Magnet Configurations

Bends are on strings in

MDRs, PPDR, LTRs, RTLs, BC2s, IRTs
MDR bends have trims for orbit correction
PPDR needs correction elements added

Quads & Sexts have individual supplies

all need trim supplies for BBA if on strings
(used rarely, one at a time)
linac quads need DC trims for lattice adjustment
Candidates for strings

- Linac sector quads - main & injector linacs - 20% DC trim
- Linac diagnostic section quads (11 of 14) - 20% trim
- DR arc and wiggler quads - 2% trim
- DR sextupoles - 20% trim
- BC2 quads - 20% trim
- IRT big bend, SCS, and CCS quads - 20% trim
- maybe LTRs, RTLs, other

All trims except linacs for BBA only
Caveats:

- CD1 estimates contain many errors and shortcuts, e.g. trims on individual supplies in DRs, oversized cable and power supplies, etc.
  Improved estimates will significantly reduce the cost even without strings.
- Estimates depend on string length, redundancy, etc.
- Optics considerations need study:
  - Tighter tolerances for supply stability
  - Reduced flexibility in optics tuning
  - Simulations of beam based alignment
- Savings from conventional facilities not yet estimated
Cost Model (1)

BC2 bend string (15 KW - 11 magnets, incl. short cables)  
$38.5K ($3.5K/magnet)

individual supply (2.5 KW - smallest used)  
$23.6K

long cables (same cost for 2.5/5/10/15 KW supplies)  
at $5.6K (cable) + 3.6K (install) + 6.7K (tray)  
$16K/unit - $1.5K/magnet (for string)

Cost savings (PS only) - 85% (cable) - 90%  
from Carl Rago

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Cost Model (2)

MDR quads (20 KW individual supply)

$41K per magnet

from J.J. Lipari

Strings - 8 magnets (75 KW - 4 out of 5 rack mounted)

switchable boost supply (2.5 KW, 4 per 120 ch)

$8.8K per magnet

from J.J. Lipari

120 arc quads/MDR

individual @ $41K = $4,929K

16 strings @ $62.8K+ 4 boosts @ $15.3 = $1,059K

Cost savings (PS only) - 78% (cable) - ???
# $e^+/e^-$ MDR Summary

<table>
<thead>
<tr>
<th></th>
<th>of</th>
<th>CD1</th>
<th>Strings</th>
<th>Savings</th>
<th>Trim removal</th>
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</thead>
<tbody>
<tr>
<td></td>
<td># total #</td>
<td>K$/unit K$ total</td>
<td>K$ total K$</td>
<td>% removal</td>
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<tr>
<td>arc quads</td>
<td>120 128</td>
<td>41.1 4932.0</td>
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<td>arc quad trims</td>
<td>120 128</td>
<td>15.3 1839.7</td>
<td>61.3 1839.7</td>
<td>1839.7</td>
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<tr>
<td>wiggler quads</td>
<td>28 36</td>
<td>45.5 1273.4</td>
<td>304.2 944.4</td>
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<tr>
<td>wiggler quad trims</td>
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<td>15.3 429.3</td>
<td>24.7 429.3</td>
<td>429.3</td>
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<tr>
<td>sextupoles</td>
<td>120 120</td>
<td>24.5 2935.3</td>
<td>778.1 2060.2</td>
<td>70.2%</td>
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<tr>
<td>sextupole trims</td>
<td>120 120</td>
<td>15.3 1839.7</td>
<td>97.1 1839.7</td>
<td>1839.7</td>
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<tr>
<td>Total</td>
<td></td>
<td>13249.4 2262.9</td>
<td>6877.8 75.2%</td>
<td>4108.7</td>
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* Trims are unnecessary with individual supplies
Note: PEPII style interlocks assumed - cost should go down

Cost savings - 6.9M$ / ring - 75% (+ 4.1M$ *2 trims )
+ cable, AC distribution, cooling ...
NLC Summary

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<th>of CD1 Strings</th>
<th>Savings</th>
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<td>IRT Big Bend</td>
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<td>IRT SCS +</td>
<td>54 54</td>
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<td>IRT other (50%)</td>
<td>7816 3908</td>
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Note: assumed cost is 25% for simple strings, 30% for linac quads

Cost savings - 60M$ (incl. cable) + more from CF ...

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Permanent Magnets

- Injector linac quads need trims for optics adjustment could be permanent with hybrid design

- DR bends, quads, sexts
  design calls for ±5% energy range for flexibility
  also radiation damage concerns
  → not a good candidate

- BC2 bends could be permanent magnets, but lose energy flexibility or must have trims - may be OK

- BC2 quads must adjust for bunch length, unless change can be done with BC1
Permanent Magnets (2)

• Main linac quads need trims for optics adjustment

• A. Ringwall & J. Frisch have possible hybrid design

• If trims can be weak enough to avoid water cooling, reduces vibration sources plus cost savings on plumbing, Conv.Fac.

• But what range of CM energy must be accommodated? Top @ 350 Gev? Higgs @ 200 Gev? Z @ 90 Gev? also 2nd 1/2 of linac must upgrade to 1 Tev
→ this is likely a show stopper