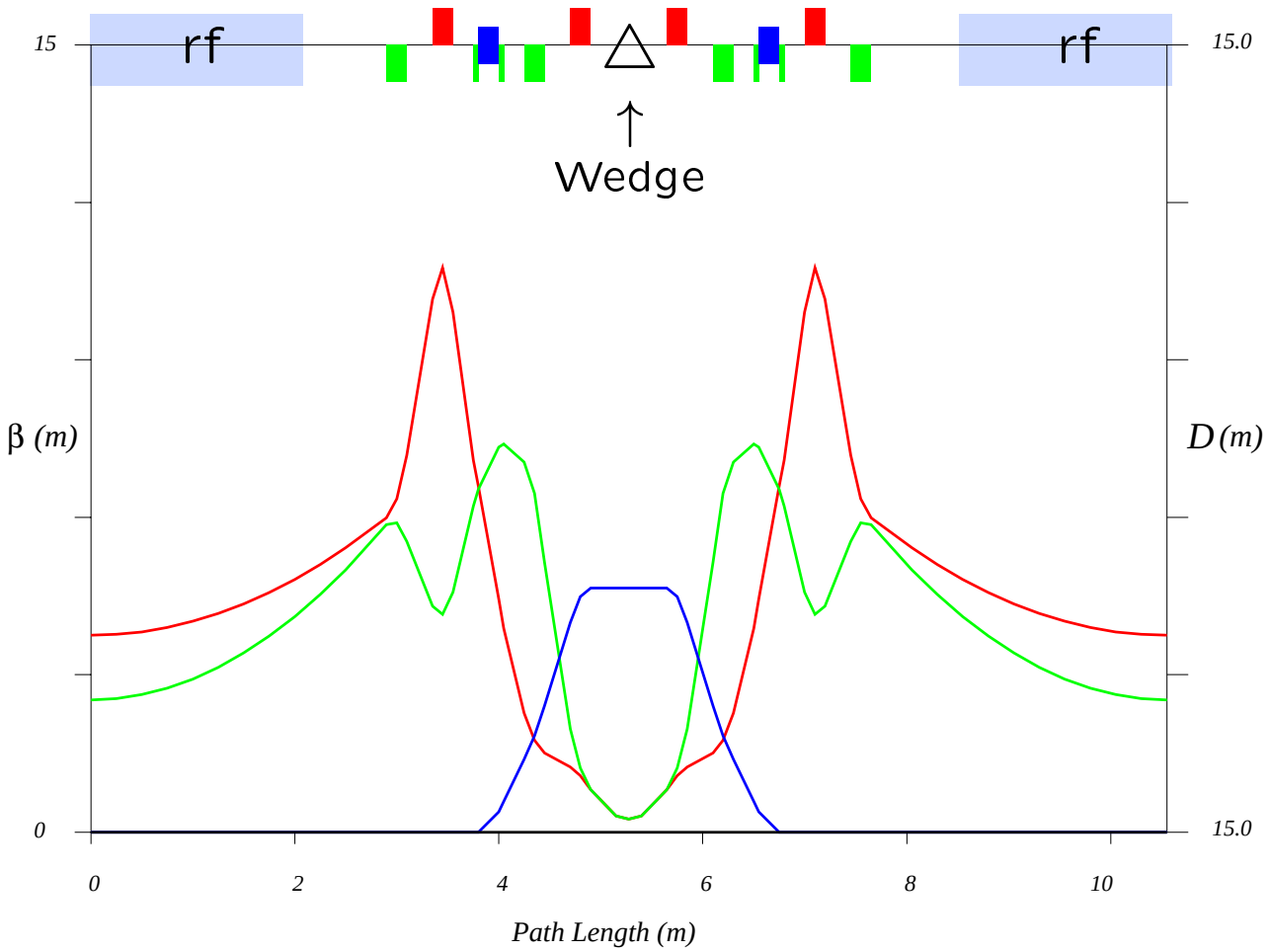


Icool Processed



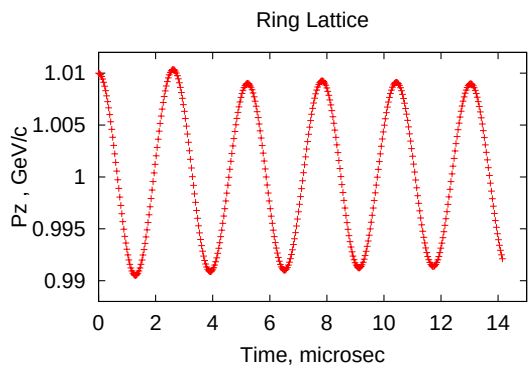

Ring Lattice: Twenty Four Bend Cells
0.01
0.005
0
-0.005
-0.01
Px , GeV/c
-0.02
-0.01
0
0.01
0.02
X, m

