Wiggler for bunch merging in Muon Collider

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Friday Meeting

• Required Lattice for Bunch Combiner
Combiner Method

- Apply 5 MHz RF to give momentum time correlation
- Drift
- Recapture at 201 MHz

Requirement for Drift

- Large Momentum compaction
to keep length short
to reduce decay losses

- Losses for straight channel = 51.5 % \((L=152+548=701 \text{ m})\)
  - Compaction 1.6 × straight: Losses = 32.2 % \((L=438 \text{ m})\)
  - Compaction 2.3 × straight: Losses = 22.4 % \((L=304 \text{ m})\)
  - Compaction 3.3 × straight: Losses = 15.6 % \((L=212 \text{ m})\) \((k=-3 \text{ FFAG})\)
High Momentum Compaction Methods

- Negative k Scaling FFAG
  Scott failed to design one
  I failed to design one

- Wiggler
  Scott got factor approaching 2
  I have designs up to 2.5
Wiggler Approaches

- Use sinusoidal bending fields, Period = 2.05 m
- 2 Geometries:
  - Rectangular Magnets + horizontal focusing gradient
    (use straight ICOOL reference in BSOL 4)
  - Sector Magnets + vertical focusing gradient
    (use transport ICOOL reference in BSOL 4)
- Note: Separate channels needed for each sign, or reverse directions
Parameters Tried

<table>
<thead>
<tr>
<th>Case</th>
<th>Geom</th>
<th>By max</th>
<th>Grad</th>
<th>Amplitude</th>
<th>Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>T</td>
<td>T/m</td>
<td>cm</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Rectangular</td>
<td>0.8</td>
<td>0.2</td>
<td>21</td>
<td>1.68</td>
</tr>
<tr>
<td>6b</td>
<td>Rectangular</td>
<td>0.96</td>
<td>0.37</td>
<td>29</td>
<td>2.30</td>
</tr>
<tr>
<td>7</td>
<td>Sector</td>
<td>0.96</td>
<td>-0.45</td>
<td>≈21</td>
<td>1.64</td>
</tr>
<tr>
<td>7b</td>
<td>Sector</td>
<td>1.3</td>
<td>-0.5</td>
<td>≈35</td>
<td>2.51</td>
</tr>
</tbody>
</table>
Example of trajectories (case 6b)
Compaction

Factors

pp7b sector  1.3 T  2.51
pp6b square  .96 T  2.30
pp4  square  .8 T  1.68
pp7  sector  .96 T  1.64
pp5b straight  1.0
Strong Resonance in case 7b near 190 MeV/c
Weaker resonances in all
Strong Resonance again in case 7b
Tunes

Strong Resonance at $y$ tune=0.33
Conclusion

- Momentum compaction up to 2.5 times straight achieved
- No obvious advantage in sector cases

- But a resonance is seen near $\text{ytune}=0.33$ with larger factor cases
- This will lead to losses for largest factor case
- But larger factor cases have less decay loss

- Optimum should be found
- Sextupoles might fix the resonance