Comparison of Lattices for NLC Linac

Four lattices have been studied. One general requirement is to provide the number of RF structures per cell growing with the beam energy as

\[ N_{\text{str}} \sim E^\alpha, \]

where \( \alpha = 0.45 \). This is done in a step-wise fashion by dividing the lattice in several periodic sections with increased number of structures per cell in every subsequent section. The transition between sections is matched with 6 quads to maintain periodicity and to minimize chromatic effects.

The initial and final energies are 10 and 500 GeV.

Description of lattices:

1) Based on two RF structure modules and FODO lattice.
   5 sections with 2, 4, 6, 8, and 10 structures per half cell.
   RF transitions are at 30, 80, 165, and 290 GeV.

2) Based on three RF structure modules and FODO lattice.
   3 sections with 3, 6, and 9 structures per half cell.
   RF transitions are at 45 and 155 GeV.

3) Based on three RF structure modules and doublet and FODO lattice.
   Half of the 1st section is made of a doublet structure.
   3 sections with 3, 6, and 9 structures per half cell.
   RF transitions are at 45 and 155 GeV.

3a) Same as lattice #3 but with 8 quads in the transition between the doublet and FODO cells for a better chromatic match.

Quad length per section:

- Lattice 1: 0.2, 0.3, 0.4, 0.6, 0.8 m.
- Lattice 2, 3, 3a: 0.25, 0.5, 0.8 m.

Simplifications:

Constant phase advance per cell (90° - FODO, 80° - doublet).
No RF voltage for optics calculations.
Number of structures per half cell with energy

$(2\text{-RF vs } 3\text{-RF})$
90 degree FODO cell with 3 structures.
RS6000 = AIX version 8.15/2

Table name = TWISS
90 degree doublet cell with 3 structures.
RS6000 - AIX version 8.15/2

\[ \frac{\delta_x}{\beta_x c} = 1. \]
Table name = TWISS
Quad strength vs. cell phase.

FODO - solid
Doublet - dash
Max. & min. beta vs. cell phase.

FODO - solid
Doublet - dash

Beta (m)

Phase (deg.)

min.
max.
Linear chromaticity vs. cell phase.

FODO - solid
Doublet - dash
Test NLC linoc FODO lattice: 2,4,6,8,10 structures per half cell.

RS6000 - AIX version 8.15/2

\( \delta_{1,2} = 1 \)

Table name = TWISS

\( [\ast 10^{\ast 3}] \)
Test NLC linoc FODO lattice: 3, 6, 9 structures per half cell.

RS6000 - AIX version 8.15/2

\[ \delta \beta / \beta_c = 0, \]

Table name = TWISS

\[ [*10**(-3)] \]
Test NLC linoc doublet & FODO lattice: 3,6,9 structures per half cell.
RS6000 - AIX version 8.15/2

Table name = TWISS

\[ \delta_{0}p_{0}c = 0. \]

\[ \text{[*10**(( 3)]} \]
BMAG-1 function.
Test NLC linac FODO lattice with 2, 4, 6, 8, 10 structures per half cell.
Momentum error = +2%.

X (solid), Y (dot)
BMAG-1 function.
Test NLC linac FODO lattice with 2,4,6,8,10 structures per half cell.
Momentum error = -2%.
BMAG- 1 function.
Test NLC linac FODO lattice with 3,6,9 structures per half cell.
Momentum error = +2%.

Distance (m)
BMAG-1 function.
Test NLC linac FODO lattice with 3,6,9 structures per half cell.
Momentum error = -2%.
BMAG-1 function.
Test NLC linac doublet & FODO lattice with 3,6,9 structures per half cell.
Momentum error = +2%. 6 quads per transition.
BMAG-1 function.
Test NLC linac doublet & FODO lattice with 3,6,9 structures per half cell.
Momentum error = -2%. 6 quads per transition.
BMAG-1 function.
Test NLC linac doublet & FODO lattice with 3,6,9 structures per half cell. Momentum error = +2%. 8 quads in 1st transition.
BMAction.
Test hac doublet & FODO lattice with 3, 6, 9 structures per half cell. Moment = -2%. 8 quads in 1st transition.
BMAG-1 vs $dp/p$.  
Test NLC linac FODO lattice  
with 2,4,6,8,10 structures per half cell.

X (solid), Y (dot)
BMAG-1 vs dp/p.
Test NLC linac FODO lattice
with 3, 6, 9 structures per half cell.

X (solid), Y (dot)
BMAG-1 vs dp/p.
Test NLC linac doublet & FODO lattice
with 3,6,9 structures per half cell. 6 quads per transition.
BMAG-1 vs $\Delta p/p$.
Test NLC linac doublet & FODO lattice
with 3,6,9 structures per half cell. 8 quads in 1st transition.
Tolerance comparison:

Input parameters:

- Number of particles per bunch: \( N = 1.1 \cdot 10^{10} \)
- Bunch length (rms): \( \sigma_z = 150 \ \mu m \)
- Wakefield value: \( W_{\perp} = 9.95 \cdot 10^{19} \ \text{V/c/m}^3 \)

<table>
<thead>
<tr>
<th></th>
<th>2-RF FODO</th>
<th>3-RF FODO</th>
<th>3-w doublet + FODO (1)</th>
<th>3-RF doublet + FODO (2)</th>
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