Bending Cell Lattice for Cooling Ring

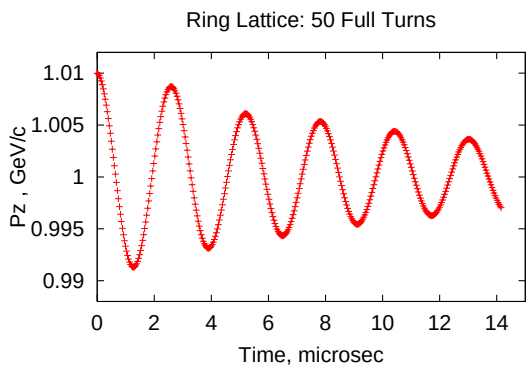


1 GeV/c Cooling Ring: Fifty Full Turns

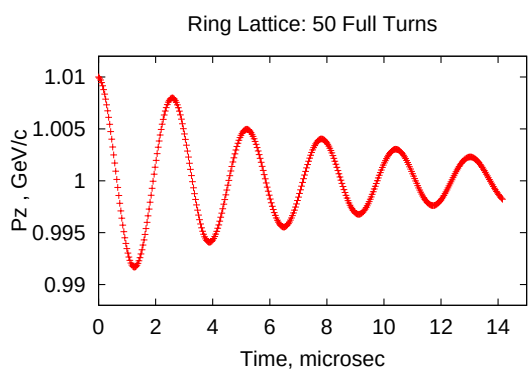
0° Absorber



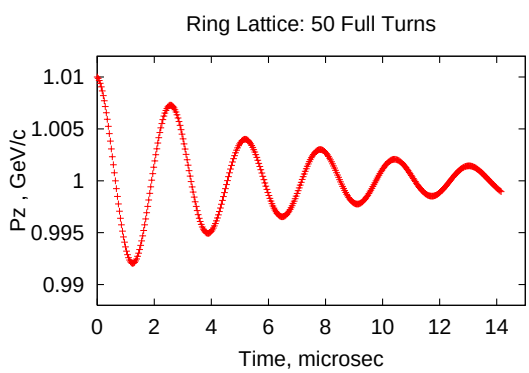
10° Wedge



15° Wedge

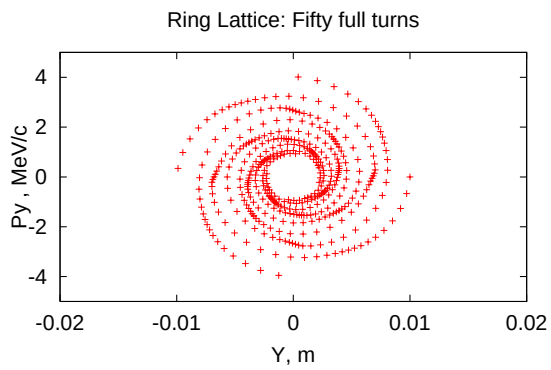


20° Wedge

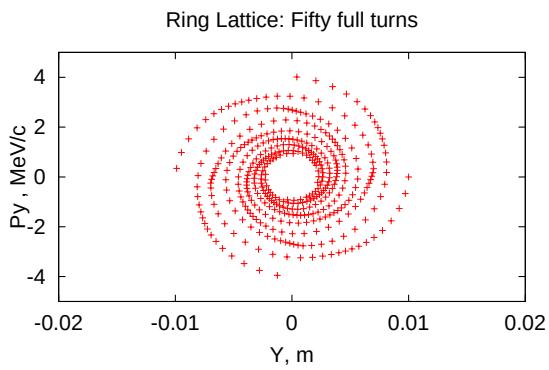


1 GeV/c Cooling Ring: Fifty Full Turns

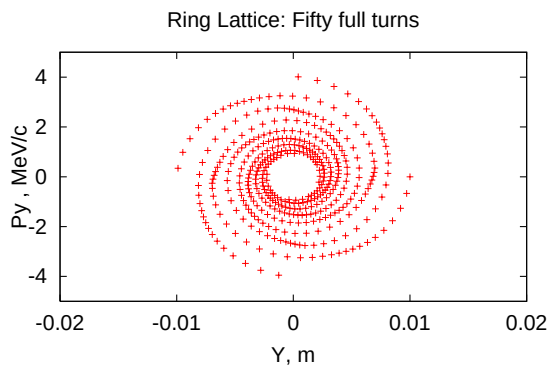
0° Absorber



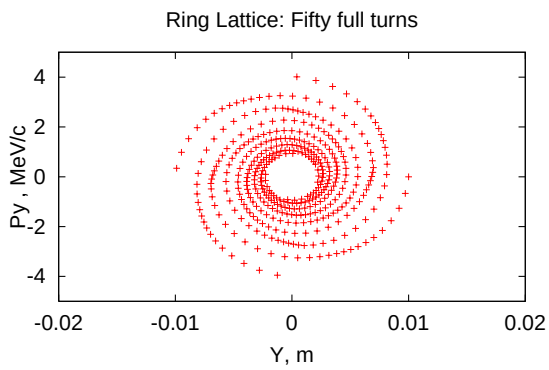
10° Wedge



15° Wedge

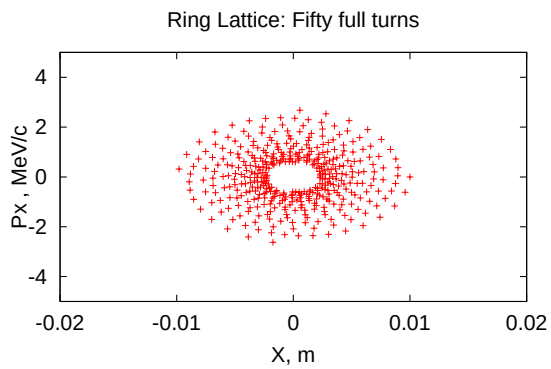


20° Wedge

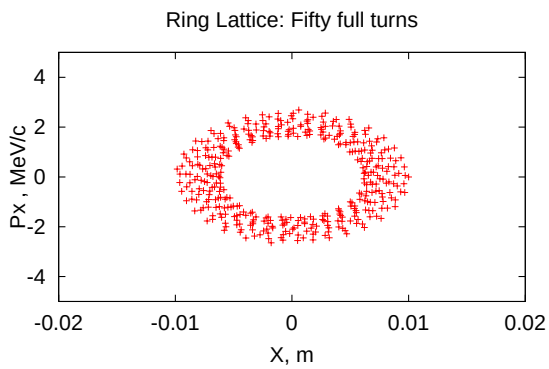


1 GeV/c Cooling Ring: Fifty Full Turns

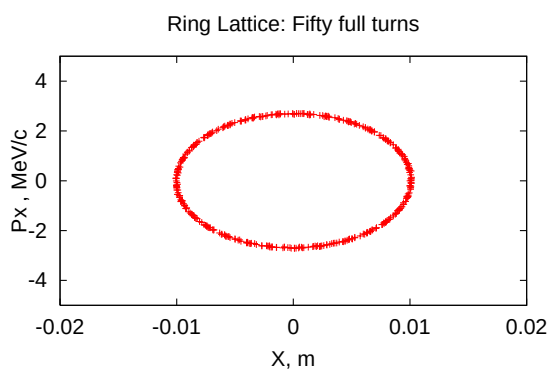
0° Absorber



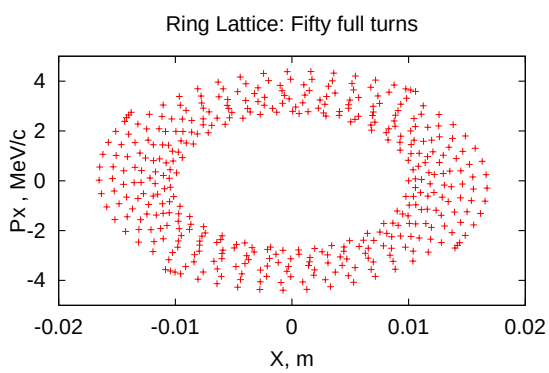
10° Wedge



15° Wedge



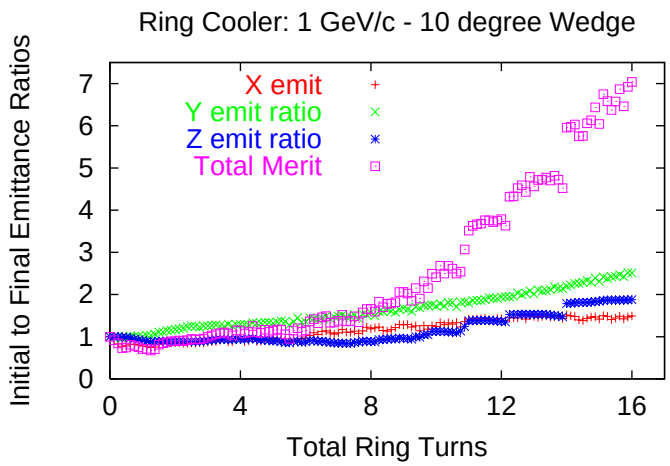
20° Wedge



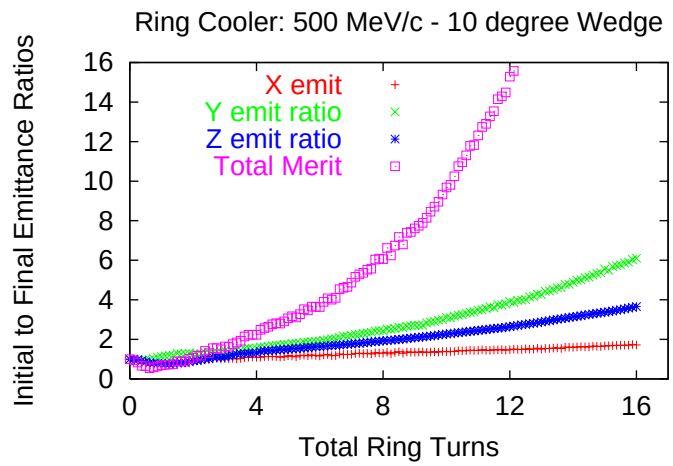
Cooling Ring: 10° Wedges

No Multiple Coulomb Scattering–No Straggling

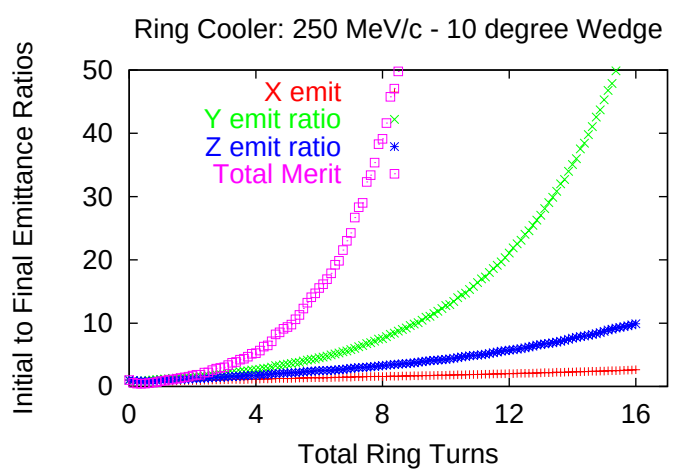
1 GeV/c



500 MeV/c



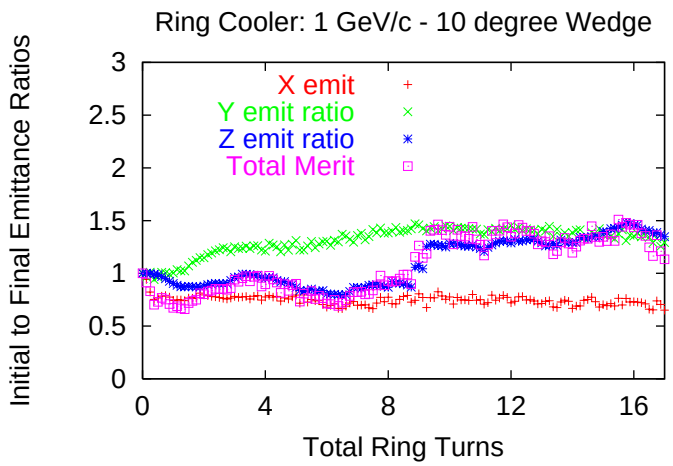
250 MeV/c



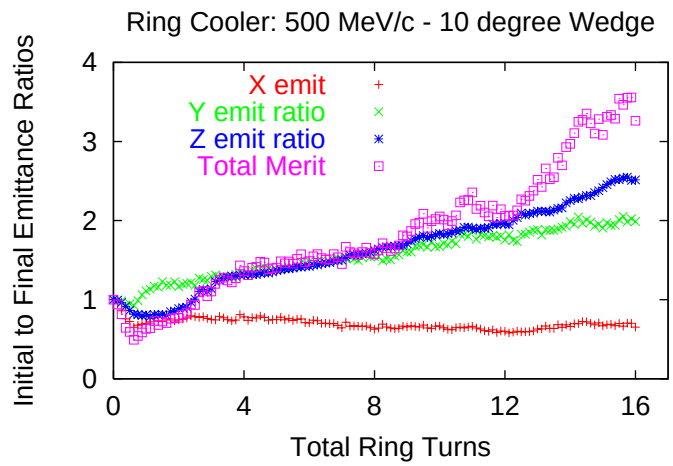
Cooling Ring: 10° Wedges

With Multiple Coulomb Scattering and Straggling

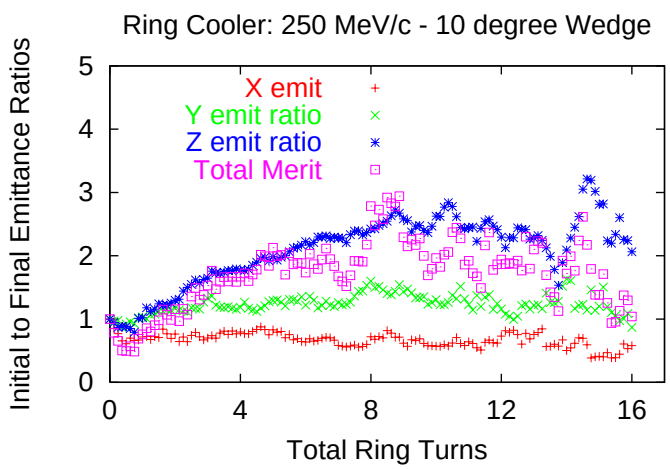
1 GeV/c



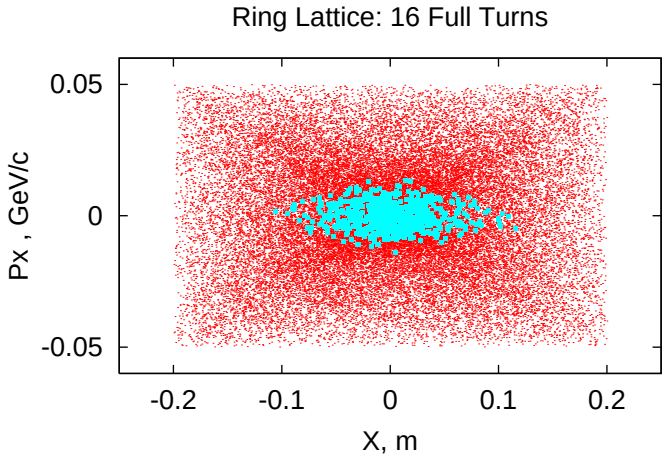
500 MeV/c

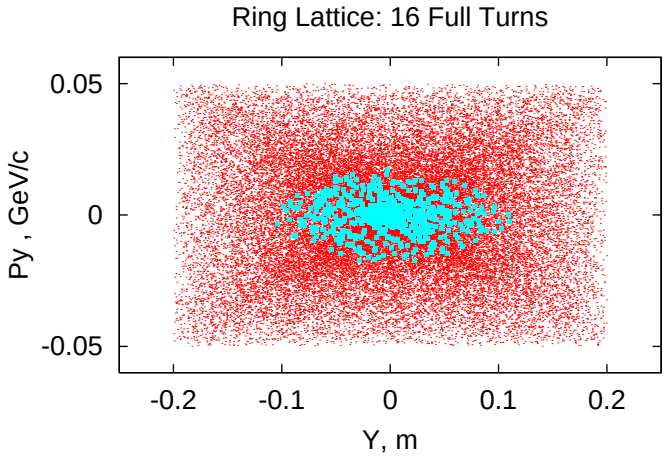


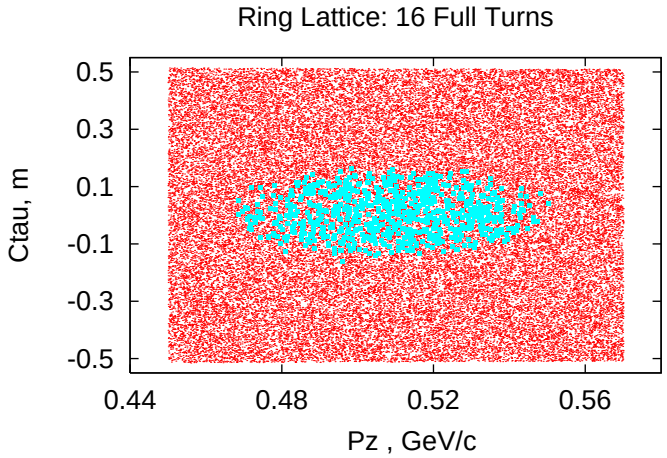
250 MeV/c



Cooling Ring: 0° Absorber Admittance



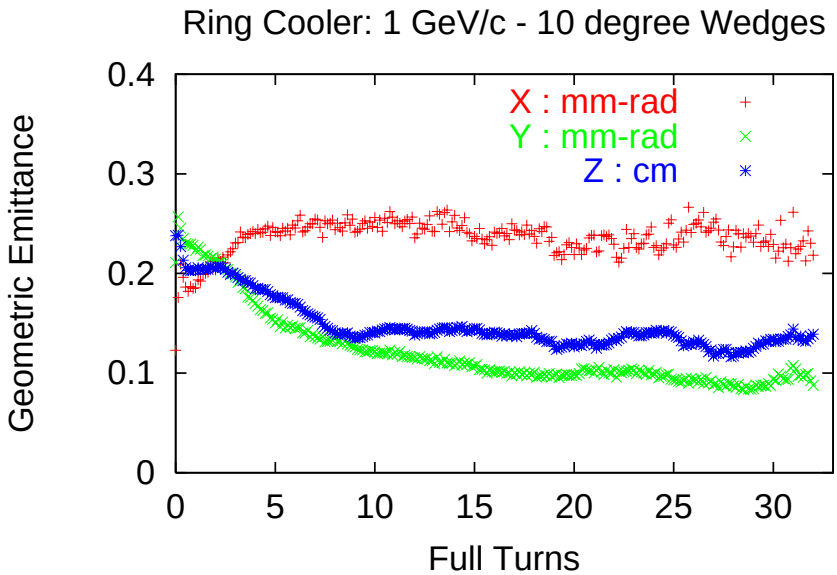




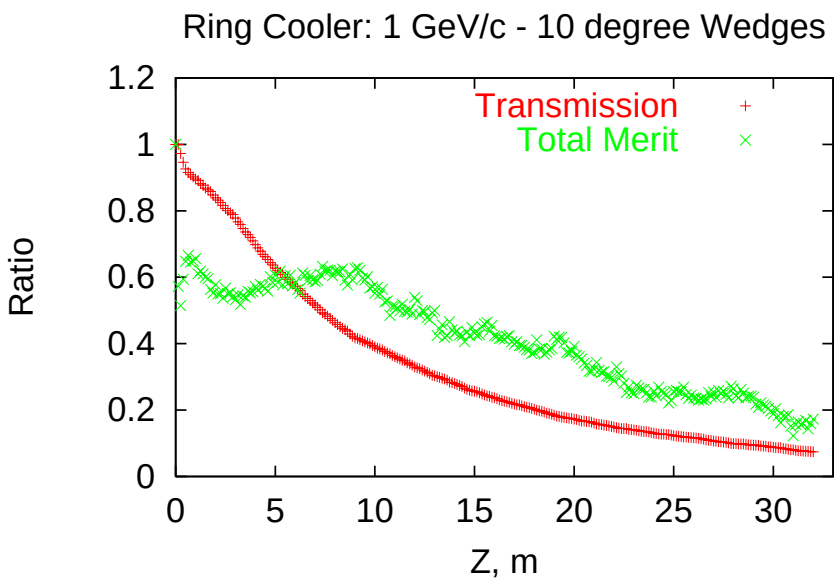
1 GeV/c Cooling Ring: 10° Wedges

With Multiple Coulomb Scattering and Straggling

$$\gamma\beta\epsilon_{x_i} = 1.2mm;\ \gamma\beta\epsilon_{y_i} = 2.1mm\ ;\ \gamma\beta\epsilon_{z_i} = 22mm$$



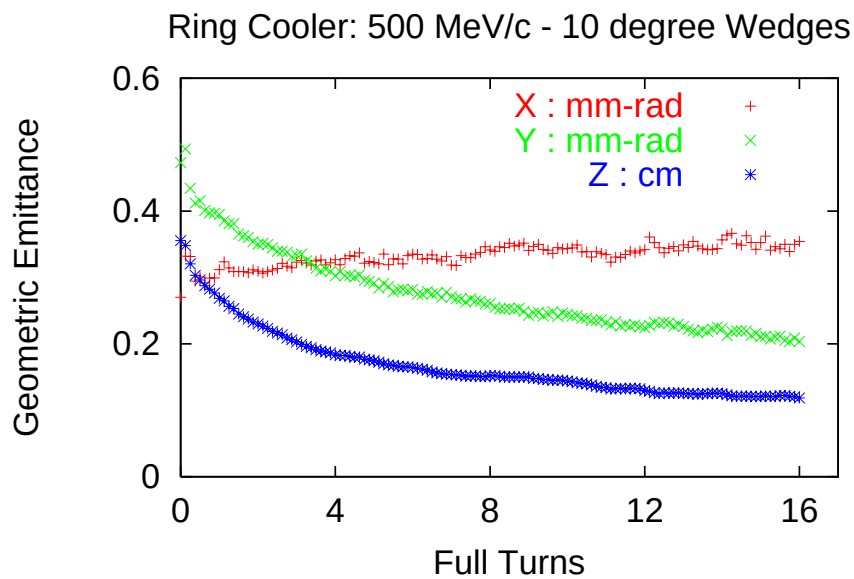
$$\text{Total Merit} = \text{Transmission} \times \frac{\epsilon_{x_i}}{\epsilon_{x_f}} \frac{\epsilon_{y_i}}{\epsilon_{y_f}} \frac{\epsilon_{z_i}}{\epsilon_{z_f}}$$



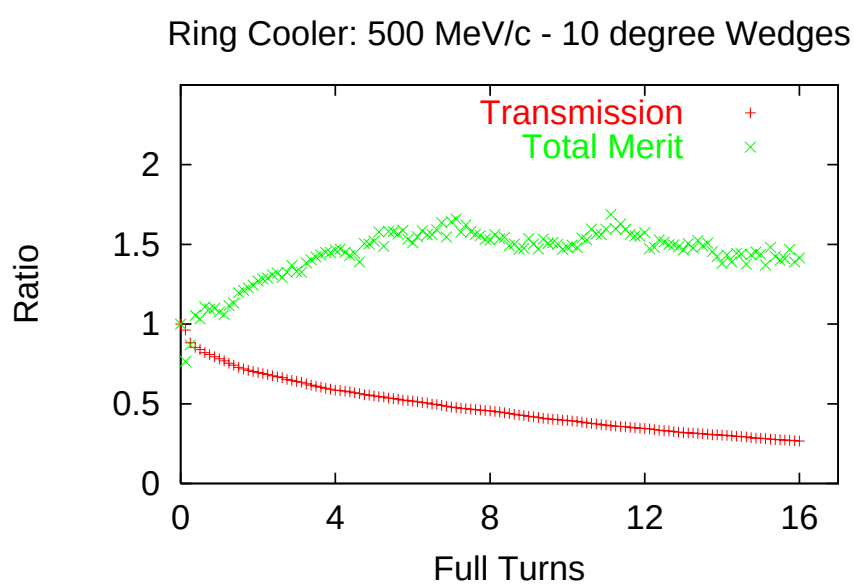
500 MeV/c Cooling Ring: 10° Wedges

With Multiple Coulomb Scattering and Straggling

$$\gamma\beta\epsilon_{x_i} = 1.3mm;\ \gamma\beta\epsilon_{y_i} = 2.2mm\ ;\ \gamma\beta\epsilon_{z_i} = 16mm$$



$$\text{Total Merit} = \text{Transmission} \times \frac{\epsilon_{x_i}}{\epsilon_{x_f}} \frac{\epsilon_{y_i}}{\epsilon_{y_f}} \frac{\epsilon_{z_i}}{\epsilon_{z_f}}$$



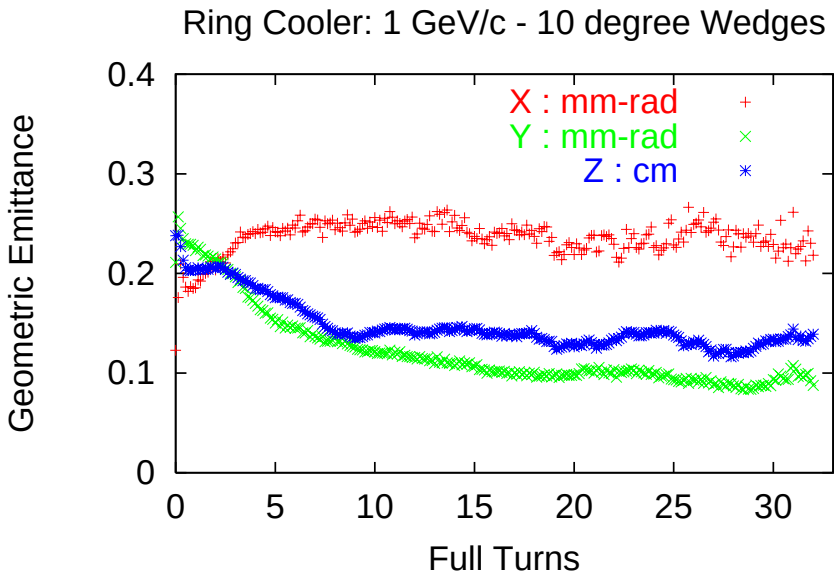
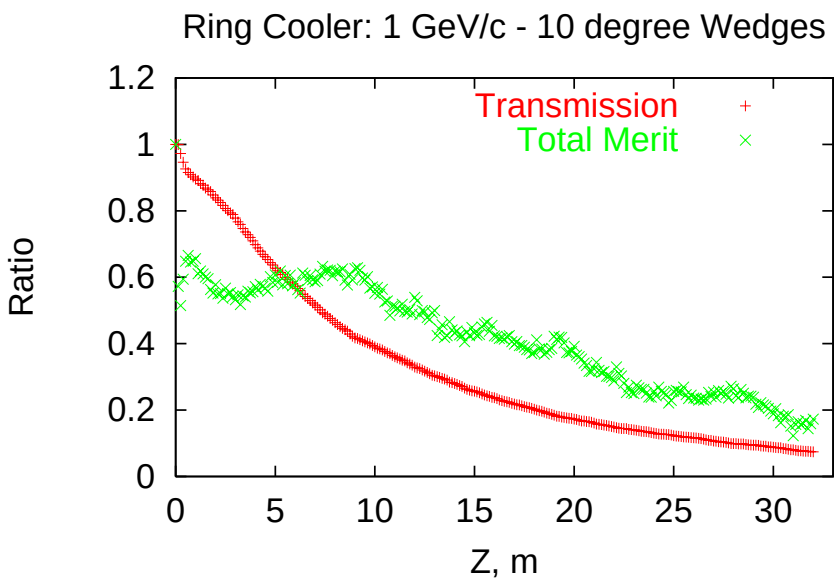
Summary

- SYNCH $\rightarrow$ ICOOL strategy works
- Emittance exchange demonstrated
- Transmission losses need study
- Need to consider realistic quads
- Need to incorporate soft edges

1 GeV/c Cooling Ring: 10° Wedges

With Multiple Coulomb Scattering and Straggling

$$\gamma\beta\epsilon_{x_i} = 1.2mm;\ \gamma\beta\epsilon_{y_i} = 2.1mm\ ;\ \gamma\beta\epsilon_{z_i} = 22mm$$



$$\text{Total Merit} = \text{Transmission} \times \frac{\epsilon_{x_i}}{\epsilon_{x_f}} \frac{\epsilon_{y_i}}{\epsilon_{y_f}} \frac{\epsilon_{z_i}}{\epsilon_{z_f}}$$